Rainwater Harvesting Evaluation: A Quick Survey among Malaysian

N. Shaari[1], A. I. Che-Ani[1], H. Yahaya[2], N.A.G. Abdullah[1], N.M. Tawil[1]
[1]Department of Architecture, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia. euda@vlsi.eng.ukm.my
[2]Faculty of Architecture and Built Environment, International University College of Twintech Technology, Malaysia

Abstract

Rainwater harvesting (RWH) is a technology used for collecting and storing rainwater from rooftops, the land surface or rock catchments using simple techniques such as jars and pots as well as more complex techniques such as underground storage tank. In Malaysia, the implementation of RWH is moving steadily with the encouragement from the government. A step by step is now taken by the respective government agencies to promote rainwater harvesting, as well as promoting it to the public. In this paper, a survey was conducted as to know the respondents' perception towards RWH. The research conducted among 145 respondents. The methodology adopted is using the personally-assisted questionnaire survey and the data is analyzed using the SPSS, in identifying the level of respondent's agreement of RWH. The main finding reveals that the implementation of RWH can reduce water bill, increased agricultural productivity and reduced soil erosion. Among the issues highlighted is not enough awareness of the RWH benefits, government seems not very supportive and not enough professional to design the RWH system.

Keywords: building performance, rainwater harvesting, resident experience, sustainability

1.0 Introduction

Malaysia is one of the countries in the world nowadays that having rapid growth of population and expansion in urbanization, industrialization and irrigated agricultural. The impacts of the growth have put excessive demands on water supply and water resources. In 1998, Malaysia facing the serious water crisis because of the drought from climate changes (El Nino Phenomena). The State Water Board has to ratio all the water supply to make sure the entire user get enough water at that time. Government had listed some of the effort that can be used to overcome water shortage; and rainwater harvesting system is a part of it (Mohd.-Shawahid et al., 2007).

Malaysian government under Ministry of Housing and Local Government (MHLG) have set up a working group that looks into the mechanism in incorporating rainwater system to Malaysian building. To date, the MHLG encourages all new buildings (except residential) to be rainwater harvested.

Generally, rainwater harvesting system is the direct collection of rainwater from roofs and other purpose built catchments, the collection of sheet runoff from man-made ground or natural surface catchments and rock catchments for domestic, industry, agriculture and environment use. The systems can be categorized as small, medium and large scale (Gould 1999). Normally, the size of rainwater harvesting was based on the size of catchment area (Thamer et al., 2007).

Rainwater harvesting also refers to collection and storage of rainwater and also other activities aimed at harvesting surface and groundwater, prevention of looses through evaporation and seepage and all other hydrological studies and engineering interventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit as a watershed (Agrawal and Narain, 1999). Rainwater harvesting system has been implemented in many countries such as United States of

America, United Kingdom, Japan, China, India, Africa, Germany and Australia to support the increasing water demand (Thamer et al., 2007). The integration between rainwater harvesting system and existing conventional water supply systems will help to meet the demand and contribute in the sustainability of the water supply.

2.0 Implementation of Rainwater Harvesting in Malaysia

In Malaysia, rainwater harvesting system was officially introduced after the 1998 drought by MHLG. The 1999 'Guidelines for Installing a Rainwater Collection and Utilization System' can be seen as the initial phase of the rainwater harvesting policy in Malaysia. The main purpose of these guidelines is to reduce the dependence on treated water and provides a convenient buffer in times of emergency or a shortfall in the water supply. It also proposed the construction of 'mini dams' or rainwater tanks in urban area instead of continuing to build giant dams upstream (Mohd.-Shawahid et al., 2007). This guidelines is intended as an 'ideal manual' for reference for those who want to install a rainwater harvesting and utilization system (MHLG, 2008)

After five years of this guidelines, namely in 2004, the MHLG has prepared another cabinet paper to the National Water Resources Council to encourage government buildings to install a rainwater collection and utilization system. The Council has later announced that rainwater utilization is to be encouraged, but not mandatory. The Department of Irrigation and Drainage and The Ministry of Energy, Water and Communication (KTAK) (now is known as Ministry of Energy, Green Technology and Water (KTTHA); due to the restructuring of cabinet as announced by the Prime Minister of Malaysia on April, 9 2009) are the other two government agencies that implement the rainwater harvesting system in the early. The acceptance on rainwater harvesting system in the beginning is not good enough. Only few areas like Sandakan and Shah Alam that has introduced rainwater harvesting system in new housing developments (Mohd.-Shawahid et al., 2007).

