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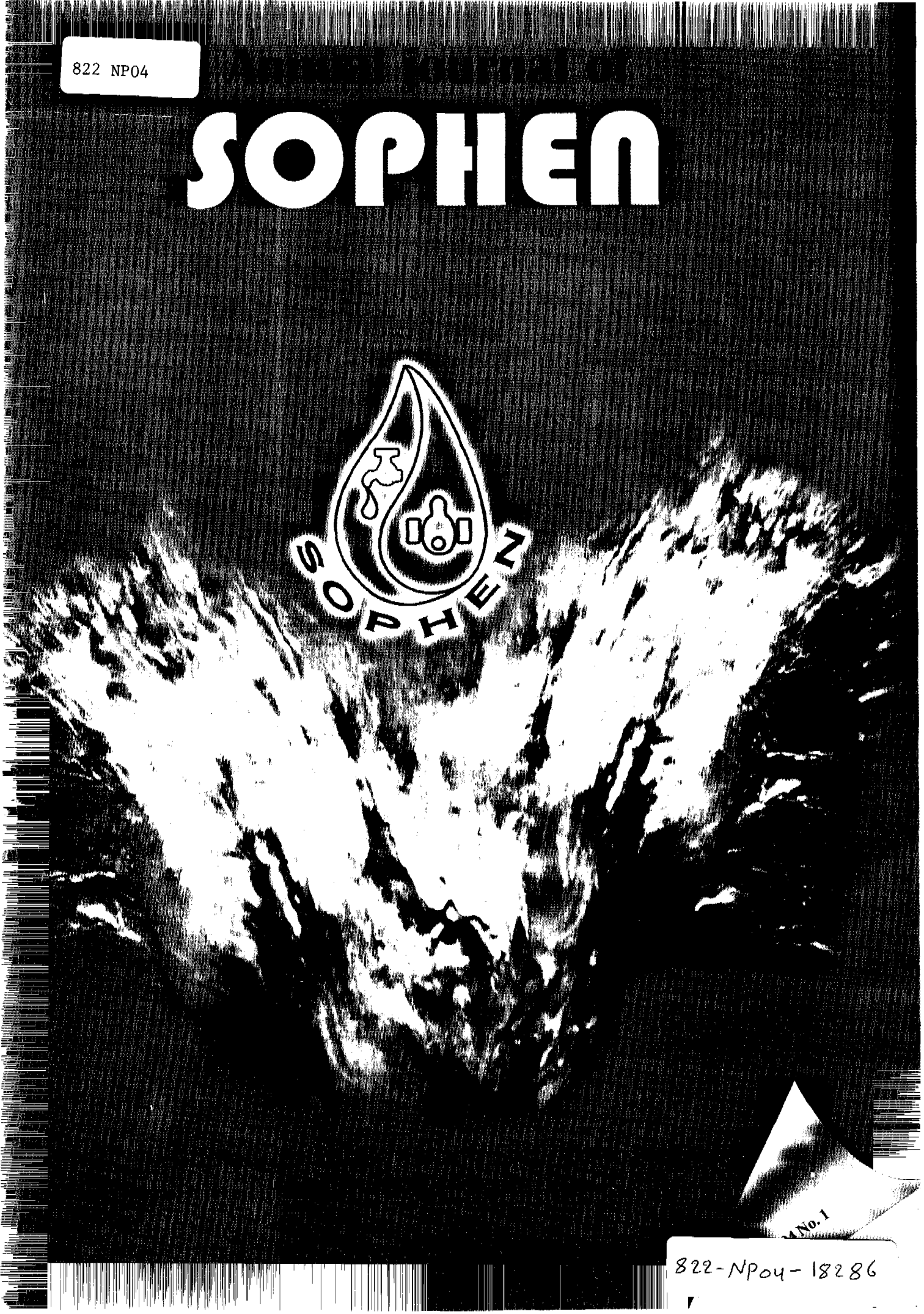

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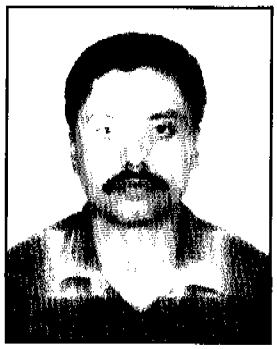

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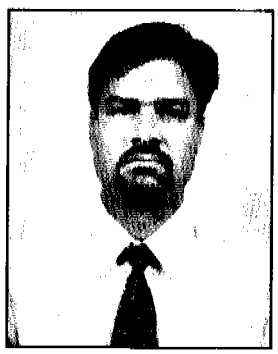

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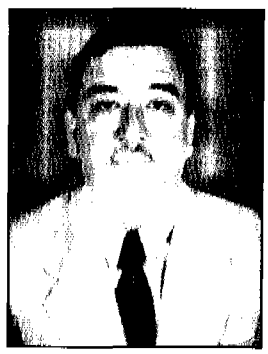

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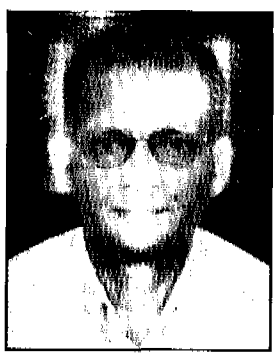

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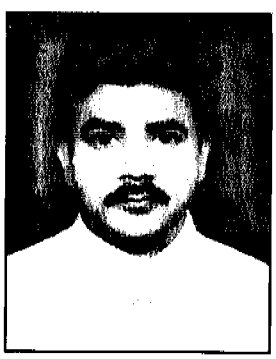

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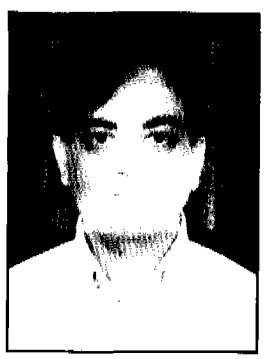

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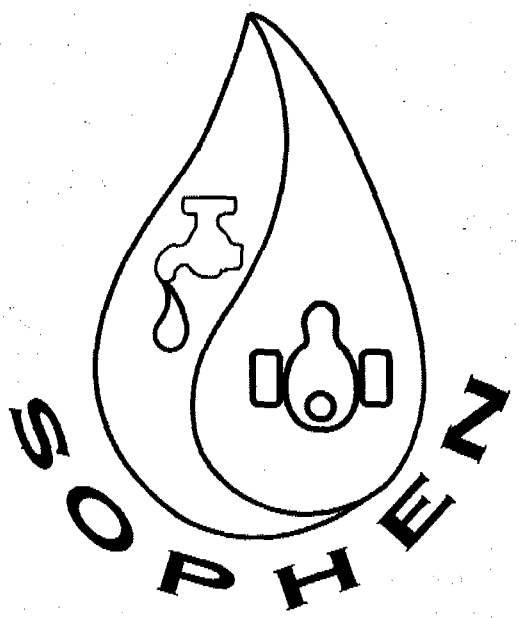
March 2004 (Falgun 2060) Issue 1



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SINGHA DURBAR,
KATHMANDU, NEPAL

Felicitations

On 22nd March, World Water Day is being observed throughout the World with enthusiasm. SOPHEN is playing a crucial role in Nepal to sensitize the policy makers and civil societies in general on the economic and social values of water and the need for its protection, conservation and for its effective and efficient uses. Campaigns such as this will definitely assist in developing a practical National Water Plan for Nepal complimenting the strategies laid out in the National Water Resources Strategy of HMG/N.

The World Water Day that was observed on 2003 with a theme **"Water for Future"** in Pokhara was well organized and had meaningful deliberations with wider participation from the engineers, academia, civil societies and NGOs. I congratulate the Organizing committee and SOPHEN Executive Committee, in particular for the successful outcome.

I sincerely wish for the SOPHEN's success in the days to come.

(Er. **Dinesh C. Pyakural)**
Secretary
(Immediate Past President / Advisor-SOPHEN)

Society of Public Health Engineers, Nepal
(SOPHEN)
सोसाईटी अफं पब्लिक हेल्थ ईञ्जिनियर्स नेपाल (सोफेन)
DWSS Building, Pulchowk, Kathmandu, Nepal

Message

It gives me great pleasure to present before you the "First Annual Journal of SOPHEN". I believe SOPHEN will now be able to publish the Journal as a regular feature.

I would like to thank SOPHEN member, adviser, authors and staff in bringing out the first issue and hope full cooperation from them in the coming future. With Best Wishes,

(Er. Dhruva Bahadur Sherstha)
President,
Society of Public Health Engineers, Nepal
(SOPHEN)

From the desk of the General Secretary

I feel honored and privileged to present this "First Annual Journal of SOPHEN" before you. This issue, which is an outcome of collective efforts of the executive members and well wishers of the society, includes papers presented in different **Seminars** organized by SOPHEN and the SOPHEN Membership Directory.

On the eve of publication of this issue, I would like to take this opportunity to highlight some of the activities carried out by the third executive committee, which are as listed below.

- Talk Program on **"Water Quality management"** on Aug. 16, 2003
- Participation by SOPHEN executive member on the WEDC Conference held in Kolkatta, India on Nov. 5, 2003.
- Half-day Seminar on **Water Quality** with Dr. Chris Mc. Gahey of USA, the guest speaker, on Feb. 5, 2003.
- Celebration of **"World Water Day-2003"** organized jointly with DWSS, WHO, NEA Pokhara Region, Pokhara Engineering College Phirke and UNICEF in Pokhara on March 22 & 23, 2003. The Pokhara Declaration, which was passed at the closing ceremony, was submitted to different concerned agencies for necessary actions.

Major Events of Two-days Program of WWD

- National Seminar on **"Managing Water Resources for Poverty Alleviation"**
- Talk Program on **"Water For the Future in Nepalese Perspective"**
- **Art Competition** on "Water & Sanitation" among the students of the Higher Secondary Schools of Pokhara.
- First **National DOHORI-Geet (Folk-Song) Competition** aiming to bring about awareness on water & Sanitation.
- **Mass Awareness Rally** with traditional & cultural parade (Jhanki)
- **Cultural Program**

- Celebration of **"World Environment Day-2003"** jointly with DWSS and WHO on June 6 and 7, 2003.

Major events of Two-days Programme of WED

- National Seminar on the International Theme **"Water: Two Billion People Are Dying For It"**
- National Debate on **"Environment versus Development"** among the students of Engineering College and Universities.

- Discussion Seminar on **"Challenges of Development: Poverty, Environment & Infrastructure Nexus"** in joint collaboration with Asian Institute of Technology Alumni Asso ciation (AITAA), Information Dissemination Initiatives (IDI) and South Asian Institute of Technology (SAIT).
- **Honoring Dr. Bindu Nath Lohani,** Secretary to the Board of ADB, Manila for being elected to elite US Academy of Science & Engineering in joint collaboration with AITAA, IDI, and SAIT.
- Four days Workshop on **"Economic Valuation of Environmental Resources"** from Aug. 3-6, 2003 jointly organized with AITAA, IDI and SAIT.
- **A Greetings Exchange Program** for Dashain & Tihar National Festivals on Sept. 30, 2003
- SOPHEN has been successful in being selected as a partner country by European Commission to work in a Research Project on **"Innovative Decision Making for Sustainable Management of Water in Developing Countries" (DIM-SUM)**
- The Coordination with counterpart organizations within the SAARC Region also is being looked into. Recently SOPHEN received an invitation from the Institution of public Health Engineers (IPHE) India for the Visit of its members to India so that best practices on Health and Sanitation issues for poor communities in SAARC countries could be shared.

I would like to sincerely extend my gratitude to all the SOPHEN members and well wishers of the Society without whose collective efforts, these activities would not have been possible. I believe this journal also will be a milestone for the growth of this organization.

We look forward for your greater cooperation, support and guidance for continued prosperity of this organization. Any constructive comments and suggestions are also heartly welcomed for improving the forthcoming issue of the journal.

With Best Wishes,

(Er. Birendra Man Shakya)
General Secretary
SOPHEN

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Er. Dinesh C. Pyakurel, Co-ordinator
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The Pokhara Declaration on Managing Water Resources for Poverty Alleviation

Preamble

Poverty reduction is main priority of the tenth five year plan of His Majesty's Government of Nepal. Water Resources Management includes managing water for food, energy, sanitation, environment, economy, etc. Optimal and sustainable use of water resources plays vital role in poverty alleviation for which different actors of the society including community, policy makers, planners and implementers have to show sincere concern and their active participation at all level. In order to focus different issues related to ensuring sustainable Water Resources Development, thus resulting to reduction of poverty, the Society of Public Health Engineers Nepal (SOPHEN), Department of Water Supply and Sewerage (DWSS) and Nepal Engineers' Association, Regional Centre, Pokhara with co-organization of Pokhara Engineering College, Pokhara, organized a two days (March 22-23, 2003) program in Pokhara, Nepal on the eve of the World Water Day 2003. One day technical session as National Seminar was held with the participation of more than 300 engineers, planners, social scientists, practitioners and community representatives. This Pokhara Declaration is the outcome of the extensive discussion and adoption by the participants of the National Seminar on Managing Water Resources for Poverty Alleviation.

The Pokhara Declaration on Managing Water Resources for Poverty Alleviation

We the engineers, scientists, social workers and practitioners in the field of water resources representing government, non-government and private sector from all over Nepal, have come together from March 22 to 23, 2003 in Pokhara, Nepal, celebrating World Water Day 2003 to commit ourselves to Manage Water Resources for Poverty Alleviation, hereby declare that :

A. Pro Poor Focus

1. For the overall development of water resources, people's initiative and their management capacities should be put at the center of planning.

2. Government, Non government, private sectors and civil societies should collectively work to achieve sustained development of water resources for poverty reduction.

3. The development strategy should empower people through self-reliance and capacity building to understand options for change.

4. The importance of women and socially disadvantaged population in water resources development should be recognized making it core of development planning, programming and implementation.

5. There is strong correlation between water and poverty, therefore, inter-sectoral reallocation of financial resources should focus on water resources development that will ultimately result in poverty reduction through economic growth and social equity.

6. Urbanization is engine of economic growth. Due attention should be paid to improve basic infrastructure services and employment generation in the urban areas without marginalizing the urban poor.

B. Integrated Water Management

7. Integrated Water Resources Management (IWRM) is key to meet the present and future water demand efficiently. Basin and sub basin management approach should be strongly adhered to ensure social, economic and environmental sustainability.

8. Appropriate technology and indigenous approach should be adopted in Water Resource Management. Approaches such as water harvesting, waste recycling, ground water recharging, water rights trading, polluters pay principle should be promoted. Data base and Information system should be emphasized at all level.

9. Management of water at all the lowest possible level is key to ensure productivity and social equity. Therefore, decentralized and participatory approach should be adopted.

C. Valuing Water use

10. Water has social and economic value. Cost recovery principle should be introduced in all kind of water use. To make water use affordable to all sections of the society, cross subsidy or the lower economic sections should be emphasized by adopting appropriate modalities in its' pricing.

D. Capacity Building

11. For the overall management of water resources, enhancement of capacity and skill development building at all level should be promoted.

Dated March 23, 2003

महिला र बालबालिकालाई केन्द्रित गरि पानीको योजना र विकास गरौं ।

Strategic Directions to meet "Future Water Demand " in Nepal

Er. Dinesh C. Pyakural

1. Background

Water, because of its hydrological cycle, is a renewable but a finite resource and is one of the five essential elements necessary for human survival. The hydrological cycle generally implies the renewal of this resource where as the length of time between the completion of the cycle of its renewal vary greatly from one place to another. Water is also a mobile resource in the sense that after reaching to earth from the atmosphere, it moves over & under the earth's surface some eventually reaching to the ocean and some evaporating directly back into the atmosphere and some infiltrating into the underground storage. Between 1900 to 2000, there is nearly ten fold increase in total water demand, whereas in the drinking water sector the increase is 25 fold.

Apart from living, in order to fulfill the daily domestic demand and personal hygiene, water is equally essential for people. Water is also important for food for irrigating land to increase productivity and to meet the ever increasing food

Global trend in Water demand for various Uses

Water Uses	Year 1900	Year 1960	Year 1980	Year 2000
Irrigated Areas (Mha)				
Water demand (Cu Km/Yr)	47.3	142	217	347
Agriculture	525	1550	2290	3250
Industry	37.2	330	710	1280
Water supply	16.1	82	200	441
Storage Reservoirs	0.3	23	120	220
Total	579	1990	3320	5190

demand due to the rapid population increase. To fulfill the ecological and biodiversity demand the water for nature or environment, which was generally ignored in the past, has been one of the major concerns today.

Because of this competing demand for different uses of water, the resource has to be planned cautiously. Increase in conflicts in its allocation and distribution for the competing uses has been a common phenomenon and lack of the multi sectoral approach in its planning, d evelopment and management in the past has been one of the main reason for its inefficient and ineffective use of this precious resources. Integrated approach in its development has thus been the major development focus from early Ninetees.

Water is one of the main natural resources supporting the economy of Nepal. There are about 6000 rivers and rivulets which add up to approximately 45000 Kms in length contributing to 170 billion Cubic metres of average surface runoff to the Ganges river system. In terms of its use for different purposes, nearly one third of the population do not have access to safe water and only one fourth have access to proper sanitation, 33 % of agricultural production is based on irrigation systems and 17 percent of total cultivated land has year round irrigation facility and less than 400 mega watts of Hydropower is installed.

The population is expected to double in 30 years and hence the demand of water for the respective uses particularly for consumptive uses like drinking water and Irrigation will rise substantially. A careful planning is therefore essential for the use of the water resources that can be used in an optimal manner to meet-the future water demand.

2.0 Major Use of Water Resources and its Development status

2.1 Domestic water supply & Sanitation

Despite of huge Water Resources potential, less than 30 percent of the population still lack access to safe water and three fourth lack adequate access to sanitation. HMG/N has allocated priority in funding in this social sub sector through generation of both internal and external resources. The coverage at the end of Ninth
Plan is as follows:

S. No	Description	Population Benefited by Ninth Plan ' 000					
	Rural	Urban No.	%	Total No.	%	No.	%
1	Basic Water Supply	14464	71.3	2512	72.6	16976	71.5
2	Basic sanitation	4094	20	1826	53	5920	25

Future development Target in WRS is set as follows:

Year	Access to safe Water supply %		Provision of Safe Sanitation %
	Basic Services	Good Services	
2007	85	40	60
2012	100	60	80
2017	100	85	100
2027	100	100	100

2.2 Irrigation

Nepal has a cultivated area of 2,642,000 hectares, of which two-thirds is potentially irrigable. At present, 41 % of the cultivated area has irrigation of some sort, but only 17 % of the cultivated area has year round irrigation. It is estimated that the existing irrigation systems contributes approximately 33 % to the country's current agricultural production. The Irrigation Development status in Nepal is as follows:

2.3 Hydropower

Nepal possesses energy sources mainly from Hydropower and fuel wood only. Renewable energy resources including Solar & wind power are being developed on a pilot scale and biogas is getting popular in the rural areas

Irrigation Development Status In Nepal- 1999/2000

Geographic Region	Overall cultivated area '000 ha '000 ha	Total Area Irrigable '000 ha	Total Irrigable Area'000 % ha	Irrigated As % of Cultivated	Yr round Irriga Ted'000 ha	Yr round Irriga Ted as % of irrig.	Yr round Irr as % of cultivated
Terai	1,360	1,338	889	65	368	41	27
Hills	1,054	369	167	16	66	39	6
Mountains	227	60	48	21	18	38	8
Hills	2,642	1,766	1,104	42	452	41	17

Source: WRSF Consortium Report

The WRS Strategy has set the following Target for Irrigation sector

Achievement Targets	By 2007	By 2022	By 2027
1. Year Round Irrigation (% of Irrigable land)	60	67	90
2. Increase in average Cereal Yield in Irrigated areas (%)	40	125	125
3. Establishment of WUAs that are capable of managing Irrigation systems up to (ha)	500	5000	5000
4. Average cropping Intensity (%)	200	200	250
5. Increase in effective use of Command Area (%)	-	80	100

3. Water For Future

The ever increasing demand of water resources globally will limit the per capita availability in 2025 to 4800 cubic meters from the present level of 6600 cum. In Nepal though the per capita availability at present is 10000 Cu.M / yr is above global average, will lessen to 6600 Cu m in 2027 due to the population increase.

Summary of Economic Hydroelectric Development Opportunities

Category	No of Projects Identified	Total capacity MW	Total generation Potential GWH/Y
10-100 MW	157	6,200	38, 000
100-300 MW	47	7,815	42, 056
300-1000 MW	20	9, 437	45, 723
> 1000 MW	5	19,463	50, 985
Totals	229	42,915	176, 764

Source: WECS Estimate, 2000

WRS - Hydro Power Development targets

Target Indicators	Unit	2007	2017	2027
Hydropower Capacity Domestic Export	MW	 820 72	 2230 400	 Substantial
Households supplied with Electricity	%	25	38	60

Nepal's current water use and potential use in 2027 is as follows:

The challenges in use of the abundant water resources are:

- the volume of runoff into the country's streams and rivers varies greatly from place to place due to large variations in climate & topography
- the seasonal variation is very great. In an average year, 82 % of the annual river flowoccurs in june to Nov. Even in large rivers, the dry season flow in an average year is only 12.5 % of the annual flow.
- There are large flow variations from dry years to wet years
- Water resources are not available at the demand centers
- High sediments load in the rivers
- Over abstraction of ground water/ lowering of water table / drying of Artesian flows

Future water needs in Nepal thus necessitates coordinating and managing water use for various uses including environmental considerations to maintain the ecosystems in the downstream of the rivers. The following table explains the summary water balance study conclusions on major rivers of Nepal

Estimated National Water Use I n Nepal

Water Demands/ Use	Year 2000	Water Volume Mill.cu M/yr	Year 2027	Water Volume Mill. Cu.M/yr
1. Consumptive use	22.9 Mill Popln	800	38.8 Mill Popln	1,800
Domestic water use	1.1o4 Mill ha	13000		
Irrigation		80	1.766 Mill ha area	37000
Industrial				180
2. Non- Consumptive	Capacity		Capacity	
Hydro Electric Power	342 MW	1000	22000 60000	MW
Total Demand/ Use		14,880	98,980	
Water Supply Capacity (surface & ground water)	230,000			230,000

(Source: WECS Estimate 2000)

3.1 Strategic Directions of WR Development

With lot of consultations with the stakeholders and more on a participatory manner HMG/N has developed and approved the National Strategy on Water Resources for the next 25 years and WECS at the moment is busy in finalization of a National Water Plan and program to reach to the short, mid and long term goals in 5, 10 and 25 years respectively. The Strategy

in its long term approach, has emphasized on the need to develop WR at the basin and sub basin level of the major river systems in Nepal. So as to promote the integrated planning and development at present, it has recommended a Central planning body (within WECS) and to coordinate and monitor the central level activities.

At the Global level, a Vision has been set for the current millennium on the Water resources development and similarly strategies has been identified to meet the future water demand that is required to meet the water for people, water for food and water for nature. In view of the Global vision and strategies, an effort has been made in the following paragraphs to suggest for additional efforts in the form of the plan & program and actions required to build on the National Strategies.

Summary of Water Balance Study Conclusions

River Basin	Study Conclusions
Mahakali	Present & future water needs can be comfortably met
Karnali	Water surpluses offer opportunities for large multi purpose benefits
Babai	Water shortage exists in Babai. If diversion from karnali Basin (Bheri) is undertaken, a large water surplus is available
West Rapti	Water supply will be adequate to support some surface irrigation
Gandaki	This is a water surplus basin with potential to irrigate the adjacent Terai area
Bagmati	Water shortages exists now and quality problems are evident
Kamala	Available flow can be balanced with newly developed irrigation areas
Koshi	water surpluses are forecast if operation policies for power, irrigation and flood control are prioritized
Kankai	water shortages will occur in March, April and may if full irrigable area is developed using surface water

Source: WECS Study 2002

Water Demand Management

A careful planning for the development & management of the water resources at the basin or sub-basin level is being initiated in the current water resources strategy demanding for an appropriate Institutional arrangements. In order to meet the future water requirements for social, economic and environmental demand at the basin or sub-basin level, water use optimization study needs to be conducted for its optimal utilization through demand management. Such studies on demand management will refine the analysis related to population, migration, use of water resources and explore the possibilities of demand management through rain water harvesting, wet season storage, recycling of waste water. Ground water recharge, trading of water rights, public awareness etc. Such a study will also look into the sequential investments depending on their set priorities of development.

Due to lack of such vision or study in the past, we have to go bring water into the Kathmandu Valley from the farther source (Melamchi) than the feasible nearer source (Kulekhani).

Increasing water productivity

In terms of Water resources Use, irrigation sector consumes nearly 70 % of the total water demand in comparison to Domestic & Commercial and Industrial water demand which will consume to the maximum extent of 5 %. So bringing element of efficiency & effectiveness in the service delivery by generating awareness to the common farmers and institutional reforms is a must to meet the future water demand. The general practice of flood Irrigation to grow high duty crops (rice) and lack of proper drainage system and Institutional weaknesses in effective management has been the major concern of waste of this precious resources.

In order to meet the ever-growing demand of the water resources for the different and competing uses, the water crisis that is eminent in near future can be averted by means of increasing the water productivity. The more we produce with the same amount of water, the less the need for the infrastructure development, the less the competition for water, the greater the local food security and the more water for agricultural, household and industrial uses. If it can be achieved, the nature will get more water to balance the natural eco system. Greater water productivity: more crop per drop

Increasing water productivity alone, Globally it is estimated that it could meet halve of the increased demand by 2025. Recycling, supplemental irrigation with low cost precision technology offers a means for poor farmers to produce more. This change in the development philosophy does also demand for the redefinition and re delineation of the present Institution's roles & responsibilities.

Meeting this challenge of greater productivity will require a far greater effort and significant changes on how water is managed. Getting more crops per drop will demand for better plant verities and agronomic practices with the introduction of shorter duration and higher yielding crop verities. The future strategies thus should focus on:

Firstly through better agronomic practices

- Crop varietal improvement
  Plant breeding plays a vital role in developing varities that yield more mass per unit of water consumed by transpiration
- Crop Substitution
  Switching from a more to a less water consuming crop or switching to a crop with higher economic or physical productivity per unit of transpiration.
- Improved cultural practices
  Better soil and land management, fertilization and pest and weed control increases the productivity of land and often of water consumed.

WRS for the irrigation sub sector emphasizes implementation and promotion of sustainable efficient Irrigation systems, based on the opportunities to intensify and diversify agricultural production. So as to attain technical & financial sustainability, the strategy emphasizes on the importance of the sustained opportunities for farmers in commercialized agriculture and increased productivity from the land and has undertaken the following strategies:

- Integrate irrigation planning and management with agricultural development
- Develop year round Irrigation in support of intensification & diversification of agriculture
- Strengthen local capacity for planning, implementation and management of Irrigation
- Encourage consolidation of land to promote irrigation/agricultural efficiency
- To establish an effective partnership of agencies and users associations to plan, develop, operate, maintain and sustain irrigated agricultural development
- Revise and update the Agricultural Perspective Plan implementation plan
- Develop access to markets

And secondly, through better water management practices.

Better Water management

The performance of many irrigation system is significantly below potential due to inadequate design, use of inappropriate technology, inappropriate governance arrangements and poor management practices. Because of the unreliable supplies, poor maintenance and so on, the users are discouraged from organizing themselves in taking over the o/m responsibility and are unwilling for the service charges.

Better water supplies can reduce stress at critical crop growth periods increasing yields and the farmers will tend to invest more on inputs for better output with the same volume of water.

- Deficit, supplemental and precision Irrigation It is aimed at increasing productivity that do not meet full evaporative requirements. Irrigation supplementing rainfall can increase the productivity when limited supply is available to crops at critical periods. Precision Irriga tion, including drip, sprinkler etc reduces non-beneficial evaporation applies water uniformly to crops, increasing productivity.
- Reallocating water from lower – higher value uses Shifting from agricultural to mu nicipal or industrial uses of water or fromlow value to high value crops, it can in crease the economic productivity or value of water.
  Developing Biotechnology for agriculture. The application of advances on biotechnology including genetic engineering, tissue culture and marked aided

selection will be essential for:

- Raising yield ceilings
- Reducing excessive pesticide use
- Increasing the nutrient value of basic food
- Providing farmers on less favored lands with verities better able to tolerate drought, salinity and lack of soil nutrients.

Increasing Storage / Recharging Ground water

Retaining flood runoffs until the moment needed for its different use is an essential element of water resources management especially in South Asian context where 90 % of precipitation is under less than 3 months. As water becomes increasingly scarce, a higher proportion of the normal flow of water will be consumed and the risk of shortages at periods of low flow, harming human uses and eco systems will increase. For this reason the need for an additional storage as a proportion of the total water consumed will increase in future. Each of the storages technologies has comparative advantages & draw backs under specific conditions and has to be judged best on its overall merit. The optimum strategy is therefore to be a combination of its storage in aquifers, in household jars and with small and large impounding reservoirs and establish sort of an integrated system of storage..

Though the need for such storage projects for facilitating both year round irrigation and hydropower generation to meet the demand in dry season the WRS is silent in identifying appropriate strategies. to meet the peak energy demand at low flow situation, promotion of such storage type Hydropower needs to be prioritized.

There is a great environmental threat due to the over abstraction of ground water in many areas. New techniques and institutional mechanisms are urgently needed to recharge ground water aquifers. Limiting access through registration & licensing and incentives to users to limit or stop pumping is the alternative.

In KV, the possibility of recharging excess runoff into the underground lime stone deposits in the South Western hilly areas (Champa devi area) in Kathmandu valley seems a possibility and further study is to be made as possible options of meeting the future water demand in the valley. At the moment, NWSC focusing on the conjunctive use of the ground water to supplement where there is deficit in supply from the surface water sources. Possibility of recharge in the underground confined aquifer in KV, is going on at the moment on a pilot scale in the Manohara area, the result of which is still awaited.

Rainwater Harvesting

It is a socially attractive alternative to large construction, provides opportunities for decentralized, community based management of Water resources and generally is a low cost alternative source of water supply. The limitation of rain water harvesting is primarily related to the storage capacity that is required to store for a longer period because of the rainfall pattern. Since the harvested rain water could be used for other consumptive uses, it will lessen the burden on water scarcities. Theexperience of the rain water harvesting in the Gulmi & Arghakhachi Districts has shown fruitful results and validated the rainwater harvesting as one of the feasible technical option. It is in this context the WRS has recommended to establish a well-equipped unit to promote rainwater harvesting.

Institutional Reforms

So as to manage the water resources at the lowest possible stakeholders especially at the community level through women's involvement, the political will & commitment is a must to bring about the desired changes in the present institutional role & responsibilities.
The WRS has highlighted the following institutional developments.

On domestic water supply & sanitation, strengthening implementation capacity, enhance institutional capacity for coordination, planning, implementation and monitoring, enacting and enforcing standards and regulatory mechanisms for water quality and effluent discharge are some of the key strategic direction on institutional reforms.

Similarly on Irrigation sector, Integration of Irrigation planning and management with agricultural development, improving planning and implementation of new Irrigation systems, strengthening local capacity for planning, implementation and management of irrigation are the major directions of institutional development.

Similarly developing Institutional capacity to develop more Hydropower projects through Public – Private sector financing and Institutional reform in the form of separation of the presently combined responsibilities to separate Generation or production, Bulk and retail distribution is also being promoted to bring an element of efficiency in services and also to promote the private sector.

Valuing the water services

Water prices can serve an important role in overall water demand management.\the water pricing policies and structures must be based on overall policy directives of the government. The conflicting goals of cost recovery, efficient allocation of resources, income distribution and subsidies to the poorer sections of the society can be reconciled by the correct combination of the pricing alternatives.

It has been learned from the past lessons that making water available at low cost or for free does not provide incentive to its users and sustainability is always in question of such services. Water services need to be priced at full cost for the optimal use of these precious resources for various uses. Even pricing water at its full cost would still be affordable to all economic sections of the society if appropriate modalities were applied in setting its tariff. Pricing water at full price will also attract the private sector in its development.

In the water supply sector, the strategy to implement and enforce equitable mechanism for cost sharing has been adopted. In the rural water supply sector, mechanism of cost sharing rather than of cost recovery is the principle that is being followed which helps ultimately to generate a balance between social equity and economic efficiency. Whereas in the urban sector, gradual cost recovery leading to full cost recovery principle is being adopted with the gradual increase in the service level.

In the Irrigation sector, the cost recovery has been a problem in the government operated systems and in most of the cases even the o/m costs is also not recovered. The WRS strategy is to the implementation of sustainable, cost effective and equitable projects. Irrigation systems asessed and ranked in terms of sustainable and economic efficiency will receive priority for implementation. In the strategy a definite cost recovery mechanisms as well specified in the wss sector needs still lacking in the present WRS.

In the Hydropower sector, full cost recovery is the principle that is being adopted since long and for the reason has attracted the private sector (IPP) in the development of Hydropower. The electricity tariff of Rs. 6.5 per unit (KWH) is very high in comparison to the other developing countries and therefore NEA should shed extra effort to reduce the non-technical losses and eliminate high accounts receivables.To sell the surplus power to the neighborly countries, strengthening the institutional and physical infrastructure for power export has also been identified as the key strategy for the sector.

Gender mainstreaming – pro poor strategy

The official data of 38 % , amounting to nearly 10 million, of the population living below poverty line in Nepal needs special attention because water is having a stong correlation with the level of poverty. In the hills of Nepal, a Unicef study has shown that 4.2 K cal per day per family can be saved apart from the time saved in fetching water if a water tap is installed within reasonable access. Though access to water is a primary requirement for the poorer communities to combat water borne diseases, be healthy and use the saved time for other income generating activities, a comprehensive approach is required to deal the problem. Since the poorer families will have a small land holding, a major income generating strategy is to improve the agricultural output of their holdings through pro poor programs. Targeting these people and ensuring year round irrigation, supplementary irrigation and water harvested and conserved with a range of water management techniques will ensure greater productivity and thus supplementing their income. Evidences has shown that there exists a synergy

between promotion of small holder irrigated production and agricultural growth from the following results:

- have higher net sown proportions of their land irrigated
- have higher cropping intensities
- apply more fertilizer per unit of cultivated land
- cultivate more diversified, higher value, and more labor intensive crops
- obtain higher yields per crop per unit of land

The poor people also gain from wage employment in water dependent business. The expansion of irrigated agriculture will provide massive wage employment opportunities to the rural poor. The poorer are always threatened with floods because the economic distressed people live in the flood prone low lying areas and thus water management through flood control measures are also important for the poor.
The pro poor strategy for the water sector thus needs to focus on launching priority program to target these people to reach to basic levels of health, income And free them from present drudgery.

User Responsive/ Community Management

Service oriented management focuses on making managers responsive to user needs. The services needs and expectations of users will be influenced by the price they have to pay for those services, especially if it is not subsidized. Service oriented management thus requires a mechanism to ensure that services can be provided at the lowest possible cost.

The sector vision on water for people is to put people's initiative and capacity for self-reliance at the center of planning & action. Vision 21 has taken people centered development approach takes the household as the prime catalyst for change, the first level in planning and management of environmental services.

Alliance of local communities, NGOs and water agencies can contribute much to achieving the effective management of WR at the local level. They could jointly manage:

Watershed action programs, tackle local problems in water rehabilitation and pollution, community action on disaster prevention, controlling water borne diseases, monitoring water quality etc.

Valuing Eco system functions

In order to achieve more satisfactory environmental performance, there needs to be a shift away from the sectoral approach of environmental management to a more collaborative views involving the stakeholders. This will lead to a more efficient and accountable system of environmental management.

Awareness building amongst the communities is, therefore, essential for the communities to understand the interrelationship between the needs of water for life, water for food and water for the nature or environment. Additional studies are also needed to improve our understanding of ecosystem functioning and to value the devices that these systems provide. Such knowledge will allow careful assessment of the impacts of use & developments of WR on the eco system.
The actions to understand the ecosystem are:

- Leaving the required amount of water for downstream functioning of the ecology
- Protecting wetlands and flood plains to enable the benefits from seasonal flooding and provide storage for extreme flooding
- Protecting & planting forests in upper catchments especially in mountainous slope
- Requirement of full effluent treatment on the polluter Pays principle
- Creating protection of groundwater
- Rehabilitation of degraded areas to recover lost eco systems

4. Conclusion- The Water Future

The strategic directions that has been set for good planning, development and management together with following a system of good governance, after 25 years ie by 2027

we expect to see in Nepal that every woman and man, girl and boy either living in cities, towns or villages will be aware on the importance of hygiene and adequate water & sanitation and are fully aware of t-he social & economic importance of water. The community, we hope by then will be working in close laison with the government and non – governmental organizations managing water resources and protecting the environmental eco systems. The increased national income due to the export of hydropower to the neighbors will bring about a substantive change in the socio- economic and physical status of the common Nepalese. This is the future we are really aiming for.

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Water Resource Development for Poverty Reduction

Dr. Jagadish C. Pokharel, Ph.D.

Introduction

70% of the earth surface is water. 50 %– 65% of human body contains water. In Nepal alone 225 billion m^3 water flows every year which studies suggest can generate over 40,000 MW electricity. In most Terai area we can find water at shallow depth. In Kathmandu alone there is significant amount of ground water being used for decades. Every 220 Km^3 water falls from the sky. Why then 1.2 billion people globally do not have access to drinking water? Why more than 30% of the Nepali people do not have access to safe water? These and other questions largely indicate the complexity of water development issues. Much of the answer to these questions lie in the nature of the water itself and the way humans relate themselves with water. Given the prevailing paradox between plenty and scarcity how is Nepal trying to develop its water resources and what issues still remain unresolved?

Water and Humans

Water is essential element of human life. It has two sides—one it is something that is indispensable for human body; human body must maintain certain level of water in the body to remain healthy. Second water is a useful resource for the livelihood of the people and major source for generating wealth.

Various studies have determined the minimum amount of water an individual needs to main physically fit. This amount differs by the way individuals live. In rural areas its average is 45 liter/day and the same for urban context is 112 litre/day. If we use this calculation then 1260 million liter water is needed only for the daily consumption of the humans in Nepal. 380 million litre for 14% urban people and 880 million liter for the rural population.

Water is a major input for food production. In rural areas poverty prevails because of low agricultural productivity. Misuse, inappropriate use and limited to access to water remain the main factor for lower production in agriculture. Water is also an essential input for the livelihood of the people. It is an essential input for agriculture, animal husbandry, for industries and other economic activities. The water demand for each of the activity depends on their nature and characteristics. For instance certain type of paddy cultivation requires more water than others. Horticulture needs less water than paddy. Some industries need more water than others.

Water is a resource that means-with some capital investment it can generate economic benefit. Hydropower is the most glaring example of this intrinsic quality. Countries which have the potential like Nepal, hydropower generation can significantly contribute to the economic growth. Being a renewable resource integrated management of water therefore, can help achieve sustained development.

Water is also key for balanced ecosystem. A minimum level of fresh water is required to maintain wetlands functioning and alive. Balanced ecosystem is important for economic sustainability of a society. It is the poor people who actually pay very costly for the loss of biodiversity and degradation of ecosystem.

Water and National Development

Water is an economic resource. It can generate wealth if properly developed and used. Because it is also essential for human survival, its development requires balancing social as well as

economic goals. Like any resource available in the nature, water is also a free gift for the humans. This reality has two majorimplications for water use and development; one that humans are used to exploiting it freely and the other that it requires money and technology to make usable and accessible. Left alone in its natural state it gets wasted and cannot be reused.

Nepal's recently approved water development strategy tries to justify water resource development by establishing link with poverty reduction. It suggest that poverty can be reduced by following two prong approach—investment for growth and employment generation and investment on social aspect of water development. Hydropower generation and expansion of irrigated fall in the first group and basic water supply and sanitation under the second category.

Reducing Income Poverty

Within this schema, water resource is taken as a main growth sectors identified for achieving the required rate of growth for poverty reduction. Conceptually the higher GDP growth rate is expected to contribute to faster rate of poverty reduction. For instance, it suggests that with a medium growth scenario of 6.5% per annum for the next 30 years there will be no household below poverty absolute poverty line. The most important premise is that the employment sensitivity of GDP growth will not decline. The key issue here is investment. Among the three growth scenarios (base case, medium and high) even or moderate growth annual investment as a percentage of GDP will be between 18 to 21% (average) per annum. The gap in investment demand and the revenue supply is expected to be met by private sector.

Attracting the private sector investment therefore, is the most challenging task in water resource development. As money is available in the market and behaves according to its rules. It is attracted to places and sectors where there is greater security and higher profit. It is always looking for areas that give them maximum return in shortest time. To address this competition for private sector money there should be consistency and simplicity in policy, regulatory and institutional arrangements. This is the challenges for an evolving nation like Nepal where institutions and processes are still developing.

Improving Social Conditions

When we view water as something essential for human survival then it tends to become a basic right of an individual to have secured access to minimum level of drinking water. In such case one cannot justify investment in water development on direct economic benefit and const calculation. Allocation decisions have to be taken on the basis of social values. When we decide for 100% water supply for rural Nepal in the next 15 years, we are basing our decision on social grounds. It is more of a distributive decision than economic one. It is the value that society attaches to providing water to every one that guides this decision. Such decisions are likely to be debated on several grounds, but it is the state's value to provide water to all. Of course, here the issue of cost and affordability cannot be ignored. A kind of compromise between the quality and availability is made. It has implication for the kind of technology, the approach, and the quality of service given to the community. Partnering with non-governmental and community organizations is therefore required. The idea is to increase access to water through simple technology and less costly manner. In such case the state or the government agencies play facilitators role.

The strategy for enhancing social conditions through better access to clean water in poor community and rural areas largely counts on the partnership between the government and community. The government has made several arrangements for financial and technological support for such projects. The Fund concept—Rural Water Supply and Sanitation Fund Board, the Local Development Fund, the Local Trust Fund, and the Poverty Alleviation Fund at the center are all designed to fulfill this partnership need.

In addition to this the devolution of responsibilities to the local bodies – District Development Committees, Village Development Committees, and Municipalities are expected to further the process at the local level. Volunteer and Community based organizations are also encouraged and coordinated by the government to participate in this partnership approach to replicate and expand the most effective and sustainable models are then replicated through. Water

supply in this model goes hand in hand with social capital building at the community level through social mobilization and meaningful engagement of the true beneficiaries in decision making.

Similarly the policy and institutional changes introduced by the government have changed the hydropower development regime in the country. This change has given ample incentives to motivate private sector and community to come forward and invest. The removal of licensing requirements for schemes smaller than 1 MW, and commitment to purchase power at certain rate, has encouraged private and community involvement in rural power sector. The various models of community ownership of the power schemes are good example of this sector being attractive for investment. Same thing cannot be said to drinking water supply. Communities participate in constructing and sharing water but pure profit making approach is still not feasible in rural areas. The government directly or indirectly has to subsidize the community initiatives. It has to take leading role until this sector becomes attractive for private sector.

It is expected that expanding basic services in water supply and energy to the rural areas will be instrumental in instigating a chain of activities for social transformation. The improved water supply and sanitation will release women from drudger and allow them to participate in personal development activities. The women, girl child and poor people will devote time in education and participate in decision processes affecting their livelihood.

Issues for Further Discussion

Nepal's plan to develop water resources for poverty reduction raises several issues which should engage the community of professionals and intellectuals. A few questions are that come to mind are:
How to deal with the cost and price issues of our hydropower product, particularly, in the context of single buyer regime?
How do we explain the absence of any major investment by the private sector in the hydropower sector over the past decade?

Is there a national consensus among the different views regarding our approach to hydropower development?

For rural water supply, rural electricity, and sanitation the government relies heavily on the non-government organizations, community organizations, and local bodies. Given that people hold government and not these actors accountable for failures, what strategies are there for shifting the accountability?

Water sector, will have to compete with other sectors, established (roads, telephone, and others) and newly emerging ones (Information and communication) for public and private resources, what be the effect of such competition on the water resource development ?

These and other questions demand a continued dialogue, debate, and revisiting of our plan for water resource development. Government agencies, academia, business, industries, and civil society at large should be encouraged to debate the issues. Water as we said earlier is not only economic resource but a life sustaining means for the humans and planning should resolve these two sides with due importance.

Integrated Modeling On Water Resource Management

Madhav Narayan Shrestha,
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Introduction

'Water' word is associated with –*life & soul, and gentleness & quietness.* Water is a precious gift of nature. Living things need water in different forms. Without water, life on earth cannot be sustained. Water is also an inherent component of the ecological chain on which all life and life sustaining systems depend. The fact that the whole world is facing a water crisis and increasing clear in recent years parallel to the economic and scientific development. Populations are growing and economies and lifestyles are developing, all adding to the stresses on water resources. Exactly which drivers are most important varies from place to place, but it is worth noting that while global population increased threefold in the twenty-first century, our use of water increased six fold. The millions of world's poor, use less water, directly or indirectly, but depend upon its resources for their livelihoods for more than the rest of us. Yet it is poor who are hit first and hardest when crises do come.

With over 60% of the world' population expected to be living in urban areas by 2030, cities and towns are rising to the top of water resources policy agenda. Efficient ways of responding to rapid change and its associated demands are being explored, especially through better water resources management, better service pricing, and greater public participation. Urban planning is facing the challenge of securing safe and affordable access to water for urban poor. Unless better efficient water resources management is instituted, the degradation and depletion of freshwater resources will threaten the very livelihoods and the sustainability of economics and social development.

Water System

It is necessary to understand the water system from source to sink (Fig.1). Sources are rainwater, surface water, groundwater and/or snow. Rain should be taken as source for calculation of water available for urban or semi urban centers in hilly and terai regional whereas rain together with quantity of snow melt for rural as well as urban centers in mountainous region. Sink is receiving body such as river, lake or bay. Source is for supply and sink for disposal. Source determines purification system and distribution system whereas sink determines treatment plant configuration and collection system in the water supply system.

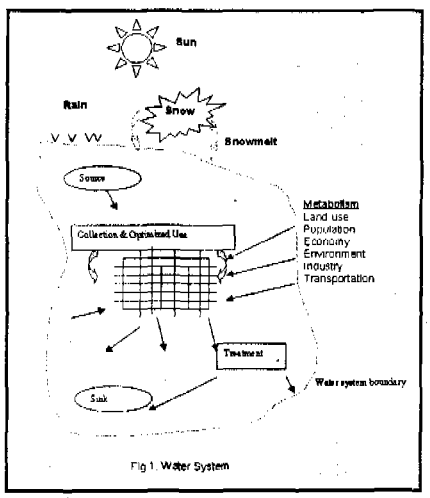

Fig 1. Water System

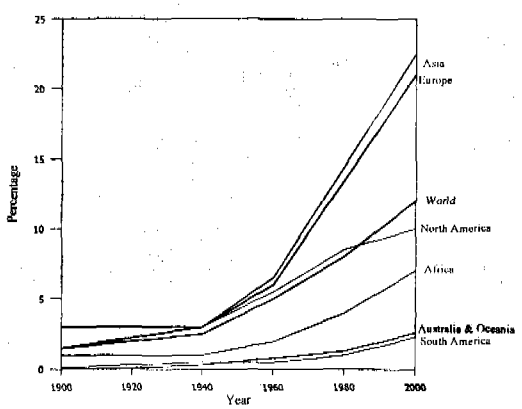

Fig.2. Percentage of Available Water Resources Consumed

Global Prospect

Taken globally, we use only small proportion of the world's potential water resources. About 10 % i.e. in the range of 4-5000 km^3 per year out of total annual runoff of about 42,000 km^3 is being used. But this water is unevenly distributed in time and space. For example, Canada has huge quantity of water but low demands. Many part of Asia, has demand that represents a very high proportion of the water available as shown in Fig.2. The range and patterns of uses of water resources are as complex and varied as the resources themselves. Globally agriculture is the largest direct user of water, accounting for about 70 % of total withdrawals as shown in Fig.3. 4-5000 liters of water is needed to produce the average daily diet. Separable domestic use was accounting from 1960.

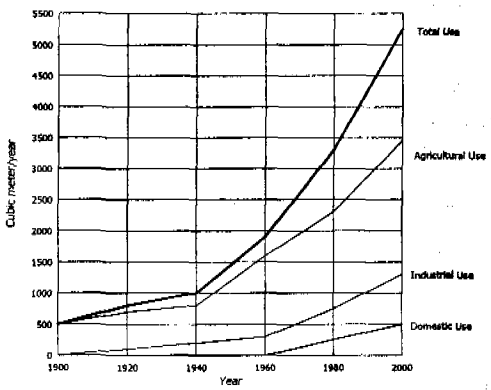

Fig.3 Global Water Use

Water Resource Planning and Management

Water resources development need to move closely integration with sustainable social and economic development. The social development, economic development and environmental suitability are interrelated functions

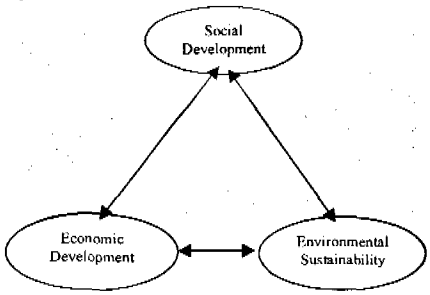

Fig.4 Interlink between development and sustainability

The planning of water system should be done in two ways namely passive and active.

i) Passive planning: - It accepts the estimated water demand by the regional planning considering population, economic activity, land use etc. It proceeds on one way and does not have the feed back loops. Process of the passive planning should consist of flowing steps;

a) Calculate the amount of water for given objective with known constraints
b) Choice of sources
c) Setting of output level (given)
d) Design of various components
e) Integration of total costs

This planning procedure should only apply in the case of no limitation of water resource and no economical constraint.

ii) Active planning: - This planning is most suitable incase of trade off optimization of water resources. Suppose that the amount of water resources cannot meet water demand, there are competitions among domestic, agricultural, industrial and environmental use, energy and economical limitation and water quality restriction in receiving body, pollution load, treat-

ment level and dilution capacity, active planning is first choice. There are supposed to have three options namely suppress water demand, transport water beyond the watershed boundary and reuse of water. Thus this planning of water system makes a rule for the total regional planning.

For efficient water resource management following steps are important.

a) Objective functions of the management of water resource should be accurately designated considering flow direction of water. It should be free from political boundaries. For development of water resource management, each must have Integrated Information System (IIS). Each water resources system must consider its interrelated subsystems as shown in flow chart (Fig.5).

b) Land-use/Land cover: Land-use /land cover should be periodically recorded and updated. Urbanization and deforestation are major responsible factor for natural disaster. Periodically information on land-use/land cover helps on proper land-use planning and management.

c) Socio-Economical scenario: Economical distribution, gender participation, income status, migration and resettlement should be well grasped. Environmental degradation and promotion are dependent on those scenarios.

d) Potential water resources, demand and use: Net potential water available should be estimated including surface water and safe yield of groundwater. Demand should be projected for short term, medium term and long-term strategy. Detail water use plan should be developed.

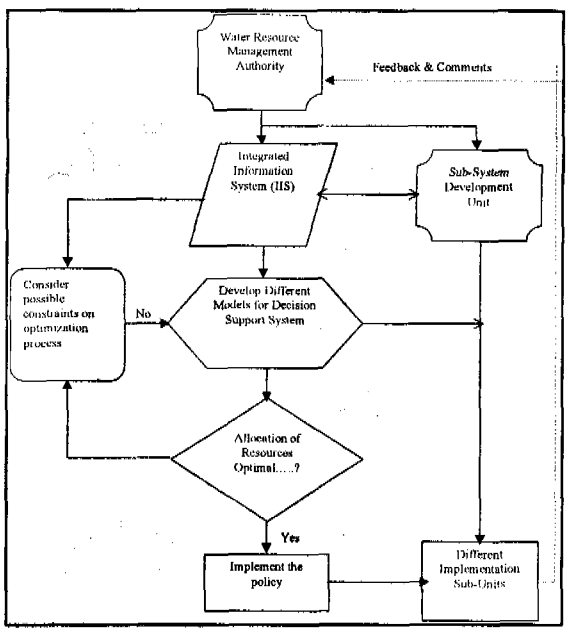

Fig.5. Flow chart of Water Resource Management Actions

e) Potential water energy: The energy available is considered mainly of energy produced from water although negligible contributions on energy production are from wind and heat. Potential hydropower should be defined on real-time basis considering worst conditions also.

Development of Decision Support System (DSS)

Different mathematical and physically based models are to be developed with all possible constraints. Method of developing of DSS is shown in Fig.6. Geographical Information System (GIS) should act as a platform for developing various models. Input and outputs to the models are shortly discussed below,

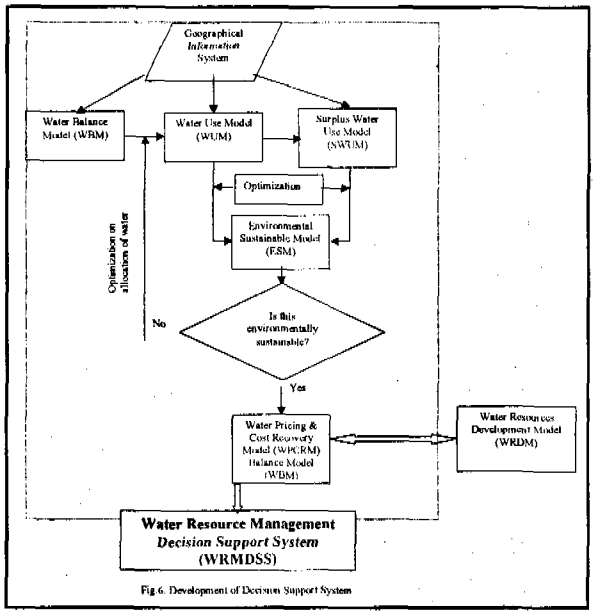

Fig.6. Development of Decision Support System

i) Water Balance Model (WBM): WBM will be formulated considering all hydrological processes. Abstract and result would be drawn. These models will be of daily, monthly, seasonally and yearly balanced models so that three strategies i.e. short term, medium term and long term can be formulated and implemented.

ii) Water Use Model (WUM): Water Use Model will consider availability of total water and its safe yield. The model will also consider the potential and optimized water use for different strategies. Total water demand for given objective function considering all constraints, will be taken into consideration and surplus or deficient will be calculated. Net water available should be estimated considering total water loss. Net evapotranspiration model will be formulated and its output will be used in accounting water loss. Inter-basin movement of groundwater and subsurface water should be considered in the model.

iii) Surplus Water Use Model (SWUM): The surplus water abstracted from WUM will be considered in this model. Possibility of exploring the water use will be focused for intra-basin and inter-basin navigation, recreation and tourism related to water use, commercial fishing, natural aquatic habitat and wetland preservation. Allocation of water for different uses will be optimized. The priority for water use will be as on drinking water supply, irrigation and hydropower development and then weather based cultural, recreation and tourism opportunities.

iv) Water Pricing and Cost Recovery Model (WPCRM): Total cost of establishment including of debt, full cost recovery for O&M and for future extension to cover the demand needed for short, medium and long-term strategies, should be considered in this model. Interaction and participation from user groups is must in this case. Private sector and/or communities involving in the different types of programmes and projects will be considered and expected contribution to economic growth and poverty alleviation. The model will give priority to the people who are affected by a project and make arrangement to encourage participating or take ownership. Possibility of selling of water to adjacent basin will be explored from this model. The model will also help to fix up water and wastewater tariffs for different types of water users.

v) Environmental Sustainable Model (ESM): ESM should be formulated with activities interrelated among social development, economic development and environmental sustainability activities. It will consider the conservation, management of natural resources and ecosystems while modifications occurred in these to meet the needs of present and future generation. The model will incorporate environmental database. The environmental database will consist of information on water-induced disaster, watershed and aquatic ecosystem. Outputs from the model will help to prepare map of vulnerability zone with aspect of groundwater pollution, floods, landslides and droughts. The risk analysis will be performed and produced risk map of different vulnerabilities. It will help for water-induced disaster management.

Water Resources Development Model (WRDM):

Nowadays water resources development should consider environmental and ecological issues at every level of the processes from policy making and strategy formulation through project planning, design, implementation and operation. Environmental impact analysis considering biodiversity, endemic, rare and endangered spices, and habitat should assess the model. The model formulated should consider multi-purpose use of resources and optimal allocation of water with environmentally sustainable and should account every possible positive and negative factor, which formulates the important constraints. The model should result in reduction or no incidence of natural and manmade environmental impacts and disasters. Optimizing the net benefit should solve any conflict or competition to use the resources. Trade-off optimizations technique will be formulated

Main Issues on Management of Water Resources

i) Sharing water resources

Sharing water resources has led to an ever-greater pressure to develop more effective policies and systems. It is a growing issue that is concerned at all levels, from local communities to the international stage. But the fact is that 60% of the world's freshwater flows along cross national boundaries and brings conflict. It diverts all attention to focus on the international level.

ii) Water as a common good

All must agree that water is a common good, one of the basic public goods. It is allowed to oppose to the private ownership of water resources precisely because water is not a commodity. The service of making clean water continuously available to all, and returning water to the natural habitat once it has been treated. It is the price of that service that is billed, not the price of water as a raw material.

iii) Public-private ownership

In any case the public sector must retain ownership of water resources. In addition, the transfer of water infrastructure from public to private ownership is unnecessary in most developing countries. A good model is that of a public-private partnership in which the operation of the assets is entrusted to a private operator for the term of the contract. It is up to the operator to maintain and improve the infrastructure.

iv) Fighting against poverty

Fighting against poverty is not an option; it is an obligation and even more, a number of obligations. All must fight for education, health and food. How can one do this if do not tackle the water issue, which remains the essential condition for fending sustainable alternatives to poverty? Of course, protecting water resources in the long–term perspective of sustainable development must also be one of our top priorities. But although it is a scarce resource, water itself is not at stake; the real challenge is to manage it in a proper and efficient manner for poverty alleviation.

v) Achieving Water Security

Changes in social aspirations and consumption patterns are all part of the development success that has been billions of peoples living more secure and prosperous lives than was ever thought possible by preceding generations. But these achievements are not evenly spread and billions still live in relative or absolute poverty. One of the changes that must aspire to in the future is a fairer, more equal world.

