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Lessons Learned: Water Supply to Underprivileged Community

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Abstract

A water supply project to an underprivileged indigenous community (also known as "Orang Asli") involving an intake structure, HDPE pipeline and limestone horizontal roughing filter was undertaken by Universiti Sains Malaysia in collaboration with other related public agencies and departments. The purpose of this project is to provide clean and safe water supply for the community. This is because previous work of this nature that was done by the Perak Health Department were without any treatment and thus exposes the community to water contaminants such as Escherichia coli. This paper will discuss on the work involved beginning from staff mobilisation to project completion. It will highlight some of the strengths, shortcomings and lessons learned from the project, particularly in the aspects of community engagement, volunteerism, readiness, communication, budgeting and other technical problems.

Keywords*: water supply, filter, mobilisation, volunteerism, community engagement*

Introduction

Most aboriginal settlements in Malaysia are located in remote areas where accessibility to treated drinking water is a major concern. The cost of providing treated water is considerably high due to natural topographical problems normally encountered in the tropics with hilly and mountainous areas. The scattered locations of the indigenous community are additional factors that may cause higher capital investment to the water supply authorities. The underprivileged communities in Malaysia such as "Orang Asli' (OA) often lacks the financial resources to fund the water supply project. Unlike in Kenya, rural communities have involved community participation in planning of the water supply infrastructures over the past several decades (Marks & Davis, 2012). Results of the study in Kenya indicated that ninety-one percent of respondents were able to report the amount of money they had contributed to the installation of the water system. Among the 48% of sampled households which reported making up-front cash

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contributions toward water system construction, the median cash payment was US$91. Seventy-three percent said they had been aware of the water project before construction began, and 71% identified local actors being the water committee and village residents as having had the greatest influence over decisions related to service level, tariff structure, and the amount of up-front contributions required of users. Finally the findings suggest that the capital cost sharing policies of many developing country governments and international donor agencies may be broadly useful for instilling community sense of ownership for installed water supply infrastructure, but not when project rules require only small or “token” contributions from households. Studies in Indonesia and Togo suggested that for community-based water supply projects, it required substantial inputs of time, resources, skill and persistence from both the community and external agency (Eng, Briscoe, & Cunningham, 1990). These inputs must be sustained by both parties in all phases included planning, construction and maintenance in order to achieve lasting improvements in water supply and other aspects of community life. Despite decades of development assistance, over one billion people still do not have access to safe drinking water; the global community has acknowledged this problem, and one of the targets of the Millennium Development Goals is to halve the proportion of people without access to safe drinking water. Conventional wisdom argues that community participation is important to help us secure this target; however, there is little solid evidence to support this claim (Prokopy, 2005). Since the community of our proposed water supply project area has different background from those in Kenya, Indonesia and Togo, the only immediate solution is to propose our treatment technology and the community will be invited to participate for the project implementation.

The use of roughing filter as a pretreatment process has been well recognised and could be easily found in the literatures (Adlan, Aziz, Maung, & Hung, 2008; Affam & Adlan, 2013; Wegelin, 1996; Lin et al., 2006; Pacini, Ingallinella, & Sanguinetti, 2005). Horizontal flow roughing filters are simple, require no mechanical parts, have low capital cost, can be operated for a long time due to their high solids retention capacity, and with a wide variety of raw surface water characteristics (Sittivate, 2001). Roughing filters are long troughs open to the atmosphere with a series of flow-through compartments containing decreasing sizes of gravel. The gravel often consists of crushed river rock media from a 20-mm average diameter in the first compartment to a 4-mm average diameter in the last, and common flows range from 0.3 to 1.5 m/hr of horizontal filter area. Adlan et al. (2008) reported that turbidity removal are found to be 92% in 1.91mm filter media, 87% in 4.6mm filter media, 75% in 16.28mm filter media and 81% in a combination of the three filter media in horizontal roughing filter for the treatment of domestic wastewater. Coliform organisms’ removals are also found to be 82% in 1.91mm filter media, 83% in 4.6mm filter media, 67% in 16.28mm filter media and 96% in combination of three sized filter media. Rooklidge, Ketchum Jr, & Burns (2002) found that turbidity and suspended solids were removed at 79 and 94% respectively using limestone horizontal roughing filters. Results from the works of Maung (2006) indicated that in one of the wastewater sample the removal of *E.Coli* was 100%. Based on the capability of limestone media as an adsorbent, a proposal was forwarded to Division of Industry and Community Network (DICN), Universiti Sains Malaysia (USM) for water supply project to the underprivileged community. Due to financial constraint, discussions were held with Department of Health, Perak (DoHP) and Jabatan Kemajuan Orang Asli (JAKOA), the department which is responsible for the wellbeing of the aborigines in Malaysia in order to obtain financial assistance and facilitation of the project respectively. A financial assistance of RM120,000.00 was obtained from the Ministry of Health (MoH), Malaysia in early 2012 through DoHP. The fund was controlled by DoHP.

