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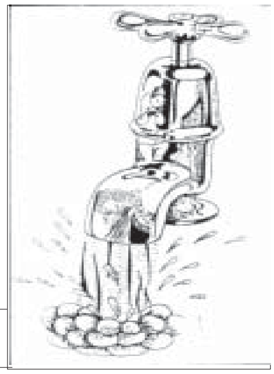
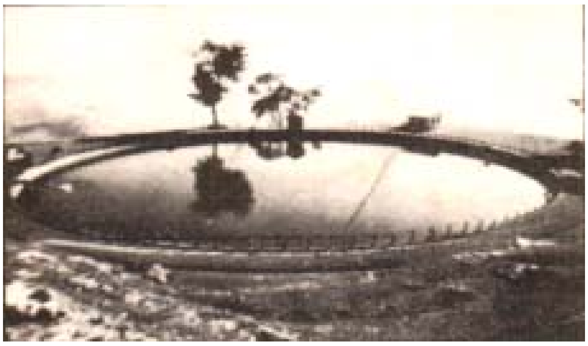


WATER DEVELOPMENT JOURNAL

ON THE OCCASION PF THE SIXTIETH AUSPICIOUS BIRTHDAY OF HER MAJESTY THE QUEEN MOTHER

75 YEARS OF SERVICE



Reservoir

Power House

(Seventh-five years ago, during the reign of His Majesty King Prithvi Bir Bikram Shah Dev, the first hydropower project of the country was inaugurated in Nepal. The plant can still generate its rates power, if the water, which is now diverted to meet Kathmandu's growing needs, is fed to the turbines the profile of the first power project based upon the report submitted by the British electrical engineer on the day of inauguration of the Pharping power house (Jestha 1968 B.S.) is presented below.)

Designs

The design and estimations of the project was prepared by late engineer Kishore N. Rana. The project was completed in about four years, from the time it was conceived. The designs and estimations according to the British engineer were of high quality.

Water Source

Pharping powerhouse utilised two sources at Shikha Narayan and Satmule. Brick masonry head works with gates were constructed at the sources and metal pipes were used to bring water to the reservoir. Water was brought in a 44" diameter pipe from Satmule and pipes of 10" and 9" were used in the section from Shika Narayan. Air values were provided in both the pipelines.

Reservoir

A circular reservoir of 200 feet diameter having a capacity of 5,28,783 cubic feet was provided. The reservoir was made of brick masonry in lime surkhi mortar and was plastered inside. Spillway was also provided to drain excess water. A 20" diameter penstock was led from the reservoir to the powerhouse. Water pressure at the turbine was 288 lb/in^2. Provision for closing of the penstock automatically was provided at the reservoir.

Power House

From the penstock water was led to two pelton runners which were coupled with three phase 11 KV generators. The generators were manufactured by the General Electric Company U.K. and each produced 250KW thus producing a total of 500KW when

WATER NEPAL

ADVISORY COMMITTEE

EDITOR

AJAYA DIXIT

Water Nepal is published once in three months in English.

Water Nepal aims to function as a forum for sharing of experiences among technologists, engineers, and scientists engaged in different aspects of water resources development in Nepal. It is distributed among the institutions and individuals that are involved in development and management of water resources.

Views expressed in this publication are that of the witers and do not reflect the opinions of te editor or supporters of this publication. Contributions on various issues of development of water resources and its management in Nepal are invited from the readers. Typed articles not exceeding 1500 words should be sent to the editor. Unpubished articles will not be returned. Readers are also requested to contribute discussion papers on published articles. The final decision papers on published articles. The final decision to published any article and letter will lie on the editorial committee.

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EDITORIAL

All societies need water for sustenance and development, Nepal's location on the southern side of the Himalayas and her physical geography have endowed the country with numerous large and small streams, forming river basins such as the Kosi, the Gandaki and the Karnali. The water wealth, which is due to precipitation of the monsoon clouds in the form of snow and rain, is regarded as a vast natural and perennial resource offering immense opportunities for the country's development.

How effectively we at present have addressed to the issues of development and management of water resources will be evaluated in the future. There is however, no denying the fact that, with population growth and distribution water need of our society will grow and after the water use patterns. Industrial growth while augmenting economic development, can also create unusable water pockets by pollution. the need of the hour, therefore, is to institute more national water management practices so that our developmental efforts reflect changing water use patterns consistent with efficient uses.

