Economic and Social Analysis of the Model of Optimal Water Consumption in Order to Education Sustainable Urban Development

Mahsa Arab 1 *, Mehdi Khakzand 2
1- PHD Student, Architecture, School of Architecture and Environmental Design, Iran University of Sciences & Technology (IUST), Tehran, Iran, mahsaas94@gmail.com
2- Associate Professor, Department of Architecture (Landscape), School of Architecture and Environmental Design, Iran University of Sciences & Technology (IUST), Tehran, Iran, mkhakzand@iust.ac.ir

Abstract
As recent studies show, the world will face a severe water shortage crisis over the next two decades. According to experts, this crisis will be caused by pollution of surface water and groundwater resources, lack of participation of countries in the optimal use of water, mismanagement in the storage of precipitation and excessive and unprincipled use of watershed resources. In the meantime, measures should be taken to minimize the withdrawal of surface and groundwater reserves from watersheds without harming the lives and livelihoods of individuals. This requires extensive research, the most important of which should be to reuse unconventional water, effluents and, in a word, water recycling. The main issue in water recycling is its economic dimension because it is a costly process. First, the costs of providing drinking water were examined, and then the decision was made to recycle water in its simplest form. For this purpose, the costs of the project and the benefits of it were examined, and in the meantime, the reduction of consumption and water costs of the subscribers were studied. The result of the study was that Gray water recycling with different implementation methods can reduce the common monthly consumption by 10 to 25 percent, which in turn reduces the amount of water. In this article, the amount of Gray water recycling and its return to the consumption cycle is discussed through economic analysis and evaluation of water consumption pattern in order to develop watershed management.
Keywords: Gray water treatment, consumption pattern, water shortage crisis, economic analysis of water consumption.

1. Introduction

The need for planning and management of water supply on the one hand and the limited amount of fresh water resources available on the other hand causes the use of unconventional resources such as gray water resources to be considered by all managers and experts. The rapid growth of development and increasing human needs for natural resources, including water resources, has caused an imbalance between supply and demand and has ultimately created instabilities in most parts of the world, especially arid and semi-arid regions such as our country. These instabilities have become much more pronounced, especially in the face of climate change such as declining rainfall and rising temperatures, and have led to unrest in life and even social tensions. Until a few decades ago, the most important concern of water resources managers was water supply and supply from different remote or deep areas, but today, consumption management is also a priority in planning and comprehensive management of water resources [1].

One of the ideas that is increasingly popular with researchers and decision makers in the field of municipal services management is the idea of waste management at the source of production. This idea has been considered in the field of municipal solid waste management, in the form of dividing the produced waste into different types and separating them at the source in order to better manage recycling and disposal. In the field of municipal wastewater management, this idea has been proposed as an inevitable solution. The important issue in this case is that the optimal point in wastewater management is not only its disposal but also due to the considerable volume of wastewater produced in homes on the one hand and increasing water demand and the need for new water resources on the other hand, wastewater as a source of unconventional water is considered.

Sewage produced in homes can be divided into two groups according to the above idea. Sewage produced from household uses such as bathing and washing clothes is called gray water and sewage produced from toilets is called black water. In many systems used in the world, gray water is combined with black water and is disposed of by the municipal wastewater disposal system. Gray water, on the other hand, has a higher quality and has a higher potential for reuse due to its lower pollution content. If gray water is reused both in and near the production site,there is a potential that the need for new water resources to be reduced, resulting in energy and carbon savings and a wide range of social and economic needs [2]. In particular, the reuse of gray water can reduce the need for high quality drinking water, which is also expensive.

Water scarcity and growing population is one of the world's biggest problems. Pollution of water resources on the one hand and industrialization on the other hand has been a threat to humans, ecosystems and sustainable development. This situation has led us to think of another source for water and wastewater treatment. Population growth combined with socio-economic development has put these resources at risk. Declining watersheds, drying up rivers and high levels of water pollution are signs of water scarcity. The results of research indicate that since 2000, Iran is included in the list of countries with water deficit and by 2030, the country's renewable water resources will be less than 1500 cubic meters per person [3]. Gray waters recycling and reuse has significant potential to reduce wastewater treatment and water supply costs, as well as reduce the supply and demand of drinking water. For this reason, recycling and reuse of Gray waters has become one of the main components of drinking water management [4]; Therefore, the main issue in this research is the management of household gray water and its recycling.

2- Literature and research principles

Water management and protection in watersheds

Water is a vital resource for every biological and human phenomenon and one of the important basic resources for the development of countries. Today, water management and protection is of great importance not only in developing countries, but also in developed countries [5]. Iran is located in the arid and semi-arid region of the world in terms of climate. Dehydration is one of the main climatic characteristics of the country, which has caused many sufferings and difficulties in the form of periodic droughts throughout history. Currently, water shortage in the country has created many challenges to achieve development goals. In many provinces of the country, there is no balance between the amount of water extracted and available water resources. Only in seven provinces out of 30 provinces, the ratio of extracted water resources to available water resources is less than 40%, and 23 provinces are facing water shortages with varying degrees, and in twelve provinces, this ratio is more than 100%. Also, the water resources extracted for wheat production in 2004 were equal to 11 to 14 billion cubic meters, while due to the increase in the country's population, the amount of water required to supply the wheat needed by the country in 2020 is about 17 billion cubic meters. It will be and is expected that many provinces of the country will face a water shortage crisis and there will not be enough water to ensure the country's food security [6, 7]. It seems that with the continuation of the current trend of water consumption in the country and the forecast of 90.4 million people in 1400, the amount of water required by the country is 130 billion cubic meters [8]. Obviously, it will not be possible to supply this amount of water from the country's renewable water sources. As a result, any increase in consumption, including agricultural development in order to be fully self-sufficient in exporting agricultural products or improving and improving the quality of health by maintaining the current consumption pattern and also removing some renewable water resources (such as groundwater and some rivers),complicates water consumption in the future due to unconventional pollution.

