Case Study on WSP Implementation and Lessons Learned: Amarapuri Water Supply, Nepal

The Amarapuri Water Supply case study was originally submitted for the IWA 2012 Drinking Water Supply Award, which recognized the effective development, implementation and ongoing revision of WSPs to manage drinking water safety. This version further develops the original case study to include updated information since the Award Submission.

This case study was developed using a case study guide and template which was designed by the World Health Organization to collect important information on the benefits, challenges, and lessons learned associated with the WSP implementation. The case study guide and template is available at

http://www.wsportal.org/ibis/water-safety-portal/eng/my-toolbox.

1) Background information and context

Country: Nepal
Date: July 2013
Authorship: This case study was developed by Ms. Thaís Terceiro Jorge during her time as an intern at WHO with the assistance of Mr. Nam Raj Katri (consultant, formerly WHO CO Nepal), Mr. Bishnu Kandel (Amarapuri WSP Team), and Mr. Kiran Darnal (Nepal Department of Water Supply and Sewerage). For further inquiries on this case study, please contact Mr. Kandel (dipeshkandel07@gmail.com)
General information about the water sector, including regulatory/oversight authorities (general legal framework for oversight, regulation, and enforcement, if applicable) and consumer characteristics. The Department of Water Supply and Sewerage (DWSS), under the Ministry of Urban Development, is the lead government institution in Nepal's Water, Sanitation and Hygiene (WASH) sector, coordinating activities with other government and non-government agencies. The National Drinking Water Quality Standard (NDWQS) - developed by the DWSS - assigns responsibilities to stakeholders. The water suppliers are required to monitor water quality. The DWSS is responsible for providing technical support to the service providers and assistance to their monitoring activities. Water quality surveillance falls under the Ministry of Health and Population (MOH); however, the MOH has not actively performed its regulatory responsibility thus leaving water quality monitoring to the DWSS. After construction, water supply systems are operated by users' committees (or by the National Water Supply Corporation or autonomous management board if the system is large). There are approximately 36000 rural, 200 periurban, and 22 urban water supply systems in Nepal. In 2011 water supply and sanitation coverage stood at 82% and 43%, respectively. Water supply systems adopt community-based management principles that are built upon intense user participation. The WSP approach bolsters user participation thus aligning with the stated management principles.
General information about the water supplier and their water supply system(s) (e.g. number of systems, type of systems, population served/number of service connections, annual water production, etc.) if the case study is for one water supplier: The Amarapuri Water Supply System is located in the Amarapuri Village Development Committee (VDC) of Nawalparsi District in Western Nepal. The water supply system was built in 1975 and handed over to the users' committee for full management in 2000. This peri-urban setting consists of 1531 households (9286 people) being serviced by 1180 private taps and 20 community taps. The system supplies 1000 cubic meters a day of treated water and service is available for 6 hours a day (3 in the morning, 3 in the evening) each day. Raw water is obtained from a local stream though a gravity flow system. From the point of intake to the treatment plant the water is transported through 2 km of transmission lines. The catchment's surrounding is forested thus leading to high water turbidity in the rainy season. The treatment plant includes a sedimentation tank, a roughing filter, a slow sand filter and a chlorination unit. Treated water is stored in underground tanks of a combined capacity of 300 cubic meters and is distributed to consumers through a pipe network of 18 km. Amarapuri's water supply system is run by 7 paid staff. Water charges are based on a minimal tariff of Rs 50 (1US$ = 95.25 Rs, as rate of July 2013) for a month's consumption of 8 cubic meters in combination with progressive tariffs for additional use. Total monthly revenue is Rs 130,000 and expenditure is Rs 115,000. Resources are allocated as follows: 50% to staff cost, 25% to maintenance, 15% to management promotional activities and 10% to savings account.

