

Promoting equitable water distribution system from Melamchi Water Supply Project in Kathmandu Valley

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ABSTRACT

The effective and efficient supply of drinking water resources are key to its long-term use and access. In recent decades, the population of Kathmandu Valley has exploded owing to several factors. The water supply system here has also undergone remarkable changes and efforts have been made to enhance its equitable distribution. The major effort, of course, is the Melamchi Water Supply Project (MWSP). As the project approaches completion of its first phase, we would like to point out several key issues for the water distribution system here and express our opinions on promoting equitable water distribution. For this we conducted a thorough literature review and found that improvement in the water distribution network and water tariff in the valley, along with promotion of alternative mitigation options, are the focal issues for promoting an equitable water distribution system in Kathmandu Valley.

Key words | Kathmandu Valley, Melamchi Water Supply Project, water distribution system, water policy, water tariff

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HIGHLIGHTS

- Gives a glimpse of water supply network and distribution system in Kathmandu Valley.
- Highlights key points to be considered for Melamchi Water Supply Project.

INTRODUCTION

The demand for drinking water in urban areas is ever increasing because of population growth and corresponding increase of economic activities. The situation also applies to a fast-growing area like Kathmandu Valley which today is facing an acute water shortage. The rural-to-urban migration (the highest contributor to which is driven by economic opportunities), economic centrality – concentration of social and economic services, socio-political factors – the decade-long Maoist insurgency (1996–2006) and booming real estate market have all contributed to increasing the population of Kathmandu Valley (Ishtiaque *et al.* 2017). In

1991, the population of the valley was 1.11 million which increased to 1.65 million in 2001 and to 2.53 million in 2011 (based on Kathmandu Valley watershed delineation by Thapa *et al.* (2016) for which the ward-level population data was used from CBS (2003) and CBS (2014)). By 2020, the population of the valley is estimated to be around 4.5 million (KVWSWSI 2010). The water demands have also increased progressively, with a demand of 35.1 million litres per day (MLD) in 1988 (Gyawali 1988), 155 MLD in 2000 (Moench & Janakarajan 2009), 320 MLD in 2009 (KUKL 2009), 370 MLD in 2015 (KUKL 2015) and now at 430 MLD (KUKL 2020). However, KUKL is only able to produce an average of 103 MLD of water as of 2020 (KUKL 2020).

Increasing urbanization does not guarantee reliable access to safe and sustainable water supply and it often

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causes inequality of water supply (Rode 2009). The basic human water requirement is considered 50 L per capita per day (lpcd) (Gleick 1998) and for economic use of water for domestic and industrial needs, it is considered 135 lpcd (Chenoweth 2008). The Government of Nepal has made the categorization of water supply service in Nepal as (presented in terms of quantity only) basic with ≥ 45 lpcd water supply, medium with ≥ 65 lpcd water supply and high with ≥ 112 lpcd water supply (MoUD 2014). Drinking water supply shortage has forced families to manually carry water from far-away sources or to purchase bottled or jar water which may not be affordable on a regular basis (Molden et al. 2020). Inadequate access to proper drinking water has led to increased instances of diseases, health risks and associated economic burdens, which disproportionately impact the poor and vulnerable groups of the valley (ADB 2015).

Diverting water from the Melamchi River was considered one of the best alternatives for a long-term solution. Hence, the Melamchi Water Supply Project (MWSP) was designed, but it has almost been two decades that the MWSP has been under construction, plagued by multiple delays. According to the project update report of July 2020, 97% of infrastructural work of this project has been completed. An announcement to complete the first phase by mid-July, 2020, has also been made by the Ministry of Water Supply. But a further delay is likely because of the Covid-19 pandemic as a majority of the workers have left the project site due to the lockdown imposed by the government (TKP 2020).

