

Sunga constructed wetland for wastewater management

A case study in community based water resource management



A WaterAid report

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Front cover image: WaterAid/Marco Betti

“The environment has improved and this has had an impact on health. The number of water borne diseases has reduced and diarrhoea has reduced. The plant is good because it impacts on health and there are no landslides and it has improved the school. The stream used to be polluted, it is nice now. I am involved in spreading health messages after seeing this community and the changes here. I feel really good about this.”

Ram Kesari Shrestha, Sunga wastewater treatment plant, Thimi, Nepal

Contents

Background	2
Constructed wetland – a decentralised wastewater management technology	2
Project area	2
Technical features of Sunga constructed wetland	4
Community engagement	4
Community members participating in an interaction meeting and workshop	5
Sustainability	5
Sunga constructed wetland – from WaterAid in Nepal’s community based water resource management perspective	6
Visits from other communities/municipalities	8
Conclusion	8

Background

Urbanisation is a global trend which, when well managed, can no doubt enhance economic development opportunities, particularly in developing countries. However, poorly managed urbanisation has also seen excessive pressures on natural resources and basic services such as water and sanitation.

Mismanagement of urban growth has resulted in pollution and deteriorating living conditions, particularly for the poorest section of the society. Although only 15% of Nepalese live in urban areas, the rate of urbanisation in Nepal is one of the highest in the world. Urban water supply and sanitation services and infrastructure are major challenges at the moment.

The Kathmandu Valley is facing critical problems with the availability of drinking water, quality of water and wastewater management. The large scale central systems for water and wastewater management are complex and expensive to construct and operate. In recent times, the shift to small scale, decentralised systems has been increasingly promoted as they incur lower costs and are more manageable. Such systems have proved to work more effectively and be sustainable when local communities are involved in their planning and management.

Constructed wetland – a decentralised wastewater management technology

The constructed wetland is a biological wastewater treatment technology designed to mimic processes found in natural ecosystems where wetland plants and their associated micro-organisms remove pollutants from wastewater. This technology was introduced for decentralised wastewater treatment in Nepal in 1997 by Environment and Public Health Organisation (ENPHO). Since then ENPHO, with the support from various partners and donors including WaterAid in Nepal, constructed 13 such treatment systems, ranging from single household units with capacity of 0.5 m³ per day to institutional plants treating 50m³ per day.

Most of the constructed wetlands that have been constructed for managing wastewater are based on reed bed treatment systems. The major challenge at present faced by this technology is the availability of land to promote and expand the use of this technology across the country. ENPHO, with the support from WaterAid in Nepal, UN-HABITAT and ADB, piloted this technology first time in Nepal, in a Sunga community in Madhyapur Thimi municipality, using a community based approach. It is hoped that this demonstration encourages its replication and wider application once other sector actors, institutions and individuals can see the benefits.

Project area

Madhyapur Thimi municipality, one of Nepal's oldest settlements, is a small municipality located in Kathmandu Valley. It has a population of around 48,000

and covers 11.11km² with 20% residential area, 70% agricultural land and around 10% vacant land. The settlement in this municipality is on an elevated land surrounded by three river tributaries of the Bagmati River, one of the major rivers of the Kathmandu Valley. Although the historic town has some sewer networks without treatment facilities, the untreated municipal wastewater is discharged directly into the nearby water bodies like streams, thus polluting them along the periphery where most of the agricultural land is situated. Previously, these rivers used to serve as one of the main sources for irrigating agricultural land. Sunga, the project area for demonstrating the constructed wetland using a community based approach is one of the many communities of the municipality.

As the local people of Madhyapur Thimi and the municipality showed an interest in managing the wastewater, ENPHO with the techno-financial support from WaterAid in Nepal, UN-HABITAT and ADB, developed an innovative project for improved sanitation. In addition to the funding agencies, Madhyapur Thimi municipality provided the required land for construction along with the financial assistance for operation and maintenance of the wastewater treatment plant.