2) Description of the WSP initiative

Rationale and scope of the WSP:
Reason/motivation for WSP implementation, such as voluntary, policy, regulatory, etc.: In 2010 Amarapuri was one of the 20 urban locations selected to partake in the national WSP program supported by DWSS/WHO. A three-day workshop was organized by the DWSS to provide training on the systematic implementation of WSPs. Amarapuri was selected due to the high level of commitment of its water service provider and the potential to become a reference project for the region. Although not mandated by law, the water supplier recognizes that WSPs are a powerful tool in improving service and meeting the quality standards required by NDWQS.
Description of any existing legislation/regulations related to WSPs. This includes providing information on whether regulations explicitly promote or require WSPs or an equivalent preventive risk management approach. Please also include details on the name given to the WSP initiative (WSP, risk management plan, HACCP, etc.): National legislation states that the water supplier is responsible for meeting the quality standards detailed in NDWQS. Although WSPs are not yet mandated by national legislation, it is recognized that WSPs would support achievement of these quality standards and safeguard water safety by providing a framework to effectively manage and continuously improve the system. Additionally, there are plans for amending the NDWQS and implementation guidelines to specify WSPs as a mandatory requirement.
Water supply components covered in the WSP (e.g. catchment, water intake, treatment, distribution, storage, consumer point of use, etc.): The Amarapuri WSP covers catchment to consumers. It includes the catchment area near the intake point, intake points, transmission line (2KM), treatment units (sedimentation tank, roughing filter, slow sand filter and chlorination unit), reservoir tanks (300 cubic meters), 18 km distribution networks, taps (1180 private and 20 public), and sanitary conditions of 1518 households and the overall community.
WSP steps developed and implemented to-date, such as development of WSP team, hazard identification, risk assessment, development and implementation of improvement plan, review of the WSP, etc.: (1) The WSP Team is comprised of 13 members coordinated by a representative from the users' committee. WSP team members have been assigned specific tasks and responsibilities. Monthly meetings are held and meeting minutes are actively recorded. (2) The water supply system has been analysed from catchment to consumer through development of detailed supply diagrams and layout maps. All WSP team members have visited each step in the water supply chain. (3) Potential and existing hazards have been identified from catchment to consumer. A total of 17 hazards were identified and the appropriate risk scores assigned based on severity and frequency. (4) Control measures for the identified hazards have been described and documented. Validation of the effectiveness of control measures and improvement works has been carried out. (5) The WSP team developed an improvement plan for the control measures that were not in place or showed poor performance. The identified needs are being actively addressed. (6) A monitoring plan based on regular physical inspection of the entire supply system (from catchment to consumer) and water quality testing (turbidity, E. coli, pH, and free residual chlorine (FRC)) has been prepared and implemented. Additionally, water quality data has been shared with local health centres and official health reports detailing diarrheal illness in the community have been obtained from health service providers. (7) A system for regular verification of monitoring works was developed and is led by the users' committee.

Activities and results are reviewed and recorded every 6 months by focal engineers from the DWSS.
(8) Standard Operating Procedures and general manuals have been developed and are actively followed. Emergency procedures have also been devised.
(9) The WSP team carries out consumer satisfaction surveys and annual awareness campaigns on the WSP, the water supply system, water quality, point-of-use treatment, and safe storage. Orientation training for interested members of stakeholder groups is offered regularly.
(10) A comprehensive WSP document highlighting the milestones achieved has been compiled. This document is to be updated annually and shared at the community, district, and national levels.

Details of the WSP:

General description, timelines (for development, implementation, review, etc.) and milestones achieved (e.g. How were the WSP steps developed, implemented and reviewed?):

In September 2010, three members of the users' committee attended a three-day WSP workshop held by the DWSS with representatives from other 19 pilot projects. The WSP team was formed shortly after by the users' committee in coordination with stakeholders. In the span of one month, the team analysed the water supply system, identified hazards and control measures, and prepared an improvement plan. The improvement works were carried out in the following 6 months. The monitoring plan was prepared in February 2011 and regular monitoring was initiated soon thereafter. The users' satisfaction survey was carried out in March 2011 and the report compiled in June 2011. Representatives from all 20 pilot projects (including Amarapuri) attended a review meeting organized in July 2011 by the DWSS. In November 2011, the project was reviewed by an external WSP expert as part of the WHO/AusAID Water Quality Partnership, which aims at supporting the sustainable scale up of WSPs in selected countries in the Asia Pacific region. The assessment confirmed the successful implementation of WSPs in Amarapuri.