The equitable and efficient distribution of water supply to the residents of the valley requires that policy makers adapt to changing socio-economic, environmental and geographic contexts. The equitable supply of drinking water resources is key to its long-term use and access. This paper attempted to find out the real problems of water distribution and suggested the actions to be taken for maximizing public benefit from the MWSP in Kathmandu Valley. We did a thorough literature review of the research publications, KUKL reports, MWSP reports, issue papers and more to find the problems behind an equitable water distribution system in Kathmandu Valley. We recommend MWSP requires adoption of certain reforms which are discussed below, but first a glimpse of Water Supply and Demand in Kathmandu Valley is provided.

WATER SUPPLY AND DEMAND IN KATHMANDU VALLEY

The Kathmandu Valley is a watershed comprising three districts: Kathmandu, Bhaktapur, and Lalitpur. Kathmandu Valley Water Supply Management Board manages the water supply system in Kathmandu Valley and is responsible for developing and overseeing service policies, providing licenses to service providers for water supply and sanitation systems and monitoring to ensure supply of sufficient potable water. Kathmandu Upatyaka Khanepani Limited (KUKL) operates the water supply and wastewater services under its License and Lease Agreement. KUKL, which is responsible for managing the drinking water supply in Kathmandu Valley, currently covers 45% of the total valley area and serves 71% of the valley's population (Thapa et al. 2016). In other bigger towns and cities, water supply systems are managed by the Nepal Water Supply Corporation or Water Supply Management Board. The economic regulation of the water supply sector in Nepal is conducted by the Water Supply Tariff Fixation Commission. It determines the water tariff on the basis of commercial principles and scientific criteria.

In the Kathmandu Valley, the supply of water is disproportionate in terms of quantity with only service areas Madhyapur Thimi, Lalitpur, Kamaladi and Chhetrapati meeting the basic human water requirements (considered 50 lpcd) and none meeting the water required for economic growth (considered 135 lpcd) (Thapa et al. 2018). KUKL manages the valley's water supply system, including piped distribution systems, meter fittings, tap connections and bill collection systems in its respective service areas. It supplies water to two metropolitan cities, and 16 municipalities (ten municipalities in Kathmandu, four in Bhaktapur, two in Lalitpur) in Kathmandu Valley through nine service areas (previously ten) (Figure 1). KUKL plans to supply an additional 510 MLD of water to the residents of the valley through the MWSP (ADB 2015).

At present, there are 221,649 taps (total connections) across the valley which supply water at 5–10 alternate days under KUKL (KUKL 2020). KUKL can only currently meet 22% (dry season) and 46% (wet season) of the valley's water demand (KUKL 2020) (Figure 2). Of this total water supply, 67% of water is supplied by using water from surface