Under this initiative, ENPHO joined hands with the local people of Sunga and constructed a community based reed bed treatment technology for managing the wastewater as a demonstration project.

The main objective of this demonstration project is to promote a simple but effective, community based, urban wastewater treatment technology to improve sanitation, improve water quality of rivers, provide alternate water uses other than for drinking purposes, and to link with livelihood opportunities for poor communities and finally demonstrate the successful application of a community managed wastewater treatment plant.

After successful construction of this treatment plant, the operation started in October 2005 under the constant supervision of the local user's committee with technical assistance of ENPHO. The constant monitoring for evaluating the treatment efficiency of this wastewater treatment plant revealed that community based decentralised wastewater management system using reed bed treatment technology proved to be effective in removing pollutants. Tests conducted on effluents from the treatment plant found the quality to be within the Nepalese Standards for wastewater to be discharged into Inland Surface Waters. After the successful monitoring of the treatment efficiency, the Sunga wastewater treatment plant was handed over to the local User's Committee jointly by ENPHO and the municipality on 1 September 2006. This community based treatment plant is now under the direct supervision of the local community users who are responsible for its continued operation and maintenance. ENPHO provided technical training to the user's committee members and caretaker of the plant and also assured to provide technical support whenever the community is in need. In addition, ENPHO also assured to develop a technical handbook for operation and maintenance for the plant and provide to the committee to help to combat with minor technical problems.

Technical features of Sunga constructed wetland

Major components of the project	
Total area	- 500m ²
Total beneficiary HHS	- 200
Capacity of plant/design discharge	- 50 m ³ /day
Screen and grit chamber	- 1 unit
Anaerobic baffled reactor	- 42m ³
Two horizontal reed beds followed by two vertical reed beds	- 150m ²
Feeding tank (two)	- 3.38m ²
Sludge drying bed	- 55m ²
Collection tank	- 6m ³
Influent quality (in terms of BOD) 900 mg/l
Effluent quality	
BOD removal efficiency	- 80%
COD removal efficiency	- 80%
TSS removal efficiency	- 90%
Total phosphorous removal efficiency	- 60%
Ammonia removal efficiency	- 75%
Faecal coliform (CFU/100) removal	- 99%

Source: Effluent Monitoring Report, ENPHO

Community engagement

The Sunga Treatment Plant is the first community based wastewater treatment system in Nepal, and was materialised following the realisation by the community of the importance of sanitation. The community's active participation in the inception, planning and implementation of this project has been central to its success. The responsibility for the management of the project was taken on by the management committee which comprises of 17 members representing local leaders, community based organisations, the community, municipality and local schools. The community was able to play an active role in identifying the land for the plant and lobby the municipality for the construction site.

The community provided labour for construction while WaterAid in Nepal's urban partner ENPHO provided the technical support. The active engagement of the people thereby reduced costs and ensured that the interest and engagement of the people were sustained during project implementation. On completion, the management committee took complete responsibility of operation and maintenance of the plant. Thus, the management committee has become the main managing and operating body of this wastewater treatment plant.

Community members participating in an interaction meeting and workshop

The community has shown great enthusiasm for the project, which has been well demonstrated through the positive responses and willingness to support the project. The participatory manner in which this project was implemented has led to considerable support from the community and their obvious ownership and pride towards the project. This has been a significant reason behind the success of the treatment plant.

The management committee of the treatment plant having been operational for 12 months has not received any complains from the local community. Views of teachers and students of the local school situated close to the treatment plant also indicated that the treatment system has been accepted. Although students complained of foul odour from the plant during the very initial stages of the operation, later on such smell subsided gradually and no complains were received from the students.

Similarly, the surrounding communities have understood the functions and benefits of the treatment plant by visually observing its operation and treatment efficiency. During the hand over ceremony, many other local communities requested ENPHO to support the construction of additional similar treatment plants in other parts of the Municipality. These opinions and demands from the local community clearly indicate that the treatment plant has been well accepted by the people.