National Hydraulic Research Institute of Malaysia (NAHRIM) that established under Ministry of Natural Resources and Environment in 2004 is also one of the agencies that carried out pilot projects for rainwater harvesting system. The projects are (i) double storey terrace house located at Taman Wangsa Melawati, Kuala Lumpur, (ii) Taman Bukit Indah Mosque, Ampang and (iii) Headquarters of the Department of Irrigation and Drainage, Kuala Lumpur (Jamaluddin and Huang, 2007). In support of the government's interest in RWH, NAHRIM also actively involved in designing and installing rainwater harvesting system for several schools (Mohd.-Shawahid et al., 2007).

In 2005, the Federal Constitution has been transferred all matters related to water supply services from State List to Concurrent List (Mohd.-Shawahid, et. al. 2007). This enable the Federal Government involvement in the water services sector and to establish regulated water services industry. Due to this, KTTHA has come up with two new water related laws; Water Services Industry Act 2006 and Water Services Commission Act 2006. In the new act, the Ministry is actively involved in the water saving programs which encouraging rainwater harvesting system implementation. Figure 1 showing the development of rainwater harvesting implementation development in Malaysia since 1975 until present.

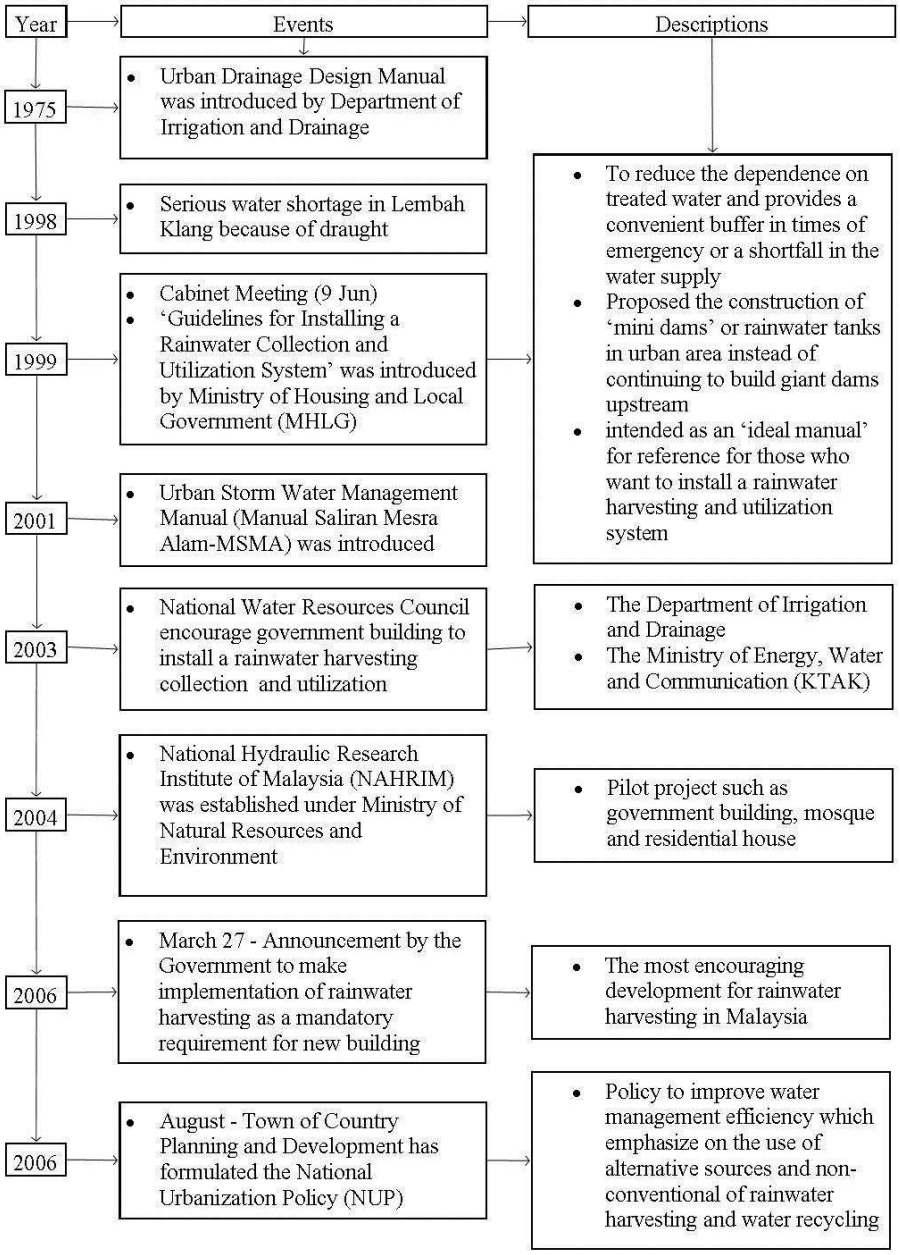

Figure 1: Development of Rainwater Harvesting System Implementation in Malaysia

3.0 Methodology

The research was conducted among 145 respondents from Malaysia during a period of 4 months, starting from January to April 2009. The respondents are randomly selected among Malaysian. The purpose of this survey is to gauge the respondents' perceptions towards the RWH implementation. It is important as to know how Malaysian believed about the system. The data collection was carried out using a set of questionnaires, with the approach of personally-assisted questionnaire survey. The evaluation was set on nominal, ratio and interval scale given as 0% agrees to 100% agree. To simplify this report, the figures of respondent's agreement level shown is for more