The WSP has led to multiple improvements in water supply management, operations, and water quality in Amarapuri. Consumer satisfaction has markedly increased since implementation of the WSP. Similarly, no cases of diarrheal illness have been recorded in the community and the local health official has consistently declared Amarapuri to be "waterborne disease free". The Amarapuri WSP team is active in supporting national efforts to scale up WSPs by providing WSP training and water testing to interested communities.

WSP Team composition and other stakeholders (including external support organizations/experts) involved in the process (e.g. How was the team formed? What organizations were involved? How did team members/stakeholders become interested in the WSP?):

The WSP Team is composed by 12 members with a team coordinator nominated by users' committee. Two other members are representatives of the WUSC and the remaining members were selected among health workers, local teachers, social workers, and users. (School teachers were included due to their important role in educating students, who can then become WSP advocates in their own homes and further disseminate information.) Selection criteria included – among others – the commitment to volunteer time and work towards improvements in water quality. An engineer from the district water supply office who had participated in a four-day WSP training organized by DWSS facilitated the process.

Activities to support development and implementation of the WSP:

In Nepal the WSP approach has been customized to suit its own context. A 10-step WSP approach was developed based on the WHO/IWA Water Safety Plan Manual. The Amarapuri WSP team has completed all the ten steps highlighted in Nepal's WSP program. A comprehensive checklist of WSP documents has been prepared to track progress of WSP implementation. The project uses its own laboratory facility which is equipped to test for pH, conductivity, turbidity, E. coli, total suspended solids (TSS), total dissolved solids (TDS), and chlorine. Water quality has consistently met the quality standards required by NDWQS.

Another supporting activity include an effective and comprehensive annual 2-day workshop to improve users' awareness and support for WSPs. Themes include sanitation, household water storage and handling practices, the water supply system, and the WSP. In order to encourage safer water practices in the users' household, a prize system has been developed to reward households for cleanliness of tap platforms and water storage areas.

Recognizing that the practice of open defecation poses a microbiological threat to the water supply, extensive efforts have been made to improve sanitation practices in an upstream village. The village is now declared open defecation free.

Mechanisms used to verify progress of the WSP (internal or external reviews, views of consumers, WHO/IWA WSP Quality Assurance Tool, etc.) (e.g. What verification activities took place? How were these activities conducted? What organizations were involved?):

The WSP project was reviewed by an external WSP expert in November 2011. Monitoring and test results are verified and signed-off every month by user's committee. The focal engineer from the DWSS reviews and compiles the WSP activities and monitoring results every 6 months. These are formally signed-off annually. Verification activities additionally include assessment of consumer satisfaction. Surveys are carried out every 3 months (although the WSP document states 2 annual surveys) to assess whether consumers are satisfied with the water supplied. Questions further aim to assess the occurrence of diarrheal illness, the understanding of the links between drinking water and health, and general hygiene practices.

Progress on improvements identified through the WSP process:

Improvement works have been implemented taking into account the risk scores, the time required for implementation and the associated cost. These have focused on the treatment plant, leakage controls in pipe networks, and awareness works. Examples of improvements implemented to date include cleaning of the roughing filter, construction of chlorination units, repair of gate valves and installation of barbed wire around settling basin. Some improvement works were planned for the future due to money or time constraints.

Additional resources required for development and implementation of the WSP (human, technical, etc.): The DWSS has recognized the Amarapuri project as a resource centre for the region (Western Nepal). The project has provided training to neighbouring users' committees on WSP implementation, and O&M practices. However, in order to continue to meet this demand, it is expected that in the long-run the project will need its own training facility. Additional resources are also needed for implementation of improvement works.

Financial mechanism(s) in place/required for development and implementation of the WSP (What mechanisms were utilized for distributing funds to finance training, improvement programmes, etc.?): Training and technical support was provided by the DWSS/WHO. Some nominal funds were available for urgent improvement works; these were disbursed to all 20 participating supplies as an initial incentive. Urgent improvement works have been identified from the assigned risk score. Due to financial limitations some high-cost improvement works have been postponed until resources are available. Each supply was responsible for mobilizing its own resources for implementing WSPs and completing improvement works. Overall, WSP implementation has led to a reduction in the cost of maintenance, water testing and sanitation works.

