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Financing water infrastructure: waqf as a solution

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ABSTRACT

The WEF's Global Risks 2015 report stated that global water crises are the biggest threat facing the planet over the next decade. Currently, 1.6 billion people live in countries with water scarcity and expected to rise to 2.8 billion people by 2025. Despite this, a staggering 32 billion cubic meters of treated water is lost around the world, costing US$14 billion due to aging pipelines that distribute drinking water. There are 42,977 km of asbestos-cement (AC) pipes in Malaysia that are over 60 years old that need to be replaced to reduce leakages. The study found that the AC pipes can be replaced within 20 years and **3.8 billion cubic meters of water, worth RM 4.5 billion can be saved** from leakage. The paper also looks at financing of water infrastructure from Islamic history and proposes a decentralized approach that allows the community to be directly involved in ensuring water security for themselves.

Keywords: water conservation, water infrastructure, *waqf*
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INTRODUCTION

By 2030 an estimated US 10 trillion will be needed worldwide for repairing and expansion of ageing dams and water treatment plants. The demand for drinking water and wastewater treatment infrastructure in developing countries are increasing but the governments do not have the financial means for the high-capital and long-term water infrastructure projects (Michell, 2016).

Demand for water is expected to increase in all sectors of the economy. It is estimated that the global food systems will require 40 to 50 percent more water, municipal and industrial water demand will increase by 50 to 70 percent and the energy sector will see water demand increase by 85 percent (World Bank, 2016). Climate change is wrecking havoc with droughts and floods, and developing countries are finding it difficult and costly to distribute water. It is expected that 2.8 billion people will be affected by absolute water scarcity by 2025 (Alavian et. Al, 2009). This is against the vision of the United Nations Sustainable Development Goals (SDG), Goal Six, which is to provide access to safe and affordable water for all by 2030. In order to achieve this goal it is important that water is managed sustainably and not wasted, even more so with the effects of climate change.

In fact, the increased demands for water has earned it top place as the highest risk in the 2015 World Economic Forum's global risk analysis. This is because water security is much more than a component of wider economic goal. In fact it is a crucial influence on economic development due to the water–energy-food nexus. Water runs through all investments in all forms of energy, agriculture, transport, healthcare and manufacturing (Sadoff et.al, 2015). Strategic water investment decisions can open up opportunities for economic development. Sustained investment in water infrastructure and its "enabling environment" is an essential pillar for growing economies (Winpenny, 2015).

The lack of investment in water infrastructure has resulted in much of the world's water is used inefficiently by industry, agriculture, and cities even in arid areas; and much of it is wasted without economic benefit, often with negative environmental impacts. In fact, a staggering 32 billion cubic meters of treated water is lost to urban supply systems around the world each year through physical leaks in the pipes. Half of these losses occur in developing countries where customers already frequently suffer from interrupted supplies and poor water quality. (Kingdom et al., 2006)

The continued inefficient use of water in this age of increasing water scarcity due to growing population, overconsumption, increased industrial use and climate change, is not sustainable for future water security. Inaction by nations would lead to serious repercussions in the future.

1. Literature Review

It can be argued that the dominant paradigm around the world during the nineteenth and twentieth centuries is that there are few limits to economic growth and that it is always desired. Neoliberalism is based on the tenets of no limits to growth and what matters are economic growth, globalization and free trade. Although economic growth is shown to be beneficial but when natural resources are depleted, it is becoming clearer that our current paradigm of growth is not helping humanity (Daly, 1996)

The continued depletion of these resources, has led to new terms such as "Sustainability". In the 1970s, Daly proposed a steady-state economics that does not deplete the environment beyond its regenerative capacity or cause irreversible repair through pollution (Daly, 1973; Daly, 1991). All modern sustainability literature is based on this concept. Sustainable development was first used in the *World Conservation Strategy* drafted by the United Nations Environment Programme UNEP and the International Union for the Conservation of Nature (IUCN) in 1980. The UN's Brundtland Commission Report, *Our Common Future*, defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Repetto (1986), Solow (1991) and Pezzey (1992) gave varying definitions of sustainability but basically, all definitions refer to the future generations and their well being by conservation and preservation efforts.

In September 2015, during the historic United Nations Summit, 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development was adopted by world leaders and came into force in January 2016. The goals are unique as they call for action by all countries to promote prosperity while protecting the planet. Goal Six of the United Nations Sustainable Development Goal (SDG) is to provide access to safe and affordable water for all by 2030.