Scope of Work

The scope of works for the water supply project include construction of an impounding reservoir at an elevation of 333m above sea level (ASL), roughing filter at 239 ASL and laying of 75mm diameter HDPE from the intake to the settlement (153 to 173m ASL). The engineering design of all components of work was done by USM team members. The team from DoHP was responsible for pipe laying and providing 4WD transport. JAKOA provided liaison with the workforce or volunteers from the community, while USM staff took responsiblity for the skilled volunteers for the construction of intake weir and horizontal roughing filter.

Design Stage

This stage involved site investigation prior to designing of the water supply infrastructures. Data such as number of households and population in the village are important in order to determine the water demand and designed flow rate in the conveyance pipeline. Elevations of intake, horizontal roughing filter and supply area were collected in order to calculate the availability of water pressure in the supply areas. Previous water supply gravity feed system was unable to supply water to the houses that were located at high elevation due to low pressure in the pipeline.

Project Planning

The activities involved during project planning were meetings with stakeholders (orang asli community), DoHP and JAKOA primarily to discuss the following issues:

1. Purchasing of materials – Most of the materials such as HDPE pipes, cements, aggregates, sand and fittings were purchased by DoHP as they controlled the project funding given by the MoH. Amount of materials to be used were calculated by the technicians based on the prepared drawings.
2. Equipment – Since USM team is the main technical skill for the construction of the dam and reinforced concrete filter, basic equipment such as buckets, scoop, shovel, drills, generator, cutters etc. were to be provided by USM.
3. Fabrication works – USM to fabricate formworks, cutting of steel bars to the required length, and fabricated inlet channels for river diversion works. All fabrications were done at USM's laboratory.
4. Transportation – JAKOA and DoHP were to assist USM and OA to transport the construction materials from OA village to the project site using 4WD vehicles since USM has only two 4WD.
5. Communication – Since cellular telephone line is not available in the forest, USM staff has to carry walkie-talkie.
6. Accommodation for USM staff during project implementation – JAKOA was to provide free boarding at their transit center which is located at Sungai Siput Utara.
7. Food during project implementation – USM to provide food during construction works whereas JAKOA to provide assistance in the form of rice for the OA to cook.
8. Mobilisation of workforce – Last meeting between USM, DoHP and JAKOA was held on 10 May 2012 at School of Civil Engineering, USM. It was agreed that JKOA is to get workforce or volunteers among OA community to help USM team members to carry out materials and equipment from OA settlement to the work sites, help in installation and striking of formworks, help in concreting works, installation of limestone media etc. Staff from DoHP

will involve with pipe laying works and JAKOA will act as a facilitator for OA community. USM team was divided into two groups, the first team dealt with the construction of the weir and the second team with the construction of horizontal roughing filter.

9. Project schedule – Project schedule was drafted by USM team members after consultation with DoHP and JAKOA. It was agreed that the project should start on 11 June 2012 and to be completed on 5 July 2012 with 4 working days per week (Monday to Thursday). Prior to starting of work, it was agreed that on 4 and 5 June 2012, site clearance of access road to the intake and leveling of site for horizontal roughing filter should be made by hiring back-hoe from individual owner. Final site visit prior to construction works was made on 24 May 2012 to gather any missing data.

Project Implementation and Challenges

The project area is shown in Figure 1, in the district of Kuala Kangsar, Perak, Malaysia. The nearest town is Sg. Siput Utara, which is 15 km from OA settlement connected with state road to Kg. Kenang and thereupon with a narrow rural road pavement to the settlement.

Prior to project implementation, several site visits and meetings were conducted at the village of OA. On 12 October 2011, the first site visit was conducted. The villagers took USM team to the existing source of water supply where it was learned that the water is subjected to pollution from pesticides as the area is in the oil palm plantation. A new source was recommended by the community which is free from agricultural activities. Site visit to a new source was conducted on 16 February 2012 and water samples were taken for quality measurement. As the water samples were found acceptable in terms of turbidity, color and *E.Coli*, USM team members agreed to the proposal by community to have the intake at the new location.

In the project implementation, the first challenge was to carry the equipment and materials from OA settlement at an elevation of 153m above sea level (ASL) to the proposed filter and dam sites at an elevation of 253m and 333m ASL respectively with a total distance of 3 km. This involved materials such large size formworks, cement, aggregates and sand which had been transported by lorry to the village. However the earth road track heading to the site is very steep, undulating and slippery. 4WD vehicles were unable to carry some of the materials due to large size of formworks and long steel bars. After consultation with the nearby estate manager and on the basis of humanity project for water supply to OA, the USM team was able to secure a tractor with a large carrier to carry out the construction materials and equipment subject to payment to be made to the driver of the tractor. When the tractor was loaded with the materials, the driver does not want to take the risk of climbing the first hill nearby the village because of its steepness, slippery condition and additionally he has never experienced such steep hill. To overcome this hindrance, a driver from the OA managed to handle the tractor and have successfully transported the materials to the filter site.