Sustainability

Operation and maintenance of the plant

As per the tripartite agreement made between ENPHO, the management committee of Sunga Wastewater Treatment Plant and Madhyapur Thimi municipality, the municipality has committed Rs 50,000 annually for operation and maintenance including remuneration (NRs. 3000/month) and equipment for the caretaker. The annual operation and maintenance cost at present is less than the amount allocated by the municipality. It has been agreed that the surplus amount will be transferred to the operation and maintenance reserve fund for future maintenance of the plant.

Selection of caretaker

The caretaker for operating the plant was selected from the local community considering the person's interest, and general technical know-how, and the selection process is based on the recommendation of the committee and the judgement from ENPHO. The person selected as a caretaker of the plant was involved from the very beginning of the plant's construction phase. ENPHO trained the caretaker on operation and maintenance activities and technicalities of the plant although the maintenance of this type of treatment system is much less and more manageable compared to other conventional types of treatment plants. The caretaker is responsible for the day-to-day operation and maintenance of the plant.

Revenue/tariff generation from connections to wastewater treatment plant

The management committee is planning to collect nominal connection fees regularly from individual households for connecting their sewers to the treatment plant. Discussion within the management committee, community beneficiaries and other stakeholders is underway for fixing an appropriate tariff. The collected amount from the tariff is planned to be deposited in the operation and maintenance reserve fund. There is a very important role for the management committee to make the community aware of the importance of such a reserve fund to ensure the sustainable management and maintenance of the wastewater treatment plant. The influence of the municipality is also vital in making the local people pay for the connection. The committee is having discussions with the municipality regarding revenue generation.

The responsibility of generating the operation and maintenance reserve fund from the municipality and tariffs from the household connections to wastewater treatment plant lies within the management committee itself in addition to the responsibility of mobilising operation and maintenance fund for future operation and maintenance activities of the plant.

Regarding the management of operation and maintenance reserve fund, the management committee was given training on book keeping by ENPHO along with the technical orientation regarding operation of the plant. Follow-up trainings were also provided to the management committee.

Technical support

ENPHO committed to provide technical support to the management committee as and when needed to ensure the efficient operation of the plant; and effective management of the operation and maintenance reserve fund in the long run. In the first year, ENPHO will closely monitor the efficiency of the treatment plant both in terms of its technical efficiency and institutional effectiveness. During the process of providing technical support to the committee, a focal person nominated from the management committee will be trained to take the responsibility of future operation and maintenance of the plant even if ENPHO withdrew its technical assistance. This plant has been developed as a demonstration plant for educational purposes and for future replication in other areas.

Sunga constructed wetland – from WaterAid in Nepal’s community based water resource management perspective

WaterAid in Nepal’s minimum conditions of community based water resource management

Giving due consideration to the challenges put forward by the current increase in water scarcity and its impacts, WaterAid in Nepal has therefore placed an increased emphasis on the concept, tools and techniques of community based water resource management. In the coming years, WaterAid in Nepal plans to make an operational linkage between community based water resource management and all its water, sanitation and hygiene programmes. Realising these needs, WaterAid in Nepal’s community based water resource management

guideline highlighted two minimum conditions that need to be incorporated while devising any water and sanitation (WATSAN) programme to ensure:

- Sustainability of the water resources
- Avoidance of contamination by controlling risk of pollution to avoid deterioration in the quality of water resources
- Possible use of water sources for multi-purpose

Improved river quality

The Sunga constructed wetland has incorporated WaterAid in Nepal's minimum conditions of community based water resource management through firstly by treating the wastewater to an optimum standard before discharging into the nearby streams thereby avoiding the possible pollution in the water body. On the other hand, this has further augmented the river flow to some extent through the treated effluent of the wastewater treatment plant.