Along with the growing population and the rapid growth of industrialization, among the important challenges facing communities, reducing the quality of water resources and wastewater management to achieve sustainable development are more important. Therefore, the Millennium Development Goals emphasize on sustainable access to drinking water as well as proper environmental health such as sanitary disposal of sewage [9], the experience of different countries shows that water improvement is directly related to reducing infectious diseases. ; So that after providing safe drinking water, the mortality rate has decreased by 74.1%, tuberculosis by 63.3%, dysentery by 23.1% and diarrhea by 42.7% [10]. According to the results of the 2011 population and housing census, 93% of households have access to safe and hygienic water (public water supply network and improved water source) for drinking and 96% for cooking. Also, only 30% of the country's households have access to the public sewerage network, which compared to the statistics of 1385, 5% has been added to the facilities of the public sewerage network, which seems to have not improved much due to the increase of five million populations. Currently, the most important method of wastewater disposal in the whole country is through absorption wells, and 17% of households distribute their kitchen wastewater in the surrounding area. This figure is 20% for other wastewater [11]. On the other hand, more than 90% of the country's renewable water resources are used in agriculture. (Similar to developed countries), in twelve provinces of the country, the ratio of extracted water resources to available water resources will be more than 40% and in four provinces will be more than 100% and the country will continue to face water shortage crisis [7]. On the other hand, considering the effect of increasing water cycle and determining irrigation efficiency at the catchment scale has shown that increasing irrigation efficiency at the field level does not lead to solving the problem of water shortage [12, 13, 14]. In this critical situation, creating a stable balance between supply and demand has become a major problem in the country. Considering that relying on increasing irrigation efficiency will not meet the future needs of the country, recycling and reuse of effluents will be among the sustainable sources of water supply, which with principled and managed operation can threaten its pollution with the opportunity to benefit from it. Considering that outlining the prospects and future prospects of the water sector and being aware of future demand developments is a prerequisite for the planned and efficient use of water resources, the purpose of this study is to explain the importance of the role of water in the economy. Examine the language of water scarcity and, second, demonstrate the importance of investing in wastewater recycling to compensate for water scarcity. Then, from a social perspective, the relationship between how to access drinking water and wastewater disposal of a residential unit and the multidimensional poverty situation of households is examined.

The need to manage water consumption and reuse wastewater

At present, in Iran, about 60 to 70% of water consumed in the industrial sector is returned as wastewater and creates a very high volume of pollution. According to the forecasts, the volume of effluent produced in the country in 1400 is estimated at 40 billion cubic meters [15]. Therefore, despite the high volume of wastewater in the country, its management, recycling and reuse of these effluents is a must that can have a great impact on the conservation and maintenance of groundwater resources and significantly reduce the amount of exploitation. Water obtained from recycling and treatment of various effluents produced in the country can meet the consumption of many agricultural, urban and industrial sectors, which will be the best step in order to preserve water resources. Groundwater aquifers are composed of different components and parts. The most important factor in feeding these aquifers is rainfall, which in many countries; various measures have been taken to prevent wastage of rainwater and snow. Also, water recycling and wastewater treatment up to the standard level of pollution can be transferred to the environment to feed the aquifers, except for various uses. Various factors affect the nutrition, maintenance, reduction and groundwater resources that need to be addressed.

Out of about 600 study basins in the country, 300 basins are facing severe water loss [16]. About 80% of water consumption in homes and higher percentages in industry are converted into wastewater and their reuse is considered as renewable water resources [17]. The amount of water consumed and consequently the wastewater produced at the household level is affected by factors such as the number of family members and their age distribution, method and standard of living and family culture, as well as differences in household consumption patterns. Given that about 50% to 80% of domestic wastewater is gray wastewater, it can be called the largest source of water storage potential in the home. It can also be recycled with proper management and in accordance with sustainable urban development; So that public health and home health are also supported. The treated gray wastewater can also be used for irrigation purposes. In this case, a significant amount of consumption of municipal treated water is reduced. As a result, by designing a gray wastewater treatment and recycling system to a suitable standard, it is possible to reduce domestic water consumption by up to 40%, which is equivalent to 10% to 20% of municipal drinking water demand [18].

Gray water

The effluent produced at home, except for toilet effluent, is called Gray water. Gray water makes up an average of 57% of domestic wastewater and can be reused as a rich source. This will reduce water costs by about 40% [19]; Gray Water, or recyclable water, is part of the total wastewater that is extracted by people in all uses, both domestic and non-domestic, from various activities during the day and night, and in fact Gray water can produce all wastewater, except sewagewhich is called black water). In classifying waters based on color, we know them in 3 general categories: 1- White water is in fact the same as drinking water and sanitation. 2- Black water, which is the same as the toilet outlet. 3- Gray water, the middle of white water and black water that is suitable for recycling and reuse. The division of water is shown in the following figure:

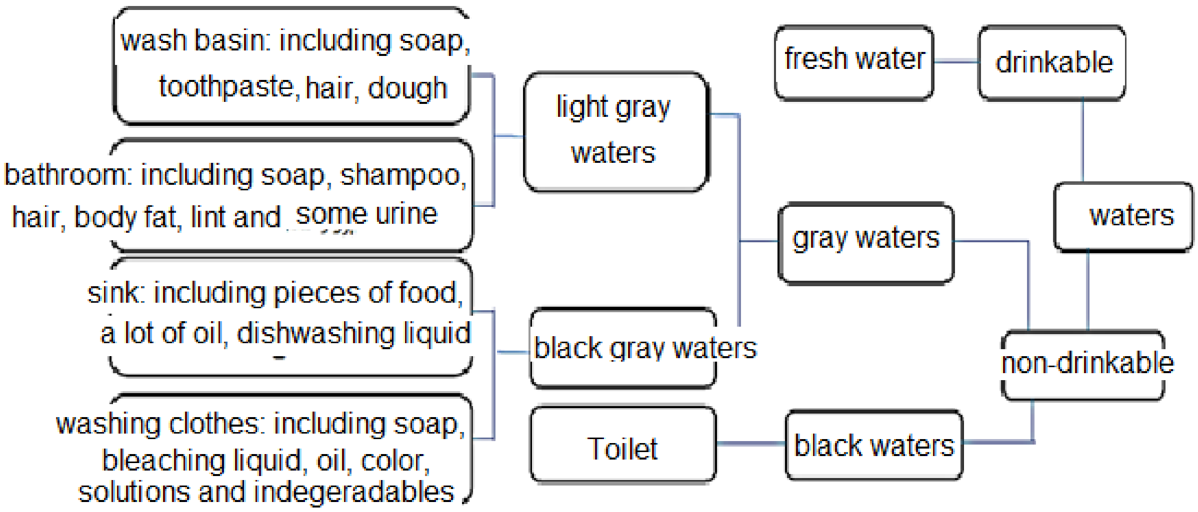

Figure 1: Classification of types of water consumption

An overview of gray water research reveals several general contexts. Some of these studies have focused on gray water as an alternative and unconventional source of water. These studies, either with case studies at the level of a household or a complex or even a city, have conducted quantitative and qualitative studies of gray water in order to reuse it on site and its effect on reducing drinking water consumption or environmental conditions and opportunities and challenges. Gray water reuse has been studied in a particular country. The first group includes research [20] and [21] that has used gray water in military centers in the United States and shopping centers in Brazil, respectively, and the second group includes research [22] and [23]. They discuss the potentials and opportunities of gray water in Ghana and the prospects for using gray water in Israel, respectively. In this regard, some studies have examined public acceptance in some countries due to the extraordinary importance of public acceptance in the success of reuse of gray water. These include studies [24], [25] and [26] that have addressed the general acceptance of gray water in Spain, South Africa and the United States, respectively. A large group of research related to gray water, to study the quality parameters of gray water and its different treatment methods such as sand filter [27, 28], anaerobic filter [29, 30], drip filter, membrane bioreactor, bilayer membrane with polyalelectrolyte [31]] And electrical coagulation [32]. A significant body of research has also examined the environmental and economic consequences of gray water reuse. These studies have dealt with various consequences such as the effect on energy consumption [33], the effect on groundwater [34], the effect on soil [35], the effect on the performance of wastewater collection networks and the effect on wastewater flow and quality [36,37,38] .

In arid and semi-arid areas with the growth of urbanization and increasing the volume of urban wastewater, the use of this wastewater was considered as a low-cost alternative to irrigation. At present, in Iran, about 60 to 70% of water consumed in the industrial sector is returned as wastewater and creates a very high volume of pollution [15]; Therefore, despite the high volume of wastewater in the country, its management, recycling and reuse of these effluents is a must that can have a great impact on the conservation and maintenance of groundwater resources and significantly reduce the rate of exploitation. The water obtained from the recycling and treatment of various effluents produced in the country can meet the consumption of many agricultural, urban and industrial sectors, which will be the best step towards conserving water resources.

Drinking water: It is refreshing water that its physical, chemical and biological factors are such that its consumption does not cause side effects in the short or long term in humans.

Urban drinking water: It is the treated water of surface water and groundwater aquifers, which is available by creating a dam and digging wells, and after purifying and storing it, and finally through the water supply networks, it reaches the consumer.

Consumer: It is a subscriber who uses piped water in the field of agriculture, industry, home, etc. and pays the approved fee for it. The amount and cost of its consumption will be announced to the subscribers in a form as a water bill (water price).

Price of water

It is the cost that the consumer pays to the country's Water and Sewage Company for the amount of urban water he consumes and is calculated as follows:

$$\frac{\text{Course consumption}}{\text{Course duration * Residential unit}} \times 30 \quad \text{(One-month consumption of a residential unit (in liters} \qquad (1)$$

$$\text{The amount of water costs one unit per month} \times \text{number of residential unit} \times \frac{\text{Course duration}}{30} \quad \text{Total amount of water payable - VAT} \qquad (2)$$

The amount of each cubic meter of water throughout the country is the same size and constant. Consumption of each residential unit is calculated on a monthly basis and based on liters. The price of water has been increased gradually in order to calculate a lower amount for low-consumption customers.

The basis for calculating the water price of each subscriber in the final formula is the "average monthly consumption of the subscriber" multiplied by the "price relative to the surplus" and from this product, the fixed number in the predetermined formula is deducted. This number is then multiplied by the coefficient of the city of use to calculate the amount of the subscriber payable. In this calculation method, a separate table is defined for each province and the fixed numbers in these tables are different. But in general, the total amount of water can be calculated with this general formula.

The total amount of water is multiplied by the coefficient of the city where it is used, which is called the urban adjustment coefficient. These coefficients are announced by ABFA Company.

For example, the urban adjustment coefficient for the city of Tehran is 1.32. This figure is different for other cities. For some cities this coefficient is below number one and for some cities it is above number one.

Costs of drinking water supply

The selling price of water varies according to its quality, and in some cases the price difference is very high and people travel long distances to get quality water. For example, the water of some springs that causes the treatment of some complications and diseases and has therapeutic value, such as SIDLAR spring water in MIANAH city and MASOOLEH or GHOOCHAN spring water, etc. As a result, it is the duty of the government and the Ministry of Energy to provide drinking water with the best quality and purify it to consumers, and this time a lot of financial burden has been placed on the government. Because it has a government subsidy, it sells for almost half the price. No matter how much drinking water is wasted and wasted, it has a negative impact on the country's economy. The most basic costs for the preparation, treatment and transfer of water are as follows:

1. The cost of controlling surface water by creating water structures and digging water wells
2. Costs for construction of treatment plants, chlorination strains, telemetry and water quality testing
3. Costs of water supply facilities and construction of water tanks to store it
4. Cost of preparing and implementing water distribution networks
5. Costs of maintenance and operation of water and repair and replacement of old and worn water supply facilities
6. Hiring human resources to manage and implement all the above programs

Costs are rising day by day and many measures have been taken in supply management, distribution and water supply networks and consumption management, but to no avail. It is true that some religious and patriotic people follow the principles of consumption management, and statistics show that the difference between the cost price of water and the selling price is increasing day by day.