The second technical problem that was encountered during this project was the diversion of the stream. The stream needed to be diverted so that the working area to construct the dam area is free of flowing water and therefore drilling and concreting works could be done. However the prefabricated inlets which were prepared in the workshop was found not suitable and water still leaking when the sand bags were placed. Realising this problem, the team member has to discard the prefabricated water inlet channels and only used a flexible pipe with sand bags placed following the contour of the base of the stream. The lesson learned is that for any diversion works, it is better to lay sand bags by following the bed profile of the stream and then placed the diversion pipe in between the sand bags. It will be a waste of resources and time to prefabricate the inlet channel of rectangular shape whereas the stream channel has a circular shape.

Figure 1 – Project area (in green colour)

The third challenge is about the steel bars that had been erected for the wall of the roughing filter. The bars were not laid vertically as well as not tied in a straight position. As a consequence, the steel bars have to be dismantled and rebuilt.

It was also found that during project implementation, the raw material especially the amount of cement ordered was inadequate. At this situation, the project leader had to buy the extra 50 bags of cement using his own money first. The problem with this project is that no petty cash was given to deal with any shortcomings. The financial control is done from USM main campus which is located 50 km from the Engineering Campus and communication for project financial obligation is a major challenge. This has happened at the beginning of project implementation where the team did not have petty cash for purchasing of basic materials such as food and beverages to be used during project implementation. Cash is needed to purchase tea, coffee, biscuits, noddle, eggs and etc. so that the volunteers have something to drink and eat during construction works. The team members then collectively agreed to advance RM500 for the project implementation and to later claim from the project funding.


Figure 2- Intake weir

Figure 3 – Horizontal roughing filter

The project was practically completed on 5 July 2012 with the construction of a water intake weir (Figure 2- Intake weir, horizontal roughing filter (Figure 3) and pipe laying works.

Lesson Learned and the Way Forward

The primary objective of this project is to provide safe water supply for the health of the indigenous population. In doing so, many parties were involved in realising the objective. The USM research team has successfully created a strong link with the lead agencies, particularly the JAKOA and DoHP to be part in this project. It is through this linkage that the project was able to be materialised successfully.

Outreaching to the community is another aspect that contributes to the success of the project. With the help of JAKOA, the research team was able to get connected with the community leaders and community at-large. The element of community engagement is manifested particularly when the research team has successfully carried out the needs assessment of the community. It is the needs assessment that helps to identify the community's understanding and level of acceptance towards the project. It is also through rapport building, trust building as well as needs assessment that further involved the community to participate in the building of the intake weir, roughing filter and the pipe laying works. On the whole, the community has contributed quite substantively in terms of their time and energy in ensuring the success implementation of the project. This is possible as the research team was able to inculcate some form of sense of belonging among the community of the project and its advantages, especially on the health aspects. Such commitment from the community is indeed one of the evidence of community engagement element that has been emphasised in this project.

The element of community engagement is also marked by the transferring of knowledge by the research team to the community. The construction work have somewhat taught the community on the ways of building a safe and practical water supply using simple resources. This transfer and sharing of experience has contributed to their better understanding on the importance of clean water supply. In terms of maintenance, the community has shown their full commitment to clean the intake screen after heavy downpour.

Other problems occurred during the post construction stage include the threat of wild elephants, damage to the cover of the roughing filter, as well as strong currents during heavy thunderstorms that can displace the pipe at the dam site which can lead to failure of connection at the fittings. Technical problems were also encountered due to lack of funding during project implementation where only basic design needs were provided. This included the positioning of the scour valve that was placed immediately under the weir and has caused water falling over the scour valve. The solution was donated by a water supply contractor who moved the scour valve downstream.

Other problem arising from the implementation of basic design need is a long delay in water travelling time from the intake to the village after the incident of intake clogging. This is due to air entering the pipelines when cleaning the water intake. The community was advised to avoid exposing the intake inlet point to prevent air from entering the pipelines. Until now, the USM team is trying to secure funding to provide air valves in the pipeline system so that air could be discharged in order to prevent delay in supplying of water to the community.

This project provides meaningful experience to USM staff and students on voluntary work and their commitment to contribute back to society. In fact, this experience exemplifies USM's aspiration to conduct research that can also benefit society immediately. Research should not only have desirable outputs but also meaningful outcomes.

To-date, the project is still ongoing. The current focus is now on the maintenance of the system to ensure its sustainability. The community has been able to maintain the water supply intake. This however will involve a continuous series of training sessions and monitoring for better awareness among the community to fully take charge of the project.

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