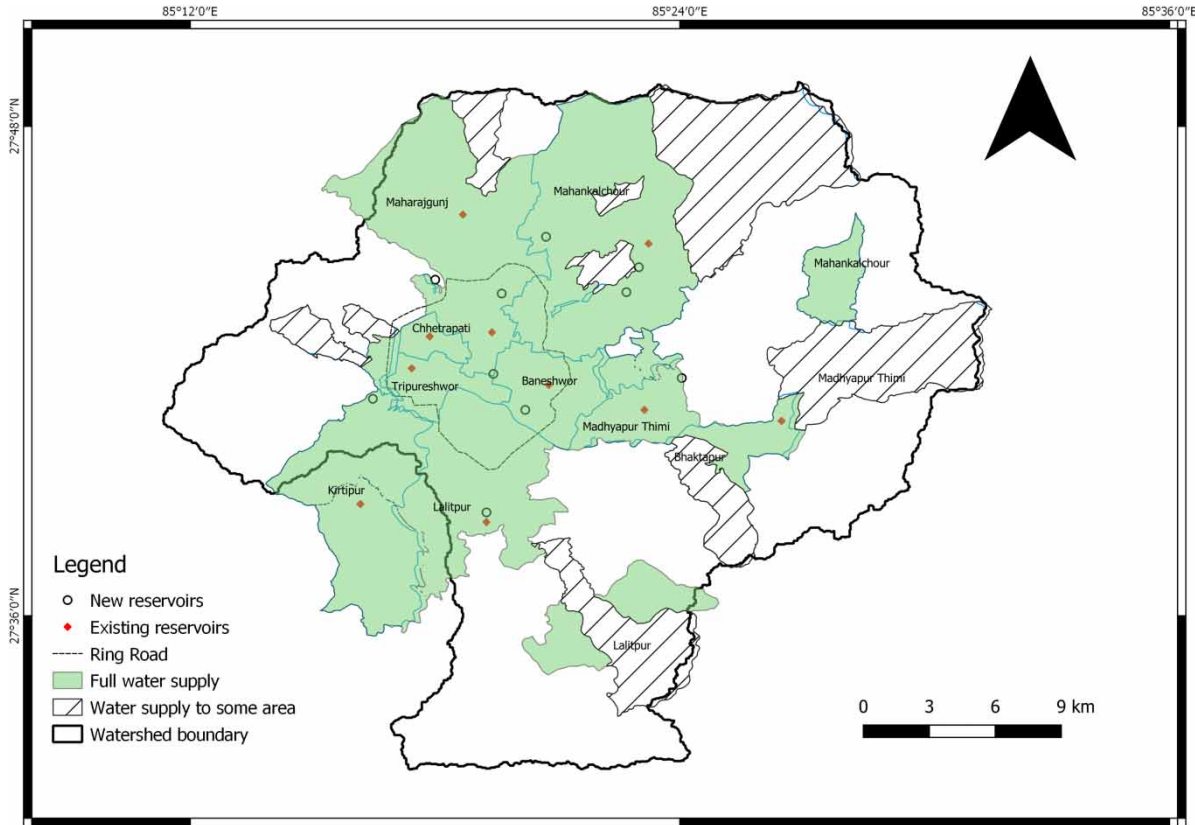


Figure 1 | KUKL water supply service areas with reservoir locations. KUKL (2020) has published its service area according to the 2015 restructuring of administrative boundaries, which were changed again in 2017. Hence, to accommodate this change, partial coverage of water supply to wards is shown. The watershed boundary was created with Chobhar as pour point (point near Dakshinkali) (see Davids 2019).

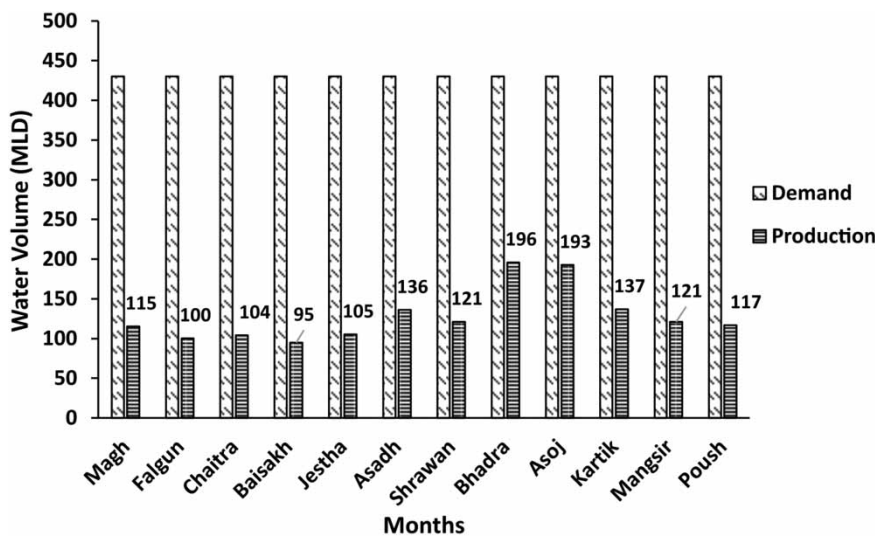


Figure 2 | Demand and average daily water production in MLD in the year 2018/19. The months are given in Nepali. Magh corresponds to Jan/Feb, Falgun corresponds to Feb/Mar and so on. Source: KUKL (2020).

water sources, while the remaining 33% is supplied using groundwater (KUKL 2020). The failure of the public sector water utilities in providing reliable service and severe water shortages in the valley have been observed. Many households only receive water a few hours a day as a result of inadequate investment in both expansion and maintenance and infrastructure deterioration (Whittington *et al.* 2004). Kathmandu Valley thus suffers from chronic water shortages, which have worsened in recent years, making an impact on household well-being (Thapa *et al.* 2018).

