AN ESTIMATE OF THE ECONOMIC VALUE OF DOMESTIC WATER SERVICES: CASE STUDY IN JORDAN

Mohammad A. Tabieh, The University of Jordan
Emad K. Al-Karablieh, The University of Jordan
Amer Z. Salman, The University of Jordan
Amani Al – Assaf, The University of Jordan
Mohammad E. Majdalawi, The University of Jordan
Tala H. Qtaishat, The University of Jordan

ABSTRACT

In relation to the real cost of supplies, most households get domestic water at a reasonable cost. This condition, along with a minor increase in operation and service performance, resulted in a significant shortfall in infrastructure investment to maintain and extend the water system. The goal of this study is to assess the value of home water as a tool for determining the appropriate water tariff and identifying the true economic worth of domestic water. Water's value to users is a fundamental component of extrinsic values that may be quantified using the willingness to pay technique and stated as the cost of water to users. The availability of data is an important consideration for deciding the best method for valuing water. This factor prompted the use of the opportunity cost method. The total cost of water delivery and the opportunity costs are the two most important aspects of this strategy. The findings suggest that the average domestic water value per cubic meter is 1.85 JD, and total domestic water in Jordan is projected to be JD 338 million, with spatial differences across governorates, while it is greatest in Jordan's distant locations with a value of about 2.35 JD/m3. The higher numbers are attributed to the high cost of providing water supply in certain locations owing to inefficient operations. Improving utility performance by minimizing non-revenue water will lower water service costs and, as a result, the value of residential water. Water price is a touchy political subject. Simultaneously, when water prices fall short of covering the expenses of delivering and maintaining services, major issues develop. In this case, the water utility must take proper measures. To pay the expenses of metering, invoicing, illegal connections, and leakage, cost recovery needs costly and effective services. Water conservation methods should include pricing, as well as adequately implemented environmental fines.

Keywords*:* Domestic Water, Water Pricing Policies, Opportunity Cost, Water Management, Strategic Management, Jordan

INTRODUCTION

Jordan is ranked as one of the world's least water-rich nations per capita (USAID 2018). In 2020, there will be no more than 125 m3 of water per person (MWI 2020). Currently, Jordan's drinking water and wastewater systems serve 98 percent and 66 percent of the country's population, respectively (MWI, 2016; Al-Karablieh, 2019). The ministry's many projects and strategies aim to enhance wastewater services by up to 85% during the next several years (MWI 2016).

Water supplies a wide variety of natural life-support systems that are difficult to assess, yet it is important for life and many human activities and enterprises. Understanding water's scarcity and worth, as well as human requirements, is an important part of water economics, as is determining the costs and advantages of various options and the long-term

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

effects of different pricing schemes (Al-Karablieh & Group, 2012; Al-Karablieh et al., 2012).

Jordan is struggling to keep up with the country's rising water needs. Due to the rising shortage of water, water pricing is becoming more popular as a way to "improve" water allocations, promote water conservation, and help water utilities maintain a sustainable financial position. Increased water and wastewater tariffs, reduced water losses, and a relative improvement in performance have been enacted by the Jordanian government in recent years in an effort to raise WAJ's cost recovery and financial viability. Because of a lack of resources, the WAJ cannot continue to operate effectively and efficiently (Fileccia et al. 2015).

The rising expense of delivering water has necessitated the heavy subsidization of water services. However, as economic pressures mount, gasoline costs rise, and financial resources are in short supply, the case for complete cost recovery is gaining traction. As a result, the decision-makers are forced to balance the needs of the water authority with the public's desire to keep water rates low for the poor. Water price is the most critical component of a demand management strategy that aims to maximize water consumption while minimizing environmental impact. To ensure that water systems are able to satisfy current and future water distribution needs, they must be operated and maintained properly. Understanding the value of water is critical for making sound policy decisions on water sector investments, water allocation efficiency, and water pricing (Young and Loomis 2014). Domestic water quality is infrequently studied in Jordan, and the factors that influence these values are hardly considered. Al-Karablieh, et al., (2012) has studied irrigation water qualities in Jordan (2012). The findings reveal that JD 0.51 m-3 may be used to assess the irrigation system's weighted average water value. In 2008, Salman et al. investigated Jordan's household water consumption. Water demand and income elasticity are both shown to be inelastic. Life need an inelastic supply of water that relies on the low income elasticities associated with lower-income populations. In a country with low per capita consumption and a rationing program of water distribution, a progressive rate structure does not benefit the disadvantaged groups nor does it reduce their water consumption; most of the poor have large household sizes and their per capita consumption falls below 40 liters per capita per day.

Water demand elasticity in the greater Amman region is studied by Al-Najjar, et al., (2011). Price inelasticity (-0.52) and a positive inelastic income elasticity were found to characterize the projected demand for both models. The Amman-Zarka basin's household water demand function is studied by Tabieh, et al., (2012). There is a strong correlation between a household's water consumption and its marginal price, premium rate structure, amount of household income, and several other welfare variables. The findings demonstrate that the projected elasticity of demand for residential water is negative and poorly sensitive to price changes (-0.47). This means that the demand function becomes insensitive to price rises below specific thresholds. A person's thirst for water rises in direct proportion to their household's size, income, and degree of education. Accordingly, given the country's significant water scarcity and low price elasticity of household water consumption, the pricing mechanism is not an effective instrument for conserving water.

The allocations of water supply in 2020 were as follows: 54% highland irrigation and irrigation in Jordan Valley, 49% municipal usage, and 4% tourist/industrial use as illustrated in Table 1. However, these statistics may understate both irrigation usage and overall water consumption due to several causes. Irrigation consumes 567 mcm of the presently available supply. A distant second is the domestic market, which consumes around 516 million cubic meters, followed by industrial usage, which consumes about 35 million cubic meters, or less than 4 percent of the overall supply.