GIS In Water Resources Planning: A Nepali Perspective

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Introduction

Water is an important natural resource for human survival and economic development. The available water resource is however fixed. Although Nepal is blessed with abundant water resources potential (about 10,000 m^3 per capita per annum), temporal and spatial variations of the availability of water and the demand for the same may lead to the resource being categorized as "scarce". This leads to increased competition for the scarce water. Shortages and competition among different water uses and regions can lead to conflicts, both in terms of quantity and quality. Hence, there arises the need for optimal water management (allocation) and tradeoff analysis among various uses and regions.

The Water Resources Strategy (WRS) (2002) has recognized the above reality. Conventional supply-oriented water development strategies mostly based at the sub-sectoral level, such as hydropower, water supply and sanitation, irrigation etc, will not be adequate. A new approach of water development will be required, emphasizing integrated resource planning, resource conservation, demand side management, water use efficiency, and social, cultural and environmental impacts of water resources development. The Water Resources Strategy has thus adopted the principles of Integrated Water Resources Management (IWRM). The three overriding criteria for IWRM are as follows:

(i) 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.

(ii) 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.

(iii) Environmental and ecological 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.

Over the last decade or so, Geographical Information System (GIS) has emerged as an useful computing system (tool) for collecting, storing, manipulating and displaying geographic information. The present challenge for GIS in water resources planning is on how GIS can facilitate more effective and efficient water resources management in line with the IWRM principles.

GIS Needs for Water Resources Planning

One of the important features of water resources planning lies in land and water interactions. River basins or watersheds are recognized as natural units for water resources management and related problems. GIS applications in water resources are mainly related to the hydrologic cycle and related processes in the river basins or watersheds. The major objective of water resources planning is to find ways to match the available supply of water and the demand for various uses at specific time and location including prevention of droughts, floods and pollution of the water sources. This paper dwells on three such areas that are important in the Nepali perspective.

Management and Delivery of Data

The spatial and temporal variations and characteristics of different hydrological processes have to be understood for better water resources planning and management. These involve various types of geospatial (geographic) data sets such as precipitation, runoff and river systems, topographic, soil and land information. Precipitation data are mostly point data. Topographic information is based on grids, contours or triangulated irregular network (TIN) models. Soil and land cover data sets consist of raster grids or polygons. River systems consist of links (streams) and nodes (stream junctions). GIS provides a means to integrate these different data types. An example of such a process is presented in the following figure.

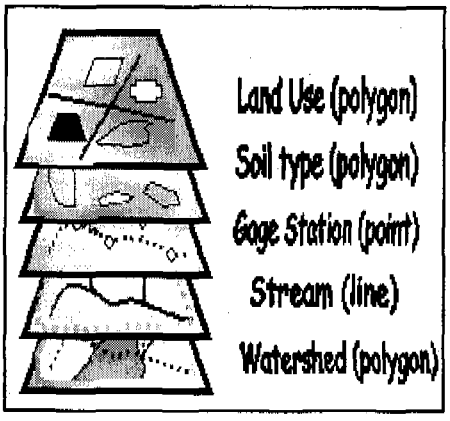

Figure 1: Geo-spatial Database

The Department of Hydrology and Meteorology (DHM) has the government mandate to collect, analyze and disseminate hydrological and meteorological data in Nepal. The Department of Surveys (DoS) deals with all topographic information. Similarly, other line agencies of the government dealing with different water sectors and land resources collect and manage related data. Other national and international non-governmental agencies like ICIMOD and IUCN deal with environmental and related data sets.

A good source of GIS (ArcInfo coverages or ArcView shape files) based topographic and related datasets for the whole country are now available from DoS. The data sets cover the following:

Table 1: GIS based Digital Datasets

Data classes	Data Type	Remarks
Transportation	Line	Roads
	Polygon	Areas related to transportation
Building	Point	Locations of building
	Polygon	Built_up areas
	Point	Settlement name
Topography	Point	Spot elevation
	Line	Contour lines
Hydrography	Line	Rivers and streams
	Polygon	Wide rivers and lakes
Landcover	Polygon	Landcover areas
Utility	Line	Electricity lines
Designated Area	Polygon	National Parks and wild life reserves
Administrative (Ward)	Polygon	Ward boundaries

Similarly DHM is in the process of implementing a Hydrological Information System (HIS) that is based on GIS and a relational database system for the management of all hydrological and meteorological data of the country.

Extensive use of GIS by the above agencies and others involved in data management and delivery can lead to the delivery of data from tables (numbers) and analog maps to digital maps and to support various forms of spatial analysis.

Hydrological Modeling

The spatial capability of GIS to produce consistent modeling inputs as well as quality control before, during and after the modeling process is recognized. One important type of hydrological modeling is rainfall-runoff (R-R) modeling. R-R models are particularly important in Nepal. It is used to extend short streamflow data time series and to generate streamflow data in ungauged sites. It can also be used to assess the implications of natural and man made interventions in the catchment area such as changes in forest cover or land use. Such models are of two types, namely the lumped/conceptual models like the NAM, TANK, UBC an, Stanford models and the distributed models like the MIKE She. Both of these models require the alysis of various geo spatial data dealing with the catchment characteristics such soil type, land use, size, shape and size, drainage cross-section and slope etc.

Popular GIS software can be used to generate Digital Elevation Models (DEMs) from the available contours and subsequently to trace the drainage network, delineate catchments at different points of the drainage, use Thiesan Polygons or other methods to convert point data over the space of interest and finally to use that information as input in the rainfall runoff model. The following figure presents an example performed using the GIS features of the MIKE BASIN model (DHI, 2002)).

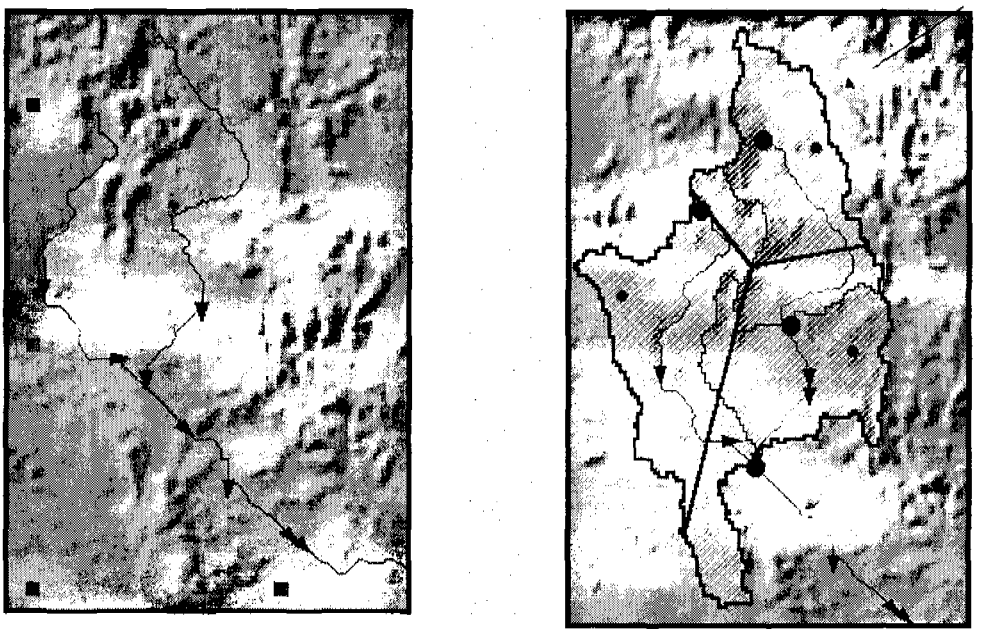

Figure 2: An Example of Tracing of Rivers, Catchment Delineation and Thiesen Polygons from a Digital Elevation Model (DEM)

Water Resources Decision Support Systems

The importance of Decision Support Systems (DSS) to assist decision-makers make better decisions can not be emphasized. The Water Resources Strategy (2002) has rightly adopted river basins as natural units for water resources planning. Hence a DSS for river basin planning is being developed as part of the ongoing National Water Plan (NWP). The DSS will basically consist of two components: (1) a GIS based information system containing basin maps, hydrological, water demand database etc and (2) an analytical system (tool) containing supply and demand assessment and water balance models.

The DSS is used to develop River Basin Plans that consist of the following:

- Inventory of basin's water resources and related lands
- A summary of basin's present water uses
- A projection of future water needs
- Identification of alternative decisions to meet or not to meet the indicated water needs
- Coordination and cooperation with local river basin planning efforts

An example of such a DSS that integrates GIS and simulation (water balance) modeling for integrated water resources planning is the MIKE BASIN model (DHI, 2002). GIS is used to collect, manage and display map related information and the simulation model is used to

assist decision makers understand the physical systems and how various interventions and policy decisions affect the system.

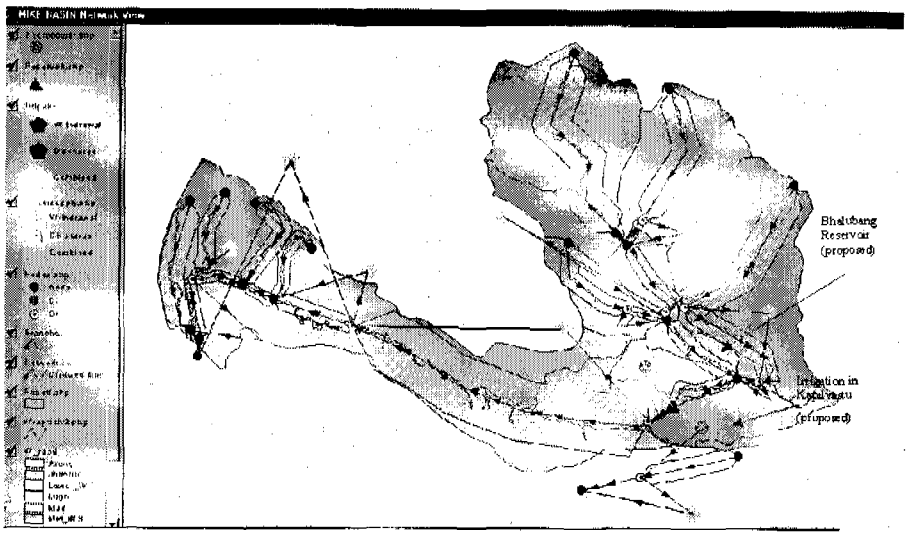

Figure 3: An Example of a DSS for West Rapti River Basin

Figure 3 presents an example of a DSS for West Rapti Basin using the MIKE Basin model. The DSS can be used to assess the alternative decisions to meet or not to meet future demands. In the figure, a scenario of the option of the proposed West Rapti reservoir at Bhalubang is shown (assessed) in meeting the irrigation demand of additional areas in Deokhuri valley, Banke and Kapivastu districts as well as to generate hydropower from two power plants, one located at the toe of the dam and the other at Surai Naka which will feed irrigation water in Kapilvastu district.

Where Should we be Heading?

The present challenge is thus to apply GIS and other related tools like Remote Sensing, GPS and Information Technology to facilitate more efficient and effective water resources management. The following issues among others are important in meeting this challenge in the context of Nepal.

- Data Management and Accessibility
- Data Standardization
- River Basin Approach
- Institutional Setup

A National Data Policy may need to be formulated to address the above issues. The quality and standards of the data and their accessibility varies from one source to the other. As a river basin approach is advocated, data will have to be segregated in terms of river basins rather than on the basis of political or administrative boundaries as presently done. For example, a basin and/or sub-basin wise hydrological cataloging units dividing the country into hydrological planning units may need to be formulated for water resources data management system. A metadata containing information about where, when and how the data were collected and by whom has to be prepared. Standardization and quality control of such data should be given highest priority.

In the context of institutional setup, in the developed countries agencies like the United States Geological Society (USGS) manage and deliver real time hydrological and related data using GIS and web based tools. The long-term goal for Nepal should perhaps be to evolve towards such an institutional setup.

Summary and Conclusions

It can be concluded that Nepal can not lag behind in taking advantage of modern tools like GIS to develop its water resources potential. Integration of GIS with

traditional water resources models will be an important task for the water resources and GIS professionals. However, certain enabling environment has to be in place to integrate GIS in water resources planning. Some of these are related to the following issues:

- Data Standardization
- Data Accessibility vs Intellectual Property Rights
- Software and Hardware Availability and Costs
- Sharing of Knowledge and Information

The multiplying effects of easy and cost effective access to data need to be recognized while formulating any policy on pricing and data accessibility. As the saying goes "Garbage in Garbage Out (GIGO)", water resources and hydrological models will not be any better than the information used in them. Hence, as "Information is Power", a paisa spent on collection, management and dissemination of data is worth many rupees in terms of more MWs and GWhs generated, more cumecs supplied, more ha irrigated, more watershed protected and more land reclaimed.

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Water And Sanitation: An Instrument For Alleviating Poverty

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Introduction

In Nepal, until now water and sanitation programs were implemented while assuming water and sanitation facilities belong to social sector. However, there have been some endeavor to integrate community development and even in some cases to focus gender and poverty. Some programs such as Small Town Project has already considered water as an economic commodity. Therefore, economic and financial analysis became paramount in this project. When water and sanitation facilities are looked upon as an instrument to alleviate poverty, we have to emphasize on principles centered paradigm. The principles referred here are not esoteric, mysterious or religious. These principles were developed over the years when development vision has undergone a shift in 1980s on "Human-centered Development". When "Poverty alleviation" is the main mission as stated in 10th plan, then water sanitation program should truly embrace the following four principles and they are:

- Community Management and Participation Approach
- Livelihood approach
- Gender and Poverty Focus
- Integrated Water Resources Management

1. Community Management and Participatory Approach

Community management of services, backed by measures to strengthen local institution in implementing and sustaining water and sanitation program was one of the guiding principles of Earth Summit in Rio-de-Jenerio in June 1992. Global consultation in water and sanitation in New Delhi in 1990 also had a similar statement and promotes an integral approach including changes in procedures, attitudes and behaviors and full participation at all levels of sector institutions. Dublin statement (1988) underlined that women play a central part in the provision, management and safeguarding of water. It further stressed that water should be recognized as an economic goods and its management should be based on participatory approach.

The major reasons why community management approach is required in water and sanitation program can be grouped under three headings:

1. For reliability, sustainability and replicability;
2. It provides stimulus to community development; and
3. It works

Community management goes beyond community participation, and equips communities to take charge of their own water supply and sanitation improvements. Some critical features that distinguish community management from community participation are:

- The Community as legitimate authority and effective control over management of the water supply and sanitation system and over the use of water.
- The community commits people and raises money towards the construction and up keep of the system.
- Supporting agencies provide advice and technical support but all key decisions are taken by community themselves. Thus, supporting agencies become facilitators rather than providers and it involves a long term and

changing partnership between them.

- Development of people is a parallel goal with development of water and sanitation. Community management is people-centered. Therefore, special capacity building and skill building efforts are required together with water and sanitation facilities.
- Scope and benefits of community management extend beyond water into other development activities.

Participatory approach is a first step in providing suitable skills techniques and materials to enable communities to perform their roles. It encompasses human-centered development, which is a means for enlarging peoples capabilities in terms of skill, productivity and inventiveness. In other words, participatory approach gives emphasis on "human-driven approach" rather than "economic-driven approach". This means, the development starts with our heart not with our head that is intelligence. If our heart is not in it then it is difficult to have compassion and commitment we need to make development to success. Development in these terms is something that is done by people themselves rather than for or not to them. And it is this essential of peoples participation that defines the right to development in both its economic and social aspects.

Participation is a two-way proposition. The people must be open to making a response. 'Empowerment' also implies rising the voice of oppressed by them and insure that their voice is heard. This will express the desire to become involved and gain greater control over their lives. In each community, there is universal need for freedom, an equal right, dignity and an opportunity to change through self determined choice. Now, it is suffice to remind, "The essence of development work is not try to change people, but to create new opportunities. The people will change themselves." An the facilitator's challenge is to listen, to speak the people's language, to understand, to walk the path of opportunity with them so that they can reach that higher ground.

2. Livelihood Approach

The main objective of providing water and sanitation facilities is to safeguard health of the population. Therefore, water and sanitation in itself does not improve the standard of living in rural areas, there must be some complimentary inputs that will produce some income in their hands. Most of the population in rural areas in Nepal is distinctly characterized as subsistence farmers. Therefore, this subsistence farming has to be the main target in order to improve living conditions of the vast majority of the population. Better access to market, improved variety of seeds, irrigation and better skills in agriculture practice are some of the interventions that will definitely yield more rural income.

In this context, irrigation should be an integral component of water supply system. This does not mean per capita demand has to be increased in all cases. Tradable pump in Terai and rainwater harvesting in hills and mountains could provide additional water for irrigation. Where source is enough 65 to 80 lpcd will cater both the demand. This is based on our experience that spring crops require more water and irrigation demand is about 35 litres per ana per day. Considering 4 ana plot and family size of 5, approximately irrigation per capita demand is about 30 litres. The drip irrigation component cost is around NRs. 1000. So, with little increase in investment, substantial benefit can be achieved integrating both irrigation and drinking water provision in rural areas. Another intervention necessary in rural areas is micro-credit. Micro-credit differs from saving and credit. Credit channeled through Gramin Bank is micro-credit. Saving and credit is feasible where there is substantial income and saving. For those poor households who do not have enough to eat the whole year, how can they participate in saving and credit? Even they participate NRs. 5 or NRs. 10 per month what can be expected? The saving will not be enough for a chicken in Dashain.

There are enough success examples in Bangladesh, in India and even in some areas in Nepal, micro-credit could be one of the principal instrument to alleviate poverty. Therefore, if poverty alleviation is the main mission as stated in 10th plan water and sanitation must integrate micro-credit component.

In addition, skill development training are necessary for creating an opportunity for additional income. Until now training are limited to preparation of soap, candle sticks etc. In rural areas, animal husbandry, agricultural training are potential. In hills and mountains, horticulture has very high potential. Horticulture further more likely to protect environmental degradation such as landslides and sediment transportation. For creating products,

access to market should be facilitated by the program. If micro-credit is integrated in the skill development training, there is enough opportunity for alleviating poverty in rural areas.

In sanitation, echo-friendly dry toilets should be promoted. Excreta are resources. So, why not use it for productive purpose. Echo-sanitation provides good manure and soil conditioner to farm without any extra cost.

3. Gender and Poverty Focus

A gender approach helps to predict and take actions to improve how different members of society or households will be affected by development efforts and to what degree they will be able to participate and benefit from the efforts. It looks not only at roles and activities but also at relationship. It asks not only who does what, but also who makes the decision, and who derives benefit, who uses the resources such as water, land, credit and who controls these resources. As the economy changes, traditional gender-based division also changes. because of traditional gender-based division of roles and responsibility, woman and men often have different knowledge of and priorities in the use and management of water resources. If these are not taken into account then many opportunities are lost and new problems are created.

An important aspect of main streaming gender is to achieve involvement of women and men in decision-making process in the project cycle. Therefore, this approach insures woman acquire some key positions in the users committee. Together with male staff, woman field staff is also necessary. This will enhance access to information to poor and vulnerable woman in the community. It also provides opportunity to hold separate group discussion with woman so that their perspective is understood and ensured in the design and implementation. In addition, for monitoring and evaluation purpose, woman and children specific indicators are developed so that whether they have been benefited or not can be evaluated. Likewise, this approach demands poorer and *dalit* men are also adequately involved in users committee, in all phases of project cycle and in gainful employment, poorer and woman should get priority.

4. Integrated Water Resources Planning and Management

In future, water crisis will lead many difficult situations including water. Even the present water shortages have drawn attention of various countries reviewing the demand side and supply side of management of water resources. In fact, among all the resources, water resource is single most important resource in Nepal and her development and poverty alleviation strategy hinges on this resource. At community level, water resources are critical for sustaining life and food. At the national level, hydropower, irrigation, navigation etc play critical role in economy and growth. Therefore, planning and management of water resources in an integrated manner at the micro level is as important as integrated and holistic water resources planning at national level.

Since the water and environment conference held in Dublin, integrated water resources management has become universally recognized as the holistic, people and environment focused paradigm by which water should be managed. Later that year, at the Earth Summit in Rio-de-Jenerio, the importance of securing fresh water resources was endorsed. At the national level, the units of management could be river basin, acquifer and or catchments and boundaries within which water resources could be quantified, and secure system of water rights developed. At community level efficient water use, water catchments conservation and protection, involvement of all stakeholders, water is being treated, as having economic and social value etc. are pertinent issues. In addition, there is water right issue. Water right issue should address water allocation between various stakeholders within a national and local framework.

As impending water crisis is not resolvable without major policy changes. Water can be re-used and recycled. Future consumption levels of water will depend on the efficiency of its supply and use. Both supply and demand side management are important. A safe limit should be identified for abstraction of ground water. Conjunctive use of surface water and ground water is the key to utilize water resources optimally. Integrated water resource management will involve all stakeholders and therefore minimizes source disputes. The poor, vulnerable and low-cast people also raise their voice during the implementation of integrated water resources management and therefore protect their interest.

Managing Water Resources For Sustainable Livelihoods In The Galaundu-Pokhare Khola Subwatershed, Dhading District, Nepal.

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Introduction:

With an ever-growing population and increasing agricultural intensification, water demand has drastically increased in the middle hills of Nepal. As there exist no clear-cut regulations with regard to proper distribution of water, farmers in this region are now facing serious social conflicts. Farmers feel that proper pricing of water should be initiated for equal and efficient distribution of water. As the potential availability of water within a watershed is limited and subject to climatic conditions, efficient utilisation, conservation and equitable distribution are essential. There is a need for integrated management incorporating water quality, quantity and socio-cultural issues in middle hill watersheds of Nepal. Galaudu-Pokhare Khola subwatershed (GPSW) lies in the central development region in Dhading district with latitude 27° 40' to 28°14' N and 84°0' to 85°1' E covering a total area of 27.09 sq.km. Gajuri and Pida are the two villages covered in this subwatershed. Gajuri village encompasses ward numbers 3, 5 and 6 and Pida village ward number 2 with Galaudu and Pokhare Khola as the major rivers. The main roadway connecting the watershed to other parts of the country is the Prithvi highway covering approximately 4 km making it one of the few easily accessible watershed by road. The climate of the watershed varies from subtropical to temperate. During the study period, the maximum temperature recorded in the month of July was 35.8 degree Celsius with a total rainfall of 840.9mm. Despite inaccessibility and difficult terrain conditions, the GPSW is densely populated. According to field survey, NAF (1999) the density of population in the area is 195.8 persons per sq. km. The total population of watershed is 5305 of which 47.66% are female and 52.23% are male.

Methodology:

a) Classification of types of public sources

Water resources in Galaundu-Pokhare Khola subwatershed were classified into seven different categories based on source types, namely:

Source ID	Source Type/ *local terms in use*
I	Running Spring or *mul*, or *muhan* or *padera* or *dhara*
II	Stagnant spring or *padera* or *kuwa*
III	Taps or *kal dhara* or *pakki dhara*
IV	Tanks or *pani tanki*
V	Stream or *khola*
VI	Well or *inar*
VII	Pond or *pokhari*

Springs are locally called *mul* or *muhan*. According to Nepali definition *mul* is the place of immerging water. Actually springs are the ground water, which flow according to the force of gravity i.e. comes in surface through a well-defined outlets from rock or soil material. Taps are locally referred as *dharo* or *dhara*.

Taps are usually diverted from the springs and rivers trough a pipeline. In this watershed taps are mostly pipeline and only few are well formed. *Kuwa* is a form of small reservoir tank for storing water coming from the springs. *Kuwa* and *padhero* are local names and are common public water sources frequently seen in the watershed. The meaning of *Kuwa* or *padhero* in Nepali dictionary is a small water reservoir tank from which water can be drawn easily by hand. Stream or river is surface water fed by ground water and rainfall. Stream is locally called *Khola* or *kholo*. Some *Kholas* of the watershed have been used long since for drinking purpose. Well is locally called *Inar*.

b) Water Quality:
A water resources survey sheet was maintained for recording the field-measured parameters and latitude and longitude of the sites. Longitude and latitudes reading were taken with GPS.

The physical parameters such as temperature, pH, conductivity, and dissolved oxygen were analyzed on site.

The 50 ml water samples for the analysis of cations were preserved in 5 ml concentrated nitric acid for the further analysis in laboratory and the ones for anions were kept in icebox and analysis was carried out as soon as samples were brought to the laboratory, in most of the cases the next day. For the Presence/Absence (P/A) test of bacteria in water, two methods were used, such as HiMedia's user friendly PA Coliform Test Kit (MS1186) and Hydrogen Sulphide Test using test strip in vials. For the Himedia PA Coliform Test kit, 100 ml water was mixed with a Lauryl Tryptose Broth and incubated for 24-48 hours at a temperature 30-35°C. A colour change from reddish-purple to yellow indicates the presence of coliform bacteria. The test can also indicate the severity of water contamination.

In the hydrogen sulphide (H_2S) test, a treated paper strip is incubated with the water sample at temperatures between 25°C and 35°C. If bacteria are present, they will produce hydrogen sulphide, which turns the paper black. Water quality classification of the rivers was done based on Nepalese Biotic Score as suggested in Sharma, 1996.

c) Water quality management
Indigenous methods of water quality management were also documented, the methods used for which was direct survey, interview with the key respondents and site observation.

d) Water Uses and Water Use rights
A questionnaire survey in the local language was administered to different households for understanding the uses of water resources and existing water use rights in resource utilization.

Results and Discussion:

i) Classification of types of public sources
This study revealed altogether 79 sources, of which 25% were running springs (*dhara*), 18% stagnant springs (*kuwa*), 45% taps, 3% tanks, 6% streams, and 3% ponds.

ii) Physical characteristics of water:

a) pH: The pH of water sources varied from a minimum of 5.63 to a maximum of 11.00 (Figure 1). A typical value of pH 4.5-8.5 is reported for streams and rivers throughout the world. During the present survey, high pH values were obtained in springs (*dhara*), taps, streams and pond: and low pH in springs (*kuwa*) indicating high calcium or magnesium contents or higher photosynthetic activities in the previous sources and less in the later source. High pH values in public drinking water distribution systems, such as in this case the taps and also in the stream, can be attributed to high calcium contents in water, where the intake was built.

b) Temperature: The temperature in freshwater normally varies from 0 to 35°C, depending on source, depth and season. In Galaundu-Pokhare Khola subwatershed, temperature varied from 19-24.8°C (Figure 2) with not remarkable seasonal difference such as, 19.10°C to 24.30°C during Pre-Monsoon and 19 to 24.80°C during Post-Monsoon. WHO (1996) has not mentioned any standard value for temperature and has stated that the water temperature should be of acceptable levels for drinking purpose. However, the EC Drinking Water Directive (80/778/EEC) has stated a value of 25°C as maximum admissible temperature. Water temperature in stream depends on turbulence, dilution, and water velocity. In the US, river temperatures more than and equal to 30°C are not uncommon, whereas in the British Isles river temperatures above 24°C are rare.

c) Conductivity: Conductivity in the studied sub-watershed varied from 3.85-975 µS/cm (Figure 3) with highly variable values in the public taps followed by springs (*dhara*). In Pre-Monsoon conductivity varied from 32-382 µS/cm and in Post-Monsoon 3.85-972 µS/cm.

Conductivity is related to the concentration of total dissolved solids (TDS), and increases as the concentration of TDS increases. In general, the corrosivity of the water increases as TDS increases. World Health Organization recommends a maximum permissible limit of 400 μS/cm in drinking water.

d) Dissolved Oxygen: Dissolved Oxygen in the area studied varied from 0.10–6.20 mg/L (Figure 4) with a maximum value in public taps and minimum recorded in springs (*dhara*), however the mean value was highest in streams and not highly variable in other sources. Typical dissolved oxygen concentrations reported for natural water in streams and rivers throughout the world are 3 to 9 mg/L (Malina 1996). EC Drinking Water Directive (80/778/EEC) recommends that the oxygen saturation should be above 75% for surface waters. Higher oxygen concentration in tap water is due to its contact with atmospheric air while sampling (Figure 5).

iii) Chemical characteristics of water:

a) Hardness: Calcium and magnesium ions are the major constituents causing hardness in water. Magnesium concentration in different sources of Galaundu-Pokhare Khola sub-watershed varied from 0.88 to 20 mg/L (Figure 6) with maximum value reported in public taps. Similarly, calcium concentrations varied from 3.2 to 102 mg/L (Figure 7) with maximum value reported in public taps. Minimum required concentration of total hardness intended for human consumption is 60 mg $CaC0_3$/L as recommended by the EC Drinking Water Directive (80/778/EEC).

b) Inorganic anions: Ammonia (NH_3-N) concentration in water is usually low, with surface waters containing up to 12 mg/L (WHO, 1996). In Galaundu- Pokhare Khola subwatershed, its concentration varied from 0.08 to 2.9 mg/L. High variations were observed in springs (*dhara*) and public taps. Cement mortar used for coating the insides of water pipes may release considerable amounts of ammonia into drinking-water (Wendlandt, 1988). Ammonia may also be present in drinking water as a result of disinfection with chloramines. Ammonia is not of direct importance for health in the concentrations to be expected in drinking water. A health-based guideline has, therefore, not been derived (WHO, 1996).

Nitrate and nitrite are naturally occurring ions that are a part of the nitrogen cycle. Nitrate ion is the stable form of combined nitrogen for oxygenated systems and nitrite ion contains nitrogen in a relatively unstable oxidation state. Chemical and biological processes can further reduce nitrite to nitrate. The nitrate concentration in surface water is normally low (0-18 mg/L), but can reach high levels as a result of agricultural run-off, refuse dump run-off, or contamination with human or animal wastes. EC Drinking Water Directive (80/778/EEC) recommended 0.1 mg/L value for nitrites-N and WHO (1996) recommended 25 mg/L as maximum admissible value of nitrates-N in drinking water. In the area studied the concentration of nitrite-N varied from 0-0.054 mg/L (Figure 8), and nitrate-N varied from 0.05 to 2.4 mg/L (Figure 9), with maximum value reported in springs (*dhara*) and streams, respectively. The higher concentration in springs or streams is due to nitrogen rich inorganic fertilizers added in agricultural fields. As a result of agricultural activities, the nitrite or nitrate concentration can easily reach several hundred milligrams per liter (WHO, 1985).

c) Parameters concerning toxic substances (Heavy metals): Chromium, Copper, Zinc, Lead, and Nickel concentrations in different types of public water sources were analyzed. Chromium concentration in the water bodies of Galaundu-Pokhare Khola sub-watershed varied from 1 to 15.8 mg/L (Figure 10). Maximum value was reported in springs (*dhara*) and minimum in public taps. The current WHO maximum admissible concentration value is 0.05 mg/L (or 50 mg/L). Approximately 18% of the population of the USA is exposed to drinking water levels between 2 and 60 mg/L and, 0.1% to levels between 60 and 120 mg/L (EPA, 1987). Chromium is widely distributed in earth's crust and found in small amounts in soils and rocks. Copper concentration in the area studied varied from a minimum of 2.4 mg/L in streams to a maximum of 20 mg/L in taps (Figure 11). WHO recommended a provisional guided value of 2 mg/L (2000 mg/L) of copper concentration in drinking water. The EC Drinking Water Directive (80/778/EEC) however recommended 3000 mg/L at the point where the water is made available to the consumers. Zinc concentration varied from a minimum of 28 mg/L in spring (*dhara*) and taps to a maximum value of 124 mg/L in spring sources (Figure 12). In tap water, the zinc concentration can be higher as a result of the leaching of zinc from piping and fittings. WHO recommended a maximum permissible limit of 3 mg/L of zinc in drinking

water, whereas the EC Drinking Water Directive recommended 5000 mg/L at the point where the water is made available to the consumers. Lead concentration in the water bodies of Galaundu-Pokhare Khola subwatershed varied from 1.28-30 mg/L (Figure 13), with minimum value reported in spring (*kuwa*) and maximum in tap water. Lead is present in tap water to large extent due to PVC pipes, which contain lead compounds that can be leached from them and result in high lead concentrations in drinking water. WHO recommended a guide value of 0.01 mg/L of lead in drinking water. The EC Drinking Water Directive stated a value of 50 mg/L of lead in drinking water. In running water, where lead pipes are present the lead content should not exceed 50 mg/L in a sample taken after flushing. Nickel concentration was minimum in tap water (1.54 mg/L), and maximum in streams (54 mg/L) (Figure 14). WHO recommended a guide value of 0.02 mg/L of nickel in drinking water, and EC Drinking Water Directive recommended 50 mg/L as maximum admissible concentration. Nickel concentrations in drinking water around the world are normally below 20 mg/L (Grandjean, 1984).

iv) Indigenous water quality management:
Ten indigenous water quality management methods were identified from the watershed as follows,
Tap studded with an idol and instruction (Figure 15)
Barbed wire surrounding the numbered tap (Figure 16)
A routine to clean (Figure 17)
Tap and a conservation pond (Figure 18)
Awareness writings on and around the tap (Figure 19)
Erection of tank at the spring source (Figure 20)
Water storage in the households (Figure 21)
An overhead channel for runoff (Figure 22)
Drop structure as an erosion control (Figure 23)
Torrential flow control mechanism (Figure 24)
v) Public dependency on the water sources:
Sixty three percent of the total households (n = 46) surveyed had access to tap water through water supply and sanitation support programme launched with support from local NGO's such as, Nepal Water for Health (NEWAH), Support Activities for the Poor Producers of Nepal (SAPROS), and Nepal Agro-forestry Foundation (NAF). Additionally, several small water supply schemes initiated and funded through public participation are also in existence.

Conclusions and recommendations

Further detailed investigation on the classification of bacteria is strongly recommended, and serious thought must be given to protect water sources from domestic runoff in order to prevent bacteriological contamination.

Dissolved Oxygen in the area studied varied from 0.10–6.20 mg/L, the mean value was highest in streams and not much varying in other sources. In other sources minimum values were recorded in springs, and maximum values in water tapes. High values of dissolved oxygen in public tapes are due to contact with atmospheric air while filling the sampling bottles with water. If a stream is unpolluted, dissolved oxygen levels are high. In addition there will usually be a diverse community of plants and animals in a healthy river ecosystem. A total of eight family level taxa were scored in the lowermost reach of Pokhare Khola with an average score per taxon calculated as 7, classifying the river to its water quality class I-II i.e. slightly polluted.

Physical parameters:
Although the values obtained do not show any differences distinctly, there is a tendency of decrease in water quality in Galaundu Khola downstream. On the contrary, Pokhare Khola revealed improvement in the quality of water downstream.

Ph values were usually higher in the area studied (5.63-11) indicating high calcium contents in water. The pH of domestic waters is limited to the neutral range of 6.5 to 8.5 units. At values outside this range, water can be corrosive or cause precipitation of metal salts. At pH values above 8.5, precipitation and scaling can result. At pH values below 6.5, corrosive characteristics are evident.

In Galaundu Khola pH at source was not high, but increasing downstream. Elevated pH in

the middle reach of the stream is due to profuse algal growth depleting carbon dioxide from the water and, for weakly-buffered waters, induces a large increase in pH. In Pokhare Khola, the change in pH is not remarkable.

Highly variable conductivity (3.85-975 μS/cm) in the studied sub-watershed is related to the total dissolved solids in the water. High conductivity was reported during monsoon period.

Chemical parameters:

Nitrates: The principal sources of nitrogen in the springs of Galaundu-Pokhare Khola subwatershed include runoff from fertilized agricultural lands, decaying vegetation and others. Concentration of nitrate-N in the area studied varied from 0.05 to 2.4 mg/L, which is much below the WHO (1996) recommended 25 mg/L as maximum admissible value of nitrate-N in drinking water. At this stage, there appears to be no problem of nitrate in drinking water supply, however source protection to prevent likely contamination from agricultural runoff must be given priority.

Hardness:

Calcium concentrations varied from 3.2 to 102 mg/L with maximum value reported in public taps indicating that the water is moderately hard. Hardwater increases consumption of soap, and may have an adverse effect on clothing and other articles being cleansed. Hardness can also shorten the life and decrease the efficiency of pipes. Calcium hardness is also a measure of highly mineralized water. Demineralization measures must be considered in advance before launching any drinking water supply projects in the area studied.

Chromium:

Chromium concentration in the water bodies of Galaundu-Pokhare Khola sub-watershed varied from 1 to 15.8 mg/L. Little chromium goes into solution unless the pH is quite low. The pH of water sources in the area is high (varied from a minimum of 5.63 to a maximum of 11.00). The proposed chromium limit of 0.05 mg/L is less than the level at which no adverse health effects were observed. Because chromium is a strong skin sensitizer, and because of the possibility of dermal effects from immersion in waters containing chromium, potable water supplied should be limited to the stated maximum contaminant level.

Nickel:

Nickel concentrations in drinking water around the world are normally below 20 μg/L Nickel concentration was minimum in tap water (1.54 mg/L), and maximum in streams (54 mg/L). WHO has recommended a guide value of 0.02 mg/L of Nickel in drinking water. A value of 54 mg/L of Nickel in streams is an indication of pollution by natural or industrial nickel deposits or leaching from nickel-chromium plated taps and fittings occurs. Any such activities must be traced out and stopped.

Copper:

Copper concentration in the area studied varied from a minimum of 2.4 mg/L in streams to a maximum of 20 mg/L in taps, much below WHO recommended provisional guided value of 2 mg/L (2000 mg/L) of copper concentration in drinking water. At present concentration of copper does not seem to be a problem, and it is a fairly common trace element in natural water.

Zinc:

Zinc concentration in the area studied varied from 28-124 mg/L. WHO recommended a maximum permissible limit of 3 mg/L of Zinc in drinking water. Concentrations of zinc of 30 mg/L or more impart a strong astringent taste and a milky appearance to water. Although zinc at present does not seem to be a problem in general, its increasing concentration in the water flowing through galvanized (GI) pipes is an indication of its presence due to corrosion of pipes. A proper selection of GI pipes is recommended when used in public drinking water systems. Lead: Lead concentration in the water bodies of Galaundu-Pokhare Khola subwatershed varied from 1.28-30 mg/L. WHO recommended a guide value of 0.01 mg/L of Lead in drinking water. Lead is present in natural waters throughout the world, ranging in concentration from 1 to 10 μg/L. The use of lead pipes in pipelines in the presence of corrosive waters has resulted in higher lead concentrations at the tap in the area studied.

Great care must be exercised to avoid corrosive waters. Lead is likely to be dissolved from distribution piping or plumbing by water that is low in hardness, bicarbonate, and pH, and high in dissolved oxygen and nitrate. Lead contamination in water supplies is believed to come principally from water pipes. Lead has no known beneficial or nutritional value for humans. It is a toxic constituent that accumulates in humans and animals, but acute lead poisoning of consumers is extremely rare. The most common forms of lead poisoning are anemia, intestinal cramps, loss of appetite, and fatigue. Symptoms of these forms of lead poisoning take time to develop and become evident.

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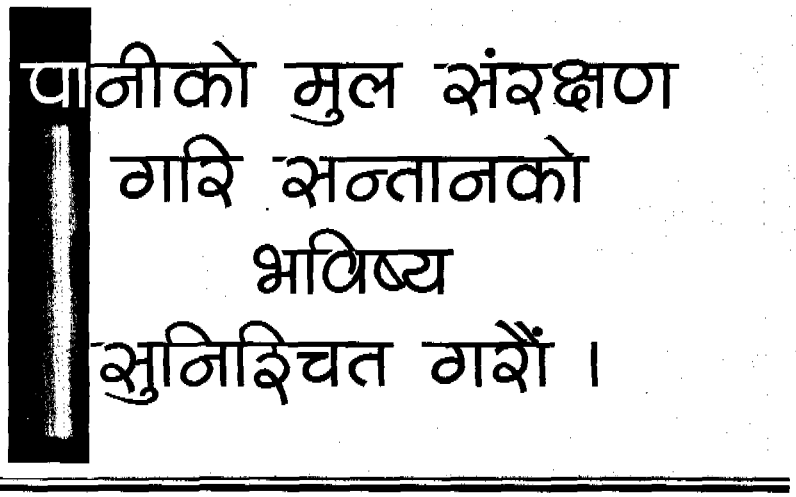


खानेपानी तथा सरसफाइ कार्यक्रममा सामाजिक न्यायको स्थानः सिम्ले कुसुन्डे खानेपानी योजनाको एक अध्ययन

प्रस्तुतकर्ताहरु:
रामप्रसाद ज्ञवाली, नेपाल रेडक्रस सोसाईटी
कृष्णप्रसाद तिमिल्सिना, सिम्ले कुसुन्डे उपभोक्ता समिति

पृष्ठभूमि:

नेपाल रेडक्रस सोसाईटी, कास्की जिल्ला शाखाको स्थापना २०२२ सालमा भएको हो । प्रारम्भमा यसले एम्बुलेन्स, रक्तसंचार, दैवीप्रकोप आदि जस्ता सेवा कार्यक्रमहरु मात्र संचालन गरेको थियो । तर २०४५ सालदेखि, संकटाभिमुख समुदायलाई लक्षित गरी सामुदायिक विकासका गतिविधिहरुमा पनि यसले काम गर्न शुरु गऱ्यो । २०४५ सालबाट नै जापान रेडक्रस सोसाईटीको सहयोगमा आधारभूत स्वास्थ्य सेवा तथा खानेपानी परियोजना ५ वर्षसम्म संचालित रह्यो । त्यसपछि जापान रेडक्रस सोसाईटीको सहयोगमा २०५० देखि २०५५ सालसम्म दोश्रो चरणमा सरसफाइ र महिला सहभागितामा विशेष जोड दिने रणनीति अपनाई खानेपानी र सरसफाइ कार्यक्रम संचालन गरियो । यी कार्यक्रमहरुबाट प्राप्त अनुभवहरुले खानेपानी र सरसफाईको क्षेत्रमा थप पाइला चाल्न हौसला बढायो । परिणामत: फण्डबोर्ड संग २०५४ सालदेखि नै नेपाल रेडक्रस सोसाईटी, कास्की शाखाले सहकार्य शुरु गऱ्यो; जुन अहिले सम्म चौथो चरण पूरा भई पांचौं चरणको पूर्व संघारमा आइपुगेको छ ।

प्रस्तुत् कार्यपत्रमा फण्डबोर्डको सहयोगमा चौथो चरणमा संचालन गरिएको लेखनाथ नगरपालिका वडा नं. ९ को सिम्ले कुसुण्डे खानेपानी योजनालाई घटना अध्ययन (Case Study) को रुपमा लिएर उक्त आयोजनाको संचालन प्रकृया, आयोजनाले अवलम्बन गरेको सहभागितात्मक पद्धति, आयोजना अन्तर्गत संचालन गरिएका गतिविधिहरु, आयोजनाका लक्षित उपभोक्ताहरु (दलित तथा उत्पीडित) ले प्राप्त गरेको प्रतिफल तथा उनीहरुप्रतिको सामाजिक न्याय एवं स्वास्थ्य र सरसफाई क्षेत्रमा आएका परिवर्तनहरुलाई संक्षिप्तमा प्रकाश पार्ने जमर्को गरेका छौं ।

हालसम्मको उपलब्धिहरु:

आधारभूत स्वास्थ्य सेवा तथा खानेपानी परियोजना:

आ.व. २०४५/०४६ देखि आ.व. २०५०/०५१ सम्म जापान रेडक्रस सोसाइटीको सहयोगमा कास्की जिल्लाको राखी, माझठाना, लेखनाथ तथा राखी गा.वि.स.का जम्मा १६ वडाहरुमा संचालन भएका १६ वटा खानेपानी योजनाहरुमा १६८ वटा धाराहरु निर्माण भएका थिए । जसबाट १८१६ घर परिवारका १६,६६८ व्यक्तिहरु लाभान्वित भएका छन् । यी योजनाहरुमा जापानी रेडक्रसबाट रु. ६३,००५३२/६३ बराबरको सहयोग प्राप्त भएको थियो भने रु. २२,२३,२३२/१५ बराबरको जनसहभागिताको काम भएको थियो । यसै अवधिमा करिब ३०० वटा सुलभ शौचालयहरु पनि निर्माण भएका थिए । (यस सम्बन्धी विस्तृत् विवरणको लागि अनुसूची १ मा हेर्नुहोस्)

खानेपानी तथा सरसफाइ कार्यक्रम:

आ.व. २०५१/०५२ देखि २०५४ सम्म जापान रेडक्रस सोसाईटीको सहयोगमा कास्की जिल्लाको अर्मला र पुरुन्चौर गाउं विकास समितिमा कूल रु. १,४४,९३,७०४/२५ को लागतमा १५ वटा योजनाहरु सम्पन्न भई १९८ धाराबाट ९९४ घर परिवारका १०,९१२ जनसंख्या लाभान्वित भएका छन् । जुन निर्माण कार्यमा रेडक्रस सहयोगबाहेक रु. ५७,३३,६७६/८६ बराबरको जनसहभागिता रहेको छ । यस अवधिमा उक्त दुई गा.वि.स. मा ३८१ वटा सुधारिएका चुल्हा, ३ वटा फोहर निकास गर्ने नाली, ४५१ वटा जुठेल्ना, १२४ वटा फोहर फाल्ने खाडलहरु बनाइएका थिए । त्यसै गरी कार्यक्रम क्षेत्रका कूल ९९४ घर परिवारमध्ये ९२४ घर अर्थात ९२ प्रतिशत घरमा सुलभ चर्पीको निर्माण भएको थियो । सरसफाईका यी गतिविधिहरुबाट त्यस क्षेत्रका समुदायहरु विशेषगरी पुरुन्चौरको वडा नं. १ र २ र अर्मलाको वडा नं. ८ र ९ का दलित (उत्पीडित) समुदायको जीवनपद्धतिमै आमूल परिवर्तन आएको महसुस गरिएको छ ।

फण्डबोर्डको सहयोगमा संचालित कार्यक्रम:

फण्डबोर्डको आर्थिक सहयोगमा आ.व. २०५३।५४ बाट शुरु भएका खानेपानी आयोजनाहरुबाटै हालसम्म कास्की जिल्लाका १४ वटा गाउं विकास समिति र लेखनाथ नगरपालिकाका २ वटा वडाका गरी २,००३ घर परिवारका ११,४१३ व्यक्तिहरु लाभान्वित भएका छन् । यस अवधिमा रु. १,७४,३८,१३५।४० फण्डबोर्डबाट प्राप्त सहयोग र रु. ८४,६४,३५८।०० बराबरको जनसहभागिता गरी कूल २,५९,०२,३९५।४० को लागतमा २२ वटा खानेपानी योजनाहरु अन्तर्गत २९८ वटा धाराहरु निर्माण भएका छन् । यस बाहेक यी उल्लेखित कार्यक्रम क्षेत्रका करीब ९० प्रतिशत घरहरुमा सुलभ चर्पीको निर्माण र प्रयोग भएका छन् । महिला प्राविधिक सेवा समूहको सहयोग प्राप्त गरेका २२ वटा समूहमा घटीमा रु. १२,०००।०० देखि बढीमा रु.२०,०००।०० सम्मको कोष स्थापना गरी कूल ३,२०,०००।०० कोष महिलाहरुको लघु आय आर्जन र सीप विकासमा प्रयोग भएको छ । यी समुहहरुको प्रत्येक महिना घटीमा रु. ५।०० बचत उठाई कोषलाई बृद्धि र परिचालन गरेका छन् । यसै गरी गरीब तथा विपन्न वर्गको लागि चर्पी बनाउन ऋण सहयोग प्रदान गर्ने उद्देश्यले प्राप्त करीब रु. ३,७५,७५०।०० शौचालय घुम्तीकोषको रुपमा परिचालन भईरहेको छ । हालसम्म यस कोषको प्रयोग गरि ७०० गरीब परिवारले चर्पी बनाएका छन् । हरेक उपभोक्ता समितिसंग उल्लेखनिय रुपमा मर्मत संभार कोष छ । बाइस वटा आयोजनाहरुमा गरी कूल रु. १०,५०,०००।०० मर्मत संभार कोष रकम रहेको छ । ग्रामीण मर्मत संभार कार्यकर्ता (VMW) र ग्रामीण स्वास्थ्य प्रवर्धक (VHP) द्वारा क्रमश योजनाको मर्मतसंभार एवं सरसफाईको अनुगमन गर्ने काम भइरहेको छ । (विस्तृत् विवरणको लागि अनुसूचि-३ मा हेर्नुहोला)

दलितहरुले सामाजिक न्याय प्राप्त गरेको सिम्ले कुसुण्डे खानेपानी योजना:

लेखनाथ नगरपालिकाको वडा नं. ९ अन्तर्गत बेगनासतालको किनारमा रहेको पिप्ले गाउंमा दलित जनजातिको बाहुल्य रहेको छ । कूल ४९ घर परिवार मध्ये २६ परिवार जलाहारी परिवारहरु (दलित) रहेका छन् । अधिकांशत: सुकुम्बासीको रुपमा रहेका यी समुदायको मूख्य पेशा माछा मार्नु हो । यिनीहरु आर्थिक रुपले अत्यन्त गरिब र सामाजिक रुपले अत्यन्त पिछडिएका छन् । साक्षरताको प्रतिशत अहिले पनि २५ प्रतिशत मात्र छ । जसमध्ये महिलाहरुको साक्षरता प्रतिशत १३ मात्र छ । एक त दलित बस्ती, त्यो पनि सुकुम्बासी क्षेत्र, यही कारण हुन सक्छ राज्यबाट उपलब्ध गराइने सामाजिक सुविधाहरुबाट बन्चित भएको मात्र नभई सरकारको स्थानीय निकायको प्राथमिकतामा यो बस्ती नपर्नु कुनै आश्चर्यको विषय रहेन । विगतका कतिपय चुनावी वर्षहरुमा भोटसंग खानेपानीको सुविधा विनिमय गर्ने भाषण गरेर जनतालाई भुलभुलैयामा पारेको तीतो यथार्थ पनि समुदायले भोगिसकेका छन् । यो समुदायले भोग्नु परिरहेका अनेकौं समस्याहरु त अहिले पनि यथावतै छन् । तर ती मध्येको प्रमुख एक समस्याको रुपमा रहेको पिउने पानीको समस्या भने रेडक्रसको माध्यम, फण्डबोर्डको सहयोग र जनताको पसिना मिलाएर समाधान भएको छ । विगतमा धेरै वर्षसम्म तालको फोहरपानी पिउन बाध्य भएका सिम्लेबासीहरु अहिले सफा पिउने पानीको प्रयोग गर्न पाएकामा हर्ष विभोर बनेका छन् । आयोजना कार्यान्वयनको क्रममा भोग्नु परेका समस्याहरु बिर्सेर उनीहरु अब यस योजनालाई दिगो कसरी बनाउने र समुदायका अन्य समस्याहरु (विद्यालयको स्थापना, सामुदायिक प्रतीक्षालयको निर्माण) आदि कसरी समाधान गर्न सकिन्छ भनेर उपायहरु निकाल्न छलफल चलाउदैछन् ।

आयोजनामा काम कसरी सम्पन्न भयो ?

