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WATER, SANITATION AND HYGIENE: CHALLENGES OF THE MILLENNIUM

Water supply and resources in Kathmandu Valley

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KATHMANDU VALLEY ENCOMPASSES about 600 sq. km. of land of which about 400 sq. km. is the valley floor at altitudes ranging from 1300 m to 1400 m above mean sea level (msl). The floor lies towards the center of the valley. The rest of the land is hilly that rise up to heights above 2000 m surrounding the valley floor. The five cities of Kathmandu, Lalitpur, Bhaktapur, Kirtipur and Madhyapur Thimi are situated towards the center of the valley floor. Semi-urban settlements and agricultural land occupy the remaining part of the valley floor surrounding the city core. The outer hills are mostly forest with some rural settlements. Land form features in the valley include elevated river terraces, flood plains, alluvial fans, talus slopes and bed rock spurs. The total population of the valley is about two million.

There are a number of streams in the hills of the valley that flow towards the valley floor joining into five major rivers, which ultimate merge into one of them, the Bagmati, before draining out of the valley in the south at Chobhar. Bagmati ultimately joins the Ganges River after crossing the boarder in the south. The maximum average monthly flow of Bagmati at Chobhar is 53.43 m3/sec in August and the minimum is 1.55 m3/s during March. The average annual rainfall is about 1580 mm, 80 per cent of which takes place during the monsoon, Jun-Sep.

The hills and the basement beneath the valley floor are composed of intensely folded, faulted and fractured igneous and metasedimentary rock. Upon this basement complex rests unconsolidated to partly consolidated sediments that accumulated within the basin as a result of blocked drainage due to differential orogenic uplift during late Pliocene times when sediments were deposited in a lake which developed within the valley floor. The lake was ultimately breached during Holocene times at the location of the Bagmati river gorge at Chobhar. These sediments which range from thin deposits along the valley floor margins to over 600 meters thick in the central portion form the principal groundwater reservoir of the valley.

Water supply systems

Drinking water for about 1.1 million people of Kathmandu Valley cities is distributed through seven systems that have 24 surface water sources in the hills of the valley, utilizing almost all of the available dry period surface water of the valley. These sources were developed during 1896-1994. Due to the lack of additional surface sources, about 37 deep tube wells have been drilled, most of them after 1983, that add about 30 million liters per day (mld) of water to the above systems. The service area covered by these systems is about 70 sq. km. The supply capacity of these systems is about 80 mld and 120 mld during the dry and the wet seasons respectively against the estimated demand of about 160 mld. To supplement the municipal supply, most of the institutions and industries such as carpet, textile, beverage and hotels have their own deep tube wells (drawing about 20 mld), and the domestic consumers use dug wells, rower pumps (that draw shallow ground water) and the traditional stone spouts. Besides the inadequacy in supply, the distribution is inequitable varying from 24 hours supply in some of the low-lying areas and near the transmission mains to virtually no water in some areas.

The distribution system consists of pipes of ductile iron, cast iron, galvanized iron and HDPE of sizes 25 mm-800 mm diameter. Due to the inability in extending the systems as per the growing demand of the last two decades, there are consumer connections from distances more than 100 m also leading to a 'spaghetti' lines some of which are exposed, laid on open drains and crossing manholes of sewer lines. Besides the location of most of the surface sources in the protected area in the hills, the quality of the supplied water is poor due to contamination during distribution and inefficient treatment. There are about 100,000 connections in which 1278 are public tap stands.

Sewerage systems

The first sewer system in the valley was built about 100 years ago for surface drainage. These are of cross section up to 1500 mm x 1050 mm connected by lateral sewers in the form of rectangular brick culverts with concrete or stone cover slabs totaling about 40 km in length. Since 1950 most of the houses adjoining these sewers have started discharging the raw and septic sewage into these sewers.

About 26 Km of new sewer was laid during 1974-1988 in order to discharge sewage into treatment plants constructed during the same period. After 1988 various agencies and local people have been constructing sewer. The total length of these sewers is about 170 Km. These are of RCC pre-cast pipes in sizes 200 mm-1200 mm. About 34,000 houses have sewer connections.

There are four major wastewater treatment plants of lagoon type, one of them of capacity 15.4 mld and the rest three totaling 3.6 mld. The former is not in operation due to problem with the pumping main and the rest are partially in operation due to problems in sewer lines and high load. A new plant of capacity 17.3 mld is under construction.

Status of water resources

The rivers of the valley, which are in good quality in the hills and outer periphery of the valley floor, as they flow into the core area of the valley are heavily polluted due to the discharge of domestic and industrial wastes. The possibility of contamination of the shallow aquifers is also very high. Some of the deep well water are also contaminated with microorganisms due to poor construction of the wells. Most of the deep wells contain excess ammonia, methane, iron and manganese. There has not been any continuous quality and quantity monitoring of the surface and ground water which is useful for planning development. The deep aquifer abstraction has significantly increased from 1986 causing decline in water level of about 23 meter.

Institutional aspects

The current deteriorating service level of the water supply system marked by poor quality, inadequate quantity, inequitable distribution, inability to maintain and expand the system as per demand, and improper tariff collection; and the deteriorating surface and groundwater resources of the valley parallels with the prevailing inadequate institutional mechanism. The water resource act of 2049 permits every one access to a water resource without obtaining license. Regulations to prevent pollution of surface and shallow groundwater have not been enforced and a single agency has not been appointed responsible for this. Similarly the development of deep tube wells are also without any regulations.