Table 1
NATIONAL WATER SUPPLY AND CONSUMPTIVE USE BY SECTOR MCM 2020

Water Source	Municipal	Industrial	Irrigation	Livestock	Total Water Uses	Parentage Share %
1-The Surface Water	147.78	6.18	200.52	8.5	364.87	32.3%

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

The Jordan Rift Valley	121.82	6.15	151.83	0	281.78	24.9%
The Highlands	25.95	0.04	48.6	8.5	84.08	7.4%
The Springs	24.05	0.02	17	0	42.06	3.6%
The Base & Floods	1.91	0	31.6	8.5	41.03	3.7%
2. The Groundwater	366.45	24	199.68	1.51	592.68	52.6%
The Renewable GW	245.81	20.28	170.28	1.51	437.88	38.7%
The Nonrenewable GW	118.8	4.72	29.42	0	151.83	13.6%
The Desalination	5.34	1.2	0	0	6.44	0.6%
3.The Treated Wastewater	0	3.36	165.75	0	171.08	15.1%
The Registered JV	0	0	135.91	0	135.91	12.0%
The Non registered HL	0	3.34	31.83	0	34.16	3.1%
The Total Utilized Water Res.	517.25	34.55	565.93	9.91	1126.63	100.0%

Source: Ministry of Water and Irrigation (MWI 2021).

Municipal water demand is outpacing population increase, although real need has never been fulfilled due to system capacity and insufficient supplies. Water use is rationed by rotating supplies and giving intermittent services throughout the dry months (June – August) to solve the shortfall and gap between supply and demand. By 2025, the water resources should be developed to 1,662 mcm. After completing the capital investment plan, the Disi began operations in 2013 and began providing 107 mcm yearly. The Amman-Aqaba Desalination and Convenience system is projected to be operational by 2025, and treated wastewater should be entirely used by 2030. (MWI 2016). Groundwater extraction should be significantly limited (MWI, 2009). Jordan's water comes from surface and subsurface sources, as well as wastewater treatment facility water reclamation (MWI, 2016).

Wolff, et al., 2012) employed several forecasting methodologies in conjunction with various scenarios to project future water demand in various water-consuming industries. According to the findings, overall water consumption in 2025 might range between 1,219 and 1,620 mcm. Using the same technique and data as the AFD research to anticipate future demand for a longer time, the contributions to this rise and its variations varied significantly amongst the sectors of water consumption (2030-2050). According to the findings, total water consumption in 2030 was about 2,080 mcm, 2,350 mcm in 2040, and 2,530 mcm in 2050.

Table 2
JORDAN'S FUTURE WATER DEMAND IN MILLION CUBIC METERERS FROM 2020 TO 2050

Year	**2020**	**2030**	**2040**	**2050**
The Agriculture	1,048	1,155	1,245	1,375
The Municipal	452	703	825	828
The Industry	167	213	271	308
The Tourism	9	12	14	22
Total	1,678	2,084	2,352	2,533

Source: Wolff, et al., (2012)

Sector of Domestic Water

Jordan's water and wastewater services are provided by the Water Authority of Jordan (WAJ), a governmental agency. There must be a pricing system in place in order to assure the sustainability of the service. The government and the donor agencies are still required to support WAJ's capital investment projects, which is why tariffs are not enough to cover all of the expenditures. The degree of cost recovery accomplished by WAJ is affected by a number of variables:

- Since the sudden influx of refugees and internally displaced people left virtually no time for any organized population settlements planning, and they all settled in or near urban areas far from water sources, the rapid and unplanned population growth that occurred during several refugee waves in the 1990s contributed to an increase in water

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

supply costs. The last wave is the Syrian refugees during 2012-2015. The MWI (2013) indicate that there are 1.3 million of Syrian people consume about 21 percent of domestic water consumption (MWI 2018)

- - The capital expenditures of creating new water projects in Amman and Zarqa, which need enormous conveyance systems remote from populous regions, like as the Disi Amman water conveyor project, which is anticipated to cost 0.74 JD per m3 according to MEE (2015).
- High operating and maintenance expenses for water and wastewater installations that need pumping and treatment and use a lot of power;
- Many sections of Jordan have seen a significant increase in the amount of cash invested in cutting-edge technology for wastewater treatment;
- low collection rates and high personnel levels are only two examples of the inefficiency in the water utilities' operations, which are also plagued by significant water losses and low collection rates.

Increased water and wastewater tariffs, reduced water losses, and a relative improvement in performance have been enacted by the Jordanian government in recent years in an effort to raise WAJ's cost recovery and financial viability. There is still a long way to go before the earnings pay all of the costs. Only the operating costs and a tiny fraction of the construction costs are covered by this insurance policy. JD 0.72 per cubic meter of water billed and JD 0.32 per cubic meter of billed wastewater are the average returns from the water and wastewater tariffs in 2013. Only 88% of the O&M costs and 56% of the total cost were covered by current revenues.

The operating margin is very negative, indicating that WAJ's overall revenues, including pumping income that were not paid to WAJ, do not even cover the expenditures of the company's employees. There is only 10% of irrigation water used in the overall operational cost coverage ratio of 30% or less (World bank, 2013).

For the period 2004-2006, WAJ achieved greater cost recovery than in 2007-2009, owing to high inflation, the extra costs accumulated by As-Samra wastewater treatment plant, adding more costly water supply sources (primarily Zara Ma'an desalination facility), and restricted performance improvement. In 2012-2013, when Disi's pricey water became available, the cost recovery ratios fell even more. A comparison of past cost recovery rates is shown in Figure 1.