रेडक्रसमा निवेदन दिएको ६ महिनापछि मिति २०५६।१२।२५ मा आवश्यक अध्ययन तथा अन्य प्रकृया पूरा भई आयोजना स्वीकृत भएको जानकारी समुदायले पायो । अनि सामुदायिक भेला, उपभोक्ता समितिको गठन, सामुदायिक कार्य योजनाको निर्माण र कार्यान्वयन तालिम, डिजाइन इष्टिमेट आदि गतिविधिहरु क्रमबद्ध रुपमा हुदै गए । महिला प्राविधिक सेवा समूहको गठन, सुलभ शौचालयको निर्माण, स्वास्थ्य शिक्षा कक्षाको संचालन तथा जनचेतनामूलक कार्यक्रमहरु शुरु भएपछि उक्त समुदायमा एउटा नयां लहर वा हलचल नै आयो । तर पनि सामग्री खरिदमा समुदायले थप्नुपर्ने कूल आयोजना लागतको २.५ प्रतिशत र मर्मत संभार कोषका लागि उठाउनु पर्ने ३ प्रतिशत रकमको विषय भने ती गरीबहरुको निम्ति बोझिलो बन्यो । तर खाने मुखलाई जुंगाले छेक्दैन भने जस्तै उनीहरुले पनि विभिन्न उपायहरुको खोजी गर्न थाले । जसमध्ये स्थानीय गाउंमै बाटो खन्ने कार्यमा श्रमदान गरेर प्राप्त गरेको दश हजार रकम पनि योजनाको उक्त कोषमा जम्मा गरे । यो बाहेक स्थानीय माछा समुहले रु. ३,०००।०० सहयोग उपलब्ध गरायो । यसबाट नपुग बांकी रकम पनि प्रति घर कुरियामा भाग लगाई उठाइयो । त्यसपछि आर्थिक समस्या सजिलै टर्‍यो ।

दिनभरि रोजगारीमा नगए बेलुकी हातमुख जोर्न धौ धौ पर्ने समुदायले कुसरी आयोजनाको निर्माण कार्यमा सहभागी बन्लान् भन्ने चुनौतीले सहयोगी संस्था र उपभोक्ता समिति सबैलाई चिन्तित तुल्याइएको थियो ।

तर आवश्यकतामा आधारित आयोजना (Demand-led scheme) भएर होला आधापेट खाएर भए पनि प्रत्येक घरले करीब ३५ दिनसम्म नथाकिकन आयोजनाको निर्माण कार्यमा काम गरेर आयोजना प्रतिको उच्च स्वामित्वभाव प्रदर्शन गरे। आयोजना सहज रुपमा निर्धारित समयावधि मै सम्पन्न भयो।

योजना विवरण		
लाभान्वित समुदाय	:	लेखनाथ नगरपालिका वडा नं. ९, सिम्ले
कूल लागत	:	५,६०,८३८।००
फण्डबोर्ड सहयोग	:	३,८६,९९४।००
जनसहभागिता	:	१,७३,८४५।००
लाभान्वित घर परिवार	:	४९
लाभान्वित जनसंख्या	:	२६२
जम्मा धारा संख्या	:	५
पाइप लाइन लम्बाई	:	२,९९२ मी.
हाल रहेको मर्मत संभार कोष	:	७०,०००।००
लगानी भइरहेको घुम्ती शौचालय कोष	:	९,०००।००
लगानी भएको महिला प्रा.सं. समुह कोष	:	९,८००।००
प्रयोगमा आएको चर्पी संख्या	:	४५ घर

आयोजनाको तात्कालिक प्रभाव:

१. झण्डै ९२ प्रतिशत घरपरिवारले चर्पीको प्रयोग गरेको कारणबाट गाउं एकदमै सफा देखिन्छ। समुदायको भनाई अनुसार पहिले हुने गरेको झाडा पखालाको समस्या अहिले देखिएको छैन।
२. सरसफाई सम्बन्धी बानी व्यवहारमा आएको परिवर्तनले उनीहरुको जीवनस्तरमा सुधार आएको छ। विशेष गरी घर र गाउंको सफा वातावरणले केटाकेटीहरुको स्वास्थ्यमा सुधार हुनुका साथै शैक्षिक कृयाकलापमा समेत अनुकूल प्रभाव परेको छ।
३. आयोजना पर्यटकीय महत्व राख्ने वेगनासतालको किनारमा रहेको र त्यहां वनभोज खान जाने समुहलाई पानीको सुविधा पुगेको छ। वनभोजमा जाने प्रतिटोलीबाट धाराको पानीको सुविधा उपलब्ध गराए वापत रु. ३०।०० शुल्क लिने गरिएको छ। जसबाट मर्मत संभार कोषलाई ठूलो टेवा पुग्ने अनुमान छ। हाल २ महिना भित्र यस्तो सेवा शुल्कबाट करीब रु. १,५००।०० आम्दानी भइसकेको छ।
४. सामाजिक एकता भयो भने उपलब्धि प्राप्त गर्न सकिदोरहेछ भन्ने आत्मविश्वास समुदायमा बढेर गएको छ। त्यस क्षेत्रका अन्य समस्याहरु समाधान गर्नेतर्फ समुदायको चासो र सकृयता बढेको छ। महिलाहरु विशेष गरी दलित जातिका व्यक्तिहरुमा सामाजिक चेतनाको स्तरमा बृद्धि हुनका साथै नेतृत्व सीपको विकास हुन गएको छ।
५. आयोजनाको हरेक चरणमा समुदायको सकृय सहभागिता रहेको र हरेक निर्णय प्रकृया, सामग्री खरीद समेतमा पारदर्शिता रहेको कारणले समुदायमा एक अर्कोप्रति विश्वास छ। नेतृत्व स्थापित छ। अन्य सामुदायिक विकासका कार्यक्रमहरुमा पनि समाज परिचालित छ। समुदायलाई अरु समुन्नत बनाउन सबैमा जागर र प्रतिवद्धताको विकास भएको छ।

सामाजिक न्यायको दृष्टिकोणले हेर्नुपर्ने केही सवालहरु

१. गरीबहरुको जनश्रमदानमा सहभागिता,
२. गरीबहरुको मर्मत संभारकोष तथा सामाग्री खरिद लागतमा सहभागिता, (बैकल्पिक उपायहरुको खोजी)
३. गरीब र अलग्गिएका बस्तीहरुमा धारा वितरण र प्रतिव्यक्ति लगानीको आधार, (कम घरमा वा बढी लागत भएपनि धारा दिन सक्नु पर्ने)
४. गरिबी निवारणका लागि पानीसंगै आय आर्जन कार्यक्रम
५. उपभोक्ता समितिमा पिछडिएको समुदायको प्रभावकारी सहभागिता,
६. विपन्न बस्तीमा सामाजिक परिचालनको प्रकृयामा विशेष जोड,
७. ग्रामीण मर्मत संभार कार्यकर्ता र ग्रामीण स्वास्थ्य प्रवर्धकको छनौट गर्दा विपन्न वर्गबाट हुन सक्ने संभावना,
८. विपन्न वर्गको शसक्तीकरणको लागि अनुगमन र विशेष कार्यक्रम

केही सुझावहरु:

१. निर्माण चरणको कार्य समाप्तीपछि पनि कम्तीमा एक बर्षसम्म अनुगमन कार्यक्रमको रुपमा फण्डबोर्डबाट सहयोगी संस्था मार्फत सहयोग पुऱ्याउने नीति अपनाउन सकेमा योजनामा दिगोपना

ल्याउन विशेष टेवा पुग्ने देखिन्छ ।

२. शौचालय घुम्तीकोष र महिला प्राविधिक सेवा समुहको लागि हाल दिइने रकमलाई क्रमशः बढाउदै लैजानुपर्ने देखिन्छ ।

३. योजनाको समाप्ती पछाडीको चरणमा समुदायको माग र आवश्यकतामा आधारित अन्य सामुदायिक कृयाकलापहरु संचालनका लागि सम्पर्क, समन्वय र सहयोग पुऱ्याउन सकेमा समुदायको क्षमता विकासमा सहयोग पुग्ने देखिन्छ ।

४. स्थानीय उपभोक्ता समितिको संस्थागत विकासलाई सहयोग पुऱ्याउने उद्देश्यले केही बजेट उपलब्ध गराउनु वान्छनीय हुन्छ ।

५. पूर्व संभाव्यता पछिको विकास चरणको लागि तथा निर्माण चरणको लागि गरिने संझौता समयमै गर्ने र समुदायको कार्य व्यस्ततालाई ध्यानमा राखि योजनाको निर्माण चरणको तालिका मिलाउनुपर्ने देखिन्छ ।

६. समुदायको बनावटलाई ध्यानमा राखी विशेष गरी उत्पीडित/दलितहरुको लागि क्षमता विकासका विशेष रणनीति अपनाउनु पर्ने देखिन्छ ।

सन्दर्भ सामाग्रीहरु:

१. *नेपाल रेडक्रस सोसाईटी, कास्की शाखा, कास्की रेडक्रस चिनारी, २०५८*

२. *सिम्ले कुसुण्डे खानेपानी योजना प्रगति प्रतिवेदन, २०५९*

३. *ने.रे.सो. कास्की शाखाका खानेपानी आयोजना संबन्धी अन्य विवरण ।*

अनुसूची: १

नेपाल रेडक्रस सोसाइटी, आधारभूत स्वास्थ्य सेवा तथा खानेपानी परियोजना, जिल्ला शाखा कास्की, खानेपानी योजनाको प्रगति विवरण

आ.व.	क.सं.	योजनाको नाम गा.वि.स./वार्ड नं.	जम्मा रकम (रु.)	रेडक्रस खर्च (रु.)	जनश्रमदान	घरसंख्या	जनसंख्या	प्रतिव्यक्ति लगानी	धारा संख्या
२०४५/४६	१	लौसी डांडा राखी, ९	९९,४५५।२२	८६,०५०।८९	२३,४०३।३३	३८	४०५	२१४।०५	५
	२	बराल डांडा राखी, ४	३,४१,९१९।९४	२,४६,९५४।६३	९४,९६५।३५	८९	९४२	२६२।१५	१२
	३	रत्नशोभा माझठाना, ५,	९३,४१,६८९।५०	२,७८,६२०।८०	६३,०६८।७४	७८	८०६	२८३।६५	१४
	४	ज्यामिरे माझठाना, ५	७२,०२०।५१	५५,१३१।३५	१६,८८९।१६	२९	३०६	१८०।१६	३
२०४६/४७	१	डांडा गाउं माझठाना, ७	१,३७७०।३५	८४,९५०।५५	५२,७५६।८०	५३	३२९	२३३।००	५
	२	आहाले माझठाना, ७	१,४१,५४६।९	७१,०८,,५५५।५६	३२,९९१।४२	४२	२३३	२१०।८८	३
	३	प्रगति चोक लेखनाथ,२,३	९,६०,५१२।	२८७,११,७११।०६	२,४८,८०१।२२	२५३	१७४७	३४९।५४	१८
	४	भुनकुना किपट लेखनाथ,२,३	७,४९,००५।	६०५,६६,९७८।७९	१,८२,०२६।८१	१५९	१०७३	३३२।४४	१२
	५	अर्घौ सुन्दरीबजार लेखनाथ,३,७,८,९	५,१६,४७७७२	४,०५,५४५।२५	१,१०,९३२।४७	११४	१२०७	२९४।५६	२०
२०४७/४८	१	लक्ष्मी आदर्श लेखनाथ, ६,७	७,३९,४५६।४२	५,४२,६११।६१	१,९६,८४४।८१	१२५	११५८	४६८।५८	१२
	२	तालचोक भण्डारीढीक शिशूवा, २	७,४६,८८३।०९	५,५२,६८१।८५	१,९४,२०१।२४	१५०	१५१२	३६५।५३	१४
	३	गोकूलदासे कटुन्जे शिशूवा, ६	१,३०,२२१।२९	८५,४१२।१६	४४,८०९।१३	३१	२२८	३७४।६२	६
२०४८/४९	१	गगनगौडाशिशूवा, ६	१०,५४,२५३।५०	८,१३,६४२।५८	२,४०,६१०।९२	२०४	२०८८	३८९।६७	१०
	२	भण्डारढीक, खूदी शिशूवा, ६	८,१२,०९४।७३	६,१५,७६१।९१	१,९६,३३२।८२	१९८	१५८४	३८८।७४	१०
२०४९/५०	१	डांडाकोनाक, अर्घौ लेखनाथ, ४	७,५८३६७।६८	४,७९,५७१।०२	२,७८,७९६।६६	१४५	१५६०	३०७।४२	११
	२	पटनेरी शिशूवा, २, ३	९,२२,२५३।८९	६,६६,३५२।६१	२,५५,८०१।२८	१०९	१४९०	४७७।२२	१३
कूल १६			८५,२३,७६४।७८	६३,००,५३२।६३	२२,२३,२३२।१५	१,८१६	१६,६६८	१५८	१६८

अनुसूची: २

नेपाल रेडक्रस सोसाइटी, जिल्ला शाखा कास्कीद्वारा संचालित खानेपानी र सरसफाई कार्यक्रम विवरण
आ.व. २०५०।०५१ देखि २०५४।०५५ सम्म

क) अर्मला गाउं विकास समिति

योजनाको नाम	आ.व.	वडा नं.	लम्बाई	धारा	घर	जनसंख्या	रेडकस लागत	जनसहयोग	कुल लागत
अर्मलाकोट	२०५१।०५२	८,९	६,५६५	२०	१२२	१०५४	७,९३,६०६।७४	६,५६,६८७।५७	१,४५,०२९४।३१
केहोरे	२०५२।०५३	४	६५८	५	१९	१७१	१,६६,१६८।०८	१,१५,७८९।८८	२,८१,९५७।९६
धारापानी पंधेरो	२०५२।०५३	३	-	२	१८	१२०	२६,२०२।९४	१७,५१२।११	४३,७१५।०५
हरीपाऊ	२०५३।०५४	१,३,४	१६,३४०	२७	१४५	१८१०	२०,२५,८२५।७६	१३,२४,८८५।७४	३,३५,०७११।५०
नौधारे ओख्ले	२०५३।०५४	५	६,९७३	३५	७७	११६५	१५,००,२८६।८८	७,००,८४६।१६	२२,०१,१३३।०४
सिस्नेखोला	२०५३।०५४	२	६,४५०	१३	८४०	४२	३,१२,४२४।७७	२,९८,२५९।२०	६,१०,६८३।९७
लप्सी खोला	२०५४।०५५	२	२,५११	७	२८०	२३	६,५३,९३७।५४	३,९७,४०४।००	१०,५१,३४१।५४
कूल ७ योजना				१११	४५९	५५३०	५४,७८,४५२।७१	३५,११,३८४।६६	८९,८९,८३७।३७

ख) पूरुन्चौर गाउं विकास समिति

योजनाको नाम	आ.व.	वडा नं.	लम्बाई	धारा	घर	जनसंख्या	रेडकस लागत	जनसहयोग	कुल लागत
रुवीखोला	२०५२।०५३	१, २	६,३२४	३०	२००	२२३७	८,६६,७२५।००	५,८३,२६९।५९	१४,४९,९९५।४५
ठूलोखोला	२०५४।०५५	१,२,४,५	११,२०६	३४	१८१	१९२३	१४,१७,२९५।३२	१,०२,३८७।९७	२,४५,९६८।२९
चुरुङ्गा	२०५४।०५५	१	६,५००	१२	६२	५८८	८,०६,९२२।६५	४,६६,३९५।२४	१२,७३,३१७।८९
हांडिपाखा	२०५४।०५५	१	(	२	१२	७०	३३,१८९।०८	२४,३६३।३६	५७,५५२।४४
पिप्ले पंधेरो	२०५४।०५५	५	(	२	१२	८०	३३,९०२।१३	२८,५६०।५८	६२,४६२।७१
छापा पंधेरो	२०५४।०५५	३	(	२	५०	३६४	२४,७८३।११	१९,१८५।४०	४३,९६८।५१
भूजेल पंधेरो	२०५४।०५५	५	८५०	३	६	५०	७९,२४८।३७	२०,७६७।९७	१,००,०१६।३४
अलैंचे पंधेरो	२०५४।०५५	३	(	२	१२	७०	१९,५०८।१६	३७,३६२।०९	५६,८७०।२५
कूल ८ योजना				८७	५३५	५,३८२	३२,८१,५७४।६८	२२,२२,२९२।२०	५५,०३,८६६।८८

Role Of Media And Environmental Journalists In The Management Of Water Resources For Poverty Alleviation

Sanu Babu Silwal,
President, Society of Environmental Journalists Nepal

According to UNDP report 2001 64% the people of Nepal do not have proper housing facility, 58% are not properly clad; 51% do not get balanced diet; 59% do not get proper medical care; 46% of population are illiterate and 73% of population can not generate minimum income to sustain.

These findings have once again reiterated that Nepal is a poor country. The main objective of the State as laid down in its 10th five-year plan (2002-2007) has once again repeated the theme of "Poverty Alleviation". In fact 42% of our population are living a constrained life in the abject economic situation. This theme is appropriate, but it does mean nothing until the people feel it with the outcome

Many Western countries are providing financial and technical assistance to Nepal since mid 20th century. Two third of the development aid including internal revenue is misused mostly due to defective governance. Economic upliftment through industrial development has never been encouraging. Its share in the national GDP has remained almost constant each year at 10% despite government's continuous efforts. Import always supersedes export. The population of Nepal increased by 52% during the short span of 20 years as known from the latest census. Our development planners are always confused with numerous factors of development strategies. They are satisfied after they finalize voluminous planning document. Nobody deny that they have missed to pay due attention to "water" as the prime factor of development suitable for Nepalese geographical condition. They have not grasped the enormous potentiality that lies in the management of water resources of the country for poverty alleviation. Ironically, this is not the main objective of 10th five-year plan of HMG. Water resources of Nepal in fact can be as good as the mineral oil is for the Middle East Countries. SEJ-Nepal is fully confident that we can achieve complete economic wellbeing from poverty alleviation only through water resource management.

The geographical position of Nepal with the lofty Himalayas in the North ranges bordering the autonomous region of Tibet. It is a gift of nature for Nepal. Nepal gets two-reason monsoon rain, besides intermittent cyclonic rain during the year. There are almost 6000 small and big river and rivulets in this country. Some of them are perennial. Nepal has exploited them very little for economic purpose. They could be the only natural resource enough to alleviate poverty. Irrigation or hydro energy for poverty alleviation is the best usage of river. Besides they can be used for drinking water, sanitation, rafting, and fishery. Secondly, a great economic potentiality lies with the rainwater. Dr. S.K. Sharma in his "river system of Nepal" has assessed that 71% of rain water runs off to Bay of Bengal; with an enormous quantity of Nepalese alluvial soil with it. It has caused agriculture degradation, which is one of the reasons of food deficit in Nepal. Thus the problem of food shortage can be substantively settled. Nepalese agriculture suffers most either due to excess or less precipitation. There are numbers of patches of fertile land, which remain dry most of the time. These patches of fertile land fail to yield second harvest for want of moisture in the soil. SEJ-Nepal therefore, has been advocating constructing thousand of seepage proof rain harvesting ponds throughout the country. So that poverty alleviation through water management from this method can also be a reality.

It is the duty of any democratic country to formulate plan and policy suitable to its land. Otherwise if the government, for example, diverts its attention to the import of chemical fertilizers and pesticide instead of working upon the internally available indigenous potentiality, poverty alleviation will remain a far-fetched dream. Water should be universally accepted as a prime input for agriculture and energy in a country like Nepal where most of the water resources are wasted and runs off toward the south across the boarder.

As the only national networking environmental media organization, SEJ-Nepal therefore, has been continuously advocating for priority based government policy on water management. Journalists and matured economists including experienced social dignitaries of the country should subject the plan and policy formulated by foreign trained planners to scrutiny. Media organization can bridge up the gap between public and government. Economic planners should benefit from producing their document only after enough brain storming with media people.

Media people also maintain the bridge among policy makers in the government, experts, economists and general people. The development-motivated journalist of our country is not as efficient as in other developed countries. This deficiency can be mitigated if our planners could manage to interact and share opinion with them occasionally. Journalist of this country can be helpful to our government in the task of poverty alleviation through water resource management. The already published printed materials and audio-visuals transmission from NTV and others means of the media advocacy by SEJ-Nepal can be equally best guidelines to the government. Equally the on-going future media dissemination programmes of SEJ-Nepal can be good guidelines to the government provided they should care for them. SEJ-Nepal believes that general people can be mobilized for national development if the nationwide media network of SEJ-Nepal actually should be encouraged from all development conscious citizen and government of this country.

SEJ-Nepal believes that media people only can make the policy making authority, expert, government and general people alert, coordinative and united for the daunting task of poverty alleviation from the indigenously available water resources as the prime factor of development for this country.

Media advocacy has vital role to disseminate factual information to the public about the good or bad initiatives of authority, about the corruption, development activities, human right of clean environment, air, water and natural food. Thus developing a coordinated process among all people can help to achieve anticipated outcome in the end, which can only be successfully materialized with the role of media people. In a democratic country media has therefore, greater responsibility to put the nation in a right track.

Water resources management of Nepal therefore, should be accepted as the primary task to be attended to. Water resources in the form of perennial rivers and the untapped rain water of the monsoon reason if managed properly they will provide every things, all sorts of consumer goods and services to alleviate poverty from Nepal.

फोहोर पानी
रोगको खानी
छोपेर राखौं खानेपानी

Community Managed Rural Energy System

Govinda Ram Maithili KC
DoLIDAR, MoLD

Background

Two third of the earth surface is covered with water. In addition, extra water in the form of precipitation is available in rainy seasons all over the world. Water is used for food, water is used for energy, and water is used for everything. Water is life. In short, water is needed for the existence of living things as well as non-living things. It can be noticed that most of the developed nations, developed cities and towns are situated near the water source. It shows that water is essential for development of settlements, development of cultures, and development of nations as well. However, if the water is not managed properly, it can destroy anything. So, water should be utilized, managed, and protected in a proper way to obtain maximum benefit out of it. It is always a necessity to take care of protecting the sources of water and watersheds in a sustainable way so that the water is available for generations.

Nepal has a tremendous amount of water resources. However, most of it flows out of the country without much use and benefits to the country. Instead, it causes flooding and landslides resulting into the damages to the economy and lives of people of the country. Rural livelihood is predominant in Nepal. Unless the water resources could not be developed, the country can not move forward with its development activities in rural areas. Keeping this in view, HMG/N jointly with UNDP have implemented Rural Energy Development Programme (REDP) since 1996 to utilize the water resources for multiple applications and enhancing the rural livelihood through the promotion of community managed micro hydro scheme as an entry point.

Energy itself is not considered as a basic need but it is an essential component to fulfill basic needs. However, only 15 % of total population of Nepal has access to electricity whereas, only 5 % of rural people belongs to it.

REDP Districts

Initiated in 5 districts as a pilot basis, the programme has been expanded to 15 districts covering 100 VDCs. The following table shows the districts where REDP has launched its programme:

Far-western Devt. Region	Mid-western Devt. Region	Western Devt. Region	Central Devt. Region	Eastern Devt. Region
Baitadi	Dailekh	Myagdi	Sindhupalchowk	Okhaldhunga
Dadeldhura	Pyuthan	Baglung	Kavrepalanchowk	Tehrathum
Bajura		Parbat	Dolakha	
Acham		Tanahun		

Stakeholders

For a smooth implementation of the programme and to provide a sense of ownership to the community, the communities are considered as the main stakeholders. The following stakeholders are engaged in the programme:

a) Communities
b) Elected Bodies (DDCs and VDCs)
c) Non Government Organizations (NGOs)
d) Private Support Organizations (PSOs)
e) UNDP(REDP), and
f) His Majesty's Government of Nepal (HMG/N)

Resource Mobilization

Resource for implementation of schemes in REDP is mobilized as per the following table:

Particulars	Non Local Cost
REDP	50%
HMGN Subsidy	20%
DDC Investment	5%
VDC Investment	5%
Bank Loan	20%
Total Cost	100%
Break Down of Total Cost	
Non Local	85%
Labor + Local Materials	15%

Community Mobilization

Keeping in view the importance of community involvement in the process of rural energy development, REDP launched the programme with six basic principles of REDP community mobilization, which are: (i) Organization Development, (ii) Skill Enhancement, (iii) Capital Formation, (iv) Women's Empowerment, (v) Technology Promotion, and (vi) Environment Management. Local NGOs are engaged for the implementation of community mobilization package at the community levels. The thrust in community mobilization is for the self-development, self-governance, and self-management, thus creating a sense of ownership among the community members.

Characteristics of Community Managed Micro Hydro System:

- Self – Development: - Involvement in all stages from planning to management
- Self – Governance: - Involvement in decision making process
  - Own rules and regulations based on transparency and accountability
- Self – Management: - Operation and management
  - Repair and maintenance
  - Tariff collection
  - Fund management

Among others, the community people share the cost of the schemes amounting to about 20% of the scheme cost. The REDP Community Mobilization Package encourages local people to form Community Organization to promote self-governance and initiate development work through self-help approach and mobilize resources from within the community and outside to undertake micro hydro schemes and other community development initiatives. Normally, fifteen to thirty persons living in the same vicinity or sharing common interests form a community organization. Mandatory requirement under REDP community mobilization process requires one man and one woman from each household to participate in the formation of Community Organizations (COs) of men and women separately and then joining at equal number in the formation of the Functional Group (FG). It yields gender balance in all development process. Consequently, women of programme areas take part equally in all decision making along with their male counterparts in matters pertaining to their households and community needs.

Achievements

As of 31 December 2002, the programme has succeeded to achieve the results as listed below:

(i) Organization Development

	Unit	Male	Female	Total
Community Organizations	No	1365	1369	2734
Orgaqnization Members	Person	27151	28020	55171
Functional Groups:	No			637
Micro Hydro	No			116
Others	No			521
Micro Hydro Cooperatives	No			3
Support organizations (NGOs)	No			5
Rural Energy Service Centers (PSOs)	No			14

(ii) Skill Enhancement

	Unit	Male	Female	Total
Technical	Person	978	216	1074
Environment	Person	978	638	1616
Income Generating & Enterprise Development	Person	2825	2110	4935
Institutional Development	Person	2081	1940	4021
Study / Orientation	Person	928	628	1556
Others	Person	2730	1334	4064
Total	Person	10400	6866	17266

(iii) Capital Formation

	Unit	Male	Female	Total
Weekly Saving	Rs	9,854,448	8,820,409	18,674,857
Investment (cumulative)	Rs	20,082,190	18,449,657	38,531,847

(iv) Women's Empowerment

	Unit	Total Achievement
Community Organizations	No	1365
Training on Various Disciplines	Person	6866
Weekly Savings	Rs	8,820,409
Cumulative investments	Rs	18,449,657

(v) Technology Promotion

	Unit	Total Achievement
Micro Hydro system	No	102 (1313.5 kW)
Biogas with Attached Toilet	No	2,601
Solar PV Home System	No	1,450
Improved Cooking Stove	No	6,651

(vi) Environment Management

	Unit	Total Achievement
Community Managed Forests	No	180
Tree Plantations (Fruit and Non fruit)	No	1,501,305
Toilet Construction	No	9,902
Water Tap / Tank (Renovation)	No	524

Tentatively 100,000 people have access to electricity from the REDP supported community managed rural energy systems. A remarkable example can be seen in Bhoksing VDC of Parbat district where all 227 households are electrified with the installation of 2 micro hydro plants, 2 peltric sets, and 20 solar PV home system. Bhoksing is probably the first and the only VDC in the entire country to have electric lighting in all households from the mix of different energy systems.

Major Impacts

The major impacts contributed by the community managed rural energy systems include labour saving and drudgery reduction, reduced consumption of fuel wood and petroleum products, enhanced irrigation, improved health and sanitation, better education, increased employment opportunity and better income, strong feeling for rural development, and efficient use of water resources. Most importantly, the major benefits can be seen in the strong feeling of ownership on the micro hydro plants and other complementary activities by the rural people. Besides, a reduction of carbon dioxide emission is also a contribution to the global warming reduction.

The REDP has been recognized as a "best Practice" programme in the country and abroad. It was awarded Energy Globe Award 2002 Austria and featured at EXPO 2000 Germany.

Conclusion

Community Mobilization is the key for harnessing people's potentials, mainstreaming gender, and ensuring equity. Local people are capable to implement and manage rural energy systems with guidance provided and building their capacity. Community managed Micro Hydro and Solar PV are the best means to increase access of electricity to rural people. Involvement of women in all levels is essential and a holistic development approach is needed for the multiple uses of water resources, and for achieving the national goal of the sustainable development and poverty alleviation in the country. In short, Rural Energy is an effective entry point for sustainable development and poverty alleviation.

Small Towns Water Supply & Sanitation Sector Project (STWSSSP)

The 15-Year Development Plan for Small Towns Water Supply and Sanitation Projects adopted by His Majesty's Government has identified 209 emerging towns in the country. The cost to improve water supply and sanitation services required is estimated at US$ 117.11 millions. The first phase of this project amounting to US$ 53.87 millions is being implemented from December 2000 with the financial assistance of the Asian Development Bank for a period of six years.

Based on the existing water supply and sanitation condition, service level, hardship, willingness for participation by communities and local bodies etc. the 43 towns are selected for implementation. The project will provide water supply limited drainage and sanitation facilities in these towns following a demand-driven, interactive procedure that ensures full participation of the local water users' group. Interacting with communities on various stage of project implementation the project is designed in a partial capital cost and full operation and maintenance cost recovery approach in 12-15 years of project operation which is the main difference in comparison with the previous water supply projects implemented by Department of Water Supply and Sewerage. Apart, at each project the total cost is equally shared by government and water users. The financial plan of this project includes 5 percent cash and 15 cash/kind from users, 30 percent sub-loans from Town Development Fund and 50 percent contribution from government account.

Objectives

- To improve Water Supply and Sanitation Facilities and provide Health and Hygiene
- To education Program in each town project;
- To support Community participation in the development of water supply and sanitation facilities; and
- To promote community based water quality monitoring.

Project Components

1. Public Awareness Campaign and Health and Hygiene Education
2. Water Supply and Sanitation Facilities Development
3. Technical Support to Water Users Committees
4. Project Implementation Assistance

Definition of Small Towns

- Population more than 3000 in the Hills/5000 to 40,000 in the Terai
- Population density 40 person per hectare
- Road Access- all weather road along East/West or North/South
- Basic Infrastructure facilities- Electricity/Telecommunication/Bank/Lower Secondary School/Health Post.
- Proven hardship regarding Water Supply and Sanitation

How to apply

Interested town under the definition can apply as a candidate town. The respective Water Users and Sanitation Committees and local bodies may submit an application jointly for project approved by district assembly. The required application forms and other project related information can be obtained from:

Small Towns Water Supply and Sanitation Sector Project
Project Management Office

DWSS Building, Panipokhari, Kathmandu, NEPAL
Phone: 977-1-4423848, 4412348, 4432885, Fax No: 977-1-4413280
Email: info@stwsssp.gov.np, Website: http://www.stwsssp.gov.np

Water, Improving Quality Of Life And Livelihood Opportunities In Rural Hills Of Nepal

Bhim Kumari Ale
Gorkha Welfare Society

Introduction:

Rural Water and Sanitation Programme (RWSP) of Gurkha Welfare Scheme (GWS) a field arm of Gurkha Welfare Trust (GWT) UK has been working in Rural Water sector since 1976 in Eastern and Western region of Nepal. Since 1989, Department for International Development (DFID) then ODA of the British Government is funding GWS to support the RWSP in Phase I (1989 to 1995) Phase II (1995 mid to 1999) and Phase III (Mid 1999 to 2005).

Since 1996, (Phase II) RWSP introduced social development and sanitation awareness a major component of the programme. And introduced the process oriented 'Stepwise Implementation' Approach ' aiming to improve health, hygiene, quality of life and livelihood opportunities in rural village communities with measurable indicators of reduction in time and improvement in nutritional status. RWSP follows 6 month, 2 years monitoring visits once scheme is built.

The paper is based on the monitoring outputs of selected 59 of Phase II and 91 of Phase III schemes and highlights on how far the drinking water supply is able to reduce the time of water fetcher and facilitate to improve the quality of life and livelihood opportunities.

1. Reduction of Time in household water collection

Data collected during operational phase scheme monitoring compared with data collected prior to scheme development shows that there has been significant reduction in time of women and children in water collection.

Minimum and Maximum time reduced per household after water supply

Time taken in water collection for each scheme community is recorded before scheme construction during social profiling and at 6 month and 2 year monitoring visited after scheme construction. As long as the scheme is functional time is definitely saved with improved water supply, Women and girl in particularly are relieved from physical/ mental stress of water collection. The minimum and maximum time saved per household of phase II and III is shown below in Tables No 1 and respectively. The data is selected year wise of that scheme where the water fetcher women's minimum and maximum time has been saved.

Table No.1
Minimum Time Daily Saved per HH After Scheme Built with Regular Water Supply

Construction		Before Scheme Phase	After RWSP Water Supply in Operation	
PHASE	Scheme Construction	Maximum Time to get water	Time to get water	Time saved
		Total in minutes per day (going/waiting/collect/return)	Total in minutes (going/waiting/collect/return)	Total in minutes
II	1996	N/A	N/A	N/A
II	1997	8 Mins.	7 Mins	1 Min
II	1998	4 Mins	3 Mins	1 Min
III	1999	7 Mins	3 Mins	4 Min
III	2000	4 Mins	3 Mins	1 Min
III	2001	27 Mins	1 Mins	26 Min

Sample Selected – Minimum and Maximum time consumed in dry season to fetch water in one round trip in Initial Phase (before water scheme built) same area household selected for comparative study in Operation Phase (after water scheme built). Data is based on one round trip to fetch water by the same person. Water collection pot is 20 liters (before and after water scheme built).

Table No. 2
Maximum Time Daily Paved Per HH After Scheme Built with Regular Water Supply

		Before Scheme Construction	After RWSP Water Supply in Operation Phase	
PHASE	Scheme Cons-truction	Maximum Time to get water Total in hr/m/s per day (going/waiting/collect/return)	Time to get water Total in hr/m/s day (going/waiting/collect/return)	Time saved Total in hr/m/s
II	1996	2 hrs 40 Mins	4 Min	2 hrs 36 Mins
II	1997	1 hrs 40 Mins	5 Mins	1 hrs 35 Mins
II	1998	2 hrs 15 Mins	4 Mins	2 hrs 11 Mins
III	1999	3 hrs 10 Mins	5 Mins	3 hrs 5 Mins
III	2000	2 hrs	6 Mins	1 hrs 54 Mins
III	2001	4 hrs 30 Mins	4 Mins	4 hrs 26 Mins

2. Reduction in time improved quality of life and livelihood opportunities

There is tremendous effect in quality of life & community livelihoods due to D/W near to door-steps and latrine in most of the households.

2.1 Reduce human sufferings/relaxation in scheme operation phase

Water near to doorsteps and continues waterflow in taps releases the water fetcher's tension from water collection. The physical burden of carrying water from steeply up and down, time spent in waiting in queue has been reduced. The worry of men folk about security on lives of women and girl children (due to source exists in dangerous location) has been ended. The women are free from tension of water store management. They felt comfort, ease in their daily lives. They can have sound sleep, eat well. Good sleep and eat well also impacts positively on health.

Table No: 3
Relaxation after D/W supply in schemes Operation Phase

Phase	Construction Year	Scheme in Total	Comfort/ Easiness	Security	Remark
II	1996	20	20	8	2 years monitoring
II	1997	23	22	11	2 years monitoring
II	1998	16	16	14	2 years monitoring
	Total:	59	(98%) 58	(56 %) 33	
III	1999	23	22	10	2 years monitoring
III	2000	40	37	6	6 month monitoring
III	2002	28	28	8	6 month monitoring
	Total:	91	(96%) 87	26%) 24	

2.2 Utilization of Saved Time In Schemes of Phase

The time that has been saved by the water fetchers means that the community have more time available for involving themselves in other socio economic activities. The following Table No.4 represents the response of principle water fetcher (women and girls).

Table No. 4
Utilization of Saved Time in Schemes In Operation Phase

Phase	Const ruction Year	Sch- eme in Total	More input in House hold work	Help in agriculture	Sanitation improve- ment	Adult literacy	Learn sewing knitting	Children edu- cation
II	1996	20	18	16	19	3	0	15
II	1997	23	23	15	18	8	4	18
II	1998	16	16	14	15	6	7	13
	Total:	59	(97%) 57	(76%) 45	(88%) 52	(29%) 17	(19%) 11	(78%) 46
III	1999	23	20	21	20	0	1	20
III	2000	40	37	36	39	2	3	39
III	2001	28	28	25	28	10	0	26
	Total	91	(93%) 85	(90%) 82	(96%) 87	(13%) 12	(4%) 4	(93%) 85

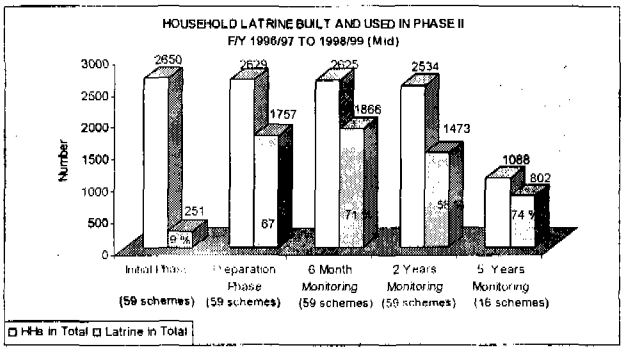
Table No. 5
Enhancement Of Opportunities

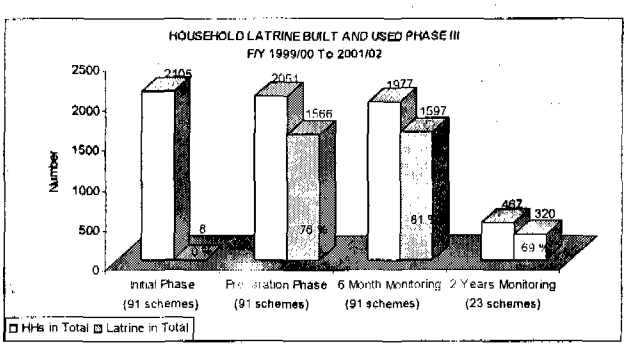
Phase	Construction Year	Schemes in Total	Involved in Devt. Activities	More Participation in Meeting	Out exposure to meet people
I	1996	20	9	11	17
I	1997	23	18	20	20
I	1998	16	5	10	8
	Total:	59	(54%) 32	(69%) 41	(76%) 45
III	1999	23	6	6	5
III	2000	40	2	5	3
III	2001	28	7	9	9
	Total:	91	(16%) 15	(22%) 20	(19%) 17

3. Demonstrate Hygiene Behavior Change

in scheme operation phase, there is demonstrated a significant change in key hygiene behavior over time in scheme constructed in phase II and III

Household Latrine Built And Used In Phase Ii (F/Y 1996 To 1998/99)
Chart No.1

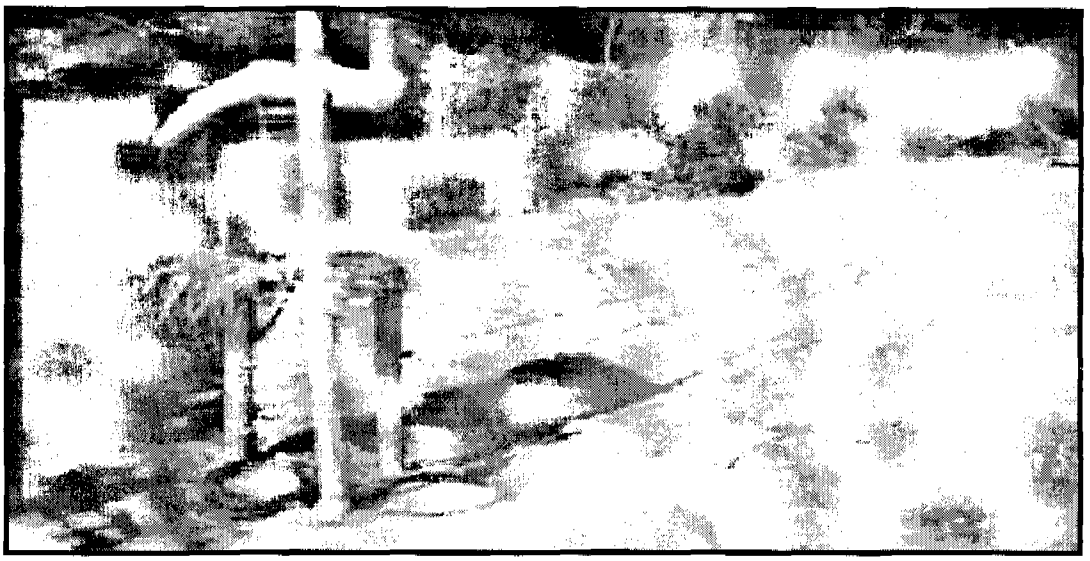




4. Introduction of Simple Drip Irrigation Programme

RWSP has introduced and is supporting scheme communities in operation phase for installation of Simple Drip Irrigation (SDI) The aim is to introduce new technology and is utilize saved time for growing off season vegetables which increases nutrition and income generation opportunities This section shares the outcome of some selected schemes.

Picture No. 1 SDI System for Vegetable Gardening in Bhojpur/East Nepal



4.1 Adoption of New Technology- Simple Drip Irrigation For Home Gardening

Out of 196 households of 3 schemes in Syangja and Palpa district, 39 households installed the new technology in their home garden.

Table No: 6
Adoption of Simple Drip Irrigation System (Jan. 2000)

Simple Drip Irrigation System Introduced						
Phase	Construction Year	Schemes	HHs	Drip Users HHs	VDC	District
II	1996/97	Phedikhola	155	9	Phedikhola	Syanja
		Sijakharka	17	11	Tulshibhanjyang	Syanja
II	1997/98	Rumaldanda	24	19	Chidipani	Palpa
	Total:		196	39		

4.2 Production of Off Season Vegetables

These 39 households able to produce the below off-season vegetables in different harvesting season.

Table No: 7
Production of Off Season Vegetable March 2000 to March 2002

S.N.	Schemes	Production of vegetables	Remark
1.	Phedikhola	Cucumber, Beans, Chiraule, Bitterguard, pumpkin, Tomato, Chilly, Cabbage, Cauliflower	Harvesting May 2000 onwards
2.	Sijakharka	Cucumber, Tomato, Better guard, Chiraula, Pumpkin, Beans, Chilly, Brinjal,Cauliflower, Cabbage	
3.	Rumaldanda	Cucumber, Chiraula, Tomato, Better guard, Pumpkin, Beans, Ladies finger, Brinjal,Cauliflower, Cabbage	

4.3 Productions and Family Consumption Of Vegetable

The Table below shows 291 family members (adult / children) of 39 households consumed the off season vegetable. Sure, there is an effect on nutritional aspect.

Table No: 8

Productions And Family Consumption Of Green Vegetable
March 2000 to March 2002

S.N.	Scheme Name	HHs	Family Members			Production Total Kg.	Family Consumption Total Kg.
			Adult	Children	Total		
1.	Phedikhola	9	40	15	64	7821	3722
2.	Sijakharka	11	65	52	117	12986	5385
3.	Rumaldanda	19	70	40	110	6204	2595
		39	175	107	291	27011	11702

4.4 Productions / Distribution and Sales of Vegetable

There is tendency of new vegetables being distributed to relatives free of cost which reinforce the relationship with relative. Few crops are spoiled due to lack of technical know how. The remaining vegetables are sold.

Table No: 9

Productions/Distribution And Sales Of Green Vegetable
March 2000 to March 2002

S.N.	Scheme Name	H Hs	Product Total Kg.	Family Consumed Total Kg.	Distribution Relative Total Kg.	Spoiled Total Kg.	Sold Total Kg.
1.	Phedikhola	9	7821	3722	1449	729	1921
2.	Sijakharka	11	12986	5385	960	897	5744
3.	Rumaldanda	19	6204	2595	1554	111	1944

4.5 Expenditure on Livelihood

The amount received from sold of off-season vegetable has been expended by some households to meet daily livelihood, children's education improvement of facilities and one household in medical treatment. See below table No. 10.

Table No: 10

Gross Income, Expenditure and Saving

March 2000 to March 2002

Scheme Name	HHs	Product Total Kg.	Sold Total Kg.	Cash in Hand Total NCR	Expenditure Total Total NCR	Saving Total NCR
Phedikhola	9	7821	1921	26362	14208	12154
Sijakharka	11	12986	5744	107426	68111	39315
Rumaldanda	19	6204	1944	27812	22658	5154

Table No: 11
Expenditure on Livelihood

S.N.	Scheme Name	HHs	Expenditure Total NCR	Expenditure for what
1.	Phedikhola	9	14208.00	Payment Electricity bill, Medical expenditure, School fee, Purchase of manure, school uniform, vegetable seed, milk, pulse
2.	Sijakharka	11	68111.00	Payment to Electricity fitting, School fee, Purchase of books, Drip set, soap, glossary (Salt, oil, rice, sugar, tea), Vegetable seed, medicine, books and clothes
3.	Rumaldanda	19	22658.00	Payment of school fee, purchase of stationary (books, copy, pencil), glossary (Salt, oil), SDI set, Vegetable seeds and treatment of sick person, wire fitting

The above outcome indicates that the scheme communities effectively using there saved time in off season home gardening through SDI System and benefiting from opportunities to improved their livelihood.

Lesson Learn:
There is no doubt that the continues rural water supply is able to save the time of water fetcher's and and there comes changes in water and sanitation related behavioral practices within the community and that improves their quality of life and daily livelihood become more easier. It opens the door of opportunities such as adoption of new technology of irrigation for homestead vegetable gardening. and improve family nutrition as well as small amount of income generation for daily subsistance

The lesson learnt is that there must be continues supply of water, people must know the value of water and better care off. There must be equitable opportunity to all with social justice the benefit of water and requires the establishment of good management system.

सधैं सोचौं-पानी मानव
समुदायको लागि
पानी जीवनको लागि ।

वृक्षारोपण गरौं
पानीको श्रोत जोगाऔं ।

Impacts of Renewable Energy Technology In Water Supply And Sanitation

Govinda Prasad Devkota

1. Introduction

Water has diversified applications such as drinking, cleaning, sanitation, power generation, irrigation and recreation. The sources of water may be rain, spring, surface or ground water. Water may have some pollutants. The type of pollutants may be infectious and toxic agents, oxygen-demanding substance, organic chemicals, plant nutrients, suspended matters, radioactive substances etc. These may come from natural sources, agricultural sources, wastewater and impoundment. Potential pollutants from natural sources are atmosphere, dissolved minerals, decay of vegetation, aquatic growth and so on. Agricultural sources include animal waste, fertilizer, pesticides etc and wastewater sources may have municipal sanitary sewage, industrial waste and so on. Similarly, impoundment includes leaching from bottom deposits and other sources may be mines, landsfills and ground water.

However, according to WHO guidelines, the drinking water should be free from pathogens, the concentration of toxic substances should be very low, there should be no turbidity and no saline, no taste or odour. But here in this paper the focus of water is mainly on power generation and sanitation. Alternative energy promotion is one of the major programs in community development. The main objective of this sort of communication is to establish relationship between water supply and sanitation and alternative energy promotion in Nepal and other Himalayan countries.

More than 78% of the total energy consumption is met by firewood in Nepal showing a heavy dependence of energy need on already dwindling forests and forest resources. Firewood consumption is a major cause of deforestation, which is a major environmental problem including water source reduction, soil erosion and landslides in Hindukush Himalayan Region. This simple scenario can justify the interdependence of water and energy. Renewable energy technologies (RETs), which use local energy resources (other than commercial fuels) and biomass fuel (firewood, agricultural residues and animal wastes) in traditional forms, can directly reduce the dependency on forests.

2. Objectives

The main objective of this paper is to focus water supply and sanitation through renewable energy technology. Dissemination of Renewable Energy Technologies (RETs) such as biogas with toilet attachment helps to improve the sanitation in the area and reduce methane, nitrous oxide and carbon production and saves firewood and ultimately living trees and consequently wild animals. Similarly, micro-hydro, wind and solar energy technology also have direct and indirect positive impacts on lifting water for drinking purpose, irrigation and overall livelihood of the rural people.

3. Methodology

While preparing this paper data are collected both from primary as well as secondary sources of information such as literature review, case studies, experiments and field works. These data are tabulated and analysed to develop this paper.

4. Environmental Issues of RETs and Water Supply and Sanitation

4.1 Treatment process

There are various methods of water and wastewater treatment processes. Some of the drinking water treatment methods are aeration, coagulation, filtration, sedimentation, disinfection and so on. Similarly, wastewater treatment processes are of activated sludge system, oxidation ditches, trickling filters, lagoons, denitrification, biomethanisation and so on. Here the focus is on biomethanisation from cattle dung, nightsoil and various wastes from industries, municipalities, sewage and so on.
The water used in biogas should be to that of drinking water. Similarly in micro-hydro, river water is generally used for running turbine.

4.2 Forest depletion

Forest constitutes Nepal's largest natural resource in terms of coverage. Majority of Nepalese use forest products as firewood, food, fodder, timber and medicine. The pressure due to population growth is one of the main causes for forest depletion. Firewood is the major source of energy consumption as shown below.

Fig 1: Consumption of Energy by type in the year 1997/98

In Nepal, 78 percent of the people are using firewood, 4 percent agricultural residue, 6 percent animal wastes, 9 percent petroleum products and 2 percent coal and 1 percent electricity as fuel type in the year 1997/98 (*WECS, 1998).*

The following table shows the rate of forest depletion during the period of 1978-1994.

Table 1: Change in forest coverage

Type	LRMP 1978-79	Master Plan 1985-86	NFI1994
Forest	38.0	37.4	29.0
Shrub	4.7	4.8	10.6
Total	42.7	42.2	39.6

Source: DFRS 1999

About 29 percent of the total area of Nepal are under forest coverage and 10.6 percent as shrub or degraded forests. The forest area that was 37 percent in 1886 and 45 percent in 1966 has declined considerably. Shrub land area has doubled from 4.8 percent in mid 1980 to 10.6 percent in mid 1990. The annual deforestation is estimated to be 1.7 percent with 2.3 percent in hills, and 1.3 percent in the Terai.

Forest depletion has a direct impact on sources of water. Firewood consumption is a major cause of deforestation, which is a major environmental problem including biodiversity loss (e.g., wildlife species and their habitats), soil erosion and landslides in Hindukush Himalayan Region.

4.3 Drying-up of water sources

Forest depletion and conversion of broad leaves forest to needle-leaves forests or shrub lands has increased drying-up of spring and well, particularly in the hills. Due to this local people have to spend more time fetching drinking water. However, forest protection, plantation and regeneration and expansion of community forestry have shown positive impacts on the re-sprouting of spring. The occurrence of floods and landslides as a result of deforestation has affected not only the degradation of land but also human lives and property.

Drying up of water sources also reduce in generating hydro-power from rivers, streams and lakes.

4.4 Climate change

Burning firewood has degraded indoor air quality in many rural households. There is co-

relation between chronic bronchitis and decline in lung functions and biomass burning, particularly in rural women. The increase in carbondioxide has also increased the amount of radiant energy, thus by warming the local climate.

It is estimated that the annual deforestation of 26,602 ha has emitted 7.77 million tonnes of carbon into the atmosphere (SEAMCAP, 2001). Firewood burning has also considerably emitted other pollutants such as TSP, HC, NO_2 and SO_2 into the atmosphere.

Table 2: Estimated emission (tonnes/year) from firewood use

Year	TSP	CO	SC	NOx	SOx
1980	138, 749	346, 872	309, 583	10, 406	5, 203
1985	178, 913	447, 282	399,199	13, 418	6, 709
1990	197, 579	493, 949	440, 849	14, 818	7, 409
1995	221, 867	554, 667	495, 040	16, 640	8, 320
1998	236, 677	591, 692	528, 085	17, 571	8, 875

Source: UNEP, 2001

4.5 Agriculture

The Terai and inner valleys are suitable for agricultural production. Agricultural production largely depends upon the structure of the soil and presence of nutrients. Availability of these nutrients to agricultural crops is decreasing due to soil erosion, landslide, flood and sedimentation. Acidification, alkalinity, salinity and inappropriate use of agro-chemicals such as insecticides and pesticides also affect the land. Application of bio-slurry from biogas plants or lift water irrigation from micro-hydro, solar or wind energy greatly improves the agricultural production.

4.6 Biodiversity

Forest depletion has a direct impact on wild species of flora and fauna. Habitat destruction, overgrazing, fire and human activities have increased pressure on forest. The application of renewable energy technology helps in conserving forest and ultimately the sanitation in the area.

5. Emerging Renewable Energy Technologies

Renewable Energy Technologies (RETs) is a synonym for new, renewable and non-conventional forms of energy i.e. the technologies, which use local energy resources (other than commercial fuels) and biomass fuel (firewood, agricultural residues and animal wastes) in traditional forms. The main sources of these alternatives are biomass, water, sun and air.

In Nepal, more than 106,000 biogas, 2046 micro-hydro schemes including peltric sets (generating 13615 kW power) about 140,000 improved cooking stove (with the efficiency of 18-28%). 25, 000 solar PV home systems have been installed in the country.

5.1 Biomass

Biomass as a source of energy mainly consists of fuel wood, agricultural residue and animal dung. Fuel wood and other biomass fuels are burnt in traditional stoves of various kinds. Agricultural residue can be converted into briquettes or burnt directly for energy purpose. Conversion of biomass technology into other efficient and convenient energy forms include biogas, improved cooking stoves, briquettes and gasifier.

5.1.1 Biogas

Since biogas is a high quality fuel, it can be used for many purposes besides cooking and lighting, such as fuel for running dual fuel engine, for agro-processing, pumping water and for generating electricity. By the end of July 2002 about 106,000 family sized biogas plants (mostly 4 to 10 cubic meter total volume capacity) have been installed in the country. This has tremendously conserved the forest and ultimately the animals in the jungle. The slurry produced from biogas plant increases the fertility of the soil hence agricultural products are of high quality. Biogas plant is run only after mixing cattle dung with water.

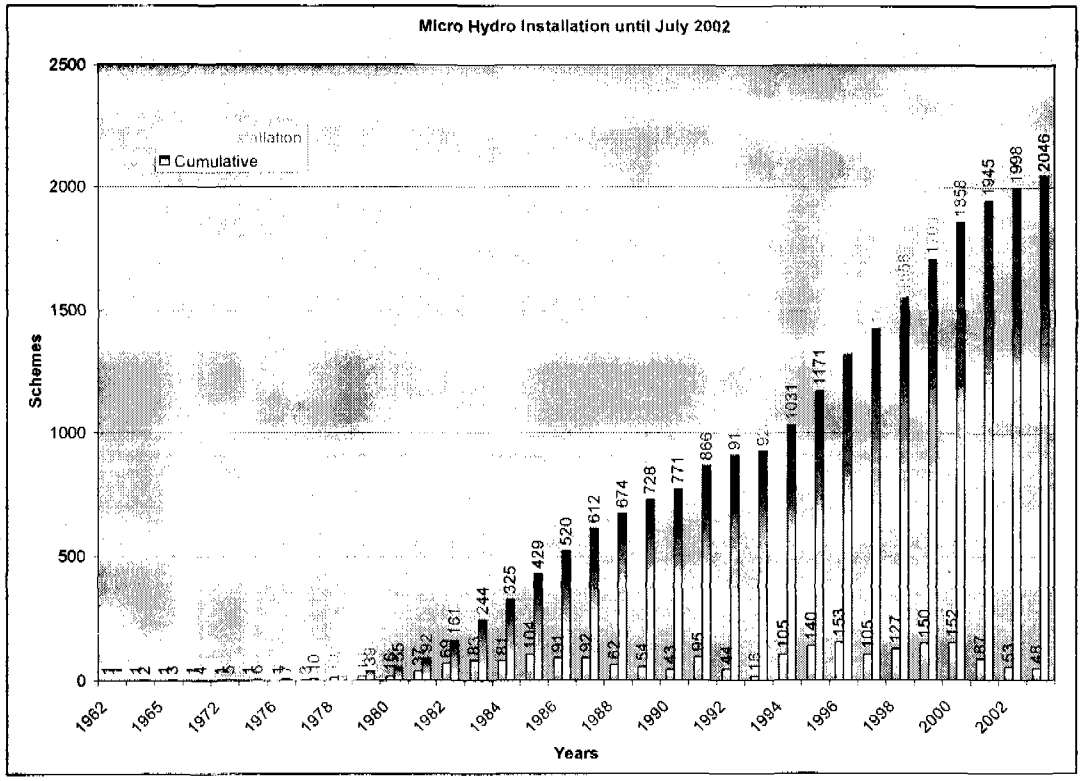


Fig 2: Biogas plant installation until August 2002
Source: GGC/BSP

In Nepal, more than 106,000 biogas plants have been installed so far. It is estimated that a 6 cum biogas plant (most common size) displace the use of 3 tonnes of firewood or 38 lit. of kerosene annually. It produced 27 tonnes of digested slurry and reduces 4.2 tonnes of carbondioxide equivalent per year. This shows the saving of 11.6 trees annually (i.e. 0.055 ha of forest). Toilets are attached in about 60% of the plants where as there is a provision of toilet attachment in 90% of the plants installed. It is believed that burning biogas is much cleaner than burning biomass or using open toilet. Toilets not only improve hygienic conditions in and around the farmyard but also generate biogas.

5.2 Mini and micro-hydro power

With more than 6,000 rivers and streams, many with hydraulic heads and flow, Nepal is very rich in hydropower potential, second in the world, next to Brazil. About 17 companies manufacture and install micro-hydro units in Nepal.
Fig 3: Microhydro plant installation until July 2002
Fig 3: Mircrohydro plant installation unitl July 2002
Source: AEPC/ CADEC 2002

Most of the turbines are installed solely for agro-processing. Some of the units are also coupled with electric generators.

Mini and micro- hydro technology has enormous potential to promote environmentally sound sustainable development in hilly region of Nepal. So far about 13.6 MW of power has been generated from about 2046 micro-hydro plants including peltric sets. Most of these turbines are installed solely for agro processing. Some of the units are also coupled with electric generators. Micro-hydro ranges from 5-100 kW and is commonly used in Nepal mainly for rural electrification and agro-processing. The trend of rural electrification and other end use applications are being widely promoted these days.

It is environment friendly and clean technology and assist in preserving flora and fauna in the country. Renewable energy technology has enhanced the ecotourism especially in the conservation areas of the country.

5.3 Solar energy

Today there are about 30 manufacturers of solar water heaters and the total installed capacity in the country is estimated at 10,000 sq. meters of solar panels. Solar photovoltaic (PV) is not a new technology to Nepal. It is estimated that about 14 companies have installed more than 25,000 units of PV in 66 of the 75 districts of the country. Solar cookers and dryers were also developed and propagated some time back in the country.
Photovoltic modules give electrical power. PV modules generate electricity directly from sunlight and their operation is pollution-free. Solar generated electricity can supply autonomous power in rural areas. Solar home systems are mostly used for light, children's study and operation of radio and TV in rural areas.

5.4 Wind energy

Wind is still one of the unharnessed energy sources in Nepal. Its countrywide potential has not been assessed yet. Some studies have indicated that wind potential for power generation is favorable in Tansen of Palpa, Lomangthang of Mustang and Khumbu regions of Nepal. However, wind monitoring and mapping data are not available for many places.

Wind energy has also played a significant role in lifting water and agro-processing.

6. Relations of RETs and water supply and sanitation in the community

6.1 Community organisation and mobilisation

Most of the micro-hydro schemes are installed on community basis to undertake the activities of common benefit of the people. Similar case is to that of water supply and sanitation programme.

6.2 Resource mobilisation

The communities are required to show their commitment by sharing the cost for the installation of micro-hydro as that of water supply and sanitation.

6.3 Integration of hygiene and sanitation

Health, hygiene and sanitation education is considered as integral part to sustain health benefit of the individual households and ultimately the communities in water supply and sanitation programme. Toilet attached biogas plants helped in enhancement of personal health and environmental sanitation. Renewable energy has positive impact on personal health of the users as it is considered as clean technology.

6.4 Supports government's goal on poverty alleviation

Through the application of renewable energy technology and health benefit it has aimed to achieve improvements in the living standard of the rural people. In order to support government's goal on poverty alleviation it has focused on: skill development for income generating activities, generating employment opportunities at the community level, and technology transfer at the grassroots level as that of rural water supply and sanitation programme.

6.5 Women empowerment

Application of RETs and water supply and sanitation programme both have enhanced women empowerment by reducing workload, saving time in cooking and cleaning vessels. It has also helped to improve the general health conditions by eliminating indoor air pollution due to smoke containing carbonmonoxide and other particles. It has ultimately raised the social status of the family, improvements in children's education etc.
Promotion of renewable energy technology and water supply and sanitation programme in the country have following issues. Hence, the following strategies and activities are recommended for smooth implementation of the programme.

Issues

- Development and promotion of alternative energy is essential to reduce traditional sources of energy and minimise the use of firewood, and reduce the pressure on limited natural forests.

- Limited introduction of hydropower, solar and wind energy technology in the programme areas and their buffer zones has gained popularity nevertheless it has not reached to the people who are really poor. Hence, adequate research to be done to reach the technology to the people below poverty line.
- Adequate supply of good quality water in the rural as well as urban area and maintenance of these plants has become a problem.
- Installation of drinking water and wastewater treatment plants in the programme areas.

Strategy

- Develop networking linkages with small-scale hydropower, solar energy and ICS companies and private entrepreneurs.
- Categorise the resources available and implement the programme.
- Supply clean drinking water to the people and encourage for the installation of wastewater treatment plants.
- Emphasis on the installation of drinking water and waste water treatment plants in the needy areas.

Activities

- Promote renewable energy technology such as biogas, micro-hydro and solar energy in the potential areas of the country. Similarly, generate power from municipality waste, sewage and industrial waste.
- Promote water supply and sanitation programme in the needy areas of the country.
- Provide training to local people to install, repair and maintain water supply schemes as well as renewable energy technologies.

7. Conclusions

Water is a vitally important substance, with properties that are unique and wide ranging in potential impact. An understanding of its nature and behaviour requires knowledge of certain fundamental facts about its physical and chemical properties, which play major role in determining water quality. Water has diversified applications such as drinking, cleaning, power generation, irrigation and recreation. The sources of water may be rain, spring, surface or ground water. However, in this paper, the focus is mainly on power generation and sanitation programme.

