Chapter 6
A Potential Reuse of Greywater in Developed and Developing Countries

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Abstract The interest in greywater reuse as an alternative water supply is increasing in most part of the World. In Perth, Western Australia (WA), an industrial association to promote greywater reuse named Grey Water Industry Group (GWIG) has been established. Malaysia is a country seemingly endowed with abundant water resources with an annual average rainfall of more than 2000 mm. Despite its high rainfall and water resources compared to other regions in the world, Malaysia still suffers water problems (both excesses and deficits). The present work describes the suitability of greywater reuse in water supply strategy and wastewater management in Malaysia in comparison to that applied in Australia. Greywater should not be seen as a waste product, but as a valuable resource in wastewater management. Based on the comparison study between Australia and Malaysia, it appeared that the adoption of greywater treatment in Malaysia is more feasible and meaningful than the reuse approach, which creates problems in some instances when the greywater system is inappropriately designed for the type of environment. However, proper legislation, awareness and environmental considerations in terms of geochemistry characteristics, selection of the treatment method and the need for a paradigm shift are essential keys to ensuring optimum utilization of greywater as a future water resource in Malaysia.

Keywords Greywater management · Greywater · Malaysia · Perth
Water resources

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6.1 Introduction

Wastewater management is an increasingly serious issue demanding attention in both developing and developed nations worldwide. It is one of the problems that developing countries, such as Malaysia, have experienced due to its rapid development and urbanization. It has been demonstrated that six million tonnes of wastewater are generated annually by its 26 million inhabitants. Juahir et al. (2011) stated that 60% of the main rivers are used mainly for domestic, agricultural and industrial activities. Therefore, the main sources of pollution concerning rivers are sewage disposal, and discharges from small and medium-sized industries that are yet to be equipped with appropriate effluent treatment facilities. Juahir et al. (2011) also reported that the river basins are polluted with 42% of suspended solids (SS) ensuing from poorly planned and abandoned land clearing activities, biological oxygen demand (BOD) with 30% from industrial release, and 28% with ammoniacal nitrogen from animal husbandry activities and domestic sewage disposal. The wastewater is treated to varying levels and discharged into the rivers from which most of Malaysia's freshwater supply originates. Therefore, a more effective and sustainable wastewater management is required.

In the late 1990s, water reuse received great attention in Australia, due to the major national drought, and new water policies and resource protection legislation which were adopted to conserve more water (Ryan 2014). Most of the cities have been experiencing pressure from water restrictions, as well as unpredictable climate and declining rainfall. The stress on water supply in Perth, Western Australia (WA) will be further exacerbated by the predicted population increase from 1.5 million people to as many as 4.2 million by 2056 (Weller 2009). Despite the low rainfall, Australia is one of the world's largest water consumers. In 2010, the Australian Government issued the Water for the Future Framework a 10-year, AUS$12.9 billion investment in strategic programmes aimed at improving water management schemes and a renewed commitment to deliver a range of water policy reforms nationwide.

Greywater is wastewater drained from showers, bathtubs, washing machines and kitchen sinks excluding toilet waste, i.e. blackwater (Simon and Elisa 2013; Santos et al. 2012; Bino et al. 2010; Allen 2010; Mohamed et al. 2016). Greywater represents a resource, since it is generated in every household daily independent of the weather (Mohamed et al. 2013a). In fact, local authorities in WA have placed importance on water recycling with a projected target of 30% in 2030 which aimed to reduce the pressure on the finite water resources (Water Corporation of WA 2009). In comparison, greywater treatment and reuse have been gaining popularity in Australia due to the need for resource substitution during periods of low rainfall. However, does this practice fit the Malaysian condition? Australia and Malaysia are located in different geographical and climate zones, and face different issues in water resources. This paper explores the applicability of greywater and its necessary treatment for the situation in Malaysia. The reuse of greywater is not a key interest in Malaysia due to its abundant rainfall. Whether or not greywater treatment is a suitable approach to assist Malaysia's water management problems is discussed and compared.