3) Assessment of implementation: benefits and challenges

Institutional Changes (Benefits and Challenges)
1. Improved communication and collaboration between WSP team members, stakeholders, public/customers and/or within the water service provider among staff and management. (If change was observed, between which parties/groups?): The efforts to assess users' satisfaction and increase awareness on WSPs, the water supply system and household water handling and storage, have bolstered communication with the public and other stakeholders. There is continuous communication with school teachers and social workers; these groups are represented in the WSP team and are also the target audience of some WSP workshops.
2. Increased awareness, knowledge, and understanding among water service provider staff/departments (examples of possible knowledge areas include the water supply system and its operations, workplace safety, management procedures (e.g. Standard Operating Procedures (SOPs)) and needed improvements) (If change was observed, within which parties/groups?): There is an increased understanding within the users' committee and WSP team of the value of the WSP process. They are committed to the continuous implementation of the WSP and keeping it current and effective. The WSP has become fully integrated into the water supply operation and management and WSP team members and staff have demonstrated thorough knowledge of the water supply system. Operators are aware of the need to use Standard Operating Procedures (SOPs) for running the treatment plant. Additionally, the importance of implementing improvements identified through a WSP is understood and is being applied in practice. The users' committee, WSP team and operators attended workshops on WSP implementation and O&M. The links between water sanitation and health have been clearly established at all levels of staff.
3. Improved attitudes and increased acceptance of WSP methodology and/or water safety operations among WSP team members, stakeholders, public/customers and/or within the water service provider among staff and management (If change was observed, within which parties/groups?): The Users' committee, WSP team, users and other stakeholders have accepted the WSP methodology due to efforts to involve all parties during all stages of WSP implementation, and regular WSP awareness-raising and training events. For example, efforts made to share water quality performance and disease data have led stakeholders to better appreciate the importance of safe water to decrease waterborne diseases. Furthermore, the WSP process has been transparent and accessible to different stakeholders.
4. Increased capacity building and training within the water service provider among staff and management (If change was observed, between which parties/groups?): Workshops and training sessions were regularly organized by the WSP team and DWSS. These were available to water service provider staff. Users' committee learned the benefits of a WSP. The WSP team gained hands-on experience on WSP implementation by following the ten step process detailed in Nepal's customized WSP materials. Staff learned the importance of adopting SOPs.
5. Increased overall ownership among levels of staff within the water service provider: WSP implementation led to clearer assignments of job responsibilities and roles. Highlighting individual contributions to the provision of safe drinking water has increased ownership among staff. The staff members understand the importance of safe drinking water and take pride in continuously supplying water that meets quality standards. Public recognition of the importance of safe drinking water has also contributed to increased ownership among staff.

6. Improved workplace productivity within the water service provider:
   WSP implementation has led to more time-efficient operations and maintenance due to adoption of a risk-based, preventive, planned approach. The service provider (users' committee) feels more efficient at managing the water supply.

7. Other institutional changes not captured above:
   The WSP improved service provider popularity among various stakeholders within and outside the community. Amarapuri has been selected to become the resource centre for WSPs in the region.

Operational Changes (Benefits and Challenges)

1. Improved/updated system infrastructure:
   Hazards identified during the risk assessment step of WSP implementation were addressed, as needed, by updating or implementing the appropriate control measures. Some of the improvement works included cleaning of intake point and surroundings, correction of all leakages, addition of a chlorination unit, and cleaning of treatment units.

2. Improved management of water supply system (e.g., improved treatment process control, improved source water protection):
   The water supply system operates under SOPs (developed by the users' committee) and there are clear procedures for managing emergencies and incidents. Traditionally SOPs have not been commonly used in Nepal; they were introduced in Amarapuri during WSP implementation.

3. Improved documentation and implementation of management procedures (e.g. SOPs):
   SOPs have been developed for operating the water supply, including operation of treatment units, and management of emergencies and incidents, and inspection of catchment, community taps, and distribution system. SOPs were devised based on long term experience.

