

Environmental Impacts of Melamchi Water Supply Project (State of Implementation of Environmental Management Plan)



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Executive Summary

Increased population and inadequate surface and groundwater recharge accelerated drinking water scarcity in the Kathmandu Valley. The Valley had only 0.3 million people in 1920 AD. Its population is expected to reach 3.7 million by 2021. People yet to receive basic water demand of 50 litre/capita/day. In order to meet water supply demand, the Government realised the need for exploring water sources within and outside Kathmandu Valley in 1970s. In 1992, Melamchi river was identified the best alternative source of water to Kathmandu Valley. The Government established the Melamchi Water Supply Limited (MWSL) in 1995 and Melamchi Water Supply Development Board (MWSDP) in 1988 to implement water diversion from Melamchi to Kathmandu. The Board advanced the work to bring 170 million litre per day (MLD) in Kathmandu from Melamchi river at its first phase and equal quantity of water from Yangri in second phase and Larke khola in Project's third phase, totalling to 510 MLD. Accordingly, the Melamchi Water Supply Project (MWSP) prepared an Environmental Impact Assessment (EIA) report and got approval as per the Environment Protection Act (1996) and its Rules (1997). It also prepared supplementary EIA report in 2001.

Project construction officially started in 2001 and restructured in 2007 and construction took speed. In 2012, Ministry of Urban Development issued a white paper to improve water supply situation in the Valley and informed the demand of 350 MLD and supply of 105 MLD during the wet season and 90 MLD in dry period. People of Kathmandu Valley met their water demand from deep and shallow tube wells, tanker, bottling company, and traditional stone taps. In 1988, 2000 and 2015, water demand was 35, 155 and 370 MLD respectively. At present, water demand has reached to 430 MLD and average production is only 129 MLD and supply is 103 MLD, i.e. ¼ of its demand is supplied. People of Kathmandu met shortage from private sector tankers. About 650 tankers are estimated in current operation but quality of supplied tanker water may be questioned.

In order to understand and update the state of water demand, production and supply in Kathmandu and environmental impacts of MWSP, Nepal Forum of Environmental Journalists (NEFEJ) conducted this study. Publications and documents related to this Project and EIA report and Environmental Management Plan (EMP) of this Project were thoroughly reviewed; field visit was organised and study team discussed with key stakeholders such as residential engineers, safety officers, medical officer, workers, implementer of the social upliftment programme (SUP), and Municipality Mayor, including Project officials and Project affected local people. This study is limited on Melamchi water diversion scheme and water treatment plant (WTP) at Sundarijal.

As of March 2020, headwork is under construction at Ribarma; access roads, 26.5 km long tunnel and 4 adits, and WTP in Sundarijal have been constructed; local roads including road joining with Kathmandu Valley have been improved; and Project has provided demand-based financial support for infrastructure development, education, health and income-generating activities as parts of SUP. The Project analysed water quality, controlled riverbank cutting and landslides, conducted afforestation, and supported for water source conservation and irrigation channel as environmental management programmes. The Project has established environmental laboratory at Melamchi Project site office. However, the Project has reduced the time (man-months) of the Environment Officer from 2014 and did not include its position in the approved organizational staff of the MWSD Board for FY 2077/78. This rules out the implementation of adverse impacts mitigation measures and limits to make the Project environment-friendly and sustainable.

After construction completion of 85 MLD capacity WTP at Sundarijal on 31 December 2017, and tunnel on 28 December 2018, the Italian company breached the contract. The MWSDB and the Sinohydro Corporation Ltd signed the contract agreement in last September and October 2019 to complete the remaining works for tunnel finishing, and construction of headwork.

The Government has received financial support from Asian Development Bank (ADB), JICA, NORDIC and OPEC Funds to construct this Project. During Project restructuring in 2008, US\$ 249 million was estimated as Project cost and it reached to US\$ 312 million in 2015 with additional US\$ 63 million. Out of total expenditure of NRs 27 arba, NRs 19 crore and 27 laths (0.7 percent) has been spent for environmental management by FY 2018/19 (BS FY 2075/76).

The MWSDB issued a white paper in January 2020 (BS Poush 2076) with updates on accomplishments of major activities mainly construction of tunnel, adits, access road, rural roads, WTP and implementation of SUPs along with expenditure on major components of the MWSP by FY 2018/2019. The White Paper also informs about detail studies, design and investments for 9.5 km long Yangri tunnel and 2 km long tunnel Larke Kholā and headworks, and WTPs, including EIA study.

The approved EIA report (2000) and its EMP includes adverse impacts of the Project on local people, natural and man-made resources and/or impact on physical, chemical, biological, social, economic, and cultural aspects of the environment, and measures to avoid, mitigate or compensate adverse impacts, including monitoring requirements. Based on discussions with Project officials and site observation, implementation of adverse impacts mitigation measures is unsatisfactory for construction period. Measures related to occupational health and safety (OHS) as mentioned in the agreement have been effectively implemented while other measures were considered non-implemented.

The field visit was conducted from 27 to 29 February (BS 2076.11.15-17) in Melamchi area, and on 3 March 2020 (BS 2076.11.20) in Sundarijal, and outcomes of the interactions and discussions with concerned Engineers, people's representative, SUP implementer and local people, including field observations are summarized below:

- a. Construction of road and school building and student scholarship and implementation of income-generating activities under SUPs have improved socio-economic conditions of the local people and opened multi-doors for economic activities & benefits. Trout fish entrepreneurship has been improved; workers have enhanced skills; and workers have used safety equipment and significant accidents were avoided.*
- b. Water source has dried-up and water has come out from Gyalthung and Sindhu adits; muck disposal sites have yet to stabilise; stones and soils from disposal sites may reach farmland during heavy rain; sanitation in workers camp and drinking water quality should be improved; tunnel finishing works should start after construction of ventilation (vent shaft) though health check up and oxygen measurement is on-going; and big boulders at headwork (left side of river) may create problems during the rainy season.*
- c. Progress in tunnel finishing works and headwork constructions and successful test of water diversion in 1 km long tunnel convinces Government's commitment to distribute Melamchi water in Kathmandu Valley by mid-July 2020.*
- d. Continued financial support for people's demands has increased 'dependency'. Only one-fifth of the total SUP expenditure is on environment management. The EMP has not been implemented; and environmental monitoring has not been carried out. Although river flow discharge and water*

quality was analysed and plant nursery was established temporarily, local people experienced non-implementation of environmental programmes with the change in Project director.

- e. Environmental measures related to soil erosion control, pond construction and watershed conservation, replacement plantation, air quality maintenance and waste discharge/disposal were not seen or understood implemented. Furthermore, environmental monitoring has not been carried out, and environmental management responsibilities have not been accomplished.*
- f. During Project operational stage, the Government should provide 'levy' to local governments to implement activities to maintain or improve crop & fish production, operate water mills, and improve livelihood of fish-dependent population, and provide drinking water to local people.*
- g. The Project has provided NRs 75 million each year for SUP activities such as income-generation, rural road, school building and scholarship, and developing skills in making dress, thanka, electric wiring and iron welding.*
- h. Important learning of this Project is effective implementation of occupational health and safety (OHS) requirements, albeit ventilation was considered secondary. However, water diversion may increase water temperature in the downstream and may adversely affect trout fish farming. Furthermore, it is necessary to stabilize the muck disposal site.*

In summary, EMP implementation is inadequate except OHS provisions as contained in the contract agreement. Effectiveness of measures is unknown due to lack of environmental monitoring. Effort in making the Project environment-friendly and sustainable through the implementation of environment protection measures is sufficiently side-lined.

Non-implementation of EIA report, approved as per country's law, is very sad. As Project construction is nearing to completion, EMP implementation is minimal, and punishment provisions exist for non-compliance with the approved EIA report, this study recommends to:

- a. implement adverse impacts mitigation measures, as contained in the EMP, to make the Project environment-friendly by creating stakeholders awareness about the importance, needs and usefulness of environment conservation;*
- b. make public an annual monitoring report about possible impacts of river water diversion on e-flow, water mills, trout fish, and crop production during Project operational stage;*
- c. implement measures to maintain river water flow while considering the demand for 'levy' from local government and people, and 'payment for environmental services'; and*
- d. develop a system to provide prior information to the Project about the possible impacts of all types of infrastructure development, socio-economic and income-generating activities in Project affected areas and future liabilities (to/on the Project).*

These suggestions may be useful to make similar type of projects, natural resources utilization, and infrastructure development activities environment-friendly and sustainable.

INTRODUCTION

1.1 Water supply challenges in the Kathmandu Valley

The bowl-shaped Kathmandu Valley (KV) has 2 metropolitan cities and 16 municipalities as administrative units with geographic area of about 655 km². The Valley has experienced three times increase in population during the last three decades. The total population reached to 2.468 million in 2011 from 0.766 million in 1981 (Table 1.1) with annual population growth rate of 4.63 percent. One estimate indicates 4 million population of the Valley in 2020 and 6.7 million in 2030, assuming 6.5 percent growth rate (KVDA, 2015). Centralised socio-economic and infrastructure facilities, and high migration during Maoist conflict increased total population. During the last century, it has increased 12 times from 1920 population of only 0.3 million. In addition, many people come to and go from Kathmandu Valley each day and exert additional pressure on water.

Table 1.1 Population of the Kathmandu Valley

SN	Year	Total population	Growth Rate	Remark
1	1920	306,909		No use of scientific methods in census
2	1952/54	410,995		Census completed in two times
3	1961	459,990		
4	1971	618,911		
5	1981	766,345		11.1 percent migration recorded
6	1991	1,105,379	4.2 percent	19.4 percent migration recorded
7	2001	1,656,951	4.9 percent	
8	2011	2,468,316	4.63 percent	
9	2021	3,753,678		Estimated
10	2025	4,288,209	5.7 percent	Based on KVDA report (2015)
11	2031	5,820,147	""	
12	2035	6,048,942	""	

Note: Population data till 1991 were taken from Environmental Planning and Management of the Kathmandu Valley (1999) report, 2001 data from Bagmati Action Plan (2009-2014) report, and remaining data from KVDA's draft Master Plan (2015-2035) report.

Initial population data were for districts of the Valley such as Kathmandu, Lalitpur and Bhaktapur. Later data were separated for Kathmandu Valley.

The Valley is drained by Bagmati and Vishnumati Rivers with number of their tributaries namely Manohara, Hanumante, Tukucha, Dhobi, Sanga, Mahadev, Nakkhu, Kodku, Godavari, Gundu, Tribeni and Balkhu kholas. Taudaha, Ranipokhari, Nagdaha and Kamalpokhari are recognised wetlands in Kathmandu. The 2009 study reported 233 stone taps in then municipalities but without water in many stone taps. Few such taps were encroached. The domestic water needs in the Valley are met from surface water, groundwater and stone taps. The 1999 report records that Nepal Water Supply Corporation supplied 105.3 MLD during wet (rainy) season and 70.8 MLD in dry season (MoPE, 1999). About 65 percent of the total water supply accounts surface water and remaining from groundwater sources. Although the Corporation provided water for domestic, industrial, commercial and institutional uses, about 79 percent was for domestic use. As water scarcity continued, people of Kathmandu Valley met their basic water needs from 31 and 20 water tankers of private sector and the Corporation. Quality

of private tankers is questioned as they collect water from rivers, streams and private tube wells. They supply water to hotels, restaurants, carpet factories, hospitals and offices. The December 2019 news informed water demand of 35 MLD in 1988, 155 MLD in 2000 and 370 MLD in 2015 (<https://www.thethirdpole.net/en/2019/12/13/thirsty-kathmandu-waits-for-water-that-never-arrives/>). Water demand is high for domestic uses along with population growth and economic activities in the Valley. The 2020 annual report of the Kathmandu Upatyaka Khanepani Limited (KUKL) mentioned water demand of 430 MLD, average production of 129 MLD (95 MLD minimum, and 196 MLD maximum) and average supply of 103 MLD by considering 20 percent leakage.