Table 6.1 Summary of the weather conditions for Perth, Western Australia and Kuala Lumpur, capital city of Malaysia

	Perth[1]	Kuala Lumpur[2]
Climate type	Mediterranean	Hot and humid
Average annual rainfall (mm)	600–900	2500
Evaporation rates (mm/day)	1650–1180	2.0–6.0
Humidity (%)	51	74

[1]Bureau of Meteorology (BOM), Western Australia, Ali et al. (2012)
[2]Malaysian Meteorological Department (2015), Lim et al. (2013)

6.2 Weather of Perth, Australia and Kuala Lumpur, Malaysia

Perth and Malaysia's weather conditions are summarized in Table 6.1. Perth's weather is characterized by cool wet winters and hot dry summers in a temperate zone with a Mediterranean climate. Perth Metro has recorded rainfall ranging from 600 to 900 mm (BOM 2013). In comparison, Kuala Lumpur (Capital city of Malaysia) has a hot and humid weather in the tropics all year round. The temperature averages at 28 °C and the average humidity is 74% with an average rainfall between 2500 and 3000 mm (Azizul et al. 2011; UNEP 2015). Malaysia's climate is dominated by the effect of two monsoons or 'rainy seasons', which affect different parts of Malaysia to varying degrees. From November to February, the east coast Peninsular of Malaysia is affected by the northeast monsoon, which brings heavy rainfall, strong winds and huge waves along the entire coast. From April to September, the west coast of Peninsular of Malaysia is affected by the southwest monsoon, which is weaker compared to the northeast monsoon and from March to October, which are the transition period between the monsoons which is characterized by light wind.

6.3 Residential Water Consumption in Perth

In Perth, the water consumption issue has been heightened due to the declining rainfall by 12% since 1991. According to Water Corporation (2010), the domestic water consumption in Perth is approximately 52.8% inside the homes, 43.4% outside the homes and 3.77% is lost through private plumbing leaks. It is estimated that the average person uses around 112.33 L of scheme water per day to irrigate household lawns and gardens. Large residential lot sizes, sandy soils and hot windy conditions over summer are major contributors to the high outdoor consumption (Burton et al. 2009). It has been indicated that Perth was the highest residential water user in 2011–2012 despite the water scarcity crisis (Lehane 2014). However, there has been a reduction in the trend of residential water use in the city owing to the government approach to implement a scheme that will reduce water consumption across the state. One of the government strategies to embark on water use reduction is the release of its 50-year plan ‘Water Forever’ (Water Corporation 2009). It highlighted that reducing water consumption per person in conjunction with increasing water recycling and developing new sources were pivotal in achieving this aim. Together with the community, the Water Corporation sets a goal of reducing the consumption rate per person by a further 15% by 2030. In most of the developed world, water conservation measures are being mandated for new residential and commercial buildings such as the installation of dual flush toilets and filtration systems as well as refurbishments (Micou et al. 2012). For instance, the UK Code for Sustainable Housing includes an excellent calculator for house water use rating (BREEAM 2010).

6.4 Residential Water Consumption in Malaysia

In Malaysia, the problem of improper utilization of water resource in some states has limited the availability of water supply in other states. Consequently, water shortage has resulted in water rationing in most of the big cities (Ithnin 2007). Water consumption in Penang city, in the north of Malaysia, has increased by 11.8%, from 262 litres/capita/day (L/pc/d) in 2001 to 293 L/c/d for 2014 (PBA, 2015). In Selangor, one of the industrial states in Malaysia, a person in Selangor consumes an average of 226 L/pc/d—far greater than many developed countries, as shown in Fig. 6.1. A Malaysian needs about 17.2 L of water daily. The study found that the average person uses 5.2 L per day for toilet flushing and 4.8 L for bath or shower, accounting for approximately 58% of overall water use. The potential for high water consumption may be climate induced. The country’s yearlong hot and humid weather results in a higher frequency of shower and change of clothes (hence laundry), as there is higher tendency to sweat more intensely.

6.5 Water Scarcity

6.5.1 Quantity Issues in Perth

In recent years according to the statistics, a decrease in rainfall has led to the forecast of 20% lower rainfall in Perth by 2030 compared to the 1990 levels (Water Corporation 2009). Perth is situated in the temperate southwest of Australia, with an estimated resident population of 2, 021, 200, which was recorded on 30 Jun 2014, an increase of 2.5% from the year of 2013 (Australian Bureau of Statistics 2015). In the Perth region, these measures include limiting garden irrigation with mains water to two nominated days per week, and three times per week when irrigating with water from a private bore.