Renewable energy technology is a clean technology, which prevents emissions and waste formation. In Nepal, more than 106,000 biogas plants have been installed so far. It is estimated that one 6 cum biogas plant (most common size) displaces the use of 3 tones of firewood or 38 litres of kerosene annually. It produces 27 tones of digested slurry and reduces 4.2 tones of carbondioxide equivalent per year. This shows a saving of 11.6 trees annually (i.e. 0.055 ha of forest). Burning biogas is much cleaner than burning biomass. More than 2046 micro-hydro schemes including peltric sets (generating 13615 kW power), about 140,000 improved cooking stove (with the efficiency of 18-28%), and 25, 000 solar PV home systems have been installed in the country.

Hence the impacts of renewable energy technology in water supply and sanitation is immense. Dissemination of Renewable Energy Technologies (RETs) such as biogas with toilet attachment helps to improve the sanitation in the area and reduce methane, nitrous oxide and carbon production and saves firewood and ultimately living trees and consequently wild animals. Similarly, micro-hydro, wind and solar energy technology also have direct and indirect positive impacts on lifting water for drinking purpose, irrigation and overall livelihood of the rural people besides rural electrification.

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Rural Water Supply And Sanitation Sector Strategy - An Introduction

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Background

The rural water supply sector in Nepal is very rich in character and has a lot to offer in terms of experiences, innovations and diversity. However, these inherent qualities in the sector lie scattered and not coherently used for better and effective service delivery. With a view to accommodate and consolidate the sector experiences, the Community Based Water Supply and Sanitation PPTA team embarked upon the development of a Rural Water Supply and Sanitation (RWSS) Sector Strategy with a "Design Through Consensus" approach. This effort involved obtaining sector-wide stakeholder participation in a series of intensive, professionally-facilitated workshops addressing an array of issues, culminating in the Sector Strategy, which could be presented to HMG as the most thorough and accurate reflection of a consensus of all stakeholders. This highly participatory approach was somewhat unconventional for a PPTA effort, but was intentionally selected as the most effective means to resolve critical issues facing the water supply and sanitation sector in Nepal.

All issues, discussions and conclusions were drawn out in open through participatory events characterized by small group working sessions, dialogue on small group presentations and open discussions of recommendations being considered. This participatory approach welcomed virtually any stakeholder input, rather than restricting attendees to a select group or holding private meetings between team experts and government staff. Open dialogue was encouraged and crucial inputs from NGOs, donors, and other stakeholders were received. Workshop results were openly and widely shared among stakeholders within days of each event. Sector stakeholders not only included sectoral institutions, both government and non-government, but others as well including representative institutions of local governments, consumers, private sector and others. The entire process was inclusive, transparent and participatory in nature.

Workshops were built around issues identified by and agreed to by stakeholders. This was accomplished in two steps. First, an Issues Assessment was developed at the end of Phase I of the PPTA that grouped issues into eight categories derived from stakeholder interviews, desk reviews of relevant documents and policies, and inputs from key officials. Second, these eight issue areas were presented, discussed and agreed to at the 1st plenary by the stakeholders. Thus, the thematic areas explored in workshops and ultimately incorporated into the (draft) RWSS Sector Strategy genuinely arise from and reflect stakeholder consensus.

The purpose of Rural Water Supply and Sanitation (RWSS) Sector Strategy is to improve facilities and service delivery to RWSS customers in Nepal, as well as to help guide His Majesty's Government of Nepal (HMG/N), donor agencies, I/NGOs and the private sector to prioritize investment decisions according to a commonly agreed approach. The strategies are designed to facilitate the implementation of broad sector policies as outlined in the National Water Supply Sector Policy (1998) and the draft National Sanitation Policy (2002) and to be responsive to the Local Self-Governance Act of 1999 (LSGA).

The Principal Objectives of this Draft RWSS Sector Strategy Area to:

- Increase rural WSS coverage,
- Maximize positive health impacts
- Decentralize planning and implementation of WSS services
- Integrate critical factors such as poverty, gender, caste and ethnic participation, etc. for equity and sustainability;
- Improve WSS service provision by developing a more effective institutional framework

- Attain financial viability of Water User and Sanitation Committees (WUSC)
- Recognize water as a finite resource with an economic value

A number of key principles have been identified to help insure sustainability of sector interventions, and equitably provide improved services to targeted groups such as the poor and the disadvantaged. These principles or premises focus on decentralized and effective service delivery taking full advantage of available resources including human resources/skills to maximize health benefits. Demand driven approach shall not only ensure the empowerment of the community to make informed decisions, but also to carry out their responsibilities effectively. Based on these key principles, strategies have been developed with consensus focusing on eight major themes, namely:

- Development of an institutional framework for effective service delivery
- Site selection and coverage criteria
- Appropriate and affordable technology options and issues
- Gender, caste and disadvantaged ethnic group participation
- Health, hygiene and sanitation
- Financial sustainability and affordability
- Legal issues
- Environmental aspects

Institutional Framework

The institutional framework for policy formulation, planning, budgeting, implementing, operating, maintaining and monitoring WSS services in rural Nepal is a complex array of activities currently characterized by multiple and often overlapping responsibilities. The most contentious and complex issues were concentrated around issues concerning the institutional framework in which rural water supply and sanitation services would be delivered: who should do what at each level of activity? The strategies illustrated under this theme are in part intended to clarify and rationalize the process.

Policy Formulation

The sector stakeholders after much deliberations agreed that the Ministry of Physical Planning and Works (MPPW) will play the lead role in RWSS policy development and formulation, in close consultation with other sector stakeholders for key elements like service levels and coverage, technology, water quality standards, research and development, public-private partnerships, human resources development, monitoring and evaluation. The strategy further advocates that MPPW will also be charged with maintaining intra- and inter-sectoral coordination and collaboration and will enable an effective system of monitoring and evaluation, and encourage social and technical auditing of RWSS systems through participation of I/NGOs, CBOs and civil society in general.

Planning and Budgeting

Similarly, with reference to planning responsibilities, the National Planning Commission (NPC) will have overall responsibility for developing long-term RWSS sector objectives, goals and targets and linking these to budget allocations incollaboration with the Ministry of Finance. MPPW will have the responsibility for developing sectoral plans and implementation and monitoring modalities, which shall largely be derived from inputs provided by District Development Plans (DDP).

The DDCs will be the prime agency responsible for local planning, prioritizing monitoring and defining coverage and technology priorities for their areas through the preparation of a "District Water Supply and Sanitation Profile" on an ongoing basis leading to the DDP. Priorities established and incorporated into DDPs will be adhered to by government agencies and other non-government organizations.

Implementation Arrangements

It has been elaborated in the Strategy that RWSS implementation roles and responsibilities will rapidly evolve toward a fully decentralized system as expressed in the LSGA (1999) and related government policy documents. The DDCs will continue to be

responsible for *coordinating* the implementation of RWSS in their respective DDCs, primarily by means of periodic planning and provision of technical assistance once they establish RWSS sector units. Similarly, the VDCs will in turn assume responsibility for *facilitating* implementation of RWSS schemes through the WUSCs, which shall have the prime role in implementation.

The Strategy states that sectoral line agencies will prepare and implement a plan to phase out of direct implementation and will shift to that of facilitator of RWSS services, as envisaged in the Water Policy of 1998. The Government shall rationalize RWSS service provision to eliminate economic inefficiencies and poor manpower utilization.

Operations and Maintenance (O&M)

The need to strengthen WUSC O&M capacity and capability for greater sustainability has been highlighted in the sector strategy. With a view to institutionalize the WUSCs, all the WUSCs are required to be registered under the Water Resource Regulations (1992) with the District Water Resources Committee (DWRC).

An O&M Fund with upfront contributions will be established at different levels and linkages can be established with income generating programs. Other supporting actions like training of technical assistants at the VDCs in O&M, effective VMW selection and training will also be taken up. Performance monitoring and evaluation of WUSCs and special post-project support to WUSCs will be delivered by DDC/VDC in coordination with implementing and supporting agencies (I/NGOs, etc.).

Monitoring and Evaluation

This strategy addresses the need to establish regular monitoring and evaluation (M&E) procedures so that planners and managers have a better understanding of the progress and success (or failure) of project efforts. In its new role as a facilitator of RWSS services, DWSS will take the lead in organizing and managing a countrywide RWSS M&E system. RWSS monitoring and impact evaluation indicators will include physical infrastructure coverage and functional status, Poverty reduction, Sanitation and hygiene behavior change, Environmental and social impacts, equity access to services, Economic and financial impact, and Institutional and policy impacts.

Site selection and Coverage

This strategy addresses the need to increase sectoral coverage in an efficient and equitable manner. Enhancing sector coverage involves both provision of new services and repair and rehabilitation of existing schemes. MPPW and MLD shall review and will then develop an agreed upon clear, transparent, and easily applicable set of project prioritization/selection criteria to ensure equitable access by all users, prioritizing poor communities that are either unserved, or are in need of major rehabilitation.

The demand-driven, poverty-focused project prioritization/selection criteria will incorporate, at minimum, consideration of hardship, poverty, willingness-to-pay, existing WSS coverage and condition, prevalence of water borne / related diseases, and environmental concerns.

MPPW will develop policy; action plan and performance indicators for addressing RWSS rehabilitation needs and specifically allocate budgetary resources for rehabilitation and/or major repair of existing water systems. Poor communities will be specifically targeted to raise their awareness to generate demand for improved WSS services.

Appropriate and affordable Technology options and Issues

This strategy focuses on technology issues in the delivery of RWSS services to empower communities to make informed decisions. In this regards, DWSS will take the lead to develop a consumer-oriented catalog with a wide range of RWSS technical options. This catalog will allow different socioeconomic groups to make informed choices about RWSS facilities and services based on their needs, affordability and willingness to pay. The choice of the appropriate technical options shall include consideration of customer demand, physical constraints, construction and O&M costs, users capacity and capability for O&M.
The strategy envisages that MPPW will take the lead in formulating and obtaining approval

for drinking water guidelines and drinking water quality standards. MPPW / DWSS will develop a program for Water Quality Surveillance and improvement programs including arsenic.

Gender, Caste and disadvantaged Ethnic group Participation

The strategy addresses the critical issue of ensuring that all men, women and children from all castes, dalits and other ethnic and economic groups have equal access to improved RWSS facilities and services, its planning and implementation process. In this regard MPPW will review existing policies and incorporate relevant changes to reflect gender, caste and ethnic concerns and also formulate rules for the formation of wuscs to ensure their proportional representation. HMG agencies responsible for sector development, in consultation with their multilateral, bilateral, NGO and private sector development partners, will review alternative O&M tariff options that are affordable to poor men and women.

Health, Hygiene and Sanitation

Existing experiences clearly show that providing safe water alone does not contribute significantly to reducing diarrheal disease in Nepal. Providing and using sanitation facilities and promoting hygienic behaviors have been shown to be critical additional factors in reducing these diseases. The Basic Sanitation Package jointly developed by DWSS and UNICEF or the Fund Board (RWSSFDB) promoted SRLF (Sanitation Revolving Loan Fund) could serve as the standard field implementation guideline for sanitation improvement and behavior change activities. In accordance with the same, health impact evaluation of RWSS programs will analyze improvements in knowledge, facilities, and practices rather than disease-specific morbidity and mortality. Water supply improvement will be integrated with the activities of Basic Sanitation Package in accordance with the Hygiene Improvement Framework (HIF).

Financial Aspects

The key cross-cutting issues are the mobilization of financial resources, including local resources and the establishment of appropriate cost recovery mechanisms. The mobilization of financial resources will reflect modalities of funds flow that ensure a minimum level of administrative effort and cost.

Community contribution has been successfully mobilized by a number of sectoral programs and projects. In fact the Fund Board Schemes have been able to generate nearly 40 percent in community contributions. However, this extent of community contribution may not be feasible in places or conditions. Therefore, as agreed between sectoral stakeholders it will be a minimum of 20 percent for water supply hardware for non-local materials and labor and kind, and at least 1 percent has to be in cash. Equity consideration to disadvantaged groups/ propoor shall be incorporated. Some direct subsidy for latrine construction shall be considered for poorer households, defined by food sufficiency, female headed, wages levels or disabled indicators. Local governments will contribute a portion of their routine operating funds to co-finance such subsidies. However, regular O&M costs will be fully borne by the community or individual households.

Legal Aspects

The Water Resources Act of 1992 provides an overall framework for the sustainable development and management of water resources including water supply. The Local Self-Governance Act of 1999 provides local bodies with the legal framework for the development and management of water resources and other development responsibilities, including management of devolved sectoral responsibilities and resource mobilization. However, the issues of groundwater extraction and pollution, and water rights allocation disputes need to be addressed. The strategy envisages that MPPW and MWR will jointly develop and enforce a legal framework for such issues.

Environmental Aspects

This strategy addresses incorporating environmental issues in the planning and implementation processes to maximize benefits and mitigate damages through proper safeguard measures. In this regard all environmental concerns must be

independently reviewed and approved by the concerned Ministry (MPPW) and all the stakeholders will have the opportunity to comment, participate and contribute to the environmental appraisal through an open process of consultation.

Way Forward

The Government's 10th Plan has set major targets for the water and sanitation sector to be achieved by the year 2007 and even beyond. The sectoral investments required for such targets is quite extensive and considering the available financial resources there is bound to be a resource gap in the sector. This shall involve either increasing available financial resources or prioritizing investment in the sector to best meet the sectoral objectives set in the national plans. Since immediate enhancement of available financial resources for the sector is fairly difficult considering other competing development sectors, it is natural for sectoral planners and stakeholders to think in terms of optimizing available resources through prioritized investment.

The development of the rural water supply and sanitation strategy with the consensus of a majority of sectoral stakeholders in this regard should prove instrumental in development of sector and effective service delivery. In accordance with the consensus reached in the Sector Strategy discussions, the implementation modality for the sector can be based on the following fundamental principles:

(i) Decentralization of decision making to the lowest practical level;
(ii) Full involvement of communities in subproject planning and implementation;
(iii) Involvement of the private and non-government sector in support activities,
(iv) Developing the facilitation, not implementation, roles of HMG sectoral line agencies;
(v) Utilization of the highly specialized skills and experience of technical staff with either HMG sectoral agencies or the non-government sector at the District level, where those skills are most needed.

Management Of Water Resources Urbanization And Community Approach For Urban And Rural Water Supply And Sanitation Project

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1. General

The total urban and rural population having reasonable access to water supply and sanitation by 1999/2000 has been estimated to be 66.16 % (2.29 million) and 67.47 % (13.36 million) respectively. The supply in most of the cases is intermittent and in-equitable. Although the targets of Ninth Five Year Development Plan (1997 – 2002) have envisaged to cover the whole population of the country by water supply and 40% of the population by sanitation facilities, the targets have turned out to be not covered.

In most of the cases the rivers and streams of urbanized area are extremely polluted due to discharge of raw (untreated),domestic sewage, solid wastes, and other chemical and hospital wastes. The raw sewage being discharged are likely to percolate through the soil resulting in the groundwater pollution. The regular supply of adequate water for domestic and other purposes will greatly enhance the quality of life of the residents in many ways like (i) minimizing the risks of several water and waste related diseases (ii) relief from tension of water shortage and irregularity (iii) waste of time and labour for fetching water and its healthy storage and (iv) maintaining environmental sanitation.

2. Management of Water Resources:

Management of water resources particularly Water Supply and Sanitation Systems could be considered in two different processes – Urban Centres and Rural Areas.

2.1 Urban Centre Water Supply Systems (UCWSS)

Currently there is no government approved specific procedures for the implementation of UCWSS. There are 4 types of organizational setups managing UCWSS which include as follows:

(i) Management of a group of municipalities by a corporate organization like existing NWSC,
(ii) Similar management by DWSS,
(iii) Management by Local User Group,
(iv) Individual Municipal Management.

HMGN has been working to allow privatization process by appointing a Private Operator (PO) through a Management Contract (MC) on the competitive bidding basis for the next 10 Years. The overall performance of PO will then be assessed for the next move. Also an autonomous organization "Kathmandu Valley Water Supply and Waste water Authority"(KVWWA) and "National Regulatory Body (NRB)" would be established under separate legal frameworks for fixation of tariff, control of pollution, monitoring of quality standards, licensing of groundwater, penalizing the defaulters and general monitoring and surveillance, etc. Undertaking Consumer Education and Community programme to maintain a good rapport and communication between water utilities and consumers and development of a long-term UCWS covering all the urban centers are desirable.

UCWSS require establishment of self-sustaining, autonomous and competent water utilities for adequate management. The system of institutional structures should be decentralized with consumers being more accountable and involved with all the processes of initiation, survey and investigation, implementation, management and Operation and Maintenance (O&M).

The price of the water under supply should be rendered affordable by all categories of consumers including poor people. The large domestic users and commercial and institutional consumers should pay economic cost of water with the tariff rationalization. At the same time the water utility operator should attempt to achieve the following cost reduction processes:

- Progressive reduction of unaccounted-for-water (leakage and wastage),
- Increase in the number of consumers,
- More efficient collection of tariff,

Recently HMGN has approved Sector Policies and Strategies : (i) National Water Supply Sector Policy, 1998 (NWSSP) (ii) Nepal National Sanitation Policy and Guidelines for Planning and Implementation of Sanitation Programmes, (NNSPG) 1994 (Revised, 2001). The objectives of these policies and strategies are clearly stated in NWSSP and NNSPG.

2.2 Main Issues and Remedial Actions for UCWSS

Some of the main issues and actions to be discussed and concluded are the following:

a. Proper planning, design and construction of the projects by establishing planning horizon of the next 20 / 30 years for the growth of the population and water demand through trading off of water for other uses with the development of necessary institutional and skilled manpower capability to discourage traditional bureaucratic process of the project and general information should be maintained among the consumers in order to ensure their participation.

b. Preparation of a "Manual" incorporating all essential elements required for standardization of UCWSS systems .

c. The poor people should not be deprived of supply of appropriate quality water in adequate quantity in compliance with WHO Standard. The extent of poverty in the urban areas, the methodology of existing supply systems, and its quantity and quality, current cooperation and participation with the management of supply, need to be assessed. Although it is difficult to define and quantify the poverty, the people living in the squatter settlements and slums (Sukumbasi), low income groups and the people de pending upon the public standposts could be treated as poor. Another method could be applied for a shared tap in the name of ward. Water vending through Tankers are not commonly used by the poor people.

   So far as sanitation services are concerned the programme for on-site sanitation systems, septic tanks, water carried sewerage systems, surface water drainage, in different phases and the public toilets (Municipal Pay and Use toilets) could be introduced. Usually the current charges are Re. 1.0 and Rs 2.00 for urination and defecation.

d. Development and enforcement of appropriate tariff structure with objectives of water for all within affordable capacity of larger sections.

e. A regular monitoring and evaluation process of the project should be set up to control leakage, wastage and illegal connection.

3. Rural Water Supply and Sanitation System (RWSSS)and Community Approach

The management of RWSSS should pay due attention to the following approaches in a holistic and sustained manner, along with the protection of environment.

(a) Changing the traditional role of the government as a supplier or provider or implementer to that of a supporter or facilitator through the mobilization of locally available skill, initiatives and resources of users and beneficiaries by making them more responsible and accountable as prescribed in NWSSP,

(b) Well organized and focused training of the WUC members and stakeholders to enable

them to handle the new responsibilities in all phases of RWSSS (operation, maintenance and management).

(c) Instituting an effective programme for training and reorientation of personnel in DWSS, NWSC and other RWSSS related agencies involved with the community based programmes / approach.

(d) Integrated implementation of water supply and sanitation programme,

(e) to the concept of decentralized operational modalities,

(f) Framing of the effective legal provisions for raising tariff to cover O&M cost and other necessary works,

(g) Undertaking Rand D for developing appropriate technology with networking with other national and international organizations.

3.1 Project Implementation Cycle

The project implementation cycle for RWSSS should include the following actions:

1. Master Planning and Preparation of Perspective Plans,
2. Identification of Projects,
3. Interaction programme with Water Users Committee (WUC) and other beneficiaries by holding mass meeting, focus group discussion and household surveys,
4. Technical, economical, social, institutional and environmental feasibility study, and their impact assessment,
5. Detail Engineering Survey, Design and Estimate,
6. Construction,
7. Handing over of the project to WUC or any other local organization.
8. Beneficiary monitoring and evaluation.

Poverty And Sustainable Rural Water Action - Reflections From The Lumbini

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Poverty, water and environmental sanitation

Water is a basic need and human right. Internationally it is well established that improving the water security and sanitation of poor people will help to eradicate poverty and support sustainable development both in terms of health and in terms of direct and material ways. Investments in water and sanitation are central to poverty reduction. Presently it is claimed that the poorest groups are sometimes left out from the water supply and environmental sanitation (WES) schemes due to their lower capacity to contribute in cash or in kind, and their lower levels of education and awareness. The poor are also likely to have lower political status and confidence to make their voices heard.

Millennium Development Goal aims on halving the number of people without access to drinking water and improved sanitation by 2015, recognising the cross-cutting role that water and sanitation sector has to play in overall poverty alleviation. The 3rd World Water Forum in March 2003 and the World Water Council stated three main steps necessary to propel the global community towards meeting its commitments to poor people (The 3rd World Water Forum Statement 2003):

- Building on people's energy and creativity at all levels, requiring empowerment and building the capacity of people in households and communities to take action, and applying technologies that respond to actual needs.
- Holistic approach, acknowledging hygiene, water and sanitation as a human right, and relating it to human development, the elimination of poverty, environmental sustainability and the integrated management of water resources.
- Committed and compassionate leadership and good governance, changing long-accustomed roles, leading to new responsibilities of authorities and institutions to support households and communities in the management of their hygiene, water and sanitation, and in being accountable to users as clients.

Objectives and Methodology

Rural Water Supply and Sanitation Support Programme (RWSSSP) in its Phase III is aiming at improving its post-construction activities by learning from the experience of its community partners from Phases I and II. At the same time the consultations provided an avenue to explore how the poverty focus could be sharpened in the Programme. This paper adds to the on-going discussion about poverty and WES by giving an overview on the opinions and recommendations of the Water and Sanitation Users Committee (UC) representatives and other community members. The findings were gathered during the 13 post-construction experience sharing workshops that were held between December 2002 and March 2003 in Palpa, Gulmi, Arghakhanchi, Kapilvastu, Rupandehi and Nawalparasi Districts.

The participants represented the water supply and sanitation schemes constructed during the Phases I and II of the Rural Water Supply and Sanitation Programme (RWSSP) between the years 1990 and 1999. The participation in the workshops especially in the Hill areas was very high, more than 95% of the schemes and UC were represented together with some Village Maintenance Workers (VMW) and key persons from the VDC and DDC levels. In some of the six Districts also the Local Development Officers, ex-DDC Chairman, DDC Planning Officers, and other DDC staff were actively participating in the plenary sessions.

Raising the poverty issue in the post-construction experience sharing workshops raised eyebrows. At first the workshop participants did not see why they should be concerned with the poor, especially in the context of WES. Many participants themselves were poor according to global criteria, yet, within their communities, they probably represented the more wealthy households and relatively higher educational levels. Towards the end of the small group discussions the attitudes started to change and the groups were suggesting various ways of getting the poor involved and covered with the WES facilities. In the small group discussions the sensitive poverty issue was approached through WES as the workshop topics covered a wide range of issues ranging from the technical status of the WES facilities to UC management and training topics. Most of the opinions and figures presented in this paper reflect the views of the participants and facilitators, and are by no means the final statements. They represent the points of view of the people living in these sometimes very remote VDCs, often poor people themselves, and are meant to be discussion starters.

What is Poverty?

Poverty has to be seen in its wider societal and cultural context. Poverty is interlinked to such key concepts as gender and ethnic equity, participation and long-term sustainability. Traditionally poverty has been measured in monetary terms, yet, it is a complex issue that has many other faces. Poverty is associated not only with insufficient income or consumption, but also to ill health, malnutrition and low education levels including literacy, to deficient social relations, to insecurity, and to low self-confidence and powerlessness. Non-monetary and qualitative indicators of well-being are needed to draw a real picture of poverty. As poverty can be a very sensitive local issue, both the definition of the poverty and the reasons behind it change from village to village, and from time to time, and depending on "who is asking about it".

What is poverty, what makes a household poor, and who are the poor? Who are the poor that should receive a special attention or special subsidy within a WES scheme area? What are the indicators that planning could be based upon? Who will name a household a poor household qualifying for special support? What really are the priority problems to be taken into account should a WES programme truly try to tackle poverty? Finding reliable and cost-effective indicators for poverty is a great challenge should a WES programme integrate poverty focus efficiently into its programme approach. Communities should be the best to define what poverty means locally, and to identify the poorest groups within a community. Participatory poverty monitoring should be carefully explored and piloted before mainstreaming the practice. In this case the context is rural and poverty is seen from the communities' point of view.

The participants were first asked to define poverty. Definitions of poverty in rural context included: landless (*Sukumbasi*) or refugee; labourers; those who cannot provide education to their children; those who cannot wear proper clothes; those who cannot survive more than about two months with the food grain produced from their own land and have to be labourers for the rest of the year; and those who cannot eat sufficiently proper food around the year. One group also recognised the size of the land, stating that 10 *kathaa* as a poverty level. Those who have less than 10 *kathaa* can be considered poor in a rural context. These are also typically female-headed households as the males have to move after the work to other areas.

It was concluded that nationally applicable and feasible criteria should be established for rural areas. Such criteria as food sufficiency and food security, land size, income level, living standard and education level were suggested. Following the given criteria or guidelines, the community itself could identify the poverty level of the households with the assistance from the VDC, stating those in special need.

Understanding Poverty

The participants noted that poverty also means illiteracy, low education and awareness levels which leads to the situation where it is difficult to get the poorest groups involved in the schemes. One participant noted that *"the poor are not aware of anything due to illiteracy. They do not give importance on drinking water and sanitation."* The practical implication for a WES programme is that emphasis early enough in a scheme should be first on public awareness and training activities.

Some participants suggested that awareness programmes should especially target the poorer households. It was instantly challenged and claimed that *all* should be involved in any health and hygiene education, and other public awareness programmes, not only the poor. This very

practical suggestion has deeper meanings indicating that a pro-poor programme should work with a community as a whole. A pro-poor programme cannot divide a community and discriminate households whether rich or poor. Bringing both rich and poor together within a cluster or ward is essentially bringing together neighbours that can work out best solutions within themselves. Finding options for local poverty mitigation together could be a corner stone for building poverty-focused WES programmes.

The other problems encountered due to poverty *while* planning and implementing schemes, other than involvement of all groups, included both cash and in kind contributions. It was agreed that existing modalities are not in favour of the poor as not all can contribute the same although many programmes expect the same input from each. High contribution discouraged poor households from joining schemes. If some households could not contribute in cash the burden had to be taken by the other households to have a scheme. If the scheme area is in average poor, the increased burden on the less poor can be heavy. Labour contribution was a problem for the poorest of the poor who often have to take paid labour, whether in the community or outside, to make the ends meet. Furthermore, labour contribution is also a physical burden to poor who may already suffer from malnutrition or have health problems. The poorest of the poor, especially the labourers, should be paid for unskilled labour. Very high labour contributions were reported, reaching up to several months in a year from per household. The effect for the implementation of the schemes was the delay.

The participants reported that communities themselves, including UC, have made an attempt to help the poorest. For instance, the contribution expected from the poorest households was subsidised within the community, and in kind was accepted instead of the cash contribution. Some UC have constructed latrines for the poor up to the plinth level, leaving only the superstructure to be constructed by the household. It was recommended that the cash and kind contribution in general should be decreased, since 70-90% households are under poverty line. Furthermore, for the latrine construction 100% subsidy *in kind* for permanent type of latrine construction *up to plinth level* should be provided for the poorest households. Temporary latrines are not long lasting and less acceptable. Willingness to pay (in kind or cash) appears high but not necessarily because of paying capacity but due to hardship: especially water supply is a high priority for Hill communities.

One aspect of the contribution problem is the chosen technology. The schemes are typically providing only one kind of technology, such as gravity flow system. Low-cost options, such as improved and protected traditional sources, should be made available along the more expensive options.

Use of revolving fund for sanitation was suggested, although it was also recognised that there are risks involved if the use of fund is not properly monitored. Both in terms of paying back the loan and in terms of using the loan for the right purpose. Some UC have also been providing loans to the poor people without interest, and the UC should be encourage to mobilise the O&M Fund instead of keeping intact in a bank account for years after years. Presently RWSSSP is piloting a UC managed, WES focused, micro-credit scheme.

Poverty continues to be a problem *after* implementation of the scheme. Such as fund raising for the Operation and Maintenance (O&M) Fund to pay the Village Maintenance Worker (VMW) or for the materials can be become a problem. However, there were examples of notable sums of money raised for the replacement of main pipelines that were damaged by the landslides or lime encrustation, the two most common technical problems reported for the gravity systems.

It was notable that certain ethnic groups were strongly committed to pay for the VMW. The poorest communities clearly did not expect to get anything free of cost, not even the services of the VMW. These contributions included in kind payments to VMW in rice or grain, or in terms of agricultural man days in exchange of VMW work (one or two days per household for the VMWs land). VMWs' work was also considered as a community work, and no further work was expected. However, there were also some very poor practices, and in the worst case a VMW had been provided a loan by the UC and consequently forced to work as bonded labour for the interest.

VDC Approach and ward-wise Poverty Status

RWSSSP is presently developing a working modality which would address all

households within a scheme area regardless of economic, ethnic or other status. The approach has a working title "*VDC Approach*" meaning that within a VDC a cluster wise approach in implementation should be adopted. The cluster wise implementation will ensure total service coverage in a limited scheme area, including all people and hence also the poorest of the poor, leaving nobody out due to technical reasons or due to the lack of money or other resources. From the technical point of view, it means offering various technological options within one scheme.

Total coverage approach in a scheme would also function as a conflict mitigator in one area between those who have and those who have-not. Total coverage also gives an opportunity to share public money, i.e. subsidies, in a fairer manner. In latrine and rainwater harvesting construction the monitoring and supervision of the construction of the numerous structures will be more efficient. Also the training and public awareness campaigns could cover all involved within a defined working area, thus encouraging also those typically not involved to get involved. The VDC Approach offers an opportunity to integrate and mainstream the poverty focus into the Programme approach as all households within a ward or cluster would receive attention.

The VDC Approach was discussed in the workshops in the context of service coverage and poverty. As explained earlier, it is generally claimed that the poorest groups tend to be left out from the schemes. First the participants were asked to estimate the coverage of WES facilities in each ward. The figures 1 and 2 represent the estimates given by the participants from Gulmi District. The estimates are fairly reliable for those VDCs that had several UC present in the workshop. For instance Khadgagot VDC had nine schemes presented and thus, persons from most of the wards.

Having first discussed in depth about what is poverty, participants were then asked to identify where in their own VDC are the poorest of the poor, and which ward could be identified as the most poor ward. The following figures summarise these two results, the shaded ward representing the one chosen as the poorest ward of all. The %-figure given after the name of the VDC indicates how many households with that poorest ward are poor, as defined and estimated by the participants. The Gulmi case does *not* indicate that the poorest wards would be the left out wards from the water supply services. However, in the case of sanitation the difference can be recognised. The poorest wards are rarely amongst the highest sanitation coverage wards.

Poverty Alleviation in Action

What does a poverty focus mean in practice? What can a WES Programme do to alleviate poverty and to ensure that also the poorest of the poor will benefit? How the poor should be

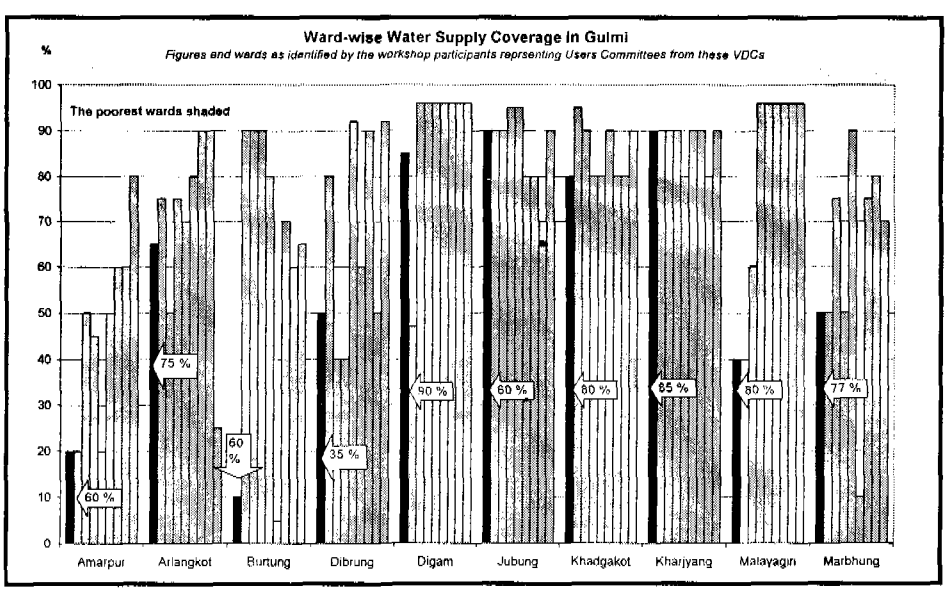

Figure 1. Ward-wise water supply coverage with the poorest ward highlighted in Gulmi District. The %-figure in the arrow gives an estimate of the share of the poor households in the poorest ward.

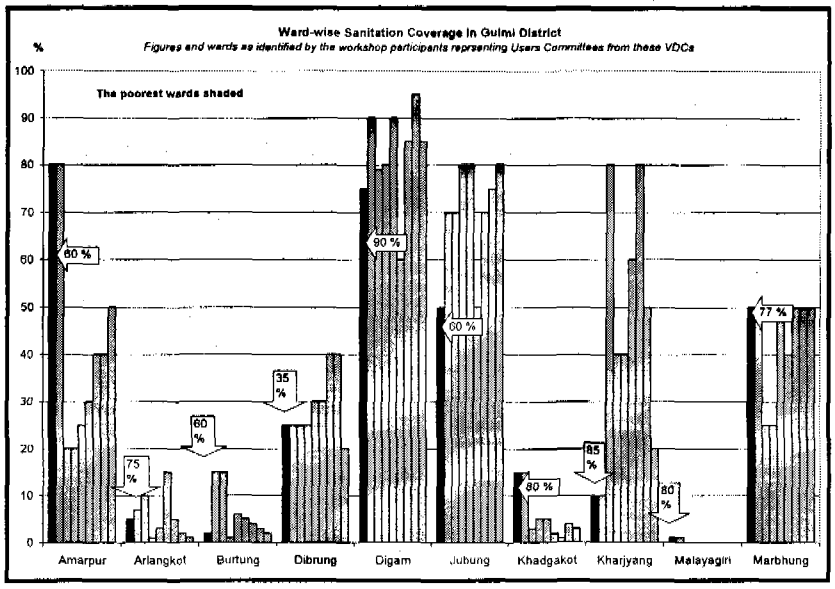

Figure 2. Ward-wise sanitation coverage with the poorest ward highlighted in Gulmi District. The %-figure in the arrow gives an estimate of the share of the poor households in the poorest ward.

supported? The participants gave a wide range of practical recommendations, but first of all, the concept of poverty should be agreed. Secondly, it should be recognised at the policy level that the rich and the poor need different kind of approach and support. This involves rethinking contributions and subsidies, as well as training components and contents of public awareness programmes. Continuity and follow up over a longer period of time is needed to ensure sustainability.

The following were recommended during the workshops concerning the VDC Approach and poverty focus:

- The steps towards high or even total coverage should be started from the less covered VDCs. This was also challenged as it was noted that it is likely to be the poorest groups of the community who have not benefited from the services in those VDCs that are otherwise well covered;
- Technology options to be decided case by case, and should be varied, such as RWH to patch up gravity scheme areas. Case-by-case micro schemes utilising small low-cost options such as improvement and protection of the traditional water sources *Kuwa* and *Dhara*. Existing UC should identify the areas and clusters that could benefit from micro-schemes, and recommend action through VDC to be forwarded to DDC if the action cannot be taken entirely within the VDC.
- One UC should extend the services and facilities within their cluster or ward, no separate UC should be established for small clusters or schemes.This suggestion has its implications for training and other human resource development activities. Existing UC would have a key role to play in monitoring and supervision of the smaller works (see above).
- Solving source disputes in the case of gravity schemes, especially for inter-district or inter-VDC cases, would ensure the sustainability of the service. The cases should aim to win-win solutions so that all parties involved in the dispute will get water. Parties should be encouraged to solve these disputes amongst themselves, and the UC and VDC should take initiative and act as mediators. The Programme should support the solutions by providing technical assistance rather than getting involved in the dispute.
- Upgrading and rehabilitation of the most affected gravity schemes together "the rehabilitation and up-grading" of the UC as an institution.The most reported technical problems related to gravity schemes were lime encrustation and landslides. These were often beyond the local capacity to repair in a sustainable manner. As the communities have grown over the year, the system could be upgraded and extended to cover both the new and previously left out clusters where technically feasible.
- Pay special attention to the landless backward families and illegal settlement. The

problem is a legal one as WES facilities should *not* be constructed into a government land for illegal settlements that can be moved at any time. Later the families have been provided small land lots in other areas and slowly these illegal settlements are getting also legally established. Today it should be easier to identify the new settlements to include them into the plans. The participants in Tarai districts suggested that the Programme should also approach the illegal settlements to truly provide for the poorest as well.

Conclusions and Recommendations

Particularly in rural areas increased levels of activities with poverty focus are needed to improve WES also for the poorest of the poor. To be able to provide special attention and support for the poorest, poverty should be defined and clear guidelines be provided for the participatory poverty monitoring and preparation of a community poverty profile by the community itself. Poor families should not be expected to provide cash and provision of free labour should also be realistically thought. Sometimes the poorest of the poor cannot afford free labour. The rich should support the poor within a community, each contributing according to the status. However, it was recognised that minimum cash contribution even by the poor is essential to raise the sense of ownership and to boost up participation. Participatory approaches have improved the sense of ownership.

VDC Approach aiming at full WES coverage was received very well. UC should be empowered to take the key role to play in aiming at full WES coverage considering that technically this may mean several micro-schemes in upgrading and extending existing facilities, and protecting and improving alternative and traditional water sources, and in constructing latrines with local materials. UC and VDC should be also sensitised to pay attention to gender and ethnic/caste balance, or rich/poor equity in selecting the schemes.

Livelihood approach would further integrate WES with the use of water for food production, to reduce water-related hazards, and to protect ecosystems on which the poor often rely for their livelihoods. Deforestation and related floods and landslides are an important aspect for sustainable water resources management. Linking skills development and mobilisation of the O&M Funds into income generation activities should be encouraged where feasible as capacity building and human resource development related to these activities can be above the resources of a usual WES programme. Inter-agency and inter-office partnerships and coordination are a must.

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पानीको धारा वरिपरि
सधैं सफा गरौं
खेर जाने पानी
करेसाबारीमा लगाऔं ।

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Water Resources Enabling To Rural Poverty Reduction

Rajendra Prasad Shah

Introduction

Water is finite, vulnerable and essential resource, which should be managed, in economic return value. There should be sound economic development come out poverty reduction that safeguards base for future generations in sustainable development. Renewable Freshwater Availability was 7,885 m^3/per capita in 1995 and going to diminish 4,439 m^3/per capita in 2025 in Nepal (Tom Gardner-Outlaw and Robert Engelman, 1997).

There are opportunity to use and management of water resources in economic return to reduce rural poverty, which is demand oriented measures to develop micro hydropower along with fisheries to fight against food security, intensive farming for cash crop strawberry, fruits and vegetable in mountainous region.

Water Saving 50% For Management Practices Of Rice Cultivation

Rice is one of the oldest domesticated crops, with farmers having grown it under irrigated conditions for more than 4,000 years. It is the world's single most important food crop, being the primary food source for more than a third of the world's population, and grown on 11% of the world's cultivated area (Khush 1993).

A system of rice cultivation developed in Mahadevpatti, Saptari in the July 2002 where Latitude 26°36' and Longitude 86°54'. It has been showing that yields can be doubled or more just by changing certain common practices for managing the interactions among rice plants, soil, water, and nutrients. By transplanting rice seedlings early, carefully, singly and widely spaced, with soil kept well aerated, i.e., moist but not saturated, during their vegetative growth phase. The yield result increased from evident *synergy* between the greater growth of rice plant roots and more growth of tillers (stalks) in response to these practices, with consequent synergistic increases in grain filling.

These gains in production require more labor and skill, but not more capital. They are not the result of using new varieties or chemical fertilizer. Moreover, water requirements are reduced about 50% because fields are not kept flooded during the vegetative growth period. All rice varieties used thus far -- both traditional and improved -- have responded positively to practices, although some respond better than others.

Component Practices

Historically, farmer practices for growing irrigated rice in the past have been selected not just to produce the highest yields but also to minimize the risk of crop failure and to reduce labor. Unfortunately, the cultivation practices most commonly used around the world for millennia have the effect of lowering yield, according to the understanding of rice production we have gained from management practice of rice cultivation.

- Management practices of rice cultivation are transplanted when they are very young - less than 15 days old.
- Management practices of rice cultivation, single seedlings are transplanted, and in a square pattern rather than in rows. Transplanting is done very carefully, with seedlings transferred from the nursery into the field within 15-30 minutes as far as early. Intensivecare is taken during transplanting so that seedling root tips are not inverted by being thrust down vertically into the soil; instead, roots are slipped horizontally into the moist soil (not flooded) with tips laid in so that they can easily resume their downward growth.

- Instead of planting seedlings densely, they are ***widely spaced*** in a square pattern, rather than in rows, which increases spacing and facilitates weeding. They are planted at least 25cm x 25cm apart and up to 50cm x 50cm. With wider spacing, rhizome (roots) have more room to grow, and plant shoots have more opportunity to intercept light.
- Management practices of rice cultivation is having ***well-aerated soil*** during plant growth.

Management practices of rice cultivation, however, rice fields are never flooded during the plants' vegetative growth phase. Enough water is applied to keep the soil moist but never saturated while the plants are growing. The soil is even dried out periodically to enhance its aeration. After panicle initiation and during the plants' reproductive phase, a thin layer of water (1-3 cm) is maintained on fields. About half as much water is used as in usual practice.

Structure in plant component

Tillering With management practice of rice cultivation, the number of tillers per plant goes up dramatically, from 5 to10 tillers to 30 to 60, depending on water management as well as on soil fertility, temperature and other factors. Some of this change in tillering is to be expected with the wider spacing between plants. But the other practices also contribute to this result.

With wider spacing, there are fewer plants per unit area, so only with greatly increased tillering per plant will there be more total tillers producing grain. It is shown to maximize the number of *fertile* tillers/m^2 while getting maximum grain filling.

Table 1:
Water Saving In Comparison To Traditional and Management Practices Of Rice Cultivation

Sr. No.	Methods	Plots	Areaha	Soil Type	Seed kg	NPK kg	Water Use %	Yield ton	Yieldton /ha	Yield Increased %
1	Traditional	a	2.12	Sandy Loam	150	300	100	5.83	2.75	
2	Traditional	b	1.41	Clay Loam	100	200	100	5.13	3.64	
3	MPRC	c	1.60	Sandy Loam	30	226	50	9.17	5.73	53.21
4	MPRC	d	0.56	Clay Loam	10	80	50	3.76	6.72	46.67

Sources: Field Research of Intensive Rice Cultivation

MPRC-Management Practices of Rice Cultivation; NPK-Chemical fertilizer

Economic Strategy For Rice Cultivation

Table 2:
Economic Analysis of Rice Cultivation

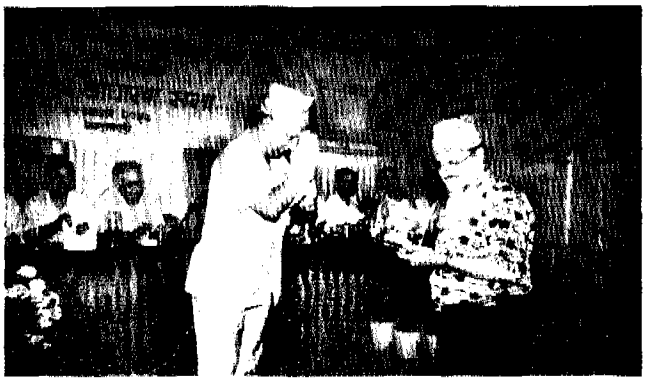
Rank	Categories	Cost of Investment (Rs)		Cost Recovery (Rs)		Net Profit (Rs/ha)		% of Economic Rise	
		Traditional	MPRC	Traditional	MPRC	Traditional	MPRC	Traditional	MPRC
1	Cultivation	3816	3816						
2	Labor	19080	25440						
3	Seed	3180	636						
4	Accessories	1500	1000						
5	NPK	3000	2260						
6	Paddy			40810	64190				
7	G. Total	30576	33152	40810	64190	4827.35	19399	100	401.85

Source: Field Research of Intensive Rice Cultivation

MPRC-Management Practices of Rice Cultivation; NPK-Chemical fertilizer

Photographs of Different activities of

SOPHEN



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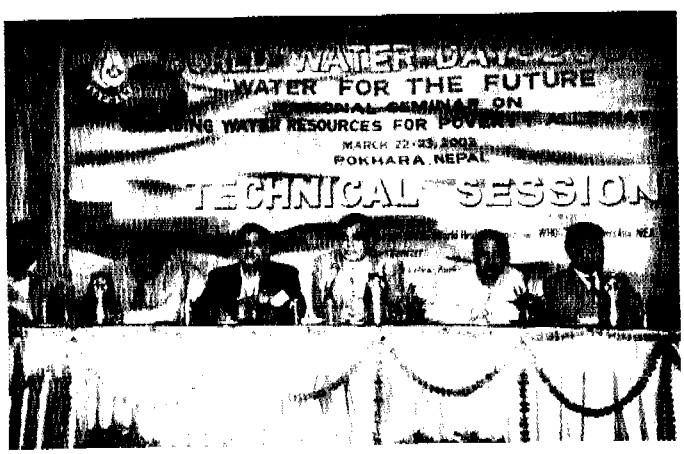
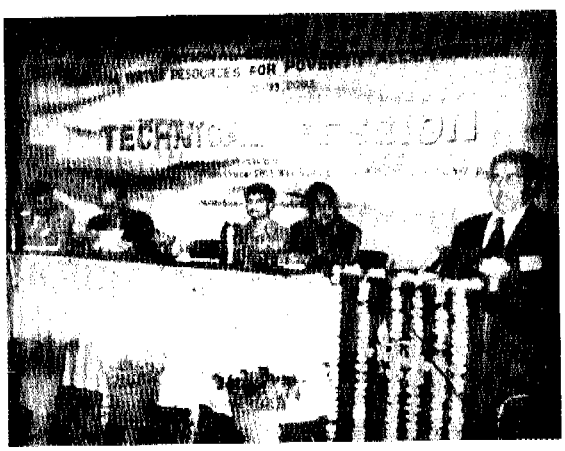
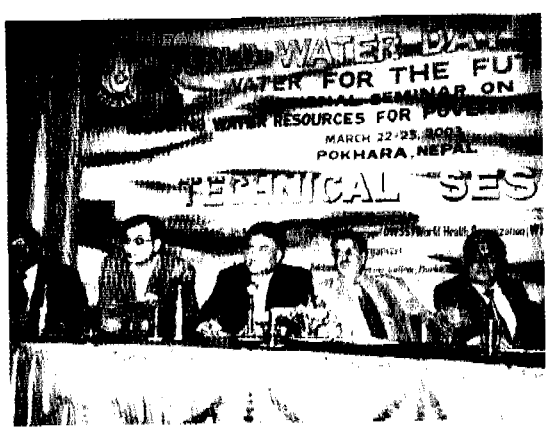

WATER FOR THE FUTURE
MARCH 22-23, 2003
POKHARA, NEPAL
TECHNICAL SESSION

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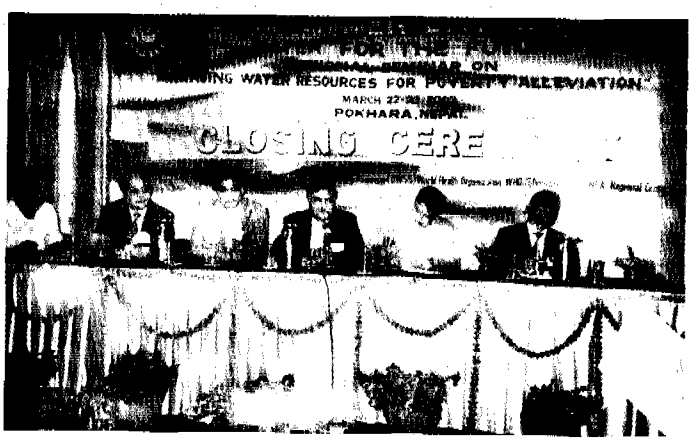
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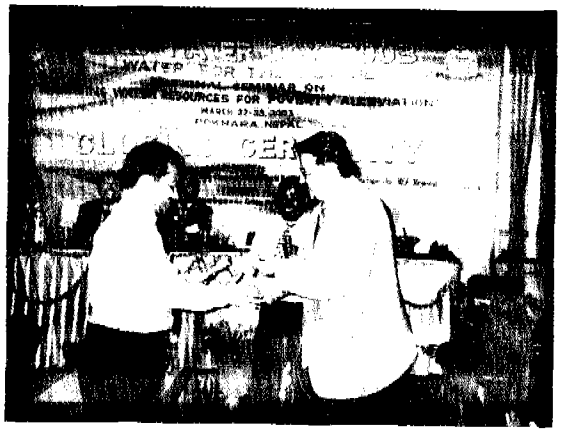

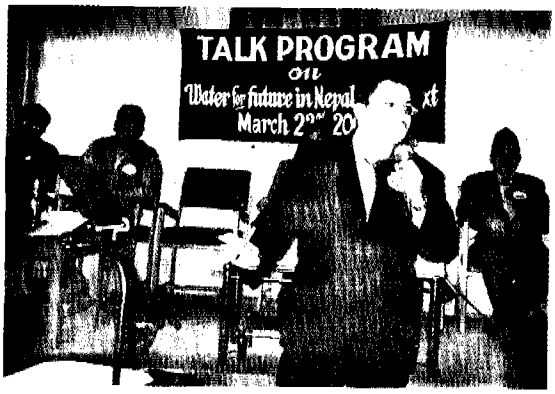
TALK PROGRAM
on
Water for future in Nepal
March 2


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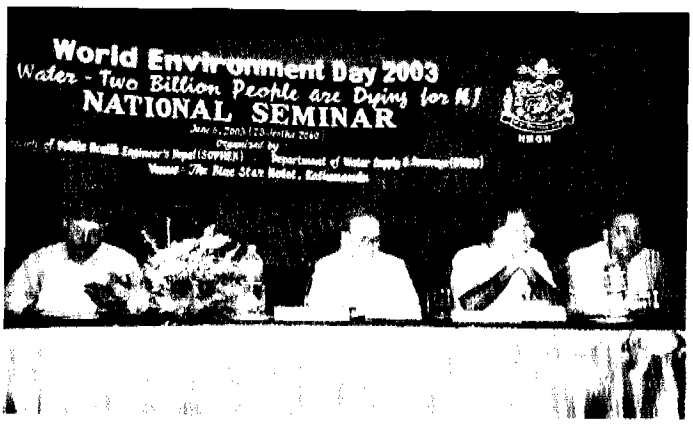
on
Water for future in Nepalese Context
March
2003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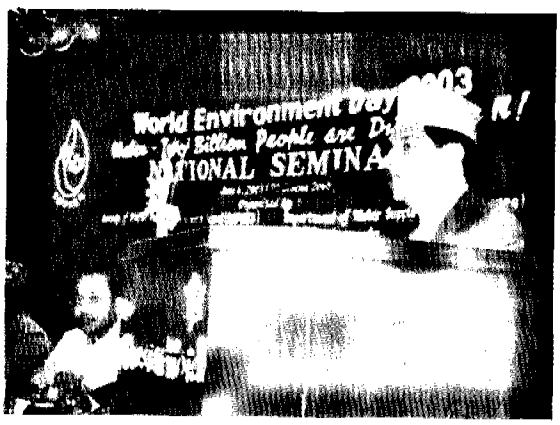
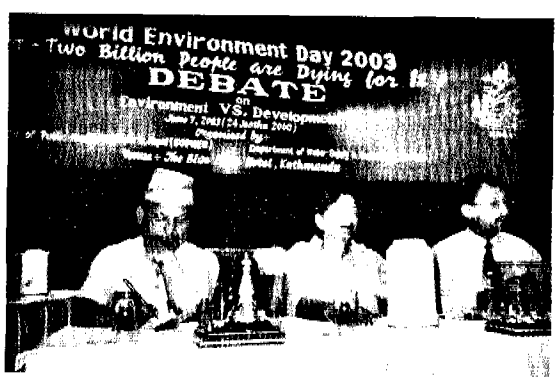
Water - Two Billion People are Dying for it!
NATIONAL SEMINAR




World Environment Day 2003
Two Billion People are Dying for
DEBATE
on
Environment VS. Development

Water Saving 77% Economic Return 320% For Kaju Cultivation

Kaju has cultivated in tropical climate temperature ranges 24°C-32.7°C in summer and 21.3°C-32.2°C in winter where rainfall 320 cm (June - Sep) in India. Soil type - humus clay and mixed humus is suitability to high yield.

Flatland Terai is less or more matches the climatic condition and land suitability to cultivate cash dry fruit in the substitute of rice cultivation. Water Scarcity for the irrigation 1.69 km^3 in 2001(Climate Change Study Report, 2002). Population dimension growth has 2.3 % in rural and 2.1% in urban area. The food scarcity and economic dimension have to measure cash crop of Kaju having high economic value.

Together with trial and research of adaptability and suitability in the location Latitude 26°36' and Longitude 86°54' Mahadevpatti, Saptari has experimented since 5 years. The plant has grown very well and no found diseases and infection. During the period of 3 years, there is no yield received. In the fourth year, yield has received 850 gms/ per plant and in the fifth year 1787 gms/per plant. The experiment is still continued.

Planting Component of Kaju

The planting of Kaju, there are three options- 3mX3m, 2.5mX2.5m and 2mX2m. Among them, 2.5mX2.5m spacing of plantation is more suitability in economically and sustainable.

Economic Component Of Kaju

The economic value as compared to base value of rice 100% is 320% yield distribution of yearly basis during the five year. Water irrigation as compared to base value of rice 100% is 33% water demand for irrigation.

Water Use Of Micro Hydropower Perspective Food Security

Nepal is a mountainous country; water falls from high terrace to the lowland. Water is economic resources for micro hydropower development, cold water fisheries production, irrigation for changing cropping pattern practices to economic measures and fish, food for nutrition. Energy has prime necessity to access the rural community by designing micro hydropower development on the basis of water availability to the various places in the country. It has been seen that tail water of micro hydropower that could be used for cold fisheries in the series of ponds will have been made along the terrace land. The running water contains dissolved oxygen (8-9 mg/l in winter and 5-7 mg/l in summer), when goes to turbine makes more saturation. Saturated water coming and going out to fish room, managing high fish population for the survival stage. The series of fish rooms will be made 12X12X12 cubic ft or size of the room depend site scenarios and tail water of hydropower. The sustainability use and management of water resources cash in the rural community from the economic stagnation.

Basic Hypothesis Of Micro Hydropower

The population density in rural area is very low, where water is main resource to access the energy, fisheries, economize sprinkler irrigation that water aerated in atmosphere having high value oxygen maintains high yield of crop. Aerated water and aerated soil moisture are the productivity improvement technique to produce high yield crop that farmers get economic return, cover full meal round a year, able to pay cost of energy price and self-help raise livelihood. They are able to facilitate employment opportunity reducing pressure to urban migration and not facing the water stress in the urban area. It is seen that either development budget or urban budget transfer to diverse rural area. A micro hydropower creates multiple projects with less investment of cost promote integral cost of benefit overcome stagnation of poverty.