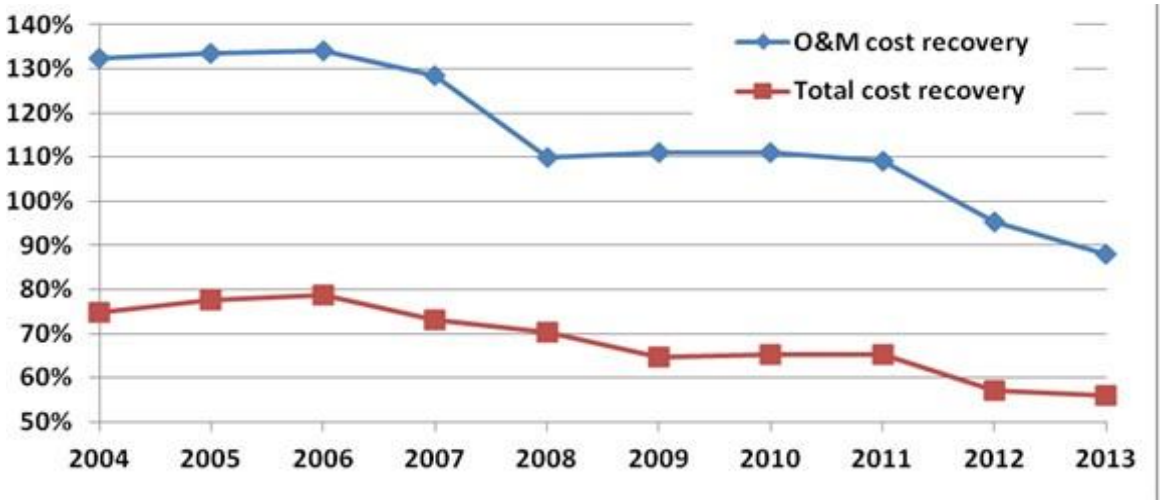


FIGURE 1
FULL COST RECOVERY LEVELS OF WAJ AND HISTORICAL O&M

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

Public Water Network

A complicated tariff formula was created during the following years from a single charge for each block of usage in Jordan in 1975. In the previous 20 years, water tariffs have undergone a number of changes to accommodate rising construction expenditures and operating and maintenance expenses. Tariff reform was also used by the government to promote water conservation and demand control strategies. MWI, 1997, outlines the goals of Jordan's water tariff policy in its 1997 Water Strategy: "Recovery of the cost of utilities and the provision of services shall be targeted. Recovery of operation and maintenance cost shall be a standard practice. Capital cost recovery shall be carefully approached. The role of water tariffs shall be considered as a tool to attract private investment in water projects."

Jordan's water tariffs are different between Amman and the rest of the country. Bill values and water tariff structures in use at the time of this writing. As a result, the present municipal water tariff structure is the same as it has been since 1997 with the addition of the extra premium in 2003, 2005, 2012, and 2014. Changed in 2012, the water tariff almost doubled, which was a huge rise. A 20 percent rise to the tariff was all that was imposed in 2014 due to the new levies. Residential consumers should expect to pay 1.92 JD/m3 in water tariffs. At a quarterly usage rate of 18 m3 or less, a minimum water service fee amount of JD 3.9 and 3.75 for Amman and other governorates accordingly, must be addressed.

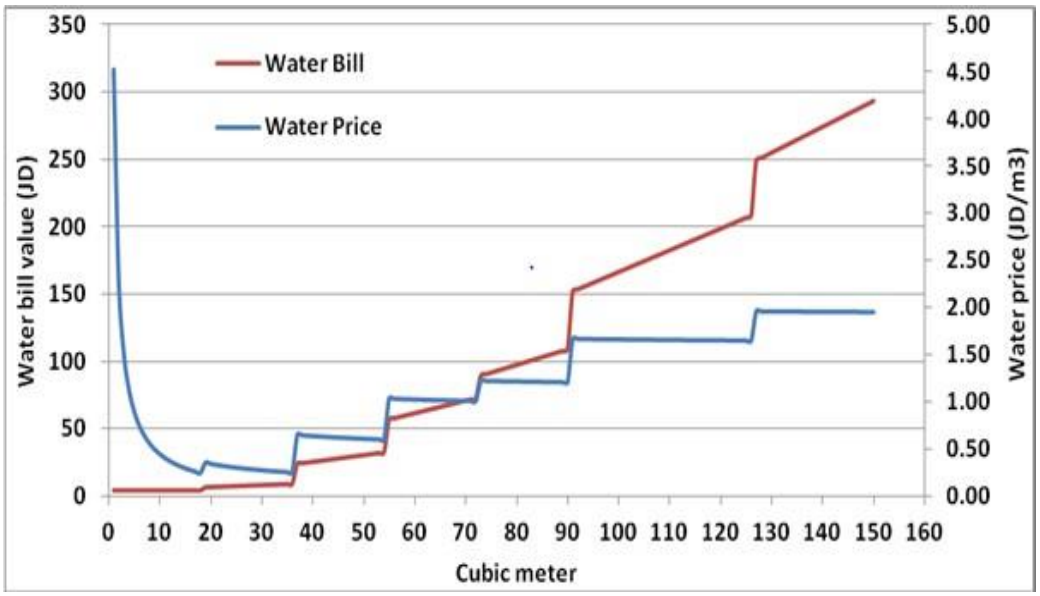


FIGURE 2
THE VALUE WATER BILL IN AMMAN AND THE STRUCTURE OF RESIDENTIAL WATER TARIFF

1.3 JD/m3 for water service in all Jordanian governorates is charged to non-residential clients with a minimum use of 6 each quarter. For all users, WAJ imposes additional non-volumetric costs in addition to the volumetric rate. Except for Amman, where the extra cost is 5.15 JD/bill, customers who use less than 6 cubic meters will be charged 6 JD/bill, while those who use more than 6 cubic meters will be charged 7.8 JD/bill.

OBJECTIVE

As a means of determining the appropriate water tariff and recognizing water's true economic worth, this article aims to evaluate the value of home water usage.

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

DATA COLLECTION

In order to accurately estimate the value of household water, a broad variety of data is needed. As a result, our technique relied on the availability and quality of data. The desire to pay for water in Jordan's area, for example, is not well documented. Surveys and evaluations that are not accurate for estimating the value of residential water may be found.

Water Authority of Jordan records and recent research on home water consumption in Jordan were used to gather data on residential water use. In the financial statements released by WAJ for itself and its subsidiaries, Jordan Water Company (Miyahuna), Yarmouk Water Company, and Aqaba Water Company, the cost of delivery via the public network in Jordan is included.

METHODOLGY OF VALUATION

The economic worth of water and the expenses connected with its availability may be evaluated using a number of criteria. When water resources meet water demand for user sub-sectors throughout time and geography, the value of alternative uses and opportunity costs are concurrently calculated. If suitable policies are applied to address externalities, water markets will be able to match water demand with supply. A partial equilibrium technique should be used to estimate values, costs and tariffs since ideal market systems are not accessible for practical applications. In order to represent the cost to society of denying other sectors of the use of this water, it is necessary to estimate the potential cost of water when utilized in a specific sector (Rogersat el., 1998).

