Chapter 4
Policies and Institutions for Water Harvesting in Nepal

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1. Introduction

Nepal has a population of about 21 million with 7.5% and 42.6% residing in the mountain and hill regions respectively. The mountain region is rugged and remote, and its people face great hardship. Tibeto-Burman speaking people dominate the north; whereas Nepali speaking people dominate in the mid-hills. Ninety per cent of the population live in rural areas and are engaged in agriculture, which is the basis for subsistence. Nepal is a poor country with a per capita annual income of US $ 210.

Ecologically, Nepal is divided into three regions: the high mountains, the hills, and the flat land (Terai). The Terai is the bread basket of the nation. With the variation in altitude from the high Himalayas in the north to the flat plains of the Terai in the south, the climatic change across the country is dramatic. The Terai region close to the Indian border receives about 1,500 mm of rainfall per annum. In the hills, the average rainfall is around 1,800 mm a year, but varies from place to place. There is a significant temporal variation in the amount of rainfall. About four fifths of the annual rainfall occurs during the monsoon season which lasts from mid June to September.

The high mountain ecological belt receives quite light rainfall, and some of the districts are rain shadow districts. The eastern region receives heavy rainfall compared to the Far Western region. The meeting point between the Churia hills and the flat lands of the Terai is called the Bhabar zone and the soil is porous and the water table quite deep. The water scarcity areas in Nepal are the mountain/hill tops, rain shadow hill districts, and the Bhabar zone (due to the deep water table). In the hills and mountains, there is usually excess water in the monsoon season, creating havoc with landslides and soil erosion, and no water in dry seasons.

2. Review of National Policies and Programmes on Water with Particular Reference to Water Harvesting in Mountain Areas: Evolution and Present Status

Water harvesting in mountain areas: evolution and present status

The traditional water-harvesting system is based on conservation of rain water where it falls and its utilisation to meet the diverse requirements of the local people. There is evidence of

such systems all over the country, in general, and in Kathmandu Valley in particular. These systems met the basic domestic and irrigation water requirements of the local population. These systems used low-cost, user-friendly techniques and were kept in good operational condition by local communities. These facilities not only served the minimum requirements of individual households but also fostered social cohesion and self-reliance.

Rain-water harvesting and utilisation (RWHU) is not a new technology; it is an ancient legacy. On top of the hills and mountains of Nepal, ponds were dug in ancient times to collect rain water mainly for livestock use. At present, significant numbers of ponds are filled and put to other uses. Stone spouts were constructed in the hills and also in urban areas. The ancient people had a good knowledge of the hydrological cycle, and they constructed ponds to collect water for the dry season and also to recharge the springs and increase soil moisture. Springs and stone spouts were constructed; and these were the main source of water before the introduction of piped water supplies. At present, such springs and stone spouts are still being used. For example, the intricate system of the traditional water supply for Patan, which consists of a network of 'Rajkulo(s')', ponds, and stone spouts is centuries' old. As a result of urbanisation, it has fallen into neglect and disuse; however, ample facets of this system are still working.

Trusts ('guthi') were established to maintain some stone spouts and several ponds properly. However, most of the systems have been neglected and most of the ponds are encroached upon for other uses.

Managing and making available drinking water are considered religious acts. In the old days, people used to construct ponds for the benefit of the public as a noble act. These types of ponds are prevalent in the Terai region, and they are sources of groundwater recharge. These ponds at present are a good source of income for the VDCs which contract them out as ponds for fish farming. Some people provide drinking water near 'chautara' (resting places below big trees) for trekkers especially in summer.

Spring sources in the hills have a special meaning for the women of Nepal. They are places to meet fellow women, to socialise, or just to relax for a while from the drudgery of household chores. Due to social norms, opportunities to meet with the opposite sex are limited. Normally, springs are also places where rural girls and boys can meet.

To capture rainfall runoff from the sloping hills, the farmers of Nepal construct terrace lands with bunded fields to accumulate rain water for irrigated agriculture. Terracing the sloping land and using for paddy cultivation are efficient ways of using otherwise excess rain water which would have washed away the nutrients and eroded the topsoil. Many visitors to Nepal are impressed by the beauty of the series of contours of the terraces, ingenuity, and hard work of Nepalese farmers.

Historically, the communities in Nepal have used local water resources successfully for centuries. Nepali farmers irrigate their fields by diverting water from streams and to a lesser extent from small ponds. About 70% of the irrigated area in Nepal is covered by farmer constructed and managed systems called farmer managed irrigation systems (FMIS). These FMIS have survived and continued to function over the centuries. Even though the technology is at a low level and simple, the system functions well due to its strong institutional base and adequate networking in the organisation. The FMIS vary in size from a few hectares to a more than 10,000 ha and are still functional. There has been

considerable research and documentation in institutions on the management of these FMIS. Valuable lessons can be learned for application in agency-managed irrigation systems. Some of the important FMIS are Chhattis Mauja Kulo, Rupandehi (3,000 ha); Raj Kulo Argeli, Palpa (48 ha) ; and the Budi Kulo system, Bardia (12,000) ha (several kulo in the area combined). These FMIS have been in existence for 160,110, and 160 years respectively. The Rajkulo of Patan, which divert water from the Naldu and Lele rivers, is said to be 1,000 years old. HMG/N has recognised the importance of FMIS. It has made provisions for rehabilitation and improvement of FMIS. Large numbers of FMIS are still functioning without any support from HMG/N.

Before public sector initiation in irrigation systems' development, several Rajkulo (canals) were constructed through state patronage. In the 17th Century King Ram Shah declared that irrigation and its management were community responsibilities (Riccardi 1977).

The modern development process gradually undermined these innovative systems. Ancient RWHU systems are dying out and are gradually losing their importance. Currently, there are some efforts to revive this dying wisdom. Rapid population increase, urbanisation, and improved quality of life have increased the demand for water. This means that RWHU systems need to be revived. Slowly, efforts are being made to revive and promote RWHU. The modern approaches to RWHU are collection, storage, and use of rain water from the rooves of houses. Ponds lined with plastic are used for small-scale sprinkler irrigation. Small earth dams are used to create small reservoirs for irrigation and other uses. In Kathmandu, a project to pilot test groundwater recharge is being introduced.

In the early 1960s, the mission Hospital in Tansen, Palpa, constructed a Rain water Harvesting System (RWHU) system and it is still functioning well. The major ongoing work of RWHU at household level are undertaken by the Rural Water Supply and Sanitation Project, FINNIDA (RWSSP/F) in the two districts of Palpa and Gulmi in Nepal. This project involves user participation. It is considered to be a successful programme. The Department of Water Supply and Sewerage (DWSS) has also undertaken some RWHU at community level in Syangja, and Tanahu districts through its district offices with little or no cost sharing. Peace Corps, Nepal, constructed some RWHUs with ferro-cement tanks. Some NGOs, with support from INGOs, have built small RWHUs mostly with plastic-lined tanks for small irrigation for marginalised farmers. Some agencies have constructed RWHUs for their own use. ICIMOD has constructed small, plastic-lined tanks in Kabhre and Godavari. In Ramechhap district, a pond with a capacity of 3,300 cubic metres with plastic lining for use in irrigation is being constructed by the users with assistance from the Canadian International Development Agency (CIDA). The Department of Soil Conservation and Watershed Management (DSCWM) also undertakes establishment of RWHU systems through its district and project offices. Ponds are constructed without lining to allow seepage to recharge springs and increase soil moisture downstream. Under the DSCWM, there are several watershed management projects that are being implemented with assistance from donor agencies.

Most of the houses in the hills and mountains have thatched rooves, and they are not suitable for collecting rain water for domestic use. It is a great constraint.

The present status of RWHU is given below.

About 30% of the erodible land in the hills, covering 365,000 ha in Nepal, has been terraced (Yadav 1998). The majority of traditional systems are dying out because of a

number of reasons. Many traditional ponds have been encroached upon, especially in urban areas. Slowly, attempts are being made to revive the systems. For example, in Patan and Kathmandu, a few ancient stone spouts are being rehabilitated. The following is a list of the work undertaken in recent times.

- RWSSP/F constructed 478 jars of ferro-cement by March 1998.At the household level ferro-cement jars of two cubic metres in capacity are used to collect water harvested from CGI rooves.
- Plastic-lined small tanks/ponds along with sprinklers are being used in several dozen places for very small-scale irrigation by marginalised farmers.
- Ponds have been constructed by government departments, but they are very few in number.
- For drinking water, small community-level RWHU schemes have been successfully constructed, mostly by the DWSS.
- About 40 small ponds have been constructed without lining by the Bagmati Watershed Management Project (BWMP) in and around Kathmandu Valley to increase soil moisture and spring flow downstream.
- Peace Corps Volunteers have constructed ferro-cement tanks for RWHU.
- The existing, traditional water-harvesting systems have not been documented yet. However, their numbers are substantial. There are numerous stone spouts in urban and rural areas. Judicious use of such sources can augment domestic water supplies.
- Large numbers of ancient ponds have been filled in and put to other non-water-related uses.
- With the assistance of the Asian Development Bank (ADB/Manila) a pilot project is being introduced to use water from the Manahara River to recharge groundwater by injection through the tubewells.
- The lakes and ponds, which are 637 in number, have been documented along with the location, size, and so on by the Department of Hydrology and Meteorology. However, its present use and potential for use have not been described.
- FREEDEAL, a legal firm/NGO, organised a seminar on Water Rights' Law Study in March 1998.

The progress up to date in RWHU has been quite insignificant. However, an encouraging effort is being made and activities in RWHU are moving ahead slowly. INGOs, NGOs, and some government departments are slowly entering into this field. A boost will be required to accelerate these activities. RWHU needs to be promoted in water scarce areas, considering its potential to free women from the drudgery of fetching water for drinking and other domestic uses.