In order to achieve this goal, the World Bank estimates that around USD 114 billion is required globally, and yet only a third of the figure has been raised. In order to close

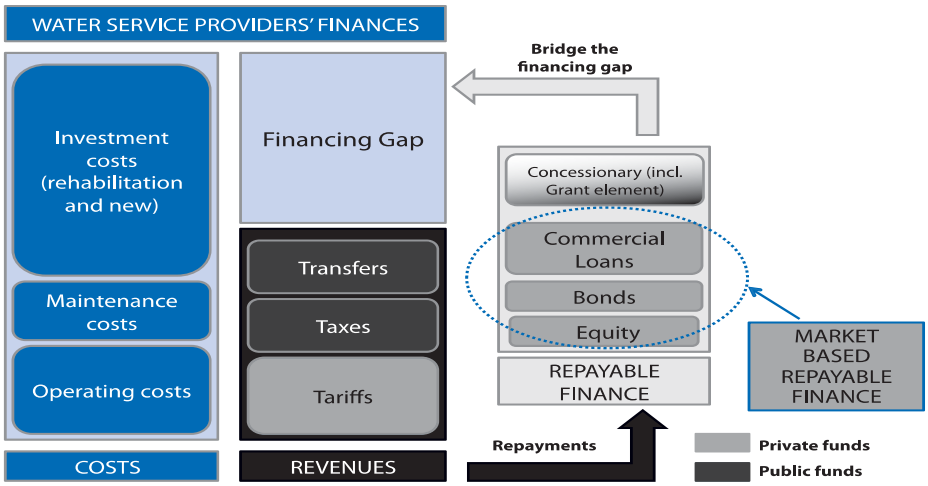
the financing gap, countries need to mobilize financing from various sources, which may include reducing costs, and increasing efficiency. The common "3T" referring to traditional sources of finance like tariffs, taxes and transfers may not be sufficient to close the financing gap.

Landmark reports, like the Camdessus Report in 2003 (Winpenny, 2003) and the Gurria Report in 2006 (Hofwegen, 2006) prompted much interest in water financing. The Camdessus Report called for an increase in private sector participation. Financing water infrastructure requires high-capital investments and long pay-back periods. Financing is needed not only for initial investment but also long-term administrative, operations and maintenance. The Gurria Report focused on innovative financing options for local governments, as there is lack of funding due to absence of credit worthiness and a lack of awareness.

Some of the reasons for lack of private investment are the infrastructure projects are not "bankable", meaning they do not appear to deliver high enough risk-adjusted returns to attract private-sector equity or debt. There are regulatory issues, price of water to cover cost and mismanagement of the water sector that deter investments into the sector.

In 2014, The World Water Council and OECD jointly convened a High Level Panel (HLP) to raise the global debate on how to scale up financing of water infrastructure. The main solution that was discussed is the need for innovation in financing water for example the green bonds are a growing market and water-related projects are a growing subset of the green bond market. The emphasis is on more innovative finance mechanism to bridge the financing gap in the water sector regardless if it is a public or private entity. The traditional basic source of revenues for water services, tariffs, taxation and transfers also commonly known, as 3Ts are no longer sufficient (OECD 2009b). Market-based repayable finance, referring to loans, bond and equities, can be provided to either public or private operators (see Figure 1).

Figure 1: *Market Based Repayable Finance*



Source: OECD (2010), *Innovative Finance Mechanisms for the Water Sector*, OECD, Paris.

While the world looks for innovative methods to finance the building and maintenance of water infrastructure, the Islamic world had a solution that was practiced since beginning of Islam more than 1400 years ago. One of the earliest examples is the well of Bir Ruma which was purchased by Sayyidina Uthman ibn Affan from the Jewish owner and made it a *waqf* (religious endowment) for the use of the Muslims (Faruqui et al., 2001).

2. Waqf and Water

Water is a major theme in the Quran with 63 verses with the word (ماء mā') which means water in Arabic, and even the meaning of Shariah or Islamic jurisprudence is the "way to the watering hole". In Islam, water plays an important part in religious purification before the obligatory prayers, such that it has become a central part of Islamic architecture. Drinking fountains known as *sabils* are an architectural feature of Islamic cities. In fact, they are found in the center of the city where water is provided free for consumption of the public. These fountains are usually *waqf* property with detailed deed to ensure the continued maintenance of the fountains. (Haleem, 2001). Some of the famous fountains are Fountain of Qasim Pasha (1527) and the Fountain of Ahmed III (1728) at the Topkapi Palace in Istanbul. This clearly shows the legacy of the Islamic culture to provide free water for public consumption.