In late 1990s, the Government provided 146 MLD in the Valley and its 81 percent was used in urban areas (Valley has had rural and urban populations. After 2 decades, all considered urban population). The Corporation distributed only 10 MLD and 0.425 MLD was from groundwater sources. This clearly indicates poor water security in the Valley. In 2003, a study documented 83, 7 and 3 percent of water sources Corporation, wells and spring respectively. Water demand continued to grow in urban areas and people continue to experience inadequate drinking water, both in supply and source. People were not worried about quality of supplied water.

Several international organisations and World Health Organisation (WHO) set 150 lpd (litre per day), a standard for basic needs of water (for drinking, sanitation, cooking and bathing) and Nepal aimed to make it 135 lpd for meeting domestic and economic requirements after the completion of the Melamchi Water Supply Project (MWSP). The KUKL has planned to supply 510 MLD within ring road through its network systems by 2030 and this will make water supply easy.

The geological condition of the Kathmandu Valley is appropriate for water storage. Groundwater deposit in northern, middle and southern part of the Valley is considered high, medium and low. As mentioned above, people of Kathmandu Valley have met water demand from tanker supply. The 7-year back estimates indicated high amount of water sale from tankers and it was about NRs 20 million. The Government started registration of private sector tankers. About 650 tankers were involved in providing water for domestic purposes by 2017 and 460 tankers of the KUKL were registered (<http://therisingnepal.org.np/news/19663>). Still many people met their water demand from private tankers. The Government has issued blue sticker to supply standard-met, clean and healthy water for domestic use. The private tankers sell about 5000 litre of water in around NRs 2000, which largely depend upon water quality and distance between water source and household. Till Melamchi water is supplied, tankers will continue to enjoy from water market/trade.

Although total population of 2001 and 2011 as mentioned in several studies does not tally/match perfectly, water demand for domestic use has been estimated for few years in between 1994 and 2011 (Table 1.2).

Table 1.2 Estimated Water Demand for Domestic Use in the Valley

SN	Year	Estimated Population	Water Demand (MLD)		Remark
			Theoretical	Observed	
1	1994	1,545,000	196.5	136.0	Observed water demand will increase by three-fold in 18 years
2	2001	1,995,000	259.1	221.1	
3	2006	2,274,000	333.1	279.0	
4	2011	2,799,000	421.8	386.1	

Source: MoPE, 1999.

During the supply of drinking water from the Water Supply Corporation, supply deficit reached to 56 percent of the total population in 1994 and was estimated to reach 68 percent in 2006. As preliminary works of the Melamchi Water Supply Project were initiated, this deficit was expected to lower down to one-third of the total population by 2011 if Melamchi water is supplied in the Valley. It means, water supply situation will be like that of 1981 (30 percent deficiency) (MoPE, 1999). Another study estimated domestic water demand of 35.1, 155, 320 and 370 MLD for the years 1988, 2000, 2009 and 2015 (Thapa et al., 2018). The KUKL has supplied only 115 MLD during the wet season and 69 MLD in dry season. This indicates the deficiency of 322 MLD water for domestic uses by 2021.

Increased water shortage in the Valley along with population growth encouraged the Government to harvest rainwater, and explore drinking water sources within and outside the Valley for meeting long-term water demand.

The Government of Nepal prepared physical development plan (1972), land-use plan (1976), physical development concept (1984), wetland and riverbank conservation, urban development and conservation scheme (1988), urban development plan and programme (1991), Bagmati river basin water management strategy and investment programme (1994), urban regulatory framework (1995), environmental planning and management (1999), long-term development plan (2000) etc to promote planned development of the Kathmandu Valley. These plans and programmes also analysed water supply situation and focussed on long-term water supply needs. In addition, the Government formulated and implemented policies such as National Urban Policy (2007), National Landuse Policy (2012) and National Urban Development Strategy (2017), and the Parliament enacted Urban Development Act and Kathmandu Valley Development Authority Act to regulate physical development works in the Valley. The policies advanced water supply initiatives.

The 2012 White Paper on water supply situation and improvement plan in the Valley, issued by the Ministry of Urban Development, accepted water supply a great challenge to meet the drinking water demand for 3.2 million people of 2012 and projected 5.1 million people by 2025. In 2012, KUKL supplied 150 MLD water in the rainy season and 90 MLD in the dry season in spite of demand for 350 MLD of the urban and rural population of the Valley. The KUKL provided drinking water to 71 percent of the total population who live in 45 percent of the total area of the Valley. Several organisations, hotels, industries, hospitals, apartments/housings, tankers etc. totalling to 233 licensees extract 50 MLD mainly from groundwater and deep tube wells to meet water demand. About 600 tankers provided about 10 MLD in 2012. In addition, 67 Bottling Companies, private wells, shallow tube wells and traditional stone taps and springs were used to meet water demand. Water is also used for fish farming, tourism, cultural activities and brick production. A study has informed the use of 0.75 litre of water to make a brick and about 63 MLD was estimated used to produce 85 million bricks.

The Rural Water Supply and Sanitation Strategy (2004) mentioned the need for 45 lpd for domestic use. Industries and hotels meet their water demand from groundwater extraction without knowledge on its 'recharge'. This resulted to decline of water table by 2.5m annually in first few years. During the last 20 years, ground water table has declined from 6 to 15 m in Manohara, Gokarna, Bansbari and Bhaktapur areas (MoPE, 1999). This level in some parts of central part of the Kathmandu reached to 20m down. The water source of private wells has also dried; stone taps are also dried up; and wetlands are experiencing low amount of water. Increased temperature along with climate change and population growth in urban areas has increased water deficit in the recent years.

Minimum amount of water has not been supplied to the people in the Valley even after using all available water sources. This prompted to realise the urgency of exploring water sources outside the Kathmandu Valley in 1970s. Analysing all available water sources, Melamchi river was considered environmentally appropriate source for Kathmandu Valley (Stanley and Associates, 1990). In 2000, the then Government completed the engineering design of this Project. The proponent prepared an EIA report and was approved in 2000 as per the provisions of the Environment Protection Act (1996) and its Rules (1997). The proponent also prepared supplementary EIA report in 2001.

1.2 Institutional development on water supply

The water supply responsibility of the Nepal Water Supply Corporation in the Valley was transferred to the Kathmandu Water Supply Management Board (KWSMB) after its establishment as a self-governed and organised body as per Section 7 of the WSSMB Act, 2063 (BS). The Board has entrusted KUKL – a public-private partnership organisation – for water supply in the Kathmandu Valley. The KUKL is facing challenges to supply water due to water at source, equipment and old pipes, and high leakage. The KUKL is making every effort to provide water for domestic uses by increasing its capacity, utilising groundwater at maximum level, and minimising leakage.

Between 2010 and 2013, KUKL focussed its programmes to improve water sources, collect rainwater, construct ponds, construct treatment plant to purify drinking water, construct bulk distribution facilities, develop distribution network, ensure proportionate water supply and control leakage. It invested NRs. 3 arba (3 billion) and added 27 MLD in the existing water supply system. In its second phase (2012-2016), KUKL constructed 20 new tube wells, 22 km long bulk distribution network within ring road, ponds of different capacities and added 20 MLD with investment of around NRs 9 arba (9 billion). In its third phase (2016-2025), KUKL will invest NRs 13 arba to construct treatment plant, develop bulk distribution system, increase water ponds capacity and add distribution network, including implementation of wastewater management programme. Furthermore, KUKL will supply water through 10 new reservoirs within ring road. In spite of these efforts, people of Kathmandu Valley have not received minimum quantity of water. There is no way out besides waiting the Melamchi Project.

The Government of Nepal established the Melamchi Water Supply Limited in 1995 and Melamchi Water Supply Development Board (Committee) in 1998 and started Melamchi Water Supply Project (MWSP) to bring 170 MLD water in its first phase. The Project construction will continue to bring additional 170 MLD from Yangri Khola in its second phase and equal amount of water from Larke Khola in its third phase. Key activities and milestones of the Project are summarised in Table 1.3.

1.2.1 Major activities of the Melamchi Water Supply Project

The MWSP is under construction to solve long-term drinking water problem of the Kathmandu Valley. The Project includes activities related to the construction of access road, headwork (water diversion scheme), tunnel, and water treatment plant (WTP). In addition, the Project constructed rural road, improved existing roads, and implemented Social Upliftment Programme (SUP).

Access road: The Project has constructed 17.7 km long road from Melamchi Pulbazar to Timbu – place of water diversion of Melamchi river. Access road to Gyalthung is linked to this road, and another access road is constructed to join Sindhu adit.

Headwork: The temporary tunnel is constructed for maintenance of the headwork. A 'coffer dam' is nearing to completion to divert water from tunnel. A weir (dam) is under construction at Ribarma as a permanent structure to divert water from Melamchi river to Sundarijal.