4. Improved record keeping and data collection:
   Water quality data is now registered on a computer thus replacing the previous manual records. The results from the periodic water quality and control measure performance assessments are systematically recorded. Similarly, inspections and users' satisfaction surveys' data are analysed and thoroughly documented. WSP activities and results are annually documented in the WSP report.

5. Improved monitoring (operational and verification) and surveillance:
   As required by the WSP document, control measures are inspected by a responsible party according to a defined schedule; water quality indicators are also tested periodically according to an established schedule. Compliance to NDWQS is now being monitored. The monitoring schedule includes daily visits to the treatment plant and intake area, and weekly visits to the distribution network and the consumer domain. Water quality testing takes place at different points: twice a month at intake point, after roughing filter, slow sand filter, and reservoir, and at the tap at five different endpoints. Parameters tested include pH, turbidity, E. coli, and free residual chlorine (FRC) from reservoirs and taps. Verification is carried out by the systematic review and documentation of WSP activities and the consumer satisfaction surveys. Further review of activities and results is performed by the focal engineers from the DWSS. Monitoring data helps to reduce the need for further monitoring and testing.

6. Improved monitoring of costs and expenditures:
   As expected, the preventive nature of WSPs has led to a short-term increase in maintenance costs. In the long term maintenance costs have decreased and monitoring costs have increased, such that overall costs have not significantly changed after WSP implementation.

7. Improved formal or informal auditing of operations (internal and/or external):
   Informal auditing has improved as expected due to regular monitoring and verification efforts. No formal auditing system has been developed to date.

Investment Changes (Benefits and Challenges)

1. Better targeting of investments (e.g. Investments based on prioritized risk assessment):
   The risk assessment step and the resulting risk matrix that was developed allowed more effective targeting of investments to the mitigation of priority hazards. For example, the risk assessment identified addition of a chlorination unit and adoption of SOPs as priority improvements. Limited funds have led to the postponing of some improvement works.
2. Increased financial donor support/investment (domestic and/or international support) and/or increased donor awareness for future financial support:
   There has been increased international donor support for training, purchasing of equipment and chemicals, etc. Government, donors and sector agencies are showing more interest towards this project and are encouraging it to become the resource centre for the region. Additionally, Amarapuri has been selected to be one of the 10 model VDCs for piloting total sanitation program by DWSS.
3. Increased resource allocation to supporting programs (e.g. training, environmental monitoring, epidemiological surveillance, watershed protection):
   In order to support implementation of the WSP resources have been and continue to be allocated for staff training, public awareness campaigns and workshops, and catchment protection. The users' committee allocates an annual budget of Rs 150,000 for WSP supporting programs.
4. Water supply cost recovery (consumer payment compliance, cost reduction, etc.):
   There have been no significant additional costs after implementing the WSP. The preventive nature of the WSP has led to an overall decrease in maintenance costs. Monitoring costs have increased as expected. Overall cost has remained the same.
5. Other investment changes not captured above:
   The management staff have devised a long-term plan for improving the treatment unit and protecting the catchment area.

Changes in the 'Enabling Environment'

1. Increased promotion and knowledge-sharing of the WSP with other water suppliers, local/national government, and/or others:
   This project has shared WSP knowledge with neighbouring districts and has presented its WSP training approach in workshops. The users' committee and WSP team have recently initiated service to 15 water supply systems which included a two-day WSP orientation training, water quality testing and other technical supports. This initiative will provide water quality testing and monitoring free of cost for the participants. The Amarapuri WSP team is directly supporting national efforts to scale-up WSPs.
2. Improved legislation, regulation(s), standard(s), and/or policy enforcement around water quality guidelines due to WSP implementation:
   NDWQS now include WSPs as an option for meeting the required management improvements. WSPs are not required by national legislation, although there are plans for amending the NDWQS and implementation guidelines to specify WSPs as a requirement.
3. Improved government educational initiatives around water quality aimed at the public:
   Local teachers have been given training on WSPs and can now educate their students. Moreover some

workshops on WSPs and sanitation have been regularly organized by the users' committee to target local students. Total sanitation projects supported by the government have incorporated WSPs as a component.