At this juncture of the century, time has bestowed tremendous responsibilities on the shoulders of we engineers, scientists, technologists and policy makers to address to the problems of development and the uses of available water. These have become even more important to meet directives of His Majesty King Birendra Bir Bikram Shah Devto provide minimum basic needs to the people by the turn of the century. These provisions become sustaining only when all villages have potable water supplies, when all irrigation canals provide water and when all hydropower projects generate electricity. This requires commitment from every one concerned to confront the daunting task of development and thus realise the noble wishes of His Majesty.

It is a matter of satisfaction, that a corp of expertise has already development to a certain level in water resources section. Sufficient experiences, success and failure stonies and ideas, in the context of water uses exist today, which need to be shared by other professionals. For examples, a functional water maintenance model at a region offers opportunities of duplicating the model with modifications at other projects, especially when different organisations are involved in the implementation of similar projects. If problems of irrigation development at a particular project have been successfully tackled, then the experiences thus gained should be utilised elsewhere and the state of art should be improved. What is needed is a forum that will enable continuous interactions of such nature.

This journal has been initiated with the objective of functioning as a medium for dissemination of these ideas and experiences. It will focus on publishing contributions of quasi-technical nature, which may not be outcome of a thorough research, but yet be of importance and utility to others. We will attempt to circulate this journal among institutions and individuals engaged in different sectors of water development. This should provide fairly wide audience for the presented features.

We have presented materials of general nature in this issue to give some indication of the approach we are trying to follow. From subsequent issues, we will include individual contributions on areas like hydrology, hydropower, pollutions, sanitation and other sectors of water resources. We look forward to your contributions and also suggestions for refinements of this journal. We welcome help in any form. Water Nepal will sustain its publication relying on donations and contributions from well wishers and supporters. Please help us by subscribing in this journal. With your support, we will be able to bring out this journal on a regular basis.

running at 600 RPM. The generators were provided with high quality switches and oil governors. High-tension switch gears were provided in a separate room to ensure against fire hazards.

Transmission

A seven-mile long transmission line connected the powerhouse with the city. The 11KV power was stepped down to 2300 volts for distribution in the city from the substation. All together 2667-service connections were expected to be taken of which 260 were streetlights. Telephone connection was provided between the powerhouse, substation and residence of the British engineer.

Cost of the Project

The total cost of the project was Rs. 713,275.00 and the breakdown is as follows:

a)	Three pipelines, Reservoir and Headwork's	Rs.	196324.00
b)	Powerhouse, Tail race, Quarters	Rs.	156778.00
c)	Sub Station, Store	Rs.	36172.00
d)	Transmission line, Telephone lines, Street lights and Distribution	Rs.	111049.00
e)	Shipping Cost including Packing and Commissions, from London to Calcutta	Rs.	28699.00
f)	Transportation cost including taxes from Calcutta to Bhimphedi	Rs.	40372.00
g)	Transportation cost from Bhimphedi to Kathmandu	Rs.	40372.00
h)	Fees for engineer, consulting engineer and miscelleneous	Rs.	103565.00
	Total	Rs.	713273.00

A remaining balance of 8000.00 was kept for maintenance and reparis during the rainy seasons in coming years.

The cost per a unit of electricity was fixed at Rs. 1.00 so that maximum connections would be taken by the public and during day time the power generated could be used for Industrial purposes. brick factories, saw mills, cotton and cloth weaving mills and grinding mills were identified as some of the industries that could use power from the plant.

Local Components

All together nine lakhs and fifty thousand Nepali labour days were spent on the project. Out of the total cost of the project, Rs. 367,584.00 was spent in the country.

Problems Encountered

A number of problems were encountered during the construction period. Major problem was caused when the powerhouse site was covered with debris from a huge landslide. Additional 850,000 cubic feet of hard black cotton earth had to be removed as a result. The excavation of the reservoir also caused problems as hard rocks were reached at shallow depth. The transportation of heavy machinery from the border town of Raxual also posed problems as labourers in adequate numbers were not available in time. The outbreak of cholera epidemic the year before also caused manpower problems. The engineers rated the powerhouse at par with rest of the powerhouses built in these part of the countries during the period. He was confident that smooth operation and regular maintenance of the powerhouse could recover the amount invested in a short time.

