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Transforming School of Humanities University Sains Malaysia into an Example of a Best Management Practice in Water Demand Management

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Abstract. Institutions of higher learning in Malaysia are huge water consumers. The main reason is that only the administration pays for the water but not the staff, students or visitors. Hence, there is a lot of wastage resulting in huge water bills. In University Sains Malaysia, the School of Humanities is taking the lead to reduce water consumption via a Best Management Practice (BMP) Demonstration Project on water demand management. The main objective of the project is to reduce water demands via finding alternative water source such as a rainfall harvesting system, change water behavior via changing water fittings and changing human behavior in water use. The methodology involves installing a rainfall harvesting system whereby the rain water harvested is used for toilet flushing and gardening, changing conventional "water-wasting" fittings to "Water-Friendly" fittings, and changing the mindset of all staff, students and operators in the school from that of "Free Water" to "Paid Water". Results of the project showed that there was a water savings of about 50 % in the school. There was also a noticeable increase in awareness and commitment of Staff, Students and Visitors on water conservation. Finally, this project has paved the way towards the ultimate reduction of total water consumption in the university to a level that can be benchmarked as being a "Water Responsible" and sustainability-led university.

Keywords: Water Demand Management, Rainfall Harvesting, Water-Friendly Fittings, Sustainability-led University

1. Introduction

Water security is considered one of the most important issues faced by countries in the 21st century. Although Malaysia is considered a country with bountiful water resources, it still suffers from periodic water stress and many other water problems. Hence, from a previously situation of relative abundance, the country is now faced with a situation of scarcity both in terms of space and time [1]. Hence, it is imperative that water consumers, especially large water consumers such as businesses, hotels and universities are engaged to save water. The time has come to change from a mindset of consumptive wastage to careful conservation amongst consumers. University Sains Malaysia (USM) has prided itself as a sustainability-led university and should lead by example [2]. Notwithstanding other aspects of sustainability that USM has achieved, the university's average water consumption is very high by any standards. In 2010, the USM main campus's water bill averaged MYR200,000 (MYR1= US$0.327 as of 4 October 2012) per month or equivalent to about 200,000 m^3 of water consumed. This adds up to about MYR2.4 million per year or (at the average water tariff of MYR1/m^3 (1m^3= 1000 litres), the amount of water used is about 2,400,000,000 litres in 2010. If we divide this by 20,000 people (main campus staff and students), the per capita water consumption is about 120,000 litres/capita/year or 329 litres/capita/day (lpd). In comparison, the United Nation's international recommended standard is 165 lpd, Penangites average is 286 lpd and Malaysia's national average is 220 lpd. The average industry benchmark for educational institutions is 144 lpd. This puts USM's usage of 329 lpd at 2.28 times above the industry's benchmark. With such enormous water usage, USM is a long way from becoming a sustainability-led university, at least in terms of water sustainability! The main sources of water wastage in USM are as follows: Timer Operated Urinals; Traditional Single Flush Cisterns

(every flush uses 9 litres of water); Manual Taps (often left leaking); Manual Showers (often left leaking); Leaking Taps/Pipes; No Alternative Water Source such as Rainwater or Well/Groundwater (USM depends 100 % on PBA water); Human Apathy/Irresponsibility since when people don't pay, they don't care! (In USM, the warga USM such as staff and students do not pay for the water they use). Hence, it is time for change. USM needs to install water savings fittings, replace water-wasting fittings with water-saving ones, and educate its staff and students on the importance of water savings. This project is a first step towards that direction [3].

Notwithstanding the USM case, almost all other institutions of higher learning in Malaysia are huge water consumers. The main reason is that only the administration pays for the water but not the staff, students or visitors. Hence, there is a lot of wastage resulting in huge water bills. Hence, it is imperative that such institutions embark on water demand management to reduce their water footprints via using green technology and changing consumers' behavior [4]. In USM, the School of Humanities is taking the lead to reduce water consumption via a Best Management Practice (BMP) Demonstration Project on water demand management. The main objective of the project is to reduce water demands via finding alternative water source such as a rainfall harvesting system, change water behavior via changing water fittings and changing human behavior in water use. The methodology involves installing a rainfall harvesting system whereby the rain water harvested is used for toilet flushing and gardening, changing conventional "water-wasting" fittings to "Water-Friendly" fittings, and changing the mindset of all staff, students and operators in the school from that of "Free Water" to "Paid Water" [5].