Economic targeting of watershed management projects

After various studies on water prices in the first phase of targeted subsidies; the average price of drinking water in the home sector was set at 2,500 rials and implemented. However, the price that was received from the people before the implementation of the targeted subsidies was 1125 Rials. Also in the non-household sector, depending on the type of industrial, commercial or training centers, public, government and free consumption, various prices were considered. In general, the average selling price of water in the domestic and non-domestic sector before the implementation of the law was 1385 Rials, which increased to 2885 Rials after the implementation of the first targeted phase.

Every Iranian uses an average of 150 to 152 liters of water for home consumption, which, considering the regional conditions, on average only about 5 to 10 percent of this purified water is used for drinking and cooking. Every Iranian spends about 15 liters of water a day drinking and cooking. According to these cases, the cost of buying drinking water can be seen in the table below:

Table 1: Consumer payment costs

Approximate cost of purchasing daily drinking water	Average drinking water consumption of each Iranian per day	The price set for 1.5 liters of mineral water by the Iranian Mineral and Drinking Water Association in June 2020
20 thousand Tomans	15 Liters	5000 Tomeans

Of course, this is while the mineral water or drinking water reaches the consumer at the approved price, otherwise one should expect a higher cost. The point is that according to the estimates of the Ministry of Energy, if every family of four consumes 25 cubic meters (about 800 liters per day) of water during a month, they will end up with a bill of 7,000 Tomans. This shows how much the separation of drinking water from sanitary water in homes increases the cost of households. That is, every month, the cost of drinking water for each person is three hundred thousand tomans, for a family of four, about one million and two hundred thousand tomans per month, so this process needs to stabilize the main price of water.

3- Materials and methods

Quantitative and qualitative analysis of Gray water for recycling and reuse in watershed

The main purpose of this research is the management of industrial and domestic Gray water and its recycling. The use of Gray waters reduces the financial burden of sewage and pollution of sewage-related ducts, as well as reducing water consumption in watersheds. Accordingly, the recycling of gray water in a situation where the restoration of groundwater aquifers is one of the country's priorities can help reduce the withdrawal of groundwater resources and prevent the death of the country's aquifers.

Stabilize the original price of water

Research on rising water prices has not been mentally acceptable to many consumers. After managing water resources and observing engineering principles in the implementation of water supply and management in operation, water consumption should be managed in both agriculture, industry and home. .

We assume that the cost price of water, without considering the cost of branching, is 10,000 Rials per cubic meter and its selling price for home consumption is 4,000 Rials. We consider 100 households of 4 people from the least consumed household to the most consumed household, and we consider the average consumption of each household as 20 cubic meters. Out of 100 households, 20 are high-consumption households, 50 are low-consumption households, and 30 households are normal consumers.

Table 2: Water supply before water price reform (stabilization) (hypothetical)

Row	Cost difference and water sales	Sale price of water	Cost of water	Water consumption	Consumer (4person household)
1	6.000.000 Rials	4.000.000Rials	10.000.000 Rials	50Cubic meters	%20
2	5.400.000 Rials	3.600.000Rials	9.000.000Rials	30Cubic meters	%30
3	6.000.000 Rials	4.000.000Rials	10.000.000 Rials	20Cubic meters	%50
4	17.400.000 Rials	11.600.000 Rials	29.000.000 Rials	100Cubic meters	%100

Table 3: Water supply after reforming and stabilizing water prices (hypothetical)

Row	Consuming waterIncentive package price	Sale price of water	Excess water consumption	Cost of water	Water consumption	consumer
1	3.000.000Rials	2.000.000 Rials	10 Cubic meters	5.000.000Rials	25Cubic meters	%20
2	4.500.000Rials	0	0	4.500.000Rials	15Cubic meters	%30
3	5.000.000Rials	0	0	5.000.000Rials	10Cubic meters	%50
4	12.500.000 Rials	2.000.000 Rials	10 Cubic meters	14.500.000Rials	50Cubic meters	%100

You can see that before correcting the price, the total amount spent on drinking water supply for 100 households in a month is about 29,000,000 Rials. On the other hand, the amount obtained from the sale of water in a month is 11,600,000 Rials. That is, the amount of 17,400,000 Rials was an additional cost for water. The consumer saves at least 50% on water consumption and the costs are as follows.

The total amount for drinking water supply for 100 households in a month is about 14,500,000 Rials. On the other hand, the amount obtained from the sale of water in a month is 2,000,000 Rials. That is, the amount of 12,500,000 Rials is a surplus cost for water. The amount saved from providing drinking water in one month for 100 households is about 14,500,000 Rials. On the other hand, the amount obtained from the sale of water is about 2,000,000 Rials, of which the total amount saved is 16,500,000 Rials.

So in the price correction stage, not only 3,900,000 Rials have been more profitable than the previous stage, but also the initial cost has been halved and 50% has been saved in water consumption, since the observers of the consumption pattern are encouraged and about 80% of households are free from They used water and 50% of them were even exempted from paying for water, sewage and taxes. It will definitely have a positive effect on public opinion.

The result is that if we implement this method, instead of the surplus cost of 17,400,000 Rials, 12,500,000 Rials is the surplus cost, it will be given to consumers in one month, the profit of which is 4,900,000 Rials, but the initial credit will also save 14,500,000 Rials. Saved a total of 19,400,000 rials in a month has benefited from the cost of 100 households.

In this study, the amount of water consumed by 20 families was calculated. According to the different scenarios, the amount of Gray water recovery was estimated and evaluated based on the cost price of water and mortar related to wastewater treatment and the cost of designing a Gray water separation system. Considering that the water consumption in 1399 was 91130000 cubic meters, the share of Gray water and its amount was estimated and its economic value was calculated according to the cost price of water and the price of wastewater treatment. Then, considering the cost of implementing the Gray water recovery plan, several scenarios were proposed and its feasibility was examined economically.