The gap in water supply and demand is currently being met through private groundwater extraction by households and vendors. Since 1986, the abstraction rate has exceeded the recharge rate. The extraction of groundwater from the deep tube wells in Kathmandu is around 143 MLD (Thapa *et al.* 2019), the sustainability rate for which has been calculated as 26.3 MLD by Stanley *et al.* (1994) (although the estimates vary). Amid the daunting water deficit, hopes arose with the Melamchi Project envisaging 510 MLD of water in two stages: 170 MLD (by September 2016 which has been delayed) in the first phase and 340 MLD (by 2023) in the second phase for Kathmandu Valley from Melamchi, Yangri and Larke Rivers of Sindhupalchowk District. The Melamchi Project is complemented by other on-going ADB-financed projects such as The Kathmandu Valley Water Supply Improvement Project which aims to improve water availability (80%), efficiency and service delivery in the valley.

WATER SUPPLY NETWORK AND DISTRIBUTION SYSTEM

Water is supplied through a network system in Kathmandu Valley. The demand for water is fixed but the supply depends on a number of factors. Lack of adequate and reliable water sources, inequitable distribution and leakage in pipelines are problems in the existing water supply system. On one hand, insufficient water sources in the valley owing to rapid land use change (Davids *et al.* 2018) has failed to meet the water demand of the valley, and on the other hand, absence of a systematically laid-out distribution network has led to the uneven distribution of available water to households with presently only three service areas out of ten meeting the basic human water

requirements (Thapa *et al.* 2018). Even the plan of water distribution after completion of the MWSP has been criticized, with claims it will lead to an inequality in water distribution, mostly because the redistribution of potable water with reference to population increase has not been envisioned (Thapa *et al.* 2018). To overcome the water distribution problem we recommend that the reconfiguration of the water distribution network be planned. In an intermittent water distribution network such as in Kathmandu Valley, maintaining equity is especially important as consumers who are far from water sources or at high elevation get low pressure resulting in getting less water than those living near sources or in low-lying areas (De Marchis *et al.* 2010). This can result in heightened difference in water access. Hence, we recommend the existing distribution network needs to be expanded and reconfigured as outlined by Thapa *et al.* (2018). Their recommendation on expanding KUKL's existing distribution based on study of population projection rate, water demand and water supply would help to ensure the sustainability of equitable water distribution.

Leakage is another major problem observed in the water supply system in Kathmandu Valley that accounts for 20% of the supplied water being lost through the system (KUKL 2020). Although leakage has substantially decreased from the 35% to 40% reported in 2012 (KUKL 2012), efforts have to be made to maintain this rate through regular maintenance. Currently, KUKL has installed PVC pipes to replace the existing GI pipes and it is believed they will last for the next 20 years. It has also used information and communications technology including modules such as a Leak Management Android App (for reporting water leakage in the area), Network Monitoring Tools (for monitoring ICT infrastructures and devices) etc. KUKL has constructed ten additional service reservoirs at several commanding locations for efficient supply of the Melamchi water. It is believed that a newly engineered water supply network, construction of service reservoirs and bulk distributed system will address the problem of leakages and illegal connection.

WATER TARIFF

The tariff is regulated by the Water Supply Tariff Fixation Commission in accordance with the Water Tariff

Commission Act. At regular intervals, KUKL submits a proposal for tariff fixation providing necessary documentary evidence and the Commission makes a decision on amendment as deemed necessary. KUKL's existing water tariffs follow the Increasing Block Tariff (IBT) system, which depends on consumption by volume and a connection tap size. Presently, KUKL customers with 1/2" connection size have to pay NRs 100 (~0.84 USD) for 10,000 litres of water per month and an additional NRs 32 per 1,000 litres of water use (for metered connections). Households without meters are charged NRs 785 for the same connection. For higher water use there is a check mechanism in place with additional charge but within the lifeline block of 10,000 litres, the payment is the same regardless of whether 3,000, 7,000 or 10,000 litres of water are used. This hardly encourages wise use.