Review of national policies on water with particular reference to water harvesting in mountain areas

The country has promulgated various acts and policies in the water resources' sector. These include irrigation policy, water resources act, water resources' regulations, national policy on water supply, and sanitation policy. Some of these acts and policies have indicated the importance of RWHU in the hills and mountains. There is no separate policy on RWHU. Most of the topics, such as institution building and gender/children's issues, mentioned in the above policy statement are also relevant to RWHU. However, the lack of strong commitment is clearly observed. The following is a relevant quote from Dhungel and Bhattarai (1997).

"Governmental and non-governmental agencies involved in water resources, agriculture, forestry/soil conservation and road construction have not given rain water conservation the due recognition and priority it deserves in relieving the drudgery of mountain people, particularly women and children. Sparse reference to rain water conservation, direct or implied, is found in some policy statements of intent. However, direct commitment has been conspicuous by its absence, a situation which is exacerbated by an acute lack of data and research into the appropriate technologies to be adopted. "

The necessity for promoting RWHU in water scarce areas of Nepal has been recently recognised and several agencies are engaged in this endeavour with the support of different promoters.

The HMG/N policy has shifted from an agency-managed system to a user-managed system and promotion of the private sector in the water sector. Recently, it has been the thinking that the government should be acting as a supporter or facilitator instead of a provider or implementator. At the implementation level, RWSSP/F, in its first phase, worked as an implementator or more like a contractor. Now, in the second phase, it is working as an advisor and as back-up support; whereas the district development committees (DDCs) and user groups are the actual implementators.

The government departments began development/management of the water-related systems. Agency-managed irrigation systems were caught in the vicious circle of construction, deterioration, and rehabilitation. To make it sustainable, the concept of users' participation in planning, construction, and operation and maintenance (O&M) was considered vital. This vision is reflected in the Irrigation Policy (IP) which has been revised twice. Similarly, a water supply policy has also been formulated. This concept of users' participation is also introduced in the water supply sector. In actual practice, there are various levels of users' participation; in most cases, the participation is less than required. Continuous efforts are required to entice users to participate.

The Water Supply Policy establishes a service fee to cover full O&M costs and capital cost recovery from urban users. However, this policy has not been implemented in practice. Previously, sanitation was not given much importance in water supply schemes; however, at present, both these aspects are considered together during scheme planning, design, and implementation.

NGOs were promoted to deliver efficient services. NGOs usually out-perform government departments. In the eighth and ninth Five-year Plans (FYPs), emphasis was given to the promotion of NGOs. A Social Welfare Council (SWC) was established to regulate/facilitate NGOs and the activities of INGOs. However, the SWC itself has not been able to function effectively. The DWSS has prepared a policy for the participation of NGOs in the drinking water/sanitation sector. There are encouraging results and performances of NGOs operating under INGOs, Rural Water Supply and Sanitation Development Board (BOARD) and the World Bank Funded Project 'Janatako Khanepani Tatha Sarsafai Karyakram' (JAKPAS). Secondary data on the status/performance of NGOs under the Development of Water Supply and Sanitation (DWSS) are not available.

The Associations' Act - 2034 prescribes registration of NGOs and user groups/associations to give them legal status. As per this Act, user groups/associations and NGOs were registered at the Chief District Officer's (CDO) Office. At present, all the water user groups/associations

are required to register with the District Water Resources' Committee (DWRC). This committee also issues licenses to use water resources. There have been some reservations about the ability of DWRC to process applications and issue licenses.

On the initiative of the World Bank, the Rural Water Supply and Sanitation Fund Development Board (BOARD) was established as an autonomous institution within the government framework for delivery of services in the water supply sector through service organisations, (NGOs, Community Based Organisations (CBO), and so on). BOARD has proved to be an efficient and really autonomous institution without a government bureaucracy. In the water supply sector, there are more than 19 INGOs providing services through NGOs.

The following is a list of related acts and policies.

1. The Ninth Five Year Plan (1998), NPC
2. Water Resources' Act (1992)
3. Water Resources' Regulations (1993)
4. National Water Supply Sector Policy (1998)
5. Irrigation Policy (2053-1996-97)
6. Soil and Water Conservation Act (1982)
7. Village Development Committee (VDC) Act (1962)
8. Association Registration Act (2034-1987-88)
9. National Environment Impact Assessment Guidelines, IUCN (1993)
10. National Code Act (*Muluki Ain*) (1964)
11. Nepal National Sanitation Policy and Guidelines for Planning and Implementation of Sanitation Programme (1994)
12. Social Welfare Council Act (1992)
13. Fishes, Aquatic Birds, and Animals' Conservation Act (2017-1970-71, revised in 2021-1974-75).
14. Policy on the Participation of NGOs in Water Supply and Sanitation Programme (1996)
15. District Water Supply Coordination Committee: Guidelines for Work Implementation

The following are some of the provisions in the above policies that are applicable to RWHU as well.

National policy on drinking water

- The policy has considered different aspects, such as legal, institutional, human resources, technology level, user participation, and so on, for overall development and management of water supplies in the Kingdom.
- In very remote areas and places where alternative viable sources of drinking water are not available, RWHU will be used.
- Communities will be enabled to take up leading roles in all aspects of water supply schemes.
- Sanitation programmes will be made part of water supply programmes.
- Appropriate technology, such as rain water harvesting, will be promoted.
- Research and development (R&D) will be undertaken with regard to development of appropriate and sustainable technology.
- A minimum of 10% of costs is to be met by users in cash/kind or volunteer labour. After completion of the schemes, full O&M responsibility is to be given right away to the users.

- Traditional sources, such as stone spouts, wells, and springs, will be rehabilitated, conserved, developed, and protected and promoted.
- Technology should be simple, affordable, sustainable, and replicable by users.
- Small gravity water supply systems for less than 500 persons will be the responsibility of VDC.

Policy on irrigation

- The Irrigation Policy (IP) -2053 (1996-97) mentions use of RWHU. This IP has given a lot of emphasis to the active participation of the users. Irrigation schemes smaller than 25 ha in the Terai and 10 ha in the hills are considered private schemes and are not usually undertaken by the Department of Irrigation. These small projects are usually constructed with ADB/N assistance and users have to meet 40% of the cost. IP emphasises that at least 20% of the members of the executive committee of the user group should be women.

The 'ninth plan'

- Water-harvesting techniques will be tested for small-scale irrigation. Irrigation facilities will be provided through RWHU in areas where surface and groundwater are not available.
- Studies will be undertaken by the bank in order to extend loans for sprinklers and drips for small-scale irrigation for high-value crops in hilly and remote areas.
- Institutional and procedural arrangements will be made for appropriate management and conservation of ponds, lakes, and wetlands.
- To counter negative impacts, watershed management will be implemented along with water resource development and conservation.
- Pricing is to be based on realisation of costs based on investment and O&M from urban users and recovering O&M costs only from rural water users for drinking water supply.
- O&M, rehabilitation, and extension of the water supply system in the 58 municipalities will be undertaken to improve the system with active involvement of the municipalities.
- Local institutions, NGOs, CBOs, and private operators will be given the responsibility of water supply schemes for less than 500 persons
- Subsidies will be gradually phased out for sprinkler/drip irrigation systems.

The 'water resources act', 2049[1]

The Water Resources Act, 2049 has given the highest priority to drinking water and water for domestic use. This Act has specified that the ownership of water lies with the State. However, most of the planners and people in the villages are unaware of this provision, and there would have been less conflict had they known. Any water resource developer has to get a license from the DWRC. However, for household and community-level domestic use no license is required.

The 'water resources' regulations, 1993

The Water Resources' Regulations, 1993 prescribes registration of consumers' (users) associations, formation of a DWRC, arrangements for conflict management, and a licensing procedure for the use of water resources.

[1] The Water Resources' Act – 2049 (1992) deals with rational use, conservation, development, and management of water resources in the country in an environmentally sound manner, with provision for mitigating the adverse effects and preventing pollution. It has made legal provisions for formation of users' groups, establishes priority for different uses, and outlines requirements for licenses to use water resources.

An environmental impact assessment (EIA)

An Environmental Impact Assessment (EIA) is not required for RWHU at household or small community level. An Initial Environmental Examination (IEE) is required for systems with water impoundment/development in a catchment area.

The 'VDC Act'

This Act authorises the VDC to construct, repair, and maintain the water resources in common use in the village. It can organise volunteer labour for such work. It has the power to frame bye laws - on pollution of drinking water/spring water, disposal of dirty water, and blockage of drainage.

'Soil and Water Conservation Act'

In protected watersheds permission is required from the Watershed Conservation Officer to use water resources. This Act prescribes land use according to the prescribed land-use plan. An interview with a senior officer in the DSCWM revealed that this Act has not been put into practice. For example, it is impractical, for various reasons, to advise people not to farm steep hill slopes. This Act is now in the process of being updated.

'Fishes, and Aquatic Birds and Animals Conservation Act – 2017'

This Act defines 'Private Water' as ponds/reservoirs on personal land for which land taxes are paid. HMG has prohibited capturing or hunting of certain species of fish and water-loving birds and animals. Even the owner of 'Private Water' is not allowed to kill fish by poisoning them.

'Muluki Ain - 1964'

This Act prescribes that those people who constructed or invested in the canal system to bring water for irrigation shall have the right of first use. Further, no one shall obstruct the flow of water to the fields. It prohibits the pollution of water and the blocking of natural drainage.