The cost price of water is 2643 Rials per cubic meter and the cost of wastewater treatment is about 1850 Rials per cubic meter. According to the amount of recoverable Gray water, the numerical amount of raw savings can be calculated. Of course, it should be noted that not all Gray water can be recovered because Gray water sources are diverse and its quality is different. Gray water recovery has different backgrounds depending on the type of treatment and equipment required. Therefore, in the selected method, the cost of recovery should be calculated and by considering the cost of the recovery method and the expected savings, the ability to recover is calculated economically. The amount of Gray water produced is given in the table below.

Table 4: Estimation of water consumption in residential areas

Type of sewage	**Waste water**		**Gray water**	
	Percent of total	Liters per day	Percent of total	Liters per day
Toilet	15	24	-	-
Bathroom	33	53	56	53
Kitchen	8	12	-	-
Washing face and hands	5	8	9	8
Washing clothes	11	17	18	17
Washing dishes	10	16	17	16
Cooler	3	5	-	-
General cleaning and…	10	16	-	-
Irrigation of apartment flowers and gardens	6	9	-	-
Total	100	160	100	94

According to the cost of finished water, the price of recyclable water can be calculated. The numerical raw amount of Gray water saving is shown in the table below.

Table 5: Estimation of the numerical value of raw water recovery Gray water

Type of sewage	**Annual average of Gray water**		**Amount in Rials**
	Percent of total	m3/year	Rls/year
Bathroom	33	3007290	7948267470
Washing face and hands	10	455650	1204282950
Washing clothes	11	1002430	2649422490
Washing dishes	10	911300	2408565900
Total	59	5376670	14210538810

If we want to calculate the amount of savings based on the household, we must calculate the amount of gray water for each household. For this purpose, the percentage of gray water is multiplied by the per capita water consumption and then the household. Considering the average per capita of 160 liters per day as per capita consumption and household size equal to 5 people, the amount of Gray water is calculated, the formula of which is as follows:
Amount of Gray water (liters per year) 365 * Per capita water consumption per day * 5 * Percentage of Gray water

Table 6: Estimation of Gray water at the household level

Type of sewage	**Annual average of Gray water**		**Amount in Rials**
	Percent of total	m3/year	Rls/year
Bathroom	33	963.6	2546794.8
Washing face and hands	10	146	385878
Washing clothes	11	321.2	848931.6
Washing dishes	10	292	771756
Total	59	1722.8	4553360.4

As can be seen, considering the price of each cubic meter of drinking water 2643 Rials, the total amount of savings for each family of 4 is 4553360 Rials, which is due to the gradual rate of water and also considering the seasonal coefficient in hot seasons. It can be more. In addition to the fact that this volume of water goes back to the consumption cycle of the subscribers and requires less water consumption, less sewage is produced and less sewage costs must be paid, which considering that the cost per cubic meter of sewage is 1850 Rials. The total cost of economic evaluation for each household is 7740540 Rials. Due to the fact that the cost of water supply and distribution is much higher than the cost of water for subscribers, the economic assessment of Gray water effluent can be significant for the country.
In major systems in Iran, drinking water enters the building through a pipeline for multiple uses and waste water or sewage is discharged through a pipeline. In this system, all appliances that use water, as well as all water applications in the building, consume water of the same quality. This water is completely purified drinking water. In other words, the quality of water

used is not consistent with the quality required for consumption; Therefore, it seems that conducting an analysis of bills after using Gray water in order to know the percentage of Rial reduction and Rial savings and formulate related strategies to chart a brighter future for the reuse of gray water in Iran is not useless.

In order to recycle and reuse Gray water, it is possible to use Gray water outlets and separate piping to separate it and collect it in a suitable place, and after performing a kind of recycling system instead of entering the main sewage network. , To be used for special purposes. To better understand the concepts, we have divided the effluent output of the building into three categories, which are described below:

Method 1: Use only the toilet output in recirculation.

Method 2: use the toilet outlet, shower, bathtub and part of the dishwasher waste.

Method 3: Use the toilet outlet, shower and bathtub, laundry, dishwasher, kitchen sink, waste water and all floor washings, except rainwater and toilet sludge.

On the other hand, since any action, in addition to technical justification, must also have the necessary economic justification, for this purpose, in the process of reusing Gray water for specific daily uses, its impact has been examined from two perspectives: Consumer consumption and billing. In addition, the three methods with different consumption patterns have been considered.

According to the research done with the 3 methods mentioned on the water bill of the price of a 20-unit branch with different consumption patterns, the results have been evaluated in Tables 1 to 3. These samples show the current calculations of the company and based on the operating tariffs of the country's water and wastewater engineering company and compare it after the implementation of the Gray water recycling process.

4- Discussion on data

Consumption pattern of 20,000 liters per month per unit

For this consumption pattern of subscribers, each family saves 70 liters per day for the first method, 110 liters for the second method and 160 liters for the third method.

Table 7: Comparison of micro-calculations before and after the process with the mentioned methods) Number of residential units: 20 and household dimension: 4)

Subject		Normal bill calculations	Invoice calculations after the implementation of the water recycling plan with existing methods		
			70Liters per day	110Liters per day	160Liters per day
Consumption (liters)		400.000	358.000	334.000	304.000
Saving rate (liters)		0	42.000	66.000	96.000
Consumption reduction rate (percentage)		0	% 10.5	% 16.5	%24
number of days		30	30	30	30
calculations (	Water price	1.464.437	1.238.329	1.109.124	947.618
	Sewage disposal cost	1.025.106	866.830	776.387	633.333
	Warm season	0	0	0	0

	Subscription	200.000	200.000	200.000	200.000
	Sewage subscription	200.000	200.000	200.000	200.000
	Note 3 of Water price	1.075.100	889.166	782.918	650.108
	Note 3 Sewage disposal cost	537.550	444.583	391.459	325.054
	Budget Law Duties	80.000	71.600	66.800	60.800
	Excess than pattern	218.977	185.167	165.847	141.697
	Value Added	260.059	225.464	205.696	180.986
Sum		5.061.229	4.321.139	3.898.231	3.369.586
Rials savings			740.090	1.162.998	1.591.633
Rials reduction rate (percent)			% 11.7	% 19.7	% 31.5

In the above table, the comparison of two water consumption options with the amount of the joint bill, before and after the implementation of Gray water in the joint residential bill with the mentioned methods has been examined. The result of the implementation of Gray water for this joint will be a reduction of 10.5% with the first method, a reduction of 16.5% with the second method and a 24% reduction in water consumption with the third method. But the important point is to reduce the joint billing in the type of executive methods, which is shown in the table above and Figure 2.