This School of Humanities' BMP is a first of its kind in the whole country. The project has great potentials as the water savings, both in terms of water saved and monetary savings are enormous. When it is successful, similar projects can be replicated in all Schools, Centres, Canteens, Hostels, Buildings in all 3 campuses in the university as well as it all other universities. The main objectives of the project are: (i) To install a rainfall harvesting system (an alternative water source) for all PPIK's buildings; (ii) To change all conventional "water-wasting" fittings to new "Water-Friendly" fittings; (iii) To change the mindset of all staff, students and operators in PPIK from that "Free Water" (Paid by USM) to "Water Paid by PPIK" (Water Use KPI of PPIK); (iv) To increase awareness and educate all PPIK's Staff, Students and Visitors on Water Savings in all buildings in PPIK towards the sustainability of water in the school; and (v) To reduce Water Consumption to a level that can be benchmarked as being a "Water Responsible" School in an APEX-Sustainability-led University.

2. Methodology

The methodology involves both fizikal installation of water structures as well as changing human behavior in terms of water awareness and water use. Traditional water fittings that waste a lot of water such as timer-based urinals, 9-litre flushing system and manual taps are changed to push urinals, dial-flush system and automatic taps respectively. The water pressure is also manipulated by installing water balance regulators to control water flow to a satisfactory level adequate for most usage that did not compromise on comfort. Fizikal installation also involved installing a rainfall harvesting system complete with gutters on rooftops in the four buildings of the school that were connected via drain pipes into 4 water tanks of between 5,000 litres to 10,000 litres capacities. The tanks were also connected to the piped water supply whereby during the dry season when there is not enough rainwater collected, piped water would automatically be channeled to the toilets and garden taps for uninterrupted use. The rain water harvested is only used for toilet flushing and gardening. Another method is the use of education to increase water awareness and change the mindset of all staff, students and operators in the school from that of "Free Water" to "Paid Water". In this respect, periodic road shows and talks were held, and water saving pamphlets, postcards and calendars were distributed to staff, students and visitors. In order to monitor the amount of water used, water meters were installed in all four buildings. Readings were taken before and after the project started. Quantitative and qualitative surveys were also conducted to test the staff, students and visitors' awareness on water issues.

3. Rainfall Harvesting System

The School of Humanities' Rainfall Harvesting System consists of a rooftop gutter system that drains rainwater down several pipes to several water tanks between 5,000 litres to 10,000 litres capacity. The water tanks are then linked by water pipes to the toilets (for flushing) and garden taps (for washing and gardening). Results indicated that a large amount of rainwater can be harvested every month. This is because there is abundant rainfall every month, averaging between 200 to 500 mm per month [6]. Hence, the lesson learnt is that Malaysia has high rainfall all year round and has great potentials for rainfall harvesting. Unfortunately, however, we are not capitalising on our rich potentials on rain water at the moment [7]. Installing a Rainfall Harvesting System in apartments is fairly easy as most rooftops have built-in gutters and drain-pipes trapping rain. Chan (2012)[8] showed that a condominium has harvested more rain water than it could use. To use more of the harvested rainwater, it needs to be diverted to the area whereby washing activities such as car washing and garbage bin washing take place. In the School of Humanities project, the four tanks would fill up quickly to the brim after each heavy rain storm event. Hence, the school is currently not fully utilizing all its harvested rainwater. The school's cleaners and gardeners also prefer to use the piped water as they provide better water pressure to enable them to finish their work faster. The school also has a small garden in front of building C24 and C20. There are not that many plants to water (for gardening) in and around these two buildings. Hence, it was proposed to build a car-washing bays utilising rainwater next to building C20. It was also suggested that rainwater be channeled to other buildings next to the school, viz. the Centre for Global Sustainability Studies (CGSS) and the Institute of Postgraduate Studies (IPS).