Policy on the participation of NGOs in the water supply and sanitation programme, 1996

This policy recognises the importance of local-level NGOs and advocates their promotion. It describes the possible areas for involvement of NGOs, provides selection criteria, and specifies the support to NGOs (honorary remuneration), including monitoring/ evaluation. A format is provided for the NGO to provide information on its capability and experiences. Interviews with senior officers (SOs) of the DWSS reveal that NGOs are not available in sufficient numbers. This is quite opposite to the experience of the BOARD who have no problem mobilising SOs. It means that the provision of this policy is not attractive to the NGOs compared to that applicable to INGOs funded and other programmes.

District water supply coordination committee, guidelines for work implementation – 2053 (1997)

HMG/N has established a Central Drinking Water Coordination Committee at the national level. These guidelines have been prepared for creation of district-level committees. The Local Development Officer (LDO) is the chairperson of this Committee. This committee also

includes representatives from nationally recognised political parties. The overall objective is to promote and coordinate the rapid expansion of water supply services/schemes and to resolve the problems. In schemes to be implemented in participation with NGOs, this committee has the responsibility of selecting NGOs. It prescribes the duties and responsibilities of user groups. Further, it has the responsibility of establishing user groups where there are no user groups. The provisions in these guidelines are excellent. However, interviews with senior officers from DWSS indicate that this committee has not been effective. This Committee meets only twice a year and is almost defunct. This conflicts with the provisions made in the Water Resources' Regulations specifying a committee under the Chairpersonship of the CDO to look into the conflicts over water sources or use of water.

The national sanitation policy

The National Sanitation Policy prescribes mandatory participation of 50% for women and formation of the District Water and Sanitation Coordination Committee.

It is observed that the existing policies do not provide and adequate framework for the promotion of RWHU in mountain areas. Analysis of the findings about traditional water-harvesting systems is extremely limited. Recently constructed schemes are very few and their impact has not yet been studied. Under the circumstances it may be desirable to introduce some changes based on the suggestions made above. These primarily relate to resolving confusion, streamlining inconsistencies, and improving effectiveness of institutions at local level.

3. INSTITUTIONS INVOLVED IN WATER HARVESTING AT VARIOUS LEVELS

Central-level institutions

At the central level, the institutions involved or with the potential to be involved in water harvesting are the following.

Department of water supply and sewerage (DWSS)

The DWSS, a government agency under the Ministry of Housing and Physical Planning, is responsible for providing drinking water and promoting sanitation and sewerage. It has offices in all the 75 districts of the country. The DWSS provides services to 22 small towns. It has plans to prepare district profiles of all districts, each covering the water resources and water supply sanitation situation. The DWSS has undertaken RWHU in three districts: Tanahu, Syangja, and Gulmi. The National Policy on Water Supply stipulates that a minimum of 10% of the costa should be shared by users, but this is not applied (by DWSS) in practice in the case of RWHU as it is considered to be a test case. The DWSS has a community NGO Mobilisation Section and has prepared a policy to promote NGOs. Further, the DWSCC has a branch in each district for smooth implementation of water supply schemes. All district-level schemes need approval from the District Development Committee.

A World Bank Report on the Rural Water Supply and Sanitation Project (1996) indicates that the success of NGO schemes contrasts noticeably with the performance of many DWSS schemes.

The DWSS has not given much importance to RWHU, possibly due to its tendency to cater to large communities. The DWSS may take greater interest in RWHU in future, especially in

those places where alternatives prove to be extremely costly. A sum of Rs 0.5 million each for the districts of Tanahu and Sankhuwasabha had been allotted for RWHU in the 1998/99 budget. The JAKPAS[2] evaluation indicated that a share of 40% of the total cost by users is no problem, whereas in the DWSS, the percentage of the share in costs is quite low. The Fourth Rural Water Supply and Sanitation Project with ADB/N assistance is being implemented in three regions and is being executed by the DWSS. Some of the DWSS engineers (when interviewed) involved in RWHU are not too enthusiastic about RWHU systems.

Water and energy commission secretariat (WECS)

The WECS advises the government on policies and strategies for environmentally sustainable development/management of the water and energy sector. The WECS undertook a feasibility study (FY 1997/98) in Tansen Palpa for rain water harvesting and use. A programme to pilot test the RWHU system in Tansen Palpa in partnership with the DWSO and Tansen Municipality has been initiated. The three agencies will share equal costs with 10% contributed by users and their active participation. It intends to undertake construction of about 20-25 RWHU at household and community levels in Tansen. The WECS intends to promote the construction of RWHU at household, community and agency levels. The WECS has undertaken the formulation of a Water Resources Strategy for Nepal. It intends to formulate a national policy on RWHU in consultation with stakeholders in the near future. It has reviewed the Water Resources Act (2049) with a view to reformulation. Now, to make it active and to provide leadership, a revised mandate is in the final stages of approval.

Ministry of local development (MLD)

The MLD oversees integrated rural development projects: usually water supply components. Rural water supply is a local function. The MLD is the line ministry for local authorities such as VDCs, DDCs, and municipalities. In the Rural Water Supply and Sanitation Field Testing Project (RWSSP/F), 50% of the costs are borne by this ministry.

Department of soil conservation and watershed management (DSCWM)

The objective of the DSCWM is to conserve soil and water for beneficial use. The DSCWM promotes water harvesting as one of the important elements in its overall policies and programmes on water and soil conservation. These policies and programmes are, in general, expected to positively influence RWHU works at local level. The main activities are to protect spring sources, gully protection, protection from erosion by collecting rain water in ponds, afforestation, and watershed management. Under this Department, the implementing agencies are the District Soil Conservation Office, which has offices in 55 districts, and six watershed management projects are being implemented with donor assistance. Out of the six, four projects are centrally managed by the DSCWM. Several donor agencies are assisting the DSCWM. It seems that soil conservation and watershed management are of interest to the donor community in Nepal. In all the watershed management projects, ponds are used to conserve water. Most of the ponds used are rehabilitated ones rather than new constructions. The DSCWM publishes a newsletter, 'ASIAN WATMANET' on watershed management.

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[2] Nepali acronym for Rural Water Supply and Sanitation Field Testing Project (a World Bank assisted programme which has completed its mission and has been closed.)

Department of irrigation (DOI)

The Department of Irrigation has the responsibility of developing and providing irrigation facilities. It has offices in all 75 districts. It has not yet undertaken any RWHU for irrigation purposes. The Ninth Plan stipulates that research is to be undertaken in RWHU for irrigation. However, the DOI has not taken any initiative in this respect. The DOI has made an increasing effort to encourage users to participate in its programmes and to transfer completed, small projects to users. However, efforts need to increase even more for positive results.

Rural water supply and sanitation fund development board (BOARD)

BOARD, with assistance from the World Bank, is an agency independent from the DWSS, and is responsible for undertaking rural water supply schemes for small communities in the Central and Western Regions of Nepal, mostly in rural areas. It will spend US$ 21.25 million over a period of six years, ending in 2002. The programmes are implemented through support organisations (NGOs, CBOs) with users' participation and cost sharing. Because of the regular monitoring and evaluation activities and care in selection of sub-projects, the programmes have been successful. No water-harvesting work has been undertaken yet. It is learned, however, that on request RWHU will also be undertaken. It has great potential as a capable institution to undertake RWHU work. The cycle of the scheme is estimated to be 36 months, which seems quite long for small schemes. It has set an example of creation of an autonomous body within the government framework. It has opened a possibility for private sector service delivery which was not there before.

INGOs

INGOs activities have been significant, both quantitatively and qualitatively. There are at least 19 INGOs (1996) involved in the water supply and sanitation sector. The main ones are the International Red Cross, Water AID, CARE, Save the Children, HELVETAS, Redd Barna. HELVETAS is the largest INGO effort in this sector. UNICEF has been a catalyst in starting community-oriented programmes. The INGOs have shifted from direct services to assisting NGOs in providing services. In most cases, the performance of NGO-INGOs is better than that of the DWSS. User participation and cost sharing is greater in INGO-assisted programmes than in HMG-funded programmes. Peace Corps volunteers have undertaken establishment of some RWHU systems with users sharing costs. Their feeling is that the system is more successful at household level than at community level.

International development enterprises (IDE)

IDE, an INGO, is promoting drip irrigation and treadle pumps for small and marginalised farmers with low incomes. The target groups for IDE are (a) small farmers with less than one of ha land; (b) farmers who have small and scattered landholdings; (c) small entrepreneurs for technology development and sales; and (d) technicians who install the systems. It has developed a simplified low-cost drip irrigation system and is pilot testing the system in Gorkha, Tanahu, and Kathmandu districts. The treadle (foot-operated) pump, which can irrigate 0.33 ha land, is suitable for the Terai areas. IDE has field offices in Gorkha and Tanahu

Agricultural development bank (ADB)

The ADB has been promoting sprinklers and drip irrigation systems, and it provides loans and technical advice for their installation. It has promoted small-scale irrigation systems with users' participation and cost sharing of up to 40%.

Nepal water supply corporation (NWSC)

NWSC is responsible for supplying water to 13 large municipalities and sewerage systems to the three municipalities of Kathmandu Valley. NWSC has not undertaken RWHU work except in one or two isolated cases.

District development committee

This is one of the institutions most likely to undertake RWHUs for rural areas, as demonstrated by the experience of RWSS/F in Lumbini Zone. This system is functioning well with some support from the project. It has contributed its share to the cost of the RWHU. The Local Development Officer (LDO) stationed in the DDC is the disbursing Officer handling all the expenses of the project in the district. Further, the LDO has an important function in the DWRC and DWSCC. All water supply/sanitation schemes require the approval of the District Development Committee.

Implementing agencies at local level

The following are the local-level agencies providing services for RWHUs.