Other water infrastructures that were built include dams, aqueducts and underground waterways called qanats. The qanat brings underground water to the surface using gravitational force. Ain Zubaidah is a water canal built by Queen Zubaida Bint Ja'far

Al Mansour in 801 A.D. Zubaida was the granddaughter of Abbasid Caliph Al Mansour and the wife of the fifth Abbasid Caliph Harun Al-Rashid. The canal was built to supply free water to pilgrims during the Hajj because water was sold at an exorbitant price. Water was transferred from the Hunain Valley to Makkah. The queen bought the Hunain valley and surrounding area, to begin construction work. Transporting water through the hot desert would cause water to evaporate, thus the engineers had to build qanat under massive rocks and tunnels along slopes over 10 miles. It was an engineering feat at the time and was a costly project.

The system consisted of canals (qanats), galleries for water collection and transport, manholes, retaining walls, culverts, dams, bridges, pools, water storage tanks and distribution outlets embellished with beautifully shaped stone taps. The project took ten years to build and cost was approximately one million dinars which was paid fully by Zubaida, thus the canal was named after her as Ain Zubaida.[1]

The most interesting feature of Ain Zubaidah is that it operated under the auspices of waqf. The liquidity is derived from incomes generated by vast property holdings. The waqf was self-financing and provided capital for the purchase of material and the labour force to perform the operation and maintenance. The waqf deed had stipulated salary for 500 employees, who were selected based on skills approved by a committee. The water canals were to be inspected weekly for routine checks and a standard maintenance was conducted every 6-12 months. Special post-flood maintenance work was to be carried out every 10 years. It is important to note that the Ain Zubaidah water canals provided pilgrims with free drinking water for over 600 years and only became discontinued about 40 years ago and now is being restored to maintain its historic importance.

It was not only royalty who built waqf water infrastructure. Looking at waqf deed examples in Iran in the 15th till 19th centuries, many rich but common residents of towns provided public utilities like public baths called hammam, water wheels, qanats and wells among others. The deeds stipulated the waqf property clearly and the salary of the employees to maintain the waqf. Water rights to the qanat were stipulated for

[1] Prof. Omar Siraj Abu Rizaiza, lecture on the historical dimensions of Ain Zubaida at a meeting organised by the London Middle East Institute (LMEI) at the School of Oriental & African Studies (SOAS), University of London at the Brunei Gallery, on 30th of April, 2012.

registered qanats in water rights units for each qanat. (Kondo Nobuaki, 2003).

Using waqf to build and maintain water infrastructure is a tried and tested method in the Islamic world that could provide a solution to problems faced globally.

In this study, replacement of asbestos cement (AC) water distribution pipe in Malaysia is taken as a case study.

3. Malaysia

Malaysia has a population of 30 million with a growth rate of 1.5 percent and consists of 14 states. It has an annual rainfall of 2,500 mm and per year but with growing population and industries, as well droughts, it is facing serious shortages. In March 2014, two states in Malaysia, Selangor and Negeri Sembilan were affected by prolonged hot and dry climatic conditions that lasted from February to August 2014. It had caused a huge impact on industries, such as food and drinks processing, rubber, chemical, electrical and electronics as well as tourism. The water crisis occurred again in April 2016, with dams especially in the northern states of Perak, Penang, Kedah and Perlis drying up. The Linggiu Reservoir in Johor, which also supplies water to Singapore was only one-third full .The Bukit Merah Dam in Perak, Malaysia's oldest dam, hovered at 6m while the normal storage level for full water supply is 8.7m, way below the "danger" level of 40 percent. The Ulu Muda river, which supplies 96 percent of treated water supply to Kedah and 80 percent to Penang, is running dry. (Spykerman et. al, 2016)

Although the main reason for the crisis is blamed on the El-Nino phenomenon, which has been the strongest yet with months-long heat wave is the cause of the dying of dams and rivers, excessive deforestation and mismanagement of the dams are other factors exacerbating the problem.

Despite the looming water scarcity and rising water demands that will stress the water resources, the water industry in Malaysia is mired with inefficient water management issues. Inefficiency of water management has allowed water loss through pipe leakages to reach as high as 56 percent in some states while the national average is at 38 percent (MWIG, 2015). The water operators are unable to solve this problem due to the insufficient revenue due to low water tariffs. Thus there is no cost recovery and the water operators have no incentive to spend on maintenance or replacing ageing water pipes that contribute to the leakages.