than "75% agree". All tables and figures are drawn from this survey, unless otherwise specified.

4.0 Results And Discussion

4.1 Respondent's Profile

Analysis of the data indicates that of the 145 respondents, it was found that almost 55% of the respondents are male and the other 46% of the respondents are female. Table 1 show the distribution of respondents by gender and education. From this distribution, majority of respondents having a university qualification (73%), thus giving some insight and trustworthiness for the survey conducted.

Table 1: Respondents' Distribution by Gender and Education

Distributions		Respondents (%)	Total (%)
Gender	Female	45.5	100
	Male	54.5	
Education	Primary	2.1	100
	Secondary	11.0	
	College	11.7	
	University	73.1	
	Did Not Respond	2.1	

4.2 Water Consumption and Experience with RWH

Water Bill Amount

Mean water bill per month (RM) = RM32

The water bill per month with number of respondents is shown in Table 2.

Table 2: Frequency and Percentage by Average Water Bill

Average Water Bill/Month (RM)	Frequency	%
Less and equal RM 19.99	37	25.5
RM20.00 - RM39.99	46	31.7
RM40.00 - RM59.99	22	15.2
RM60.00 - RM79.99	6	4.1
More than RM80.00	17	11.7
Did Not Respond	17	11.7

Close Experience with Domestic RWH

From 145 respondents, only 14.5% of them were use rainwater in their house and 8.3% of them had involved in rainwater harvesting projects. However, 61.4% of them never had experience with rainwater harvesting but interested with these system while the other 8.3% did not respond. In summary, Figure 2 shows the Respondent's Percentage by

Experience with Domestic RWH. This shows that majority of respondents interested to apply the RWH system. Indirectly, this is a positive move in the awareness about RWH.