Water resources projects are generally designed for a period ranging from 50 to 100 years. The fact that a 75 year old power plant in Nepal is still operational today, is the indication of the good quality technical input and proper operation and maintenance of the project. We would be doing a grate service to this nation if our grand children can make similar evaluation of our current inputs.

The amount are in IC, figures less than a rupees has not been shown.

SMALL IS POWERFUL

There are thousands of places in the hilly regions of India where small hydroelectric power generators ranging from a few kilowatts to several megawatts could easily serve remote rural settlements. But small hydropower development in India has been almost totally neglected, although the first small hydroelectric plant of 200 KW capacity was installed at Darjeeling in 1887.

In comparison, China had over 88,000 small hydropower stations with a total installed capacity of 6,929 MW in 1980 which generated approximately one-third of all the electricity consumed in rural areas in that year. Over 86,000 stations has an installed capacity of less than 0.5 MW each and accounted for 60 per cent of the total installed capacity of small hydro units.

Smaller units can be built, maintained and operated by rural communities and need not become part of the national grid. A 0.5 MW station can energise 100-watt bulbs in 5,000 households; in other words a small hill village can be well off even with a 0.1 MW unit. However, in 1980, India has an installed capacity of only 220 MW in small hydro units, most of them in Uttar

Pradesh, Himachal Pradesh, Jammu and Kashmir, Arunachal Pradesh, West Bengal and Sikkim. These units ranged in size from 5 KW to 6,800 KW less than 10 per cent of the installed capacity was represented by units of a size less than 500 KW, and less, which are actually classified as micro hydel units.

A detailed survey of small hydro potential has yet to be conducted. According to an official estimate, this potential is about 2,000 MW in the hilly areas but this is definitely an under estimate especially if sites for microhydel units less than 100 KW – are included. Another 3,000 MW worth can be set up to utilise the small falls that dot irrigation canals in the plains.

According to the Central Electricity Authority, small hydel units work out costlier per kilowatt installed than larger hydel projects: between Rs. 8,000 and Rs. Rs. 15,000 as compared to Rs. 3,000 to Rs. 7,000. But the smaller the unit, the smaller the initial capital required and the gestation period. Most important, they can be operated by local communities without any national bureaucracy being involved.

In China, the people are encouraged to participate in small hydel development. A small station is financed mainly by the local community itself and subsidised – one-quarter to one-third of the total investment – by the government. In recent years, commune and brigade-run stations can obtain medium or short-term loans from the People's Bank of China. The small hydel plants are gradually integrated into the national grid when certain necessary conditions are satisfied.

In early 1983, the Ministry of Energy announced that Rs. 100 crore - a pittance when compared to the money spent on large power projects - had been allocated by the Planning Commission for the promotion of small hydel units. But the commission soon backtracked and told the ministry that state governments should find their own funds for small hydel units. Many engineers continue to argue that small hydel units are not economically viable and government should continue to invest exclusively in large hydel projects. Nevertheless, the Punjab government has announced its intention to set up a micro-hydel corporation and the Karnataka, Uttar Pradesh, Orissa and Mizoram governments have announced several small hydel schemes using low canal heads and sites in hilly areas.

Meanwhile, a number of voluntary organisations in the country have started experimenting with micro-hydel units. In Chamoli district of Uttar Pradesh, the Jakheswar Shikshan Sansthan has established a 10 KW unit at a cost of Rs. 65,000, lower than government estimates. The unit powers flour mills, oil expellers and saw mills. The Tangsa Gram Swaraj Sangh near Gopeshwar has set up another 10 KW unit and in Tehri district, the Lok Jiwan Vikas Bharati jas also established a small unit at Bhudha Kedar and it hopes to provide electricity even to households. The Garhwal University is also experimenting with a micro-hydel unit and the Roorkee University has successfully converted a traditional 'gharad' (water mill) into a 5 KW power unit.

Micro-hydel units offer enormous scope for local innovation. When a botanist who wanted to study the flora in the Valley of Flowers, needed electricity to power his incubator and microscope in the valley itself, a young engineer from IIT Delhi, got a local carpenter to build a wooden turbine and, with parts from a discarded truck, provided sufficient hydel power.

The main problem that these organisations face is spare parts. Equipment purchased from the cities has to be regularly repaired and serviced and every small snag becomes a crisis. Once the local people are trained in servicing and operating the small stations - and even to introduce homemade innovations - there is no reason why the units should not turn out to be a really pragmatic and environmentally healthy answer to local power shortages.

