# CHAPTER 6

# Conclusions and Recommendations

## *6.1 Conclusions*

***Potential of Using Rainwater***

Similar to other regions in Thailand, rainwater is one of important sources for domestic water supply for both non-potable and potable use in Bangsaiy Municipality for a long period. Being located in Ayutthaya where the average annual rainfall of 1,347 mm. is not as high as other regions such as southern part of Thailand, the rainfall in Bangsaiy Municipality, if harvested, is sufficient for portable use particularly drinking and cooking throughout the year for the whole year and other domestic purposes in the long rainy season. Although the quality of rainwater has been much a concern of the local residents due to the increase of polluted environment, in accordance with past studies and research, chemical parameters particularly heavy metals meet the drinking water standards. High biological contaminants which mainly come from flusing rooftops when rainwater is harvested at the beginning of the rainfall can be removed with hygienic handling of rainwater, improving rainwater collection methods and installing simple treatment systems. According to the questionnaire survey and field observation, approximately, one third of households have rainwater conveyance and storage facilities put in place, although some of such facilities are not in good conditions. Considering supply side, with no doubt, there is a high potential in rainwater harvesting in small urban areas like Bangsaiy Municipality.

***Assessment of User demands in Rainwater Utilization***

In addition to the supply side, assessment of user demands is applied in this study to reduce risk of failure when a pilot project of rainwater harvesting is really implemented. Demands are assessed in five dimensions including quantity, quality, willingness to pay, levels of service and operation and maintenance of rainwater harvesting facilities. The key users including household users and public institutions were assessed their demands in this study.

For household users, piped water supply from groundwater nearly covers all areas of Bangsayi Municipality at present. As a consequence, quantitative demands in rainwater are declining. In contrast, qualitative demands are still high both for rainwater and piped water. Physical and

biological contaminants - such as bird droppings, dust, and pathogenic organisms - and asthetic apperances are at the top concerns in water quality of the surveyed households. As such, it is necessary for the local residents to seek alternative water sources which are safer or to improve quality of available water sources, mainly piped and rainwater, for drinking. According to the survey, purchasing bottled water and treating water by boiling or purifying it with on-site purification devices are among dominated options of drinking water. Given the local culture and confidence in using rainwater in the past, a high demand level of using rainwater is found in this study. More than 90% of respondents are interested in using rainwater if its quality meets the standard.

Nowadays piped water tariffs are considerably low ranging from 4 to 5 THB per cu.m. Approximately, 70% of household surveyed are satisfied with the current rates. However, the tariffs cannot be maintained at these rates for long because of the increase of fuel prices which are main operating costs for pumping groundwater. Therefore using rainwater as an additional water source can help reduce water expenditure. On the contrary, expenses in relation to drinking water such as purchasing bottled water and installing purification equipment are relatively high. Given the circumstances of the high payment for drinking water, it is reflected in a finding from the survey that 63% respondents who currently purchase bottled water are interested to shift to using rainwater as a source of drinking water if its quality is improved. This proportion can be future target users of using rainwater for drinking if a pilot project is implemented.

Levels of service of the current water supply are very high as almost every household can access individually to the piping system. For supplying drinking water, there are two levels of service. Those who could afford moderate to high prices of water costs could gain a higher level of service such as home delivery services of bottled water run by private operators and installing on-site purification equipment. Relative low prices of drinking water are also available with a lower level of service. This appears in the case of drinking water services of community-owned-enterprises in which prices of bottled water per gallon is in average 5 THB cheaper than prices fixed by private enterprises but users must be proactive in access to the drinking water by themselves. Therefore a pilot project of potable and non-potable rainwater shoud be designed in such a way that deliveries of stored rainwater for domestic use is similar to, or at least not lower than, the current levels of service.

Rainwater coveyance systems and storage devices installed at households are operated and maintained by their owners. Operation and maintenance activities are basically simple for example periodic cleaning the conveyance systems and devices and repairing and changing broken equipment. The current piping and treatment systems of water supply require maintenance by technicians. Similarly, installed on-site purification systems for production of drinking water require periodic maintenance by professionals such as changing filters or membranes. Therefore on-site rainwater harvesting systems of a pilot project for non-potable use which installation of filtration and disinfection are not necessarily added, it shoud be designed to be easily operated and maintained by their owners. Otherwise, if advanced rainwater harvesting systems are required in case of potable water, there is a demand in enhancing capacity of local technicians. Alternatively, getting technicians of private operators in water supply sevices in touch with the local users has to be initiated to help prevent operation and maintenance problems foreseenable in long run.

For public institutions, based on interviewing, there are two key factors influencing demands in rainwater utilization. The first one is the desire to conserve historical traditions related to rainwater utilization. The second one is related to creating awareness and educating young generations in water conservation. Apart from these, basically, the other demands are similar to household users.

***Design of a Pilot Project for Rainwater Harvesting Systems***

Rainwater harvested can be used as potable and non potable use. However using rainwater for drinking has more potential and directly responds to the demands of household users and public institutions. For portable use, rainwater must be treated to remove the contaminants and generally the main required treatment processes are filtration and disinfection. The existing tank in schools could be use as integrate water resource during dry period. Furthermore, this rainwater could be combined with drinking water treatment sytem in school and/or household to mak drinking water as alternate resource. Additionally, Rainwater harvesting system in the study area could be combined with the existing system as shown in Appedix IIb

However, to develop future potable water usage such as drinking water, some simple treatment have to include such as first flush device. Therefor, in this study, the possible site location could locate in school and in household which locate in communities because of the high potential to supply rainwater for consumption.

## *6.2 Recommendations*

In other part of Thailand and developing countries, the design pilot project might be change depending on annual rainfall and catchment area. Acceptionally, the main system of rainwater harvesting woul be the same. For example, in North East of Thailand which has shorter period of rainy season and less annually rain fall, the larger storage and larger catchment area may define to use and adaptable.

As mention the results from questionares, the main critical factor to do drinking water from rain water is the quality of rainwater. People in study area worry about water quality and also some disease especially bird flu. It is recommended that the pilot project should not much big size to test the drinking water and make sure that people accept the quality of drinking water from rainwater.

For nonpotable purpose, there are 6 ferrocements in Wat Bang Sai Nai schools already made but need to maintainace and fix the systems. These could be run as model for non potable use which is safe cost more than doing the new one. For alternative drinking water, By pass use with existing drinking water treatment sytem are available.