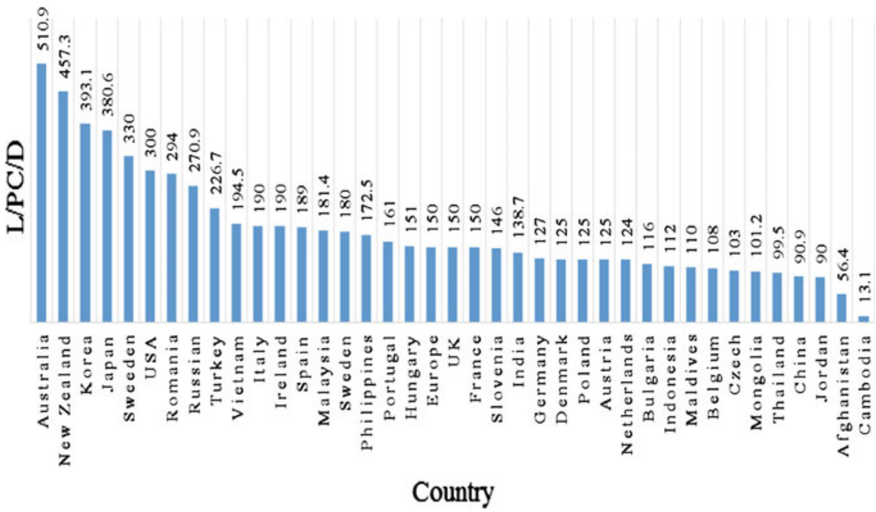

Fig. 6.1 Consumption of water litre per capita per day (L/pc/d) in Selangor, Malaysia compared to a number of countries in the world

6.5.2 Quality Issues in Malaysia

The state of the river has been aesthetically reduced due to the deterioration of the surface water as a result of pollution. Domestic sewage discharge has been reported to be the largest contributor of organic pollutant load (Al-Gheethi et al. 2016). In Johor Bahru, the average concentration of chemical oxygen demands (COD) of greywater was 1400 mg/L (Ujang and Henze 2006). In Sarawak, the rivers are seriously polluted with coliform bacteria derived from faecal matter due to the discharge of partially treated or untreated wastewater from the city into the river (Larsen and Lynghus 2004).

On 19 February 2014, Malaysia experienced a water crisis in Kuala Lumpur and the state of Selangor. A water shortage was reported in seven reservoir dams due to a substantial drop in water level caused by the hot and dry seasons in Peninsular Malaysia. The water crisis took a turn for the worse, with 2.2 million consumers in Selangor, Kuala Lumpur and Putrajaya experiencing water rationing from 10 March 2014. One of the reasons stated was the closure of two water treatment plants at 11th Mile, Cheras and Bukit Tampoi, due to the ammoniacal nitrogen content in the raw river water supply. This indicates that even though Malaysia experiences abundance of rainfall annually, problem of water pollution limited the availability of potable water. Hence, it becomes difficult for the water regulators to guarantee constant water supply. These results serve as an alarming warning for the authorities to implement a more effective wastewater management system for a sustainable future.

6.6 Greywater Treatment and Its Reuse Practice from a Global Perspective

Today, a wide range of greywater treatment technologies has been investigated to restore and maintain the physical, chemical and biological integrity of polluted greywater. Various forms of treatment systems have been developed to treat different types of greywater types ranging from low, medium and high. The primary treatment is mainly used to treat low and medium greywater which aimed to reduce BOD, COD and TSS.

Many researchers have sought to develop filtration-based treatment during the primary treatment as reported by researchers with different sources of greywater, including residential quarters (Nnaji et al. 2013), village houses (Mohamed et al. 2014a; Wurochekke et al. 2014), residential college hostel (Parjane and Sane 2011) and house kitchen wastewater (Mohamed et al. 2013b). The primary treatment can provide high reduction of BOD, COD and TSS (37–98, 74–90.8 and 40–95%, respectively) (Sahar et al. 2012; Parjane and Sane 2011). Sahar et al. (2012) revealed that pine bark filter achieves 98% of BOD reduction due to its high absorption capacity, as well as easy transportation of greywater. Al-Jayyousi (2003) found that the greywater treatment system consisted of a sand filtration unit has achieved 40 and 74% reduction of SS and BOD.