The State of India's Environment 1984-85, The Second Citizen Report, Section Citizen Report, Section on Dams, p. 110

RESERVOIR SEDIMENTATION

Dams and reservoir are needed to regulate river discharges for rational management of water resources. Construction of reservoir on a river changes; its channel morphology, condition of sediment transport and modifies its discharge regime. Reservoir, also greatly disturbs the social and economic environment even before its benefits are felt.

Rivers carry sediments and any reservoir on a sediment-carrying river will silt up though the process may take a long-time. It is most important to take care that reservoirs do not silt up before the benefits from it are fully achieved. Even it the siltation rate is anticipated in the beginning, and provisions made to minimise the effects, uncontrolled land surface erosion accelerates sedimentation rate. Excessive siltation apart from affecting economic viability of reservoirs, also damage turbines and downstream structures.

Tarbela reservoir on the Indus River in Pakistan is posed with a serious siltation problem. Completed in 1974, Tarbela is the first barrier the sediment in the Indus encounteres on its way and the impoundment forms an ideal settling basin. Uncontrolled forestry practices on the slopes of the Himalayas have drastically increased a erosion rate in the steep valleys of the region. The Indus us estimated to collect some 440 MT of sediment during its journey to sea. As a result, the storage capacity of the reservoir has been grossly reduced and is expected to be useless in less than fifty years. Although the actual effects on turbines and downstream areas are yet to be studied, it is believed that the damage by sediment could be considerable.

The excessive build up of sediment has caused Pakistan's Water and Power Development Authority to commission a study from US consultants to find ways of alleviating the problem. The study fond that there was little that could be done to prevent the advance of deposited silt to the dam itself within six to seven years. Their recommendation s to build 600 M long under water dyke around the four main power tunnel intake gates at the reservoir not later than 1992 to protect turbines and downstream structures from effects of siltation.

REFERENCES

1. 'Methods of Computing Sedimentation in Lakes and Reservoirs', UNESCO-PARIS, 1985.
2. 'Under Water Dyke May Answer Tarbela Problems', World Water, Vol. 10, No. 2, March 1987.

REGIONAL COOPERATION FOR FLOOD CONTROL

Floods and flood related problems of a number of countries of the South Asian region like India, Nepal and Bangladesh are similar in nature causing immense losses of life and property and serious dislocation of programme of development almost annually. The problem of floods is further aggravated by soil and bank erosion with its ever-increasing intensity as a resultant of reckless and unregulated human interferences in the watersheds.

The problems of floods and erosion in this most densely populated region are causing immense miseries to the people having one of the lowest per capita income in the present day world. These should not be allowed to go unabated any longer.

Piecemeal efforts had been and are being pursued by the individual countries to tackle this dual problem. But time has proven that sporadic and isolated individual efforts cannot achieve and isolated individual efforts cannot achieve the objectives of floods and erosion control which are essentially regional problems in the context of existing geophysical realities of this region. Forces of nature do not have any respect for political boundaries.

In the interests of well being of the millions of people who are and who will be living in this region, integrated and concerted steps need by undertaken by the countries in the region – India, Nepal and Bangladesh in particular through cooperative efforts for tackling this problem unitedly on a regional basis.

Immense opportunities do exist for optimum development of water resources and watershed management for achieving the objectives of flood mitigation and erosion control to the mutual benefit of all the countries in the region. Besides flood control, such development works would bring in manifold benefits in terms of production of a very large and cheap hydropower, improved navigation, increased dry season flows in rivers, improved forestry, fisheries etc. for the entire region.

The inter-governmental initiative such as SAARC has opened up an era of mutual trust, friendship and opportunities for cooperation amongst the nations of the region. these opportunities if exploited rightly are capable of ushering in a prosperous future of this region through collective efforts towards mitigation of floods and erosion.

The problems of flood and erosion in the South Asian region need be tackled regionally through pooled efforts by the countries of this region.

A combination of structural and non-structural measures will prove to be the most effective strategy towards achieving the objective of controlled flooding and erosion.

Immediate halt of a mass scale deforestation in the upper catchment areas of the rivers and their tributaries in the region has become obligatory for the individual Governments to safeguard against land degradation, increasing erosion and the degrading delicate ecological balance of the region.