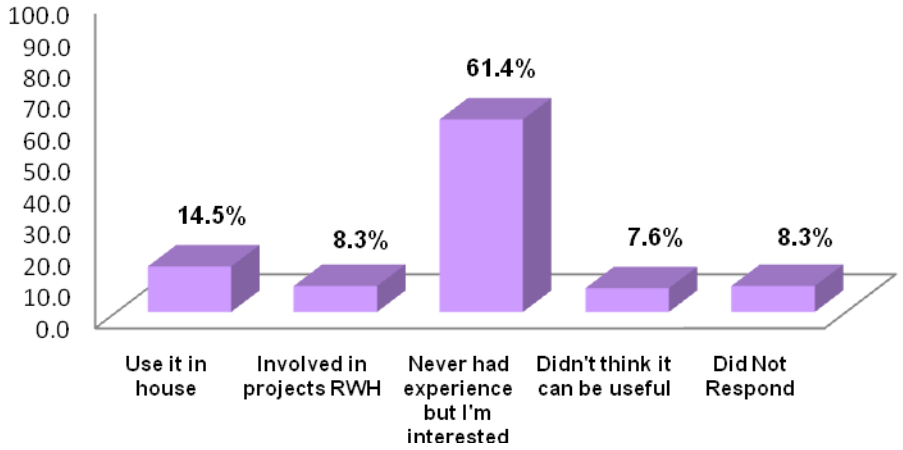

Figure 2: Respondent's Percentage by Experience with Domestic RWH

Willing To Install a Rainwater Tank

From 145 respondents, 6.9% of them already have rainwater tank and more than half (64.1%) of the respondent willing to install a rain water tank on their property if it was made easy and inexpensive. 9.7% of respondents will not install it, while 13.8% of them said not sure and the other 5.5% of them are did not respond. In summary, Figure 3 shows the respondent's willingness to install rainwater tank. This also portrays a positive move among the respondents' perception in implementing RWH.

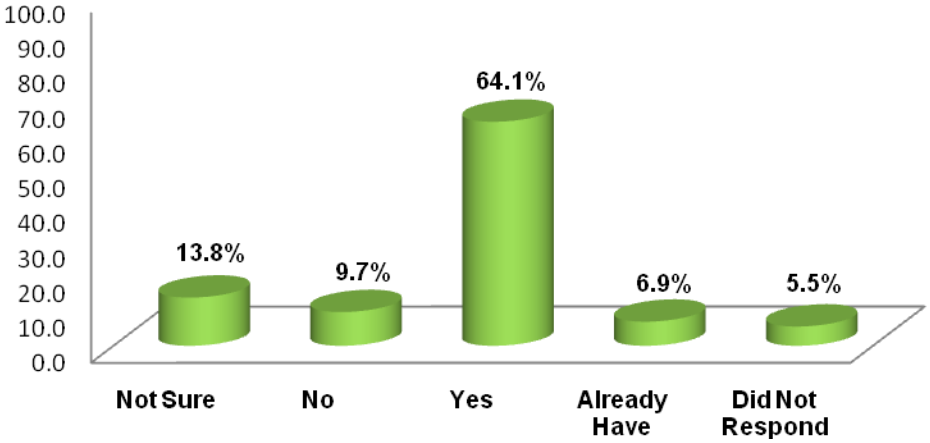

Figure 3: Respondent's Willingness Percentage by Installing Rainwater Tank

The Use of Rainwater

If RWH was set up properly, 71.7% said 'yes' to use the rain water for gardening and cleaning house (outdoor). 69.7% said 'yes' for flushing toilet and 60.7% of respondents said 'yes' to use rainwater for cleaning vehicle. Figure 4 shows the percentages of respondent which said 'yes' for each uses. From this findings, the needs for using rainwater is concentrated on the outdoor-type activities, thus making the internal plumbing, particularly for kitchen is not necessary (unless for flushing toilet

only). This is because the respondents still did not ready to use the rainwater for food preparation, laundry, cleaning house (indoor), drinking, cooking, washing dishes and bathing.