- Rural Water Supply and Sanitation Project, Lumbini Zone (RWSSP/F)
- District Water Supply Offices (DWSO), Gulmi, Syangja, Tanahu, and Palpa
- District Offices of Soil Conservation and Watershed Management
- Bagmati Watershed Management Project (BWMP) and other Watershed Management Projects
- NGOs – SAPROS, INSAN, and others.
- Service organisations (SOs recruited by the BOARD)
- District offices of ADB/N
- User Groups (UG) – some of the agencies mentioned above encourage user group formation and they involve the UGs in construction of the system. Recently, greater importance has been given to user groups than before, so that all the schemes are conceived, planned, designed, and executed with the active participation of users and who take responsibility for the organisation and management.
- The Bagmati Watershed Management Project (BWMP) is under the DSCWM and has also established RWHUs by constructing about 40 ponds without linings. The rain water stored in the ponds is allowed to seep away slowly to increase soil moisture and spring flow downstream. Its field of operation lies in Bagmati basin.

Critical gaps in institutional capacity development

There is no policy focus on the development of RWHUs, except for some reference in the Ninth Plan. The sub-sectoral policies on water supply and irrigation deal marginally with this issue. The focus is inadequate when viewed in the context of the potential of this resource. The following constitute some of the gaps identified during the course of the study.

i) There are no specific policies and programmes related to RWHU development in the country.
ii) Several institutions, such as DWSO, RWSSP/F, and NGOs, are carrying out RWHU activities in different districts of the country in their own way with varying degrees of user participation and cost-sharing.
iii) There is a lack of coordination among these institutions. This has resulted in the institutions developing their own criteria for implementing RWHU projects, and these need to

be harmonised for the sake of uniformity, efficiency, and effectiveness.

iv) Schemes undertaken by the DWSO do not have an adequate mechanism for strengthening water user groups (WUG) through a systematic training programme.

v) The ability of DWRC to process and issue licenses to water users is in doubt. The provision needs to be revised in the light of the limited ability of the DWRC.

vi) The inherent weaknesses in the government department, mainly because of bureaucratic processes, result in everything moving very slowly. NGOs, on the other hand, can be efficient and can produce results in a short time. There have been some criticisms about high expenditure on NGOs. This can be checked with proper monitoring systems. The Ninth Plan Document says NGOs will be mobilised. However, in practice, HMG has to take some concrete steps in this respect. For example, INGOs can only engage local NGOs through the Social Welfare Council (SWC). For amounts of up to Rs 2,00,000, permission of the SWC is not required to receive funding from an INGO or donor agency. However, notice has to be given to the SWC. This amount is small for social work and needs to be increased. The SWC was established to facilitate, promote, and coordinate the activities of NGOs. However, this institution is not yet effective. The policy concerning participation of NGOs in the water supply and sanitation programme (1996) has not attracted NGOs. It requires revision.

vii) The Soil Conservation and Watershed Management Act and the DWSCC - Guidelines for Work Implementation are not effective and need revision.

viii) The BOARD and NWSC have not undertaken any RWHU work. The relevant agencies have not persuaded these agencies to take up RWHU work.

ix) There has been no clear-cut demarcation between the functions of local institutions and government agencies regarding water supply work.

x) There is no clear process for the registration of users' groups and NGOs.

xi) There are still many small water supply and irrigation systems which have not been handed over to users' groups.

xii) VDCs and DDCs have not been persuaded to bear the costs of additional investments in the water supply and sanitation sector.

4. CRITICAL ANALYSIS OF IMPACTS OF NATIONAL POLICIES AND PROGRAMMES ON MOUNTAIN HOUSEHOLDS (IN PARTICULAR ON WOMEN, CHILDREN AND MARGINALISED FARMERS)

The main area of focus has been the collection and use of rain water for drinking purposes, domestic use, and also for small-scale irrigation—especially for marginalised farmers. Fetching water for domestic purposes is the responsibility of women. The children also help. The national water supply policy indicates that great importance should be given to gender issues and to involving women in user groups. It is observed that the required numbers of women do not participate in the process. Due to social norms and illiteracy, it is difficult to involve women in community activities. It is expected that the RWHU systems will benefit women, children, and men equally. Time saved from the drudgery of water collection would help improve the quality of life. Increased household income from irrigated farming will help to send children to school. Women will have an opportunity to cultivate vegetables, and hence improve family nutrition. Increased crops mean increased fodder and less fodder to collect from the forest.

Even though the FMIS have been in existence for many generations, the government recognised and began to consider assisting them only in 1981. The Irrigation Policy-2049 (1991-2) and its revision 2053 (1996-97) consider assistance for rehabilitation of FMIS. The second irrigation sector programme in the eastern and central regions and National

Irrigation Sector Programmes in the three western regions are continuing with ADB/Manila and World Bank assistance respectively. These programmes include generous assistance for rehabilitation and improvement of FMIS. These rehabilitation works are undertaken through close participation of and cost sharing with users. After completion, the schemes are operated by the users themselves. In the IP 2049 (1992-93), the requirements for user participation and other requirements were simple. Due to non-compliance and non-seriousness on the part of the users and implementing agencies, more demanding requirements were added to make users' participation more active. IP 2049 (1992-93) has made provision to include a minimum of women's representation of 20% on the executive committees of user groups. However, very few user groups met such provisions.

Incentives

There are no general policies to provide incentives for RWHU, except in some specific RWSSP/F programmes.

The RWSSP/F has given an attractive incentive to start the programme. Each household is required to provide Rs 300/- in cash plus collect and transport local materials, provide unskilled labour, provide water for construction, and supply transport for construction materials from the nearest roadhead. For a household with a thatched roof, provision is made for a two cubic metre tank and 180 sq. ft. of CGI sheet to replace the thatched roof.

In the small pond type RWHU established by NGOs, the NGOs provide plastic sheets, high density polyethylene (HDPE) delivery pipes, a gate valve, and one sprinkler to each household for high-value vegetable farming. Unskilled labour costs are borne by the users.

The incentives packages offered by the DWSO and donor-supported projects differ to a great extent. The NGOs to be selected by the DWSCC and administered by the DWSO do not have adequate attractive incentives.

In DWSS implemented RWHU schemes, users do not share the costs but are usually responsible for O&M.

Schemes implemented by the BOARD require that users contribute unskilled labour and local materials for water supply schemes. In irrigation schemes, the users are required to pay a minimum of 10 and 15% for new and rehabilitation schemes respectively. The percentages are more for sprinkler and drip irrigation systems. Further, for schemes smaller than 25 ha in the Terai and 10 ha in the hills, the users are required to pay 40% of the costs.

Impacts

The advantages of RWHU are:

- time saved from collecting water,
- improved health because of use of clean potable water,
- less drudgery and hardship,
- adoption of irrigated agriculture on a small scale, and
- improvements in the environment and arresting soil erosion.

The major impact has been the reduction of time needed to collect water and improvement in health and sanitation. In the hills where there are no nearby water supply systems, a family spends an average 126 minutes per day fetching water. A minimum of 30% of the

total time saved can be used for other economically productive activities (NPC 1998). In communities where RWHU has been installed, it has saved time normally used to fetch water and thus helped to lessen drudgery and hardship.

The RWSSP/F have not provided sufficient jars for year round use. They have provided two jars and one jar where thatched rooves have been converted into CGI roofs, against a requirement of sic jars. When the rain water collected is finished, the households are forced to use their usual water source, with a very high probability of contamination, thus defeating the very purpose of the programme.

It has been reported that, due to traditional water-harvesting from ponds, land terracing, and use of water from trails, the yield of maize increased by 50% in the BWMP. Similarly, a 35% increase in yield has been reported in the hills of Lalitpur and Kabhre as well as a reduction in loss of manure as a result of runoff management.

The small farmers have benefitted from sprinkler irrigation from plastic-lined ponds constructed by some NGOs, making vegetable farming possible.

The traditional water supply system in Patan not only increases domestic water supplies, but also provides a beautiful and artistic monument admired by many.

Case Studies

Case studies have been grouped according to the type of rain water-harvesting systems such as (a) rain water collection from roofs, (b) RWHU systems from ponds, (c) springs and stone spouts, and (d) sprinkler and drip irrigation system. Further examples are given of integrated approaches to water management. The case studies are presented below.

Rain water-harvesting from rooves

Daugha[3] VDC, Gulmi

Daugha VDC in Lumbini Zone, situated at an altitude of 1,400 masl in Gulmi district is a hardship area in terms of water scarcity. It can be reached by walking for three hours after a two-hour drive from the district headquarters Tamghas. It has about 500 households, out of which 150 have CGI rooves. The population totals 4,000. Most of the people have to spend three hours for one round trip to fetch water. Children also help. Livestock are taken down to the stream for water every alternate day. Diarrhea and dysentery are common. A diarrhoea epidemic in 1995 caused five or six deaths, and a large number of people suffered from it. About 10 rich households have constructed stone masonry tanks of from 10-25 cubic metres in capacity. The DWSO has constructed nine tanks, each of 20 cubic metres in capacity and out of which six are reserved for weddings, religious festivals, and funerals, and the remaining three are for the VDC, health post, and schools. A procedure was established to mobilise the community, form and register water users' groups/ water users' committees (WUG/WUC), enlist support for cost-sharing from the VDC and DDC, and train WUCs in keeping accounts and O&M. Local NGOs were used to mobilise, coordinate, monitor, and supervise the construction.

It was proposed that two jars be kept by each household with a CGI roof and one jar and 180 sq. ft. of CGI sheeting for each household with a thatched roof. The system costs

[3] This case study is based on Mr. R. Bohara's article on Rain water: Potential Source Drinking Water and Sanitation, A Case Study of Daugha VDC, Gulmi and reference to this is duly acknowledged.