The programme of scientific watershed management and afforestation need be implemented on a emergent basis for restoration of the natural balance, control of erosion and improvement of channel morphologies of numerous rivers of this region.

Countries of the region may take up collective plans for flood control which could be taken up in two phases, viz., short-term and long-term. While the short-term phase may be pursued by the individual countries under agreed principles, guidelines and methodology, the long-term phase needs pooled efforts of all the countries.

Based on Conclusions and Recommendations of the seminar on Floods and Erosion held at Dhaka 1986 sponsored by FEISCA and Institution of Engineers Bangladesh

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WHAT DID EXPERTS SAY 25 YEARS AGO

Several problems in the operation of hydrological network system in Nepal was foreseen by VEATCH AND HULSING in 1961. The experts were commissioned to recommend a system for systematic monitoring of hydrological data in the country. Today, it is worthwhile to evaluate how successfully we have been able to overcome the problems. Their report recommended to establish, within the Government of Nepal, a separate bureau or agency devoted solely to collection, analysis and publishing of hydrological and meteorological data. The report further recommended that the agency should not be under a construction agency or water development bodies, particularly not to the one whose responsibility is limited to the development of only one phase of water use. The report also stressed the importance of (i) having basic data collection programme aimed at multi-purpose development of the nation's water resources and (ii) having it administered by a non-construction agency, which should be responsible for obtaining information's in the areas of surface and groundwater, quality of water and meteorology. All the hydrological undertakings must be multi-purpose in scope and viewpoint, the report further recommended.

SMALL HYDROPOWER DEVELOPMENT IN NEPAL

Over eighty per cent of the people's energy requirements in Nepal are met by fuelwood. The growing dependence on fuelwood has exacerbated imbalances in the country. Erosion, landslides, floods and droughts today are common occurences. This has greatly affected the agriculture productivity and hindered national development.

The challenges of meeting the energy needs of rural population and the problems of environmental conservation are difficult. One way of offsetting the dependence on fuelwood is to provide electricity to meet some of the energy needs. In a village, electricity is used mainly for lighting bulbs, cooking, in cottage industry and lifting water for irrigation and domestic consumptions. Hydropower development is an essential prerequisite for rural electrification to meet the energy requirements.

In Nepal rural distribution can be undertaken in the following ways.

(a) By extending distribution system of large power systems (national grid).

(b) Utilising streams and rivers in the hills to generate electricity by small systems to meet local energy needs.

Electricity to communities around urban areas, which have already been connected to national grid and the Tarai where development of small hydel systems are not feasible, can be supplied by option one. However, the cost of connecting remote hilly regions to existing grid can be prohibitive and these areas can be electrified by using the second option.

The potential of small hydropower systems to meet local electricity needs was not realised till the end of the fourth plan period. Development of small-scale hydropower system was taken up as a national programme only from the fifth five year plan.

The government established Small Hydel Development Board in 2033 B.S. to develop small hydropower schemes. The board was entrusted with the responsibility of implementing small-scale schemes and to undertake survey, design, construction, operation and maintenance of small hydro systems. In 2042 B.S., all organisations concerned with the development, generation and distribution of electricity like the Electricity Department, the Electricity Corporation and Boards were emerged and Nepal Electricity Authority was formed. Today, implementations of small hydropower development are handled by the Authority.

Keeping in view the increasing demand for small scale hydropower projects in the country following guidelines have been evolved for implementing schemes within the available resources. Project priorities are based upon following criteria.

(a) District Headquaters.

(b) Regions with cottage and industrial electricity needs.

(c) Regions with potential for tourism development.

(d) Multi-purpose schemes with irrigation and water supply possibilities.

Leaving aside Pharping and Sundarijal power plants, eleven small hydropower projects have already been completed in the country (Table 1) and nineteen others are under construction (Table 2).

S.No.	Name of Project	District	Installed capacity (KW)	Cost in NRs. x 1000
1.	Phidim	Panchthar	240	65,10
2.	Gorkhe	Ilam	64	22,30
3.	Dhading	Dhading	32	17,00
4.	Syanja	Syanja	80	58,60
5.	Jomsom	Mustang	240	1,37,00
6.	Baglung	Baglung	175	76,90
7.	Jumla	Jumal	200	1,40,00
8.	Doti	Doti	200	1,37,00
9.	Surkhet	Surkhet	345	1,20,00
10.	Dhankuta	Dhankuta	240	-
11.	Helambu	Sindhupalchowk	50	43,70

Table 1 Completed Schemes.