Table 1.3 Accomplished Major activities of the Melamchi Water Supply Project

SN	Year	Major Activities	Remarks
1	1972	Start of a study for long-term water supply in the Kathmandu Valley	World Bank support
2	1984	Analysis of 22 alternatives from the consultant (Binni and Partners)	
3	1992	Consultant (SMEC) identified water diversion from Melamchi, Yangri and Larke as best (alternative) out of 22 alternatives	Estimated transfer of 510 MLD
4	1995 (BS 2053)	Establishment of Melamchi Water Supply Limited	
5	1998 (BS 2055)	Establishment of Melamchi Water Supply Development Board as per Development Board Act, 1957	Start of detail feasibility study and design from Norwegian support and ADB loan
6	2000	Approval of EIA report as per the provision of the Environment Protection Act and its Rules	Preparation of a Supplementary EIA report in 2001
7	2001	ADB agreed for Project investment and made loan agreement with the Government of Nepal	Start of physical work in FY 2001/02 (BS 2058/59) to complete by 2007/08 (BS 2064/65)
8	27 Feb 2002	Agreement to construct WTP in Sundarijal and redesign of WTP with 85 MLD capacity with JICA support in 2012	Contract agreement on 10 July 2013 to complete works in 810 days with cost of NRs 4 arba 20 crore (without VAT)
9	2005	Withdrawal of Norwegian and Swedish support	Inadequate financial sources
10	2007	Difficulty in complying with commitments as included in ADB contract agreement	End of the agreement date in December 2007 before starting the construction works
11	19 Feb 2009	Agreement with the Chinese contractor to complete tunnel construction by 2 September 2013 but Contractor informed on 12 September 2012 to end contract	The 2012 White Paper informed only 15 percent work completion against 75 percent time completion (contract period)
12		Official declaration to bring water from Melamchi river by mid-2016	With concurrence of ADB
13		Agreement with Contractor in early 2013 to construct WTP by mid-2015	Completion of 85 MLD capacity WTP at present
14	2015	Loan support received from ADB for a second WTP with 85 MLD capacity, and agreement with Contractor on 7 November 2016 to complete in 540 days (July 2018)	Yet to complete, and 170 MLD to be treated after its completion
15	31 Dec 2017	Completion of WTP construction	
16	30 Nov 2018	Tunnel contractor (CMC) informed to terminate agreement due to non-payment of NRs 36 crore, and Melamchi Board informed the contractor about the termination of contract on 7 Feb 2019	Tunnel finishing work pending

SN	Year	Major Activities	Remarks
17	26 Dec 2018	Tunnel construction (opening from headwork to Sundarijal) completed	Tunnel 'break through' with remaining finishing works
18	19 Jun 2019	Contract with Shrestha Construction contractor for headwork conservation at Ribarma and immediate start of work	
19	14 Jul 2019	Agreement for ventilation (vent shaft) construction and start of the work	
20	29 Sept 2019	Agreement on tunnel package 2	Agreement with Sinohydro corporation Ltd
21	11 Oct 2019	Agreement on headwork package 1	
22	Jan 2020	Issue of White Paper by Melamchi Water Supply Development Board and commitment to divert 170 MLD water by mid-July 2020	Headwork construction to be completed by December 2020 as per contract agreement
23	Jan/ Feb 2020	Project completion dates revised in 2012, 2013, September 2016	Non-continuity in construction works by Contractor

Source: Annual Progress Report (FY 2018/19 or BS 2075/76) and other documents

Tunnel construction: A 26.5 km long tunnel construction work is completed to join Ribarma and Sundarijal. The 11 km long tunnel will be constructed to divert water from Yangri and Larke streams to Melamchi headwork site, and this 36 km long tunnel for water supply may be the second longest tunnel of Asia. At present, the Project is engaged in tunnel lining, cavity filling and rock bolting activities. These works may be completed within a month as informed by the concerned Engineers during the field visit (end of February and early March 2020).

Water Treatment Plant: Construction of a 85 MLD capacity WTP is completed in Sundarijal to treat water diverted from Melamchi water. Another WTP of equal capacity is under construction and is expected to complete soon.

Improvement of other roads: The Project supported to improve 4.9 km in Gokarna-Sundarijal section, and 21 km in Lamidanda-Melamchi Pulbazar section.

Social Upliftment Programme (SUP): The Project supported a total of then 19 Village Development Committees (VDCs) – 14 VDCs of the Melamchi Valley of Sindhupalchowk district and 5 VDCs of Mandan Valley of Kavrepalanchowk district – to implement infrastructure development works, and other activities related to education, health, income generation and community development activities. Based on 2012 White Paper, over 1 lakh and 6 thousand people are benefitted from SUP implementation. At present, the Project has supported to implement similar activities in the then 10 VDCs which are affected from Yangri and Larke sections (MWSDB, 2020).

In summary, loan agreement with the Asian Development Bank was ended before the start of the Project construction in 2007. The Project was restructured to complete its construction by 2013 and MWSDB to implement the headwork, tunnel, WTP and SUP under the MWSP. Similarly, bulk distribution system, wastewater management and capacity enhancement of the service providers were included as major components of the Kathmandu Valley Water Supply and Sanitation Project. The Project Implementation Directorate (PID) is implementing the Kathmandu component.

Environment management programme: The Board in its annual progress report includes information regarding the implementation of mitigation measures by preparing the Environmental Management Plan (EMP) to minimise adverse impacts on the local environment during construction and operational stages and make the Project environment-friendly (MWSDB, 2020). The signed agreement with the contractor also includes provisions to implement EMP. As per the progress report, the Project has analysed river water quality, riverbank cutting and landslide control, plantation, water source protection and drinking water and irrigation related measures. It has established environmental laboratory in Project Site Office in Melamchi.

The progress report documents environmental management activities as implemented till December 2017 but it was confirmed from field visit as official for environmental activities was neither hired nor any official made responsible from headwork to Sindhu adit. In December 2017, river water sample was collected and flow discharge was measured but the same report mentioned the end of hiring for environmental services by December 2014 (MWSDB, 2020). The 2018 report recommended to implementing EMP and conducting monitoring for environmental security. It reflects inadequate implementation of adverse impacts mitigation measures. In addition, the Project has implemented activities related to resettlement and compensation.

1.2.2 Institutional arrangement of the Project

After considering Melamchi, Yangri and Larke as a dependable alternative to supply water in Kathmandu Valley, the Government established the MWSL in 1995 and MWSDB in 1998. Constituted under the chairmanship of the Secretary of the Ministry of Water Supply, the Board is represented from the Ministry of Finance, Kathmandu Metropolitan City and Hyolmo-Sindhu-Melamchi Valley Social Upliftment Programme Implementation Committee. The MWSDB Executive Director functions as the member-secretary of the Board. The Project Management Unit and Project Implementation Unit are established under the MWSDB. The Management Unit has functions on general and financial administration, procurement, engineering and legal aspects and the Implementation Unit is responsible for all construction activities and mobilise its Melamchi camp site office, including facilitation of contractors' work and support for social upliftment programmes.

After the withdrawal of Norwegian and Swedish support in 2005, the Melamchi Project was restructured as a part of institutional strengthening to provide additional water in the Valley, comprehensive rehabilitation of old water supply system and enhance its distribution capacity (system).

Establishments of KUKL, Water Tariff Fixation Commission and MWSDB contributed for institutional strengthening on water supply in Kathmandu Valley. However, internal conflicts, inadequate investments, and support termination in 2007 due to Nepal's non-compliance with agreement with the Asian Development Bank delayed Project implementation. This urges to give much attention on national commitments while doing agreement.

In order to implement EMP, an organisational structure of MWSDB included Environment Management and Monitoring Unit under the Environment, Resettlement and Social Development Division. The Division directly kept under the Executive Director of the Board. During the last few years, the Unit looks non-functional. Furthermore, the approved organisational structure of the Board for FY 2020/2021 does not include position of the Environment Officer. In addition, man-month allocated to the Environment Officer/Engineer was significantly reduced in 2014 and in turn, practice of taking environmental service was terminated (MWSDB, 2020). The Project received services from Biodiversity or Watershed Officer till May 2014 and Environmental Assistant till December 2016. Currently, residential Engineer of the

Sundarijal section is made responsible to look environmental aspects and implementation of EMP was paralysed.

1.2.3 Financial condition of the Project

Major components of the MWSP includes construction of access road, headwork and diversion scheme, WTP in Sundarijal, bulk distribution system in the Valley, improvement of distribution network and wastewater management, including implementation of SUP, EMP, compensation and resettlement action plan. In 2000, a total of US\$ 464 million including US\$ 118 million from the Government of Nepal was estimated for these activities. Upon the request of the Government of Nepal, ADB, World Bank, JBIC, NORAD, SIDA, Japan, OPEC and NDF made financial commitment to construct the Project. Later, the World Bank, NORAD and SIDA withdrew their support equivalent to US\$ 133 million.

The Project was restructured in 2007 and initial estimated investment of 2008 has increased by US\$ 63 million in 2015 (Table 1.4).

Table 1.4 Estimated Investment of the Project after Restructuring in 2007

(in million US\$)

SN	Financial Sources	Investment			Total Investment	Remarks
		Initial (2008)	Additional (2014)	Additional (2015)		
1	Government of Nepal	73.9	13.0	8.1	95.0	
2	ADB loan	103.8	25.0	17.4	146.2	Tunnel, headwork & WTP-2
3	JICA loan	47.5			47.5	WTP package 1
4	NORDIC Support Fund	10.5			10.5	Tunnel const. consultancy
5	OPEC	13.7			13.7	Project design
	Total	249.4	38.0	25.5	312.9	

Source: White Paper of the Melamchi Water Supply Development Board, 2020 (Paush 2076)

Initially, the Project estimated US\$ 26 million for EMP implementation (Khadka and Khanal, 2008) which comes to 5.6 percent of the total estimated budget. The Project planned to use this budget for the implementation of adverse impacts mitigation measures, compliance monitoring, and SUPs. The Project spent NRs 27 arba by the end of FY 2018/19 (BS 2075/76) for all activities and NRs 19 crore 27 lakhs for environmental management works which comes to only 0.7 percent of the total expenditure (Table 1.5). Budget spent for SUPs totals to about 3.5 percent.

Table 1.5 Total Expenditure of the Project by FY 2018/19

SN	Particulars	Expenditure	
		(In Rs., lakhs)	In Percent
1	Compensation (land & property)	9424.72	1.8
2	Vehicles	417.52	0.2
3	Construction	190875.02	70.1
4	Social upliftment	9498.11	3.5
5	Environment	1937.43	0.7
6	Consultancy	52054.82	19.1
7	Administrative and current expenditure	7901.18	2.9
	Total	272113.8	98.3

Source: White Paper of the MWSDP, 2020

Note: Expenditure of Melamchi-2 is excluded and total percent does not round to 100.

The Project acquired 1800 ropani of land for project and resettlement purposes, and compensated about NRs 84 crore for the construction of the Project (MWSDB, 2020) (Data differs which may be due to report publication at different times. For this, source is mentioned).

1.2.4 State of Project implementation

Based on White Paper released in January 2020 (Paush 2076), field observation and discussion with Project officials and workers, the following activities have been accomplished:

- a. Construction completion of 42 km long new road, Kathmandu entry road, and adit roads;
- b. Improvement of 27 km long road (Lamidanda-Melamchi Pulbazar, and Gokarna-Sundarijal sections);
- c. Construction of infrastructure such as road and school buildings, scholarship, and implementation of health and income-generating activities in the then Village Development Committees as a part of Social Upliftment Programme (SUP) under the Hyolmo-Sindhu-Melamchi Valley SUP Implementation Committee with total expenditure of nearly NRs. 95 crore till FY 2018/2019 (BS 2075/76);
- d. Implementation of some activities as contained in the EMP with total expenditure of NRs. 19 crore and 40 lakhs till FY 2018/19 (slightly exceeds from expenditure mentioned in Table 1.5);
- e. Acquisition of approximately 1800 ropani of land, including house/building, agriculture land and property for Project construction, and expenditure of 1 arba, 12 crore and 12 lakhs as part of compensation as per MWSP Resettlement Policy 2000 (2057);
- f. Target of constructing 510 MLD capacity WTP with JICA support in Sundarijal in three phases and completion of 85 MLD capacity WTP on 31 December 2017 and expense of NRs. 3 arba and 73 crore till FY 2018/19, and water supply of 40 MLD in Kathmandu Valley by treating Bagmati River water during the rainy season till the transfer of Melamchi River water to Sundarijal;
- g. Construction completion of D-shaped 25.3 km long tunnel on 26 December 2018, and new agreement with Sinohydro Corporation Ltd in October 2019 for the construction of headwork and tunnel works finishing and previous contractor (CMC) left work on 15 December 2018 and the Government terminated the contract on 7 February 2019;
- h. 94 percent physical progress of the MWS Project, with total expenditure of NRs. 27 arba and 94 crore as per the 2020 White Paper;
- i. Completion of detail study, design and investment estimation, including EIA study to construct 9.5 km long tunnel to Yangri and 2 km long tunnel to Larke streams in order to bring additional 340 MLD water from Yangri and Larke in the second and third phases of the Melamchi Project;

In a nutshell, the Government of Nepal is committed to divert water of Melamchi River for distribution in Kathmandu Valley by mid-July 2020. Although headwork construction will complete by December 2020 as per the agreement with the Sinohydro Corporation Ltd, it is considered possible, based on present level of work progress observed during the field visit, to divert water temporarily to Sundarijal from the coffer dam after finishing tunnel works.