According to the Malaysia Water Association, there are over 40,000 km of old asbestos-

cement (AC) pipes that need to be replaced to reduce leakages, which would cost RM 13 billion to replace. AC pipes have a lifespan of 30 years, but it has been in service for 60 years or more (personal interview). Pipe leakage is among the main causes of non-revenue water (NRW). Water that is lost is known as Non-Revenue Water (NRW). According to the International Water Association (IWA), NRW is water that has been produced or treated and is "lost" before it reaches the customer. Losses can be real losses (through leaks, sometimes also referred to as physical losses) or apparent losses (for example through theft or metering inaccuracies). Malaysia has an average NRW of 36 percent according to Malaysia Water Industry Guide 2016. Japan was successful in replacing over 80,000 km of pipes which they started in 1970 and now have only about 1,000 km left to replace.

4. Methodology

The literature on financing NRW reduction in terms of pipe rehabilitation and maintenance are in abundance. One of the most cited paper is the work by Shamir and Howard (1979) that highlighted the optimum renovation period by calculating the minimum value of the sum of renovation and repair costs. Other authors added to the literature by calculating the number of failures (Loganathan et al., 2002;H.P Hong et al., 2006), social costs (Kleiner et al., 2001; Cabrera et. al, 2007) and benefits of saving energy and chemical costs (Ventakesh, 2012).

In order to perform a cost-benefit analysis of the AC pipe replacement program, the important step is to decide on the costs and benefits to include, how they will be valued, the discounting rate and the constraints involved. The discount rate is the rate at which future benefits and costs are discounted to present value (Prest & Turvey, 1968) and how individuals trade-off current consumption for future consumption. For environmental resources, social discount rate was reasoned to be better (Arrow et al., 1996; Brent, 1996).

For the purpose of this study, the approach used is by obtaining the length of AC pipes in Malaysia and calculating the cost of replacing them. The main objective is to calculate the cost of replacing the AC pipes and the cost of water saved from leakage reduction.

Generally, there are two main costs to be taken into account. The first is the pipe replacement costs while the second is the maintenance cost. For the purpose of this study, only the pipe replacement costs will be studied. The benefits will be the increased

or surplus revenue from the water losses. The intangible benefits include the increased consumer satisfaction from uninterrupted water supply both domestic and industrial. Other costs that is difficult to quantify is the opportunity cost of depriving willing buyers of quality water, the environmental stress and degradation due to excessive water demand, water evaporation from reservoirs and water lost that equates to less water in the future.

The cost of replacing pipes according to Shamir and Howard (1979) are:

$$\boldsymbol{C(t) = \frac{C\ x\ l}{(1+R)^t}} \qquad (1)$$

where $\boldsymbol{C}$ = cost of pipe replacement (RM/km) , l = length of pipe (km) , R is the social discount for Malaysia at 7.8 percent (Zhuang et al., 2007). Cost of replacement of pipe is calculated in the year t.

The benefit would be the water that is saved from leakage reduction and revenue generated from that saving.

$$\textbf{B (RM) = Water saved } (\textbf{m}^3) \textbf{ x Average revenue (RM/m}^3\textbf{)} \qquad (2)$$

The data of AC pipe lengths was obtained from the annual Malaysian Water Industry Guide (MWIG) published by the Malaysian Water Association while the cost of replacing pipes and rate of replacement per year was obtained from Ranhill Utilities Sdn Bhd, a private company that specializes in NRW water loss reduction. The 2015 data was used for this model.

The total length of AC pipes in 2015 is **42,977** km. The pipes are replaced at a rate of 0.5km/year (source Ranhill), thus taking approximately 20 years to replace all AC pipes nationwide. The total cost of replacing all the AC pipes discounted to present value (PV) is RM **19.9 billion**. Although some effort has been made to replace the AC pipes in Selangor, a nationwide effort would be more cost-effective and systematic.