S.No.	Name of the Project	District	Installed Capacity First Stage (KW)	Installed Capacity Second Stage (KW)	Cost in NRs. x 1000
1.	Taplejung	Taplegunj	125		1,59,90
2.	Khandbari	Sankhuwwasava	250		2,45,92
3.	Bhojpur	Bhojpur	250		1,93,99
4.	Okhaldhunga	Okhaldhunga	125		1,65,03
5.	Ramechhap	Ramechhap	75		1,23,62
6.	Tatopani	Myagdi	1000	2000	11,27,00
7.	Terathum	Terathum	100		1,77,95
8.	Serpu Danda	Rukum	200		3,44,76
9.	Chaurjhari	Rukum	150		2,48,67
10.	Bajhang	Bajhang	200		2,50,20
11.	Bajura	Bajura	200		3,18,50
12.	Namche	Solu	600		3,14,20
13.	Salleri	Solu	200	400	1,98,94
14.	Manang	Manang	80		1,01,14
15.	Chame	Manang	45		46,21
16.	Darchula	Darchula	50		53,41
17.	Surnayagad	Baitadi	200		1,03,83
18.	Rupalgad	Dandeldhura	100		99,75
19.	Arughat	Gorkha	150		77,00

Reference: A Brief Introduction to Small Hydropower Development in Nepal", Nepal Electricity Authority 1986. (in Nepal).

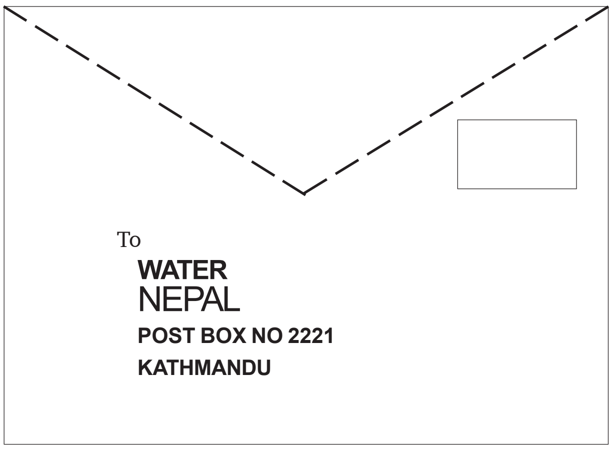
PROBLEMS OF COMMUNITY WATER SUPPLY

Provision of safe and accessible drinking water supplies to communities in the hills and mountains present formidable challenges. The scattered settlement patterns in the hills have resulted in large number of small water supply systems catering to the needs of limited household. All water supply systems, irrespective of their size, must be functional on a long term basis and proper cognizance of the need for operation and maintenance must be taken at the implementation stage.

Gravity flow is an easy, dependable and relatively maintenance free water supply technology in the hills, where water sources at higher elevations are available. No system, however is maintenance free and require institutional supports. To increase longevity, regular maintenance of community water supply system must be undertaken. A well designed water system constructed according to the design norms can have minimum maintenance needs. At remote village, construction quality of water projects have been compromised because personnel responsible for implementation of the project regard their posting as temporary exile and want to go back to cities. A total commitment is lacking which results in lower construction standard. This leads to maintenance problems later on.

Experiences gained so far and case studies of water systems in the country have found that involvement of communities in water supply project implementations can help in subsequent maintenance. Villagers still consider maintenance to be the responsibilities of the implementing bodies, even though water is regarded as a basic need and water system as one of the priorities by most. A recent HMG, NCST draft report on Hill Water Supply Projects, points out that local beneficiaries in certain circumstances. It has also been found that women have significant role to play in maintaining stand pipes and water systems because they benefit directly from the system and suffer first when breakdowns occur. Ironically, women in villages are rarely available for making decisions on maintenance of water systems.

The International Water Supply and Sanitation Decade was launched with a goal of providing all humankind with safer water supply and sanitation facilities by the end of 1990. One significant achievement of these efforts has been identification of bottlenecks and constraints which hamper smooth implementation of related programmes. The need today is to consolidate on the experiences gained and concentrate more on solving the non-technical constraints.



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