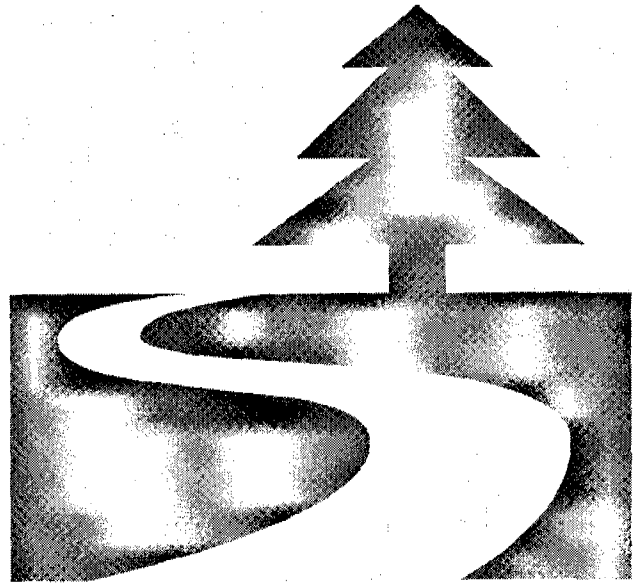
Output Of The Programme

- Strategy formulation of the National Government
- Rural community development

- Fuel wood, bio-mass consumption use in daily life must be reduced and appropriate measures of national and global climate change protection practices
- Balance food security in the rural community
- Job opportunity in the rural area
- Human health security to work hard to contribute national development activities
- Income raising
- Enable to build self-help micro hydropower along with fisheries income
- Creating water use on the sprinkler irrigation for the changing cropping pattern and enable to get food for balanced and covering full meal round a year

Recommendation And Conclusion

- Water has limited resource, use and management as optimized ways and means of economic return
- Management Practices of Rice Cultivation is most useful for food security, economic return and 50% saving irrigated water
- Kaju cultivation is appropriate in Flatland Terai irrigated water saving 77% economic return 320% as compared to 100% water and economic return of traditional rice cultivation
- Micro Hydropower is options of multiple projects-fisheries, sprinkler irrigation for food security, economic development, energy access, employment for the peace of the country
- Sustainable development -social and community in rural area of country is appropriate for water harvesting for safeguards of future generation.



भविष्यको लागि पानी
संरक्षण गर्ने बसालौं बानी ।

Privatization Of Water And Human Right

Ram Charitra Sah
Staff Scientist, PRO PUBLIC

Introduction:

Water is a symbol of life throughout the world. There will be no life on the earth unless water is available. Water is the blood of the earth and is a basic need of any life form. South African poet Mazisi Kunene describes water in his book as a basic human right. Water is a right for all living beings. Water can be also explained as a strategic resource for ensuring the integration of economic development, social development and environmental concerns. The intrinsic value of the Earth's fresh water precedes its utility and commercial value, and therefore must be respected and safeguarded by all political, commercial and social institutions. The Earth's fresh water belongs to the earth and all species and therefore, must not be treated as a private commodity to be bought, sold and traded for profit. The global fresh water supply is a shared legacy, a public trust and a fundamental human right and, therefore, a collective responsibility required to protect it a local, regional, national, international and global level.

Whether water is a social or an economic good has been a topic of debate for a long time. Oriental societies like ours carry a deep-rooted tradition, which regards water as welfare and social commodity. Beautifully crafted waterspouts in midst of the city cores and public kuwas constructed by people aiming for the welfare of society are testimonies to this. In the modern times cityscapes have changed, population has grown, watersheds have degraded and the rivers are polluted. The water is now no more a plentiful divine commodity that may be easily wasted and forgotten about. Water management therefore has got to change with blends of complex engineering and management skills and has to invent new solutions to meet its new challenges.

Many cities- both in the developed and developing world- are seeking more professional management organizations to manage their water supplies. The market of private water utilities operators have been continually expanding as they have not only successfully transformed sick water utilities into sustainable business institutions but mainly because they have been able to win the consumer confidence with better levels of service.

Water Privatization Drama in Nepal:

If we were to apply the horse and the cart analogy to our utility in Kathmandu, we can sense where the problem lies. More than one horse is trying to pull the cart - all in different directions. The resultant effect is that everyone assumes that one is putting a lot of effort to pull the cart forward, but in fact the cart is just rotating around the same point. More specifically, it can be said that water business cart is following the direction of donors desired. These horses could be identified as political segment, government, utility management, donors, etc. What we need to do is to change to a one - horse (*but a strong*) cart, which at one time will only move along one direction.

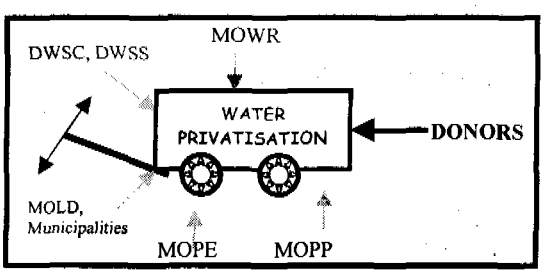


Fig. Horse and Cart analogy of Water Business

This will be the type of organization where the management does the managing, the politicians play the referees, the government sets the rules and the donors support the financing and the development and not play the role of master in decision making process of water privatization business. This can be achieved either through restructuring of the public utility, giving them ample autonomy, or through inviting a private operator to take up the distribution role. But, transforming public utilities have not proved much promising in the past; Nepal Water Supply Corporation already enjoys a fair deal of virtual autonomy indeed but results are far below public expectations.

A private operator is definitely not a magical solution to the problem we have today. The hope for betterment comes from the fundamental difference of transforming the water utility from what is now looked upon more as a welfare organization to a business entity which runs the risk of loosing money and face if it were not to perform to defined standards and consumer satisfaction.

The government formed a high level private sector participation committee in 1997 to process for the recruitment of a private operator to take over the operation and maintenance of the water utility in the Kathmandu Valley. A NGO coalition is also working as a civil society, which is closely monitoring the progress. Despite all these efforts, information needs to be more rigorously brought out into the public and a greater confidence and consensus needs to be built towards the process. Instead of blaming the donors and taking hesitant steps towards this direction, it is time that we spark off a general debate on what is good for us. Whether private or no private, we then at least have a much widely owned choice that we will have made for ourselves.

It is generally misconceived that the whole process is about selling the utility to the private operator and the operator will charge high rates affordable to only the affluent classes. The fear prevails - the poor may be denied the nature's gift of life and good health.

The facts are different. The contemplated contract does not allow the horse to own the cart. The horse can not also decide how much to charge for the delivery of goods. The state will still own the assets and the operator will have no role in fixing the water charges. An independent regulatory body of professionals will be established by the state to make adjustments in the tariff in line with a pre-defined and publicly notified tariff policy. The regulatory body is the driver of this cart. It tells the horse where to go and what standards to meet.

The state is the owner. It is therefore the state and not the operator, which will decide whether to make a profit from the water sold or to subsidize the water supply charges in the Kathmandu Valley. It will do so by defining a tariff policy. The operator will be paid his fees for water produced or sold irrespective of the water charges.

The tariff is certainly going to be hiked, not because a private operator is coming in but because the utility is currently running dangerously low in resources. The generated revenue hardly meets the cost of operation and a decent maintenance, leave alone debt servicing and investment. It is one of the main reasons why the repair, maintenance and supply side remains so poor today and is a major factor of drinking water supply system and reported up to 70 percent loss of water supply thorough leakage.

The operator fees will be tied to pre-defined and contractually bound efficiency targets. These will include the water has to deliver in the low income areas, the leaks has to fix, the billing and collection efficiency has to improve, the equitability in supply hours between different service locations, etc. But besides the government, like we need the traffic police to regulate the cart on the road, we need societies, consumer groups and other social entities monitoring the operator.

The experts, the societies, the consumer groups and above all the public have a stake in the whole exercise and need to interact more. With wider and factual information, the process is likely to win a broader support. After all, *it is not a tiger to be afraid of, it is merely a horse.* If we can tame the horse right, it will not kick our backs, it will only carry our burden for a modest dinner.

Poverty and Water Resource Management:

The government of Nepal has made poverty alleviation its priority remains in 10th Fie year

plan too and has professed its commitment to uplift the standard of the more than 50 per cent of its people living below poverty line.

To meet the principal objective of poverty alleviation, the government's focus among several sectors (such as agriculture, tourism, physical infrastructure development, industry, commerce etc.) including water resources development and management must be clearly outlined. On the development of water sector the government on the suggestion and financial loan of the World Bank is understood to have been engaged in formulating a national strategy for the overall management of Nepal's abundant surface and ground water resources.

A vicious cycle of poor quality and unreliable services resulting into the generation of inadequate operating funds and a further deterioration of services has been a common problem.

At the same time, the engineering and environmental costs are much higher for new water projects than for sources already tapped. New challenges call for new orientation, new approach and unselfish motive among our politicians, policy makers, bureaucrats and the users. Generally, the finite development budgets have often been misallocated and wasted, institutional weaknesses are rampant, policies are not carefully drafted leave alone their proper implementation and there is no seriousness in the long term investment planning. The international donors suiting their vested interest rather than serving people needs often plan our projects.

Nepal has participated in several international forums organized for improving water resources management. Water is treated as an economic commodity conroined with decentralized management and delivery structures, greater reliance on pricing and active participation of stakeholders have been the essence of comprehensive water resource policy framework prepared during the 1992 Durbin International Conference of water and Environment as well as the agenda 21 from the 1992 United Nations conference on Environment and Development to World Water Forum 2003. It could be suggested that in the National Water Resources Strategy Formulation the documents from such deliberation must be reviewed and the new strategies of based on the lessons of experience.

The government has repeatedly reiterated that it would remain fully committed to the effective implementation of the local Self Governance Act that is based on the policy of empowering the districts and villages. Decentralizing the planning allocation of water resources and the delivery of water services to the District Water Resources Committees for inducing efficient use of water has been the essence of Nepal's 1992 Water Resources Act. But for the effective implementation of this legal provision.

For poverty alleviation, low cost methods of developing new water schemes for agriculture, drinking, industry and hydropower must be pursued. Maintaining biodiversity and protecting eco system while putting special attention to new resettlements will have more positive impacts. Promoting watershed conservation practices is essential for the promotion of equitable, efficient and sustainable development of water resources, which could have a bigger impact on employment generation and poverty alleviation.

Water Resources Act, 1992

The Water Resource Act, 1992 is also related to the conservation of environment. Its primary aim is to prevent soil erosion, landslides, floods, or adverse impacts on the environment while generating electricity, digging, canal and other works. According to this Act, water resources within Nepal shall be owned by the Kingdom. This Act is a public trust doctrine. It strives to prevent environmental damage to wetlands, lakes and rivers through environmental impact assessment studies.

In Water Resource Act 1992, priority order on the utilization of water resource is clearly stated in the Article 7(1). The article provides the priority order, which should be followed while utilizing water resources. According to the articles, water for drinking and domestic purposes should get first opportunity before other purposes such as irrigation, agriculture uses, and hydro electricity etc. From the point of view of equity, this article favors women indirectly because it is women who are primary stakeholder of few domestic arenas. As fetching water for drinking and domestic purposes is generally women's work in Nepal, this provision of the

Act can be considered as bring gender sensitive. But the time has changed and if it is not changed, it is time to change of men's behavior and participate in collective drinking water as like as women do priority.

Water Privatization:

Water is becoming a scarce resource. This scarcity is a market for the water companies. The Worlds Bank, Asian Development Bank, International Monitoring Fund, World Trade Organization are the vehicles for the water business. The water sources in the whole world are in trouble. The commodification of the available fresh water is the only target of these multinational agencies. However, watershed management or pollution control is not their interest.

The ADB assisted water privatizing process was started in Sri Lanka in the year 1998 and first water policy was approved by the Cabinet in March 2000. Under this policy the Government owns the water resources (like Nepal) and the public should have entitlement to obtain water from any sources. The public protest was started against this policy in November 2000 and it was changed after several months protest.

There is large number of multinational companies involved in water business industries in the country. Although the new policy specifies that water is owned by the people of Sri Lanka, the policy process on entitlements for foreign companies are not yet defined. This could be an opening for the private water companies to get hold the nations water resources. Is the government trapped by any international organization to sell our water to foreign companies?

There is no doubt that this policy is a water pricing mechanism. The final outcome of this is that water will eventually become an economic good

What leads to Comodification?

Currently 31 countries –mostly in the Middle of East and Africa are facing water shortages. By the year 2000 seventeen countries will be added to this list including Ethiopia, India, Kenya, Nigeria and Peru.

Especially in South Asian Countries due to high population growth and rapid increase of industries, rate of destruction of watershed areas and forests, increased while water withdrawal from natural resources and ground are very high.

Activities of human beings have greatly interfered /disturbed most steps of the water cycle to a great extent. Therefore water cycle does not occur properly. This imbalance leads to the scarcity.

The total amount of available water resources remains more or les constant while the demand increases with the increase of population, industry and agriculture; water is now becoming a scarce resources through out the world. In order that this scarcity should not hamper the socioeconomic progress of the developing countries, a need for efficient planning and management of water resources is necessary.

Access to Privatization:

As a MANAGEMENT tool at the United Nations Conference, water was nominated as an economic good. According to the *Blue Planet Project,* there are 10 major corporate players in the global water industry, which work on privatization water in 21st Century. These top 10 corporations instantaneously became obsolete with the growth in the international water sector. These leading water companies are basically from United States, France, Germany and United Kingdom.
The big 10–water corporations prime the pump for privatization. The world A Bank has been indispensable in providing the financial and strategic leverage required for privatization of water services on mass scale. Getting the water services on mass scale. Getting the governments in key countries onside is also a major factors in implementing the big 10 plans for privatization.

Impact of Privatization:

Privatization means that the management of water resources based on principles of scarcity and profit maximization rather than long-term sustainability.

The privatization has not delivered high environmental standards, but has brought an increase in the price to the consumer.

According to IWMI the most important aspect of water pricing and privatization is that if encourages people to use water wisely, not waste it.

Industry claims that the privatization of water has a positive effect on sustainability, since it results in great efficiency of water use. However, the history of water privatization in England indicates rather that the unregulated corporation of water puts corporate profits before principles of sustainable water management.

The world biggest companies increasingly see water as the largest untapped commodity in the world. Water sells itself: If a company controls the local water market, its customers can't for cities, and lucrative industries such as agriculture and technology can afford to pay up or go without. When municipal water services are privatized, rates are doubled or tripled, quality standard drops, and overuse is encouraged (it increased profits). And customers who can't pay are cut off.
But the privateers don't always have an easy time at it. In 1999, the Buchtel group took over the public water system in Cochabamba, Bolvia, with the help of the World Bank. Bolvia is one of the poorest countries in South America. The company immediately increased water prices as much as 200% and 300%. Peasants and small farmers even had to buy permits to collect rain water from their own wells and roof tanks. All autonomous water systems had to be handed over without compensation. Public started protesting against water privatization in Cochabamba. Finally Bolivia took back their water from the corporate conglomerate.

The accessibility and affordability of water to women and children are greatly reduced. More than five million people, most of them children, die every five-year from illness caused from drinking poor quality water. When water becomes expensive and less accessible, women and children, who bear most of the burden of daily household chores, must travel farther and work harder to collect water often restoring to water from polluted streams and rivers.

The global water industry is going well beyond the privatization of municipal and regional water. Global water corporations are also acquiring control of water through the ownership of dams and waterways, control over bottled water, the development of new technologies to facilitate water desalinization and purification, and water exportation. While the development in these areas is being undertaken by small entrepreneurial engineering and construction companies as well as larger transnational companies, these smaller enterprises are often bought by the large transnational once they have proven their ability.

Privatization reduces the democratic involvement of both citizen and governments in water management; corporations have minimal disclosure requirements in most countries. As a result the public access to information from corporation is restricted. The public is thus unable to ensure that the resource is portable and it being managed sustainably in an efficient manner. Furthermore, the nature of the water industry is such that only one corporation can be involved in the management of water in a given region. Once private monopoly is established it is extremely difficult to reverse it.

Decisions about allocation and distribution should be democratic and based on everyone's fundamental right to a clean and healthy supply.
Management of water resources needs to be based on long-term sustainability rather than on profit maximization.

Water and WTO:

The World Trade Organization further reinforces the global agenda of water privatization, which was outlined by World Water Council. The mandate of the WTO is to promote economic liberalization through the reduction and elimination of trade barriers e.g. tariff and non-tarried barriers.

Under the current WTO rules, water is already considered as a "good/commodity". This means water is a commodity to be bought and sold in the market place. The Articles XI of the GATT (General Agreement on Trade and Tariff) rules, (which are administered by the WTO) states that no country is allowed to prohibit the exporting of any goods. As a result, any country that prohibits the export of water as a tradable commodity would be in violation of the WTO trade rules. If a complaint was brought and adjudicated, the WTO would then be in a position to force the country in question to strike down and rewrite its law, policies and programs regarding water exports

Water and GATS:

General agreement on Trade and Services (GATS) was established in 1994. GATS have been created with the interest of multinational companies in mind. GATS and WTO are least transparent, undemocratic and biased towards the interests of multinational companies and developed nations.

The inclusion of water in GATS would, in effect, give the global water corporations the tools they need to pry open the public water services of countries and turn into profitable markets. GATS rules would cover every conceivable services from fresh water and sewer services to the construction of water pipes and the treatment of wastewater.

It remains to see whether the new GATS regime will fully cover water services. The negotiations are expected to be concluded and ratified by Jan 2003. If water services are governed by the new GATS rule, then the Big 10 water corporations will be able to greatly accelerate the commodifiation of water and privatization of public water services all over the world. Moreover the process is irreversible. Once a public service has been privatized, it remains a commercialized utility under the WTO rules.

Water, the World Bank and IMF:

The World Bank adopted a policy of making water privatization and full cost pricing a condition of its loans to developing countries.

E.g. Bolivia: The World Bank refuge to guarantee a $25 million loan in 1998 to re-finance water services in Cochabamba, unless the local government sold its public water utility to the private sector and passed on the cost to consumers. In need of financing utility water was sold and finally what happened was even peasants were compelled to buy permits to collect rainwater in their communities.

E.g. Mozambique: According to Public Service International, the World Bank and other funding agencies forced Mozambique to privatize its water services utilities in 1999. The Africa Development Bank, the Dutch government and the European Union joined the World Bank in requiring the privatization of Mozambique's water services on as one of the main conditions for a $ 117 million loan. Water privatization also cited as a condition for extending Mozambique's debt relief in 1999.

E.g Sri Lanka: The strategy of privatization pursued in Sri Lanka by the World Bank has been flawed. The privatization of Plantations, Colombo Gas/Shell Gas Lanka, Sri Lanka Telecom and Buses has not delivered the expected service and development. But what resulted in privatization was quality of service collapsed. E.g. Telecom tariff increased and in the bus industry state has to take the burden of unprofitable routes.
The world Bank and its failures according to report of Summarizes of the First round Constructions for the Country Assistance Strategy (GAS) of the World Bank for Sri Lanka` are AS FOLOWS:

The main devastating reason for the economic down fall of Sri Lanka and other third world countries is the economic regime imposed on them by the World Bank and IMF.

According to the report, the reason for the failure of privatization to benefit the country and creation of negative impact for the approach is poor political and regulatory environment.

Mostly the agreements signed between the government and any donor agencies to any development project especially here with water aid project were not publicized much? Where is the

transparency? Without such information, how can media and civil society hold to government accountable?

A random review of IMF (International Monetary Fund) loan policies in forty countries had revealed that, during 2000, IMF loan agreements in 12 countries included conditions imposing water privatization or full cost recovery.

In general it is in African countries, and the smallest, poorest and most debt-ridden countries that are being subjected to IMF conditions on water privatization and full cost recovery. the majority of these loans were negotiated under the IMF's new poverty reduction and growth facility (PRGF), a reform announced with great fanfare in 1999. when officials claimed that the new loan facility would refocus the IMF's controversial structural adjustment measures on activities that borrowing government's would identify as leading to poverty reduction. Rather than contributing to poverty reduction, water privatization and greater cost recover make waterless accessible and affordable to the low-income communities that make up the majority of the population in developing countries.

Therefore, it can be presumed that in every country where IMF loan conditions includes water privatization for full cost recovery, there are corresponding World Bank loans and water projects that are implementing the financial, managerial and engineering detailed, required for such " restructuring.

ADB`s Water Policy and Privatization:

Beyond the basic needs for human survival, the Bank (Asian Development Bank) regards water as Economic Good. The Bank states that it "will stimulate its allocation to sustainable high-value uses through market based incentives. The cost of expanding eater services and improving water resources management in the region are high. Further public and private investments will require agreements to substantially increase cost recovery. Full cost recovery will stimulate the economic allocation of scarce water resources, promote water conservation and environmental protection, and raise revenue for further investment.

Conclusion:

The established factor is that the water is life driven substances and hence should be available to each most preferably free of cost and/or at cheaper affordable price. The quality rather than quality should be of most importance with respect to sanitation and health of the consumers.

Looking on the short perspective of water privatization issues, personally I feel that, the time is not suitable for go to the privatization of our water resources and losses our entitlement on water resource. Since we do not have a reliable government having clear vision on development on any resources. Since we know that Nepal is second largest country in the World in terms of water resources, but Nepalese folks have to pay relatively higher rate of electricity tariff in the South Asia region and hence there is always threat connected with the privatization of water resource to compelled poor Nepalese people to pay even for the drinking water disregarding of its quantity and quantity like paying the bill of dry water tape fitted by DWSC. The known impact of water privatization can be seen in case of Nepal too. Some company like private hotels, soft drink production and mineral water production will probably lease some area and started to suck the water for their production from either groundwater or tapping some river and stream sources. They convert it into money for their personal business leaving behind the area barren and move to the other places. But the impact of extraction of water on local ecology and environment is always under estimated. Thus looking on the interest of private companies, the international agencies provoking for privatization of water resources and consequent impact on raise of water tariff as well as losses of even entitlement of ownership from the water resources. I will conclude that privatization of precious life sustaining water resources which is free gift of nature never be a good things. The donor driven water privatization should not be happen since it is not going to protect our national interest anymore, clearly visible from the past history of water privatization of Bolivia, Sri Lanka and Mozambique. Thus there is urgent need to look precisely on the basic interest of multinational companies and other donor agencies to protect water transforming into a complete commodity like things to be bought and sold in open globalization market aiming to be created by WTO. This will help in protection of human right to access of safe and healthy water for their healthy life as guaranteed by our constitution as well as first priority guaranteed by Water Resource Act for the access of drinking water rather than its other use.

Sustainable Energy Risk Management In Nepal

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Background

Energy is the basic need for the livelihood of the human being. From the dawn of the human civilization, people used forest as the main energy resource for the daily consumption of energy that is still dominated to the national energy sector. The high rate of population growth since last two and half decades and increasing the living standard of the people mainly to those of the urban area aggravate high growth rate of the national energy consumption annually. The thrust to the forest consequences to the depletion of about 2% forest covers area annually. That resulted to the adverse impact to the natural environment and the country suffers from the loss of life and properties due to landslide and flood hazards. The continued deterioration of indigenous resources may cause risk in energy consumption and desertification within few decades. The huge amount of money flow out of country to import coal and petroleum products triggers the national economy. These non-renewable sources are also not sustainable in the context of the global energy scenario. Most of the countries of the world are reducing energy consumption from nonrenewable sources developing different technologies to harness the natural resources for the renewable energy. Nepal is still lagging behind to harness the huge potential of the hydro-energy due to lack of effective plan and policies, proper management, available funds, technology and skilled manpower. If only 40% 0f the renewable hydro energy source could be harnessed, the energy risk of the country as well as of south east Asia can be managed. The country will be one of the richest countries of the world. An appraisal of sustainable energy risk management in Nepal can be made as a) National energy consumption practices b) Renewable energy source development c) Technology practiced for energy consumption.

Present Energy consumption practices

The energy consumption practices in Nepal are made into three forms as a) domestic consumption for daily use as cooking food, heating, electrification etc. b) energy consumption for vehicles, locomotives and other services. c) energy consumption for industrial use. Nepal is mainly dependable on Non-renewable sources of energy that include indigenous sources and imported coal and petroleum products. The heavy thrust only on non-renewable sources is the main concern of energy risk and economic degradation.

Indigenous sources

Indigenous sources are the non-renewable sources of energy that include fire wood, agriculture waste, livestock residue etc. These sources are used for about 93% of national energy consumption of the country. The population explosions since last two and half decades have providing heavy thrust to the forest. The adverse impact of about 2% deforestation annually aggravates the risk in national energy and desertification. Some part of the country suffers from drought and others from landslides and flood hazards. The food grain exporting country up to end of 1970 decade has to suffer from famine now. More than 38% of the total population are below poverty level. The economic condition of the country is declining and unemployment rate is rising annually. Different government agencies as Ministry of Forest and Soil Conservation (MOFSC), Ministry of Population and Environment (MOPE) and Ministry of Water Resources (MOWR),Water and Energy Commission Secretariat (WECS) and different national and international non-government organization are working for the conservation of the forest and natural environment. However, the present practice of energy conservation is making ineffective to their efforts and investments. Priority should be given to the development of the alternative energy sources and related infrastructures development to reduce the thrust on indigenous sources for national energy consumption.

Imported coal and Petroleum Products

The coal and petroleum products as kerosene, diesel, petrol, liquefied gas etc. are imported for the supply of about 6% of the national energy demand. These products are mainly utilized to the domestic energy use in the urban area and energy required for the locomotives, transportation, industry and development works. The investment required to the Petroleum Products causes to drain out the huge amount of money that triggers the national economy annually. Besides, the import of petroleum products increases with the increase of different development activities in the country, which is unavoidable. The supplying of coal and liquefied gas are made by the private parties and Nepal Oil Corporation imports kerosene, diesel, petrol etc. and supplies in subsidized rate following the government plan and policy. The country has to face energy crises occasionally being disruption in the supply due to rise of prices and other unavoidable factors. The Petroleum Products and coal are also non-renewable source in the global context and are not sustainable energy sources in the long run. To mitigate the energy risk and reduce the out flow of the money an alternative renewable sources of imported products have to be developed.

Renewable sources

The utilization of renewable source for national energy consumption in negligible. Nepal has huge potential of renewable energy source as hydro energy, solar energy, wind energy etc. Ministry of Water Resources (MOWR), Water and Energy commission Secretariats (WECS), Nepal Electricity Authority (NEA), and Electricity Development Department (EDD) and other National and International private agencies are working for the exploitation of energy sources. The hydro energy is the main source of renewable energy. Out of total potential of hydropower it has been exploited less than 1% (535 MW) up to now due to lack of proper plan and policy, required fund and other unavoidable causes.

Renewable Energy Sources Development.

The huge potentials of renewable energy sources are the gift of nature for the economic development of the country. Among the different sources, hydro dominated energy source is more potential. The most feasible hydro potential of 44000 MW capacity if could be exploited, can be traded with Bangladesh and India for their huge demand of hydro energy. In 2002, His Majesty Government of Nepal (HMG/N) has formulated the new policy and plan to exploit power from most feasible projects that are disseminated in different parts of the country. The policy covers development of small hydropower projects for rural electrification, medium hydropower development to meet the national demand and large size project development for export to the regional demand. These three prolonged approaches correspond to short term, medium term and long term hydropower development plan. Besides, HMG/N has made different plan and policies to attract domestic and foreign investors for the promotion of hydropower exploitation. The implementation of the government plan and policies is delaying due to political instability in the country. The wind energy and solar energy sources can be tapped in different parts of country. Mainly private agencies are involved to the development of these energy sources. The energy supply form these sources can be made developing isolated energy related infrastructures on the basis of morphological and climate conditions.

In Consideration of present scenario of energy risk, renewable energy source is the sustainable source and the government should give priority to tap the different disseminated energy sources as per the requirement in different locality of the country. The development of renewable energy sources may control the present situation of environment degradation, desertification and also reduces the out flow of money result to the economic development of the country.

Technology Practiced for Energy Consumption

3The developed countries have adopted different technologies for the consumption of renewable energy sources. The daily consumption of energy is made by utilizing electric devices for food cooking, heating, washing etc. The electric devices and locomotives are promoted for transportation system. The utilization of energy from petroleum product and coal are made in limited use. The priority has been given to run renewable energy based industries. The per capita energy consumption of these development countries is very high with low unemployment problem. Nepal has to follow to practice the similar technologies to mitigate the energy crises used in different forms as describe below.

Domestic use

The domestic consumption of energy for daily used should be replaced by renewable energy source. The electric appliances related to food cooking, heating, washing, lightning etc. should have privilege to use by the common people in the country. The use of this energy will reduce the thrust on forest resulting to the conservation of natural environment. This practice will also reduce the out flow of money required to invest for the petroleum products.

Transportation use

The use of renewable energy sources for transportation will reduce energy risk and investment of money for the coal and petroleum product. The off-peak and secondary hydro-energy that is spilling at present can be utilized for locomotive and trolley bus services in urban area. The development of electrical related infrastructures in different potential sites of the country facilitate to manage environment friendly transportation system. Besides, developing electric ropeways in different parts will enable to the transportation facilities and conducting cable cars in different beautiful hilly spots may flourish to the tourism industry, which is a one of the main resources of national economic development.

Industrial use

Hydro-energy based industries have to promote for the maximum utilization of off-peak and secondary energy that is spilling at present. Different types of industries include fertilizer production from the waste material, sewerage treatment plants, recycling papers, plastic etc and others can be develop which will provide more employment opportunity and reduce the flow of money from the county. The main environment issues related to the waste material mainly in the capital and other main cities will be mitigated and the pollution problem will be reduced. The sustainable growth of industry will enable to the economic development of the country.

Conclusion

Energy is one of the basic elements for the existence of human beings. Different sources of energy are available in nature, which are categorized as renewable and non-renewable sources. In the present context of energy scenario, Nepal is mainly dependable in non-renewable source of energy due to which it suffers from environment degradation resulting flood and landslide hazard in some parts and drought in others. The economy of the country is declining and the risk in energy management is aggravated due to high rate of population growth with increasing energy demand. Harnessing renewable hydro dominated energy, a main potential source of the country, can mitigate the present situation of energy risk. For the maximum use of the renewable energy sources in the form of Industry, Transportation and domestic proposes a community basis energy consumption approach should be implemented so that the disseminated sources can be tapped on the basis of requirement and availability. The government should formulate plan and policy for the renewable energy based infrastructure development and community people involvement providing expertise to tap the disseminated sources for the mitigation of energy risk in Nepal.

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Ensuring Sustainability Of Rural Water Supply Systems

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Background:

Creation of infrastructure in overlook of sustainability is a major problem in Nepal. Physical construction and population coverage is only became the goal of the agencies. Major factors to ensure sustainability like institutional capacity building of users' committees, introducing of operation and maintenance fund mobilization system and technology transformation is always lacking behind.

Since last 10 years most of the donor supported programmes started to emphasize social mobilization and institutional strengthening of users' committees along with physical construction of the scheme to ensure sustainability of the constructed water supply and sanitation schemes.

The Rural Water Supply and Sanitation Support Programme jointly supported by HMG/N and government of Finland started to involve the beneficiaries as a manager of the water supply scheme since 1990. The major goal of the programme is to develop the system to make the schemes sustainable.

In this regard a series of one day post-construction workshops were organized in Palpa, Gulmi, Arghakhanchi, Rupandehi, Nawalparasi and Kapilvastu districts where users' committees of phase I and II (1990 to 1999) water supply schemes were participated. Altogether in 13 such workshops, UC members, VMWs and other key persons (DDC, VDC representatives) from 432 different gravity, suction tube well, rainwater, lift tube well and household sanitation schemes were participated.

This paper is focused in analysis of the outcome of the workshop of gravity schemes.

What is Sustainability ?

In case of Rural Water Supply Systems, sustainability is defined as:

- Regular Operation and Maintenance of constructed system without external support till its design period.
- Provision of fund from local level for the renewal of facility at the end of design period.

Implementation Modality of RWSSSP

To ensure the sustainability of the scheme, users' are involved in every decision making from pre-planning to post construction phase. For the proper and systematic execution of the activities step-by-step procedure is formulated and followed. Modality of RWSSSP is described as follows:

- Considering the fact that without realization of felt need by the beneficiaries, scheme can not be sustained, demand with commitment from the users for the cash and kind contribution is the first step of scheme implementation.
- The program has carried out detail survey of each and every household to classify the service level and hardship of the community. The schemes are being selected on the same basis.
- "Users' are the manager". Users' take every decision about the scheme, external agen cies only facilitate from outside.
- Until and unless local level development authorities like DDC, VDC and

other line agencies do not feel the programmes as their own it hamper the sustainability. So in RWSS Programmes such line agencies are fully involved.

- Different type of training activities to enhance the capacity of users' committees conducted.
- Regular mass meetings for the decision making and for the transparent use of fund.
- Fund for operation and maintenance of the scheme is provisioned from users' side.
- For operation and maintenance of water supply schemes Village Maintenance Workers' training is conducted.
- Representation of male/female and all ethnic groups is provisioned.

Scheme Status (Based on Post-Construction Seminar)

Out of 258 gravity schemes 12 schemes found stopped due to various reason. Out of those schemes 3 are stopped due to calcium encrustation in pipe and other due to flood. Other schemes are running well and users' committees are repairing and maintaining the systems. 30% of total schemes needs major repair and regular maintenance is sufficient for others.

In most of the cases users' committee is not reshuffled, same committee is working. So users' committees are not found active as expected in all cases.

Except two all schemes have operation and maintenance fund. Operation and maintenance fund of 50% schemes found idol in bank and users' are managing operation and maintenance of the scheme from interest of the bank. In rest of the scheme the fund found mobilized as micro credit fund and lending among the users' in reasonable interest. By which the fund is raised up to 10 time than its original amount. Naya Belhani and Dedhgaon of Nawalparasi and Maulipur of Gulmi are good example.

Village maintenance workers trained by the program are found working in scheme operation and maintenance. 25% of the schemes are found VMW less due to migration of VMW, Overaged/ dead and get better job.

Regular Tariff system is established in 75% of the schemes. But the rate and kind of tariff is different depending upon the economic condition and social custom.

Cash raising is 5 to 50 Rupees per month per household and grain 1 Pathi to 10 Pathi per year per household. In some cases 1 to 2 free labour to VMW is provisioned.

But such tariff is only to pay the VMW not for the renewal of the scheme. So users' committees are still seeking for the external support for major and even minor repair of the system. VDC is also supporting for the major repair of the system.

Due to the growth of population and changing hygiene behavior of the people water supplied from the tap is found inadequate.

In aggregate, if we see the above findings, schemes are running but there is still chance of discontinuation of the facility after certain period. Then users' will be in the same situation before the construction of the scheme. Sustainability of the scheme couldn't be ensured in such condition.

Reasons Behind

As a common practice, more focus is given in physical construction. People always become eager to get physical facility rather than software activities.

As per traditional practice, progress of the programme always evaluated on the basis of structure constructed and budget expended.

For the institutionalization of users' committee, training programs are found insufficient and quality of the training provided by NGOs are not so good.
Village maintenance workers' trained but regular follow-up and refresher training is not provisioned.

For proper mobilization of operation and maintenance fund, not such mechanism has been set so that users' could increase their fund.

No mechanism has been set to support UC from district level authorities after construction of the scheme. They are simply abandoned.

Recommendation and conclusion

For the betterment of the situation and to ensure real sustainability of the system following improvement is recommended for all agencies working in the sector of Drinking Water Supply keeping in mind that "people once supported can get facility forever."

1. Before the real physical construction of the scheme at least six months preparatory phase is needed and all kind of trainings should be given to UC to enhance the capacity of UC.
2. Besides the enhancing the capacity, training on operation and maintenance management should be provisioned.
3. Participatory Monitoring and Evaluation System should be introduced for the monitoring of the activities, such system also help to increase ownership feeling of the community towards the scheme.
4. District Level Development agencies e.g. DDC, Water Supply Office should take responsibility for the follow-up of the system and UC as well as regular reporting from UC to VDC/DDC in post construction stage.
5. Linkage between UC and other agencies who implement micro credit activities should be established beforehand.
6. UC should be make aware about regular tariff system.
7. Considering the growth of population by migration and changing hygiene behavior of the people scheme should be designed on the same basis analyzing water demand. Considering the living standard of rural people private connection in place of community tap should be implemented.

पर्यावरण बचाउन जीवलाई जत्तिकै
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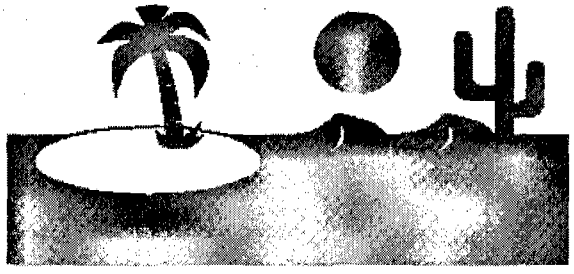

Water is Wealth: Promoting Community Approach in Water Harvesting

Manoj Kumar Lal
Water & Sanitation Engineer
RWSSFDB

Introduction

There was a time when it was believed that water is an abundance free gift of nature. Today, the demand for fresh water has increased due to rapid growth in population, urbanization and industrialization. Fresh water, once considered a free and never depleting gift of nature, has now become a costly, critical and scarce natural resource.

The challenge is to meet the rapidly increasing demands of water services in the water supply (domestic and industrial), irrigation and other sub-sectors. Poor people will continue to hit hardest by the adverse effects of insufficient water service due to scarcity of water resources.

The water is recognized as wealth. The Dublin Conference on Water and the Environment established that water has an economic value in all its completing uses and should be recognized as an economic good. Water Harvesting is, therefore, need of the hour.

Economic Value of Water

There is no doubt that the nation gets both direct and indirect benefits from an investment in any water resources projects.

The direct benefits are establishment of physical infrastructure and the employment generation for skilled as well as unskilled manpower. The indirect benefits from the project to nation the most important for the economic developments and poverty alleviation of the nation - are immense.

The major areas of water resources development projects in Nepal are Irrigation, Hydropower and Drinking Water Supply and Sanitation.

Irrigation projects help to increase the agricultural productions. By doing so, problems relating to food shortage, nutrition and poverty can be reduced.

Hydropower (energy) projects will increase the national production by encouraging mechanization in production technique. In addition, electricity projects have potential to earn foreign currencies by exporting extra power to India. This helps to boost up the national economy and ultimately paves the way for poverty alleviation.

Drinking Water Supply and Sanitation Projects facilitate to empower the health of people which results increase in working capability of people and ultimately increase the national production. This will also reduce the expense of people on medical treatments. Moreover, the reduction in drudgery and good health of women and child will create an environment conductive to women's participation in development and decision making activities. This leads to increase in national production and helps in poverty alleviation.

Water Harvesting

Traditional community based water harvesting is declining and being replaced by the role of government. This has led to wasteful and profligate consumption pattern in the country. Not only surface source but groundwater sources are also being overexploited and polluted. Therefore, it has become necessary to receive community based water harvesting. This has to be done both in rural an urban areas.

Rural Areas:

Local water harvesting technique like constructing rainwater ponds, storage tanks, undertaking watershed projects for management of rainfall on integrated basis by rural communities are promoted in rural areas.

Water harvesting in rural areas should be combined with the village ecosystem management as it can trigger a chain of substantial ecological and economic changes giving rise to adage that water is wealth.

Techniques of Pond Cascades in water harvesting can be explored in rural areas of Nepal.

"A series of ponds in cascades are excavated along contour lines and these ponds are hydrologically interconnected. Drainage from one pond forms the major inflow to the next lower pond. The lowest pond in the cascade often receives water form many ponds above it. This allows easy access to water and a better soil moisture regime. Pond hydrology has a strong influence on groundwater. Wells below ponds have consistently more groundwater."

Fig. 1 shows a typical pond cascades for water harvesting.

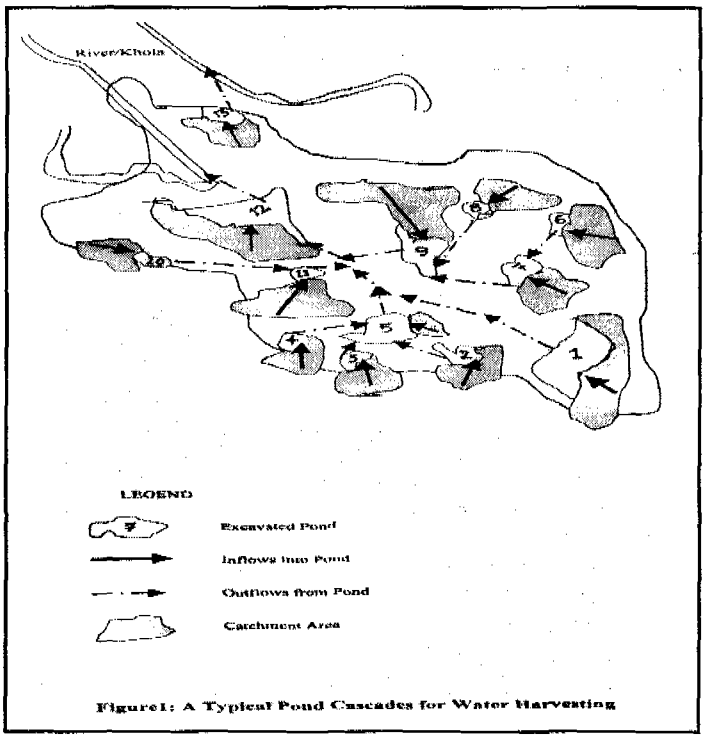

Figure1: A Typical Pond Cascades for Water Harvesting

Urban Areas:

Varieties of measures need to be undertaken to maximize abstraction of rainwater in urban areas.

- Utilization of rooftops of the building where it can help to increase water supply, recharge ground water and reduce storm water. Figure 2 illustrates a typical Roof Top Rainwater Harvesting.
- Collection of run off from industrial and institutional complexes for non-potable use.
- Catchments areas in airports are much larger than roof areas and involve harnessing of both surface runoff and roof water.

The most critical aspect of urban water harvesting is the quantity and quality of water. Untreated water is treated to attain potable quality before distribution.

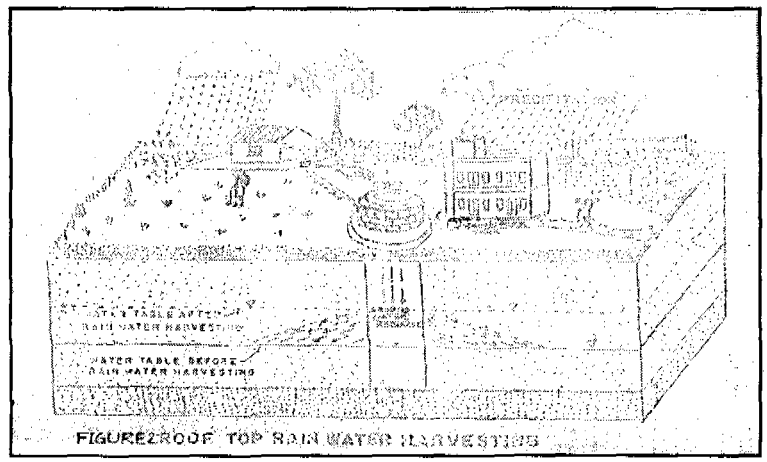

FIGURE:ROOF TOP RAIN WATER HARVESTING

Promoting Community Approach

Indigenous community approaches in water harvesting have existed in Nepal for centuries. These approaches usually go unnoticed or were largely ignored by government in the formulation and implementation of earlier water resources policies and programs. Only recently, due to increased awareness, the government has been slowly incorporative these community organizations and institutions into the mainstream of development path.

Promoting community approach in water harvesting is important for several reasons:

The shortage of and the need to manage the most precious water resource is perceived by the communities themselves.

This represent initial step towards achieving people's participation in the development process.

The communities will be continually searching for new alternative and introducing improvement in the existing ones.Indigenous systems are cost effective.These are important for sustainable use of water.

Policy Issues

In order to accomplish this, government has to address a number of policy issues first. Some of these issues are:

There is need to reform the laws that prevent rural and urban communities from undertaking water harvesting activities.

There is need to enact the legislation on water business.

The government should provide free access to water related information.

The government should provide technical and financial assistance to communities and household on water harvesting.

For urban areas, all building plans should provide for water harvesting.
Master plans of urban areas should clearly demarcate the catchments areas and leave them undisturbed.

To mobilize the people, the government should put emphasis on research that is peopleoriented and not just technology- oriented.
Needs policy on holistic approach to comprehensive water resources management and coordination among the line-ministries and different departments is essential.

National awards should be instituted for persons and communities to recognize the outstanding work towards water harvesting.

Water harvesting should be compulsory subject in schools and for engineers and town planners.

Based on hydro-geological condition of the area concerned, it is necessary to license ground water abstraction.

"Pollution Pays" policy needs to be developed for wastewater management.

Conclusion

There is no doubt that the Water is Wealth for Future World. The people must play active role in water harvesting. There is potential for a huge mass movement on water harvesting. However, this does not mean that the government has no roles to play. There is need to restore a balance between the role of government and the community/individual by giving more importance to harnessing water locally. It is only by mobilizing people as well as enacting legislation that promotes water harvesting can these aims be met. A national campaign on water literacy is required to spread the message that water is a precious natural resource. A clear policy strategy is needed to promote the judicious use of water, encourage use of treated water and promote a national level network to push for community approach in water harvesting.

Ackowledgement

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2. Miss Sahana Shrestha, Secretary, RWSSFDB

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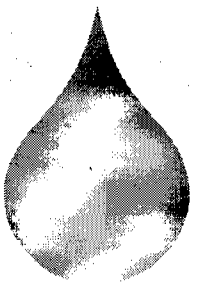


पानी जीवन हो
यसको संरक्षण गरौं ।

A Study On Water Consumption

J K Sherchan,
GWS/Pokhara

The Gurkha Welfare Scheme (GWS), an executing arm of The Gurkha Welfare Trust (GWT UK), under the Rural Water & Sanitation Programme (RWSP) has been implementing drinking water schemes in Nepal since 1976 for the benefit of ex-servicemen, their dependent and the community. So far about 460 schemes have been completed in different phases. The RWSP has adopted as a working policy, the community based participatory approach so called step-wise since 1995. Sanitation, hygiene education and social development have become the integral part of the programme. GWS implements about 60 new and rehabilitates about 30 schemes a year in eastern and western hills of Nepal.

Objective of The Study

As we know that DWSS/INGOs/NGOs have been applying the WHO consumption rate (45 lpcd for rural community) in water demand calculation. In many cases designer rejects the scheme saying unfeasible just because of insufficient water available. On the other hand community continues requesting and even putting pressure on executing organizations for the implementation of their schemes. Sometimes even community claims they do not require 45 lpd and agrees to have less and becomes ready to compromise depending on local condition. So GWS wanted to know whether Nepali rural community consumes the same amount of water as adopted in design or more or less. An additional objective is to observe the difference in between the adopted hourly consumption pattern and reality. Since the study is going on, this paper presents only some preliminary results received so far.

Study Area :
Five GWS assisted schemes, namely Phedikhola, Gabtung, Ghorbanda, Rumaldanda and Yanchok in different districts are selected. The briefs are shown in Table 1.

Table 1

Scheme	VDC/Wd No.	District	Location	Population	Tapstand
Phedikhola	Phedikhola/2	Syangja	Road side bazaar area	1039	25
Gabtung	Chirtungdhara/1	Palpa	Road side village	49	4
Rumaldanda	Chidipani/1	Palpa	1 hr walk from Arya bhanjyang	203	5
Ghorbanda	Chirtungdhara/2	Palpa	Road side village	598	11
Yanchok	Anbu khaireni/1	Tanahun	1 hr walk from Satrasaya Phant	406	14

Materials and Method

Water meters

Water meters of different sizes made in India (Rahul brand) are installed in the distribution main pipe to monitor the amount of water supplied through all tapstands. Non-return valves are installed just after the meter to avoid the reverse reading, which is very important. All meters are encased inside the Pe valve sleeve to protect from vandalism.

Meter reading

GWS requested Water and Sanitation Management Committee (WSMC) to assign a local person to read the meter on voluntary basis and oriented them on reading procedure. Reading was done on daily and weekly basis at the same time for about one year. Reading procedures were checked time to time from the HQs. Meter reading data were collected on regular basis

from the site and processed in HQs and an hourly consumption pattern survey was carried out in Ghorbanda, Gabtung, and Rumaldanda. The author himself had taken readings in Ghorbanda whereas local readers in Gabtung and Rumaldanda. The readings were taken on hourly basis so the job was very tedious, boring and time consuming.

Gap in reading

Although meter reading was supposed not to be irregular, some times reader failed to read because of his/her own household duties. Therefore, some days are missing in consecutive readings.

Data processing

All data are processed in Hqs using a computer spreadsheet programme, Excel. Daily and weekly readings were used to find average daily consumption rate per cap by month and total mean and are presented in graphs as shown in Figure 1and 2. Similarly hourly consumption reading was used to compare the adopted pattern for design purpose with the reality in different locality. These are presented in Figure 3,4,5.

Observation and Discussion Consumption Per Cap

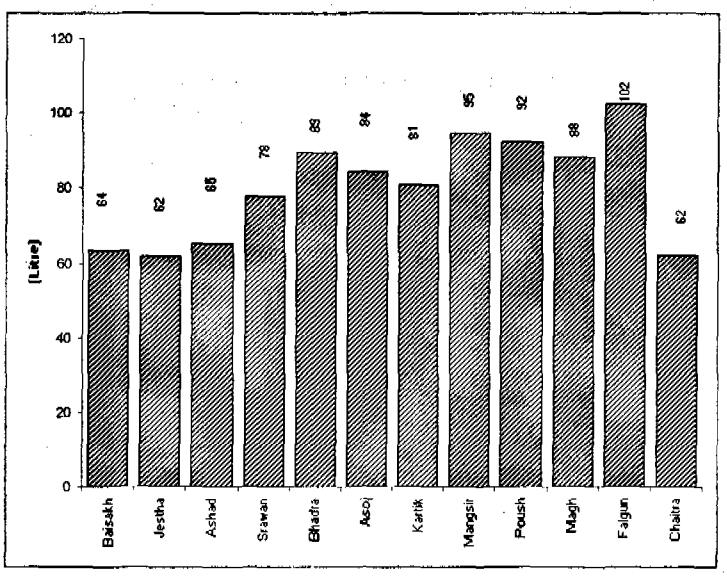


Figure 1. Average daily consumption rate in Phedikhola bazaar in Syangja

Figure 1. shows the monthly variation of consumption over the period of a year in Phedikhola bazaar, Syangja (on Siddhartha Marg). Once the meter is installed in distribution main pipe, the water supplied includes consumption for human and livestock, leakage, wastage and misuse. Consumption is highest (102 litre) in Falgun and lowest (62 litre) in Jestha and Chaitra. It was found that water was consumed more in wet season than in dry. Community members seem quite aware of not wasting water just leaving tap open in dry months because they know water in source becomes less. People use water in wet season for other purposes like in construction because they know water is more than sufficient in source. Consequently there is a big chance of leaving tap open by the water fetcher i.e. wastage. Community have managed to charge money on flat rate per month those who want to use water from public tapstand to build his/her house. There is a tendency not to start construction works in dry season. The average water consumed per cap is 80 litres. The water demand was calculated on consumption rate of 45 lpcd with unaccounted of 20%. GWS does not consider the livestock demand and thinks it can be accommodated within unaccounted and household consumption. The overall design consumption rate becomes 54 lpcd inclusive of unaccounted. It means actual supplied rate even in dry month is more than design rate by 15%. As per DWSS guidelines 60 lpcd is taken for bazaar area. It becomes 72 lpcd inclusive of unaccounted which is less than overall average. Therefore, the observation shows that the minimum required consumption rate lies somewhere in between 50 and 55 litre for bazaar area like Phedikhola.

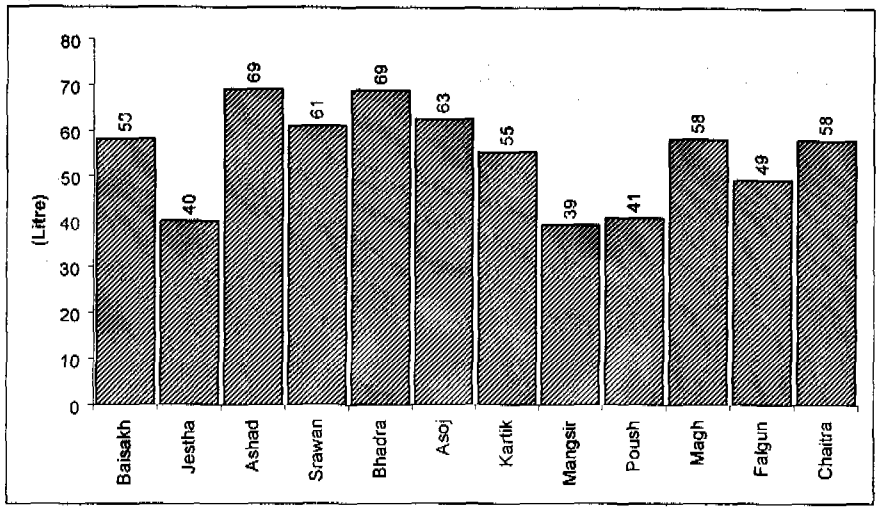


Figure 2. Average daily consumption rate per cap in Gabtung, Palpa

Figure 2 shows monthly consumption variation in Gabtung village. This is a small village with just 9 households located on roadside. Consumption is highest (69 litre) in Ashad and Bhadra, and lowest (39 litre) in Mangsir. Graph shows that like in Phedikhola, people tend to use less water in dry months than in wet. They look quite aware of water available in source although source is enough to the full rate of 54 litres. If calculated the average of dry month consumption alone, it becomes equal to about 51 litre, which is bit less but comparable with design rate.

Hourly Consumption Pattern

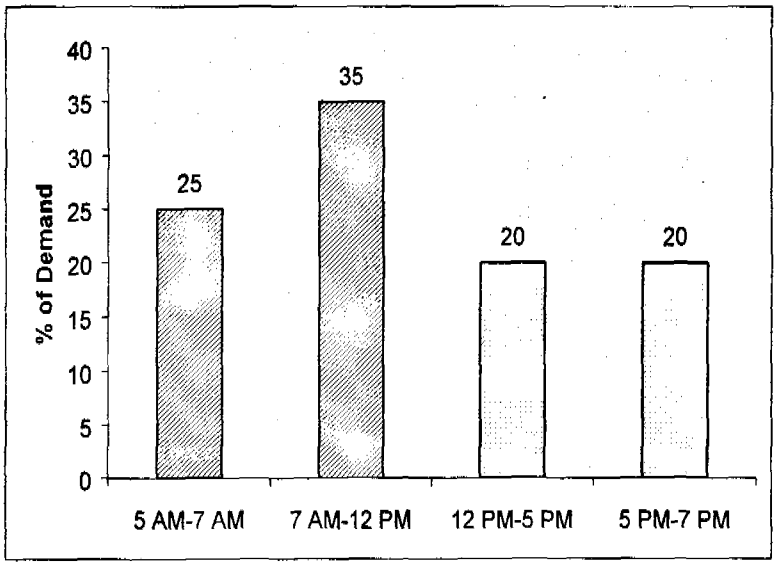


Figure 3. Persent adopted consumption pattern in Nepal.

Hourly consumption pattern being applied by many organizations in Nepal is shown in Figure 3. As per the graph, peak hour lies somewhere in between 7 am and 12 noon. Of course, this is a simplified pattern for sizing the reservoir tank.
Observation done in Gabtung is presented in Figure 4. Graph shows peak hour at 8 AM in the morning and 5 PM in the evening, which is quite comparable with the adopted. However, consumption percent of demand differs from the adopted except between 7-12 hrs. This is one time observation so author feels repetitive observation in different season and in different locality is required to draw some conclusion.

Figure 5. shows the consumption pattern of one of the village, Rumaldanda in Palpa district, located one our walk far from the Arya Bhanjyang east. Peak hours fall in at 8 am and 4 pm,

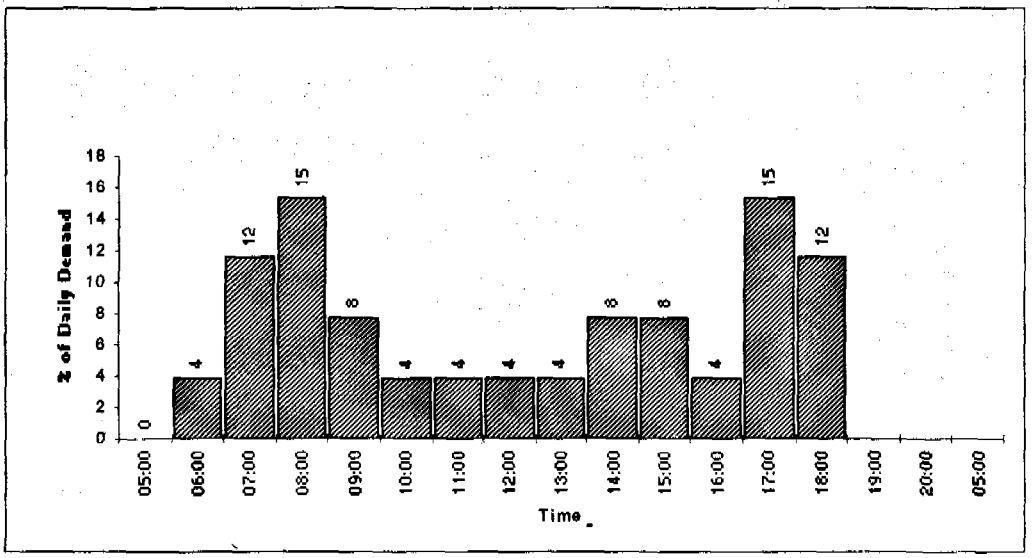


Figure 4. Hourly consumption pattern in Gabtung, Palpa

which was found in the range. It is seen there in no demand at all during daytime from 11 to 14 hrs. Almost all villagers except few must have gone to their field for cultivation and some to collect firewood, some outside, and children to the school. This is a normal phenomenon, which can be observed in most rural settlements of Nepal.