Table 1: The Cost-Benefit Analysis for NRW Loss Reduction in Malaysia

Year	Estimated NRW (%) without pipe Replacement	Equivalent in m3/year	Cost Saving (RM)
2016	38.4	157656922	166866088.8
2017	38.1	159814662	169149867.6
2018	37.8	163680875	173241917
2019	37.3	166977553	176731162.5
2020	37.1	170273008	180219114.4
2021	36.8	173765824	183915955.4
2022	36.5	177356762	187716650
2023	36.5	181772414	192390231.6
2024	35.9	185255797	196077088.8
2025	35.7	188262269	199259176.6
2026	35.4	192061186	203279998.1
2027	35.1	195657373	207086248.7
2028	34.8	199345999	210990337.1
2029	34.6	203016624	214875373.2
2030	34.2	206628212	218697924
2031	33.9	210183565	222460955
2032	33.6	213677774	226159270.2
2033	33.4	217338625	230033961.1
2034	33.1	221032108	233943190
2035	32.8	224612213	237732419.1
Total		**3,808,369,775**	**4,030,826,929**

The findings indicate that if the AC pipes are not replaced, an estimation of **3.8 billion cubic meters** of water would be lost in the span of 20 years. This is equivalent to nearly **RM 4.0 billion**, with an assumption that the price of water remains the same.

The present value of the direct benefits over the 20-year period due to leakage reduction

is nearly 5 times less than the present value of the direct rehabilitation costs. This finding is in line with the statement made by De Silva (2005) and Ventakesh (2012) about the costs of rehabilitation being prohibitive. However, replacing the AC pipes with for example, steel pipes ensure that the pipes would not leak for another 50 years, which is the life span of the new pipes. Other benefit in addition to leak reduction, is that the pipes would also not be prone to sudden bursts. Disruption of water supply costs money to consumers and businesses, although this is hard to quantity there are many reports on business losses[2]. Another important feature is water quality, which can deteriorate with old pipes. Consumers are spending money on water filtration systems to ensure safe, clean water for their use. In fact, the cost of home filtration systems is as high as RM150 per month for a household in some instances[3]. This can be used, as the amount consumers are willing to pay for clean water. This cost can be avoided by replacing the old pipes.

5. Waqf Structures for Pipe Replacement

Waqf al-Sabil (public endowment) is a type of waqf, which is established to serve the general public. Some of the examples of waqf al-sabil include construction of masjid, school, water canals or wells and hospitals. The beneficiaries of *waqf* include all members of a community as well as those who use the utility. This type of *waqf* would be relevant for the replacement of the AC water pipes. In order to include contributors from among consumers, corporations and industries, a cash *waqf* model is proposed.

The water sector in Malaysia includes the National Water Services Commission (NWSC), the state water corporation, the state water regulators and PAAB, which is the national water asset holding company. Both the NWSC and PAAB operate at the federal level (as federal agencies); whereas water corporations and state water resources regulators are state agencies operating at the state level. PAAB is the water sector financier for water infrastructure like dams and water treatment plants. In 2006, the Water Services Industry Act (WSIA) was enacted with the main objective of regulating

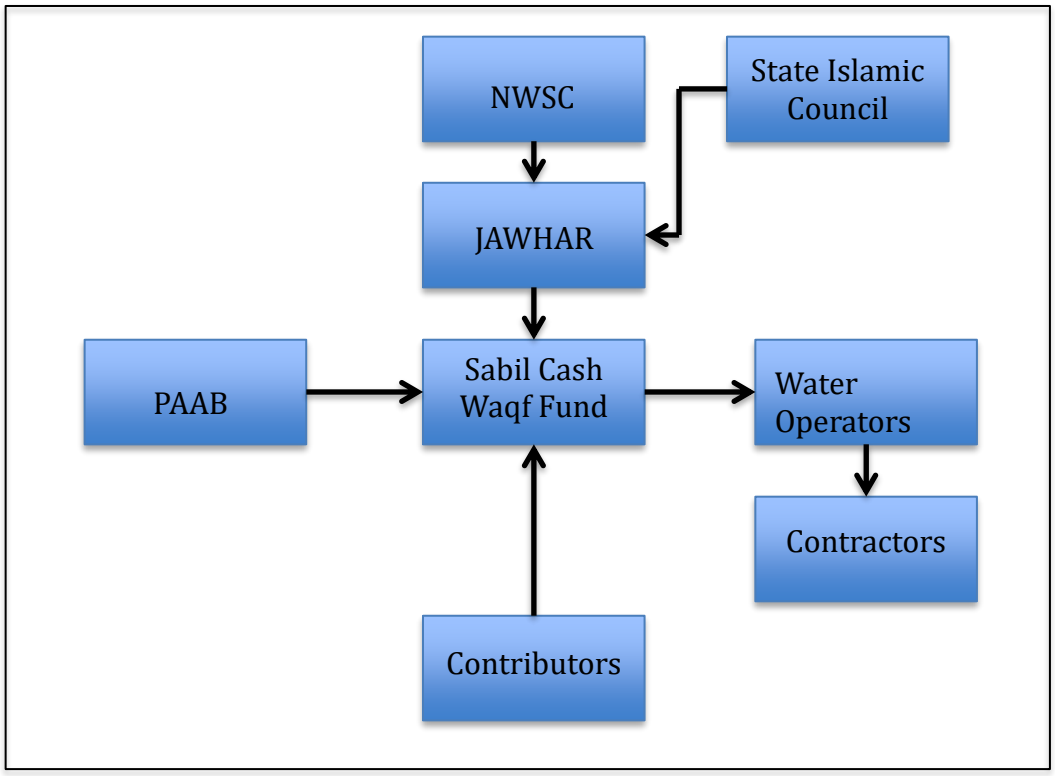
[2] *30 companies in Selangor suffer huge losses due to water crisis – Mahdzir-Bernama, November 10, 2014 14:06 MY [Online] http://english.astroawani.com/malaysia-news/30-companies-selangor-suffer-huge-losses-due-water-crisis-mahdzir-48080(retrieved on July 11 2016).*