1.3 Objectives of the Study

The main objective of this study is to update the state of implementation of the augmentation and mitigation measures to address beneficial and adverse impacts of the Melamchi Water Supply Project on the local environment. Specifically, this study attempts to:

- identify key environmental impacts during the Project construction and analyse the state of implementation of the adverse impacts mitigation measures; and
- document effectiveness of implemented mitigation measures.

1.4 Study methodology

This study has thoroughly reviewed data and information as contained in the approved EIA report of the MWS Project, White Papers, MWSDB and KUKL publications (websites) and other publications and reports related to the Project and its area. A checklist was developed taking into consideration the mitigation measures, environmental monitoring requirements, and institutional responsibilities, as contained in the EMP, to collect and verify information in the field.

This NEFEJ formed study team, composed of its Monitoring and Evaluation Officer, researchers and camera persons, visited the Project headwork at Ribarma, adits at Ambathan, Gyalthung and Sindhu, observed tunnel, muck disposal/management sites, contractors' and workers' camp, access road, improved road, and irrigation canal in the Melamchi Project area from 27 to 29 February 2020 and collected and/or verified data and information. On 3 March 2020, the study team visited Sundarijal area, observed the WTP, laboratory and tunnel works and collected information from Engineers associated with the consultant and the Board, including updates on EMP implementation.

During the field visit, the study team visited Melamchi Project site office to headwork and all adits and Sundarijal area and discussed with Project officials, consulting engineers, safety officers, medical officer, workers, SUP implementer, Project affected local people and Mayor to collect, update and verify data and information.

The study team got an opportunity to meet the Secretary of the Government of Nepal, currently in the Ministry of Water Supply at headwork and asked about its progress. On 28 February 2020, Mr. Secretary used tunnel to reach headwork from Sundarijal to Ambathan. He showed his full determination and commitment to supply water in Kathmandu Valley by mid-July 2020. If tunnel finishing works progress as planned, it seems technically possible to supply water in the Valley by mid-July.

1.5 Limitation of the study

This study covers activities of headwork, tunnel and adits, access roads, muck disposal sites, workers camp and income-generating activities in the Project area. This study also covers the implementation of provisions as contained in the agreement with the construction contractor. However, it is not the environmental auditing report. During the field visit, the study team could not meet elected personalities of the Helambu Rural Municipality and include their concerns as of Melamchi Municipality.

This study includes environmental impacts from headwork to Sundarijal WTP only. Although an Initial Environmental Examination report of the Kathmandu Valley Water Supply Improvement Project was noticed, its environmental impacts have not been covered in this study.

ENVIRONMENTAL IMPACTS

The main activity of the MWS Project is to divert water of Melamchi River to Sundarijal. After construction of headwork with 5-7 m high weir/dam at Ribarma, water flow from tunnel will be @ 6 m³/s. At headwork 70-80 m long sedimentation tank and sediment exit structure will be constructed, including control room to check water flow from tunnel. The length of the tunnel is 25.3 km, and water will be diverted from about 1425 m asl and will reach at Sundarijal at an altitude of 1411 m asl. This water will be treated in WTP. About 0.46 million m³ of tunnel muck is estimated to be managed in 4 sites, and 23.8 km long access road has been constructed to reach adits.

In Sundarijal, 170 MLD capacity WTP will be constructed in about 12.5 ha of land. The Plant has 200 ropani of land. About 200 kW electricity generation facility is developed at intake of WTP. After electricity generation, water will be treated.

2.1 Significant environmental impacts

The summary Environmental Impact Assessment report prepared in August 2000 is considered to list here the significant environmental impacts of the Melamchi Project. Data differences in the approved EIA report and summary EIA report in the same issue is considered hear a data update.

Beneficial impacts

- The social upliftment programme will be implemented in the Melamchi valley and will benefit nearly 70 thousand people of then 17 Village Development Committees (VDCs).
- About 1020 skilled and semi-skilled workers will be benefitted in Melamchi diversion scheme and 320 workers in WTP through employment (Khadka and Khanal, 2004).
- About 2000 households will benefit from the improvement of main road and construction of access roads.

Adverse impacts

- a. Access road that joins Project intake site and adits, and contractor & workers camp will likely destabilize the sloppy areas/hills.
- b. Haphazard disposal of about 0.460 m³ of muck generated from a tunnel and 4 adits will adversely affect the private and public land. Construction works will generate about 57 thousands m³ of aggregates from adits at Ambathan, Gyalthung and Sindhu, and 46 thousand m³ of tunnel muck (Khadka and Khanal, 2008).
- c. Explosives to be used in tunnel and adit construction will induce landslides and explosives may be used for other purposes (may be related to Maoist insurgency at that time).
- d. Diversion of 2 m³/s of water from Melamchi River to WTP at Sundarijal will adversely affect the aquatic system, irrigation, fish, water mills and domestic use of local people during the dry season. These impacts are not predicted significant from downstream of Keeul as streams will join the Melamchi River.
- e. Stones and soils from WTP construction and annual generation of 15,330 m³ of sludge, containing Aluminium hydroxide and polyelectrolytes from sedimentation tank and sand filter (Khadka and Khanal, 2008), including soil and silt would create adverse impacts during the Plant operational stage.

- f. About 1500 trees should be cut-down to facilitate tunnel and adit works and waste disposal site. Tree cutting might induce soil erosion and run-off and will likely affect fish and aquatic life.
- g. About 40 trees should be cut-down to construct WTP.
- h. Permanent land acquisition would be required in Melamchi area to construct the Project. About 101 ha of land should be temporarily acquired to operate camp, burrow-pit and other construction works. About 91 households will be affected and 25 households will be displaced. A total of 2,201 households and 12,499 people will be affected from Melamchi diversion scheme and WTP (Table 2.1).
- i. About 195 ha of land will be required for Melamchi diversion, and 2,122 households will be affected and 108 structures including houses, water mills and cowsheds should be demolished. Furthermore, 12 ha of agriculture land and 67 households will be affected in WTP area (Khadka and Khanal, 2008). A total of 140 impacts, both direct and indirect impacts, have been identified and predicted in the EIA report.
- j. Fixing of 500m from main structures, and consideration of 17 VDCs (then) as direct impact area is a 'blunder mistake' in the EIA report (Khadka and Khanal, 2008).

Table 2.1 Project Affected Households

SN	Project components	Acquisition for Melamchi Diversion Scheme		Acquisition for WTP	Total
		Permanent	Temporary	Permanent	
1	Agriculture area				
1.1	Project affected families	1,295	502	30	1,827
1.2	Severely Project affected families	200		48	248
2	Private land structures				
2.1	Severely Project affected families	118		1	119
3	House/shops of public land				
3.1	Severely Project affected families	7			7
4	Total affected families and population				
4.1	Project affected families	1,620	502	79	2,201
4.2	Severely Project affected families	9,072	2,811	616	12,499

Source: Summary EIA Report, 2000.

The EIA report includes economic analysis and estimated a total of US\$ 464 million as Project implementation cost. The total Project cost differs in different reports due to addition or deletion of components/activities during revision. The study estimated US\$ 2.2 million for the implementation of EMP and environment protection measures related to Melamchi diversion scheme and WTP, and environmental monitoring works for 5 years. It also estimated US\$ 6.4 million for SUPs for 10 years and US\$ 15.4 million resettlement action plan.

2.2 Mitigation measures proposed for adverse impacts

The following mitigation measures as contained in the EIA report are proposed for implementation to minimize adverse impacts (ADB, 2000).

- a. Fragile slopes will be stabilized through embankments, gabions, drainage and bioengineering works. Cut and fill approach will be adopted while designing the road and cut soil will be reused where appropriate. Non-reusable construction waste will be stored at appropriate places. Quarry sites (for stones, aggregates, sand and soil) have already been identified. In case, local people wanted to use road construction waste, it will be provided free of cost.

- b. Employment will be provided to the local people while constructing road and access roads.
- c. Tunnel and adits muck will be disposed-off and/or stored in four places, near to adits, in geologically stable, open or non-used land with due consideration on beauty of the area. Stones will be used to construct road, and will be provided, free of cost, to local people for use in building's foundation and wall construction.
- d. Explosives will be kept in bunker with 24 hour security and will not be used in landslide-prone areas. Only controlled blasting should be permitted. Tunnel workers will be trained and emergency drill will be constructed.
- e. Forty-five percent of the total river water will be released from February to April to maintain aquatic environment and water demand of the local people living downstream to the headwork. In order to maintain aquatic life in the downstream, $0.4\text{m}^3/\text{s}$ should be released. A trout nursery will be established and operated at Timbu to compensate Project impacts on fish. At headwork, fish screen equipment should be installed (Khadka and Khanal, 2008).
- f. Sludge discharged from the Water Treatment Plant can be used as base materials for road construction and sludge will be stored safely.
- g. Replacement plantation will be carried out. Fish habitat will be maintained. Fish management, including for trout fish will be implemented.
- h. Economically valuable trees cut-down in the WTP area will be compensated and plantation will be carried out in the eastern bank of the Bagmati river.
- i. Social upliftment programme will be implemented in Melamchi valley to benefit about 70 thousand people of the then 17 VDCs. Access road, improved skill and expanded market facility, as beneficial impacts, will increase income of the local people, and will reduce workload to women.
- j. Land and structures acquired for Project activities will be compensated. Direct loss or damage to economic activities will also be compensated. Employment will be provided to Project affected families with priority. The resettlement action plan (RAP) will be implemented. US\$ 15 million is estimated to implement the RAP. Similarly, SUP will be implemented to minimize adverse impacts on social and economic aspects.
- k. Health and sanitation promotional activities and enhancement of NGOs participation as included in the EIA report will support to avoid or reduce adverse impacts on social aspects of the environment.
- l. Sludge should be buried in land as sludge contains Aluminium used in treatment plant and it will be poisonous to plants.

Similarly, the Environmental Management Plan (EMP) as included in the summary EIA report documents the following measures:

- a. Divert water of the Melamchi river to the treatment plant via tunnel for drinking water purpose only and minimize adverse impacts from water diversion; water required for irrigation, water mills and domestic uses was considered sufficient for dry season as well; implement SUP during the operational stage from royalty (water tariff) paid by water users of Kathmandu Valley; and also implement fish management programme;
- b. Adopt 'cut and fill' approach to minimize adverse impacts of access road; safely dispose construction wastes at the designated site, compact and stabilise such site with plantation of appropriate species; construct drainage to divert water from the disposal site; compensate land and structures acquired; arrest dust from water sprinkling in dust-prone construction sites; plant species to stabilise degraded slopes; utilize water users royalty to maintain road; and stabilise tunnel muck disposal site.
- c. Implement SUP to minimize adverse impacts on local people,

- d. Keep offices and workers camps clean and healthy, and maintain cordial relationship with the leader of the Project affected families; and
- e. Compensate acquired land for WTP construction; plant big size trees along the borders; ensure plantation along the riverbank and buffer zone area; and dry 'sludge' before its use.