In India, the national water policy states that water charges should be determined on a volumetric basis to meet the objectives of equity and efficiency. The pricing should be guided by economic principles and the tariff rates need to be revised periodically. The tariff regime in Bangalore, for instance, charges NRs 11.22 per litre within 0–8 kilolitres (BWSSB 2014) (for comparison all INR converted to NRs, 1NR = 1.6 INR). In Delhi, the tariff is of NRs 7.04 per litre up to 20 kilolitres (DJB 2015). Likewise, in Chennai, the tariff is of NRs 6.41 per litre up to 10 kilolitres (CMWSSB 2018). The rates, although different to reflect on the water availability, investment and other issues, seem to be a better tariff regime as they charge amount per lifeline block but are considerate of volumetric use of water.

In a study by Suwal *et al.* (2019), respondents in Kathmandu Valley were found to desire affordable piped water services and water bills that are calculated fairly for everyone. But varied preferences were also found, hence instead of following the same old IBT scheme, utility managers can choose a tariff structure which best achieves cost recovery and revenue stability. End users of vended water (water bought by consumers in the form of both tanker-truck water and bottled water as a result of public water not being sufficient) pay approximately 3.4 times as much for vended water as they pay for water from the public piped water distribution system (Raina *et al.* 2019). This creates a unique opportunity to raise water tariffs with the delivery of

improved piped services. Ojha *et al.* (2018) suggest increasing the water price by 54% to meet operation and maintenance costs. However, the potential price hike and possible exclusion of the urban poor from basic human rights needs special arrangement. Different rates of water tariffs are required considering their poor economic status.

ALTERNATIVE MITIGATION OPTIONS

The first phase of the project which promises to bring 170 MLD of drinking water to the valley is already coming short as on average there is a 234 MLD water deficit in Kathmandu Valley without even considering real losses (KUKL 2020). Hence, alternative mitigation options are necessary to overcome this deficit. These options include compulsory water metering, water demand management, introducing rainwater harvesting methods and promoting potential recharge of groundwater among others (Shrestha 2012).

The strategies of saving and reusing water and avoiding wastage should be implemented at the household level. Likewise, compulsory water metering has to be stressed. Although the water tariff scheme already provides incentives for metering (charge of NRs 100 vs NRs 785 for 1/2" connection size), it should be made compulsory. In an intermittent water distribution network like that in Kathmandu Valley such a system is necessary to avoid water wastage. Consumers in high-pressure areas tend to replace old stocks with fresh stocks of water each time supply is restored (McIntosh 2003). Likewise, people tend to leave their taps open even when there is no water supply so that whenever the supply is restored it can flow straight into the storage facilities, some of which tend to overflow (Mohapatra *et al.* 2014). Without metering, such wastage can become highly rampant and disturb the equity in water supply leaving the consumers in low-pressure areas with little or no water.

Similarly, on average the rainfall in the valley is about 3,353 MLD (Shrestha 2009) which is almost eight times the current water demand in Kathmandu Valley. Hence, various micro- and macro-level rainwater harvesting structures need to be developed. The present use of groundwater is not sustainable and will need measures for recharging. Currently, 246 billion litre groundwater storage has been

created in the groundwater aquifers due to depletion and to recharge this Chinnasamy & Shrestha (2019) suggest using MWSP water to recharge groundwater during the monsoon season and using groundwater sources to ease the supply stress during the dry seasons.

CONCLUDING REMARKS

MWSP is the one of the most highly awaited drinking water supply projects in Nepal and holds high hopes for resolving the water crisis in Kathmandu Valley. But the delays in the completion of the project have brewed uncertainty and have added demand pressures on the project. Keeping a few issues in consideration would help ensure an equitable water supply in the valley. The reconfiguration of the water distribution network has to be planned and the water tariff scheme has to be improved. Furthermore, even though MWSP will ease the severe water crisis in the valley it will not be the one-stop solution. The first phase of the project is already falling short, hence we also need to be thinking of options beyond Melamchi.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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