Consumption pattern 30,000 liters per month per unit

For this consumption pattern of subscribers, each family saves 105 liters per day for the first method, 165 liters for the second method and 240 liters for the third method.

Table 8: Comparison of micro-calculations before and after the implementation of the process with the mentioned methods (number of residential units: 22 and household dimension: 4)

Subject		Normal bill calculations	Invoice calculations after the implementation of the water recycling plan with existing methods		
			105Liters per day	165Liters per day	240Liters per day
Consumption (liters)		600.000	537.000	501.000	456.000
Saving rate (liters)		0	63.000	99.000	144.000
Consumption reduction rate (percentage)		0	% 10.5	% 16.5	% 24
number of days		30	30	30	30
details of calculations (Rials)	Water price	3.484.880	2.706.623	2.261.904	1.904.101
	Sewage disposal cost	2.927.299	2.273.563	1.900.000	1.332.871
	Warm season	696.976	541.325	452.381	0
	Subscription	200.000	200.000	200.000	200.000
	Sewage subscription	200.000	200.000	200.000	200.000
	Note 3 of Water price	2.276.800	1.878.325	1.650.000	1.393.852
	Note 3 Sewage	1.138.400	939.163	825.313	696.926

	disposal cost				
	Budget Law Duties	120.000	107.400	100.200	91.200
	Excess than pattern	521.094	404.721	338.223	284.720
	Value Added	675.824	532.936	451.286	327.327
Sum		12.241.273	9.784.055	8.379.930	6.430.997
Rials savings			2.457.218	3.861.343	5.810.276
Rials reduction rate (percent)			% 19	% 30.8	% 46.6

In the above table, the comparison of two water consumption options with a joint bill, before and after the implementation of Gray water with the mentioned methods has been examined. The result of running Gray water for this subscriber, as in Table 7, will be followed by similar reductions. But the important point is to reduce the joint bill in the implementation methods of the plan, which is shown in Table 8 and Figure 3.

Consumption pattern of 40,000 liters per month per unit

For this consumption pattern of subscribers, each family saves 140 liters per day for the first method, 220 liters for the second method and 230 liters for the third method.

Table 9: Comparison of micro-calculations before and after the implementation of the process with the mentioned methods (number of residential units: 22 and household dimension: 4)

Subject		Normal bill calculations	Invoice calculations after the implementation of the water recycling plan with existing methods		
			105Liters per day	165Liters per day	240Liters per day
Consumption (liters)		800.000	716.000	668.000	608.000
Saving rate (liters)		0	84.000	132.000	192.000
Consumption reduction rate (percentage)		0	% 10.5	% 16.5	% 24
number of days		30	30	30	30
details of calculations (Rials)	Water price	7.414.260	5.527.944	4.629.841	3.619.581
	Sewage disposal cost	6.227.978	4.643.473	3.889.066	3.040.448
	Warm season	1.482.852	1.105.589	925.968	723.916
	Subscription	200.000	200.000	200.000	200.000
	Sewage subscription	200.000	200.000	200.000	200.000
	Note 3 of Water price	3.541.800	3.010.500	2.706.900	2.327.400
	Note 3 Sewage disposal cost	1.770.900	1.505.250	1.353.450	1.163.700
	Budget Law Duties	160.000	143.200	133.600	121.600
	Excess than pattern	1.108.654	826.594	692.300	541.236
	Value Added	1.397.258	1.050.931	886.039	700.555
Sum		23.503.703	18.213.480	15.617.164	12.638.437

Rials savings	5.290.223	7.886.539	10.865.266
Rials reduction rate (percent)	% 22.5	% 33.6	% 46.3

In the above table, the comparison of two water consumption options with a joint bill, before and after the implementation of Gray water with the mentioned methods has been examined. The result of the implementation of Gray water for this subscriber, as in Tables 7 and 8, will be followed by similar reductions. Therefore, consumption patterns are directly related to Gray water storage for recycling. This means that the higher the consumption of the subscriber, the more water can be stored and used for recycling and the more Rials can be saved.

5- Conclusion and suggestion

Increasing the price of water is an economical tool for water efficiency, and we should try to use this tool to improve both service and water efficiency. By increasing the price of water, we encourage citizens to use reducing equipment and valves. But it creates a false atmosphere in the society and causes the prices of other necessities of the people to rise, and the profiteering investors also take advantage of it and disturb the country's economy.

If the selling price of water is implemented in the way I said, that is, it becomes up to 50% free, according to the opinions of experts and people, they even have the previous normal consumption. People do not pay for water. The government does not pay extra for water production, and at least 50% of water is stored in more water resources. It creates a calm atmosphere in the economy of the society.

At present, the rial savings that have occurred in the water bill of consumers are insignificant compared to the operating costs for changes in domestic facilities and water recycling operations. However, considering the real price of water and future adjustments, this opportunity can be mentioned as a change in reducing water consumption and the operation of Gray water recycling in the provinces of the country with the cooperation of all executive agencies can be described as successful.