An Environment Management and Monitoring Unit will be established under the Environment, Resettlement and Social Development Division for EMP implementation. This Division will be under the Executive Director the Board (MWSDB). The then Ministry of Population and Environment (now Ministry of Forests and Environment), funding agencies, then Ministry of Physical Planning, MWSDB and Project management consultant, contractors, supervisory Engineers, local and regional government institutions, political parties and NGOs were made responsible for EMP implementation. However, MWSDB will have the primary responsibility for its implementation. Hence, EMP has clearly documented adverse impacts and mitigation measures for both construction and operational stages and also clarified the responsible agencies for implementation and monitoring.

2.3 Proposed Monitoring Indicators

The EIA report does not include clear indicators for environmental monitoring but specifies the institutional arrangement for monitoring such as Environmental Management and Monitoring Unit under the Environment, Resettlement and Social Development Division of the Project Management Unit. It has made supervisory Engineer or designated environmental consultant responsible to monitor and quality check of the contractor's activities. Environmental responsibilities of the contractor will be detailed out in the agreement document. A special environmental consultant will be hired (appointed) and will be stationed in the Project Management Unit.

2.4 Major Provisions in Contractor Agreement for EMP Implementation

The MWSDB has included several provisions in its agreement with the construction contractor to ensure EMP implementation. Some provisions as mentioned in the contract agreement (MDS/02-package 1) with the Sinohydro Corporation Ltd who is involved in constructing headwork are given as an example in the following table. State of implementation of these provisions is also given based on discussion with the Engineers during the field visit and observation of constrictors' work (Table 2.2).

Table 2.2: Contract Porvisions on EMP their Implementation

SN	Provisions (contractor's responsibilities)	State of Implementation
EMEP, Personnel and Social Requirements		
1	Contractor shall submit a detailed Environmental Mitigation Execution Plan (EMEP) within a month of the commencement date, and shall be an integral part of the specification after its (Plan) approval by the Engineer. The Plan should include in minimum, detailed palnning of all mitigation and monitoring measures, organization, line of command and responsibilities, reporting , and minutes of meeting and record keeping	No new Plan is submitted and old Plan (prepared by the former contractor) is expected to implement. Consultant submits monthly and quality report to the MWSDB Monitoring was not noticed, minuting of monthly meeting is prectised.
2	Include Environment Officer, Social/Public Relation Officer and Medical Officer in 'core team' of the contractor with clear responsibility on biological and	<ul style="list-style-type: none"> • Consultant has mobilized these officers in construction work. • Minimum role of Public Relation Officer

	physical environment, human environment and SUP implementation, and occupational health and safety (OHS).	as land acquisition work is completed. • Medical Officer records temperature and blood pressure of each worker in the morning before going to work,
3	Establish Grievance Committee to deal with complaints and social problems, with contractor's senior management,, Engineer, and representatives of the workers and local people and Public Relation Officer shall function as Secretary of the Committee	Established during tunnel construction and inactive now or only provision kept in the 2019 contract agreement with Sinohydro Corporation Ltd.
4	Employ 80 percent of total workers, at minimum, Nepali and make 20 percent skilled through hands-on training	Over 90 percent of the total workers are Nepali. No separate training provided now
5	Prohibit firewood use to meet energy demand	Workers using gas to cook meals
Occupational Health and Safety (OHS) Requirements		
6	Establish OHS Coordination Committee with Medical Officer, Construction Manager and representatives of the workers (employees)	Established in the past but not active now (in the present contract)
7	Submit OHS Plan within one month of the commencement date	OHS Plan submitted and provisions of the Plan implemented effectively
8	Provide OHS information to officials and workers of all levels, also provide training, record incidents and diseases, arrange for emergency preparedness and response measures properly Ensure periodic health check-up, provide health facility in clinic, all to have house, water and sanitation facilities, submit monthly report on OHS Plan implementation, implement traffic accident avoidance programme etc.	OHS Officer offers briefing each worker regularly before sending to work and trains to use equipment where necessary OHS Plan implementation report prepared and submitted regularly
9	Provide safety equipment to workers working at tunnel; arrange for adequate ventilation to minimize hazardous gas concentration; and ensure at least 19 percent oxygen concentration at all times in tunnel works	Each worker receives helmet, goggle, mask, boot, globe and visibility jacket as per the nature of work; workers seen using safety equipment In case of low oxygen concentration, exhaust fan used while working in tunnel
Biological and Physical Requirements		
10	Establish Environment Committee with Environment Officer, construction Manager, and representatives of the Department of Forests, Department of National Parks and Wildlife Conservation, and a representative of the local community	Established in the past but inactive now Contractor not engaged in complying such provisions and looks low or no priority
11	Conserve natural landscape, select, construct and operate contractor's workshop and office without cutting trees to the extent possible; dispose spoils and rehabilitate such spoil disposal site(s) with plantation	Construction waste/spoils disposed at near adits; disposed construction wastes used in Gyalthung site; and demand/asked for use in Mid-Hill Road construction from Sindhu disposal site, biological treatment of disposal site not observed
12	Control soil erosion from construction works	Erosion control activities not seen or may

		be implemented later
13	Cut trees after approval from owner, record each tree felled down, plant trees and conserve/take care for 1 year	No record obtained during field visit about number and species of trees cut-down, compensatory plantation site not seen
14	Avoid/minimize construction related water pollution	Hazardous liquid mixed waste water from adits treated in settling tank before discharge and drinking water supplied in workers' camp not pollution-free
15	Avoid/minimize air pollution, control dust emission and provide equipment to workers to protect from dust and (vehicle) gases	Mask provided to workers & efforts made to reduce dust in tunnel; ventilation facility yet to be in place
16	Avoid/minimize effect from exposure to high noise level; comply with noise level standards; and provide adequate ear protection devices	Ear plugs provided to workers working in areas with high noise level
17	Make office and camp clean; dispose safely or burn wastes collected from office, camp and construction site	Camps look clean, no solid waste problem but improvement required to manage liquid waste

Source: MWSD, 2019

The OHS Plan submitted by the contractor Sinohydro Corporation Ltd on 11 November 2019 to MWSD Board targets to zero accident; considers people most important asset, and declares its commitments to avoid accidents, ensure safety as responsibility of all, train workers about safety, and develop a culture of safe work. The Plan has given high importance for safety, accepted institutional responsibility and committed to implement the Plan through HSE Manager. Similarly, the Plan ensures to provide helmet, shoes, gloves, goggles, ear and respiration related safety devices to all workers and officials; limit vehicle speed; provide toilet & hand washing facilities and drinking water; and ensure sanitation in camp. In addition, the Plan prohibits for gambling, and drugs including alcohol drink. Furthermore, it includes provisions for education and training, organising orientation programme by the supervisor and conducting regular meeting regarding safety. The Plan also includes transportation facilities to workers and officials, record keeping and analysis of incidents/accidents, avoiding fire, avoiding environmental accidents, controlling pollution from oil, grease, fuel, lubricants and chemicals, prohibiting open burning of wastes, immediate reporting on any incident and emergency responses on OHS and other Project induced incidents/accidents. The Plan looks comprehensive with detail implementation responsibilities.

Observed implementation of measures related to slope stabilization, water quality, air quality, land acquisition, and health & sanitation and level of compliance was rated as 80, 10, 50, 90 and 70 percent respectively (Khadka and Khanal, 2008). Based on responses of 400 local people on impact of Project activities on social and economic development of the area, 30 percent of the respondents considered Project's contribution to manage necessary water for agriculture purposes. Three-fourth and 1/4th of the respondents told Project support effective to construct road and produce off-season vegetables (Dahal and Timilsina, 2015). Local people are happy with the Project support.

Everybody has concerns on this Project as it will supply drinking water from Melamchi river. Recently published report of the Public Account Committee (2019) instructed to complete the Project as early as possible (SFP, 2019). The Committee has shown concerns on heavy expense, and instructed payment after approval of variations regarding headwork and tunnel works.

STAKEHOLDERS CONCERNS AND LESSONS LEARNED

3.1 As seen in the field

The Melamchi Water Supply Project is under implementation and hence, environmental impacts related to construction stage are documented here with priority.

Beneficial impacts: With financial support from the Melamchi Project, SUP Implementation Committee has channelled support to construct road, school building and health centres and implement income-generating activities. This support has significantly contributed to improve the socio-economic condition of the local people. Construction of embankment or protection wall, banana farming and utis (*Alnus sp*) plantation has contributed to stabilize the roadsides. Transportation facility is substantially improved from all season roads; scholarship to school students and building construction has improved education; most of the workers are Nepali and it has contributed to improve socio-economic condition of their families as well.

Trout fish entrepreneurship is substantially increased and multi-doors are opened for economic activities. In addition, workers have enhanced their capacity and skills in Project activities, and will hopefully use acquired skill with confidence in similar future works. The OHS devices are told effective to avoid or minimize health problems, incidents and injury of the workers. The existing contractor has emphasized in workers safety.

Adverse impacts: Local people of Helambu Rural Municipality and Melamchi Municipality strongly raised issues related to drying-up of drinking water sources from tunnel construction. Significant quantity of water in Gyalthung and Sindhu adits and comparatively small quantity of water in Ambathan adit confirms possible diversion of water sources into tunnel. As tunnel 'muck' (under-quality stones and soils) was used in roads constructed with support from Project, local people questioned on the life of road itself and its use was stopped. The tunnel 'muck' disposal sites are yet to be stabilized, and local people are worried due to high possibility of reaching 'muck' in streams and agriculture land during heavy rain. This challenge can't be ruled out. Similarly, sanitation and drinking water facility in workers camp should be improved. A worker said that more than 10 persons also sleep in one room in Ambathan camp. This indicates the gravity of problems workers are facing.



The OHS devices are provided to workers, health check-up is done before entry to tunnel works, and oxygen concentration is measured in tunnel but workers in tunnel finishing works are facing difficulties due to lack of ventilation facility (vent shaft) and depend on exhaust fans.

On left side of the Melamchi river on the side of coffer dam, few big boulders in fragile slopes might fall down due to landslides and damage coffer dam or tunnel portion. This can't be ruled out and it is encouraged to take urgent action to stabilize hill slope or divert water to avoid landslides.

It is considered that water now released from Ambathan, Gyalthung and Sindhu adits will be difficult to manage and will reach to Sundarijal along with water diverted from Melamchi river. As told by workers, 'cavity filling' has not blocked the water which might be related to diversion of, may be, stream and drinking water sources into tunnel. And, drinking water issue of local people needs to address timely.