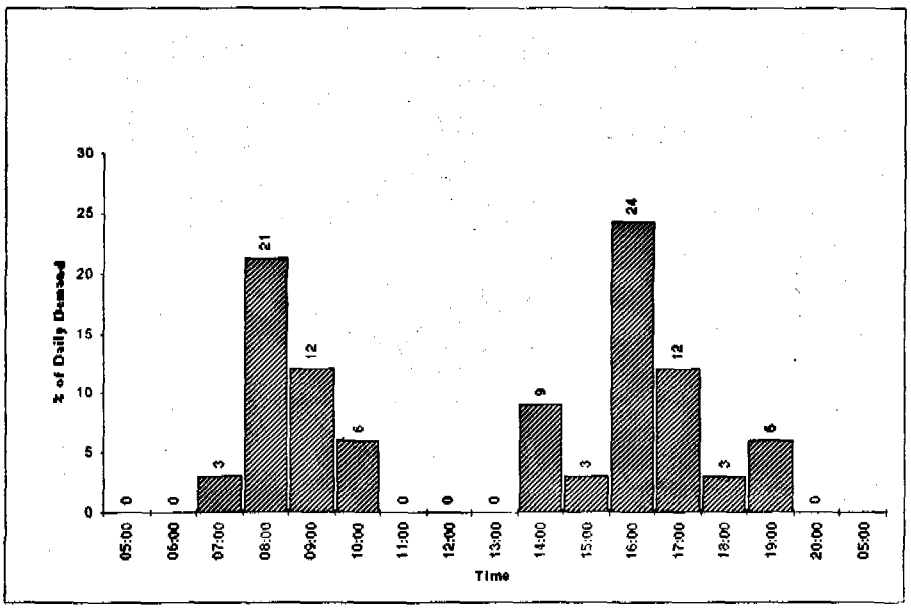


Figure 5. Hourly consumption pattern in Rumaldanda, Palpa

Conclusion and Recommendation

Since the observation is continuous, it is too early to draw conclusion. However one-year observation in Phedikhola clearly shows that 45 lpcd in bazaar area is not enough as was taken in the design. So, GWS is suggested to follow the DWSS rate for bazaar area, which is 60 lpcd. It can be observed that community is able to judge the source capacity and tries to use water efficiently in dry months. Misuse and more wastage of water can be expected if water available is plenty because quantity of water supplied in wet season is more than that in dry. Also, it is recommended to continue the study in different localities and communities with different socio-economic and cultural backgrounds.

Drinking Water Sources, Supply And Management Issues In Kathmandu City

Hari Prasad Dhakal
Deputy Manager, NWSC

I. Introduction

Kathmandu, the capital of Nepal, is a metropolitan City with a population of more than 600,000. Water supply in this city has generally been short since the last 15 years or so. With rapid population growth (about 5%), the demand of water is also rapidly growing every year. The efforts of Nepal Water Supply Corporation (NWSC), the authorized organization for the supply and management of water supply, to promote the quality and quantity of supply, has been nullified during the last decade due to high demand growth. NWSC has very limited raw water resources within Kathmandu valley, High percentage of treated water is lost in the distribution system as leakage and wastage, further deteriorating the system supply. High percentage of leakage from distribution system due to the presence of very old pipes which have already lost their life. Physical and technical barriers make it difficult for equitable supply in all distribution areas. Thus, much remains to be done for better supply conditions.

II. Sources of Water Supply in Kathmandu

The main raw water sources in Kathmandu are shown in Table 1. It consists of surface water as well as groundwater sources.

Table 1: Raw Water Sources

Name of Source		Capacity (MLD)	
		Minimum	Maximum
A. Surface Water			
1.	Sundarijal (Old)	2.0	19.6
2.	Sundarijal (New)	20.0	23.0
3.	Shivapuri/Bishnumati	2.0	22.0
4.	Balaju (Alle, Bode, Bhandare, Panchmane, Chhahare)	3.0	10.0
5.	Nakhu	2.0	4.0
6.	Dhudh Pokhari	2.5	2.5
7.	Lunkot	0.5	0.5
8.	Sim Jowahity	1.0	1.0
	Total	**33.0**	**82.6**
B. Ground Water			
1.	Manahara Well Field	4.0	7.0
2.	Gokarna Well Field	2.0	4.0
3.	Dhobikhola	1.0	1.2
4.	Bansbari Well Field	4.0	9.0
5.	Mahadevkhola Well Field	2.0	5.0
6.	Insolated (Sinamangal, Kuleswor, Kalanki, Kalimati, Tahachal, Gongabu, Chandol	5.0	5.0
	Total	**18.0**	**31.2**
	Grand Total (A + B)	**51.0 (64.2)**	**113.8 (100.6)**

A. Surface Water Sources

1. Sundarijal System (Old and New)

Sundarijal system is the main raw water source of Kathmandu. The river of which Sundarijal intake is constructed in Bagmati. NWSC gets a total of 42.6 MLD water in wet season and 22 MLD in dry season from this source, the old scheme, built in 1960's has a capacity of 19.6 MLD, whereas the new one built in 1992, has a capacity of 23 MLD.

The old system consist of a treatment plant at Sundarijal and treated water is taken to Mahankalchaour reservoir, through a 20' main pipe for city supply. A small portion (@ 5 MLD) is supplied in the area enroute. Thus effective volume coming to distribution reservoir is only about 14.6 MLD in wet season. In dry season, however, this system is treatment as a distribution line and about 2 million litres water is supplied.

The new system consists of a raw ater reservoir at Sundarijal and this raw water is carried directly to the Mahankalchour treatment plant. Full 23 MLD comes to the plant in wet season but in dry season, available water (after distribution through old system) of 20 MLD is taken to the plan.

2. Shivapuri/Bishnumati System

Two separate intakes are built at Shivapuri in the Shivapuri conservation area, near conservation office, and Bishnumati, towards northwest part of Budhanilkantha school, Shivapuri intake a popularly known as Muhan Pokhari. Lot of water is available during 3 months of rainy season, but the rivers dry, significantly in the dry season. Total water is available at driest periods is only about 2 mld, whereas 22 mld is taken in rainy season. The first resin, where by two-repartee intake was built and the water carried to Maharajgunj treatment plant and reservoir. Later in the year 1993 the system was further developed so as to bring the excess water in wet season. For treatment, new treatment plant was built in Bansbari. At present. the old system works as a distribution line, supplying water to areas like Budhanilkantha, Chapali, Hattigauda, Hepali and Bansbari. In dry months, intermittent supply is provided to the areas whereas the new system carries the remaining water for city supply.

3. Balaju System

It consists of 5 small stream sources namely Alle, Bode, Bhandare, Panchmane and Chhahare in the northern hills of Shivapuri and Nagarjun water from all sources are collected and taken to Balaju treatment plant and reservoir. After local distribution, remaining water only is taken to the plant. Combined capacity in wet season is 10 mld and that in dry season is about 3mld, local demand of about 2 mld.

4. Nakhu System

This system takes raw water from Nakhukhola, just upstream of Nakhu jail water from this Khola is extensively used for irrigation in the upstream side of taken, so that very little amount is left in the Khola for drinking purposes. The minimum quantity available during dry season is about 2 mid, which is available during wet months (almost 9 months) the water is taken to Sundarighat treatment plant and reservoir at Kirtipur. The system is in operation since 1990, but it was improved in 2000.

5. Dudhpokhari Scheme

It is a spring source, located in Dudhpokhari towards West side of Kathmandu. It is one of the old systems, total capacity is 2.5 mld which is available throughout the year. Small chambers are build in the intake site at Dudhpokhari, and collected in collection chamber. Then water is taken to Bhajangal reservoir at Kirtipur for distribution. Local distribution consumes nearly one third of water.

6. Lunkot Scheme

It uses spring source water. The source is located in Matatirtha VDC towards west-north part of Kathmandu. It is also an old system. Total capacity is 0.5 mld and is available throughout the year.

7. Sim Scheme

It also uses spring water. Water is taken from source at Sim of Kiritpur to Kirtipur town area by pumping. Two pipes originate from the source to Kirtipur with total average capacity of 1 mld throughout the year.

Thus total surface water available in Kathmandu (including Kiritpur) is about 82.6 mld in wet season and 33 mld in dry season.

B. Ground Water Sources

Nearly 48% of total supply in dry season and about 17% in wet season comes from ground water source. There are four major well fields namely Manahara, Gokarna, Bansbari and Mahadevkhola, where several deep tubewells are built at each field. These tubewells are about 300 m. are also built in other areas namely, Sinamangal, Kuleshwor, Kalanki, Kalimati, Tahachal, Chandol and Gongabu. Altogether, there are 30 tubewells in operation for supply in Kathmandu city. Total capacity is about 31.2 mid. Out of this amount, 25 mld comes from the major well fields and remaining 6.2 from isolated wells. Water from Manahara, Gokarna, and Dhobikhola well fields comes to Mahankalchour treatment plant, that from Bansbari well field comes to Bansbari treatment plant, that from Mahadevkhola well field comes to Balaju treatment plant. Water from isolated tubewells are distribution in respective local areas. Apart from these one more tubewell is built at Laganchowk which is still to be taken in operation.

Conjunctive Use:

Ground water reserve in Kathmandu, is limited and the surface water available in streams is far less in dry season. Thus in order to balance the supply in dry and wet season, surface water is used upto the capacity in wet season when ground water is taken at minimum level. Similarly, ground water is taken at maximum level in dry season when the available water from surface source is minimum.

Total Production Capacity:

With the conjunctive use, maximum capacity of production in wet season is 100.6 mld whereas that is dry season is 64.2 mld. These figures are shown in bracket in Table 1.

III. Quality of Water:

Water quality from spring sources, namely, Dudhpokhari, Lunkot and Sim, is excellent for drinking. Water from other surface sources namely Sundarijal, Shivapuri, Bishnumati, Alle, Bode. Bhandare, Panchmane Chhahare and Nakhu is also good in wet season. However, the water is turbid in rainy season. Except turbidity, all other quality parameters are good. PH is generally towards lower side in rainy season.

Treatment Plants:

There are 5 major treatment plants located at Sundarijal, Mahankalchaur, Bansbari, Balaju and Sundarighat. In Sundarijal, only surface water from old Sundarijal scheme is treated. Mahankalchaur treatment plant purifies water from new Sundarijal scheme, as well as ground water from Manahara, Gokarna and Dhobikhola well fields.

The plant at Bansbari, treats water from Shivapuri and Bishnumati sources as well as ground water from Bansbari well field. Similarly Balaju plant treats surface water from Balaju system as welt as ground water from Mahadevkhola well field.

Table 2: Capacity of Treatment Plants

Name of Treatment Plant		Capacity mill.its./day	Remarks
1.	Sundarijal	19.6	Surface only
2.	Mahankalchaur	26.0	Ground + Surface
3.	Bansbari	22.0	Ground + Surface
4.	Balaju	10.0	Ground + Surface
5.	Maharajgunj	8.0	Not in operation
6.	Sundarighat	4.0	Surface

Table 3: Description of Reservoirs

Reservoir Location		Number	Total Capacity (mill. Litres)
1.	Mahankalchaur	3	8.5
2.	Bansbari	1	2.0
3.	Balaju	1	3.5
4.	Maharajgunj 1	2.0	
5.	Sundarighat 1	0.8	
6.	Bhajangal	1	0.8
7.	Kirtipur Clean Water Reservoirs	2	0.6
8.	Mahankalchaur	1	1.0
9.	Bansbari	1	1.0
10.	Total	12	20.2

Quality of Treated Water:

There are separate water testing laboratories of each treatment plant, to test daily water quality. As per test reports, the quality in the treatment plant and distribution reservoirs is within the limits prescribed by WHO.

Apart from the laboratory at each treatment plant, there is a central laboratory at Kirtipur. The central laboratory tests water at different distribution points, regularly, co-ordinates plant laboratories and monitor overall quality of water supplied.

IV. Reservoir Capacity

Supply reservoirs are located at Mahankalchaur, Bansbari, Balaju, Maharajgunj, Kirtipur, Sundarighat and Bhajangal. Their capacities are shown in table 3. Total capacity is 18.2 million liters.

A part from these raw water storage capacity of 10 mill litres exist at Sundarijal. Similarly, clear water reservoirs, one each at Mahankalchaur and Bansbari are available. The capacity of each is one-mill litters, totaling two mill liters. Thus total clear water storing capacity is 20.2 mill. litres and that of raw water storage is two mill liters.

V. Water Demand

Demand forecasting in Kathmandu, has always been a difficult task. The difficulty exists particularly because water supply has always been short. JEC survey in 1989 showed a per capita demand of about 86 liters per day. At present about 88,000 connections are registered in Kathmandu, apart from about 700 public tap stands. Out of the total of 88,000 customers, nearly 2000 customers have two or more connections. In an average, 10 persons in an household use NWSC supplied water. Thus it is estimated that about 860,000 population is using this water.

Similarly, Industries, commercial enterprises, security personnel, institutions etc. demand about 10% extra amount of this water. These are taken care by the bigger sized connections. With these. total population equivalent comes to about 946,000. Assuming 86 ets. per capita demand per day, total demand comes to about 81.4 mld. This is an average figure and fluctuates 5% plus and minus in different months. With total capacity of 100.6 and 64.2 mld respectively in wet and dry season respectively and an estimated 38% leakage/wastage, actual available quality in the two seasons become 62.37 mld and 39.8 mld. Thus there is a high gap between demand and supply in both seasons.

VI. Supply Management

For supply management, NWSC has separated the total areas in different supply regions. Accordingly, Mahankalchaur system water is supplied to Baneshwor area (Ward 10, 34, 35), city core areas (Ward 19, 20, 21, 22, 23 24 etc.) and other area like Dillibazar, Maitidevi, Putalisadak, Thapathali, Teku, Kamaladi, Handigaun, Bhatbhateni, Chabahil, Gaushala etc. Similarly, Bansbari system supplies water to Bansbari, Maharajgunj, Baluwatar, Lainchaur, Samakhusi, Thamel, Bishnumati corridor areas. Balaju reservoir supplies water to Nayabazar,

Thamel, Paknajol, Chhetrapati, Tahachal, Swoyambhu, Balaju, Kalanki etc. water from Maharajgunj and Balaju reservoirs also enter city core areas at some parts. Kalimati, Kuleshwor, Kirtipur, Balkhu etc. are supplied through Sundarighat and Bhajangal reservoirs. Water from Dudhpokhari, Sim and Lunkot is supplied to Kirtipur area.

Supply System:

NWSC has a policy of supplying one time water during wet months and alternate day or one time in 2 days supply during dry months. This is done as an attempt to supply equitably at suppressed demand level. Average supply hour ranges between 1 to 2 hours, but there are areas getting less or more than this average duration. The systems are regulated by 6 branch offices.

VII. Characteristics of Distribution Network

1. Complicated Distribution Network:

The System is a combination of old and new systems. Balaju was the first system developed for the then demand Later on settlement increased for which new supplies was necessary. Therefore to meet the demand, Maharajgunj system was developed. The water was boosted by interconnecting these two systems and laying new distribution mains to new areas. Again, settlements increased and people residing in higher geographically elevated areas suffered from water. The available water was consumed by people residing in lower elevated areas. To meet the demand at higher elevated areas and serve new settlement as well, Mahankalchaur system was developed. The system water was also connected to place where supply was low. In so doing, all system were interconnected. Later, when supply again became short and further new settlements increased, Bansbari system was developed. This system was also connected to old system at many places. Thus the distribution network become complicated with a lot of connections and interconnections.

2. A Weak Distribution Network:

Any distribution system becomes weak when the number of connections, may be customers connection or distribution connection, became more. Kathmandu system is more weak because the connections are made between two different sized pipes, different materials pipe, different aged pipes carrying different quality water at different times. There are pipes with age more than 120 yrs and new ones, just laid. There are more than 100,000 customer connections, about 5% or say 5000 plugged holes, more than 1000 operating valves, more than 2000 distribution pipe connections and almost same number of non operating valves. Since all the system are interconnected and the quality of water from different sources, carry different type of water, the pipes carry different quality water at different times. Particularly, water containing iron is detrimental, for the life of the pipes.

3. High Percentage of Leakage:

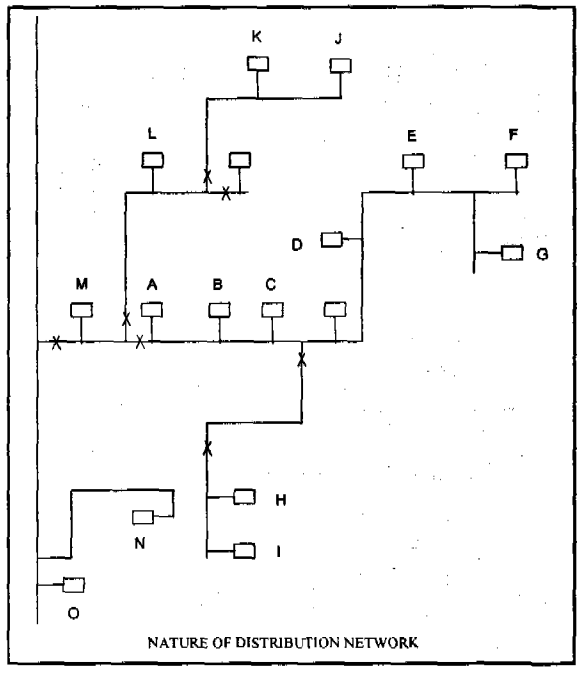
As the system is weak, there are more chances of leakage. All customer connections, valves, and other connection points are the sources of leakage. The leak increases with increasing pressure. Since the supply in Kathmandu is intermittent, high leakage is possible during supply hours. At non-supply hours, leakage exists, but at lower rate. The leakage causes removal of water from pipe at non supply hours too, such that pipes become empty For the next supply pipes have to fill again thus requiring additional fresh water

If sufficient water is available. the leakage still becomes more. It is estimated that about 50% of Households in Kathmandu (ie 50,000 connections) have fully plumbed internal systems. In one household there are a minimum of 50 joints in pipe. If only 2% of the joints leak, ie 1 number per household, then 50,000 joints are leaking. Even if the leak is in drops, the amounts of leak becomes at least 40 Its, thus making leak amount of 20,00,000 Its/day . Similarly out of 100,000 connections with minimum of 5 joints including connection point if any one of them is leaking, there shall be 100,000 leaking joints altogether . Now if leak from one joint is 40 Its/day total leak amount is 40,00,000 Its per day . Apart from these it is found that as much as 50 pipe leakage are reported every day. In general assuming the amount of leakage from one such leaks as 10,000 Its/day total amount could be 5,00,000 Its/day. Similarly, as stated earlier about 5000 number of connection fitting and valves are present in the system If one

such fittings leak at a rate or 1000 Its/day then as much as 50,00,000 Its go on leak. Thus it is obvious that a minimum, of 11,500,000 Its of water just leaks every day. Since the number of connections increase every year, the amount of leak also goes on increasing every year

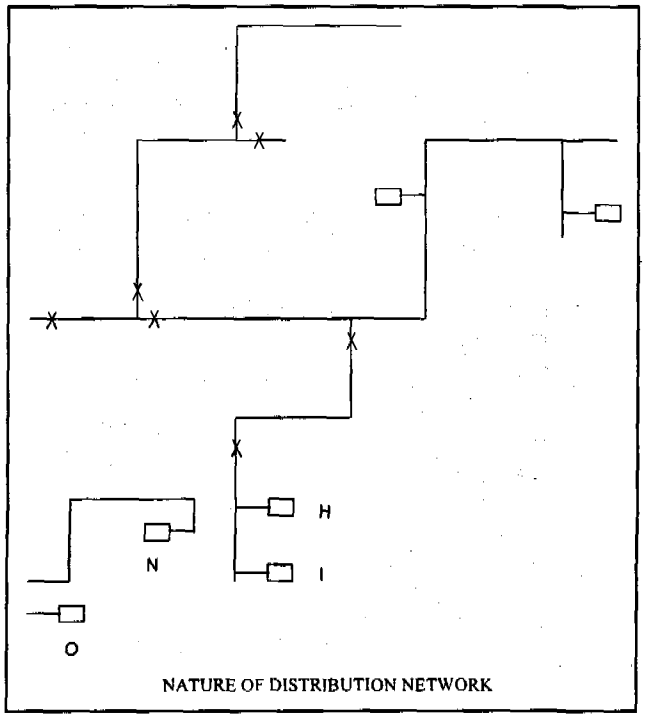
4. Long distribution mains:

Kathmandu distribution network is characterized by small diameter long distribution lines. Such lines have to be supplied for long so as to maintain supply at tail ends. A typical example is shown in fig 4.



NATURE OF DISTRIBUTION NETWORK

Customer M gets water throughout the supply period, customers A,B,C, get water for majority of period. whereas customer G gets water for a short period Since supply hrs has to be more, such network has greater leakage, Customer N has a long connection pipe and hence gets water at low pressure. This line has chance of more leakage. Customer O enjoys full time supply at good pressure.



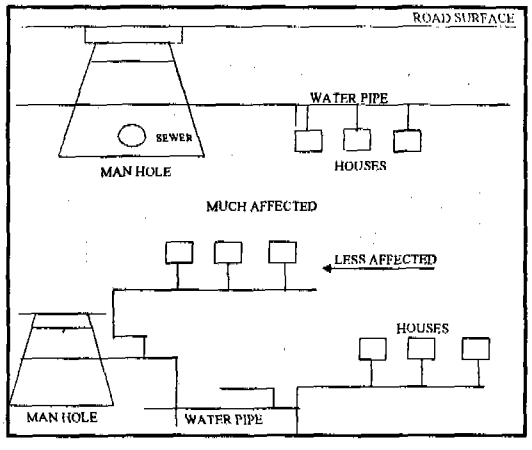
NATURE OF DISTRIBUTION NETWORK

VIII. Effects of leakage:

Apart from the fact that leakage shall have negative effect on total supply of water, its main effect is pollution Once the water leaks, it creates a passage for air and water to enter into the pipe or go out from the pipe to outer surface. That means pipe water goes out when pressure in the pipe is more and outside water (can be drain water, sewage etc.) may enter the pipe when pipe is empty and submerged in outside water . If the outside water happens to be sewage, surface run off or drain water, then serious negative effect occurs.

Drainage and sewerage system in Kathmandu is not well managed . Due to narrow lanes, sewer pipe, water pipe Telephone lines and surface drain all run near and parallel. In many occasions these pipes or drains cross each other. Particularly serious problem arise when water pipes cross through sewer manhole or a drain. Since sewer or drainage systems are not well managed, they often clog and remain full, submerging the water pipe. Water supply being intermittent. the water pipes are generally empty for majority of hours. In this period, the sewage or drain water enters the water pipe, creating pollution.

The effect is more severe when, the pipe getting pollution serves areas at lower elevation, because then, the whole of polluted water enters customer connections directly If the house happen to be located at higher elevation, and water has chances to flow towards big trunk mains, the effect become smaller.



IX. Supply Management issues:

Kathmandu water supply is generally criticized of one or more of the following issues:

1. Insufficient or no supply
2. Odd time supply
3. Inequitable supply
4. Irregular Supply
5. Poor quality Supply
6. Unsatisfactory level of repair/maintenance
7. Digging everywhere and digging after a new pavement is made
8. Charge more even when supply is inadequate
9. Problems not seriously listened
10. Delays in works
11. High rate of leakage

Let us examine why these problems exist and what NWSC is doing to cater for minimizing such criticism.

Issues numbers one and two related to inadequate production capacity. NWSC is helpless in these regards because production itself is far less than average demand. No alternative exists except bringing a new source of water or supply at suppressed demand level. Some improvements could be made by reducing amount of leakage which stay at around 38% at present, but possible reduction of even 10% shall need a huge amount of money.

Odd time supply (eg night time) is a result of inadequate water and less storage capacity. Since all customers cannot be supplied in a period by 4, 5 hrs in the morning and 4, 5 hrs in the evening with the income flow, it has to be stored in reservoirs. With sufficient storage available, there is no room to store water for more than 5 hrs. out of 24 hrs, a total of 10 hrs goes for storage, another 10 hrs goes on two shifts supply, thus 4 hrs flow becomes surplus which has to be supplied in the night time to possible and suitable supply areas. The situation still worsens in the dry months because then, alternate day supply has to be maintained, making up a total of 48 hrs between two successive supplies. Available water then, being less, supply areas have to be made still more.

NWSC has created two major areas namely Baneshwor and city areas for daily one time supply, providing one area in the morning and the other area in the evening shift. These major areas are further divided in several parts so that each part gets supply of I to 2 hrs, the division is made by operating over 500 valves in Kathmandu. In the alternate day supply too, these major areas remain same but both the areas get supply in the morning where as the evening supply is given to small other areas where supply could be practically maintained at reasonably acceptable level.

Inequitable Supply:

At supply times water has to travel a long way to reach all customers. In general big trunk mains are laid at major roads, originating from supply reservoirs and ending at the tail ends of distribution system. Water has to be given time (say 5 Itrs) from such mains so that small parts could be fed for I to 2 hrs by operating distribution valves. Many individual connections are made (Particularly common pipes) from trunk mains, who enjoy supply of full 5 hrs. similarly there are long distribution mains needing long time supply to each in the tail end connections. In so doing, customers, near to trunk mains get more supply where as those towards tail end get supply for fewer periods.

Similarly, landscape not being plain, customers at lower geographic elevation, get water at good pressure as well as for long periods.

Irregular Supplies:

Water has to be pumped and distributed when electricity fails or when pumps fail, it takes time to recovers or repair. The supply then is disturbed. One disturbed the demand in the next day rises. This affects a large number of customers stationed at elevated areas, and hence for such customers, supply becomes irregular.

High Rate of Leakage:

It is no doubt that Kathmandu water supply system is characterized by high rate of leakage. In fact NWSC has already studied the leakage and carried out extensive leakage detection and repair program. The study showed the maximum leakage occurs from the connection point of individual connections and the distribution main pipe leakage is seen from old corroded GI pipes. The study did not enter the main city core areas. but it is clear from NWSC experience, that this is the area of maximum leakage. The pipes are very old (as much as 100 yrs). At many occasions, leakage is not seen in the surface, because, the lack water enters the sanitary sewer nearly and is carried away to rivers. At times when the sewers clog, it enters thc water supply mains and pollutes drinking water. This is the reason why polluted water comes from the water traps.

Difficulty in Repair & Maintenance:

Ours is a developing country. Construction works concentrated at the viscinity of roads is a regular phenomena. Water supply works for repair and maintenance is greatly affected by the following reasons.

1. Water pipes are laid and after some time, drainage works or sewer tines are laid in so doing pipes could be damaged either due to digging or due to excavation and pavement works. Paving people are concerned only with their work and do not bother much if pipes are broken. Once paved, it is difficult and costly to get approval or a permission to dig for repair.

2. Sewer lines and manholes are made just in line with the pipes line (many be due to narrow roads). The pipes in many occasions run through the manholes. The sewage damages water pipe by corrosion and it leaks. Such points are difficult to repair.

3. Pipes laid in a narrow lane are very difficult to repair due to traffic problem. There is no alternative, except to repair at mid night, when traffic is almost is for a week and leak remains unrepaired.

4. Sometime it is very difficult to trace a leak. The broken point many sometimes be even 100 ft away from where it is actually seen.

5. Leak repair at some occasions need particular types of fittings, which may not to be available in the NWSC store and also in the local market. It needs time to procure such fittings Thc situation becomes even worse when odd sized pipes are to be repaired.

Problem of digging anywhere is the result of the fact that leaks may occur anywhere and any time. It is not wise to just wait for years to repair due to the reason that pavement is newly made.

Charge more even when supply is inadequate

NWSC has a policy of raising water tariff for water it has supplied. For this purpose. domestic meters are installed. In some occasions, when there is shortage of meters, or some difficulty in installing meters, NWSC charges a flat rate. If the customer does not get water at all or get less than 3,000 its in a month, then minimum charge. For the purpose of maintaining or keeping registration, is taken,. In case, the customer feels that he shall not get water at all, he can also close his connection temporarily. In this case NWSC does not take charge.

Since it is very difficult to certify which customer gets less than 3000 in a month, supervisors who look after the supply of the concerned area has to survey and certify the situation. The process may take a few days decision but any customer could contact concerned office and get the work done for a period of 3 months, after which he has to again file another application if situation doe not improve.

Delay in Works:

Delays are sometimes made intentionally and sometimes due to unavoidable circumstances. Particularly new supplies are delayed intentionally because of non-available of water. Similarly new pipelines are delayed due to the same reason as well as shortage of budget. Delays in other works might have occurred due to reasons stated in earlier part of issued. NWSC thinks that 90% or more customers are listened at once. Others might be unfortunate due to unavoidable circumstances or some procedural reasons. However, NWSC always respects its customers and tries to listen each and every customer's problems.

X. NWSC Efforts:

NWSC is continuously desirous to minimize the complains. The basic problem being the inadequate supply of water, its main concern has been towards improving the level of production and reducing percentage of leakage. Apart from these, it has opened branch office at 6 places so that complains could be received easily and early solutions be made for better supplies and service.

1. Increasing Level of Production

The long awaited Melamchi project is now outside the scope of NWSC. Separate provision has been made by HMG for its implementation. The design works are being carried out and the required funds are already arranged. The project is now scheduled to be completed within 6 yr. from now. After this project, there shall be no more water shortage in the valley.

Manahara project, which is expected to produce a maximum of 20 mld water is under design phase and is expected to come in operation within 1 year and 6 months from now. Similarly Sainbu project and Balkhu projects are in line for implementation. NWSC is regularly installing deep tubewells every year at potential sites. The number is around 3 to 4. They partly replace old damaged wells and partly bring more water from new locations.

2. Leakage Control and Repair Program

NWSC is launching this program since last several years. The result is not so enthusiastic but it has been able to limit the increasing rate of leakage. In fact about 2% leakage has been dropped down from 40% to 38%. This is considered useful because though the system is deteriorating, day by day due to completion of its age, and though. lot of extension works, leaving room for more leakage, are carried out annually, leakage percentage has dropped down.

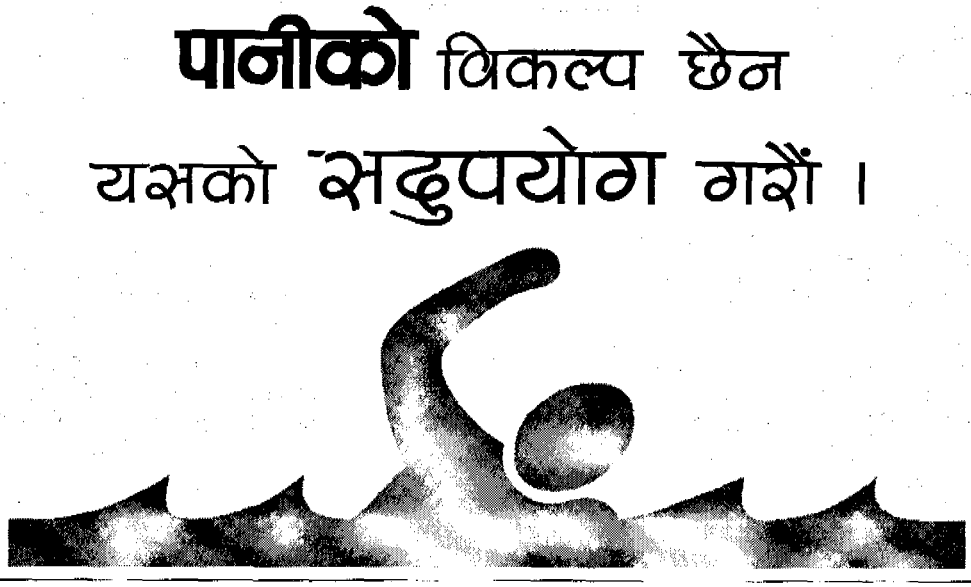
3. Provision of Branch offices

NWSC has opened branch offices in 6 places in Kathmandu. They are Mahankalchaur, Maharajgunj, Baneshwor, Tripureshwor, Chhetrapati and Kamaladi. This has helped customers to maintain a short approach to the office, easiness in paying water bills, and maintain an easy and direct contact to NWSC for problem solving.

XI. Conclusion and Recommendation:

Water supply system of Kathmandu needs a lot of improvements. In the first place, production capacity has to be increased by considerable amount. NWSC is facing a lot of problems to improve service delivery to customers, no doubt, are facing trouble . To improve the situation, two works are required. As stated earlier, the first work is to increase production and the other work is massive rehabilitation of distribution network, from where, high percentage of clear water leaks and goes waste. The leakage is a major source of pollution too. Thus with these works pollution shall be controlled and better quality shall be received at taps.

Implementation of rehabilitation works is very difficult. Major hurdles to NWSC are: budget and coordination among different agencies involved in development activities at roads or road sides. To avoid or minimize difficulties, one of the alternatives could be to take all such agencies, particularly service oriented agencies, under one umbrella, Kathmandu Valley Development Authority, if formed, is a better option. In the absence of such organization, NWSC is keen to work with local communities, and in fact should try, for better service. If close cooperation and coordination exist, results shall certainly be positive. Certain mechanisms have to be developed for cooperation and coordination.



Mainstreaming SODIS: A Promising Technology for Future

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Introduction to SODIS technology

The solar radiation has two types of effects in water: increase in water temperature and effect of UV rays to the microorganisms. The combined effect of heat and UV rays falling upon the volume of water brings about synergic impact capable to destroy the microorganisms including the pathogenic ones existing in the water volume. The water intended for drinking purpose is filled in suitable bottles made of plastic or glass with 1-2 liters capacity. These days plastic bottles of mineral water available in the market are more popular than glass bottles due to their lightness, low cost and in mass scale consumption. The bottles with full of water and airtight caps are continuously exposed in sunshine for 6 hours. Then the water in the bottles becomes fit for drinking. The empty bottles are again reused through the same process. Replacing of old and scratched bottles can improve the efficiency substantially. The technology of water disinfection by using solar radiation in such a way is called the SODIS (Short form of SOLAR DISINFECTION).

The water intended for SODIS application should be clear with turbidity level less than 30 NTU (Nephelometric Turbidity Unit). The efficiency is reduced as the turbidity and water height increases. The SODIS bottles should be exposed for two consecutive days if the sky is covered during the exposure period. In that case, the number of bottles should be doubled for everyday use till the cloudiness continues. The recent researches conducted by ENPHO/ EAWAG/SANDEC at many locations of Nepal revealed that half-black painting of bottles are no more required for SODIS application. Clear bottles without any painting are as much effective as the half-blackened ones.

Though the SODIS method is simple to apply, people will have to be introduced carefully and get guidance about day-to-day application if they are to benefit fully. There are examples in many developing countries where the users find SODIS applicable in their everyday life. A survey conducted in different countries found out the following reasons stated by those who accept and continue practicing SODIS because:

i) It is easy, practical, and provides good and clean drinking water;
ii) Its application consumes less working time and burden for daily activities (no boiling means no starting fire, no fuel, no washing up the kettle);
iii) There will occur no pathogens anymore, less sickness, less diarrhea, no stomachaches
iv) It saves costs (firewood, fuel);
v) It represents higher status of living and improver's quality of life;

The costs of SODIS are divided into investment (cost of bottles) and operating and maintenance costs. The latter ones are negligible, since solar energy is free of charge. The cost of PET bottles vary from country to country and usually amount less than 0.20 US$/ bottle for a family of an average size. For example, in Nepal, the annual costs for a household of 5 persons (4 bottles/person) would amount NRs.300.00 only, provided that the users have to buy new bottles of mineral water of one-liter capacity once every year. If compared the costs of boiling or filters in a rural area with the costs of collection and transportation of mineral water bottles from a market of tourist area, the difference is clearly significant. The only effort required is to spend some time for the collection and cleaning of bottles freely available in the market, hotels and tourist areas. These days it is also common that general people do buy mineral water bottles during their travel period. The same users in their own households could also utilize such bottles.

Insight into the past and ongoing activities

- Lumbini/Nepal (2000): Global Resources Institute (GRI) conducted a 9-month program for research and promotion in communities with 772 HHs. The number of diarrheal cases reduced from 15.7% to 3.2% within that period.
- Indonesia (2000): The number of families in two villages within a 12 months period increased up to 330
- Kenya (2000): Promotional activities were conducted and had successful results
- Sri Lanka: Promotional activities are in progress
- Latin America: In 7 countries the program has gained grand success and the govern ments have already recognized SODIS as a formal method of treatment for disinfection of water
- Thailand: In 2 villages after introduction of SODIS 86% of the gastrointestinal com plains were reduced within 5 years of intervention.
- Changunarayan/Bhaktapur (2001): A program was conducted with support from DWSS/WHO for community orientation on use of SODIS and promotion of on site sanitation. During the program 189 households in the communities started and continued to apply SODIS within a period of 8 months.

Present Activities of DWSS

- SODIS testing is in progress at many locations (Tansen, Nepalgunj, Ratnanagar, and Kathmandu)
- Promotion of SODIS is ongoing and expected to be extended in Bhaktapur/ Changunarayan
- Testing at high altitude locations Daman, Dhunche and Charikot has been planned in near future. Testing at Dhankuta and Itahari is also in the plan.

Activities of Other Organizations

- ENPHO has been working for research and promotion. A presentation of recent research data obtained by ENPHO/SANDEC indicated possibilities of SODIS in many ecological regions including high altitude ones. ENPHO is also involved with DWSS for research on SODIS.

A Focus on the DWSS experience in Changunarayan and other regions in Nepal

In the year 2001 a program was conducted in Changunarayan Village (consisting of 1120 households) of Nepal with the objectives of community orientation on application of SODIS and improved latrines through a participatory approach. Meetings were conducted in the community for dissemination of SODIS technology and orientation of the community people to apply the technology at household level. Local motivators were selected through the ward level meetings for promotional campaigns. PHAST was applied as a participatory tool since inception of the program. Trainings were provided with basic concept of SODIS and latrine construction with a good understanding of the importance of safe water, health, hygiene and sanitation at personal, household and community level. As a result of the program within 8 months' period, 189 households started to apply the SODIS method in their households. Simultaneously, 54 latrines were constructed within the period. The selection of the households interested in latrine construction was also decided through the ward level meetings. Technical support with skilled labor and non-local materials for latrine construction was provided as subsidy through the program.

Prior to the promotional activities, baseline data on situation of health, water supply and

sanitation in the wards was collected with the help of the motivators. The baseline information collected for the period of May-October 2001 revealed that there was as many as 23.5% of the population suffered from water related disease cases within the last 12 months. From the baseline survey it was also found out that 64.2% of the households have latrine facility in their premises. Similarly, 28.8% of the households were found to be using local traditional water sources such as kuwas, dug wells, stone spouts etc. for drinking purposes. Most of the water samples (35 out of 40 nos.) collected from the local sources and from household storage vessels were found contaminated with fecal coliforms.

The people participating in the SODIS promotion campaign showed their interest and enthusiasm about the sustainable application of the technology in their daily life. Therefore it had become essential to provide a support for maintaining their enthusiasm and utilization of their skill and knowledge so gained by them. The motivators had many questions and curiosities concerning the efficiency of SODIS in their community. In this context, the testing of water in the SODIS bottles used in the community revealed that 40% of the samples out of 35 nos. were found completely disinfected. It was also found that there was substantial reduction in the number of fecal coliforms in the remaining samples with fecal contamination. The percentage of completely treated samples of SODIS water is possible to increase with continuous support to the motivators and institutionalization of the promotional campaigns through organized effort at local level. In this context, the demonstration of water testing and SODIS efficiency was applied as a supporting activity for motivation. Therefore, even after a period of 1.5 years there are 66 users in the village still applying SODIS technology in their everyday life.

The program conducted in Changunarayan Village of Nepal in the one hand has achieved its objectives of promotion, but in the other hand, it was not sure whether it is possible to achieve significant level of efficiency of SODIS in Changunarayan and other regions of the country. Therefore it has become important to know where and in which conditions the technology can be applied with its maximum efficiency. As the country has diverse ecological and climatic zones, it is essential to have and use the data on efficiency of the SODIS based on the diversity of ecology and geographic locations. It is also very much important for dissemination of the technical information and subsequent promotion of the technology at the feasible locations where maximum efficiency can be achieved with minimum efforts and caring. There is no such data available for the condition of Nepal based on extensive research. In this regard a research for generation of the necessary data based on extensive fieldwork would fill the present gap.

Therefore a program for field trials on applicability and promotion has been started in different locations of the country with support from WHO/Department of Water Supply and Sewerage (DWSS)/Government of Nepal. The experimental data and information collected from the field tests would be vital for recommendation of SODIS application in the respective areas. This will provide basic guidelines for promotional campaigns in the communities. Only after then it would be possible to have confidence over the level of SODIS efficiency in different ecological zones. The tests conducted so far for demonstration purposes have shown promising results. The promotion has to begin after successful transfer of skills and technology to the local technical staff of DWSS line agencies at the districts. The activities are in progress so that the testing works and promotional campaigns can go simultaneously in the near future. It has been planned to conduct the demonstration stations at Dhankuta (1210 m), Itahari (72 m) and Daman (2314 m) also.

Lessons Learnt from Research and General Experience

Following are the basic lessons learnt and findings from international and national experiences:

- SODIS shall be promoted in areas with appropriate climatic conditions, where the population has no access to safe drinking water and does not permanently use any other kind of household disinfection method.
- Careful community education approach is required in order to establish SODIS at grass root level. Integrated approach linked with hygiene education and sanitation is more beneficial for promotion of SODIS.
- Dissemination of information on SODIS by all the organizations working in water and sanitation sector is essential in order to make SODIS widely applied by the majority of people.
- For SODIS to be efficient, 5–8 hours exposure is sufficient during fully

sunshine days as per the research results of ENPHO/SANDEC in Nepal. In average, removal rates within the range of 90-99.9% were achieved from the research at different stations including High Mountain ones.

- 83% samples (out of 53 samples) were found completely (100%) treated during the tests conducted under DWSS/WHO program. The tests conducted at Ratnanagar, Tansen, Nepalgunj, Dhunche and Hetauda revealed that complete treatment is possible during 6 hours of normal sunshine days

Current problems and issues in general

The problems and issues concerning promotion of SODIS is related with the questions how to bring it into the mainstream of the development process in order to reach the desired users and increase the demand on SODIS. The problems related with promotional programs still have to deal with the issues as following:

1. How can a large proportion of the poorest part of the population be reached with simple messages and instructions on how to use SODIS?
2. What are the factors enhancing the acceptance and application of a new method of water treatment like SODIS?
3. How could SODIS be integrated into ongoing health and hygiene education and other development related programs?
4. What are the targeted benefits of SODIS use at household level and for national economy in a developing country like Nepal?
5. Is SODIS attractive enough to arouse the broad interest of masses? Can its attraction be increased with present level of initiatives?
6. How intensive and how long should follow up on SODIS implementation projects be in order to reach sustainability?

Future implications and areas of further research

The activities so far conducted in Nepal for research and promotion of SODIS may have implications to many sectors, especially to the following, among others:

Economy and Poverty Alleviation: The reduced hardship and consumption of time for collection of fuel and boiling of water certainly imparts to economy of individual households and consequently to the national economy in general. Poverty alleviation through availability of more opportunities by the saved time can be considered as the main impact to the national economy.

- **Energy Saving and Environment Conservation:** The reduced consumption of fuel (fire wood, kerosene, gas, electricity) will contribute for energy saving programs and management of energy demands. In rural and semi urban areas with huge consumption of firewood for daily needs of the people, there will be a contribution for environment conservation, especially of forest resources.

- **Improvement of Hygiene Behavior and Sanitation Situation:** As the promotion of SODIS and its efficiency is closely related with hygiene behavior and sanitation of the individual consumers, increased use of SODIS certainly lead to improvement in those aspects. Increased awareness of people on importance of proper hygiene behavior and improved sanitation facilities help promote on site sanitation and other environment in the communities.

- ***Improved Health:*** *The basic objective of* SODIS promotion has been considered as to encourage people to drink safe water. Regular use of bacteria free water in the long run will reduce the number of diarrheal cases in the user communities. The improved health situation of the people helps reduce mortality and morbidity rates and the costs for medical treatment.

- **Research and Development:** There are many aspects and issues for study and research that could contribute for widespread promotion of SODIS throughout the country. Technical and institutional aspects may be related with testing and demonstration of SODIS efficiency in the communities. The organizations working in water and sanitation sector can promote SODIS by integrating it into their regular programs. Pilot level initiatives for promotional campaigns can help a lot to bring SODIS into the mainstream of development. Research works on impacts to the above mentioned areas and aspects would also help understanding the importance of SODIS at the policy level.

Water Quality And Role Of Engineers

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1. Introduction

United Nation had designated 1981-1990 the International Water Supply and Sanitation decade. Following that HMG/N had set a target to achieve Water Supply for all by 2000. Many hope and trust that there will be adequate pipe, water supply and sanitation services for all needed people. As per WECs 2000 various document sources the achievement is that out of 19.8 million people 13.4 million i.e. 67.7 rural population was covered and out of 3.46 million people 2.2 million i.e. 67.6 urban population was covered. Hence, approximately 33% of Nepalese population does not have piped water system. According to UN Reports Nepal ranks 78 out of 122 countries in water quality on the basis of available water ability and commitment to improve water.

Every body knows that health is wealth. Health depends on nutrition and on the other hand with water. Road, hospitals, school as well quality water supply is basic public necessity. As per socio-economic situation, financial availability, technical suitability and sustainability the water supply projects shall be economically viable, environmentally friendly and effective in quality.

From 1970 till now we have seen a development pattern in the form of people participation people involvement, gender and development emphasis on health care.

On 4 March 2003 Mr. Moran, a U.N. representative, reported that 80 percentage diseases spread from water and 2 million people die annually. He suggested that to be free from water supply by 2025, 30-50 billion dollar is required to be invested annually. As per ESCO Director General Kochiro Matsumura " Water supplies are falling while the demand is dramatically growing at an unsustainable rate. Over the next 20 yrs. the average supply of water world wide per person is expected to drop by a third. Over the past 25 yrs. we have to provide basic water supply and sanitation services."

The success of implementation depends on life of project period and its sustainability. The outcome of piped water supply shall duplicate the improvement in health and economic development. As per economic viability and sustainable participation by stakeholders project period can be determines as per requirement. Project period also depends on available resources, human resources and numbers of users. Sustainability can be observed through the feeling of ownership, felt need, awareness, conscious in health and proper management.

For all these reason the engineers, administrator, social scientist and public need to have a clearer understanding of the diseases related to water and health. Engineers facilitate technical options suitable to socio-economic conditions, taking care of 'Prevention is better than cure'. Social Scientist promote in building awareness and motivation in bringing healthy environment.

The relationship between water and health has been recognized from the time of Hypocrites. Hosting people were settled in places accessible to water resources i.e. near by rivers, lakes etc. Snow (1855) Budd, Manson (1877) has discovered relation of disease to water cholera, typhoid, filariasis respectively. The relation of personal hygiene to health had been recognized for many years. Epidemiological studies show that the access to water determines the incidence to several infectious diseases.Since 1981rural water supply program was launched integrating it with sanitation. Within two decades promotion of public awareness, habits and use of water was carried out to fulfill the water demand. In these paper simple water quality study was carried out to find the role of engineers in building community water supply.

2. Objectives

The objectives of the study are as follows:

- To identify role of engineers in community water supply schemes
- To know physical, chemical and bacteriological quality in intake construction completed gravity water supply scheme
- To appraise sanitary inspection of sources wherever quality test has been carried out and assessed in relation to water quality test results.
- To find appropriate source protection and intake system improvement.
- Surveillance of water quality test results of rural water supply schemes.
- To find a strategy which identifies source most at risk from pollu tion and possible measures to be undertaken while constructing water supply system.

3. Sampling, Location and Area

In this approach two organization that is self help programme (NGO implemented project) and Line Agency (own engineer) implemented project were selected. Random sampling was carried out to find a similar source, which falls in western region of Nepal in different districts.

4. Methodology

Two different types of methodologies were applied to assess water quality namely micro-biological and physical water quality testing.

(a) Micro-biological Indicators:

Membrane filter method was employed to count the actual number of feacal coliforms in 100ml of water. For this portable incubator with its accessories were carried to the sampling site and membrane was incubated for 24 hrs. after routine suitable medium.

(b) Physio-chemical incubators:

WWF kit was used for physio-chemical quality of water. The parameters are as follows:

Stated physio-chemical parameters are :

- Total hardness-volumetric
- Iron-colorimetric
- Ammonia-colorimetric
- Choloride-colorimetric
- Alkalinity-volumetric
- pH Paper

The survey was carried out by Udaya Consultancy.

5. Limitation of the Study

- Since the study was carried out once the interpretation is very limited.
- Accuracy of the methods and equipment are other limitation.
- Since the results provided by field kits may not be precise.

Sources of infection can be contaminated or polluted which an engineer has to optimize for the quality water supply. However, chemical risks are small compared with the hazards from microbial pollution of water.

The survey was carried out in self-help projects in community water supply project and the project implemented by the line agency. The questions were based on source measures taken during the implementation and its design process. Sources were selected alike in both the organizations. Sources were categorized in the following terms:

Case 1. » The intake area is deep in sal forest and situated in gorge like structure. The human settlement is at the upstream of the source. Geologically stable.

Case 2. » There is small stretch of paddy field just above the spring
Case 3. » Source lies at the side of a village trail.
Case 4. » The stream source flows through dense forest and rocky area.
Case 5. » At the upstream of the source there are agricultural land as well as human settlements
Case 6. » Agricultural land around the intake structure.

The observed data are given in Table 1A, 1B, 2A, 2B, comparative chart in 3 & 4.
The data obtained from Nepal Water Supply Corporation, Pokhara, is given in table 5 and the water related diseases prevalent in Pokhara are collected from Western Regional Hospital and one Nursing Home are given in Table 6.

6. Results & Interpretation

The water quality of any water can be interpreted or compared with other similar data only if data taken were in similar conditions. As such a condition is not available and followed by the agency strictly in water quality respect, therefore, water quality is compared with available standard value which are set by water authority and WHO guidelines for water quality.

Physio-chemical quality of most water of the water sample have been found to be within permissible range of guidelines. There is which involve physio-chemical composition of the surveyed water sources. All the water sources are found to be fairly good.

Major problems observed in the system are PH value minimum 6 and the hardness 40-280 which may result in corrosion of pipes and incrustation in pipes. Therefore, an engineer should be aware of design of pipeline system for available quantity of water.

WHO guidelines for bacteriological quality of water is that they are considered too stringent and cannot be applied for small rural water supplies as these would be too unfeasible considering the environment of the country. According to R. Feachem as per environment condition standards has to be developed by further study. Therefore, 0-10 per 100ml of water feacal coliforms is recommended as low risk and 10-100 feacal coliform per 100ml of water is high risk. If 10-100 feacal coliform per 100ml of water then the water needs to be treated.

In some cases it was observed that feacal coliforms exceed more than 10 and hundred. Thus Engineer should be able to design delivery of safe water.

a) Community Water Supply

From the above comparative chart Table 3 & 4 list we had found the followings:

1. Organization 1 (self help program) is weak in technical implementation, example proper site selection
2. If silt is present at the source technical design criteria has to be developed and proper pipeline system has to be carried out in order to prevent clogging in pipes.
3. If algae, mosses are found in the source in 2:1 ratio, during survey/design appropriate alternative site has to be selected.
4. Negligence in design may cause serious effects in water supply system and at the same time source protection has to be developed through awareness program as well technically by fencing the source site.
5. In both organization 1rainwater drainage was neglected, this is lack of technical experience of the Engineers.
6. If latrine is situated above the source awareness motivation programs has to be launched.
7. It was observed that spring sources have similar bio-chemical situation whereas in stream the case is different.
8. Stream sources are venerable to bio-pollution.
9. In most cases, chemical test Iron was found near to Limit
10. Sources near to field (cultivated area) found chloride. It may be due to use of chemical in field.
11. In both the case sources were situated nearby agriculture field. The chances of pollution are high. Preventive technical measures as well as awareness has to be create for users.

12. In some places bacteriological presence were seen. Since the data was taken at dry season hence in rainy seasons the probability of having coliforms are high and health risk is high too.

b) Results of Metropolitan Water Supply Corporation, Pokhara

From Table 5 & 6 the following is the result:
In Pokhara Metropolitan city it is observed from Table 6 that lots of water related diseases are found in children aged 1 to 14. The main diseases are Typhoid, Viral Hepatitis and Gastro Entritis which are water related diseases.

By observing the data provided in Table 5 & 6 we can observe that the chemicals and bio chemical data itself denotes that chemical contamination are within limits. Where as bacteriological test show that it is on high risk and has to be treated for drinking water quality.

7. Role of Engineer

Before designing the water supply system Engineer should know bio-chemical combination of the water source. Accordingly he / she can design the water supply system and he/she can give alternative choices to the community. Community plays the vital role in decision making of the alternative sources.

Engineers should deal with chances of contamination and technical option that can be offered to the community for decision-making process. Engineers should know the bio-microbes behavior and disease transmission for relevant water improvements. Only then he/she can come up with proper preventive strategy to be undertaken in consideration.

Technical Personnel's role in facilitating the Decision making.

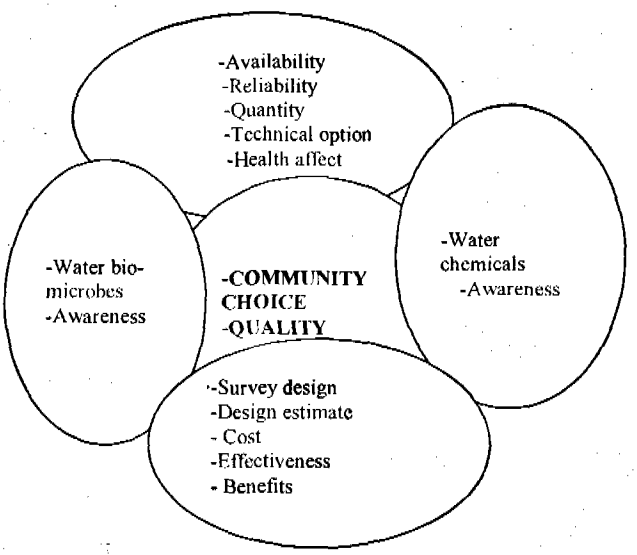

Fig. Prevention is better than cure

From the above diagram it is observed that Engineer (Public Health Engineer) should know behavior of society in availability, quality and affect of health as well technical solution in preventing water related diseases and chemical contamination. Engineers should come up with suitable technology (appropriate) that which is economical, environmentally friendly and effective in removing the water related diseases. The villagers should be able to invest, maintain and sustain the water supply scheme proposed by the engineer.

It is clearly observed by the results that self-help water supplies lack appropriate technical input and are often disorganized. This makes insignificant contribution to improve the water quality and reduce cost of projects. The finance collected is often insufficient and it hampers operation and maintenance.

Moreover, we must realize that self-help programs widely reduce cost and the chances of system falling into disrepair since local people are involved in decision-making process and their contribution has made available the pipe water system. Therefore, the project reflects internally developed aspirations and goals rather than externally generated ones. One of the main factors of the diffusion and acceptance is community choice as well as community participation. If a community implements a program by their will, the life of the project is longer and much more sustainable.

Taking the above into consideration in the beginning, qualified engineers have to involve themselves in developing alternative design options so that community have choices. The choice depends on system alternatives, system improvements, quantity, quality, felt need, finance and people involvement. Therefore, engineers should know social behavior, norms and economic condition of community whereby they can develop as appropriate technical as well social engineers.

8. Recommendations

Since community water supply schemes are small, so attention is not provided towards water quality. Therefore, the following steps should be undertaken:

- Bio-physical survey should be carried out in preliminary survey and rechecked during detail survey so that alternative choices can be provided to community
- Routine surveillance of existing supplies
- The isolation of pathogens by building appropriate sanitation facilities.
- Develop proper habit in use of water
- Developed standards of bio-chemical pollution as per the localized situations.
- Use appropriate technology for reducing diseases.
- In rivers, at least four bio-tests have to be carried out, that is two during monsoon and two during implementations.
- Primary health care programs have to stress improvement in water supply and sanitation. The concept of work effectiveness social benefits, health improvements etc. are co-related with water supply and sanitation program
- Emphasis on trained technical manpower who is both a social and technical engineer.

9. Conclusion

In total rural population 45 percent reaches the health post within thirty minutes. Still Forty Five percent of the population does not have access to the health post. Therefore, if water borne diseases is prevented by providing quality water supply then the need of health posts will be reduced.

In developing countries like Nepal the criteria for potable water has to be established by regular surveillance and monitoring for developing the national guideline. Standards of water quality are largely based on experience from water. There is still a real need for research in to the suitability of the various tests and for sound epidemiological study to establish realistic standard, which can be applied in rural communities of Nepal.

Because potable water supply is primary use and if no treatment facility is available then spring / stream protection measures / treatment standard should be imposed to protect the health of the public. The stream standard should ensure the safety of the human ailments but should not impose unreasonable quality levels. Essentially, quality similar to the natural state of the surface water is adequate.
Therefore, to reiterate the point raised earlier technologists have an important part to play in supplying quantitative information for alternative water management schemes so that objective decisions can be made by community / authorities taking into consideration the local environmental and economic conditions. Community's aim of having water supply is to have flowing water out of the taps. The technical person has to see combination of improvements in quality, quantity, availability and reliability for the purpose of design. In order to decide on which combination of improvement is appropriate to a particular case it is necessary to examine the potential benefits from the water supply.