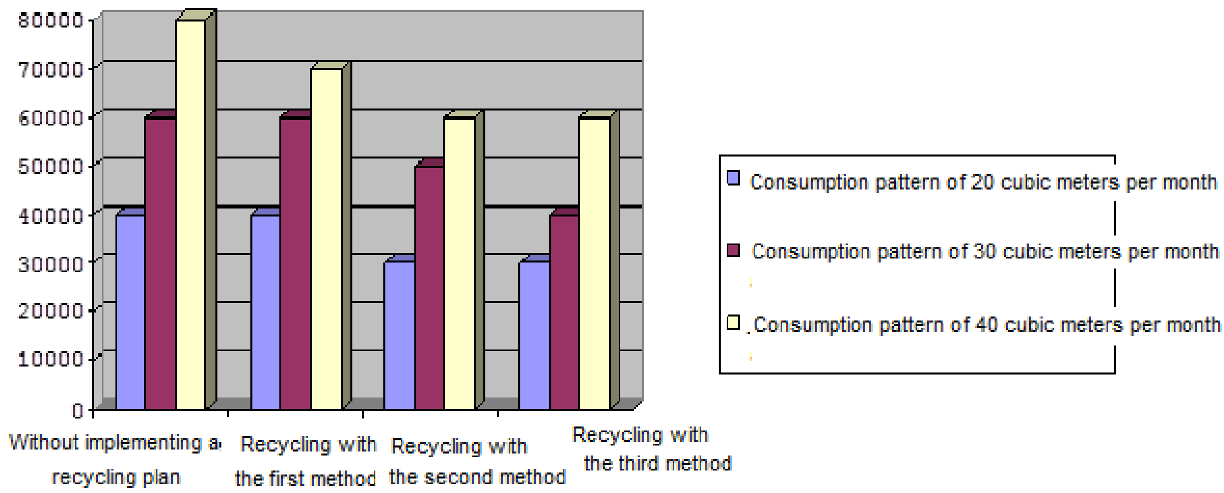

Figure 2: Consumption chart in 20 households with the proposed methods presented in the watershed water recycling plan

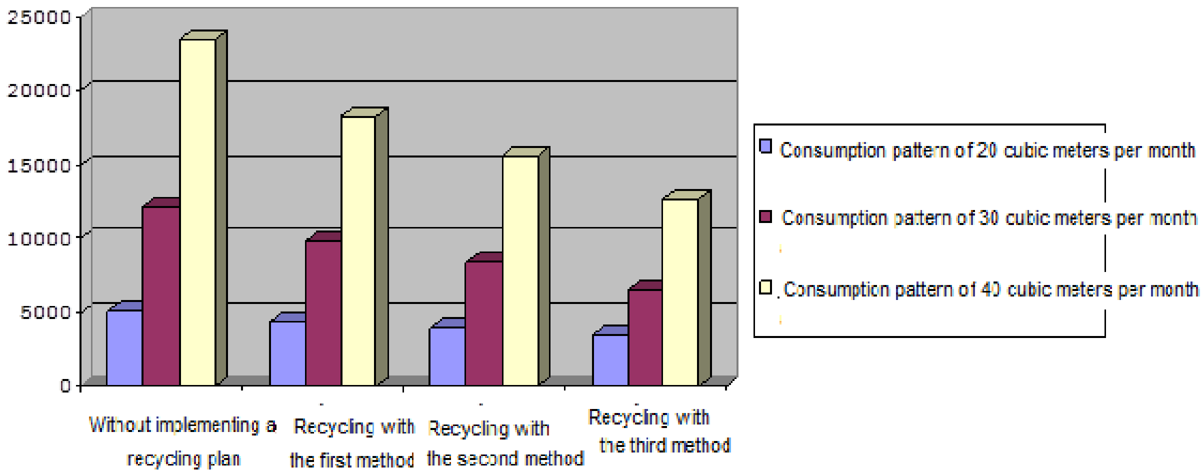

Figure 3: Chart of bill amount in 20 households with the proposed methods presented in the watershed water recycling plan

References

[1] ARDAKANIAN, REZA. (2005), An Overview of Water Management in Iran, Water Conservation, Reuse and Recycling, Iranian-American Workshop Papers, National Academy, Washington, DC, USA.

[2] L. Allen, J. Christian-Smith, and M. Palaniappan, "Overview of greywater reuse: the potential of greywater systems to aid sustainable water management," Pacific Institute, pp.654, 2010.

[3] GORGIN PAVEH, FARAZ, RAMEZANI, HADI, ABABAYEE, BEHNAM (2016). Estimation of Gray water footprint in the production of important cereals in the province on a provincial and national scale, the Second National Congress of Irrigation and Drainage of Iran.

[4] Al- Jayyousi O R. Greywater reuse: towards sustainable water management Desalination. Desalination 156 (1): 181-192, 2003.

[5] Cosgrove, W. and Rijsberman, F. "World Water Vision: Making Water Everybody's Business," Earthscan Publications, London, 2000.

[6] Alcamo, J., Florke, M., Marker, M. "Future long-term changes in global water resources driven by socio-economic and climatic changes", Hydrological Sciences Journal, 52 (2), 247-275, 2007.

[7] Faramarzi, M., Yang, H. and Abbaspour, K. "Modeling wheat yield and crop water productivity in Iran: Implications of agricultural water management for wheat production", Agricultural Water Management, 97 (11), 1861–1875, 2010.

[8] MOHAMMAD VALI SAMANI, Water Resources Management and Sustainable Development, Research Deputy of the Islamic Consultative Assembly, Office of Infrastructure Studies: p. 32, 2005.

[9] United Nations. The Millennium Development Goals Report 2011, New York, available online: http://www.un.org/millenniumgoals/11_MDG%20Report_EN.pdf.,2011.

[10] ALMASI, Sewage and Related Issues, Ministry of Health and Medical Education, Deputy Minister of Research and Technology, Volume 1 of the Comprehensive Public Health Book, Third Edition, Chapter 4, Speech 3.

[11] Statistics Center of Iran, the results of the general population and housing census of 1385 and 1390 and statistical yearbooks of different years: 1390.