3.2 Government's commitment

Tunnel Test: Hon'ble Minister for Water Supply inspected a tunnel test on 16 March 2020 (BS 2076.12.03), Monday. The Melamchi river water was diverted from a tunnel (constructed for maintenance of headwork when necessary) to 1 km far Ambathan adit and this test worked perfectly. Such tests will be carried out from headwork separately to Gyalthung adit, Sindhu adit, and Sundarijal to test tunnel. Once all tests function well, Melamchi river water will be diverted into Sundarijal, treated in WTP and distributed in the Kathmandu Valley.

Commitment of the Secretary: Coincidently, the study team met Er. Madhav Belbase, Secretary of the Government of Nepal, currently in the Ministry of Water Supply on 28 February 2020 (BS 2076/11/16), Friday at headwork site. Mr. Secretary was inspecting the progress of the tunnel and headworks and reached at headwork using tunnel. Mr. Secretary expressed his commitment to supply Melamchi water to people of Kathmandu before mid-July 2020 based on progress in tunnel's works such as lining, rock dowsling, grouting and construction of ventilators. The water will be diverted from a temporary tunnel (constructed for headwork maintenance) to Sundarijal after completion of tunnel finishing works. However, headwork construction will be completed by December 2020 as per the agreement with the contractor. 'More than 1/3rd of the total work of headwork is completed and work progress has made us optimistic and realistic', said Mr. Secretary.

In case the contractor completes the work before the date of agreement, Government has a provision to award 'bonus' (additional amount beyond agreed amount). Mr. Secretary was optimistic on completion of the tunnel works before the contract date. The 'cofferdam' is of good quality and if damaged during rainy season can be maintained soon. The Project Implementation Directorate (PID) has completed construction of water distribution system in the Valley, and final test is yet to complete. Once Melamchi river water is diverted to Sundarijal, old distribution system will be used in the Valley. About a year may be required to distribute water from the new distribution system/network.

Considering the professional and work commitment of the Secretary who inspected tunnel works as well from Sundarijal to Ambathan adit, technical know-how and knowledge, and working, it is possible to supply water of Melamchi river to people of Kathmandu if 'technical matter is not affected by political decision'.

Views of Project Engineer: On 27 February 2020 (BS 2076/11/15) Thursday, the study team met Er. Kamal Raj Shrestha, Project Manager stationed at Melamchi Site Office, and obtained the following information and views:

- a. Compensation has been paid to all acquired land, including barren land and structures.
- b. E-flow (400 l/s) will be released in Melamchi river to maintain habitat of fish and other aquatic lives. However, local people raised trout fish requires water with less than 11^oC temperature. Fish owners have shown great concerns on possible temperature rise of river water due to low quantity of water after water diversion to Kathmandu Valley.
- c. The Project supported road construction has positively and significantly contributed socio-economic development of the area. Local people seem more 'Project-dependent' for all types of work as the Project has continuously supported social upliftment programmes. Under SUP, NRs.

20,000 or more is supported for activities. Monitoring is weak, and most of such actions are ineffective. This happened so as Project direct impacted area is undefined. The Project support has focused more on social security and environmental actions are lopsided.

- d. Stones, aggregates, sands and other construction materials are collected from Indrawati river downstream of Melamchi Pulbazar. This construction material was also used for Sundarijal WTP and other structures. Major activities were completed during the time of Italian contractor, the CMC and finishing works will be completed soon.
- e. Explosives are not used now as tunnel opening work is over. Magnitude and extent of adverse impacts on water mills, irrigation canal, agriculture production and fish will be known only after water diversion to Sundarijal and/or use of Melamchi river water by people of Kathmandu Valley.
- f. The Project has adequately compensated. Tunnel muck is disposed off near adits (outside adit opening).
- g. Compensatory plantation was conducted long back at Gyalthung and sindhu areas.
- h. The Project has full concentration, at present, for early diversion of Melamchi river water.

3.3 Experiences of Project Officials

Residential Engineers: Contractor and consultants are continuously working to complete the tunnel finishing work as early as possible. Er. Sagar Tamrakar, stationed at Gyalthung adit. Mr. Tamrakar also worked with CMC contractor and informed appropriate use of OHS to avoid or minimize accidents. At present, workers are facing difficulty at tunnel work due to lack of ventilator. Vent shaft drilling at Chanaute, carried out to lower down air pressure, might have diverted water source of Gohoro stream towards tunnel and water here at adit might be that stream source.

In general, oxygen concentration should be 20.9 percent and it is 19.85 percent in the tunnel. In case, concentration of carbon dioxide exceeds WHO standard, workers are provided with 'compressor exhaust pipe' dipped into water or oxygen cylinder for work due to lack of 'vent shaft'. Review of underground air quality clearly indicates oxygen concentration range 19.5-22.0 percent, less than 25 ppm (0.0025 percent) of carbon monoxide, and 5,000 ppm (0.5 percent) of carbon dioxide (<https://www.usbr.gov/ssle/safety/RSHS/sec23.pdf>). In Gyalthung adit, after measuring water pH and turbidity, sedimentation is carried out before its discharge. Workers received all necessary OHS devices from the contractor and there is no accident as of now. Necessary service facilities are provided in workers' camp. Only 40 percent of Melamchi river water will be diverted to Sundarijal and remaining 60 percent will be released to maintain downstream aquatic habitat and for other purposes. Water will be released for agriculture purposes. During the study time, remaining works in Gyalthung are concreting about 360m tunnel, tunnel correction and door at adit and closing of adit.

After opening the tunnel on 26 December 2018, works related to rock bolting, and cavity filling were started. All works of tunnel in Gyalthung area is planned to complete by mid-May 2020. The Safety Officer informed that workers are using all OHS devices but tunnel gas and inadequate oxygen has added complexities. Although the contractor has hired interpreter, language problem continued to exist. In the past, eyes of two Chinese workers were damaged. As there is no separate Environment Officer in this site, environmental activities are coordinated and supervised from Sundarijal section.

In general, this site has no problem on food, drinking water and sanitation. Seasonal diarrhoea is a challenge. The tunnel muck was used in road construction in Bahunepati and may be used, as per demand, for the construction of Mid-hill Highway. The tunnel muck should not be used as 'base material' but it can be used for gravelling by mixing with red soil. In order to reduce pH in tunnel water,

alum (phitkiri) was used. Although there is a provision in the contract agreement to constitute an Environment Committee, it has not been formed as of date. In general, any issue or challenge is discussed and resolved in the monthly meeting of MWSDB, consultant and contractor.

Mr. Prem Bahadur Shrestha, Resident Engineer and Senior Environmental Expert at Sundarijal has joined the Project 4 months back and told implementation of EMP at minimum level. Environmental challenges have been reduced after tunnel 'break-through' (opening of tunnel). At present, the Project has not faced any significant environmental challenges. The Asian Development Bank has given much emphasis on environmental management and occupational health and safety. The Sundarijal road will be black-topped soon. During construction, water was sprayed twice a day last year to arrest dust in this road.

Four ventilators will be constructed in this Project. A 78m long 'vent shaft' has been constructed at Sundarijal section and half of the construction of the 47m long 'vent shaft' is completed in Gyalthung. Furthermore, construction of 104m long 'vent shaft' is under process, and its construction at Ambathan is yet to start.

The tunnel capacity is of 6m³/s (6,000 litre). The Project Implementation Directorate (PID) has developed 'bulk' distribution network in Kathmandu. This network is once tested using Bagmati river water but yet to test from Sundarijal water system.

At Sundarijal WTP, equipments are installed to generate 200kW hydroelectricity from Melamchi river water prior to water treatment. After electricity generation, water will be channelled to flocculation tank by adding chemicals like lime, chlorine and polyaluminium chloride. The sediment sludge will be discharged to Bagmati River and sedimented water will be channelled for filtration. The Project has established a modern Water Treatment Plant to provide water that meets Nepal's standard.

Workers' Experiences: The Project is at the final stage of construction. Contractor's and consultant's camps are in good condition but several workers should sleep in one room in workers' camp. Sanitation and drinking water facility is also of minimum quality, and drinking water is not filtered. Medical Officer checks temperature and blood pressure of each worker before sending for work. In case of fever, workers are not allowed to work. Contractor has emphasised to complete the work as early as possible.

Experience of Former Consultant: Mr. Krishna Shrestha, worked as consultant Ranger (forester), informed that the Project measured water flow, and analysed water quality in its laboratory from 2008 to 2018. Implementation of activities included in EMP is stopped from the last 13 months. As trees were felled down during Project construction, the Project established two nurseries in Nurbu village and Timbubesi of Helambu Rural Municipality and raised lapsi, utis, orange and citrus seedlings which were distributed to local people. No plantation was carried out due to good natural regeneration in forests. Bambo, lapsi and utis raised in nursery near Sindhu adit for two years were planted along the roadside. A total of 18 thousands trees of utis, chilaune, sal, botdhaneyero and kyamun were felled down. Replacement/compensatory plantation should be carried out at the rate of 1:5 (that is, plant and care 5 tree species for each tree cut down). Few tree samplings were planted in 2007-'08 and their status is unknown due to lack of monitoring.

The Project implemented environmental programmes at its starting years. Pond construction and watershed conservation although emphasised in the EMP were not implemented. Environmental programmes were discontinued or non-implemented as its budget was reduced along with the change of Executive Director of the Project. The Project concentrated on compensation and resettlement

actions and implementation of environmental programme did not get even minimum level of priority. Adverse impact of chemical mixed tunnel water on trout fish was noted from Keeul to Timbu but measures were implemented.

Mr. Shrestha advised to re-operate environmental laboratory to analyse river water quality and chemical content, and continue water discharge/flow measurement and implement EMP.

3.4 Concerns of the Municipality

On 27 February 2020, the study team met Mr. Dambar Bahadur Aryal, Mayor of the Melamchi Municipality and discussed on major issues and impacts related to the Melamchi Project. An outcome of the discussion is summarised below:

- a. Diversions of Melamchi river water to Kathmandu will ultimately dry-off a total of 8 irrigation schemes, make 10 water mills non-functional, reduce fish production and adversely affect the livelihood of Tamang, majhi and Danuwar, the fishermen. The Project area is self-sufficient in rice and milk production. Water diversion will likely reduce crop production due to inadequate water in the irrigation scheme.
- b. In wards 3 & 4 of the Melamchi Municipality, water is diverted towards tunnel and it has accelerated drying-up of drinking water sources. Inadequate water will compel to change cropping pattern. As diverted water is released from Gyalhung and Sindhu adits, the Project should support for developing drinking water facilities in affected places of Helambu Rural Municipality and Melamchi Municipality.
- c. Social upliftment programme are not implemented effectively. Spending the government budget (fund) through a non-governmental organisation (NGO) is ineffective and NGO does not have responsibility. Such programme should be implemented from the local government. The Project should support to blacktop road from Melamchi to Timbu.
- d. Tunnel construction waste (muck) was used in road and its use was stopped after complaints of local people.
- e. As Melamchi river will not have water during Project operational stage, checkdam and ponds should be constructed to maintain aquatic environment and riverbank plantation should be carried out in a comprehensive manner for disaster management.
- f. Certain percentage of 'levy' (part of water tariff collected in Kathmandu) must be channelled to Helambu Rural Municipality and Melamchi Municipality to address adverse impacts of water diversion and for socio-economic development of the local people and the area. Local government should provide services to local people through 'one window system' (i.e., 'levy' should be channelled to local government).