Similarly, the cost effectiveness of a design can be assessed and compared with that of alternative designs by weighing the cost of the savings. The design benefits have to be compared with the real value of benefits. The design benefits should be time-energy saving and help in improvement of the community's health.

Messages From Water And Situational Analysis Of Water Supply In Greater Kathmandu

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1. Introduction

The Asian Development Bank conducted a Study on Water in Asian Cities as part of regional technical assistance RETA 6031: Promoting Effective Water Management Policies and Practices. Part B of the study (Urban Social Research Component) was focused on study of Small Scale Independent Private Water Providers (SSIPWP) and covered 8 cities namely Cebu, Delhi, Dhaka, Ho Chi Minh City, Jakarta, Kathmandu, Shanghai and Ulan Batar. The overall objective of Part B was to establish relationships between the socio-economic characteristics of households and their choice of water provider. The author was hired by ADB as Urban Social Research Consultant for Kathmandu.

In order to assess the background on the role played by SSIPWP in each city, quantitative (household questionnaire surveys) and qualitative surveys (focus group discussions) were undertaken. The surveys were aimed at defining the Water Service Profile at city level, and providing insight into;

- the coverage of the Water Utility (% of HH serviced and volume of water supplied)
- the scope and scale (% HH and % of water demand) of the different level of service provided by SSIPWPs, and
- the consumer's socio-economic profile, their reactions to different water contexts within a city and their perceptions of water providers. Greater Kathmandu covering KMC and LsMC was delineated as the study area for this assignment.

2. Methods of Study

2.1 Desk Study in Inception Stage

2.1.1 Collection of Secondary Source Information and Review

Basically, all the available pertinent reports were reviewed and several stakeholders including professionals and technocrats working with water supply sector were consulted. A list of secondary source informants is provided in **Appendix - I.**

2.1.2 Regional Consultation Workshop

Desk Study in inception stage was followed by a regional consultation workshop in Bangkok from September 15 to 19, 2002. All the eight consultants responsible for selected cities, the regional and international consultants as well as responsible officer from ADB discussed the unified approach to be adopted for the SSIPWP study. For the case of Greater Kathmandu city, it was agreed that around 500 households will be covered through questionnaire survey and around ten focus group discussions will be conducted to enrich the quantitative data of the HH questionnaires. The survey had to be undertaken in such a way that all socio-economic groups as well as different water contexts in the city are duly represented. The emphasis thus, was on to assess the reaction of different income groups to water shortage conditions in the city in terms of (1) how are they coping with the shortfall supply of the utility?, and (2) what are the possible ways to meet the shortfall water requirement through secondary sources in the immediate future (i.e. until Melamchi Project is completed).

2.1.3 Household Income Structure of Socio-economic Groups

Among all the criteria to define the cutoff line far poverty estimate, the one adopted by NLSS (1996) is widely accepted in Nepal. The NLSS adopted minimum calorie requirement of 2124

calorie/ day to assess the poverty all over the country. In the context of Kathmandu valley towns, the Baseline Survey by LSMC (LUMANTI) with 2500 hh sample size estimated that NRs. 5600 per person per annum would be required to procure 2124 calorie/ day. Including other basic needs and urban services, the poverty line was defined at NRs. 9,000/- (US $ 130/ @ NRs. 69.23). Accordingly, it was estimated that 12.6% of urban households in LSMC were poor. In terms of head counts, 15.2% population was considered poor (HH size 6.79 for poor segment, average 5.64). The same criterion with slight modifications (as suggested by other references and taking into account the changes in exchange rate) was adopted to define the poverty line and household income structure of Greater Kathmandu. Table 1 shows the updated HH income structure of the city after due verification from the information collected through HH questionnaire survey.

Table 1: HH Income Structure of Greater Kathmandu

Economic Status	HH	Popln.	HH Size	HH Income		Income/
	%	(%)		Month	capita Annum	/annum
Poor	14.1	11.8	4.71	<NRs. 6,000($ 88)	< $ 1000	< $ 185
Lower Middle Income Group (LMIG)	52.8	51.6	5.50	NRs. 6,000-13,000 ($ 88-$188)	$1000 - $2,250	$ 185 - $ 400
Middle Income Group (MIG)	25.1	27.6	6.18	NRs. 13,000-22,000 ($188 - $318)	$2,250- $4,000	$ 400 - $ 667
Upper Middle and Rich (UMIG)	7.9	8.7	6.22	> NRs. 22,000(> $4,000 $318)	> $667	
OVERALL (Wt. Average)			5.64	11,587 ($ 167)	$ 2,000	$ 356

Source: HH survey under ADB - SSIPWP study, JHA, K K (October 2002).

2.1.4 Review of Secondary Source Data for Level of Service by NWSC

During Census 2001, in addition to demographic data, information pertaining to primary sources of water supply was also collected. The ward wise CBS data for Greater Kathmandu was compiled following the demarcation of KMC (Kathmandu Metropolitan City) into five areas namely Kathmandu Core, Kathmandu Central, Kathmandu North, Kathmandu East and Kathmandu West. Similarly, ward wise data of LsMC (Lalitpur Sub Metropolitan City) was also grouped into two areas namely, Lalitpur Core and Lalitpur Extension. The CBS data, compiled in **Appendix II**, indicated that 83% HHs (households) in Greater Kathmandu considered NWSC as their primary source of water supply, followed by Tubewells (7%), Wells (6%), Stone Spouts (3%) and Others (1%). It was felt that CBS data fall short of portraying the detailed picture of actual water supply dynamics in Kathmandu. In particular, it did not take into account the overwhelming dependence of households on secondary sources of water supply.

Nippon Koei and JV consultants had carried out household survey to assess "Present Water Use and Living Environment in Kathmandu" for MWSDB (Melamchi Water Supply Development Board) in 1999. The frequencies of NWSC water supply to households, expressed in terms of days per month as well as average hours per day were compiled. As shown in **Appendix III**, the data confirmed that 83% HHs are connected to NWSC distribution system but went on to suggest that 4% of theconnected HHs do not get water at all. Furthermore, it revealed that 13% HHs receive water for less than 12 days a month, 48% between 12-20 days/ month and only 19% for 20-30 days a month. In terms of monthly average hours per day, 9% HHs received water for less than an hour, 62% between 1 to 4 hours/day and only 8% HHs got more than 4 hours/day supplies. Based on Nippon Koei study, the level of service by NWSC in Greater Kathmandu can be categorized into following:

1	NC1	Households not connected to NWSC Distribution System
2	NC2	Households connected but no water at all (0 day/month or O hrs/day)
3	LC	Low Coverage (0-12 days/month or 0-1 hours per day)
4	MC	Medium Coverage (12-20 days/month or 1-4 hors day)
5	HC	High Coverage (20-30 days/month or 4-24 hours day)

2.2 Sample Design for Household Questionnaire Survey

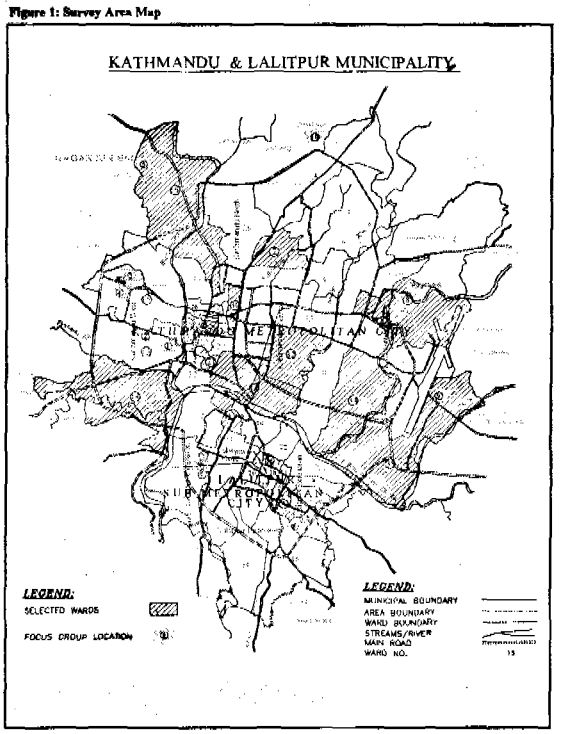
Sample design for household questionnaire survey was based upon multi stage cluster sampling process. In the first stage, 12 wards in KMC and 3 wards in LsMC were purposively selected to represent five areas of KMC and the two of LsMC (**Figure 1**). The second stage cluster sampling consisted of delineation of five categories of level of service by NWSC on ward level map (**Figure 2**). This was done in consultation with the concerned ward offices and NWSC service centres. In the final third stage sampling, households belonging to four income groups were purposively selected following the two-dimensional matrix that were separately constructed for each of the fifteen selected wards (Appendix IV). The summary of the two-dimensional sample matrix coveringentire Greater Kathmandu city is reproduced in Table 2. below:

Table 2: Two Dimensional Sample Design for HH Survey in Greater Kathmandu

Household Income Group	Categories of NWSC Level of Service					TOTAL	
	NC1	NC2	LC	MC	HC	#	%
LMIG	43	20	91	85	46	285	53%
MIG	20	15	41	42	21	139	25%
Poor	16	9	24	21	9	79	14%
UMIG	3	4	19	13	3	42	8%
	82	48	175	161	79	545	
TOTAL	15%	9%	32%	30%	14%		100%

The advantage of the adopted sampling is reflected by the fact that despite small size of sample households (0.8%), in effect 39% of the geographical area and 37% of households in the similar water contexts are covered by the sample. Thus the sample adequately represents the entire population of Greater Kathmandu City.

Figure 1: Survey Area Map

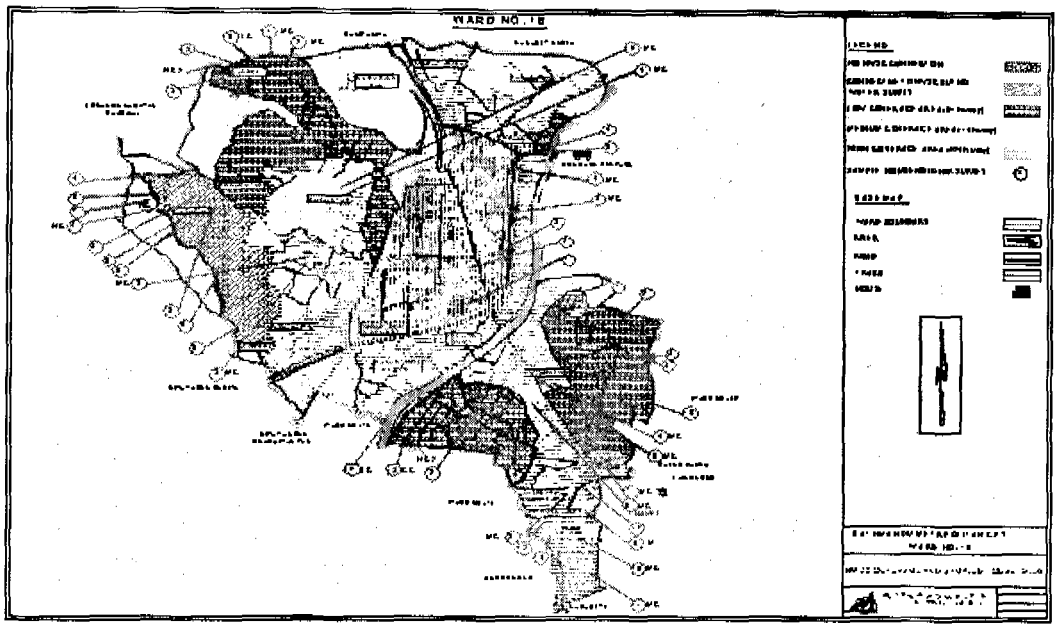


2.3 Conduction of Field Surveys

2.3.1 Household Questionnaire Survey

The enumerators selected to undertake the questionnaire survey were provided with intensive orientation covering different aspects of the survey. They were in particular trained to identify different household income groups using certain guidelines along with delineation of NWSC service areas in consultation with ward or NWSC officials, as shown in Figure 2. Adequate classroom and field pre-tests were conducted to make them versatile enough on their given assignment.

Figure 2: Sample Ward Level Map for HH Survey



2.3.2 Focus Group Discussions

The user's perception on existing water contexts of Greater Kathmandu was assimilated through ten focus group discussions conducted in various parts of the city. A brief summary of the survey is presented in Table 3.

Table 3: Location and Water Contexts of the Focus Group Survey

S.No.	Location	Water Contexts	Nr. Of Particip.
FG#1	Tankeshwori, Tahachal, KMC #13	Poor HHs, Acute scarcity of water, Served by Utility Tanker Service	14
FG#2	Chhauni Area, Tahachal, KMC#13	Posh residential colony, Poor supply from HH connection, Served by private water tankers regularly.	10
FG#3	Swoyambhu Hill Top, KMC #15	Community managed autonomous water distribution system	13
FG#4	Kimdol, KMC #15	Public Community partnership with the help of local government to improve the utility distribution system	14
FG#5	Taudal, Raniban, KMC #16	In the outskirts, utility has not been either able to provide water nor collect tariff. SSIPWP can fill the gap	7
FG#6	Maruhiti, Kathmandu Core, KMC #19	Utility pipes are age-old and leaking, need rehabilitation. People heavily rely upon the Stone Spout.	11
FG#7	Dhobighat, LsMC # 3 & 4	People heavily rely upon the famous Stone Spout, considered good for drinking, Utility stores the night flow discharge to feed its distr. system., Scope of SSIP involvement to serve 300 HHs through HH pipe system	12
FG#8	Sincha Hiti, LsMC # 17	Utility supply very poor, People rely upon Stone Spout having high discharge, Few houses pump the Spout water to their houses. SSIP can do this job in efficient way.	12
FG#9	Sinamangal, Koteshwor, KMC # 35	Utility has not extended its distribution system in the locality. People use personal or neighbors STW and wells.	14
FG#10	Dhapasi Height, Dhapasi VDC, Kathmandu North	In the absence of utility distr. system, one individual provides his well water to 32 HHs through HH Pipe system.	9
		TOTAL FGD PARTICIPANTS	116

3. FINDINGS OF THE SURVEY
3.1 General Features of NWSC Service

Around 84% of the households are connected to NWSC pipe distribution system network. But some of the households, estimated at 8% do not get water at all, despite being connected to the system. Therefore, only 76% of the households have access to NWSC pipe water, and a large majority of them get water on alternate days for less than 1-2 hours on the day of supply. The details on the level of service by the utility with reference to different socio-economic income groups are presented in Table 4.

Table 4: Level of Service by the Utility (NWSC)

Particulars/HH Income Category	Poor	LMIG	MIG	UMIG	Overall
Connected to HH distribution System	75%	85%	88%	90%	84%
Low Coverage (0- 1 hr/day supply)	52%	52%	49%	57%	52%
Medium Coverage (1-<=4hr/day supply)	9%	20%	23%	27%	20%
High Coverage (4-<=24hr/day supply)	5%	6%	3%	2%	5%
Connected but no water at all	8%	7%	13%	4%	8%
Not connected	25%	15%	12%	10%	16%
Total	100%	100%	100%	100%	100%

The HH survey data suggest that around one third of poor households in Greater Kathmandu do not have access to pipe water as compared to 14% HHs of UMIG. More than half (52%) population get less than an hour supply per day on the average, and meager 5% HHs receive more than four hours per day of supply. The recorded 9% poor HHs under medium coverage as against more than 20% for other categories, somehow reflects that affordability plays an important role between have and have nots in availing the services of the utility. The per capita consumption of water by HH income groups is estimated below in Table 5:

Table 5: Per Capita Consumption by Different Income Groups

Unit: Lts/day/person

HH Income Group Usage of Water	Poor	LMIG	MIG	UMIG	OVERALL
Drinking & Cooking	7.4	8.0	9.3	8.9	8.4
Other Usage	39.1	49.5	55.6	62.1	51.3
Total Consumption	**46.5**	**57.5**	**64.9**	**71.0**	**59.7**
Avg. HH Size	*4.71*	*5.50*	*6.18*	*6.22*	*5.64*

3.1.1 Cost of Service

Similarly, the cost incurred in availing the utility supply by different income groups is presented in Table 6. It supports the argument that in Kathmandu water tariff in itself constitute a smaller proportion (31%) of total cost. As a matter of fact people end up paying more for electricity (45%) and treatment (25%) as compared to water bills. For poor, although water bills constitute higher proportion than electricity, cost of kerosene (at 28%) to boil the water form a significant cost. It was interesting to note that increasing numbers of poor households were resorting to in-house treatment.

Table 6: Cost Incurred for Utility (NWSC) Water by Income Group

Unit: Rs./Month/HH

Monthly Bills	Poor		LMIG		MIG		UMIG		Overall	
	NRs.	%	NRs.	%	NRs.	%	NRs.	%	NRs.	%
Water Bill	116	37%	167	30%	180	30%	216	27%	171	31%
Cost of Pumping	110	35%	258	47%	275	45%	340	43%	253	45%
Cost of Treatment	89	28%	127	23%	150	25%	234	30%	139	25%
Average Cost	**315**	100%	**552**	100%	**604**	100%	**790**	100%	**561**	100%

3.2 General Water Service Profile

The percentage households utilizing the various sources for water supply in Greater Kathmandu is presented in Table 7.

Table 7: Utilization of Various Water Supply Sources in Greater Kathmandu

Unit: % of HH

Water Utility (NWSC)				SSIPWP				
HH Connection	Other Utility Services: Stand Pipe	Other Utility Services: Tanker	Neighbors connection	Private Water Tankers	Bottled Water	Community Managed Systems	Own Source Supply	Total
76%	5%	2%	5%	5%	1%	16%	31%	140%
76%	5%	3%	7%	7%	1%	21%	36%	156%
76%	4%	2%	4%	4%	1%	13%	28%	132%
Legend:	Yearly Average			Dry Season			Other Season	
Note:	Yearly Average = (Dry season *4 + Other season*8) / 12							

Source: HH survey under ADB - SSIPWP study, October 2002

The table indicates that around 76% HHs are connected to HH pipe distribution system of the utility, and the rest 24% depend on other sources of water. Among the utility connected households, only 36% are able to get all the water they need from their pipe connection, and the rest 40% (i.e. 76% minus 36%) supplement their needs from other sources. Thus in total 64% HHs (40% plus 24%) rely upon other sources of water. Taking into account the seasonal variation, 32% HHs in normal seasons and 56% HHs in the water scarcity season (dry season) supplement utility pipe supply from other sources. Among the 40% HHs that uses other sources to supplement utility pipe supply, 15% utilizes at least two sources and 5% HHs at least three sources to meet their needs. During dry season this figure increases up to 23% and 6% respectively.

The volumetric share of water supplied to households from various sources is presented in Table 8. It is apparent that in Greater Kathmandu on the average 48% of the total water consumed by households are supplied by sources other than that of utility. This figure drastically increases to 60% in the dry (water scarcity) season from 43% during the normal times. With reference to WTP study (Brocklehurst, 2001), it is pertinent to note that the total actual demand for the Kathmandu valley is estimated to be about 177,000 m^3/day against the actual water production ranging between 88,000 m^3/day in the dry season to 132,000 m^3/day during monsoon. The unaccounted for water (leakages) has been estimated at 40%.

Table 8: Volumetric Share of Water Consumption from Available Sources

Unit: % of total consumption of water by HHs

Water Utility (NWSC)				SSIPWP				
HH Connection	Other Utility Services: Stand Pipe	Other Utility Services: Tanker	Neighbors connection	Private Water Tankers	Bottled Water	Community Managed Systems	Own Source Supply	Total
47%	2%	1%	1.8%	4%	0.1%	13%	31%	100%
33%	2%	2%	2.5%	6%	0.09%	18%	37%	100%
54%	1%	1%	1.5%	%	0.06%	11%	29%	100%
Legend:	Yearly Average			Dry Season			Other Season	

3.3 Own Source Supply

The Focus Group survey confirmed that in the absence of adequate supply of water from the utility, people desperately look for other sources to supplement and meet their water needs. Almost one third of the city population, thus depend upon 'Own Source Supply' namely shallow tube-wells and dug-wells (average 20 to 40 feet deep), installed in their homes. With few exceptions, the groundwater of such wells have high content of Iron, Ammonia and Organisms. Because of offensive odor and staining, water from such wells is not even preferred for toilets, laundry and other domestic use. Rain Water Harvesting with much better quality is gaining popularity in certain quarters of the city. But due to its seasonal characteristics, its share by volume of HH supply does not even exceed 0.3% at present.

As shown in adjacent table, medium class has taken the lead in utilizing the rain water harvesting with 9% HHs. The poor and LMIG should be made aware of the benefits of using the rainwater. It is even recommended that building bye-laws should have the provision of rain water tankers as the essential component for a house to be approved for construction by the Municipality. Considering the fact that increasing sealing of earthen surface by the rapid pace of urbanization has decreased the scope of water percolation, the rainwater harvesting tanks may at least serve the purpose of recharging the groundwater. The table also indicates that irrespective of income category, all the households equally rely upon own sources of water supply.

Level of Income	Own Source Supply	Rain Water Harvesting
Low (Poor)	27%	1%
Lower Middle (LMIG)	30%	5%
Medium (MIG)	36%	9%
High (UMIG)	24%	6%
OVERALL	31%	6%

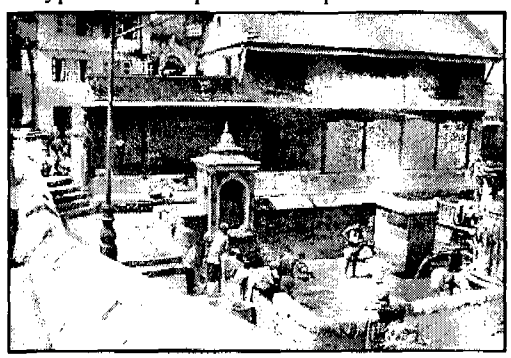
3.4 Community Managed Systems (CMS's)

Level of Income	Stone Spouts	Community Wells	Total CMSs
Low (Poor)	10%	8%	18%
Lower Middle (LMIG)	8%	9%	17%
Medium (MIG)	9%	4%	13%
High (UMIG)	8%	7%	16%
OVERALL	9%	7%	16%

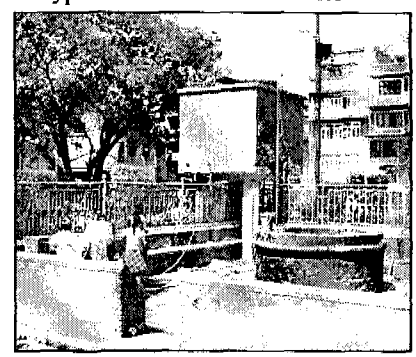
Around one sixth of the city population is served by 'Community Managed Systems', which predominantly includes the age-old traditional system of *Dhungedhara* (Stone Spouts) as well as *Inars* (Community Wells). People are used to getting free water from such sources. But as seen in the adjacent table, not only the poor and LMIG, but MIG and UMIG households as well use CMS in almost equal numbers. It was found that usually the rich access the CMS through servants or hired labourers as against poor, LMIGs and significant proportion of MIGs that avail the sources of CMSs by themselves.

Some of the major challenges facing the CMSs are its increasing reduction in quantity of supply and deterioration of its micro-biological quality. Lack of effective institutions and resources for repair and maintenance of the facilities, poses serious threats towards its sustainability. It is said that leakages from the dilapidated sewer network of the city pollute the unsealed underground channels of the *Dhungedharas* and *Inars*. The participants of the focus group discussions have overwhelmingly supported the concept of public-community-private partnership for enhancing the scope of CMSs services and sustaining the facilities. In general, it was perceived that people are coming to terms of reality as reflected by their willingness to pay for services that hitherto were expected free of cost and considered a part of government's social service obligations.

A Typical Stone Spout in Lalitpur



A Typical Comm. Well with Reservoir



Ample scope for SSIPWP's involvement has been realized through focus group discussions involving user communities of the Stone Spouts (refer FG# 6, 7 & 8). The users of *Maruhiti* are awaiting some sorts of private initiatives, at least to initiate dialogues with the community. Those of Sinchahiti have gone a step further by pumping idle water of the Spout to their homes, though inefficiently and in unorganized manner. Utility's initiative in *Dhobighat* to collect night flow into their 140,000 liter storage tank for HH distribution has shown a way for the SSIPWP to move forward in that direction. Some of the major constraints facing the community that have access to *Dhungedharas* are the following.

- Lack of financial resources with the community to optimize the use of natural water resources like Stone Spouts
- Lack of technical know how and resources with an individual community to ensure and safeguard the quality of water from the Stone Spouts.
- Lack of consensus within the community on the involvement of SSIPWP for the management of Stone Spouts. Socio-cultural believes can be considered as the constraint in this regard.

Socio-cultural Constraints towards the SSIPWP's involvement in the managementof Hitis.

- There is no question of allowing anyone to collect *Hiti's* water in large volumes during the day. But *Hiti's* water could be collected at night and be distributed to individual houses as per the need. But, there is a common belief that a certain portion of *Hiti's* water should be allowed to flow free all the time and *Hitis* should not be completely tapped. Otherwise, as the elderly people believe, Stone Spout will become dry.

- The community believes that water from Stone Spouts have been supplied to the public free of cost for generations. Therefore, it should not be used for commercial purposes. In other words, only the community should be allowed to manage the water of Stone Spouts, and no individual should make profit out of it. They would not even prefer the government institution like NWSC to take control of their *Hitis.*

- Some participants felt that if someone makes investment to improve their water supply condition using the water of *Hiti* then return on investment should be allowed. For that any operator should take the entire community into confidence. That seems to be a difficult task, though.

Possible Modalities of SSIPWP's Involvement

As an outcome of the Focus Group Discussion with the community, following modalities have been proposed in the context of *Iku-hiti* for the possible involvement of a SSIPWP.

- A public limited company could be established under the prevalent rules and regulation, with certain private investors and community members as its promoters.

- The company will mobilize resources by floating shares to the consumer households and general public.

- The Board of Director of the Company will have fixed representation from the ordinary shareholders. Such representatives will be periodically elected among themselves.

- The company will take over the management of the Spout's water. It will negotiate with the NWSC to take over the existing water supply distribution system of the locality. The company will invest on the rehabilitation of water and sewer pipes of the area, and operate the system.

- The company will not restrict the prevalent free access to Spout's water, particularly for the local consumers.

- A certain part of the profit of the company will be utilized for community development activities.

Under the above conditions, the majority of participants expressed their willingness to pay double the existing NWSC tariff, provided the company is able to provide at least four hours of regular good quality water supply to their houses through pipe distribution system.

3.5 Private Water Tanker Operators (PWTOs)

The PWTOs are the only significant SSIPWP of Kathmandu. As reflected by FG#1, the private tankers can support the Utility Tanker Service in serving the poor at affordable price in areas like Tankeshwori. An individual's initiative in Dhapasi VDC (FG # 10) can be considered exemplary in encouraging the SSIPWP to start similar operations in Sinamangal area (FG# 9) that remains un-served by the utility. Considering the fact that the water supply scenario of Kathmandu is deteriorating each passing year and that the HMG's mega initiative namely Melamchi Diversion Project will take at least a decade to show results, the possible role of SSIPWP in filling up the niche assumes prominent importance.

3.5.1 Salient Features of The Tanker Business

Some of the important aspects of the private water tanker business in Kathmandu are summarized below;

1. Presently there are 35 entrepreneurs (PWTOs) in the tanker business. They altogether operate around 65 vehicles of varying size between 8K to 12K liters water carrying capacity. Only 35% of the tankers are purchased new and the rest are second-hand (old) tankers. On the whole, 169 people (excluding owners) are employed in the private tanker business.
2. By and large, the private water tanker business cannot be considered legal. None of the PWTO is registered with government authority. Some of them though have registered with Chamber of Commerce in the Supplier's category, mainly to facilitate opening of the Bank Account and PIN in the name of the entity. The business is considered illegal owing to provision of the prevalent Water Resource Act that prohibits use of natural water resource for commercial purpose.
3. It has been estimated that in a year 1,191 trips are made by a tanker in Kathmandu and on the average $10m^3$ of water is being supplied per trip. With 65 tankers in operation, it is estimated that private tankers supply on the average 2.12 MLD of water to the city.
4. Among the customers of PWTOs services, private residences account for only 24% of the total. Industries and commercial establishments that include Pharmaceutical Factories, Cottage Industries (Garment, Carpet etc.), Bakeries and shops are the largest consumer of tanker's water, accounting almost one third of total supply. On the average, 13% of the total trips in a year are supplied to another SSIPWP, namely Bottled Water Plants. Establishments belonging to tourism, health, diplomatic mission, education and corporate sectors account for 11%, 7%, 6% and 3% each respectively.
5. The water tariff of the private tanker at $ 1.3 per m^3 is well above the utility pipe supply ($0.22 per m^3), but substantially lower than utility tanker service ($ 2 per m^3) or the bottle water ($ 45 per m^3).

Table : Comparison of Water Tariff

Unit	Private Tanker	Small Tanker	Utility Tanker	Bottled Water	SSIPWP HH pipe	CMS FGD# 3	Utility HH Connection
NRs./m³	100	125	160	3500	22 & 50	62	7.5 &17.85
US $/m³	1.30	1.60	2.00	45.00	0.28 & 0.64	0.79	0.09 & 0.22

6. It is estimated that the annual turnover of the tanker business in Kathmandu just exceeds $ 1.0 million. Profit margin with respect to annual turnover ranges between 5% for the new tankers to 11% for the second-hand old tankers. On a monthly basis, profit has been estimated to be on the average US $ 63 and US$ 141 for the new and old tankers respectively.
7. Most of the sources used by PWTOs have water with acceptable values of chemical and physical parameters, but protection of the sources from bacteriological contamination is the major challenge that they need to address. It is also desirable that periodic water quality testing is undertaken to enhance the confidence of the customers.
8. Lack of adequate sources of water, unavailability of large storage facilities (at least 5000 liters) with the customers and lack of access roads of adequate width are some of the major operational constraints faced by the PWTOs in the present circumstances. Similarly, Lack of technology at affordable cost to check iron and ammonia content has restricted the use of groundwater. Although tanker business is considered illegal, the PWTOs have not faced any prohibition from the government so far. The traffic police authority seems to be the only government line agency that PWTOs need to deal with at the moment.
9. Access to and control of the source of water was considered the most important factor for the success of this business. The participants opined that the limited availability of good water source has optimized the number of private tankers to its present level of around sixty-five tankers. In other words, this is the optimum number of private tankers that can sustain under the present market conditions. It was perceived that because of this reason, the Association (Kathmandu Valley Water Supply Traders Group) is keen on discouraging any new entrants to their folds.

3.3.2 Scope of Extension of PWTOs Services to Poor

Evidently, the volume of water made available by SSIPWPs in Kathmandu is not promi nent but their presence cannot be ignored considering their future prospects of involvement, as revealed by focus group discussions conducted in various parts of the city. Inability of the utility to meet the increasing water demand has been manifested each passing year and is expected to continue until Melamchi Project is completed. On the other hand, people have realized that poorly managed CMSs and expensive as well as ineffective ways of utilizing the private (own) sources will not solve their water problems for a long time. Under this circumstance, PWTOs have an ample scope of extending their services to fill in the niche.

Some of the scopes of PWTOs future involvement were identified as below:

1.Extension of PWTOs activities as retailers (Kiosk Operators) for low income groups

The PWTO's have so far been involved in delivering 10 K to 12 K liters of bulk water to their customers. Utility tankers are also doing the same but they also provide free tanker service for the general public, particularly the poor households (refer FGD # 1). The participants of the FGD were asked whether they could provide retail services in the manner similar to Kiosk.

The PWTOs considered the proposal very seriously and informed that they can invest in establishing water delivery centers at certain locations within a city and employ staffs to sell water at affordable price to the consumers. Their water tankers will deliver water to those centers at desired frequency. However, some of the important pre-conditions associated with this proposal are as follows:

2. Supplying tanker water in bottles to low income groups

The PWTOs came up with the idea that they can establish bottling plants under small-scale industrial set-up to deliver bottled water at low cost. Anyway, they have been supplying water to the existing BWP (Bottled Water Providers) that sell bottle water at a very high price. Instead, they can reduce the cost by using the recycled bottles of any size rather than standard bottles. They can use the services of the poor people to collect bottles from the piles of urban waste and get the bottles sterilized before filling them up with their water. Such bottled water will have high demand from the poor and LMIG people and at public places like Bus Stands etc. While doing this business, the preconditions outlined in section 9.1 above may also apply but at lesser degree. Hence, they can right away start such business with low investment.

3. Supplying tanker water to new residential areas

On possibility of extending SSIPWPs services to new residential areas like Sinamangal (FG#9), where utility has not extended its distribution system, PWTOs were of the view that without the government's guarantee they would not make any investment. Assuming that the government does allow them to operate for say at least 20 years then they may seriously consider investing on HH pipe distribution system in the locality. The water could then be either extracted in-situ through deep tube wells (similar to Pepsi Cola factory) or else transported by tankers from other areas. The actual water tariff could then be negotiated with the customers, provided all other conditions are met. The PWTO's however, reiterated that they would not get involved in similar things in older parts of the city because existing socio-cultural factors and people's attitude are much more complicated

4. HH pipe distribution system from Stone Spouts or Wells

The PWTOs categorically stated that they would not prefer getting involved with *Dhungedharas* (Stone Spouts) that were considered highly sensitive socio-cultural heritage sites. Instead, they want either the utility or the local government (municipalities) to initiate dialogue with the community. They felt that in the present scenario only the government institution may succeed in convincing the concerned communities for collection and distribution of Spouts wasted water through small scale HH pipe distribution system. At a later stage after the system is in operation, the private operators may be subcontracted to manage the scheme.

3.6 Need for Conducive Policy Environment

The FGD with various participants, including KVWSTG revealed that there is a crisis of confidence between the society and PWTOs. Many people, particularly those that are not served by PWTOs at present, suspect the quality of water supplied by private tankers. On their part PWTOs assert that they supply better quality water at lowest possible cost, and that too at the time of need. Despite that people have more faith in the water provided by utility. Under this condition, PWTOs are unwilling to forthrightly come forward and deal with the general mass of public. They feel that government should create conducive conditions for encouraging PWTO's investments at local level. The first step towards this direction would be to legalize their business and recognize their contribution. This would in turn help PWTOs commit themselves for an appropriate internal quality assurance mechanism whereby each batch of delivery is subjected to a minimum standard of water quality test.

Key Informant Interviews with the local government officials revealed that the Local Government Act 1997 has not been implemented in its true spirit and content as yet. It was felt that the central government bureaucracy is simply not prepared to devolve the power and privileges that it has enjoyed so far. First of all, the local government institu tions (like the municipalities and VDCs) should have the entire responsibility and authority in real sense to make decisions on local matters. There should also be strong coordination with the utility for providing water supply at ward level. Presently this is lacking. Once that is achieved, then together they can decide on the suitability of various modals like public-community or public-private or public-community–private partnership for a given situation. Until then the policy environment will not become conducive to the involvement of small private operators.

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अमूल्य पानीको लागि
माग व्यवस्थापनमा जोड देऊ

Cost Recovery Model In "Future Water" For Small Towns Of Nepal

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Background

The population in the urban centers along the major national highways has been increasing rapidly in the past decade mainly as a result of rural migration. The inadequate water supply and sanitation systems in these newly formed small towns have adversely affected the quality of life and health conditions of the people living in them. To address the problem of inadequate water supply and sanitation facilities in emerging small towns, HMG with the financial assistance of Asian Development Bank is implementing Small Towns Water Supply and Sanitation Sector Project (STWSSSP) in the country.

The Project will assist the Government in implementing a part of its 15-year plan for small towns water supply and sanitation development. This 15-year Development Plan has identified 209 towns and the cost to improve water supply and sanitation services required is estimated at NRs. 12.132 billion. The Project will provide water supply, limited drainage and sanitation facilities in selected small towns following a demand driven, interactive procedure that ensures full participation of the local water users and non-government organizations in the formulation, implementation, and operation and maintenance of the subprojects. In the first phase the Project will improve water supply and sanitation conditions in 40-50 new small towns with average populations of about 12,000 each benefiting about 0.6 million people in total.

Urban Categorization and Definition of Small Towns

The Local Governance Act (1991) and other related regulations have classified urban settlements into four administrative categories on the basis of existing infrastructure, population, and potential to generate resources. At the lowest level is the VDC with a population of less than 20,000. A municipality is the next higher level with a population between 20,000 and 100,000 and a minimum of NRs. 2 million in annual revenues. Larger urban centers with populations from 100,000 to 300,000 and annual revenues of at least NRs 50 million are classified as sub-metropolitan cities. A metropolitan city is at the top of the hierarchy with a minimum population of 300,000 and NRs 100 million in annual revenues.

In the case of STWSSSP the small towns have been defined by the following characteristics:

- Population – minimum of 3000 in the hills and 5000 in the terai to 40,000.
- Population density - 40 persons per hectare.
- Road access- the town is located close to an all – weather road along the east-west highway or one of the main north-south feeder roads.
- Basic infrastructure- the town should have access to grid electricity, basic telecommuni cations, banking, a lower secondary school and a health post.
- Conditions of water supply and sanitation services- the town must meet at least two of the indicators of hardship envisaged in the project document regarding water supply and sanitation facilities.

Key Lessons – Transfer from Community Participation to Community Management

Over the years of ADBs assistance to the country and the sector, valuable lessons have been learned. ADB's first two rural water supply and sanitation projects in the 1980s were essentially supply-driven, with DWSS as both project implementer and operator of the completed water schemes. There was no community participation and little cost recovery. The reliance

on the central Government budget for O & M of the rural water supply projects proved nonsustainable. The major lessons from the first two projects are that project sustainability required a participatory approach and projects must be demand driven. The commitment of the beneficiary communities, in terms of capital cost contribution and timely setting up of community based WUSCs is essential to successful implementation and sustainability of the projects. Such commitment, however, can be obtained only by involving the communities in planning, design, and O and M of the projects, which in turn requires comprehensive education and interaction with the local communities.

Applying lessons from earlier projects, the third and fourth ADB rural water supply and sanitation projects incorporated participation by communities, NGOs and women in the project designs. Under these projects, DWSS started to change from project implementer to development facilitator. By the end of Fourth Rural Water Supply the participation has gone beyond empowerment of the communities in the development process. The community management rather than the limited community participation came in the front and these lessons have been incorporated in the design of the small towns project. The project offers the local communities the decision power at each stage of subproject cycle starting from the selection to final O&M after implementation. In the small town project we never handover the project to the community, only the transfer of the documents is done once completed. The ownership of the project is always within the community jurisdiction.

Subsidies and Cost Recovery

Cost recovery and financial self-reliance are important. There is a need to emphasize for a reduction of government subsidies to water supply projects and to increase the share of capital cost contribution by WUSCs. Water supply and sanitation development in the past was subsidized. While cost recovery of O&M had been built into the design of the third and fourth ADB – assisted projects, earlier ADB assistance to rural water supply and sanitation development provided up to 90 percent of subsidies for capital expenditure. This was considered necessary because of the extremely low level of incomes and the perceived socioeconomic benefits of such projects to the poor households. The projects were completely considered in the social background.

The need to further reduce capital expenditure subsidies is an important part of future projects in the sector. Co sharing and cost recovery approach has therefore been adopted in this project. Under the proposed project, the community will bear a total amount equivalent to 20 % of the capital cost required for town project construction during implementation including 5 % up-front cash deposition. In addition the community shall pay back a loan amount equivalent to 30 % of the capital cost at an interest rate of 8 % per annum with a maturity of 12 to 15 years of town project operation to be disbursed through Town Development Fund (TDF) during the town project construction.

The TDF will examine the town projects costs in connection with the debt servicing capabilities of the local governments and WUSCs to finance the project before getting the lending money from Ministry of Finance at an interest rate of 5 percent perannum. The Government therefore subsidizes only 50 % of the total water supply costs in the project.

In similar way the local body is required to contribute at least 20 % of the construction cost of the limited public sanitation components including the drainage construction activities in the towns. The project in this case will bear 80 % of the cost and there is no cost sharing from the community. The proposed cost recovery arrangements are based on the findings of the socio-economic surveys, public awareness workshops, sector experience of other external funding agencies in the country.

Project Justification

Financial and economic analyses of the water supply schemes are made. The financial analysis is done to ensure that the proposed tariffs are within the affordable level of 5 % of the household incomes of even the poorer communities. The economic analysis concludes that the economic benefits of the subprojects outweigh the associated economic costs.

The analysis includes the least cost analysis of alternative water supply development options, calculation of the average incremental financial and average incremental economic cost per cubic meter of water sold. Comparison of these costs is done with the

proposed average tariff to assess subsidies, calculation of the economic internal rate of return and financial rate of return for each subproject as well as the combined EIRR. After that determination of a possible tariff structure based on affordability and willingness to pay and development of financial projections to determine the financial sustainability of the water user and sanitation committees. In addition to judge on the acceptance of the project sensitivity analysis is also done with respect to Capital Cost (+), Operation Cost (+) and Benefit (-).

Risks

The major risks related to the Project are; (i) ineffective project management due to poor coordination among the stakeholders (ii) poor performance of TDF in collecting and recycling the subloans because of inadequate and less experience in the sector (iii) poor financial performance of WUSCs in collecting adequate tariffs to cover the O&M cost and debt service payments (iv) difficulties of the subproject contractors in coordinating the labor communities.

Conclusion

Given the opportunity, communities can contribute significantly to the implementation of water supply schemes. Community- based approaches however in this type of new modality take time to develop completely. The problem has been seen in present first batch sub-projects. Even to get the essential upfront cash collection in some of the sub-projects is time consuming and difficult. Greater and long attention to the social processes is therefore very necessary and there is a need to set the project completion period only after the necessary formalities are over. It has also been felt that those town projects with estimated cost below NRs. 80 million are more acceptable to the community and easier to carry.

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भविष्यको विचार गरौं
प्रयोग गर्दा पानी खेर जान नदिउँ।

Design Of Constructed Wetlands Treating Domestic Wastewater

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Introduction

Disposal of untreated wastewater into the natural water bodies is a major cause of water pollution in developing countries. As emphasis is usually given to develop the infrastructures, most of the pollution problems remain unaddressed. It is on the same footing that almost all municipalities in Nepal do not have proper waste treatment and disposal facilities.

Sophisticated technology based conventional wastewater treatment schemes are costly and require skilled manpower. Therefore, the authorities in developing countries are facing difficulties in applying these conventional methods in managing the water pollution problems. In recent years, constructed wetland (CW) systems have emerged as low cost appropriate wastewater treatment alternative, which can be employed both in developed and developing countries.

CWs are gaining popularity to treat wastewater emerging from various public and private institutions such as hospitals, schools and project colonies in Nepal. In July 1997, first full scale CW using local reed was introduced to treat wastewater from Dhulikhel Hospital located at a distance of 30 km northeast of Kathmandu.

Modern electrical equipments, chemicals and extra energy are not required for operation of the treatment plant. CW technology has been found appropriate to treat the domestic wastewater in isolated institutions like schools, hospitals and university particularly in areas where land is available at a reasonable cost. Other features, which make the CW system attractive, are: high treatment efficiency, low maintenance cost and easy operation. Topographical situation of Nepal also helps to promote small treatment system without any pumping units, which reduces the construction and operation and maintenance costs. Therefore, this system is most useful in rural areas, where skilled manpower and electricity are not available. Especially this technology can be used to improve sanitation condition of the schools in our country.

Depending upon the inlet and outlet configurations and level of water column, CW is divided into two groups namely: free water surface (FWS) and subsurface flow (SF). The water level and majority of water flow are above the ground surface in FWS constructed wetlands. SF systems are designed to maintain the wastewater flow below the ground surface.

Pollutant removal processes occur by interaction with wetland vegetation, the water column, and wetland substrate. Processes may be physical, chemical or biological. Basically, constructed wetland systems are biological systems and biological processes play a major role in removal of pollutants. The basic mechanism of organic matter degradation in constructed wetlands is plant bacterial symbiotic reactions, in which gaseous oxygen photosynthetic ally produced or taken up for respiration by the plant is used by aerobic and facultative bacteria (Polprasert et al. 1998). By products of the bacterial decomposition, such as carbon dioxide and ammonium compounds, may be taken up by the plant. SF wetland can be further classified into horizontal and vertical flow beds according to direction of flow.

** For further communication*
Er. K. R. Bista
DWSS

Horizontal Flow (HF) System: In HF system, the wastewater is fed in at the inlet and flow slowly through the porous medium under the surface of the bed in more or less horizontal path until it reaches in outlet zone. During the passage wastewater comes into contact with a matrix of aerobic, anoxic and anaerobic zones. The aerobic zone occurs around roots and rhizomes that leak oxygen into the substrate (Brix 1987; Cooper et al. 1996).

Vertical flow (VF) system: In VF CW the wastewater gradually percolates down through the flat media bed and collected by drainage network at the base. The bed drains completely free and it has the ability to nitrify (Cooper et. al. 1996).

Since the CW technology does not have a long history of engineering practice, the specific rational design criteria and guidelines are yet to be established. There are two basic approaches for the design. The first design method is based on the previous empirical findings and considers organic matter loading rate, hydraulic retention time and basin depth and geometry as the influencing design parameters. Typical values of the design parameters are recommended for both FWS and SF CWs. However, there are no distinct criteria for the various types of flow configurations such as vertical flow vs. horizontal flow in sub-surface wetland, types of plants used and the influence of local climatic and other conditions on the kinetic parameters.

The second approach is basically derived from the first order plug flow kinetics. The major design variables considered are wastewater flow, influent and effluent concentrations, depth of the bed, and most importantly, the reaction rate constant. Attempts have been made to describe the associated parameters such as effectiveness factor and indigenous reaction rate of the biofilm influencing the reaction rate constant.

CW is designed as the attached growth biological reactor. Major pollutants are removed through biological processes, which follow first order plug flow kinetics. Rational design models for the removal of biodegradable organic matters, nitrification and removal of pathogens have been developed by Reed et al. (1988) and also quoted in USEPA (1988) and WPCF (1990).

$$\frac{C_e}{C_o} = e^{-kt} \qquad (1)$$

where,

Co – average influent BOD or COD concentration, mg/L

Ce - Average effluent BOD or COD concentrations, mg/L

k - the temperature dependent first order rate reaction rate constant, day^{-1}

t – hydraulic retention time, day.

Hydraulic retention time can be expressed as:

$$t = \frac{V\eta_e}{Q} \qquad (2)$$

$\square_e = \square * K_r$ (3)

where,

V- volume of reactor, m^3

$\square_e$ -effective porosity of the substrate medium during operational phase (percentage expressed as fraction)

$\square$ - equivalent porosity of substratum before plantation (percentage expressed as fraction)

K_r - porosity reducing coefficient of stratum due to growth of roots of emergent microphytes.

Q – average flow rate, m^3/ day

The basic objective of the study is to understand the kinetics of the pollutants removal in constructed wetlands and develop proper engineering design criteria. The specific objectives are to assess the performance of organic matter removal from treatment units, estimate the values of removal rate constants and propose a simplified procedure for the engineering design of the system.

Material and Method

Description of constructed wetland units

The study at operating constructed wetland built in compound of Kathmandu University was started on the 24th August 2002. The component of full-scale treatment plant consists of settling tank for pre treatment and Horizontal flow bed followed by Vertical Flow bed for final treatment. The data was generated from influent of residential complex including staff quarter and ladies hostel of KU discharging into the treatment unit. Treatment plant has been using constructed wetland of subsurface flow type.

After treatment from horizontal flow bed, effluent goes into two vertical flow beds, which are installed in parallel for final treatment. Details of treatment units are given in Table 2. The inlet arrangement comprised of 100-mm dia PVC pipe perforated with 20-mm diameter holes in 2m distances. It was placed in the inlet zone of 27m lengths about 30 cm above the ground level in the horizontal flow bed. For the vertical flow bed, 100mm dia. pipe was placed at the middle of bed as a main pipe and 50 mm diameter branch pipe is joined at 1.75m spans with 8mm-dia. hole. Wastewater distribution holes were provided in 1-m distance each. To serve the purpose of lining, plastic sheets are placed on the beds of horizontal and vertical beds of CW. The bottom slopes are provided at 2%. Phragmites karka (a local species of reed) was planted at the rate of 6 plants per square meter. The constructed wetlands were fed by primary treated wastewater. The operation of constructed wetland was first started from March 2002. After the operational period of 6 months, the plant density became an average 43 Plants/m^2.

Operating Condition

The average value of the influent COD value was found to be 377 mg/L. The HRT was determined by using the average flow rate between the influent and effluent flow rate) and porosity to compensate water losses by evapotranspiration. Performance evaluation of organic matter degradation of full scale treatment plant was done and HRTs of the components are shown in table-1. The kinetic parameter of reaction rate constant was studied in the operating full-scale treatment plant of Kathmandu University. Average flow of wastewater was found to be 31m^3/day.

Table 1 : Description of the treatment plant components

Component	Dimension L B W (m)	HRT (days)	Details
Septic Tank	7.8 x 4.8 x1.2	2.2	Masonry type with screening
Horizontal flow bed	27x8x0.6	1.03	From top to bottom: 65cm crushed gravel, Plastic liner, 5cm sand, Pore volume- 39%
Vertical flow bed	11x11x1.05	1.46	From top to Bottom: 75 cm sand, 10cm gravel (5 to 8mm size), 15 cm gravel (10 to 20 mm), 5cm course sand, Plastic liner, 5cm sand. Pore volume-30 %

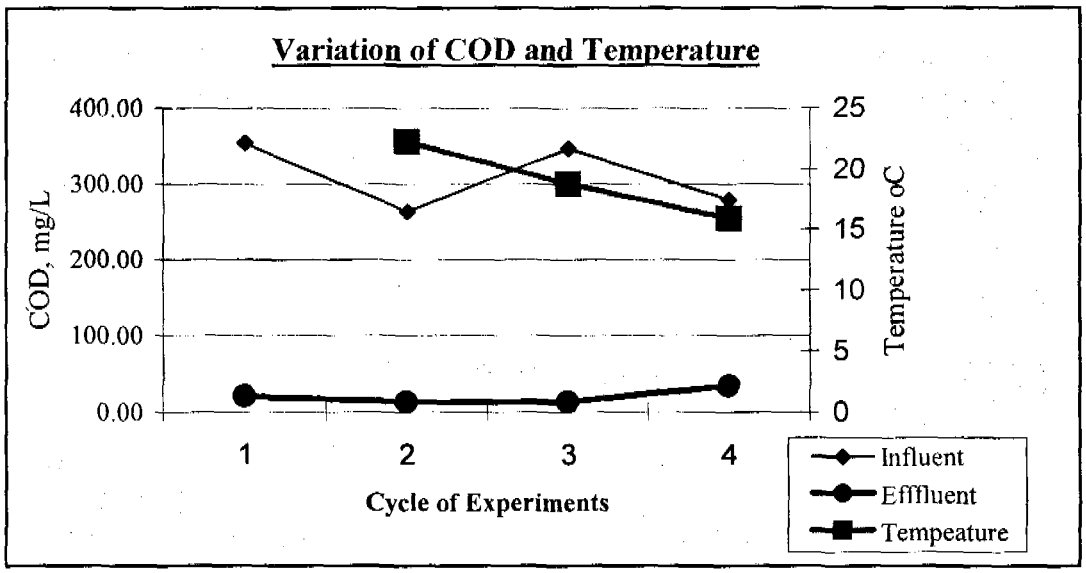
Analytical Procedure

The COD are analyzed according to method described in *Standard Methods (American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1989).*

Result and Discussion

COD loading Rate and temperature

The influent and effluent COD concentration were varied on hourly and cycle-to-cycle. The ranges of concentration were found 84.21 to 700 mg/L in influent and 3.8 to 65 mg/L in effluent. In addition to high variation in hydraulic loading rate also varied widely, influent and effluent concentration. Average concentration of COD at inlet and outlet of full-scale treatment plant of Kathmandu University was obtained 310.68 and 19.96 at the study period.



Influent loading rate shows that system was running under loading of organic matter (design influent BOD_5- 450mg/L). The average value of influent and effluent of COD discharging into the treatment plant, which is varied from 249.97 to 353.88 mg/L and 12.4 to33.87 mg/L respectively, which is shown in fig. 1. Like that, average variation of temperature is also presented.

Performance of full Scale treatment units

The removal efficiency of COD and Ammonia- nitrogen were carried during the study.
COD Removal Efficiency

The average concentration of COD in influent of settling tank was 310.68 mg/L and the average removal of COD at settling tank was 16.87 % .
The average COD concentration in influent and effluent at the horizontal bed 257.61mg/L and 88.52 mg/L respectively. The average COD removal rate was 54.67 % for hydraulic retention time of 1.03 days and average discharge of 15.29m^3/day.
The average influent COD concentration of 310.68 mg/L was reduced in 19.96 mg/L, after the full treatment. Removal efficiency at vertical bed was 21.86 %. This study was observed that overall performance of treatment units were 93.39 %. COD concentration at influent and effluent, and removal of performance at each unit are shown in Table- 1.

Table-1: Removal of COD at CW of Kathmandu University

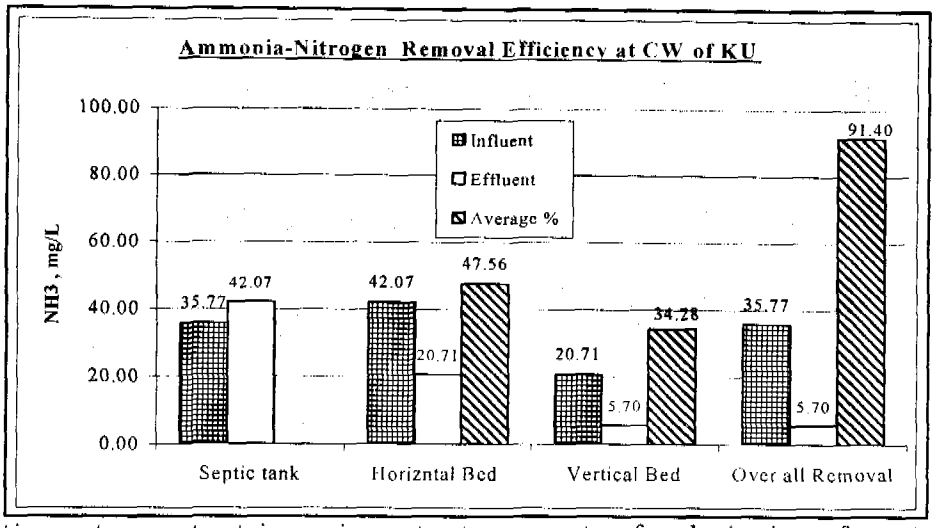
Description	Settling tank	Horizontal Flow Bed	Vertical Flow Bed	Over all Efficiency
Influent (mg/L)	310.68	257.61	88.52	310.68
Effluent (mg/L)	257.61	88.52	19.96	19.96
Removal Efficiency %	16.86	54.67	21.86	93.39

NH_3 –N Removal Efficiency

The average Ammonical – Nitrogen removal efficiency in horizontal flow and vertical flow bed were 47.56 and 34.28 %respectively. The overall performance of treatment plant was 91.4 %, while average value ofAmmonical- Nitrogen concentration in the effluent contained 5.7 mg/L.

Performance of full-scale treatment units of Kathmandu University is shown in Bar Diag.- 4.2.

Bar Diag. - 4.2 Average Ammonia Removal at CW of Kathmandu University
Reaction Rate Constant of COD



Reaction rate constant is an important parameter for designing of wastewater treatment plant. This study was focussed to determine degradation rate of organic matter in the CW. Reaction rate constants from COD removal was evaluated by using the first order plug flow kinetics ($C_e = C_o e^{-kt}$). The average daily wastewater flow rate was found 15.29m^3. Reaction rate constants for Horizontal and Vertical beds were determined from known values of influent and effluent concentrations, and hydraulic retention time. Reaction rate at standard temperature 20°C was determined by using the van't Hoff Arrhenius relationship ($k_T = k_{20} * u^{(t)}$). ÿÿ

Reaction Rate Constant for Horizontal Flow Bed

On the basis of experiments, the reaction rate constant of COD removal was found 1.664 per day at the average temperature of 22.33 °C, and the reaction rate constant at the standard temperature 20°C was calculated 1.45 per day. Average flow rate and hydraulic retention time for horizontal bed were 15.29 m^3/day and 1.03 day respectively. Average value of reaction rate constant of COD removal for subsurface flow system was obtained 1.095 per day. For biochemical oxygen demand, the value of reaction rate constant at the standard temperature has been proposed 1.104 per day to design of CW for subsurface flow system (CPCB, 2001). The obtain value of reaction rate constant for horizontal bed is similar to proposed value. But this value is higher than estimated value (k'=0.12m/d or k=0.45 per day) at the design of plant. Values of average reaction rate constants and corresponding average prevailing temperature are summarized at each cycle of experiments and presented in Table – 4.4. Also reaction rate constants at standard temperature was calculated and included in Table.