Other changes not captured above :

A Water Quality Surveillance (WQS) Unit is being formed by the Ministry of Health and the experience of the Amarapuri project has been used as guide.

Water Safety Plan Longer-term Impacts (Please include an explanation and the source of data, if available) How were these benefits achieved, evaluated and measured? How long did it take to achieve the benefits?

1. Improved water quality:
   Regular testing data indicates improvements in water quality. Furthermore improvement works identified through WSP (such as installation of a chlorinator and cleaning of roughing filter, catchment protection) have contributed to improving water quality.
2. Improved water quantity:
   Improvement works on leakage control have reduced water loss and consequently improved water quantity. An additional reservoir is currently under construction to further increase water quantity.
3. Improved water service continuity:
   Prior to WSP implementation treated water was available for 6 hours a day. Due to increased service demand post WSP implementation, water service supply has been reduced to 5 hours a day. It is expected that completion of the additional reservoir (ongoing) will improve water service continuity.
4. Improved water service coverage:
   Due to improved water quality and services people who had been using traditional water sources have opted for joining the piped water network. Improved service coverage was supported by leakage control and expansion of the pipe network, and is expected to further increase after conclusion of the additional reservoir.
5. Improved water service cost recovery:
   Expansion of customer base has improved water service cost recovery
6. Reduction in waterborne diseases (specific diseases or ailments) or waterborne disease outbreaks:
   The reduction in diarrheal illness cases was assessed from data derived from users' surveys (which included questions on diarrheal illness among the members of the surveyed household) and medical records kept at the local health clinics. The health post officer was a member of the WSP Team and actively involved on health monitoring and users' satisfaction surveys. Female health volunteers carry out visits to households to collect information on diarrheal illness and keep medical records updated.
   Prior to WSP implementation, between 30-50% of households reported diarrheal illness; post-WSP less than 1% of households reported diarrheal illness. These health benefits were reported one year after the beginning of WSP implementation in Amarapuri.
7. Improved customer satisfaction:
   WSP implementation in Amarapuri has led to increased customer satisfaction as demonstrated by the positive feedback obtained from the users' satisfaction survey.

Other noticed improvements not captured above:

Reputation. Amapuri water supply is considered the best managed water supply in Nepal and has become a WSP resource centre.

Benefits
How were these benefits achieved, evaluated and measured? How long did it take to achieve the benefits? What other policy, legal or regulatory changes do you expect to see as WSP implementation progresses? The benefits were achieved through a combination of continuous monitoring and regular verification, stakeholders' engagement and participation, regular training and awareness campaigns, and a transparent WSP implementation process. It is expected that the benefits of the WSP will be further recognized by the public as WSP implementation progresses and water supply performance improves. Furthermore it is expected that the Ministry of Health will develop a WQS system for monitoring water quality and carry out regular surveillance of the water supply systems. WSP implementation in Amarapuri has been concurrent with total sanitation (TS) programs; therefore the observed health benefits are likely not entirely due to WSP implementation but rather due to the synergy between WSP, TS, and perhaps other factors.
Challenges
Were there challenges around WSP activities related to these changes? If so, how were they solved/how are they currently being addressed? Were these challenges anticipated? As WSP implementation continues, do you expect any other challenges related to these changes? Is there a feedback mechanism to allow lessons learned to be translated into new policies? The biggest challenge has been the continuous monitoring and verification activities, which are paramount for the provision of safe drinking water. Some monitoring activities are carried out daily, which is laborious and time-consuming.

4) Assessment of implementation: lessons learned

What were the lessons learned (e.g. technical, institutional, policy, related to the WSP process, outcomes, etc.)? The adoption of a risk-based, preventive rather than reactive approach to managing the water supply system is important not only for safeguarding water quality but also supporting a more efficient allocation of investments and decreasing maintenance costs. The understanding (by the users' committee and other stakeholders) of the links between health and safe water creates a conducive environment for implementing WSP. Consumer's satisfaction surveys create a communication channel with the users and greatly facilitate verification of WSP effectiveness.