Principle of Economic Water Value

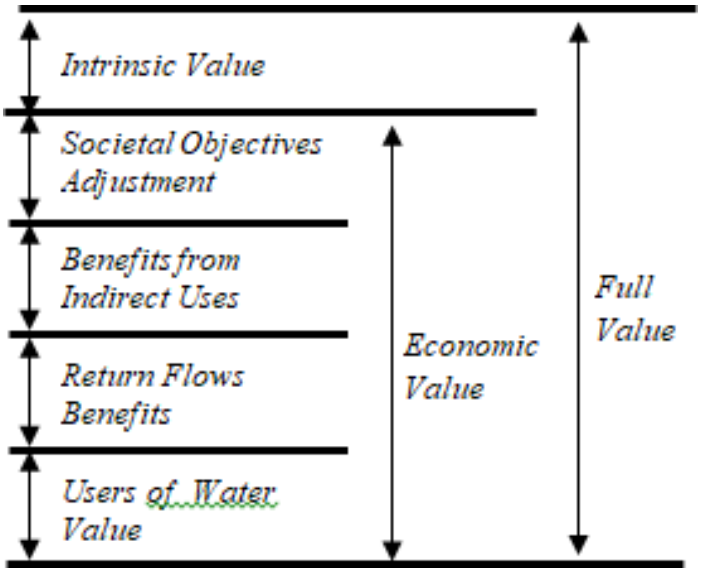
It is important to determine the "user value" of domestic water, which is the amount of money a family would swap and willingly pay for an extra unit of water at a certain place and time. Improved water supplies provide both direct and indirect advantages for water consumers, as well as for the rest of society. The fact that a community that had previously suffered from a lack of appropriate water supplies and as a consequence had to deal with hardships will no longer have to do so indirectly helps the project. Although it is easy to identify the direct advantages to water users, it may be challenging to correctly assess these benefits. Indirect benefits are difficult to quantify since they do not directly benefit water users. There are two parts to estimating water value: use values, which are termed economic values or (extrinsic values and direct use values), and non-use values, which are called intrinsic values, passive use values or existence values). Agriculture, industry, hydropower, navigation, and domestic usage account for the vast majority of water's value in various industries. Aesthetics, culture, religion, geomorphology, and nature all contribute to non-use values (Young & Loomis, 2014; Young, 2005; Agudelo, 2001). Therefore, no further evaluation or discussion will take place on the inherent qualities.

Figure 3 illustrates the basic idea of water's worth. Water's economic as well as intrinsic worth are combined to form its value in usage. Water consumers, return flow benefits, net advantages from indirect use, and modifications for social purposes are all included in the economic worth of water depicted in the image. Because of the lack of available data and the breadth of the research, the only thing that can be assessed is the worth to water consumers (Rogers, 1998). It is usual to use the willingness to pay for water as an indicator of water value, which is a lower limit on water value since there is extra value in the water. An individual's willingness to sacrifice other commodities and services in order to gain a certain commodity, service, or condition of the world is a measure of economic worth in this approach. A person's willingness to give up certain material possessions in exchange for more of another shows how highly they are valued. For all intents and purposes, the money price of

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

market items is nothing more than an extreme example of a trade-off ratio, since the money used to buy one unit represents a reduction in the quantity of one or more other components of the package as a whole. A person's willingness to pay (WTP) for a positive change may be used as a substitute for a value measure based on substitutability (Agudelo, 2001).

As a person's income rises, so does his or her willingness to pay; the more a person dislikes danger, the more eager he or she is to pay. It follows that a person's capacity to pay is the greatest amount he or she can afford to pay. Even for those who have a low tolerance for risk, the ability to pay is always more than or equal to the desire to pay. Poverty, on the other hand, means that both capacity and desire to pay are at a low level and tend to merge into one another (Karthikeyan, 2010).



Source: (Rogers, 1998)

FIGURE 3
PRINCIPLES OF THE VALUE OF WATER USE

Economically, the WTP is described by Little fair (1998) as the amount of money a customer is willing to pay for water delivery. In most cases, the WTP is determined by conducting surveys to determine the WTP of individual consumers for a product. An different method should be utilized in Jordan since there is no proper survey or evaluation of the WTP by domestic consumers. The true cost of water to the water user, both directly and indirectly, would be close to the amount that the water user is prepared to pay, according to the WTP definition. As a result, while they are not equal, the WTP's value may be expressed in terms of the water it costs consumers.

Adopted Method

Domestic water may be valued using a number of methods. Table 3 summarizes the findings of the authors' review of several methodologies. Each of these methods for determining the worth of water has its own set of benefits and limitations that determine which one is best for a given circumstance. Additionally, the availability of data is a critical component in determining the best method for valuing water. The opportunity cost technique is found to be the optimal option to use based on the requirements and availability summary shown in the table. In the next part, we'll discuss the method that was used.

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

Table 3
AN OVERVIEW OF THE METHODS AND DATA NEEDED AND AVAILABLE TO VALUE RESIDENTIAL WATER

Method name	Data needed	Data availability
Approach of Stated preference: contingent value method	Questionnaire	No
Approach of Revealed preference: Contingent Value Method	Market observation behavior	No
Estimation of Demand curve	Water demand and prices	No
Approach of Benefits transfer	socio-economic variable	No
Approach of The opportunity cost	water supply Cost and tariff	Yes

Figure 4 shows the many components that go into determining the price of water. Supply and opportunity costs may be easily estimated using readily accessible data and a basic technique, but assessing all other costs necessitates the use of complicated methodologies and several data sets that aren't readily available. Information on the cost of delivering goods and services over Jordan's public networks is available. WAJ publishes this information in its financial accounts for itself and its subsidiaries, including Miyahuna Company, Yarmouk Water Company, and Aqaba Water Company.

The Full Provision Cost: Comprises the expenses involved with the supply neither of water to a customer without account of the externalities inflicted onto others nor of the other uses of the water. Operating and maintenance (O&M) and capital charges (Capital Cost) are two different components of total supply costs that need to be assessed at their full economic input cost.

O&M COST: For the supply system to function, some expenses must be incurred. Raw water purchases, power for pumping, maintenance materials and input expenditures to operate storage, distribution and treatment facilities are among the typical costs. As a rule, there is minimal disagreement on what constitutes O&M costs and how they should be quantified in practice.