Rs 9,000. The Local Development Officer in the DDC operates the fund. The WUC maintains accounts of purchases and expenditure. Savings of Rs 2,000 out of Rs 9,000 were realised, and it was proposed that they be used to start a revolving fund. Each ward will have a WUC and thus, taking 50 households into consideration, a fund of Rs 100,000 as a revolving fund should be realised to purchase more jars in future. The proposed revolving fund did not materialise, however, because of the reluctance of His Majesty's Government (HMG) to use it as a revolving fund. Fifty per cent of the programme funds belonged to HMG. However, FINNIDA has no objection to its grant being used as a revolving fund.

Cash: An investment of Rs 1,500 (US $ 22) per capita was needed to start the programme. A household of six members would require a contribution of Rs 9,000 (US$132) follows.

- Rs 300 (US $4.41) per capita from VDC contributions
- Rs 300 (Rs 50 per capita) from each household
- Rs 1,150 per capita contribution from the RWSSP/F and the Ministry of Local Development

Contribution in kind by beneficiaries

- Collection and transportation of local materials
- Transportation of construction materials from the road head to the programme site
- Unskilled labour for construction and for fetching water.

As reported by the RWSSP/F officers, the programme in Daugha is very successful. By March 1998, 369 jars have been constructed against a total target of 834. This success was replicated in other places in Gulmi and Palpa also. Thirty additional VDCs in Palpa have requested to take part in this programme.

The RWSSP/F undertakes other water supply and sanitation works besides RWHUs. In the first phase of the RWSSP/F, the project was the implementator and worked like a contractor. Now in this second phase, the project has changed the strategy, and it works like an advisor and the user groups are asked to purchase the materials required and increased responsibilities are given to the DDC. The project works as a back-up support system. It has given a lot of importance to gender issues. In all the user groups, women representatives are always present. In some cases, there are women Chairpersons of user groups/associations.

Before the project is taken up, all disputes are settled. However, if some dispute arises the local community tries to resolve it. If they are not successful, the matter is referred to the Chairman of the DDC.

Manungkot Vyas Municipality (Ward No. 7), Tanahu

This scheme consists of rain water collection from the roof of a school building and storage in a tank with a capacity of 350 cubic metres to be used by 30-35 households. Initially, the tank was built with black soil with a lining of plastic sheets at the bottom and sides of stone. The cost was Rs 0.55 million. This tank leaked and was subsequently rebuilt by the users (with DWSS funds of Rs 168,000) with 20-centimetre (cm) stone soling (cm), topped with 10 cm of concrete in bed and cement plaster and punning in the existing stone walls. A slow sand filter has been installed and the users are advised to boil water for drinking. Occasionally, the users demand and take bleaching powder from the DWSO. According to the staff of the DWSO, the scheme is successful and there is sufficient water all year round.

As this scheme was constructed as a sample case; users did not contribute anything towards the cost. However, they have taken full responsibility for O&M. Further, RWHU schemes are planned in two more places in Jamuni VDC, Tanahu, and Rs 0.5 million has been allocated in the 1998/99 budget.

RWHU constructed by the DWSO, Syangja District

RWHU systems were constructed three years ago in Kharikot village, Kichnas VDC, Ward No. 6, Syangja by the DWSO. This place is 12 miles from the district headquarters and a day's walk from the nearest road head. Four ferro-cement tanks of ten cubic metres in capacity were constructed. There was no cost sharing. Each tank cost about Rs 0.1 million (Rs 0.125 million at present prices), which is expensive, and hence this system was not continued in subsequent years. The users are satisfied with the system according to the DWSS officials.

Rain water harvesting system at the UMN hospital, Tansen

The United Mission to Nepal's hospital in Tansen Palpa started constructing an RHWU system for its own use in the early 1960s. Rain water collected from the CGI roofing is stored in the tanks in the basement of the buildings of the hospital complex. About six to seven tanks with a total capacity of 950 cubic metres have been constructed for rain water storage. Water from these tanks is pumped to a central tank where the municipal water supply and other fresh water supplies (hospital's own system) are also stored and sent to the main distribution system. For drinking purposes, the water is filtered before use; whereas, for other uses, no filtration treatment is carried out. As the hospital is a located in a water scarce area; this RWHU system has been quite useful. This is an excellent example of a successful RWHU system.

RWHU system built by the Peace Crops in Tansen and Syangja

A ferro-cement tank of with a capacity of about four to five cubic metres and a collection system were constructed with Peace Corps' assistance near the motor garage of the Tansen municipality. The driver and family live in the garage. Even though it was nicely built, this facility has not been used, probably the actual user was not involved in the construction. In a school in Syangja, Peace Corps' volunteers have constructed an RWHS system with two underground ferro-cement tanks with a capacity of 20 cubic metres each for a total cost of about Rs 0.3 million.

RWHU systems from ponds

Small plastic lined ponds

SAPPROS, an NGO, has established (with INGO funding) 23 small ponds (community-level) lined with 300-micron thick plastic sheets for marginalised farmers for vegetable farming in four districts based on their experience with such systems in Kashmir in India. The distribution of ponds is as follows: Gorkha-eight; Lamjung- two; Chitwan – five; and Dailekh – eight. The scheme involves a group of users digging regular-shaped ponds in sizes of from 25 to 50 cubic metres. SAPPROS provides plastic sheets, 150 – 200 m of delivery pipe, one gate valve, and one sprinkler for each household. A users' committee is formed and registered with the District Water Resources' Committee. In one typical scheme, the tank had a capacity of 42 metres, served 12 households, and commanded 1.6 ha of land. According to SAPPROS, these systems are quite successful.

Similarly, another NGO called INSAN claims to be a pioneer in construction and promotion of RWHUs using plastic-lined tanks and sprinklers for small-scale irrigation.

Horticultural farm, Panchkhal, Kabhre

There are two ponds, plus one newly-constructed pond for collecting rain water for use on the farm. The site was visited at the beginning of August 1998.The ponds were not well maintained. One pond was completely covered with grass and the other was covered more than half by grass. The new pond, recently constructed with stone masonry walls, has not been put into operation. Some earthwork remains to be done. The new wall construction and the system do not appear to be robust enough to serve their purposes. These three ponds are in one line; the spill over from one is used by the other and so on and so forth. When fully rehabilitated and operational, these three ponds will help substantially to fulfill the water needs of the farm. One pond is about 1,200 sq. m. in area and the other two are about 700 sq. m. each.

Gajurang village, Makawanpur

Garjung Village, in Khairang VDC, Makwanpur district is a very water scarce area, where water is costlier than milk. It is one of the remotest areas in the district. The sixty households suffer greatly from scarcity of water. It takes a person six hours for a round trip to fetch two pitchers of water. Rain water from rooves collected from gutters made of bamboo/ banana trees is collected in ditch dugouts near the households and used for livestock.

Rain water harvesting from a plastic lined pond for irrigation, Ramechhap

A pond with a capacity of 3,300 cubic metres is being constructed in Ramechhap VDC, ward No 2, Babiyakharka, Ramechhap district. The catchment area is 2.12 ha to irrigate 3.5 ha land. The VDC, DDC, local MP, beneficiaries, and CIDA have contributed to its construction and a local NGO is implementing this construction and management. The beneficiaries and local institutions are contributing to the pond construction, whereas CIDA has contributed the plastic film and support for the NGO. The plastic film is 250 microns' thick and is called 'Agrifilm', a tough wide, black, and low density polythene (LDPE) material; which is of Indian make. It is proposed to plant trees around the pond to reduce evaporation. The total project cost is NRs 1.172 million.

Traditional ponds

Collection of rain water is large and small ponds in an old tradition in Nepal. They are mostly used for livestock, fire fighting, and also for irrigation, in some places. However, such traditional ponds are gradually disappearing due to disuse encroachment and breakdown of local institutions which in the past took care for their maintenance.

For example, a pond of covering one third of a bigha, (1 bigha in Nepal = 0.65 hectares) located at the southeast corner of the Tundikhel (playground) in Tansen was used for livestock and also for irrigation. The pond was filled and a building was constructed by the army barracks.

Similarly, Kamal Pokhari in Kathmandu is another example of this kind of pond. It is about to lose its identity because of pollution. There are hundreds of examples of disuse of, neglect of, and encroachment on once beautiful ponds in urban and rural areas.

Stone spouts and ponds

Stone spouts and ponds: traditional water supply system of Patan City[4]

The traditional water supply system of Patan has an intricate system of Rajkulo (canals), ponds, and stone spouts that were constructed centuries ago. The Rajkulo bring water from the Naldu and Lele rivers to Patan along a distance of about 16km to irrigate agricultural land and also to feed the ponds that recharge the groundwater and feed the stone spouts. The Rajkulo have a capacity to irrigate 1,250 ha. Before the introduction of piped water supplies to Patan in 1869 A. D. , these stone spouts, ponds, and wells were the only sources of domestic water supply. Some of the stone spouts date back to the Licchavi period (500-800 A. D.) and the sunken paved ponds are from the Malla era (1420-1769 A. D.). The Rajkulo system is said to be about 1,000 years old (Joshi 1993).

These stone spouts and their surroundings are artistically made with beautiful carvings: part of Nepal's artistic heritage. This system is a living example of the ingenuity of ancient artisans and craftsmen. It is quite surprising that the intricate system of Kulo, ponds, and, spouts are still working despite centuries of use. However, as a result of urbanisation, piped water systems, and neglect the ponds are subject to encroachment. Most of these ponds and spouts are in disuse and not functional. The Rajkulo system is at present functional up to a few kilometres only. Some agencies have carried out excellent research and documented this traditional system of Patan.