Multiple uses of treated effluent

There are multiple uses of the treated water. The treated water as already mentioned is helping to augment the flow with relatively clear water in the nearby river where it is being discharged at present.

The committee at present is using some portion of the treated wastewater for gardening nearby and cleaning the surroundings. Similarly, the neighbourhoods of the wastewater treatment plant and Sunga wastewater treatment plant committee are having discussions for diverting certain portions of the treated water to their farmlands for irrigation as well as for other agricultural purposes to enhance crop yield. This is because, the treated effluent is considered to have better mineral composition and high organic nutrients.

The school adjacent to the treatment plant, which already has a rainwater harvesting system supported by ENPHO, agreed to use some portion of the treated wastewater effluent for toilet flushing and cleaning the surroundings of the school during the dry season.

Management of sludge

A further product of the Sunga constructed wetland is the sludge, which is collected in the settling tank, and baffle reactor. The sludge after its removal is transported to the sludge drying bed, another component of Sunga constructed wetland, where it is piled up to dry. The sludge when dried can be used both as a fertilizer and as a fuel by converting it into briquettes, thereby generating income for the management of the plant.

The plant is now operational but not to its design capacity. This is due to the fact that the households are now gradually getting their connections to the sewer network. Once the plant is serving its design capacity of 200 HHs and a garment factory, the maximum amount of sludge will be generated accordingly to the design capacity of the sludge drying bed.

Uses of reed plants

Once the reed plants mature and grow to a considerable height, they are trimmed down to a fixed height of approximately 15cm. However, the committee is planning

to use the reeds for fencing the treatment plant to restrict unauthorised entry. If there is any surplus, they can also be used as a source of energy for burning.

Benefits to the community

The site where the wastewater treatment plant has been constructed was previously used for dumping of solid waste and open defecation by the community. However, after the construction and operation of the treatment plant, the surrounding environment has improved to a large extent. This has benefited not only the community but also the school children. This improvement has thus discouraged other people to continue with the traditional habit of defecation and waste dumping. The entire area now seems to be healthier and aesthetically attractive with an enhanced environment.

Demonstration site

The Sunga constructed wetland has received attention from different national and international visitors, policy makers, researchers, professionals, students and journalists, who have visited this site to observe and share experiences on community based wastewater treatment plant for replication, research and knowledge. The management committee and ENPHO have received positive feedbacks from all the visitors. Besides, these visits have also helped in raising awareness of this simple technology and the role of communities in municipal wastewater management. The plant is as an example of the first community based treatment plant in Nepal and is gradually proving itself as a demonstration unit for people from various parts of the country and abroad.

Visits from other communities/municipalities

This system has also been able to establish itself as a demonstration site for the ADB funded Urban and Environmental Improvement Project which is planning to establish similar treatment plants in eight municipalities of Nepal. In addition to this, this system has also attracted many visitors from WaterAid country programmes, particularly from the Asia region and from WaterAid in the UK, to share experiences.

Conclusion

The growing trend of urbanisation is increasing the level of land and water pollution. If the untreated wastewater continues to increase at its current rate, the adverse impacts on these rivers make them unusable thereby destroying the current eco-system of fresh water bodies.

The Sunga constructed wetland is a clear demonstration of the effectiveness of the community based wastewater management project and its contribution. The design of this project has many advantages such as easy operation and maintenance; adaptability in a small area compared to conventional system; working efficiency; water optimisation; recycle and reuse of the treated effluent from wastewater; and income and livelihood opportunities. In addition, the project has also become successful in enhancing the river quality and ensuring benefits to the community dwellers.

This project is an example of an approach towards the sustainable management of water and wastewater. This has inspired people to adopt this type of technology that can be managed by the community itself for the solution of currently mis-managed wastewater in the city.



WaterAid's mission is to overcome poverty by enabling the world's poorest people to gain access to safe water, sanitation and hygiene education.

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