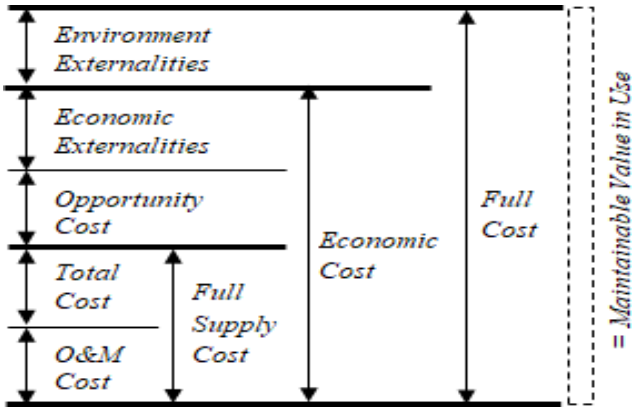
Capital Cost: Expenses related with establishing reservoirs, treatment facilities, transportation and distribution networks should include capital consumption (depreciation charges) and interest costs. The method used to calculate capital costs is subject to significant debate. Traditional approaches have a backward accounting posture and focus on the expenses of repaying previous investments.

By using water, one person takes it away from someone other. This is called the opportunity cost. This misallocation of resources results in some potential costs for society if the other user has a positive value for the water. When there is no other use for water, the opportunity cost of water is zero. Water is undervalued when the opportunity cost is ignored, which leads to investment failures and major misallocations of the resource. An opportunity cost idea also applies to environmental challenges, which are covered in more detail later in this article.

The provision and use of water for domestic purposes takes precedence in Jordan. In terms of priorities, industrial, commercial, and touristic uses of water are the second and third most important, respectively. To put it simply, the non-residential water tariffs are the most expensive; followed by the average household water tariff known as residential, and lastly the irrigation water tariff, which is regarded the least expensive of all. Non-residential water consumers, on the other hand, are the second best option for residential water suppliers. There is a section on public water network tariffs that explains the costs for household and non-residential water customers.

.

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.



Source: (Rogers, 1998)

FIGURE 4
PRINCIPLES OF WATER COST

The following equation may be used to estimate the economic worth of household water:

$$EVDo = FC + OC + EcX + EnX + NBRF + NBIU + ASO \quad (1)$$

Where EV_{Do} represents the economic value of domestic water, FC represents the full cost of water supply, OC represents the opportunity cost, EcX represents the cost of economic externalities, EnX represents the cost of environmental externalities, NBRF represents the net benefits from return flows, NBIU represents the net benefits from indirect uses, and ASO represents the adjustment for societal objectives. All of them are expressed in JD/m3. In this research, the remaining five terms in the preceding equation will not be examined, but the opportunity cost may be approximated using the following equation:

$$OC = WTNon-residential - WTResidential \quad (2)$$

Non-residential water users pay $WT_{non\text{-}residential}$, whereas residents pay $WT_{residential}$, the amount of their monthly water bill. Excluding the final five terms of equation (1), and then using equation (2), the economic worth of household water may be determined (3):

$$EVDo = FC + WTNon-residential - WTResidential \quad (3)$$

As previously mentioned, the accepted methodology significantly underestimates the true value of household water due to the exclusion of additional indirect values, such as environmental and economic externalities, social benefits, and intrinsic benefits. As for determining the worth of household water, however, this suggested technique gives at the very least a high standard of quality.

RESULTES AND DISCUSSION

The total cost of water supply and the opportunity cost are added together to arrive at an estimate of the value of residential water. The service provider, WAJ, is responsible for the complete cost of water delivery. The water supplier's opportunity cost is the amount of money that would have been saved if it had instead provided water to the second-best water customers (non-residential water users).

Water Supply Full Cost

For the Jordanian people, WAJ and its water utilities are responsible for the expense of

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

providing water service via the public water network. There are four major water utilities in Jordan: Mihayuna Company serves Amman Governorate, Yarmouk Water serves northern governorates, and Aqaba Water serves Aqaba Governorate and the remainder of Jordan (Table 4 summarizes these costs for 2009). Several factors influence the price of water service in Jordan's governorates. These include the kind of water resources, the distance and elevation difference between water resources and consumers, the density of customers, and the performance of the utility services in general.

Water and wastewater services are included in the costs shown in Table 4. It is expected that 85 percent of O&M costs and 60 percent of capital costs for WAJ are assigned to water service, while 15 percent of O&M costs and 40 percent of the capital costs are related to wastewater service (Fileccia, et al., 2015; ECO Consult, 2004). As a result, the total cost of water service is anticipated to be around 224 million JD (see Table 4). It may be calculated that the average cost for water service in Jordan is 1.23 JD/m3 of billed water and 0.65 JD/m3 of water supply based on the total billed water in 2012, which is 182.4 MCM.

Table 2
WATER SERVICE PROVISION COST IN MAIN JORDAN'S REGIONS

Item	Unit	Amman	North region	Aqaba	Rest of Jordan	Total (Jordan)
Water Revenues	million JD	56.4	17.3	11.8	37.6	123.2
Wastewater Revenues	million JD	27.1	4.3	2.2	6.4	40.0
Other revenues	million JD	4.6	3.9	0.7	5.8	14.9
Total revenues	**million JD**	**88.2**	**25.5**	**14.7**	**49.7**	**178.1**
Operational and Maintenance Cost						
Electricity	million JD	43.8	15.6	2.1	20.0	81.5
Maintenance	million JD	6.3	4.6	0.5	5.9	17.3
Others operational Expenses	million JD	17.0	2.5	0.2	2.0	21.7
Salaries and wages	million JD	15.5	11.8	4.0	23.6	54.9
Administrative and others outlays	million JD	6.8	2.7	4.7	4.4	18.7
Total of operating expenditure	**million JD**	**89.4**	**37.2**	**11.6**	**55.9**	**194.1**
Depreciation	million JD	3.3	4.8	1.7	44.1	53.9
Other expenditures	million JD	32.3	15.4	5.0	29.1	81.8
Total Capital Expenditures	**million JD**	**35.6**	**20.2**	**6.7**	**73.2**	**135.7**
Total expenditure	**million JD**	**101.1**	**47.9**	**13.3**	**167.5**	**329.8**
Net Profit/Deficit	million JD	0.02	-19.9	1.8	-114.1	-132.1
Ratio of operating costs coverage	percent	99%	69%	127%	89%	92%
Ratio of Total Cost coverage	percent	87%	53%	110%	30%	54%
O&M cost – Water	million JD	67.1	26.8	8.8	39.1	141.8
Capital cost – Water	million JD	21	13	4	44	83
Full cost – Water	million JD	88.5	40.0	12.9	83.0	224.4
Domestic Water Supply (mcm)	mcm	136.7	65.1	21.0	122.8	345.6
Percent of Non-Revenue Water	percent	32.1%	54.1%	21.3%	64.8%	47.2%
Non-Revenue Water (mcm)	mcm	43.9	35.2	4.5	79.6	163.2
Domestic billed water (MCM)	mcm	92.8	29.9	16.6	43.2	182.4
O&M cost (JD/m^3 billed)	(JD/m^3 billed)	0.72	0.90	0.53	0.91	0.78
Capital cost (JD/m^3 billed)	(JD/m^3 billed)	0.23	0.44	0.25	1.02	0.45
Total cost (JD/m^3 billed)	(JD/m^3 billed)	0.95	1.34	0.78	1.92	1.23
Total Revenue (JD/m^3 billed) W & WW	(JD/m^3 billed)	0.95	0.85	0.89	1.15	0.98
Water Revenue	(JD/m^3 billed)	0.61	0.58	0.72	0.87	0.68
Wastewater Revenue	(JD/m^3 billed)	0.34	0.27	0.17	0.28	0.30