There are 40 stone spouts: of which four are not functional, about of half of them just trickle, while the other half are in good working condition. Three stone spouts were rehabilitated through the joint efforts of the Patan Municipality, the Rotary Club of Patan, Urban Development through Local Efforts (UDLE), and the local people. Further, a proposal has been prepared to rehabilitate four stone spouts, namely, Tusahiti, Bhanderkhalhiti, Saugahiti, and Sethuhiti at a cost of US$ 32,000. In 1991, the Rotary Club of Patan rehabilitated Nahity in Ward No. 6, with contributions from the local people and the NWSC. Before rehabilitation, this was a neglected stagnant pond with blocked drains. New pipes were laid and choked outlet drains were cleared. The present discharge of two litres per second is sufficient for more than 1,000 people. The rehabilitation of spouts involves locating the source of water, clearing the pipes (from source to spout), relaying a new pipe if found necessary, clearing the blocked drain outlet, and relaying a new drain if necessary and rehabilitating the spout's surroundings.

Local people believe that spout water is clear and good for drinking. However, water quality tests have shown that substantial numbers of spouts have bacteriological contamination caused by groundwater pollution. Since the community has survived for centuries drinking the spout water, it can be concluded that previously the water was potable and at present its deterioration is due to rapid urbanisation.

The stone spout in Dhobighat, situated at the western side of Patan is being used by the NWSC to augment the municipality's supply, by storing (night time) the unused water from the stone spout and pumping it to the mains. The water is stored in about a tank with a capacity of about 100 cubic metres. This system was constructed with the cooperation of the local people. Similarly, on the eastern side the NWSC tried to tap another stone spout, but

[4] The information for this case study is borrowed heavily from the works of Eric Theophile and P. R. Joshi (1992) ; Mr. P. R. Joshi (1993) ; and N. G. Halwai (1998) and this is gratefully acknowledged.

the local people did not allow it to do so, fearing they would not be able to use the stone spouts. The NWSC thinks that such augmentation of water supplies is not economical because of the high cost of pumping. To avoid the high O&M costs, pumping would need to be substituted by a gravity-flow system.

The users' group for Dhobighat's stone spout are doing a good job in operation and maintenance. They collect one rupee from those taking bath from the spout and charge for Rs 10 for manual water collection and Rs 40 for collection with a small pump for household tanks. The surrounding area is kept clean. This process is suitable for replication in other places.

The Sundhara stone spout, a famous spout in Patan is neglected and water flow has drastically decreased. Because of poor maintenance, the drain is choked by plastic and garbage. Replicating the system in Dhobighat may be a good idea for Sundhara.

In ancient times, most of the traditional water-harvesting systems were managed by Trusts. Still, today, some stone spouts, including the one at Sundhara, and large numbers of ponds are under Trusts. A royal edict in 1887 B. S. allocated 25 *ropani*[5] and 8 *anna*[6] (1.32 ha) of land to this Trust to manage Sundhara. A person is deputed for its maintenance, and he is entitled to the produce from five *ropani* (0.25 ha) of land. Despite these arrangements, Sundhara today is in great neglect.

Most of the big ponds and tanks in Patan as well as in other parts of the country were maintained and run by religious, private or public trusti. Several ponds in Kathmandu and Janakpur are also under public Trusts. The 'Guthi Sansthan', a corporation of HMG is in-charge the of all public and religious Trusts, but has failed to manage the system properly. If cash is deposited in a Trust, then 70% of the interest can be spent of which 25% is added to the principal, and 5% is set aside for the overheads of the Guthi Sansthan.

Ponds ('pokhari')

There are 39 ponds and 218 dugwells *(kuwa)* in Patan. Out of 39, 18 are linked to Rajkulo. At present, there are only 26 ponds: one only is in good condition and the others are subject to encroachment. Retaining water in the ponds is one effective way of recharging groundwater and of supplementing recharge with rainfall.

Sprinklers and drip irrigation

Irrigation uses the most water in Nepal. Because of wide temporal variations in rainfall, substantial storage units are essential, and this makes storage costly. Sprinklers and drip irrigation systems are useful water-saving technologies and should be promoted. Sprinklers and drip irrigation systems operate by pressure and are useful in the hills where headwater is available without pumping. However, sprinklers and drip irrigation systems both require new technology with special O&M and may be unsuitable for Nepali farmers in the remote hills. For example, to avoid clogging in the drippers in the drip irrigation system, the water intensive filtration. Similarly, pipelines for fixed sprinklers can be expensive to establish. All these things have to be tailored local needs. The Agricultural Development Bank (ADB/N) has been promoting sprinklers and drip irrigation systems. SAPPROS, an NGO, is

5 One *ropani* = 0.05 hectare
6 One *anna* = 1/16 Ropani = 0/003 hectare approx.

promoting sprinklers together with plastic-lined ponds. International Development Enterprise (IDE) is also pilot testing a simplified drip irrigation system. The government policy to gradually phase out subsidies for sprinkler/drip irrigation is not justified at a time when promotion of these systems has not yet commenced.

Integrated approaches

Pilot project of the self-reliant drinking water support programme (SRWSP) of Helvetas/Nepal in Bajung VDC of Parbat district[7]

The SRWSP has developed an approach to integrated Water Resources' Management (WARM) based on local participation and in accordance with national legislation (VDC Act, Water Resources' Act). The project has developed a chair model (Figure 4.1) The chair model in the figure is self explanatory.

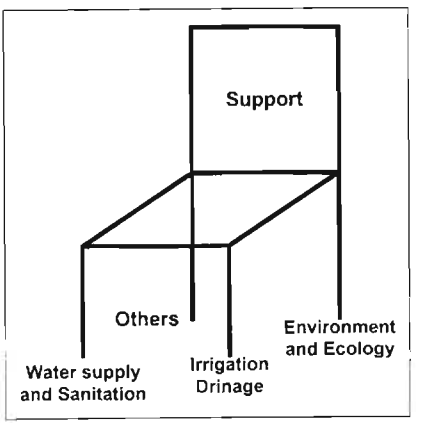

Figure 4.1: **The WARM chair**

According to the Luitel (1998), "the frequent source disputes observed by most of the organisations in the water sector necessitate a different approach to the selection and use of water sources in Nepal. For sustainability of a drinking water programme, the issue of water should not be tackled from a sub-sectoral perspective, but also with a broader approach in order to overcome the increasing water scarcity. The SRWSP has piloted a new approach to Integrated Water Resources' Management (WARM) in Bajung VDC of Parbat district to address the multidisciplinary dimension of water resources' development. The main goal of WARM is to ensure that water sources are used optimally and sustainably for economic and social development. "

5. CRITICAL GAPS

The coverage of present RWHU, whether for drinking water or irrigation purposes is extremely limited. Besides, a systematic assessment of the impact/performance of these schemes has yet to be carried out. The validity of the gaps identified below needs to be viewed in the light of the limitations mentioned above.

i) There is a tendency to use water sources for a single purpose, say domestic water supply or irrigation. Planning should properly integrate the different uses. This will also reduce conflicts over use of the source. In this respect, there is insufficient awareness about the legal provisions stipulated in the Water Resources Act 2049 (1996-97).
ii) There is no clear-cut policy relating to planning and implementation of RWHU, although its potential to serve the needs of mountain households is quite promising.
iii) In general RWHU projects undertaken so far have been managed at both the government and non-government levels and incentive packages relating to sharing of costs and users' participation differ considerably. The effectiveness of these incentives need to be examined and a uniform standard adopted as far as possible.

[7] This case study is taken from the paper entitled Need of Integrated Water Resource Management at Village Level by Achut Luitel, Team Leader SRWSP/Helvetas (9) and is gratefully acknowledged.

iv) Against a requirement of six cisterns per household (in RWSSP/F), two ferrocement cisterns are constructed as per the programme and for the rest it is assumed that the users will construct them with assistance from the revolving fund. Water from two jars lasts only about 1.5 months, after that the household will continue the old practice of using unsafe water, defeating the aim of the programme. Due to poor socioeconomic condition, it is difficult for the hill people to add jars from their own resources. Use of the revolving fund to complete the scheme as planned needs to be revived in the RWSSP/F project.

v) One survey has shown that 13.6% of the water samples from jars in the RWSSP/F system had faecal coliform. Despite the popular belief that spring water is safe and potable, tests have shown some bacteriological contamination, especially in urban areas. This means that distribution of RWHU as safe water should be undertaken with caution. Various technology options such as first flush, use of a slow sand filter, and chlorination may need to be examined and adopted to make the water potable.

vi) There is almost no information on RWHU in the mountain ecological zones. Some pilot testing may be necessary.

vii) The Ninth Plan indicates that HMG subsidies for the schemes undertaken with loans assistance for sprinkler/drip irrigation will gradually decrease. For the RWHU system, the temporal variation in rainfall pattern requires a huge storage capacity for use in the dry season. This means that water-saving technology is a necessity and, hence, sprinkler/drip irrigation is important. Phasing out of subsidies needs to be seriously examined at this stage when promotion of these schemes is not yet complete.

viii) Many of the plastic-lined tanks/ponds constructed under the RWHU system are quite small in capacity, ranging from 30 to 50 cubic metres. The water is used mostly for irrigation of high-value vegetables. Considering a general water requirement (supplement to rainfall) per hectare of area for wheat to be 4,200 m^3 in the Terai and 2,900 m^3 in the inner Terai, (HMG/DOI 1994), the tank provided is quite small. It seems that the NGOs implementing the programmes have not given due thought to this aspect. This aspect has to be considered in terms of both increasing tank capacity and promoting more efficient drip or sprinkler irrigation systems. The drip irrigation system requires a very good filtration system to avoid clogging the emitters. In this respect more research on the suitability of collected rain water is necessary.