3.5 Experience of the SUP Implementer

Two decades back, local development programmes related to education, health, income generation, community development, buffer zone development in Shivapuri National Park, rural electrification, infrastructures related to water supply and road were initiated under District Development Committee, Sindhupalchowk. After the start of the Melamchi Water Supply Project, Hyolmo-Sindu-Melamchi Valley Social Upliftment Programme Implementation Committee was established in 2005 (BS 2064) with representation from local political parties, social leaders and social organisations. With financial support from the Project, the Committee continued implementation of all activities except rural electrification from 2006 onwards. This committee is also represented in the Melamchi Water Supply Development Board (established under the chair of the Secretary of the Ministry of Water Supply). The organisation has implemented programmes in 18 wards (11 wards of Melamchi Municipality and 7 wards of Helambu Rural Municipality). Similarly, Hyolmo Upliftment Programme has been started in upper parts of the

Municipalities to support project affected families and promote socio-economic development as initial works are started to divert water from Yangri and Larke streams.

After getting information about available financial resources (budget ceiling) from Hyolmo Committee, Village Community Committees select activities and ask for budget along with recommendation letter of the concerned wards. Once the programme and budget is approved from the general assembly of the Hyolmo SUP Implementation Committee, the Committee releases budget to the Village Committees for demand-based approved activities. The Hyolmo SUP Implementation Committee organised its general assembly on 1 March 2020, Sunday and approved programmes and budgets for FY 2019/2020. All approved and budgeted activities will be implemented within remaining 4 months (by mid-July). The Village Committee should submit work completion recommendation from the concerned ward to get final instalment. Hence, the municipality wards, lowest political unit, are involved in issuing letters to Hyolmo SUP Implementation Committee about the activity that does not duplicate with ward level actions, and activity/action completion letter for final payment to ensure participation of the concerned ward.

The Project is providing financial support to this organisation at an average annual amount of NRs. 0.75 million (7 crore & 50 lakhs). The Hyolmo Committee provides financial support annually to each ward at the rate of NRs. 5 lakhs (500 thousands) for income generating activities, and NRs 19 lakhs for other activities. If budget allocated activities are not implemented, non-spent budget should be returned back to the Project. Programme monitoring is also done by the concerned wards (as it issues project completion letter) and its audit is done from the Office of the Auditor General along with the audit of the Melamchi Watery Supply Development Board.

According to Mr. Ram Prasad Sapkota, Programme Officer at SUP, the Project support is used to construct rural road and school building, to provide scholarship to students of the Project affected areas, and to offer training on cutting and weaving of clothes, thanka making, electricity wiring and iron welding. The Project supported activities are effective. After earthquake, support for school building construction is stopped as it is supported by Reconstruction Authority.

Big gap exists between people's demand and Project support. Duplication of activities and support from SUP Committee and Municipalities is avoided as people in ward and Village Community Committees are almost same. In addition, coordination is ensured right from the programme planning stage. As told by the Programme Officer, it needs clarity in advance what benefits the local people will get after water is diverted to Kathmandu; how benefits will be shared; and how much 'levy' local people will get from each litre of water diverted to Kathmandu? Similarly, it would be better to clarify in advance amount of water required in Melamchi river to maintain aquatic environment, irrigation purposes, cold water for trout fish, and impact on Project from possible water use at upstream of headwork. Furthermore, channelling of 'levy' to the local government will reduce or stop funding to this Hyolmo Committee and its programmes will be discontinued.

3.6 Concerns of the Local People

Mr. Gopi Krishna Lamichhane of Helambu Rural Municipality-4 believes that water quantity in Melamchi River is declining due to climate change-induced low amount of rainfall. It has directly and adversely affected fish, agriculture and birds. The Project must channel 'levy' to the local people in order to minimise adverse impacts after water diversion to Kathmandu. According to Mr. Lamichhane, about two and half decades back, 'we local people were asked to attend the meeting here in Helambu to discuss about Melamchi River. The meeting organiser gave us NRs 100/ for attending the meeting and now I

consider that meeting was organised to collect our consent to divert water to Kathmandu'. Two adits are in Helambu Rural Municipality and this Municipality is greatly affected. If heavy rainfall occurs, openly stored tunnel muck will be washed away and will reach to River and farmers' land. Hence, the Government should support this Municipality to minimise adverse impacts on children, youth and old-age people and also support on education, health and food. 'If Government does not support, we will march with local equipment to damage the tunnel'.

Nine trout farms are under operation along the Melamchi river in between Helambu stream and Talarang. At Helambu Rural Municipality-2, Keeul, muddy (non-transparent) water flow from Project headwork and tunnel adversely affected the fish and hatchery of Bhandari Trout Fish farm in 2013 and fish production declined. This firm sell fish @ NRs 1000/kg and sends 200-300 kg of fish to Godavari, Kathmandu in one lot. Three persons invested NRs. 2 lakhs each and jointly operated this firm. They earn about NRs. 1 crore (Rs. 10 million) annually from fish business. Mr. Madhav Krishna Bhandari, one of the entrepreneurs, informed that the fish firm requires equal amount of water that operates 3 water mills. They are confused and unclear on how to operate this firm after water is diverted to Kathmandu.

Mr. Uttam Mani Bhandari informed that this firm produces 10-12 tons fish annually and about 200 thousands fingerling from hatchery. It has planned to lease 15 ropani of land to expand fish business. In the past, fish eggs were damaged and fingerlings killed from muddy water released from headwork construction. Realising this damage from Project activity, the Project supported the firm to maintain water filtration facilities. The appropriate temperature for trout fish is 14-18°C and temperature might increase and create a problem, after water diversion to Kathmandu due to low quantity of water in the river.

Mr. Kajiman Thing of Helambu Rural Municipality-5 opined for possible decline in crop production due to tunnel muck if reached to farmland.

3.7 EMP Implementation, Compliance and Effectiveness

At the initial years of Project implementation, mitigation measures as contained in EMP were implemented. The EMP implementation received minimum priority along with the change of person in Project Executives. Impacts mitigation measures are not implemented at the end of Project construction stage. Environmental impacts of the Project operational stage are naturally unknown now. Based on outcome of the discussion with Mr. Prem Krishna Shrestha, Senior Environment Expert, stationed at Sundarijal and field visit, state of implementation of mitigation measures, compliance and their effectiveness are summarised below:

- a. Draining facilities are inadequate to drain rainwater in roads from Melamchi Pulbazar to Headwork or rural roads. Dam life is questioned as there exists high possibility of landslide on the left bank of the River few metres above the coffer dam (opposite to temporary tunnel inlet). This might be due to channelling of roadside drain in Melamchi river (near cofferdam side).
- b. As per the agreement, Sinohydro contractor should prepare, submit and implement an Environmental Mitigation Execution Plan. Contractor is told to implement the Plan prepared by the previous (Italian CMC) contractor. At this stage, Plan implementation is secondary, and there is no question on effectiveness of measures.
- c. Environmental monitoring is not conducted and no documented evidence was available about the beneficial and adverse impacts emerged during construction stage, augmentation and mitigation measures implemented and their effectiveness.
- d. As a position of Environmental Expert was included for Project design and supervision, it is considered that environmental aspects have been integrated into design. The SUP has been

implemented from the last decade (for last 10 years) with Project support to address social and economic impacts. Under the SUP support, rural roads and school buildings are constructed; scholarship was provided to students; and funding was channelled to income-generating activities. Although Environment Committee was constituted in the past, environmental improvement programmes did not get any priority along with change in Project Director and contractors. The Holmes SUP Implementation Committee and local people also did not emphasise on EMP implementation.

- e. As said by Senior Environmental Expert, monthly, quarterly, semi-annual and annual reports submitted to the MWSD Board includes environmental aspects and the Board sends report(s) to the Asian Development Bank. The Bank gives high emphasis on environmental aspects.
- f. Employment to Nepali, over 80 percent of its total employee, is fully complied with `as per the agreement between the Board and the contractor. Out of 301 workers at present, 267 are Nepali. Training to workers is just satisfactory. Gas is used as cooking energy in workers camp (firewood use is prohibited) and sanitation facility is also just satisfactory.
- g. Although the contractor has not prepared a separate OHS Plan, the contractor has given high priority to health and safety matters. Information on health and safety is adequately put on each entry of adit to remind workers and officials on safety matters. Emergency plan is also not seen which may be attributed to low or no incident. Road improvement works are ongoing to minimise transport accident.
- h. Ventilation got special priority during tunnel construction and it did not get priority in tunnel finishing works. Concentration of oxygen, carbon monoxide, carbon dioxide and nitrogen dioxide is checked before the start of work in tunnel and exhaust fan is used in case of insufficient oxygen or high concentration of carbon monoxide.
- i. Landscape conservation, although included in the agreement, has not received any attention. Tunnel muck disposal site is yet to stabilise with bio-engineering treatments and make greenery. Efforts are made to lower down pH level from 9 before discharging tunnel water contaminated from explosives and 'grouting' works. Necessary safety device is given to minimise impacts from air pollution and high noise level.

During field visit, measures implemented to control soil erosion, replacement/compensatory plantation, air quality maintenance and solid wastes disposal sites were not seen. Environmental monitoring was not carried out and environmental management responsibilities of several organisations as contained in the EMP were not understood or fulfilled.

3.8 Learning

Realising the inter-dependence between development and environment, and minimising adverse environmental impacts of a development action to attain the goals of sustainable development, an Environmental Impact Assessment (EIA) report is prepared to evaluate the significant of impacts and implement appropriate mitigation measures to minimise adverse impacts on the environment. An EIA report was prepared and approved for this Project as well. The Asian Development Bank provided financial support to implement Environmental Management Plan (EMP) which was prepared based on approved EIA report. The study team tried to collect information on environment protection measures implemented and their effectiveness but no information was available. Based on the review of available documents, discussions with Project's environmental expert, engineers, workers, representatives of the local governments and Hyolmo SUP Implementation Committee and local people, and field visit, the following learning are summarised:

- a. The agreement signed between MWSD Board and Sinohydro Corporation Ltd in October 2019 includes number of provisions to implement EMP. It means institutional effort is made to make

the Project environment-friendly. Lack of environmental monitoring made it difficult to know the environmental measures implemented, and their effectiveness, and also non-practical measures. This study could not provide any learning on effectiveness of mitigation measures.