Source: compiled from WAJ's income statement for 2012

The water supply ratio was used to reallocate the capital expenses reported under WAJ to the water utilities in order to assess the cost per area. Capital costs may now be estimated more precisely because of this method. Based on the billed and supply water costs, we've calculated an average water service cost (see Figure 5).

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

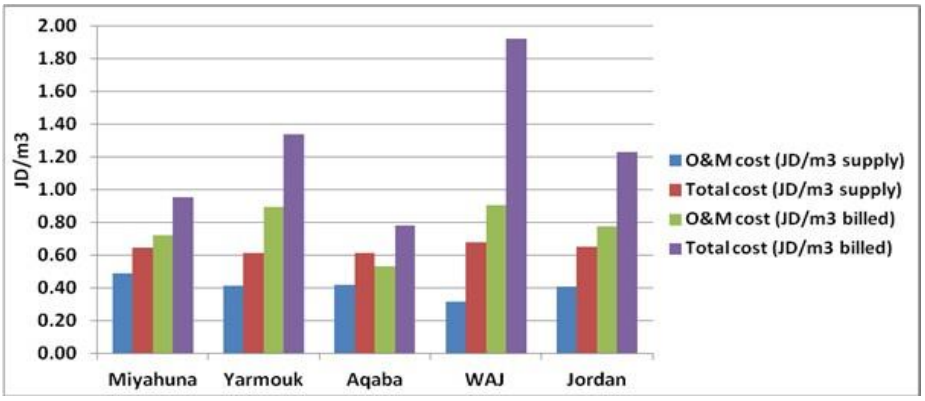


FIGURE 5
WATER SERVICE PROVISION AVERAGE COST IN MAIN JORDAN'S REGIONS 2012

A significant portion of WAJ's O&M budget is allocated to overseeing the kingdom's overall capital investment program. Overestimation of Jordan's O&M costs does not represent the true cost of providing water services. Investment projects like the Disi water conveyance project and water network repair have contributed to a rise in the cost of water service supply in recent years. Costs of water supply are predicted to rise by 50% as a result of the Amman-Aqaba Water Desalination project.

The historical development of water services provision in Jordan. The costs and revenues items are presented in Table 5. The results show a continuous trend of increasing NRW. The NRW reach 48% in 2013 in spite of all measures of water authorizes to reduce NRW. The cost of water is also increasing by time and reaches to 1.35 JD per m^3 whereas the water revenue of 1 cub meter is only JD 0.72 in 2013. In 2013, the total cost of water delivery was anticipated to be about JD 264 million, while water revenues were JD 142 million (Table 5). The average cost of water service in Jordan in 2013 was 1.35 JD/m3 of billed water and 0.70 JD/m3 of water supply, based on total billed water of 196 mcm and total water supply of 375 mcm. The cost recovery rate has dropped from 70% in 2008 to 56% in 2013.

Table 3
DEVELOPMENT WATER SERVICE PROVISION COST IN JORDAN

Year	2008	2009	2010	2011	2012	2013
Total Revenues (million JD)	152.1	142.4	150.2	170.1	178.1	204.9
Water Revenues (million JD)	105.2	98.5	103.9	117.6	123.2	141.7
Operational Costs (million JD)	138.0	134.2	135.2	156.1	187.1	232.6
Capital Costs (million JD)	80.4	124.9	95.1	104.2	124.7	133.8
Total Costs (million JD)	218.4	259.1	230.3	260.3	311.8	366.4
Water Cost (million JD)	157.8	187.4	165.6	187.0	224.4	264.1
Wastewater cost (million JD)	60.7	71.7	64.7	73.2	87.4	102.3
Losses, percent	(66)	(117)	(80)	(90)	(134)	(162)
Revenue to Total cost	70%	55%	65%	65%	57%	56%
Water Supply (mcm)	332.4	335.5	342.5	340.5	345.6	374.7
Billed Water (mcm)	192.4	195.2	199.5	201.1	182.4	195.6
Non-Revenue Water (mcm)	140.0	140.3	143.0	139.4	163.2	179.1
NRW Percent	42%	42%	42%	41%	47%	48%
O&M cost (JD/m^3 billed) W& WW	0.72	0.69	0.68	0.78	1.03	1.19
Capital cost (JD/m^3 billed) W & WW	0.42	0.64	0.48	0.52	0.68	0.68
Total cost (JD/m^3 billed) W& WW	1.14	1.33	1.15	1.29	1.71	1.87
Water Total cost (JD/m^3 billed)	0.82	0.96	0.83	0.93	1.23	1.35
Wastewater Total cost (JD/m^3 billed)	0.32	0.37	0.32	0.36	0.48	0.52
Total Revenues (JD/m^3 billed) W&WW	0.79	0.73	0.75	0.85	0.98	1.05
Water Revenues (JD/m^3 billed)	0.55	0.50	0.52	0.58	0.68	0.72

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

Wastewater Revenues (JD/m^3 billed)	0.24	0.22	0.23	0.26	0.30	0.32
Water subsidy (JD./m^3)	0.34	0.60	0.40	0.45	0.73	0.83
Subsidy ratio	30%	45%	35%	35%	43%	44%

Source: compiled from WAJ's income statement for 2008-2012

Opportunity Costs

The water price for non-residential water users is removed from the water price for residential water users in order to assess the opportunity cost. Table 6 illustrates how the average water rate may be calculated by dividing the entire amount of water invoiced by the total amount of water bill revenues, as explained in Section 1.2. Figures reveal that Jordan's major regions have a wide variety of average water tariffs, from 0.62 JD/m^3 in most areas to 0.69 and 0.58 JD/m^3 in Amman and Aqaba governorates respectively. Contrarily, no matter how much water is used, the non-residential water tariff on the public water system remains at 1.3 JD/m^3 (see section 1.2). Each region's JD/m^3 opportunity cost is shown in Table 6.