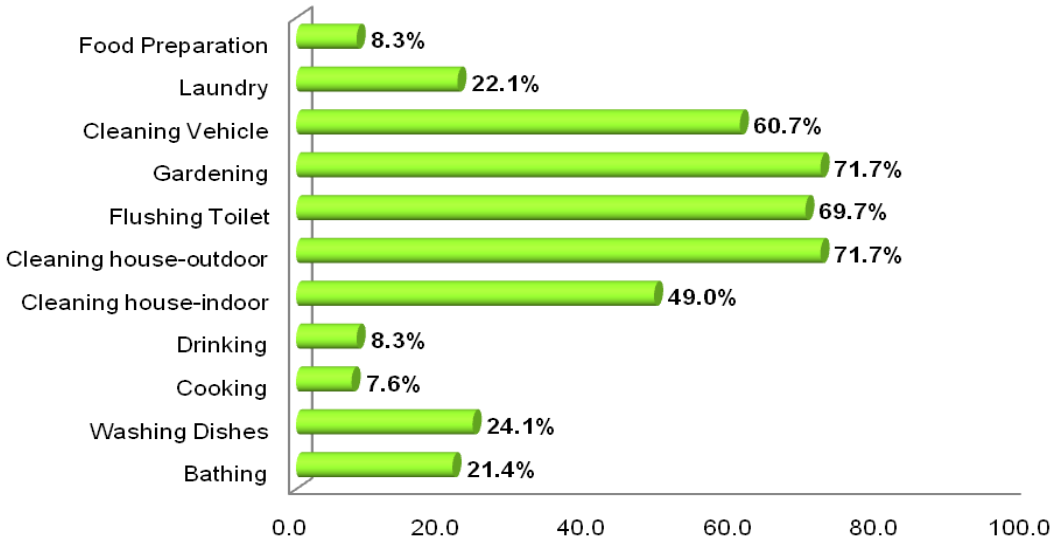

Figure 4: Respondent's Percentage by the Use of Rainwater

4.3 Effectiveness of Rainwater Harvesting System

Minimizing Problems

Rainwater harvesting can minimize the problem of water crisis, radiation, air pollution, acid rain, global warming, prevent hot spot and flash flood. Based on Figure 5, the residents feel that the implementation of rainwater harvesting system can minimize the water crisis which has a score of 62.8% (the highest score). The second problem that can be minimized is prevention of flash flood and follow by the third one, namely global warming. From this finding, it shows that the resident had experienced the rainwater harvesting system can minimized the water crisis and flash flood.

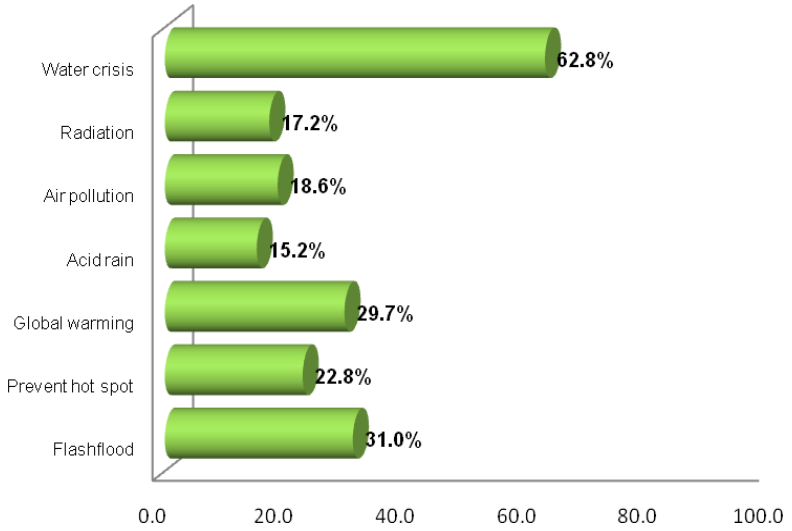

Figure 5: Respondent's agreement level on minimize problems. (More than 75% agree)

Benefits

Rainwater harvesting has a lot of benefits such as control climate change, improve river management, reduced soil erosion, reduced water bill, increased groundwater level and increased agricultural productivity. Based from Figure 6, the residents feel that rainwater harvesting can reduce water bill which has a score of 72.4% (the highest score). The second benefit of rainwater that respondent noticed by using rainwater harvesting is increase agricultural productivity (48.3%) and reduce soil erosion (42.1%)