ix) There are successful examples of integrated watershed management in India such as schemes based on the Sukhomajri concept. In the Sukhomajri concept of RWHU, the scheme is to create small reservoirs by construction of low height dams, along with programmes such as control of soil erosion, afforestation/fodder, fish farming, and irrigation use. This type of scheme has not been adopted in Nepal, although six watershed management projects are being implemented. Such schemes deserve promotion in the light of their potential to raise the economic status of rural people.

x) The BOARD in drinking water supply and the RWSSP/F in RWHU call for input of unskilled labour, local materials, transportation of materials from the nearest road head which amounts to 30-40% of cost sharing by users, against a minimum of 10% as required by the water supply policy. Most of the schemes constructed by the DWSO require about 10% cost sharing on the part of users. No effort is seen to minimise such a wide variation.

xi) Since the late eighties, development efforts in Nepal have been increasingly directed towards users' participation and cost-sharing in local works. The poor rural dweller is pulled by different departments/agencies for cost sharing, and it becomes a burden to him/her. The idea should not be to maximise cost-sharing by users; but to let the users participate and share the cost to such an extent that the users feel that the schemes are their own and O&M their responsibility. As drinking water is the basic need for sustain-

ing life, the schemes should not be denied to users merely on the grounds of their capacity to pay.

xii) The Soil Conservation and Watershed Management Act is yet to be implemented effectively. Similarly, the DWSCC is not effective; and the policy on the participation of NGOs in water supply and sanitation programmes has not been able to attract NGOs. All these acts and policies need revision.

xiii) Even though trusts were established centuries ago, the stone spouts and ponds under the trusts are not well maintained. The system needs to be revived with a view to bringing about improvement in the services.

6. OTHER SECTORAL POLICIES AND PROGRAMMES INFLUENCING WATER HARVESTING AT LOCAL LEVEL

The policies and programmes of other sectors of the economy have a varying influence on water harvesting and are summarised in the following sections.

Forest

Forests are related to watershed management. There are interrelationships between forestry, agriculture, livestock, water, and land resources. The watershed of the Siwalik region, which is quite fragile, is deteriorating rapidly due to population pressure. The Ninth FYP Plan pledges to undertake forest/soil conservation and watershed management programmes the in Siwalik range to augment groundwater recharge. A watershed management project is being implemented in the Churia hills in the three districts of Saptari, Siraha, and Udaypur with GTZ funding. The destruction of forest has adversely reduced the stream flow. The peak floods of the Bagmati and Kankai rivers have greatly increased over the predictions. These may be attributed to the reduction in forest cover in the catchment areas. At present, the community forestry programme in Nepal is showing encouraging results. Increased crops from irrigated farms means increased fodder. This will reduce pressure on the forest.

Agriculture and livestock

High-yielding varieties of crops, such as paddy, wheat, and others, need more water than local varieties. As a result of increased irrigation facilities and extension services, use of high-yielding varieties (HYV) seeds is increasing. The high doses of fertilizer required for HYV seeds also mean more water is needed. Modern agricultural technology places heavy demands on water. Lack of water/irrigation has prevented use of HYV varieties. Traditional water harvesting, such as use of ponds, terrace levelling, and use of trails to bring runoff water to places where it is needed have resulted in a 50% increase in maize production over the previous years. Soil moisture in the water use area lasts two months longer than in the untreated area (Upadhyaya 1998). Similarly, in the hills of Lalitpur and Kabhre, the increase in yield is reported to be 35% by runoff management (Shrestha 1995). The impacts of such agricultural practices on RWHU at local level have not been widely documented, because of the very small area covered by the existing RWHU. The RWHU will increase the supplies of water for livestock. In hill areas, ponds make it sprinkler irrigation possible.

Fodder deficits in the mountains, hills, and Terai account for 49, 34, and 28% respectively (DSCWM 1993). Under heavy livestock pressure most of the pastures are overgrazed. The soil loss from overgrazed grassland is estimated to be 34.7 tonnes/ha. /yr.; whereas it is around 9.4 tonnes/ha/yr. from pasture land. (DSCWM 1993).

In Daugha VDC, Gulmi, before RWHU construction, livestock were taken down to the stream every alternate day; that is, livestock used to go without water for 48 hours. After implementation of RWHU, livestock received water more frequently.

Infrastructural development

Because of very small coverage of existing RWHU, the impacts of infrastructural development on RWHU have not been documented. Roadside drains can be a good source of water, and this is widely practised in China. Hence, road/highway construction, especially the side drains, can support the RWHU system.

Infrastructural development in general influences settlements, thus exerting pressure on the use of all resources, including water. Construction of the foundation of the Sanchaya Kosh Building near Sundhara, Kathmandu, has drastically reduced eater flow to the traditional stone spouts of Sundhara. HMG/N has decided to relocate a community close to a wildlife park to the watershed area of Khageri River. This has caused great concern to the farmers drawing water from the Khageri River for irrigation in Chitwan District. Promotion of water-harvesting systems can help to ease the pressure to some extent.

Urbanisation

Cities such as Butwal, Pokhara, and Birgunj have grown very fast. Kathmandu, the capital, has undergone tremendous growth, paralysing amenities such as water supply, drainage, and others. The daily demand for drinking water in Kathmandu is 145 million litres compared to an availability of 115 million litres in the wet season and 80 million litres in the dry season. At the end of the Ninth Plan, the demand is projected to increase to 182 million litres/day (Ninth Plan Document). Acute water shortage in the Kathmandu Valley has led to excessive groundwater withdrawal, causing a significant drop in the groundwater table. The annual withdrawal greatly exceeds the annual recharge. RWHU has the potential to contribute to meeting the water requirements for at least some months each year.

In ancient times, traditional water-harvesting systems, such as stone sprouts, wells, and ponds, were constructed in urban areas, i.e., in Kathmandu, Bhaktapur, and Patan. Even though some of them are in disuse, the majority of these systems are still being used by the community, but most of them are in a state neglect. A survey by the Kathmandu municipality indicated that out of 103 stone spouts in Kathmandu, 85 are functional and most of them are in neglect. A joint project of the Kathmandu Municipality and a UN agency is rehabilitating Tamsi Pakha Ga Hiti stone spout. Even though, the water from the stone spouts is not potable, it can be used for washing clothes and bathing. A case study on the traditional water supply of Patan is given in the Appendix. The traditional water supply systems of ponds and stone spouts in urban areas in the past were potable; however, at present laboratory tests on spout water indicate that faecal coliform is present in a number of samples. There is no concerning evidence of potability in the old days; however, the community has survived for centuries on drinking water from stone spouts. This is an indication that in the old days the stone spouts were not contaminated. Therefore, a systematic study of the traditional water- harvesting system in Kathmandu Valley should be carried out to arrive at a better understanding of the system and devise ways and means to rehabilitate it in a planned manner. This would provide some support to the valley's water supply system.

Urbanisation of the Kathmandu Valley has made the rivers virtually sewers and adversely affected the environment. One example is that urbanisation has increased the demand for

sand for construction. This has resulted in large-scale sand mining with very undesirable effects. Sand mining in and near the rivers might have decreased the water retention capacity of the soil. Because of the heavy demand, sand is also quarried from agriculture land near the rivers of Kathmandu Valley. About 0.60 m of the topsoil is removed and sand is quarried. This has resulted in loss of agricultural land, the danger of river erosion, and meandering and reduction in groundwater (sand is a good aquifer).

Theophile and Joshi (1992) have pointed out the complexities of issues concerning rehabilitation of traditional stone spouts and ponds. According to them:

> "This rehabilitation nevertheless raises complex questions about how to fully exploit the potential water supply through large-scale interventions. In an urban environment as in Patan, there is[sic] conflicting demands of development and conservation. The traditional water supply system of ponds, spouts can augment[sic] to reduce the domestic water shortage in Patan. "

In urban areas, there are usually buildings with very large, CGI roofing suitable for collecting rain water. Hence, it is possible to use RWHU systems in urban areas. Agencies such as Nepal Water Supply Corporation (NWSC) should consider this aspect.

7. CONSTRAINTS AND OPPORTUNITIES IN POLICY AND PROGRAMME FORMULATION AND INSTITUTIONAL DEVELOPMENT FOR SUSTAINABLE WATER HARVESTING AT LOCAL HOUSEHOLD LEVEL FOR MARGINALISED FARMERS

Constraints

The following are the main constraints to establishing RWHU:

- The Trust established centuries ago for the maintenance of traditional RWHUs are not effective, mostly because of negligence.
- Lack of awareness about legal provisions such as giving highest priority to water for drinking/ domestic use, and state ownership of water.
- Despite the policy to recover full investments and O&M costs from the urban water supply, only nominal charges are recovered. Hence, there is no incentive for the household to invest in RWHUs. Further, most people in Nepal regard water as a free commodity instead of an economic good.
- The ubiquitous thatched rooves in the hills are not suitable for maintaining the quality of rain water collected for drinking.
- HMG's policy is not strongly committed to RWHU establishment.
- Monsoon rainfall is concentrated in a three to for month period, and this means a lot of water needs to be stored to meet both domestic and irrigation requirements. Large storage systems require substantial investments. It seems that NGOs and other agencies have not given sufficient attention to this fact.
- Impact evaluation of the existing RWHUs has not been undertaken to draw lessons learned.
- The socioeconomic condition of the hill/mountainous people is quite low. The monthly rural household income in the hills according to 1996 estimates is Rs 1,240, Rs 2,560, and Rs 3,230 per household per month (The World Bank 1996: 35-36) for the lowest, median, and average household, respectively. Several communities surveyed indicate that they are willing to pay Rs 13 - 30 per household per month (1993 prices) for water

supplies, whereas the estimate for organisation and management for the gravity system is Rs 19 per household per month. (The World Bank 996)

- To ensure involvement of women in the users' groups requires their constant persuasion and motivation.
- Though the importance of NGOs in community mobilisation has been well-recognised and is also acknowledged by the Ninth Plan document, government agencies have yet to promote NGOs. The SWC is not effective. INGOs have to get permission to engage NGOs even for small jobs for more than Rs 2,00,000/- of support.
- At the implementation level, difficulties were encountered in using HMG money in the revolving fund (i.e., RWSSP/F).
- VDC/municipalities have not been successfully (except RWSSP/F) persuaded to put additional investments in this sector.
- The Ninth Plan stipulates that the subsidy or loan will be reduced on the irrigation schemes based on the sprinkler/drip systems. This merits reconsideration at a time when these systems need extensive and intensive promotion.
- Remoteness makes transportation of construction materials difficult.