Value of Domestic Water

All of the variables in equation 3 have been determined, allowing us to estimate the domestic water value in Table 6. It was estimated that Jordan's average domestic water value in 2012 was 1.85 JD/m^3, which is higher than the rest of the Jordan region's value of roughly 2.35 JD/m^3. The higher costs of water supply in this area are a consequence of less efficient operations, which results in these higher prices.

In most cases, raising the home water tariff or enhancing the operation of water utilities would reduce the domestic water value. Residential water price increases would lower the opportunity cost and hence domestic water value. Additionally, decreasing the NRW and hence the cost of water service supply and, consequently, the value of residential water may be achieved through enhancing utility performance. As a consequence, the household water value will be reduced if water utilities are restructured and their operational performance is improved.

Consider that the capital cost is merely a reported investment in water systems, and does not include real costs to maintain and improve water systems as well as increase water services. As a result, the value of household water is overestimated due to the disparity between the predicted capital cost and the actual capital cost.

Table 4
VALUE OF DOMESTIC WATER CALCULATIONS BY WATER UTILITIES

No	Region / Item	Amman	North region	Aqaba	Rest of Jordan	Total (Jordan)	Note
1	Residential water bill revenues (Million JD)	56.4	17.3	11.8	37.6	123.2	Table 2
2	Residential billed water (MCM)	92.8	29.9	16.6	43.2	182.4	Table 2
3	Average water price for residential users (JD/m^3)	0.61	0.58	0.72	0.87	0.68	(1)/(2)
4	Non-residential water price (JD/m^3)	1.30	1.30	1.30	1.30	1.30	
5	Opportunity Cost (JD/m^3)	0.69	0.72	0.58	0.43	0.62	(4)-(3)
6	Total Cost (JD million)	88.46	39.98	12.94	83.01	224.38	Table 2
7	Total cost (JD/m^3 billed)	0.95	1.34	0.78	1.92	1.23	Table 2
8	Water value (JD/m^3)	1.65	2.06	1.37	2.35	1.85	(5)+(7)
9	Total water value (Million JD)	153	61	23	102	338	(8)*(2)

In addition, the price of water supplied by private tankers is regulated at JD 4.0 per m^3 in Amman and JD 3.5 per m^3 outside of Amman. Water from WAJ tankers is supplied at JD3.0 per m^3. The raw water supplied for distribution by private tankers is largely sourced

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

from private wells. The abstraction charge for the supply of private tankers from private wells is JD 0.5 per m^3. Similar procedures of Table 6 were performed to derive the development of water values for the period (2008-2013).

Table 7 shows the increasing water values through time. The water value increased from JD 1.27 per m^3 in 2008 to JD 1.93 per m^3 in 2013. However, these values are underestimate the real water values, since the household expenditures and income survey in 2008 (DOS, 2011) reported that the average annual per capita consumption of bottled water in Jordan is about 24 liters. At an average cost of JD 0.33 per liter, this represents about JD 48 million per year in aversive expenditures. The above figure does not include the bottled water consumption outside the households and associated with taste, convenience and lifestyle preferences.

Table 7
DEVELOPMENT OF DOMESTIC WATER VALUE IN JORDAN

Year	2008	2009	2010	2011	2012	2013
Water Revenue (JD/m3 billed)	0.547	0.505	0.521	0.585	0.675	0.724
Non-residential water price (JD/m^3)	1.000	1.000	1.000	1.000	1.300	1.300
Opportunity Cost (JD/m^3)	0.453	0.495	0.479	0.415	0.625	0.576
Water Total cost (JD/m3 billed)	0.820	0.960	0.830	0.930	1.230	1.350
Water value (JD/m^3)	1.273	1.455	1.309	1.345	1.855	1.926
Total water value (Million JD)	244.9	284.1	261.2	270.5	338.3	376.7

Source: compiled from WAJ's income statement for 2008-2012

CONCLUSION

For Jordan in 2013, domestic water value is estimated at JD 1.93 per m3 and around JD 377 million, which is the sum of the overall cost of the public network and the opportunity cost. The residential water values in Jordan vary from JD 1.37 to JD 2.35 per m^3 depending on where you are. This is, in fact, about twice as much as domestic consumers already pay. Because of this, the actual price of domestic water is much higher than it appears on the face of it, due to factors such as: (1) underestimation of capital investment required to maintain and upgrade the water system; (2) indirect subsidies provided to domestic water sector by subsidizing electricity and historical fuel subsidies; and (3) environmental cost due to over utilization of renewable water resources. It is the goal of Jordanian water policies and plans to recoup all costs by increasing efficiency and by establishing a reasonable household water tariff. However, the recent water tariff is sufficient to reach the full cost recovery if the NRW reduce to international standard. There is a political will to reduce the NRW but social pressure from beneficiaries against such measures.

Decision makers in Jordan should take into account the true worth of residential water in order to determine an acceptable rate. If there is not enough water supply or the water quality is poor, many users may spend 10 times as much for tanker water as they do for municipal water service. This is not a call for a ten-fold rise in the water tariff, but rather a call to recognize and explain the true domestic worth of water as a means of persuading the public that the right water tariff should be established. Cross-sectoral water value comparisons versus sectoral water tariffs may also be used to determine the optimal water tariff for all sectors of the economy. Low economic value-to-water tariff ratio implies there is potential for an increase in water tariffs in order to represent the true economic worth of water. Because of the high ratio, a significant rise in the water tariff is possible.