[3] *8 water filters and purifiers in Malaysia, Yoke Kit, 16 January 2015, Jewelpie.com. [Online]http://jewelpie.com/7-water-filters-in-malaysia-for-clean-drinking-water/*

water supply services through standardized licensing and enforcement of regulatory framework on water utilities. Thus, the WSIA consolidates the operation of all water utilities under one single regulatory body, the NWSC.

There are specific *waqf* laws in different states like Selangor, Johor, Negeri Sembilan and Melaka. In order to consolidate the management of a *waqf* fund for the whole country, the Department of Waqf, Zakat and Hajj (JAWHAR) can be appointed to oversee the management of *waqf* resources in the country (A Kader, 2015).

Figure 2: The Sabil Cash Waqf Model



The Sabil Cash Waqf model consists of all the main players. The cash waqf fund is established by JAWHAR with authority from the state Islamic Councils. The contributors to the Waqf fund (*waqif*) are consumers, corporations and industries. As mentioned before, there is willingness to pay for clean good quality water, thus guaranteeing clean water without disruption can encourage consumers to contribute towards the fund. A client charter by the water operators to provide clean water with no unplanned water disruption and payment of forfeit for failure to commit to charter would not only increase the performance and efficiency of service but also increase

customer satisfaction. The forfeit would be paid by the water operators. PAAB will manage the Sabil Cash Waqf.

Below are the details of the Sabil Cash Waqf Deed:

1) Cash Awqaf shall be accepted as endowment in conformity with Shariah. PAAB will manage the waqf on behalf of the *waqif* and issue a cash waqf certificate.

2) JAWHAR accepts authority from the State Islamic Councils to be the *mutawalli* of *waqf* fund to ensure that the waqf fund is used to replace the AC pipes with new pipes.

3) The water operators oversee the project of pipe replacement in their own states. The water operators will pay a forfeit if the water supplied is not clean and if there are unplanned water disruptions.

3) NWSC is declared as a trustee for the *waqif* and performs audit on the quality of water supplied and is under an obligation to make up any shortfall in payment of forfeit.

An advantage of having this *waqf*, is the centralized structured program for pipe replacement nationwide. The incentive of clean water and no water disruption will encourage consumers and industries to contribute towards the waqf fund. The added incentive of forfeit will ensure quality service and customer satisfaction.

CONCLUSION

The study shows that water scarcity is a significant problem that would affect a large part of the world. There is an important need to conserve water and ensure sustainability of our water resources. Reducing water loss is something that all utilities worldwide can do. Unfortunately, utilities are unable to pay for the extensive cost of rehabilitating pipes, as the revenue from billed water is insufficient to cover the costs. One of the reasons for this is because the water tariffs are too low to enable for the utilities to be self-sustainable. Water utilities worldwide are looking for innovative financing methods to ensure water security in the future. It is also important to spend on conserving rather than outsourcing for more water as that can lead to depleting available water sources. There is much to learn from the Islamic world especially in the financing of water infrastructure. The waqf has been instrumental in the financing of many water infrastructures that has benefited people for years. The concept of benevolence to contribute towards community good is gaining popularity indicated by the growth of SRI bonds. Islamic finance should be applied to provide the financing for water conservation, as it is very much in line with the Shariah principles.

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