From this finding, it shows that respondent had experienced the rainwater harvesting can reduce water bill, increased agricultural productivity and reduce soil erosion. The main factor for this finding is perhaps the residents experienced the impact before and after using the system. Besides, some of the benefits can be calculated to determine the advantages before and after using the system such as monthly water bill. Residents still agreed that rainwater harvesting can giving those benefits such as improve river management, increased groundwater and control climate change. However it portrays the lower percentage from the others as this benefit is not giving the direct impact to the respondents.

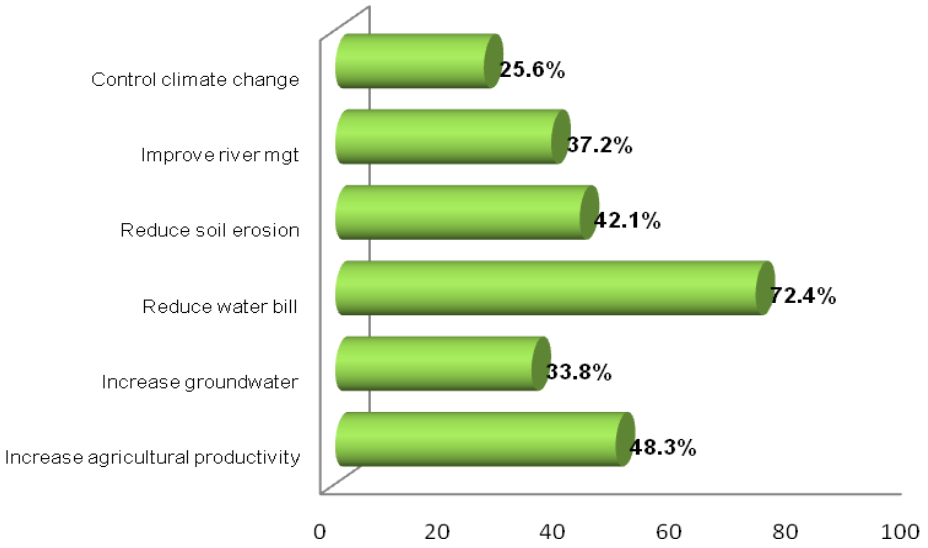

Figure 6: Respondent's agreement level on benefit RWH (more than 75% Agree)

Implementation Issues of RWH

Figure 7 shows the percentage of respondent agreement level on rainwater harvesting implementation issue. From the figure, 48.3% of respondents agree that there is not enough awareness of RWH benefits and 41.3% of the respondents also think that the government seems not very supportive towards rainwater harvesting systems. 32.5% of respondents also think that there is not enough professional to design the system.

From this finding, it shows that respondents feel there is not enough awareness of the benefits and government seems not very supportive towards RWH systems. This is perhaps because of the slow progress of the development of this RWH system in Malaysia, thus making these two issues highlighted by the residents at the fore front. Besides, the residents also feel that the government not very supportive, perhaps because of RWH is not made mandatory in Malaysia. Another issue highlighted by respondents is not enough professional to design the system. The main cause for this finding is perhaps

the system seems to be very new in Malaysia since it is officially introduced in 1998. Therefore our building industry consultant is not aware of its implementation. Furthermore, we do not have the special training program for rainwater harvesting design; unlike in India they have this kind of program under its Centre for Science and Environment (CSE), New Delhi.