4. Installation of Water Saving Fittings

The total number of water saving fittings installed in the school totalled 74 units. The types of Water Saving fittings include: 25 Dual flush cisterns; 31 Automatic Push taps; and 18 Push Urinals. The areas installed with such fittings were the toilets on all the four buildings in C20, C24, C11 and C12. Table 4 shows water consumption data for the school. Before the installation of the rainfall harvesting system on 23rd Dec 2011 and water saving fittings installation on 30th Sept 2011 (regulators) and 9th Dec 2011 (Dual flush), it is clear that the average water consumption in the school was very high, between 150 m3 to 160 m3 per week. After both systems were installed, the water consumption showed a very significant decrease. This was shown in June 2011 onwards with water consumption figures averaging between about 70 m3 to 80 m3 per week. This is a significant decrease of more than 50 %. Figure 1 illustrates the trend of this significant decrease in water consumption. In terms of monetary savings, this may not be much as the water tariff is MYR1.00 per cubic metre. This is equivalent to a monetary savings of only MYR80 to MYR 90 per week for the two buildings of C20 and C24. The other two much smaller buildings of C11 and C12 did not show any significant decrease in water savings as these two buildings housed only about 30 to 40 academic staff each.

5. Water Awareness and Education

In terms of changing human behavior on water usage, several water awareness and educational materials were made and distributed to the staff, students and visitors. These include a water saving handbook (Fig 1), a rainfall harvesting manual (Fig 2), a water saving calendar (Fig 3), and water saving postcards. These materials were distributed to staff, students and visitors. Water Watch Penang, an NGO, carried out the campaign [8].

Several talks on awareness and water savings as well as training sessions on water use were also held for staff and students. This process is expected to continue into the second semester.

6. Weekly Water Usage

Meter readings had been carried out since April 2010. Only buildings C11 and C12 are connected to rainwater while buildings C20 and C24 were connected much later in July 2012. Rainwater can only be supplied to toilets and as such this project needs extra funding for extra piping system. The meter readings for buildings C11 and C12 were monitored. Rainwater was used for all the toilets in C11 and C12 beginning week 31 December 2011 to 6 Jan 2012. It dropped during the first week of usage to 1.634 cubic metres. Strangely, on the second week the usage jumped to 3.253 cubic metres. Further monitoring is needed to

study the long term usage. It should also be noted that all usages for C20 and C24 recorded heavy usage on the same week. Figure 4 shows building C20 (main building) including use of rainwater. Even without using rainwater, the water saving fittings were shown to be highly effective in saving about 50 % of normal water use. It can therefore be concluded that there is tremendous potentials for water demand management and rainfall harvesting in universities in Malaysia. Logically, this project should be replicated in all institutions of higher learning, businesses, hotels, schools and government offices.