In order to purify high-strength greywater and for reuse purposes, secondary treatment is required. Several biological methods, such as anaerobic sludge blanket (UASB) (Lucia et al. 2010), membrane bioreactors (MBR) (Merz et al. 2007) and many more, have been applied to treat greywater. However, the treatment requires high-energy use, it is capital intensive and has high maintenance cost. Gunes et al. (2012) performed a free water surface flow-constructed wetland (FWS-CW) with a three-compartment septic system combined in series for high-strength greywater treatment. Moreover, if the system works independently, poor performance of the septic system in terms of TSS and nutrient removal has been observed. As a hybrid system, however, both performed very well, attaining up to 86, 91, 91, 57 and 45% reduction for TSS, BOD, COD, TN and TP, respectively. Dallas et al. (2004) showed that the reed bed system with ecological sanitation design presented a low-cost treatment on-site at Santa Elena-Monteverde, Costa Rica, Central America. This system has demonstrated the ability of low-cost reed beds to treat greywater from several houses to a level that meets the Costa Rican guidelines for wastewater reuse. Such constructed wetlands have been considered to be eco-friendly and financially acceptable for greywater treatment.

6.6.1 Greywater Treatment and Its Reuse Practice in Perth, Western Australia

In Western Australia, greywater treatment and its reuse systems range from simple direct diversion systems (either gravity-fed or pumped) that redirect untreated greywater from wastewater pipes to the garden, to coarse filtration and disinfection treatment systems and more sophisticated technologies, such as microfiltration. Greywater can be reused without treatment, such as bucketing bath water to the garden. However, direct disposal of untreated greywater may pose an unnecessary health risk. Greywater treatment systems (GTS) are therefore recommended where higher effluent quality is needed before reuse in irrigation (DOH 2010).

In Australia, the installation costs of these units typically range from $2000 for simple direct diversion systems up to $15,000 for higher end systems with storage capacity. To a certain degree, the variation in the cost of these systems correlates with their effectiveness and reliability in providing irrigation.

The examples of the greywater treatment and reuse application in Western Australia are presented in Table 6.2. Four houses were selected on the basis of their characteristics which might influence greywater quality. These characteristics included house type, number of occupants, presence or absence of children and pets, and landscape characteristics. Houses A and B were located at the Bridgewater Lifestyle Village (BWLV), while House C and D were located in White Gum and Hamilton Hill, respectively.

Greywater from House A and B are collected from both the laundry and bathroom, and directed to a dual sponge filter to remove hair, lint and other suspended solids. Thereafter, the greywater is pumped to the dripper system to irrigate the lawn or garden.

In House C and D, the greywater diverted from the normal waste stream is passed through a sedimentation tank for the treatment, disinfected by using ozone and then dispersed through an interconnecting substrata dripper system. This enables larger particles such as hair, lint, soap flakes and sand to settle at the bottom of the tank, thus preventing blockage of the pipe and/or soil as the greywater is dispersed through the infiltration field.

The evaluation of the greywater system was monitored for performance and reliability to meet the regulatory standards with three trial sites under the Premier's Water Foundation (PWF) research grant funded by the Department of Water, Western Australia in response to the State Water Strategy released in February 2003. The research team from Murdoch University of Western Australia conducted an assessment of the case studies, which led to the development of a new regulatory framework known as the decentralized wastewater treatment and recycling systems or DeWaTARS (Anda et al. 2010). The framework includes six main criteria which needed to be assessed when initiating a decentralized wastewater recycling project. The Technical Elements Model (TEM) was developed to determine the technical requirements and appropriate technologies for decentralized wastewater recycling for the public open space of urban villages. In order to make the technology selection process easier,

Table 6.2 Four case studies on greywater treatment for and its reuse for irrigation in Western Australia