REFERENCES

Abdalla, H., Naber H., Quossous, R., & Al-Assa'd T. (2004). Pricing as a tool for water demand management in water scarcity. *International Water Demand Management Conference*, Dead Sea, Jordan.

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.

Agudelo, J. I. (2001). The Economic Valuation of Water: Principles and Methods", IHE Delft, Delft, Value of Water Research Report Series 5, 2001.

Al-Karablieh, E., Salman, A., Al-Omari, A., Wolff, H-P., Al-Assa'd, T., Hunaiti, D., & Subah A. (2012). Estimation of the economic value of irrigation water in Jordan. *Journal of Agricultural Science and Technology*, 5, B2-487-497.

Al-Karablieh, E., & I.R. Group. (2012). Water valuation study: Disaggregated economic value of water in industry and irrigated agriculture in Jordan, United States Agency for International Development.

Al-Karablieh, E.K., Salman, A.Z., Al-Omari, A.S., Wolff, H.-P., Al-Assa'd, T.A., Hunaiti, D.A., & Subah, A.M. (2012). "Estimation of the economic value of irrigation water in Jordan." *Journal of Agricultural Science &Technology, B2*(5B), 487.

Al-Karablieh, L.B., Halasheh, M., Sobh, A., Al Baz, I., Al' Zoubi, R., Asalamat, H., Burwell, K., Götzenberger, J., Pogade, F., & Rappold, G. (2019). Decentralized Wastewater Management in Jordan. Amman.

Al–Najjar, F.O., Al-Karablieh E. K. and Salman A. (2011). Residential Water Demand Elasticity in Greater Amman Area. *Jordan Journal of Agricultural Sciences.*Volume 7. No. (1), pp. 93-103.

DOS (Department of Statisitics), (2011). Household expenditure & income survey 2008. Department of Statistics, Amman, Jordan.

ECO Consult (2004). Pricing of Water and Wastewater Services for the Water Authority of Jordan, Amman, Jordan.

Fileccia, T., Hovhera, V., Punda, I., & Manz, S. (2015). Jordan water along the food chain an analytical brief of selected food chains from a water perspective. Rome, FAO: Food and agriculture organization of the United Nations.

Karthikeyan C. (2010). Economic and social value of irrigation water: Implications for sustainability. Fourteenth International Water Technology Conference, IWTC 14 2010, Cairo, Egypt. Google Scholar, Indexed at.

Littlefair, K. (1998). Willingness to Pay for Water at the Household Level: Individual financial responsibility for water consumption". MEWEREW Occasional Paper No. 26, Water Issues Study Group, School of Oriental and African Studies (SOAS), University of London, UK, 1998.

MWI (2016). Decentralized wastewater management policy. Amman, Jordan, Ministry of Water and Irrigation.

MWI (2016). National Water Strategy 2016-2025: Water Demand Management Policy. Ministry of Water and Irrigation, Amman, Jordan, Ministry of Water and Irrigation.

MWI (2016). Water Sector Capital Investment Plan 2016-2025. Ministry of Water and Irrigation, Amman, Jordan, Ministry of Water and Irrigation. Crossref, Google Scholar, Indexed at.

MWI (2016). Water Substitution and Reuse Policy. Amman, Jordan, Ministry of Water and Irrigation.

MWI (2018). Annual Report 2018. Ministry of Water and Irrigation, Amman, Jordan, Ministry of Water and Irrigation.

MWI (2020). Annual Report 2020. Amman, Jordan, Ministry of Water and Irrigation. Crossref,

MWI (2021). Water budget for the year 2020. Amman, Jordan, Directorate of strategic planning, Ministry of Water and Irrigation, (in Arabic).

MWI (Ministry of Water and Irrigation), Water Strategy for Jordan, 1997.

MWI, Ministry of Water and Irrigation, (2011). Annual Report 2011, Amman, Jordan.

MWI, Ministry of Water and Irrigation, (2012). Annual Report 2012, Amman, Jordan.

MWI, Ministry of Water and Irrigation, (2013), Annual Report 2013, Amman, Jordan.

Rogers P., Bhatia, R., & Huber, A. (1998). Water as a Social and Economic Good: How to Put the Principle into Practice. Global Water Partnership/ Swedish International Development Cooperation Agency, Technical Advisory Committee, Sweden.

Rogers, P., Bhatia, R., & Huber, A. (1998). Water as a Social and Economic Good: How to Put the Principle into Practice. TAC background papers No (2). Global Water Partnership Swedish International. Development Cooperation Agency, S105-25 Stockholm, Sweden.

Salman, A., Al-Karablieh, E., & Haddadin, M. (2008). Limits of Pricing Policy in Curtailing Household Water Consumption. *Water Policy*, *10*(3), 295–304.

Tabieh, M., Amer Salman, A., Al-Karablieh, E., Al-Qudah, H., & Al-Khatib, H. (2012). The Residential Water Demand Function in Amman-Zarka Basin in Jordan.*Wulfenia Journal,* 19(11), Part II, 324-333.

USAID (2018). Water management initiative: Review of water scarcity ranking methodologies. Vermont, USA.

WAJ (Water Authority of Jordan), (2009). Annual Report of Water Authority, Amman, Jordan. 2010.

Wolff, H-P., Al-Karablieh, E., Al-Assa'd, T., Subah, A., & Salman, A.Z. (2012). Jordan water demand management study. *Water Science and Technology: Water Supply*, *12*(1), 38-44.

World Bank (2013). Irrigation water pricing in the Jordan Valley. The World Bank.

Young, R.A., & Loomis, J.B. (2014). Determining the economic value of water: Concepts and methods, Routledge.

Received: 18-May-2022, Manuscript No. JLERI-22-12056; **Editor assigned**: 20-May-2022; PreQC No. JLERI-22-12056 (PQ); **Reviewed**: 03-Jun-2022, QC No. JLERI-22-12056; **Revised**: 09- Jun-2022, Manuscript No. JLERI-22-12056 (R); **Published**: 25-Jun-2022

Citation Information: Tabieh, M.A., Al-Karablieh, E.K., Salman, A.Z., Al – Assaf, A., Majdalawi, M.E., & Qtaishat, T.H. (2022). An estimate of the economic value of domestic water services: case study in Jordan. *Academy of Strategic Management Journal, 21*(S6), 1-14.