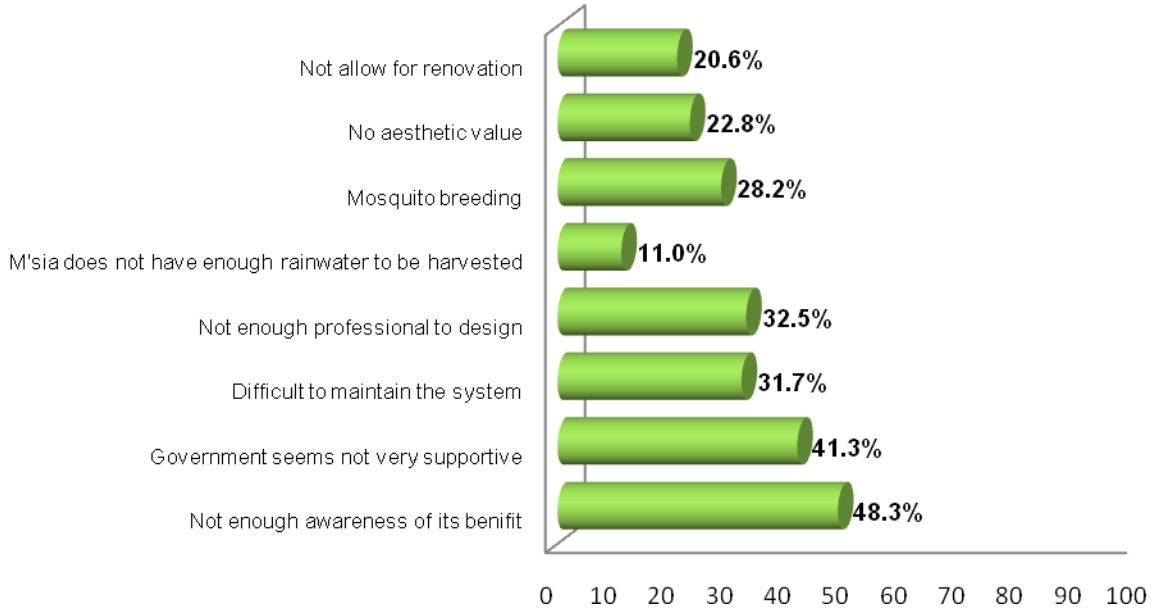

Figure 7: Respondent's agreement level on implementation issue of RWH (more than 75% Agree)

5.0 Conclusion

This paper discussed about the respondents' perceptions towards RWH system. It gives insight in the move of RWH in Malaysia. Various government agencies are actively involved in promoting rainwater harvesting system. In ensuring its success, the respondents' perception has to be gauged as to give some feedback to the government and the implementer. The key point from this study is there is a positive move in the implementation of RWH i.e. almost 60 to 65% of the respondents interested in implementing RWH and willing to install the rainwater tank. On the implementation issue, the benefits of RWH has to be widely publicised, perhaps by using mass media as to promote the RWH to public at large. With the strong move by construction industry professional via Green Building Index (GBI), we can expect the active implementation of RWH in the near future.

References

Agarwal, A; Narain, S. (1999). A Water Harvesting Manual for Urban Areas: Case Studies From Delhi. Centre for Science and Environment, Revised Edition 2003

Gould, J. (1999). Contributions Relating to Rainwater Harvesting. Paper prepared for the World Commission on Dams Secretariat (WCD) Thematic Review IV.3

Jamaluddin, S.A.; Huang, Y.F. (2007). NAHRIM's Experince in Rainwater Utilisation System Research. Paper presented at Rainwater Utilization Colloquium on 19 & 20 April 2007 at NAHRIM Mini Auditorium.

Ministry of Housing and Local Government (MHLG) (2008). Guidelines for Installing a Rainwater Collection and Utilization System, 1999. Ministry of Housing and Local Government.

Mohd.-Shawahid, H.O; Suhaimi, A. R; Rasyikah, M. K; Jamaluddin, S.A; Huang, Y.F; Farah, M.S (2007). Policies and incentives for rainwater harvesting in Malaysia. Paper presented at Rainwater Utilization Colloquium on 19 and 20 April 2007 at NAHRIM Mini Auditorium.

Thamer, A.M; Megat-Johari, M.M; Noor, A.H.G (2007). Study on Potential Uses of Rainwater havesting in Urban Areas. Paper presented at Rainwater Utilization Colloquium on 19 & 20 April 2007 at NAHRIM Mini Auditorium.