House details		Greywater treatment		Greywater reuse for irrigation		
House/Suburb	Occupancy	Greywater System and Date installed	Greywater technology	Total block size (m^2)	Size of greywater irrigation area (m^2)	Vegetation
House A Mandurah	2 adults	AWWS Grey flow 00 Installed: July 2008	GDD	280	25	Native vegetation
House B Mandurah	2 adults + 2 pets	Land and Water Technology, Land and Water Greywater Reuse System Installed: July 2008	GDD	280	25	Native vegetation
House C White Gum Valley	2 adults + 2 children	GRS WaterSave Tank and Dripper System Installed: June 2007	GDD with sedimentation tank	596	52.5	Fruit trees and ornamental garden beds; roses
House D (Community) Pinakarri	6 adults + 5 teenage children	GRS WaterClear and Dripper System Installed: July 2008	GTS with sedimentation tank and ozone generation	2000	133	Lawn and fruit trees

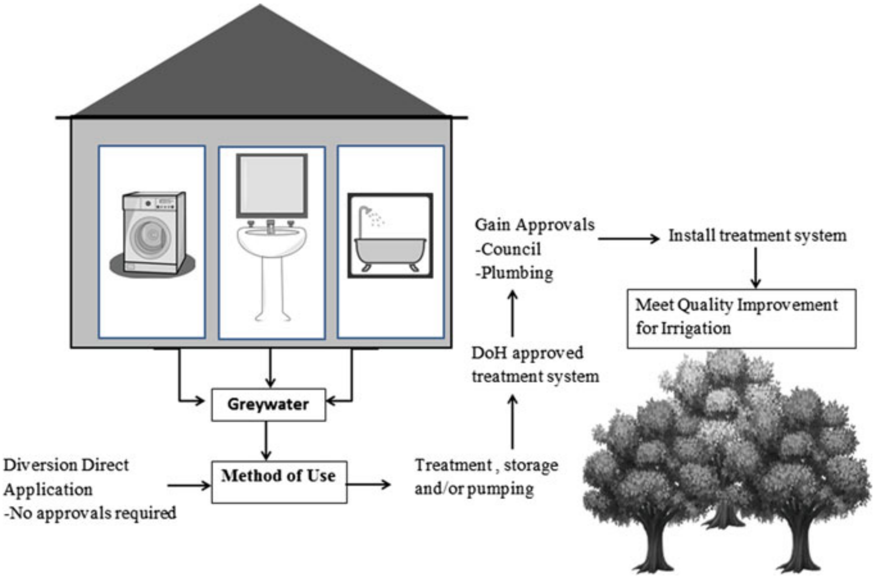

Fig. 6.2 The sequence of the household greywater reuse system in Western Australia

a decentralized wastewater treatment technology database was developed with over 150 sourced wastewater treatment products. The LaDeRS-H20 rating tool was developed for determining the water use performance efficiency of land developments.

The selection of the most appropriate greywater system depends on the source water, desired end use application and other characteristics. A greywater treatment system must be formally approved by the Department of Health before it can be installed in Western Australia. The flow of sequence of the household's greywater reuse system in WA can be simplified, as shown in Fig. 6.2. The implementation of greywater in WA requires five key processes, of which four are discussed briefly including local and state government approval, installation in each home, rebate acquisition, application and maintenance.

6.6.2 Greywater Treatment and Its Reuse Practice in Malaysia

Greywater treatment and/or combined with reuse at the household scale is still in the early stages of introduction in Malaysia. However, research on the treatment method of greywater has intensified recently. The knowledge can be incorporated to boost the setup of greywater treatment and its reuse in Malaysia. In Malaysia, most of the published articles derive from the pilot project on greywater ecological treatment in Kuching City, Sarawak, which was established in 2003. Mah et al. (2009)

explored the modelling process using a mathematical representation to evaluate a proposed greywater system. By using network simulation, Mah's modelling has shown potential savings of up to 40% through greywater reclamation for reuse as secondary sources of water for non-consumptive purposes. In Perth, a study has shown that scheme water savings from 9 to 37% can be achieved across a range of house types fitted with greywater reuse systems (Evans 2009).