Opportunities

Widespread use of RWHUs will result in improved quality of life by bringing about the following favourable changes.

- Reduction in the drudgery of carrying water from long distances in the mountains and hills. RWHU mean that drinking water is available on the doorstep, thereby reducing drudgery. In the hills, where there are no nearby water supply systems, a family spends an average of 126 minutes per day fetching water. The time saved (estimated to be 30%) could be used for other beneficial economic activities.
- Improved health and improved sanitary conditions result from an increase in water Supplies. Every year about 45,000 children below the age of five die in Nepal from sanitation related problems, which is related to inadequate supplies of and poor quality of water. RWHUs with good treatment systems can improve sanitation, reducing the number of infant deaths.
- Some of the hill towns have costly high-lift pumping systems for water supplies. Widespread augmentation in supplies of water by RWHU work will reduce the quantity of water to be pumped and hence the costs of O&M cost will decrease. For example, in Tansen, a hill town, water is pumped to a height of 500 metres at a cost of seven million rupees per annum in O&M (Rs 5 million for electricity charges alone). Large percentages of water from stone spouts go to waste in Tansen. Judicious use of water from stone spouts will reduce pumping costs.
- Use of water for irrigation will result in increased agricultural production—including high value vegetables. Marginal farmers in the hills/mountains of Nepal do not eat many vegetables Widespread use of RWHUs for small-scale irrigation in vegetable farming will help to improve this situation. Increased production of vegetables will increase their use, resulting in better nutrition. Vegetable farming is more profitable than conventional paddy, wheat, or maize cultivation. Hence, their production will increase the incomes of farmers.
- In Nepali communities, there are problems of social interaction between 'high' and 'low' castes. The occupational castes (tailors, blacksmiths, and shoemakers) are disadvantaged and they are usually deprived of the benefit of facilities. As 'low caste' people are supposed to be 'untouchables', they have problems using community taps. Use of RWHUs at household level will ensure water also for the disadvantaged groups.

- There is a good opportunity to augment domestic water supply through judicious use of spring, stone spouts, and also for agricultural use with the waste water from these sources.
- Construction of ponds will increase soil moisture and spring flow downstream due to seepage from the unlined ponds. This will result in increased greenery and increased productivity in agriculture. Further, in the monsoon, too much rain causes soil erosion and washout of nutrients from the sloped fields. Collection and storage of water during monsoon can decrease soil erosion, thus improving the environment. The problem of excessive rainfall in monsoon and little or no water in dry season can be mitigated to some extent by the RWHU.
- Integrated watershed management, which includes the components of afforestation, growing fodder, soil conservation, fish farming, and irrigation, has great potential for increasing socioeconomic conditions.
- In the hills, water head is usually available freely for use of sprinklers and drip irrigation; and hence costly pumping is not required.
- In the Bhabar zone, the groundwater table is quite deep and hand pumps cost more than 0.15 million rupees each. RWHUs may be a good alternative if other sources are not available nearby.
- Some public buildings in urban areas have very large rooves which are suitable as rain water collecting surfaces, . This opportunity needs to be tapped in cities and towns like Kathmandu where water is scarce.
- The World Bank funded BOARD is observed to be an efficient institution. If this institution undertakes RWHU, it would result in promotion of the same.
- Traditional stone spouts and ponds looked after by Trusts can be better maintained by reviving the old management system.

8. RECOMMENDATIONS FOR FUTURE ACTION

The following recommendations are suggested for the development, better management, and promotion of RWHUs:

- Provisions in the Water Resources' Act – (2049-1992-93) that stipulate that the source of water belongs to the state and drinking/domestic water receives the highest priority are not known by many planners and people, mostly those in rural areas. Awareness should be raised about them.
- *"A simple, affordable, replicable, and sustainable design of water supply projects should be developed for rural areas which will at the same time conserve and protect local, traditional water supply sources"* (Ref -9).
- Ineffective Acts and Policies need to be revised to make them practical and attractive, i.e., Soil Conservation and Watershed Management Act, Policy on Participation of NGOs in the Water Supply and Sanitation Programme, and DWCC – Guidelines for Work Implementation.
- An integrated approach should be developed for exploitation of water sources for different uses instead of for single uses. For example, waste water from stone spouts might be used for irrigation. This concept may help to reduce conflicts.
- Related key stakeholders should be encouraged to team up and draft a national strategic policy on RWHU so as to give it the importance and priority it deserves.
- Research and pilot testing should be undertaken, especially in high mountain areas, with flat rooves and in areas where thatched rooves are predominant.
- Women should be encouraged to play a greater role in RWHU activities.
- The WUGs should be strengthened through the development of an appropriate training

programme aimed at development, use, and dissemination of local skills and indigenous knowledge.

- The BOARD should be persuaded to take up RWHU in hill/mountain places where other viable alternatives are not available.
- Where thatched rooves are predominant, it may be necessary to launch RWHU at community level by using CGI rooves of schools, community buildings, and others.
- Arrangements should be made to permit HMG funds to be used as revolving funds similar to guthi (trust) arrangements.
- Policies on RWHU should take into account the unique characteristics of the regional nature, rain shadow areas/high mountains, and other hill areas.
- Impact evaluation of the ongoing and completed RWHUs needs to be undertaken to assess their impact on the community and draw valuable lessons for feedback.
- As drinking water is the basic essential for sustaining life, maximising users' cost sharing should not be the sole criterion for launching RWHU programmes.
- A suitable agency should evaluate the RWHU works and introduce awards for excellence in micro-conservation of water.
- Policies should be formulated so that the government acts as a facilitator, or supporter instead of a provider or implementator. HMG/N needs to create an enabling environment so that user groups, the private sector, and service organisations can implement small schemes. Rain water harvesting at household level and small community level should be entrusted to NGOs, CBOs, user groups, and so on with HMG agencies playing the role of facilitators.
- Effective policies for regulating, facilitating, and promoting NGOs need to be formulated. It is necessary to make the SWC an effective institution. The limit of Rs 200,000 on grants from INGOs to local NGOs, under which amount the permission of SWC is not required needs to be increased to promote NGOs. As NGOs are expected to increase their activities, this policy will facilitate increased small-scale use of water resources. Similarly, other service organisations such as user groups and Community Based Organisations should also be promoted. Further, a clear and easy registration process should be established.
- RWHUs should be promoted first at household level, with users sharing a small amount of the costs. When people see the importance of RWHU, then cost sharing can be increased. In the later stages, pond construction at community level can be promoted for irrigation. In the final stage, emphasis should be given to micro- catchment by integrating watershed management. Hence, the policy should include short-, medium-, and long-term strategies.
- As directed by the Ninth Plan, the Department of Irrigation should undertake research work on RWHU-based small-scale irrigation using the sprinkler/drip system.
- There is a need for legislation to encourage the use of RWHUs in all new houses (urban areas) to be constructed in water scarce areas, i.e., Tansen Palpa, and Kathmandu (Chennai City of South India and Bermuda (a coastal country) have similar legislation).
- Provision should be made so that households that are too poor to contribute to the costs are not denied access to community facilities.
- Even though the drip irrigation system can be very efficient to an extent of about 90%, it requires very good filtration to avoid clogging. It is a high-tech system and its appropriateness for marginalised farmers needs to be assessed. Further test and research are required on the simplified drip irrigation system before it is promoted widely.
- Traditional water supply systems, such as ponds and stone spouts in urban and rural areas, need to rehabilitated to augment the existing water supply. To the extent possible augmentation from these systems should be by gravity (without pumping) to minimise O&M costs.

- A systematic study of traditional water-harvesting systems in Kathmandu Valley needs to be carried out to have a better understanding of the system and to devise ways and means to rehabilitate it in a planned manner. Such an approach would provide meaningful support to the inadequate drinking water system in the valley.
- The ability of the DWRC to process and issue licenses to water users has been in doubt. The provision needs to be revised in light of the limited ability of the DWRC.
- Despite the popular belief that water from springs and stone spouts is safe for drinking, laboratory tests have indicated that bacteriological contamination is present, especially in urban areas. Some agency needs to monitor the water quality frequently and the users need to be advised accordingly.
- Related agencies should persuade VDCs and DDCs to bear the additional investments in the small-scale water sector.
- Since traditional ponds and spouts looked after by Trusts are in a state of neglect and are being encroached upon, Guthi Sansthan (Corporation for Royal Trusts) should be persuaded to act effectively.
- The Water Resources' Regulations – 1993 and the DWSCC have nominated different committees for conflict resolution over water sources and their use. This needs to be resolved to avoid confusion.

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