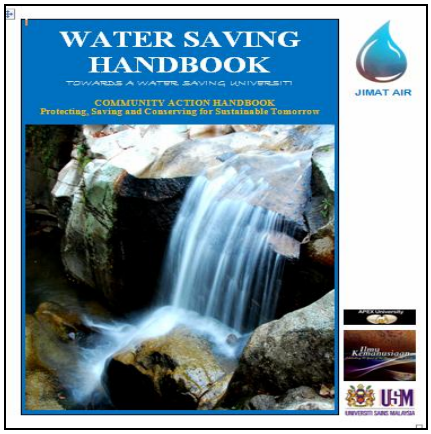

Fig 1: Water Saving Handbook

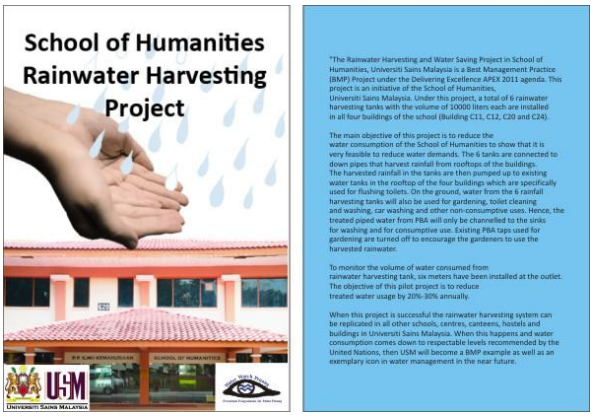

Fig 2: Rainfall Harvesting Handbook

Fig 3: Ways to Save Water

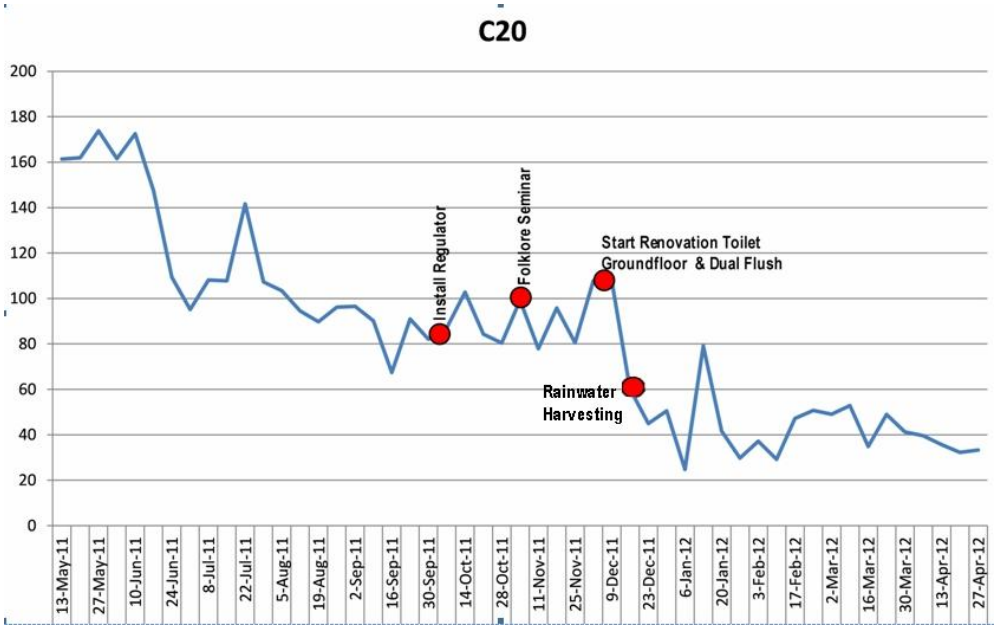

Fig 4: Meter readings for C20 (Main Building)

7. Conclusion

Overall, there is no doubt that the School of Humanities USM Water Saving Project had shown remarkable success in terms of water demand reduction and water saved as the water consumption was reduced by about 50%. When the rainwater harvested is used in buildings C20 and C24, it is expected to generate even greater amounts of water saved. The rainwater harvesting system, though initially problematic, showed great promise as more water was harvested than could be used. Water saving devices/fittings also showed tremendous potentials. Controlling the water pressure by installation of water balance regulators was very successful, although some members of the staff were initially unhappy about the reduced flow rate caused by lower water pressures. Overall, water savings were significant and the toilet fittings were also aesthetically beautiful. For the staff, students and visitors who were exposed to the water saving campaign, they became more aware of the importance of water and were enlightened on the many advantages of Water Demand Management, Rainwater Harvesting, and Water Saving Devices available in the market. Other benefit of the project includes closer cooperation amongst colleagues, among staff and students, and amongst staff and visitors. Significantly, this project can be easily replicated in other universities and institutions of higher learning across the country as the methodology is simple and effective. This project has shown that water demand management is "workable". The success story of this project needs to be publicized and this BMP should be properly documented and replicated not only in universities but in all large buildings throughout the country. This project also proves that smart-partnerships between Government, Private Sector, NGO and local communities are indeed workable. Universities are like small townships and as such have great potentials to save water, given the large amounts of water they use. This project has not only generated water savings but also changed the mindset of water consumers, which is more difficult to do. Participants in this project had shown greater awareness on water and environmental issues after being exposed to the project, proving that the project had a profound effect on them. However, some of the problems encountered include the inaccuracy of old building plans (many pipes and their connections could not be identified), underground leaking and the lack of vendors in rainfall harvesting systems. The university's rigid tendering procedures for water works was also a hindrance that caused the project much delay. At present the rainwater harvesting system is only functioning in buildings C11 and C12. Unless new budget be given to construct extra piping to the tanks (C24 and C20), this project will not be 100% successful. Nevertheless, this rainwater harvesting project can be considered a pioneer project in Malaysia and as an institution of learning, we are duty bound to welcome visits, give talks and attend conferences to publicize this sustainable project in line with USM's status as a sustainability-led university. An off-shoot of this project is that of a university-wide water saving project funded by water savings acquired from a reduction of water tariffs in three hostels given by the water service provider. It is envisaged that this project will run for seven years and by the end of that period, hopefully all buildings in USM main campus will be fitted with rainfall harvesting systems and water saving fittings, and their staff and students highly sensitized towards water conservation.

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