Krishnan et al. (2008) explored the effectiveness of an aerobic sequencing batch reactor in treating nutrient-deficit and nutrient-spiked dark greywater for agricultural reuse. Hence, a treatment of nutrient-added dark greywater at a COD: N: P ratio 100:3.5:0.75 and 100:5:1 for 36 h HRT complies with the Malaysian discharge standards for agricultural activities in rural and urban areas.

Teck et al. (2009) evaluated the efficiency of biofilters and a constructed wetland with two species of terrestrial ornamental plants in greywater treatment. The study revealed that biofilters contributed the most in terms of the total removal of BOD_5, COD, FC and NH_4–N. However, wetland and biofilters were equally efficient in TSS removal. Wetland species, such as *F. macrocarpa,* are recommended for inclusion in urban housing areas to reduce river pollution.

Wurochekke et al. (2014) studied the capability of a constructed wetland with *Lepironia articulata* plant species for removing household greywater in a village house. Greywater samples were collected from the effluent of a single house, at influent, using a pre-treatment model (particle material), mini wetland model (*L. articulata*) and control model (without plants) at two sampling periods. The mini wetland model showed high removal performance of 81.42% BOD, 84.57% COD, 39.83% AN, 54.70% SS and 45.01% turbidity. In general, the water quality parameters showed the effectiveness of the peat filter and mini wetland model in removing impurities, especially suspended solids and COD level in the greywater. However, Mohamed et al. (2013b) explored the use of gravel and peat as filter media to treat kitchen greywater. In the following year, Mohamed et al. (2014a, b) studied a similar method to treat household greywater, and, specifically, bathroom greywater. The study showed the potential of peat for reducing 72% SS, and 87% NH_4^+-N of effluent greywater. In a similar study by Chan and Mohamed (2013), greywater treatment with peat was used for the post-filtration compressibility test on greywater parameter reduction.

6.7 Greywater Treatment as a Means of Pollution Control

Greywater is a major contributor to river surface water pollution; hence, effective measures to ensure pollution control from its source are very significant. This is in agreement with Hughes et al. (2006), in which onsite or source treatment is a paramount approach for water quality control, before it mixes into different wastewater streams. The treatment of greywater as a decentralized system, which occurs before being combined with other wastewater, is often less costly and more effective and decreases the pressure on the local wastewater treatment plant (WTP) in its daily operations. The Director-General of the Department of Environment

(DOE) Malaysia noted that wastewater treatment plants in Malaysia are outdated in terms of technology and identified them as the major reason for the bulk pollution of rivers (The Star 2006). In this context, domestic greywater treatment has the potential to address the issue of contaminants entering water bodies with nitrates, microbes, heavy metals (Mohammed et al. 2013) and technological stagnancy. Furthermore, such an approach allows greywater treatment at the household level and thus reduces the pollution load on the river.

6.8 Potential of Greywater Reuse in Malaysia

In Malaysia, the first sustainable approach to greywater reuse was implemented in Kuching City. This project was a joint collaboration between the Sarawak Government and the Danish International Development Assistance (DANIDA) using an Ecological Sanitation (Ecosan) Wastewater Treatment System at Hui Sing Garden in Kuching City. Kuching has no sewerage system, and, as in most Malaysian houses, the greywater is released untreated into the stormwater drains. Therefore, the water quality of drains, streams and rivers in Kuching is heavily polluted. However, it is possible to collect and reuse greywater as it can be treated to a less health-hazardous standard (Mah et al. 2008). A row of nine terrace houses was selected for carrying out the pilot project (Bjerregaard 2004). The terrace houses were linked to the ECOSAN system, which is constructed in a large recreational park adjacent to the backyards of the houses. From the pilot project, it was found that the trap is 88% efficient in removing the oil and grease, and effective in removing the bacteriological parameters and organic matter (Bjerregaard 2004; Teck et al. 2009).