[12] ZIAEE, Calculating the Increasing Effect of Water Cycle: A Method for Determining Irrigation Efficiency at Basin Scale, DANESH NAMA Monthly: 23 (3), 137-134, 2014.
[13] Ward, F. and Pulido-Velazquez, M. "Water conservation in irrigation can increase water use", Proceedings of the National Academy of Sciences USA, 105 (47), 18215-18220, 2008
[14] Cai, X., Rosegrant, MW and Ringler, C. "Physical and economic efficiency of water use in the river basin: implications for efficient water management", Water Resources Research, 39 (1), 1013, doi 10.1029 / 2001wr000748, 2003.
[15] ALIZADEH. Opportunities and challenges of using wastewater in agriculture; The first seminar on recycled sites; MASHHAD: 1387.
[16] Science and Technology Observatory of Shakhes Pajooh Research Institute, Special on World Water Crisis, Scientific-Educational Journal of Futurology: 5, 3-5.
[17] ROHANI FARAHMAND. Localization of Gray water use along with a case study of high-rise buildings, 2nd International Conference on New Research Findings in Civil Engineering, Architecture and Urban Management: 1-13, 2016
[18] ZAMANI. Gray water wastewater recycling and quality control of treated wastewater for reuse at home in order to sustainable development of water resources and the 8th International Congress of Civil Engineering: 2009.
[19] NEZAM ABADI, MEYSAMI, ZARNEGARIAN, HAGHI. Management of reducing urban and rural water consumption with observance - economic considerations with a case study of GHARIB ABAD village in SARAVAN city in SISTAN and BALUCHESTAN province, the second national conference on water and wastewater with an operation approach: 17-17, 2008.
[20]Church J., Verbyla M.E., Lee W.H., Randall A.A., Amundsen T.J. and Zastrow D.J. Dishwashing water recycling system and related water quality standards for military use. Science of The Total Environment 529: 275-284, 2015.
[21] de Gois E.H., Rios C.A. and Costanzi R.N. Evaluation of water conservation and reuse: a case study of a shopping mall in southern Brazil. Journal of Cleaner Production 96: 263-271, 2015.
[22] Hyde K. An evaluation of the theoretical potential and practical opportunity for using recycled greywater for domestic purposes in Ghana. Journal of Cleaner Production 60: 195-200, 2013.
[23] Oron G., Adel M., Agmon V., Friedler E., Halperin R., Leshem E. and Weinberg D. Greywater use in Israel and worldwide: standards and prospects. Water research 58: 92-101, 2014.
[24] Domènech L. and Saurí D. Socio-technical transitions in water scarcity contexts: Public acceptance of greywater reuses technologies in the Metropolitan Area of Barcelona. Resources, Conservation and Recycling 55(1): 53-62, 2010.
[25] Bakare B., Mtsweni S. and Rathilal S. A pilot study into public attitudes and perceptions towards greywater reuse in a low cost housing development in Durban, South Africa. Journal of Water Reuse and Desalination 6 (2): 345-354, 2016.
[26] Rice J., Wutich A., White D.D. and Westerhoff P. Comparing actual de facto wastewater reuse and its public acceptability: A three city case study. Sustainable Cities and Society,2016.
[27] Patil Y. and Munavalli G. Performance evaluation of an Integrated On-site Greywater Treatment System in a tropical region. Ecological Engineering 95: 492-500, 2016.
[28] Assayed A., Chenoweth J. and Pedley S. Assessing the efficiency of an innovative method for onsite greywater treatment: Drawer compacted sand filter–A case study in Jordan. Ecological Engineering 81: 525-533, 2015.

[29] do Couto E.D., Calijuri M.L., Assemany P.P., da Fonseca Santiago A. and Lopes L.S. Greywater treatment in airports using naerobic filter followed by UV disinfection: an efficient and low cost alternative. Journal of Cleaner Production 106: 372-379, 2015.
[30] Alsulaili A.D., Hamoda M.F., Al-Jarallah R. and Alrukaibi D. Treatment and potential reuse of greywater from schools: a pilot study. Water Science and Technology 75(9), 2119-2129, 2017.
[31] Oh K., Poh P., Chong M., Chan E., Lau E. and Saint C. Bathroom greywater recycling using polyelectrolyte-complex bilayer membrane: Advanced study of membrane structure and treatment efficiency. Carbohydrate polymers 148: 161-170, 2016.
[32] Vakil K.A., Sharma M.K., Bhatia A., Kazmi A.A. and Sarkar .S. Characterization of greywater in an Indian middle-class household and investigation of physicochemical treatment using electrocoagulation. Separation and Purification technology 130: 160-166, 2014.
[33] Matos C., Pereira S., Amorim E., Bentes I. and Briga-Sá A. Wastewater and greywater reuse on irrigation in centralized and decentralized systems - An integrated approach on water quality, energy consumption and CO2 emissions. Science of the Total Environment 493: 463-471, 2014.
[34] Staub M., Thouement H., Remy C., Miehe U., Grützmacher G., Roche P., Soyeux E. and David . B. Aquifer recharge with reclaimed water: life-cycle assessment of hybrid concepts for non-potable reuse. Journal of Water Reuse and Desalination 5(2): 142-148, 2015.
[35] Siggins A., Burton V., Ross C., Lowe H. and Horswell J. Effects of long-term greywater disposal on soil: A case study. Science of the Total Environment 557: 627-635, 2016.
[36] Marleni N., Gray S., Sharma A., Burn S. and Muttil N. Impact of water management practice scenarios on wastewater flow and contaminant concentration. Journal of environmental management 151: 461-471, 2015.
[37] Chowdhury R. and Rajput M. Will greywater reuse really affect the sewer flow? Experience of a residential complex in Al Ain, UAE. Water Science and Technology: Water Supply 17(1): 246-258,2017.
[38] Penn R., Schütze M., Alex J. and Friedler E. Impacts of onsite greywater reuse on wastewater systems. Water Science and Technology 75(8):1862-1872, 2017.