Table-4.4: Reaction Rate Constant of Horizontal Flow Bed at Kathmandu University

No. of Cycle	Avg. Temperature	Avg. k_T	k_{20}	Std. dev
Cycle -I		1.416		
Cycle-II	22.33	1.664	1.45	0.311
Cycle-III	18.69	0.781	0.856	0.349
Cycle-IV	16.42	0.749	0.979	0.445
Average	19.15	1.15	1.095	
Std.dev	2.98	0.46	0.31	

Porosity Reducing Coefficient:

The porosity of horizontal and vertical flow beds are reduced due to introduction of roots of emergent microphytes into the substratum. As the roots expand in the soil, the net volume of the void available decreases. In order to assess this reduction, a reducing coefficient of porosity (assumed equivalent to the volume reduction of the void) was introduced. The reducing coefficient of porosity by local reed in horizontal and vertical flow beds are calculated by measuring the volume of roots by water displacement method and found to be 0.972 and 0.983 respectively.

Design Example of Subsurface Constructed Wetland

Find the area of a horizontal bed constructed wetland to treat the primary treated wastewater from a community with a population of 500 and per capita water consumption of 100 L/d. the wastewater have following characteristics: Influent COD concentration = 260 mg/L; average water temperature =20° C, Effluent COD should not exceed 50 mg/L.
Assume the followings: The CW will be reed based and reaction rate constants: k_h= 1.095 day $^{-1}$, Porosity (h) = 0.30, Reducing Coefficient of porosity (Kr) =0.972, Depth of bed =0.6m (crushed gravel)

Solution

Assuming wastewater generation will be 80 % of per capita water consumption.
Discharge (Q) = 0.8*500*100/1000= 40 m3/day
Find the HRT (t)= ln (260/50)/1.095 =1.51 days.
Find the effective volume of constructed wetland(Veff)=Q* t= 40*1.51=60.4 m3

The area of horizontal bed constructed Wetland = $\frac{veff}{\eta\, Kr\, d}$ = 60.4/(0.3*0.972*0.6)=345.22m2

Area required per person equivalent=345.22/500=0.69 m2
Required area for one household (avg.- 5) =5*0.69= 3.45m2

Conclusions

The application of constructed wetlands for treating wastewaters is gaining popularity in recent years. This study demonstrated application of kinetics in the engineering design of the system. Reaction rate constants for full-scale sub-surface flow constructed wetlands were obtained from the performance data using the first order equations The CW unit under study treats an average wastewater flow of 15.29 m—^{3} per day and is operating effectively in removing the undesirable constituents. Overall COD and Ammonia removal efficiency of treatment plant were found as 93.39 percent and 91.4 % respectively. The organic carbon decay rate in horizontal bed using local reed plant was 1.095 day^{-1}. A design procedure based on the proposed model is given.

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Waste Water Management In Urban Areas -Challenges And Issues

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1. Introduction

River and groundwater are major sources of drinking water in Nepal. Over time, the country's requirement for drinking and personal hygiene, agriculture, religions activities and industrial uses, have increased due to rapid urbanization and industrialization. Most of the urban areas suffer from water supply in terms of quantity and quality. In Kathmandu valley, water supply meets only 64% of total demand of 175 MLD, in spite of tapping all major rivers.

The majority of urban areas do not have access to sewerage networks except three cities of Kathmandu valley, The domestic waste water generated by these areas is discharged into local rivers without treatment. Out of the total urban population only 76% have access to toilets while the remaining 24% use open spaces, river banks and field for defecation. The increasing trend of constructing sewers by municipalities without considering treatment facilities is posing serious threat to sources of drinking water and aquatic life. Forty percent of total Industrial units (4271) in 1992 were related to water polluting. All industrial wastes in most cases are directly discharged into local water bodies without any treatment. It is estimated that 2800 children die each year due to diarrhea diseases. Studies of water quality from shallow acquifers throughout Nepal have found that fecal coliform contamination in water consistently exceeds the guidelines values considered fit for human consumption. (EPC 1993). The water quality studies of the Naryani at Gaidakot and orahi rivers at Mahendra Nagar found high levels of pollution at some points along the courses of the rivers due to the paper mills, especially at the zone active decomposition Industrial effluents in Pokhara and Biratnagar have high pollution potential.

Tanneries in Birgunj and Bhairhawa its effluents without any treatment direct into the sirsiya and Ghargara river respectively increasing pollution load to water bodies.

The water quality of rivers and lakes flowing through urban areas have been greatly affected The aesthetic value and bio diversity of water bodies have also been affected.

The treatment of wastewater lagged considerably behind its collection. The treatment was considered necessary only after the self purification capacity of the receiving waters was exceeded and nuisance conditions became intolerable.

The oldest sewers in the core area of Kathmandu, Lalitpur and Bhaktpur were built during the Malla period for conveyance of surface drainage and domestic sewage. The sewerage system of the core area was further developed during 1898-1950 by Rana dynasty. During that time sewers of brick masonry in oval and rectangular shapes was used. The waste water system in the period of 1899-1905, consisted of a system of brick culverts.

All the lateral sewers were laid and two waste water Treatment were constructed at Balkumari and Sundarighat.

2. Existing waste water management scenario of Kathmandu Valley

The present sewerage network in Kathmandu and Lalitpur consists of about 200 Km of sewer lines. Most of sewage except Patan area is supposed to flow by gravity to the sump well at sundrighat, from where it is to be pumped to the waste water Treatment plant at Dhobighat. This plant is provided with 2 anaerobic ponds and 1 facultative pond; having design capacity 15.4 MLD. The plant is not in operation due to non functioning of pumping station and

breakage of pumping main laid across the bed of Bagmati river. The treatment plant at Balkumari 1.1 MLD capacity is partial in operation. It receives sewage by gravity from eastern part of Patan. The plant is provided with two anaerobic ponds, one facultative and one maturation pond. The sewage treatment at Bhaktpur,2 MLD capacity is not in operation due to failure of the pumping station and farmers tapped the wastewater to irrigate their land of crops. The Department of water supply and sewerage (DWSS) has started to construct a sewage system of about 6 Km of sewer pipe length and a treatment plant (lageon type) on 20.51 hectors to serve design population of 53000 in Thimi.The newly constructed WWTP 16.4 MLD at Guheshwori by BASP is the only plant operational in the valley.

3. Urbanization and its effect

The urban population has grown two fold and the number of municipalities has increased from 23 to 58 in period (1981-2001) .The total urban population about 3.5 millions which is 14% of the total population is likely to increase up to 12 million by 2027 AD Which will be about 31% of the total population. The urban growth rate is 4.0 % compare to national growth rate of 2.1% per year. The five municipalities of Kathmandu valley have 40% of the total urban population of the country. The growing population pressure and gradually diminishing resources, all have led the urban poor to march the urban areas who in turns forms slums and Squatter as the third Shelter. The population forecast is presented in Table No.1.

Table No.1 The urbanization pattern of Nepal.

Year	No of Municipalities	Urban population (percent)	Total urban population (Million)	Total National population (Million)
1952	10	2.9	0.2	8.2
1261	16	3.5	0.3	9.4
1971	16	4.1	0.4	11.5
1981	23	6.3	0.9	15.1
1991	36	9.1	1.7	19.5
2001	58	15.2	3.5	23.1
2011	758	23.5	6.8	29.5

(Source : Census Data 2001)

Rapid growth in urban population has exerted tremendous pressure on the urban environment. Consequence of this is an increasing amount of garbage which is dumped on the river banks, encroachment of river banks, water pollution and air pollution. Most of the areas in cities are lacking drains and sewers. As a result the effluent does not pass out making the Streets and roads even dirtier.

4. Policy about waste water Management

- To install sewerage or onsite sanitation system in urban and peri-urban areas as appropriate, (National water supply sector policy 2055)
- To make Sanitation Programme an integral part of water supply Programmes.
- Increasing the number and upgrading the capacity of the existing treatment plants. laying and extension of interceptors, collector mains and collector laterals will be under taken in a phase manner.
- On site system and treatment plants employing natural treatment technol ogy in peri-urban areas. (Kathmandu valley strategy on water supply and sanitation 2057)

5. Efforts made by Bagmati Area Sewerage Project

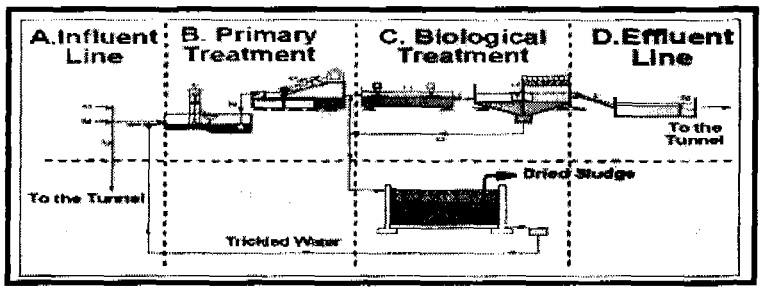


Figure No-1 Flow diagram of WWTP

Table No. 4 : Performance of WWTP, Guheshwori, Kathmandu, Nepal

Parameter	Period –I (Feb- May 2002)			Period –II (Jun-Aug 2002)			Period –III (Sept-Dec 2002)			Average % Reduction
	Inflow (mg/lit)	Effluent (mg/lit)	% Reduction	Inflow (mg/lit)	Effluent (mg/lit)	% Reduction	Inflow (mg/lit)	Effluent (mg/lit)	% Reduction	
BOD_5	368	45	87.77	229	17	92.57	363	23	93.66	91.33
COD	900	167	81.44	469	70	85.07	661	143	78.36	81.62
SS	496	69	86.08	234	48	79.48	240	63	73.75	79.77
Ammonia	43.63	26.84	38.47	29.83	13.23	55.64	38.8	27.21	29.87	41.32
-N	6.73	3.03	54.97	3.15	1.91	39.36	0	1.66	60.19	51.32
Phosphorus							4.17			

6. Challenges

In order to address all ussues in management of wastewater systems following challenges have been faced.

i) Control on population growth
ii) Perceptional and attitudinal change.
iii) Co-ordination among users, municipalities and all government agencies working in wastewater management field.
iv) poverty
v) Generate huge resources for wastewater management
vi) Providing sanitation facilities for urban poor is also a great challenge.

7. Role of various agencies

Role of public Health Engineers:-

Public Health Engineers should function in following areas of concern.

i) Avoidance of future generation
ii) Conservation, management & reuse of natural resources.
- As far as possible "Zero waste" or "minimum waste" generation concept should be implemented
- Reuse of effluent for secondary purposed such as flushing toilet and ind ustrial purposes.
- To modify the processes with latest methods for controlling the water pollution.
- Should give top priority to treat wastewater before discharging into river.
- Create awareness about effluent and proper use of sewerage system.

Role of Government

- To arrange seminars, workshops for discussion and to implement various technology of sustainable development.
- To shift government and other public offices to other places to avoid overcrowding.
- Decentralization of overcrowded industrial areas.
- To frame policies to reduce population growth.
- Development work to be taken to alleviate poverty, improvement in health services.
- Preparation of waste water management Plan for urban areas.

Role of NGO

- To encourage youth for the study of global Issues at the rational level and to work for the matter thinks globally and act locally.
- To arrange the field visits for mass education through different media.
- Initiate the decentralized small-scale treatment plants and on-site sanitation for small community and peri-urban areas assumed the valley.
- Stap to discharge water bodies without pre treatment.
- Encroachment of land also the riverbank should be stopped and demarcate the land of the river systedm.

Local Government Level

Protect the land along the bank of River system; stop the provide the land along the river for social Institutions.

- Stop to dump septic tank sludge into the river system.
- Building permit should not be allowed without having septic tank system and that also need to be mentioned

Industries

- Initial in-house waste minimization program by introducing cleaner production plan.
- Establish waste water treatment facilities and discharge their effluent as per national standard for effluent.

Citizens :

- Put pressure to Government / local government for improvement of system.
- Every citizen should act as watching to control further destruction of river enviornment.
- A stap dumping solid wastes to sewer pipes / Manholes.

Major Issues in Wastewater Management

1. Wastewater management is always neglected, and had least prority in Plan and policies.

2. Most of urban cities do not have wastewater management plan. In Kathmandu valley several studied have been made to develop plan but it has been not adopted and implemented due to lack of founds to undertake large-scale construction.

3. Overlapping of responsibilities among government agencies in waste water Manage ment. There are many agencies MPPRW, MLD, MOE, MOI working in wastewater management and pollution Control. At present NWSSC, DUSS, BASP, Municipality,INGO,NGO,users,BastiVikas company are involved in laying Drainage and sanitary sewage construct sewerage system and discharge it to river bodies without any treatment.

4. Combined system and poor solid waste management. Most of sewerage system behaves as combined through it is not designed for so solid waste dumped along road sides gets into the intake through sewer lines/open drains during storm. Also solid dead bodies of animals are thrown into sewer lines through manholes. Due to unavailability of land sewer pipes are generally laid along kholsa, blocking natural drainage. Most of tertiary sewers laid by users and municipalities without any proper design. Improperconnections of surface drains to sanitary sewer resulting frequent clogging with sand, plastic bags and chicken feathers, bones etc.

5. All new construction should be based on separate storm water sanitary sewers. Scarcity of financial resources and its mobilization.
Financial resources for waste water management is big issue. Rehabilitation of existing treatment facilities inceptor and pumping stations requires huge resources. New construction in urban areas requires additional funds. There is overwhelming demand for constructing new sewer lines due to rapid ur banization. For urban sewerage and waste water treatment only Rs 50 bil lion has been estimated to reach full coverage, instead of Rs 200 billion required to meet the target within 25 years.

6. Establishment of Regulations/ Standards and enforcement. Regulations are not enforced because they are overlapping. Regulations for siting of pollu tion facilities and permitting of wastewater discharges and standards for connecting to waste collection system should be developed. At present min istry of Environment has responsibility to monitor regulations but not func tioning efficiently due to deficient of funds, poorly manned and have inad equate infrastructure for proper regulation of the pollution control laws. One equipped enforcing agency is needed.

7. Revenue Generation:_Present tariff is insufficient to be self- sustaining and not recover operation and maintenance of the facilities. Gradual cost recovery leading to full cost recovery principal based on polluter's principle should be adapted with the gradual increase in the service level. A revision to the tariff structure for industrial consumers (point source polluters) based on ef fluent quality and quantity of water should be implemented.

8. Manpower: Sewage treatment plants are not equipped with qualified and trained manpower to operate them efficiently. Due priority for human resources development working in wastewater management system and proper attention towards staff welfare most be given.

9. Water Reclamation: Wastewater treatment is expensive, so treated effluent should be used as water resource and utilized. Treated effluent about 10 MLD Guheshwori WWTP can be used for ground water recharge for raising acquirer levels for irrigation purposes, Industrial uses and municipal uses for watering municipal parks and land.

10. Slums and Squatter Settlements
Urban Poor Communities:- The growing population pressure and gradually diminishing resources, all have led the urban poor to march the urban areas who in turn form slum squatters as their shelter. The benefits of improvements to infrastructure in urban slum often failed to reach those most in need. Sanitation needs of urban poor communities have been limited by the range of available solutions. Problems of environment and health are related to poverty of population and in-sanitary settlements. Inadequacy of housing for the majority of the urban poor with its attendant evils is the most important factor for the fast degradation of urban environment. Improvement is some of some of the basic municipal amentias cannot be implemented effectively unless the problem of settlements and human habitations for the majority of urban poor is taken care of. Government policy must be shaped to regulate services and pay attention to the need of the Poor. Cheaper technology and less expensive finanling options should be promoted.

11. Lack of co-ordination among agencies.
There is non-co-ordination duplication of efforts and unidirectional approach among water and waste water related sub-sector. There is lacking of institutional and legal frameworks for well co-ordinated and legal action.

12. Land use Planning :
Development of siting rules to be environmentally "friendly" e.g. industrial zones should be established outside of valley. Control mechanism on land use pattern should be developed.

8. Recommendations and Conclusions

a) Wastewater Management stately/Policy/plan should be prepared/ formulated and implemented one ..... incorporating a comprehensive management of water resources. Effective perspective planning for regional balance and poverty alleviation should be prepared.

b) The revision of strategies and policies should be followed by institutional reforms informs inorder to streamline and improve the functioning of Institutional machinery that deals with waste water Management.

c) Responsibilities of each agency should be redefined by institutional reform to award overlapping among many agencies dealing with wastewater, collection, treatment and disposal. Institutional capacity of the Government, municipalities must be strengthed and reoriented.

d) Legislation, regulations and standard with enforcing agency should be developed according to our local needs.

e) "Zero Waste" generation concept /adaptation of waste recycling technology/ residue

utilization Technology and resource recovery technology should be promited and adopted at household and industries level.

f) More attention should be given to opportunities for rease and recycling of wastewater, especially in Kathmandu where water scarcity is being experienced.

g) Social safeguards for low income residents for services should be promoted.

h) Additional resources for wastewater Management should be arranged from donor agencies.

1 Introduction

Very high annual growth rate in the urban areas.
Present Urban Population = 15.2%.
Estimate % of Urban population in 2011 A.D. = 23.5%.
Rapid industrialization & unplanned urbanization causes serious impact on ecology & environment.

Industrial growth & economic development are mandatory for poverty alleviation, employment generation & overall property of country.

Lack of natural resource or overuse/unplanned use of it in urban areas.
Management of industrial and domestic waste in compulsory.
To save cultural/aesthetic value of urban areas in our duty.
Bio-diversity of water bodies & environment eco-system is to be maintained.
Effort made on wastewater management challenges and issues.

2 Waste water management in urban areas "Challenges & Issues"

Introduction
Existing wastewater management scenario of Kathmandu Valley.
Urbanization & its effect
Policy about waste water management
Efforts made by Bagmati Area Sewerage Project
Major issues in waste water management
Role of various agencies
Recommendations and Conclusions.

3 Existing Wastewater management

Sewerage Network = 200 km in Kathmandu & Lalitpur
Most of sewage flow is by gravity/except Patan area.
Non-functioning of almost all STP except Guheswori STP.
Types of STP in Nepal are Oxidation ditch, Lagoon, Natural reed bed technology

Effects made by BASP
Flow diagram of WWTP
Performance of GSTP
Urbanization & its effect

The urban population growth Trend (GRaph)
Tremendous pressure on the urban environment.
Increased amount of dumped garbage here & there
Encroachment of riverbanks.
Water pollution/acid rain
Air pollution

Policy about waste water management
Installation of sewerage or onsite sanitation system. (National water Supply sector policy 2055)
Promotion of sanitation programme as an integral part of water supply programmes.
Increasing & upgrading the capacity of the existing treatment plants/sewer lines in a phase wise.

Employment of Natural Treatment Technology in peri-urban areas (Kathmandu Valley Strategy on Water Supply & Sanitation 2057)
Major issues in Wastewater Management

Wastewater management is neglected, put least priority in plan & policies.
Lack of funds/financial resources & its mobilization.
Overlapping of responsibilities.
Combined sewer system & poor solid waste management.
Management of secondary/Tertiary sewers/capacity/maintenance.
Management of secondary/tertiary sewers/capacity/maintenance.
Establishment of Regulations/Standards & Enforcement.
Revenue Generation: Self Sustainability, smart tariff structure, polluter's pays principle, revision of tariff for industries based on quantity & quality of effluent.
Manpower/Human Resource Development.
Water reclamation.
Problems of Urban poor settlement.
Lack of co-ordination among agencies.
Land use planning.
Role of various agencies

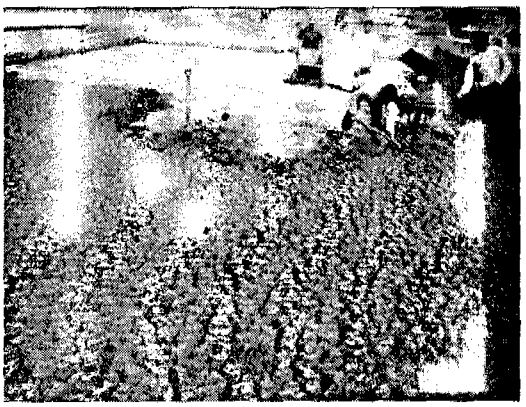
Role Public Health Engineers
Role of Government
Role of NGO
Role of Local Government Level
Role of Public

Challenges

Control on population growth
Perceptional & attitudinal change.
Co-ordination
Poverty
Generation & Management of resources.

Recommendations & Conclusions

Preparation, Formulation & Implementation of wastewater management strategy/ policy / plan incorporating comprehensive water resources management.
Institutional reform / institutional capacity building / redefine responsibilities
Development of Legislation, Regulations & Standards.
Introduction of zero waste generation concept / adaptation & promotion of waste recycle technology, residue utilization technology & resource recovery technology / reuse of wastewater as water resources.
Additional resources for wastewater management.
Social safeguards for low income residents for services.



Implementation of Demand-Responsive Approach in Rural Water Supply and Sanitation in Nepal

Raj Babu Shrestha,
ED, Rural Water Supply and Sanitation Fund Development Board

Supply driven programs had failed to provide sustained and sustainable water supply and sanitation service in the rural area in Nepal. The challenge was therefore to design a delivery mechanism which would be demand led and cost effective, and ensure full partnership of beneficiary community in all aspects of service delivery from project initiation to operations and maintenance. This was required to ensure sustained improvements in water supply and sanitation and consequent improvements in health and income and thus minimizing the drain on official budget and administrative capacity. To meet this challenge, His Majesty's Government of Nepal (HMGN) established the Rural Water Supply and Sanitation Fund Development Board (the Fund Board) in March 1996. The Board is currently implementing Rural Water Supply and Sanitation Project (the Project) with primary support of IDA credit and HMGN finances. The focus of the Project is to empower rural communities by using a participatory process to decision making to implement their water supply and sanitation schemes with the assistance of support organizations (SOs) recruited by the Board. The SOs are local national/international level non-governmental or private sector organizations established or recognized under the laws and selected by the Board to provide necessary support to users groups for planning, implementation, maintenance and operating the schemes. This paperdiscusses experiences of the Rural Water Supply and Sanitation Fund Development Board of Nepal.

The key principle characteristics of demand-driven approach the Fund Board Project approach rely on are:

- Community members make informed choices about:
  - whether to participate in the project;
  - Choices of technology and service level options based on willingness to pay (based on the principle that more expensive systems cost more);
  - When and how their services are delivered (Community Action Plan)
  - How funds are managed and accounted for; and
  - How their services are operated and maintained.
- An adequate flow of information is provided to the community, and procedures are adopted for facilitating collective action decisions within the community.
- Community capacity is appropriately strengthened to be able to participate in decision making process and take leadership in scheme development, implementation and management
- An enabling environment is created for the participation of a wide range of providers of goods, services and technical assistance to communities, including the private sector, and non-government organizations;
- Seen governments' role as facilitative, sets clear national policies and strategies, encourages broad stakeholder consultation and facilitates capacity building and learning;

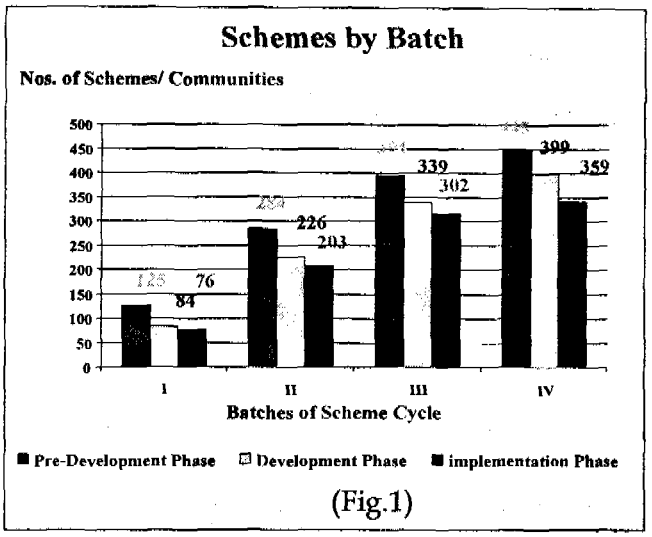
The project by its sixth Fiscal Year (2001-02) covered all five development regions of the country under implementation in 4 batches of scheme cycle. All together about 1048 schemes has been initiated with development phase, covering about 600,000 base year population and are in different stages of implementation (see Fig.1).

So far, 76 Batch-I schemes, 203 Batch-II schemes and 302 Batch-III schemes are completed. 359 Batch-IV schemes are in implementation phase. It is estimated that about 800,000 design population will be benefited by the completion of all four batches of schemes. By Batch-IV, of the total households reached, 55% of the households involved comprise of the disadvantaged communities and indigenous/ethnic groups. The benefits extend beyond water supply to im-

proved sanitation, increased empowerment of local communities and women, and increased incomes, especially for women who save time from water carrying (ref. Immediate impact study and technical audit of Batch-I and II schemes).

Prior Development Phase and social mobilization: Introduction of 10 months of Development Phase prior to implementation allows for genuine participatory decision making and prepares community to take charge.

This phase allows community to resolve conflicts through collective decision making process and come-up with acceptable scheme implementation Community Action Plan (CAP). The collective decision making process brings people together, so it helps to include all willing potential beneficiaries for equitable benefit regardless of wealth, caste, and gender. It organized the people and even lifted the development activities of the communities out of the realm of party politics. Further, it allows sufficient time to form representative Water Users' Groups and register it under the Water Resources Act to get legal status.

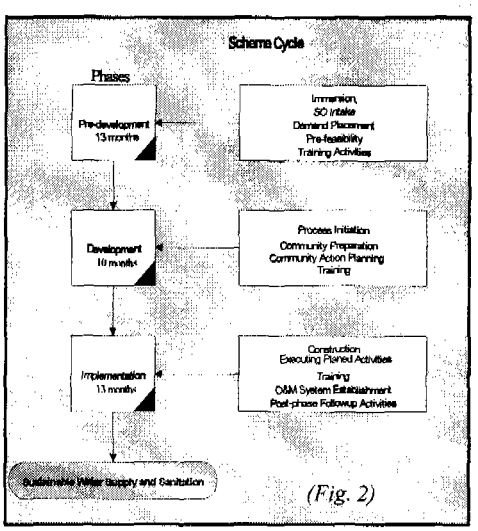


(Fig.1)

Non-formal Education (NFE) targeted women from poor and disadvantaged groups to bring them into the main stream of decision making process. Again, development phase process establishes a self selection process for scheme allocation with demonstrated transparent criteria while preparing community action plan for implementation (see fig. 2 for scheme cycle).

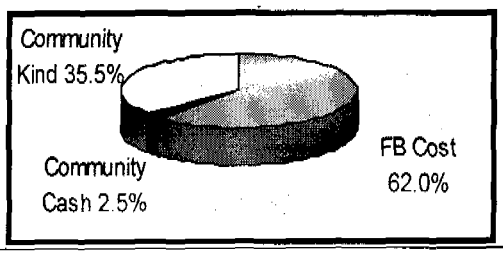
Cost Sharing, Technical Options and Operation & Maintenance

The communities are provided with technical options and service level options and it is associated with cost sharing. Community is required to contribute at least 2.5% of capital cost in cash up-front and all labors, local materials and porterage of non-local materials from road head. The additional cost required as per the higher service level opted are also required to be borne by the community. This provision of technical options allows community to choose most appropriate technologies which they can afford and sustain. The process brings higher community participation in scheme design process. The communities have contributed average about 38% of the total scheme capital costs. This bodes well for future sustainability of completed schemes.



(Fig. 2)

Further communities have established operation and maintenance fund with up-front cash collection of about 4% of total capital cost (against requirement of 3%) and is institutionalized with regular fund raising mechanism through water user's groups appropriately strengthened and registered under a Water Resources Act. Regular O&M fund collection has been found varies community to community from Rs. 5 to 50 per House Hold (HH) per month and community taken responsibility for full operation and maintenance.



The community contribution depends on technical options and service level chosen by the community in the development phase. This enabled community to prepare demand led plan and also made to seek for low cost appropriate technical

solution with development of full ownership from the beginning of the project. Resources for both capital investment and up-front O&M (including cash) can be raised from communities when they are in control of such resources.

Average HH Up-front Cash Contribution	
Capital Cost	220.00
O&M Cost	330.00
Total Cost	550.00

Transparent Financial Management and Community Procurement:
As community is also sharing the cost, community is empowered to procure the non-local materials and manage implementation of project including funds for construction. The cost for construction is disbursed in community account where community has already deposited their up-front cash contribution of 2.5% for construction. The community then manage the fund jointly with support organization to procure and transport non-local materials and pay for skilled labor. This helped to empower community, develop more sense of ownership and strengthen their management capability. The project finance and activities becomes more transparent to the community. This further helped community to control the quality and maintain financial discipline, which are key elements for sustainability.

Health Hygiene and Sanitation Education an integral part : Health and hygiene awareness in personal, domestic and environmental sanitation in the community through health hygiene and sanitation education (HSE) goes hand on hand with water supply and sanitation. This helped community to realize health and hygiene benefits through improved water supply and sanitation services. The community compares between healthy and unhealthy houses on the basis of cleanliness of the family by organizing healthy home survey, which is a participatory community monitoring tool community groups can use by themselves. Village Health Promoter (VHP) are selected and trained in health and sanitation aspects in every scheme. A Sanitation Revolving Loan Fund (SRLF) is established in each and every scheme that community can revolve even after the completion of project until all the households in the community built latrines.
Health KAP (Knowledge, Attitude and Practice) study of Batch-I schemes show behavioral changes in the community from pre- to post Project as follows: (i) bathing more than once a week has increased from 45% to 97%; (ii) use of toilets from 22% to 76%; covering of food from 51% to 90%. So far, a total of 45,423 latrines have been constructed (i.e. about 48% of total Households in communities covered) and are on use. Further' 11679 households built pit for waste disposal. By batch-III, 393 institutional latrines are constructed in schools in scheme areas. Mostly the domestic waste water were found irrigating kitchen gardens.Mothersere reporting less prevalence of diarrhea, dysentery, worm infestations and skin infections in their children.

Focus on Poverty Reduction Strategy and Women Empowerment: Women Technical Support Services (WTSS) has made impact on women, as the Project provides WTSS groups opportunity for accessing skills training, linkages with other programs, contribution of seed capital for saving and Credit funds, etc. WTSS members are found to invest their money in goat raising, vegetable gardening, handicrafts (ref. Demand Assessment Study) and have raised their income (ref. immediate impact study B-I: 78% of households surveyed have increased income). So far 1162 groups have been formed and a total of 36974 women members involved. Groups' own saving raised up to Rs. 1,39,7495. These activities help sustain social capital built in the community and reduce rural poverty. Again, the immediate impact of Batch-I schemes reported participation of women especially in decision making has increased (78%). So far by Batch-III, WUC consist of in an average 3 women member against requirement of at least 2 women and 83% of WUC treasurers are women. So far, Non-formal Education benefited about 16535 women and they are directly involved in scheme planning and implementation.

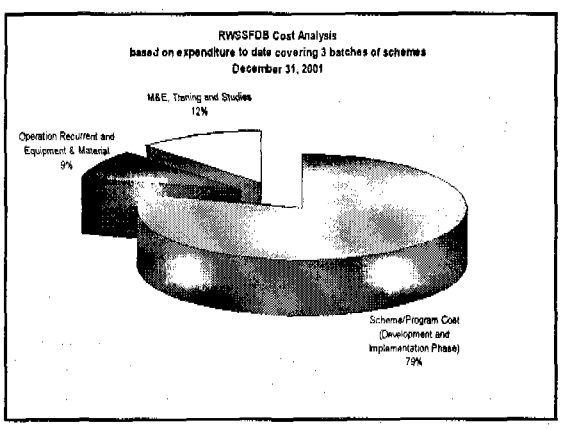
Institutionalization of Community Based Organization
Water Users' Group (WUG) that consist all the beneficiaries households in the community as a member is registered under the Water Resources Act. This recognizes WUG as a legal institution to implement and manage the scheme and allows to own the source and the scheme. It has democratically selected representative executive committee from among the WUG members, called Water Users' Committee (WUC) of 9 to 13 members.

Capacity of WUG/ WUC is developed and strengthened aiming to decentralize the management capacity at the community level for the sustainability of the schemes. Tripartite Agreement is made between the Board, Support Organization and the community (WUG) to implement the schemes as per the Community Action Plan prepared during development phase. Community starts to own the scheme right from the beginning of implementation and start implementation and management of schemes. Participatory Approach in planning and implementation, Training on Management, Operation and Maintenance, Book keeping are also provided. Technical know-how and Operation and Maintenance skill is transferred on-the job to Village Maintenance Workers selected from the community.

NGO and Private Sector Participation and Capacity Building: The Project is making a positive impact on capacity enhancement of User's Groups i.e. communities, Support Organizations (SOs) and Service Agencies (SAs) i.e. local non-governmental organizations and consulting firms/ private sector organizations, as well as the capacity of the Board Secretariat staff on participatory service delivery. Mainly the Non-governmental organizations have been mobilizedas supporting organizations to users' groups and private organizations to strengthen capacity of non-governmental organization and to carry out monitoring and evaluation. The number of SOs working with the Board has increased from 20 in Batch-I to 113 in Batch-IV. SO capacity is enhanced and a growing number of SOs are able to assist communities to plan and implement their schemes. By now about 34 different SAs has been engaged in different assignments. So far, about 4,516 SO/SA staff person has been engaged and trained/ oriented in various participatory service delivery aspects and provided employment for about 30,000 person months.

Co-ordination at Local Level: The Project has enabled to empower community in resource utilization and institutionalize their user's group. Registration under Water Resources Act, 2049, enabled communities to own the water sources and schemes. SOs and communities to coordinate with VDCs, DDCs, a four stage approach of informing/ consulting from pre-development phase to implementation phase have been employed. For further strengthening the co-ordination, the Board has also begun to play a more proactive role in coordinating with the local bodies and at the central level with relevant sector agencies, donors and NGOs.

Cost Effectiveness: Fund Board operating cost, including monitoring evaluation, training and studies, based on preliminary analysis is 21% only (against the Fund Board preliminary analysis of FINNIDA RWSSP 53%, Helvetas 43%, and NEWAH 47%). This showscost effectiveness of the Fund Board Program.Again, due to communities' direct involvement in planning with service level and technical options, implementation management and high contribution towards capital cost, the Project maximizes the cost recovery and lowers the per capita cost.



per Capita Cost	On Present Population	On Design Population
Hardware	1865.00	1360.00
Software	500.00	365.00
Total	2,365.00	1,725.00

Replicability of Model

The Fund-NGO-CBO model adopted by the Board has been identified best in efficiency performance and next to CBO model in process performance evaluation in rural water supply and sanitation sector in the recent Terai Rural Development Option Study (SAPPROS 2000 for World Bank). The similar conclusion has been drawn in the recent Hills Rural Development Option Study (draft – SAPPROS 2001 for IFAD). HMGN with its National Assessment Report presented Fund Board Approach as one of the best practice in recent Johannesburg world summit on sustainable development, 2002. Again the Poverty Alleviation Fund (PAF) document also cited to follow Fund Board model. This shows that the concept and strategies being implemented by the Fund Board is delivering services satisfac-

torily. The implementation role of Fund Board in technical support to transform the model is very essential. The Fund Board approach and concept has been used by different NGOs in other donor program on water supply and Irrigation sector (e.g. by SOLVE Nepal). The SARAR participatory tools developed by the Fund Board have been used by other agencies in the sector (e.g. NEWAH, NRCS, FINNIDA RWSSP, etc.). UNICEF is co-ordinating to develop tools on hygiene and sanitation education (called PHAST) based on Fund Board experience on SARAR tools. Water supply and sanitation sub-sector policies and strategies of the current Tenth National Five Years Plan adopted most of the Fund Board approaches such as introductionof preparatory phase for social mobilization before implementation, cost sharing based on service level, and linkages for NFE and Income generation program. Poverty Reduction Strategy Paper of HMGN envisaged establishing Fund Board as a regular institution in delivering rural water supply and sanitation services.

Key Lessons

The following lessons can be drawn from the implementation of the project:

- Participatory approach in planning, cost sharing mechanism, procurement & management of construction by the community enhance transparency and ownership that are key for successful implementation and future sustainability even in conflict situation.
- However, to increase the coverage of project in the more remote part of the country and to more poor and disadvantaged people, the community contribu tion requirements have to be reviewed with more pro-poor strategy and eq uity. It is also required to further develop more technical options to commen surate with affordability and managerial capacity of poor, disadvantaged and remote people.
- Again, there should be uniformity in policy implementation specially in cost sharing policy irrespective of implementing agencies to build transparency and trust.
- Participatory approach to RWSS service delivery including community devel opment activities, NFE (Non-formal Adult Education), HSE (health hygiene and sanitation education) and WTSS (womens' income generating activities) have been very effective in empowering the communities, including women, where communities demonstrate a willingness to make social changes like enabling women to take decision-making roles besides men in managing wa ter schemes; and thus resulting in ownership.
- System of the project facilitates community participation and strengthens community capacity to implement and sustain the program. But, for success ful implementation and sustained support to the community in future man agement of the scheme, linkages with VDC and DDCs are important. Be sides, present information sharing with VDC-DDC, linkages should be fur ther strengthen with the provision of linking FB program in the DDC plan and provision of ensured participation of VDC representatives during plan ning and monitoring activities at scheme/community level and opening the possibility of VDC/ DDC cost sharing.
- Long time is required to internalize the demand driven approach to participa tory decision making using objective eligibility criteria, particularly when it is a departure from conventional approaches.
- A small number of qualified staff (Board has a total of some 44 staff of which 26 are professional) can administer a large number of schemes using efficient management information system, local consultants, clear criteria for scheme selection and payment by results;
- For expansion, introduction of the concept of regional management, with greater roles and responsibilities to Service Agencies and Support Organiza tions is desirable.

Melamchi Water Supply Development Board (MWSDB)

Melamchi Water Supply project (MWSP)

Project Management Consultant (PMC)

The Project consists of the following components:

1. The Melamchi Diversion Scheme

- Melamchi Valley Main Access Road
- Upgrading of Access Road
- Adit Access Roads
- Power Line Construction
- Melamchi Diversion Conduit
- The Social Uplift Program in the Melamchi Valley

2. Water Treatment Plant
3. Bulk Distribution System
4. Management/Lease Contract for Water Supply and Sewerage Systems
5. Distribution Network Improvements (DNI)

- Rehabilitation Works
- Longer-term DNI

6. Wastewater System Improvements
7. Hygiene Education Program
8. Training
9. Public Dialogue Program

Scope of Project Management Consulting Services

The focus of the Consulting Services is on management including the tasks of monitoring and managing project risks associated with time and cost control, implementation schedule, and project related social and environmental aspects. The Consultant will undertake the following tasks:

- Coordinate Project activities, staff, consultants, contractors and the public
- Monitor Project status and activities
- Compile, prepare and make reports available to the government, funding agencies, the public and the press
- Liaise with MWSDB and the consultants for the various components, and ensure all parties are kept informed of relevant issues
- Be pro-active in troubleshooting and keep the Project within the time and cost schedules

Design, maintain and update the Project database system

Metcalf & Eddy, Inc.

In association with

Maunsell Limited
SILT Consultants (P) Ltd.
MEH Consultants (P) Ltd.,
Mutual Engineering Consultant (P) Ltd.

Members' Name-List in Alphabetical Order for Membership Directory

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3	178	Amar Neku	Life	Water Aid	413895	531078	
4	106	Amir Man Palikhe	Life	DWSS	413744	538499	
5	162	Amodh Dhital	Life	DWSS	413744	371784	
6	71	Anand Mohan Lal Das	Life	DWSS	413744	470884	
7	157	Ananta Prasad Gautam	Life	NSSC	422368	359364	
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10	1	Anil Upadhyaya	Life		413066		
11	117	Arjun Paudyal	Life	Dolidar	524320	427625	
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20	204	Bhoj Bikram Thapa	General	DWSS	083-21388	432265	
21	161	Bhushan Kumar Bhattarai	Life	DWSS	413744	413200	
22	104	Bidya Nath Bhattarai	Life	DWSS	413744	633059	
23	170	Bijaya Raj Chalise	General	NWSC	276923	355989	
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26	41	Binod Acharya	Life	DWSS	413744	483414	
27	24	Binod Chandra Jha	Life	DWSS	413744	631567	
28	150	Binod Devkota	Life		498446/499	544513	
29	108	Binod Kumar Agrawal	Life	DWSS	083-20600	468893	
30	217	Binod Lal Thakali	Life	DWSS	413744	528126	
31	218	Birendra Man Pradhan	Life	DWSS	413744	521546	
32	94	Birendra Man Shakya	Life	DWSS	441657	266567	sophen@ntc.net.np
33	145	Bishnu Prasad Timilsina	Life	DWSS	413744	6311631	
34	83	Bishwa Bhakta Kharel	Life	DWSS	011-661313	3715463709823	
35	25	Bishwa Mani Gyawali	Life	DWSS	01-410750	375860	Bisho lwl@ @ hotmail.com
37	58	Buddhi Prashad Gautam	Life	DWSS	413744	415641	
38	194	Chakra Pani Sharma Acharya	General	DWSS	413744	771037	
39	112	Chandra Bahadur KC	Life	DWSS	413744		
40	213	Chok Prashad Dhital	Life	WSSDO	482640		
41	166	Deepak Kant Mainali	General	270451	521777		
42	23	Deepak Puri	Life	DWSS	413744	551481	
43	197	Devendra Gauchan	General	UNICEF	413744	472015	
44	38	Devendra Karki	Life	DWSS	413744	413883	
45	154	Devendra Kumar Dahal	Life	ITECO Nep	493764	470966	

46	97	Dhrubha Mani Paudel	Life	DWSS	413744		
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48	30	Dhruva Bahadur Shrestha	Life	DWSS	413744	470810	
49	209	Dhruva Dev Prashad Kumhal	Life	DWSS	413744	051-28688	
50	29	Dhruva Raj Shrama	Life		411823		
51	138	Dhruva Raj Thapa	Life	Habitat	484072	471956	dhrubathapa@ hotmail.com
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53	173	Dibya Khadgi	Life	RWSS FDB	441076	425307	
54	122	Dilip Kumar Pradhan	Life	DWSS	413744	482594	
55	142	Dinesh Bajracharya	Life	Water Aid	413744	259516	
56	140	Dinesh Chalise	Life	MPPW	226051	372229	
57	185	Dinesh Chandra Devkota	Life		418673	433951-416479	
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59	2	Dinesh Raj Manandhar	Life	IDI	476182	4358834	mrdinesh@wlink.com.np
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62		Dwarika Shrestha			413744	410110	
63		D.N.Goyal		Sona	262252	417556	
64	15	F. M. Bullok	Life				
65	65	Gajendra Kumar Thakur	Life	DWSS	413744	529112	
66	131	Ganesh Bahadur Thapa	Life		035-20110		
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71	208	Govinda Prashad Sharma	Life	DWSS	413744	271910	
72	191	Gyanesh Bajracharya	General	NWSC	262259		
73	202	Hare Ram Shrestha	General		472791	633140	
74	118	Hari Dutta Paudel	Life	DWSS	423848	274419	
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81	64	Harikrishna Paudel	Life	DWSS	413744	056-24008	
82	32	Hariram Koirala	Life	DWSS	413290	279895	hrkoirala@ yahoo.com
83	57	Harisharan Bhandari	Life	DWSS	413744	275157	
84	86	Him Prasad Gautam	Life	DWSS	413744	331224	
85	158	Himesh Anand Baidya	Life				
86	141	Hira Das Shrestha	Life	DWSS	413744	661112	
87	89	Indra Bilas Khanal	Life	Dolidar	524320		
88	26	Ishwar Man Tamrakar	Life	DWSS	417609	275304	
89	3	Ishwari Prasad Paudel	Life	MOPPW	227280	531964	
90		Iswar Man Amatya	life	IOC			
91	48	Jagadish Mahato	Life		083-20260	083-20641	
92	193	Janak Adhikari	General	DWSS	413744	275344	
93	133	Jyoti Kumar Shrestha	Life	DWSS	413744	226878	

94	189	Jyoti Kumari Upadhyaya	General		411194	370575	
95		Juddha Bd. Thap		DWSS	441657	278455	Thapaj_b@ hotmail.com
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100	46	Khom Bahadur Subedi	Life	Melamchi	468964	4417331	
101	181	Kiran Darnal	Life	DWSS	413744	4251848	
102	42	Kishore Kumar Shakya	Life	DWSS	413744	421832/419598	
103	165	Kishore Man Pradhan	General		521723	523864	
104	77	Krishna Mani Lamichanne	Life	DWSS	413744	490270	
105	113	Krishna Prasad Acharya	Life	DWSS	413744	370583	
106	49	Krishna Prasad Shrestha	Life	CEMAT	493198	634163	
107	186	Krishna Prashad Paudel	Life	DWSS	413744	421086	
108	68	Krishna Rana	Life	Melamchi	468965	410229	
109	115	Kushumakar Sharma	Life				
110	229	kiran kumar chitkar	Life	DWSS			
111	152	Laxman Raj Shrestha	Life				
112	84	Laxmi Nath Nepal	Life	HBC 94 FM		770390/081-22098	
113	224	M. Kumar Lal	General				
114	79	Madan Krishna Chitrakar	Life	DWSS	413744		
115	168	Madhav Narayan Shrestha	General	NWSC	262289	4271429	madhavnarayan @yahoo.com
116	175	Madhav Pahari	Life	UNICEF	523200	545230	
117	196	Madhav Prashad Ojha	General	DWSS	413744		
118	17	Mani Prasad Singh	Life				
119	180	Manoj Dev Manandhar	Life		524379	225253	
120	96	Manoj Ghimire	Life	DWSS	413744	474153	
121	187	Manoj Pandey	Life	IOE	525477	5521744/412789	10956@yahoo.com
122	50	Megha Raj Regmi	Life	DWSS	413744	248957	
123	203	Mira Joshi	General	MOE	471992		
124	127	Mitra Prasad Upreti	Life	DWSS	413744		
125	90	Mohammad Reza Khan	Life	DWSS	413744	051-27110/27000	
126	70	Mohan Bahadur Karki	Life	DWSS	413744	493569	
127	102	Mohan Bikram Prajapati	Life				
128	135	Mrs. Nil Keshari Shakya	Life	DWSS	414539	410025	
129	16	Mukti Man Joshi	Life				
130	163	Mukunda Nanda Baidya	General	NWSC	262205	253940	
131	139	Mukunda Neupane	Life	IOE	536827	431524	
132	37	Murali Gopal Ranjitkar	Life	Dolidar	486232		
133	95	Murari Lal Chaudhari	Life	Dolidar	525948		
134	231	Madhan Shankar Shrestha	Life				
135	223	N. Shrestha	General				
136	184	Nama Raj Khatri	Life	DWSS	413744	570748	
137	44	Nanda Bahadur Khanal	Life	DWSS	413744	4423931	nandakharel@hotmail.com
138	98	Nanda Lal Banjade	Life	DWSS	413744	277555	
139	190	Narayan Karna	General				
140	52	Narayan Prasad Khanal	Life	DWSS	413744	495205	
141	18	Narayan Prasad Rimal	Life				
142	107	Narendra Kumar Baral	Life	DWSS	413744	051-21915	

143	160	Narendra Man Pradhan	Life	NWSC	262203	4350759	nmpoo5@ yahoo.com
144	105	Nawa Raj Khatiwada	Life	SCHEMS	354321	356017	
145	116	Nawal Kishore Mishra	Life	DWSS	413670	4488029/488	ess@wost.gov
146	40	Niranjan Khanal	Life	DWSS	473089	413744	
147	120	Nirmal Tandukar	Life	DWSS	413744	4-422054	tndkar@enet.com.np
148	148	Noor Kumar Tamrakar	Life	NWSC	229027		
149	61	Parikshith Shrestha	Life	DWSS	413744	529550	
150	110	Pawan Kumar Shrestha	Life	Dolidar	473467		
151	21	Poshan Nath Nepal	Life		431941		
152	192	Prabhakar Man Singh	General	Melamchi	427068		
153	147	Prabhat Mishra	Life		493198	492407	
154	101	Pradip Kumar Mudvari	Life	DWSS	413744	630854	
155	221	Pradip Lal KarnaGeneral			025-80042	025-80848	
156	59	Prakash Raj Lamsal	Life	Melamchi	469864/469318	4222128	plamsal@ntc.net.np
157	177	Prakash Rudra Shrestha	Life	Nepal Cons	536827	524379/246449	
158	74	Pratap Sharma Paudel	Life	DWSS	413744	370751	
159	212	Prem Prashad Dotel	Life	DWSS	413744	361569	
160	20	Purna Das Shrestha	Life	Melamchi	468965	631078	
161	176	Rabindra Man Shrestha	Life	Nepal Cons	524379	410549	
162	219	Rabindra Nath Shrestha	Life		525477	533972	
163	69	Radhakrishna Chaudhari	Life	DWSS	413744	488626	
164	7	Radheshyam Manandhar	Life	DWSS	413744	225285	
165	171	Raj Babu Shrestha	Life	RWSS FDB	4410761	4371966	raj@khaskosh.wlink.com.np
166	63	Raj Kumar Malla	Life	DWSS	4416383/493959	4498628	
167	87	Raja Karmacharya	Life	Dolidar	536223		
168	136	Rajan Raj Pandey	Life	DWSS	413744	361448	
169	76	Rajendra Kumar Kunwar Chhet	Life	DWSS	255432		
170	62	Rajendra Kumar Regmi	Life	DWSS	413744	253890	
171	214	Rajendra Prashad Neupane	Life	DWSO	311462		
172	155	Rajesh Kumar Das	Life	IOE	543129	526967	
173	39	Rajesh Prasad Singh	Life	DWSS	413290	483778	
174	183	Rajiv Raj Joshi	Life	NWSC	422368	228721	
175	75	Ram Chandra Sah	Life		242337		
176	45	Ram Chandra Devkota	Life	DWSS	413744	352031	
177	132	Ram Krishna Sapkota	Life	DWSS	413744	375302	
178	47	Ram Krishna Sherchan	Life	DWSS	413744	412049	
179	167	Ram Kumar Yadav	General	DWSS	413744		
180	6	Ram Lakhan Mandal	Life	DWSS	413744	488042	
181	85	Ram Lal Pradhan	Life	DWSS	413744		
182	137	Ram Lal Tuladhar	Life	DWSS	413744	526484	
183	134	Ram Mani Sharma	Life	DWSS	423848	277650	rmsharma@ntc.net.np
184	109	Ram Niwas Chaudhari	Life	DWSS	413744		
185	119	Ram Prasad Kharel	Life	DWSS	413744		
186	5	Ramdeep Sah	Life	Bagmati Dh	479703	470041	
187	182	Ramesh Kumar Sharma	Life	Fund Board	410761	350964	
188	144	Ramesh Rijal	Life		421268		
189	9	Ratna Kumar Siddhi	Life	Free Liancer	523693		
190	8	Ratnakar Dutta	Life		470158		
191	146	Ravi Prasad Rajbhandari	Life	CEMAT	493158	482183	

192	66	Rishi Bahadur Adhikari	Life	DWSS	610421/413744	491538	
193	78	Robin Lal Chitrakar	Life	DWSS	410785	272510/270188	
194	60	Roshan Man Singh Pradhan	Life	TAEC C.P	372899/525409		
195	216	Salik Ram Paudel	Life	DWSS	413744		
196	205	Salil Devkota	Life	SCEC	532732	522695	
197	149	Sanjaya Devkota	Life	TAEC C.P	493446	417351	
198	188	Sanjiv Bikram Rana	General		270451	220341/270541	
199	56	Sano Kaji Karki	Life	Dolidar	378899		
200	73	Saroj Kumar Baskota	Life	DWSS	441657	474462	
201	33	Shambhu Prasad Rijal	Life	DWSS	010-560062/4137	432340	sprijal@hotmail.com
202	92	Shankar Mani Gyanwali	Life	DWSS	413744	431858	snijo@wilnk.com.np
203	159	Shankar Prasad Jaisawal	Life	DWSS	413744	494195	
204	34	Shanta Bhakta Mathema	Life		272174		
205	91	Shanti Karmacharya	Life	DWSS	413744	614031	
206	35	Sharad Prasad Adhikary	Life	WHO	428988	438742	
207	220	Shiva Kumar Shrestha	General				
208	198	Shiva Nath Sharma	General		414257		
209	128	Shiva Prasad Devkota	Life	DWSS	488500		
210	210	Shiva Prashad Sapkota	Life				
211	169	Shiva Raj Pathak	General		259728	091-22539	
212	51	Shiva Ratna Rajbahak	Life	DWSS	413744		
213	114	Shrawan Kumar Upadhyaya	Life	DWSS	010-520127	4373990	
214	11	Shreeram Shrestha	Life	DWSS	413744	4-470138	
215	55	Shyam Prasad Upadhyay	Life	DWSS	770390		
216	207	Sibendra Jhha	Life	DWSS	4413744	5543131	jhashivendra555@hotmail.com
217	10	Sohan Sundhar Shrestha	Life	Dolidar	520631		
218	200	Subodh Prashad Timilsina	General	COSMOS	437179	428016	
219	100	Sudan Raj Panthi	Life	DWSS	413744		
220	174	Sudarshan Bhandari	Life	DWSS	413744	353010	
221	82	Suman Prasad Sharma	Life	Melamchi	466635	4-249308	suman@melamchiwater.org
222	99	Sunil Kumar Das	Life	Bagmati Dhal	479703	056-22515	
223	126	Suresh Mahaju	Life	DWSS	413744	261468	
224	111	Surya Raj Kandel	Life	DWSS	413744	355453	
225	164	Surya Bhakta Shrestha	General		248663	610951	
226	232	Sunil Dhose Joshi	Life	Melanchi	468965		
227	27	Tashi Tenzing	Life	World Bank	226792	522392	
228	88	Tej Raj Bhatt	Life	Melamchi	468965	530329	
229	172	Thakur Pandit	Life	DWSS	413744	4-352820/35	thakurpandit@yahoo.com
230	53	Tiresh Prasad Khatri	Life	DWSS	413744	410184	
231	230	Uma Shankar Joshi	Life				
232	12	Vashu Dev Raj Joshi	Life		417671		
233	123	Vidhan Ratna Yami	Life	MPPW	226051	248700	

पानी नै जीवन हो
जथाभावी खेर नफालौं ।

यहाँलाई थाहै छ...

काठमाडौं उपत्यकाको खानेपानीको बढ्दो अभावको समस्यालाई समाधान गर्न श्री ५ को सरकारले मेलम्ची खानेपानी आयोजना कार्यान्वयन गर्दैछ

एडीबी, नोराड, सिडा, जेबिक, ओपेक कोष तथा नर्डिक विकास कोषको सहयोगमा मेलम्ची खानेपानी आयोजना कार्यान्वयन हुँदै आएको छ। सिन्धुपाल्चोक जिल्लाका मेलम्ची, यांग्री र लार्के खोलाहरुबाट तीन चरणमा गरी दैनिक ५१ करोड लिटर पानी काठमाडौं उपत्यकालाई उपलब्ध गराउने उद्देश्य लिएको यस आयोजनाले पहिलो चरणमा मेलम्ची खोलाबाट दैनिक १७ करोड लिटर पानी काठमाडौं उपत्यकाको बितरण प्रणालीमा थप्ने लक्ष्य लिएको छ। दोश्रो र तेश्रो चरणमा यांग्री र लार्के खोलाहरु दैनिक १७/१७ करोड लिटरका दरले पानी थप्दै जाने योजना रहेको छ। समग्र आयोजनामा पाँच अबयबहरु रहेका छन्। मेलम्ची डाइभर्सन स्किम, पानी प्रसोधन केन्द्र, थोक वितरण प्रणाली, वितरण प्रणाली सञ्जाल तथा ढल निकास प्रणालीको पुनर्स्थापन तथा बिस्तार रहेका छन्।

आयोजनाको विशेषताहरु

- दीर्घकालीन रुपमा काठमाडौं उपत्यकाको पानीको मागलाई धान्न सक्ने
- चरणबद्व रुपमा पानी थप्दै जान सकिने
- उत्पादन लागत कम हुने तथा सम्भार कार्य सरल हुने
- गुरुत्वाकर्षणबाट पानी आउने
- श्रोत उपत्यका (मेलम्ची) को वातावरणमा सीमित मात्र प्रतिकुल प्रभाव पर्ने
- लाभान्वित उपत्यका, (काठमाडौं) का वातावरणमा सकारात्मक प्रभाव पर्ने

तसर्थ, काठमाडौं उपत्यकाको खानेपानीको समस्यालाई दीर्घकालीन रुपमा समाधान गर्न सरकारी प्राथमिकताका साथ कार्यान्वयनमा रहेको यस आयोजनालाई नागरिक समाज, सञ्चार माध्यम, सामाजिक संघ संस्थाहरु लगायत आम नेपाली जनताको सदस्यता र सहभागिताको अपेक्षा राख्दछ।

मेलम्ची खानेपानी विकास समिति

देवकोटा मार्ग, नयाँ वानेश्वर, काठमाडौं।

फोनः ४७५३०३, ४६८८६४/५ फ्याक्सः ४६८८६२

वेबपेजः www.melamchiwater.org