The reuse of greywater in Malaysia is increasing the possibility of reducing environmental pollution, especially in rivers. However, it may create problems when the reuse system is inappropriately designed for the type of environment. Therefore, proper planning and strategic management are essential to make the system effective and reliable. For sustainable reuse of greywater, households must recognize the need to limit their use of products with high level of sodium or phosphorus or both combined, as water conservation may not be advantageous in this instance. It is recommended that for clothes washing, products low in Na should be selected (Madungwa and Sakuringwa 2007) because greywater quality is site specific except for certain recommended household products (Mohamed et al. 2013a). If Malaysians changed their attitude and use environmental-friendly detergents, it would also assist in protecting against river pollution and will have far-reaching improvement on the river water quality. The development of a greener environment for the future would also provide business for the detergent industry in Malaysia. With these boundaries in mind, a suitable zero tension lysimeter (ZTL) was developed as a device that could be used to collect leachate from greywater irrigation in household gardens (Mohamed et al. 2012). Based on abovementioned, the studies are being monitored with lysimeters under treated effluent irrigation areas and control samples are being taken from sampling bores at the perimeters of the developments. Over time, it will be determined if the following measures are adequate to redress excessive nutrient leaching to the environment.

6.9 Juggling the Differences in Adopting the Good Practice

Adopting the 'greywater treatment and reuse' system from the experience of a developed country like Australia without taking into consideration the geographical conditions, funding availability, the development of technological know-how of environmental awareness among the general public is less likely to be successful for expanding the treatment of greywater in Malaysia. Perth and Malaysia have many differences in terms of weather and soil type. In Perth, the major consideration for reusing greywater relates to the nutrient vulnerability of the groundwater due to the major sandy soil type. However, in Malaysia, with a predominant clayey soil profile, consideration should be made for appropriate greywater applications, as inappropriate usage can potentially alter the soil composition. It also has a detrimental effect on plants which are sensitive to salt, and thus, the low infiltration rate of these soils can lead to ponding and wastewater runoff.

6.10 Institutional and Legal Issues

In Malaysia, the city of Kuching provides a good example of successful application of greywater reuse. However, to widen its practical scope over a larger scale around the country, proper and thoughtful guidelines for greywater reuse are needed. The major challenge to an integrated water management arises from the lack of inter-agency coordination. According to Moorthy and Jeyabalan (2012), a lack of inter-agency coordination often occurs between the state and federal governments over water supply and sewerage matters. In 2009, the Malaysian government set up a new ministry called the Ministry of Energy, Green Technology and Water, (MEGTW) among others, to restructure the national water framework as problems arise with the federal governments over the control of state water assets. In Malaysia, with the changing political climate since 2007, water matters have been heavily politicized between the federal and state governments in which some have seriously questioned the lack of ethics and social ethics.

In addition, Chan et al. (2002) claimed that the lack of attention in securing water resources for the long term is regretful. Such concern is needed as water demands are growing every year as a result of the booming world population. Therefore, this is no longer the question of resource availability, but a problem that is attributed to effective resource management. The greywater use guidelines from Perth, which are embedded in the Code of Practice for the Use of Greywater (DOH 2005, 2010), could be a starting point for Malaysian authorities to design and implement Malaysian greywater management strategies. The author's view on the code of practice was that it provides user-friendly assistance concerning the use of greywater reuse, which wisely includes a wide range of issues related to greywater and conservation guidelines pertaining to the quality of groundwater and water supplies. In Malaysia, there is no specific standard for household greywater. The Environmental Quality (Sewage and Industry Effluences) 1979 is used in respect of the discharge of effluent into any inland water other than the effluent discharged from prescribed premises.

6.11 Conclusions

Even though Malaysia is blessed with an abundant supply of water resources, the authorities, industries and society should not take for granted that there will always be sufficient supply to meet the demand. The water regulators should provide adequate measures to reduce the effect of water pollution which may result in water scarcity. However, in some of the reported cases of water rationing, the Malaysian authorities can learn from the Perth experience in greywater treatment and reuse. The key criteria which were identified include clear guidelines concerning the installation of treatment and/or reuse systems, appropriate rebates and awareness-raising activities to enhance residents' knowledge about the reuse of greywater. In Malaysia, as most of the river pollution comes from domestic wastewater, proper planning to reduce wastewater discharge from households is an immediate task in this region. Among several management plans, treatment is preferable compared to reuse when dealing with greywater, and it is one of the suggestions and alternative plans to reduce the pollution load to the river.

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