- b. The contractor has adequately implemented contract provisions related to occupational health and safety (OHS). No accident is recorded during tunnel construction. The contractor is clear on OHS matters. However, need for ventilation was considered 'secondary' during tunnel finishing works in February-March 2020.
- c. Replacement/compensatory plantations were not complied with for trees felled during Project construction. It seems that Project adopted 'Nature will care itself principle' to address pressure on natural resources. It was told that plantation work is given to the then District Forest Office.
- d. Drinking water and stream sources are greatly affected from tunnel construction which is also exemplified from quantity of water released from Gyalthung and Sindhu adits. The Project should support local people for drinking water if this diverted water source is locally used for that purpose in the past.
- e. Muddy/non-transparent water released from adit is made clear and high pH is reduced to pH 9 before discharge. Such water is treated in a small treatment plant located just outside the adit. However, pH level was not known during field visit.
- f. The Municipality and local people ask for 'levy' for Melamchi river water being diverted to Kathmandu. In order to conserve river water source, responsibility of the local government and people should be clearly defined and the Project should support for meeting the local needs. For this, a country-wide single standard approach or policy might not work and Project-specific norms and standards should be developed and implemented.
- g. The Project has provided financial support to Hyolmo Committee for SUP implementation at the rate of NRs. 0.750 million annually. The Committee has supported to implement rural road and school buildings, scholarship to students and few income-generating activities but no clear process exists to update effectiveness of supports. As the local government is active now, it should be decided who (local government or non-governmental organisation) should be involved in implementing and monitoring such programmes.
- h. Naturally, Project operation-related impacts such as maintenance of aquatic environment after water diversion, impacts on local fish and trout fish farm, irrigation water and stabilisation of tunnel muck is not available now.
- i. An EIA is a legal document, Project and/or its service can be stopped, in case of its non-compliance by the proponent. 'Once EIA report is approved, environment is automatically management' approach prevails in this Project.
- j. As Project impact area was not clear in the approved EIA report, Project support was invested as per local people's demand. Alternatively, awareness on importance, needs and usefulness of environment conservation was realised minimal. Reduction of man-days of the Environment Officer and non-priority on EMP implementation urges to continue awareness raising activities for stakeholders.
- k. EMP implementation requires coordination, cooperation and joint-effort but it was observed or realised that Project has impacted local investment and infrastructure activities of other sectors have adversely impacted the Project. Example, potential landslide at headwork.

CONCLUSION AND RECOMMENDATIONS

This study has been carried out to understand the implementation of benefits augmentation measures and adverse impacts mitigation measures during construction stage of the Melamchi Water Supply Project on the environment. Data and information used for this study were gathered from published documents, field visit, and discussions with Project Engineers, workers, local government, SUP implementer and local people. Some conclusions have been drawn from this study and few recommendations are given to make the Project environment-friendly and sustainable.

4.1 Conclusion

Realising the need for exploring water sources outside Kathmandu Valley, the Government of Nepal started studies in 1972 and identified Melamchi river as a best alternative to supply water in Kathmandu Valley in 1992. The Government established the Melamchi Water Supply Limited in 1995 and started Project to bring 170 MLD from Melamchi river in its first stage. In March 2020, the Project has successfully tested water supply from tunnel in between headwork and Ambathan adit. The Melamchi Water Supply Development Board has made its commitment public through its White Paper to divert Melamchi river water to Kathmandu by mid-July 2020. As per agreement with the contractor, headwork construction will be completed by December 2020. However, it seems possible to divert water from its temporary tunnel after finishing main tunnel works to Sundarijal, treat and distribute water to the people of Kathmandu Valley. The Project cost was estimated at US\$ 249 million in 2008 and additional investment of US\$ 63 million was estimated in 2015. This increase in total cost may be due to non-start of Project construction as planned and/or incomplete estimate or inflation.

The EIA report of this Project was approved as per Nepal's laws and EMP was prepared. As mentioned in the White Paper released in early 2020, the Project has invested NRs. 19 crore and 37 lakhs by FY 2018/19 (BS 2076/77) which is only 0.7 percent of the total expenditure of the Project. The Hyolmo-Sindu-Melamchi Valley Social Upliftment Programme Implementation Committee has implemented activities related to infrastructure development and income generation through Village Community Committees to contribute to socio-economic development of the local people. About NRs 95 crore has been spent for social upliftment programmes by FY 2018/2019.

Implementation of adverse impacts mitigation measures or EMP is weak during the construction of tunnel and Water Treatment Plant and available information is not convincing. During construction stage, the contractor has given adequate emphasis on occupational health and safety and necessary safety devices were provided to the workers. However, key mitigation measures such as replacement plantation, pond construction and landscape & watershed conservation activities were not known implemented. Along with the change in Project Director, budget allocation for EMP implementation was substantially reduced while implementing local people's demand through social organization got priority. Environmental monitoring was not carried out and implementation of mitigation measures was unknown. However, the Project sends progress report regularly to the Asian Development Bank, including updates on environmental conservation activities.

The signed agreement with the Sinohydro Corporation Ltd for the construction of headwork and remaining works of tunnel includes several provisions on physical and biological environment and OHS. The OHS Plan is implemented and provisions complied with. As per agreement, the contractor has to submit Environmental Mitigation and Executiong Plan (EMEP) within a month, get approval and

implement; make dynamic the established Environment Committee, stabilize spoil disposal site with biological treatment, control soil erosion, and avoid or minimize air and water pollutants, and reduce noise level, and carry out and care replacement or compensatory plantation (for cut trees) etc. The contractor is yet to submit EMEP for approval and implement. The Project has not given even minimum focus to environmental activities till March 2020.

The Project's financial support has improved the socio-economic condition of the local people. The construction-related impacts on physical and biological environment have not been addressed but social and economic activities are implemented. The Government has focused in bringing water from Melamchi river to Kathmandu and environment has become secondary or tertiary concerns of all stakeholders. At the initial stage of Project construction, the Melamchi river flow was measured, water quality was analysed, nursery was established and saplings were distributed to local people. These activities have not been continued and pond construction and watershed conservation activities have not been implemented. The local government and people demand for 'levy' from the government to minimize adverse impacts on fish and crop production which may happen due to water diversion to Kathmandu.

In a nutshell, the contractor has implemented OHS requirements as per the contract agreement. The progress report documents environmental activities such river water quality analysis and flow discharge measurement till December 2017. The 2018 report recommended to implement EMP and conduct monitoring for environmental security, which clearly indicates non-implementation of EMP.

4.2 Recommendations

Naturally, this Project has received high priority for completion and diversion of Melamchi river water to meet the growing demand for drinking water in Kathmandu Valley. However, lack of implementation of measures to reduce adverse impacts on the environment as per approved EIA report and EMP is considered inappropriate. Notably, EIA report is approved based on national environmental laws and non-compliance to laws leads to punishment.

Taking into consideration the state of Project construction work, EMP implementation, and non-implementation of the legally approved EIA report, the following recommendations are proposed:

- a. Implement adverse impacts mitigation measures as contained in EMP to make the Project environment-friendly by creating awareness of the stakeholders about the importance, needs and usefulness of environment conservation;
- b. Make public the annual monitoring report containing information on environmental flow, and adverse impacts on water mills, trout fish and farmlands that are likely to occur due to diversion of Melamchi river water in Kathmandu during Project operational stage;
- c. Ensure implementation of appropriate measures to maintain water flow while considering the demand for 'levy' of the local government and people, and existing policy on 'payment for environmental services'; and
- d. Develop a system that ensures sharing of information prior to implementation of infrastructure, socio-economic and income-generating activities which may adversely impact the Project and impose potential future liability, and clarity on Project impacted areas for the implementation of mitigation measures with Project support in view of promising trout farming, use of river water for irrigation, and potential landslide threat in headwork.

These recommendations are expected useful to similar types of Projects, natural resource utilization, and infrastructure development activities to make them environment-friendly and sustainable.

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List of Persons Met in the Field

SN	Name	Position	Organisation & Address
1	Abhikhet Kumar Mandal	Medical Officer	Melamchi Water Supply Project, Gyalthung Adit
2	Anil Thapa	Safety Officer	Melamchi Water Supply Project, Sindu Adit
3	Binod Shrestha	Electrician	Melamchi Water Supply Project, Marathon Adit
4	Dambar Bahadur Aryal	Mayor	Melamchi Municipality, Melamchi Bazar
5	Dambar Pradhan	Safety Officer	Melamchi Water Supply Project, Gyalthung Adit
6	Damodar Shrestha	Assistant	Social Upliftment Programme Office, Melamchi
7	Gopi K. Lamichhane	Local people	Helambu Rural Municipality-5, Gyalthung
8	Kajiman Thing	Farmer	Helambu Rural Municipality-5, Harikharka
9	Kamal Raj Shrestha, Er.	Site Incharge	Melamchi Water Supply Project, Melamchi
10	Krishna Shrestha	Former Ranger	Melamchi Municipality, Melamchi Bazar
11	Madhav Belbase, PhD	Secretary	Ministry of Water Supply (met at Headwork)
12	Madhav K. Bhandari	Investor	Bhandari Trout Fish Farm, HR Municipality-4, Keeul
13	Prem Krishna Shrestha	Env. Expert	Melamchi Water Supply Project, Sundarijal
14	Puskar Joshi	Resident Engineer	Melamchi Water Supply Project, Sindu Adit
15	Rabindra Kumar Yadhav	Engineer	Melamchi Water Supply Project, Gyalthung Adit
16	Ram Prasad Sapkota	Program Officer	Social Upliftment Programme Office, Melamchi
17	Ramji Lamichhane	Engineer	Melamchi Water Supply Dev Board, Sundarijal
18	Sagar Tamrakar	Resident Engineer	Melamchi Water Supply Project, Gyalthung Adit
19	Shyam Mani Subedi	Lab Technician	Melamchi Water Supply Project, Gyalthung Adit
20	Uttam Mani Bhandari	Investor	Bhandari Trout Fish Farm, HR Municipality-4, Keeul

Note: Full name of Social Upliftment Programme is Hyolmo-Sindu-Melamchi Valley Social Upliftment Programme (SUP) Implementation Committee.

Field Visit Programme

27 February 2020, Thursday

- Early morning departure from Kathmandu to Melamchi Bazar
- Meeting with Resident Engineer (Site Incharge) and information collection (documents)
- Visit to Office of the Hyolmo-Sindu-Melamchi Valley Social Upliftment Programme (SUP) Implementation Committee
- Meeting with Mayor of the Melamchi Municipality
- Discussion with Former Ranger involved in Nursery Development and water flow measurement programme in 2007-2008 (evening)

28 February 2010, Friday

- Early morning travel to Project intake site (headwork) from Melamchi Bazar
- Field observation of rural road, irrigation and conservation measures adopted for slope stabilisation
- Discussion with investor/manager of the Bhandari Trout Fish Farm at Keeul
- Observation at headwork and briefing from Site Engineer
- Short discussion with Secretary of the Government of Nepal, Ministry of Water Supply at headwork
- Observation of Marathon and Gyalthung Adits and discussion with Project officials (Resident Engineer at Gyalthung) and workers
- Observation of water treatment facility outside adit entry point and tunnel mock disposal site
- Meeting with SUP Programme Officer (evening)

Note: The study team could not meet Chair or Vice-Chair or CEO of the Helambu Rural Municipality

29 February 2020, Saturday

- Early morning start to Kathmandu from Melamchi (effort to see SUP Chair did not materialised)
- Observation of the Sindu Adit, camp site, tunnel mock disposal site and discussion with the Resident Engineer and workers
- Departure to Kathmandu

3 March 2020, Tuesday

- Travel to Sundarijal
- Meeting with Resident Engineer and Environment Expert
- Meeting with Engineer of the Melamchi Water Supply Development Board
- Observation of the Sundarijal Water Treatment Plant, water quality testing facilities (laboratory)
- Observation of the tunnel work at Sundarijal
- Departure to Kathmandu