Nepal Water Supply Corporation (NWSC), which is responsible for water supply and sewerage systems of the valley, has failed to achieve the autonomy required to operate effectively as a commercial public utility due to the following major weaknesses. Out of the ten Board of Directors, eight including the chairman and the general manager are appointed by the central government. The board is thus responsive fully to the central government and not necessarily to the customers' needs. The two members who are responsive to the customers have very little influence over the Board. Secondly, NWSC is subjected to political control and frequent change in leadership due to frequent change on the political scene.

Future plan

Having assessed the current situation of drinking water supply, sewerage and water resources of the Kathmandu Valley as above, the following preparations are being made for improving the water services alongside effective use of the resource.

Melamchi Water Supply Project

This is a new drinking water project for the valley which is at the final stage of detail design. The first stage of the project will have the capacity to add 170 mld (about 2 m3/sec) of water to the Kathmandu Valley from the normal flow of the snow fed river Melamchi in the adjoining Indrawati basin. The annual average flow of Melamchi at the location of proposed abstraction is about 10 m3/sec and the minimum monthly average flow is 2.5 m3/sec during March. The estimated cost of the first stage of the project is about 350 million US dollars and the construction is expected to take about five years.

The major features of the first phase of the project include: a) diversion weir and a diversion tunnel of length 26.4 km and correctional area 8 m2 to transfer the water by gravity; b) conventional water treatment plant at the end of the tunnel to be located in the north-east edge of the valley floor on the left bank of the river Bagmati; c) bulk distribution system that comprises of 54 km of ductile iron pipe of diameter 300 mm to 1400 m to carry the treated water to the service reservoirs (totaling about 8 hours demand volume) to be built at the outer higher periphery surrounding the service area; and d) rehabilitation and extension of existing distribution network beyond the old and new service reservoirs. The shape of the valley floor is like a concave plate, the elevations being higher as one moves from the center towards the periphery. This special feature permits the flow of water from the treatment plant to the reservoirs and from reservoirs to the consumers through gravity.

In the second and the third stages of the project, 170 mld of water can be added from each of the nearby rivers Yangri and Larke. The total capacity of 600 mld including the existing in-valley sources is estimated to meet the projected demand up to the year 2030 for a population of about 3 million. The cost of Melamchi water in 2006 is estimated to be about 0.5 US dollars per m3. This is about two times the cost of current water. The water tariff after adjusting according to use depending upon different socio-economic category of the users, is expected to be within the affordability limit of 4-6 per cent of monthly income.

In order to take care of the environmental issues, the project has included: a) Social Uplifement Program to bring a permanent improvement in the social well being in the people of Melamchi Valley as a compensation for the reduction in flow of the Melamchi river; b) Inclusion of wastewater component to take care of the increased wastewater in the Kathmandu Valley; c) Resettlement and compensation plan to adequately compensate the affected people who will be losing their land, property or business as a result of the project; c) NGO coordination; and c) Environmental Impact Assessment. Study of alternatives has been an important aspect in the project since its pre-feasibility study of 1988. At the detail design stage, the study of alternatives has changed the project design from one with a 5-25 MW hydropower plant, at the end of the diversion tunnel to that without the hydropower, on environmental grounds. A program of public relations is soon going to be started to establish dialogue with the affected and benefiting people for smooth project implementation by timely resolving any conflict that may arise. Need of hygiene education for certain group of the beneficiaries has also been identified.

Institutional reform

In order to strengthen the current institutional mechanism that is unable to have an efficient utility and resource management, some suggestions in line with the National Water Supply Sector Policy of April 1998 have been made through a study. The policy identifies a change in the role of the government from a provider of water and sanitation services to a supporter and facilitator of users group that should be accountable for the management of water and sanitation services. The success of the approach taken in the policy has been proven in many places including in the operation and management of Dhulikhel water supply project, a semi-urban system for about 10,000 people. The assets and management responsibility for the Dhulikhel system has been successfully transferred to its users committee with the agreement of the municipality. The users committee is now taking care of the system that is in sound financial and operational condition.

The following institutions have as such been identified essential for effective management of water services and resource: a) Kathmandu Valley Water Authority (KVWA) – to provide local control over utility; b) National Water Resources Planning Agency – national planning and support organization to facilitate the work of local water users groups; and c) Regulatory Board – to establish and enforce standards and provide checks and balances in the sector. The KVWA would have Board of directors with representation from the five cities, a general manager and operating staff.

Management contract

The operation and management of the Kathmandu Valley Water Supply and Sanitation Services which is currently under NWSC, is being given to private operator for an initial period of ten years through management contract. At present the pre-qualification of operators is in progress. The main objectives of the management contract are to: a) reduce unaccounted-for-water; b) improve billing and collection; c) reduce operating cost; and d) improve standard of service and water quality. The operator is also to take part in investment work for rehabilitation of the system. The operator is to be paid for its services through a lease contractor rate per cubic meter of water distributed which would cover all operating costs including direct costs of the management contract. The management contract would include monetary incentives for the operating contractor with respect to reaching target performance ratios and the operating contractor may be required to finance part of the rehabilitation investments.

Groundwater management

Program for monitoring the quality and level of the valley groundwater is being developed by using some of the existing wells and construction of some new observation wells. Similarly preparations are being made to bring the program of registration and licensing of deep wells which can serve a number of purposes: (a) they form the basis for database on usage and quality that is fundamental tool for effective groundwater management; (b) they provide basis for a tariff system; and (c) licensing of new wells will help to have sound construction that helps prevent groundwater pollution.

A pilot project of research and development scale is underway that is expected to determine the feasibility and unit cost of recharging deep aquifers of the valley through injection wells using surplus water available during the wet season. Groundwater is a scarce and important resource that needs to be protected. It may be needed any time in the future including to supplement the Melamchi water. The safe yield of the groundwater of the valley given by different studies range from 13 to 67 mld.

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