

WATER RECYCLING FOR PLANT IRRIGATION TO REDUCE POLLUTION

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Abstract. The expansion of urbanization throughout history has brought about environmental and air pollution issues, and humans have always been in pursuit of practical solutions to address these problems. In recent decades, the utilization of the sustainability approach has become one of the most frequently used solutions. In this regard, vegetation, due to their importance in oxygen production and carbon dioxide reduction, as well as its widespread role in terms of aesthetics and psychology, have always been a focus of attention for thinkers, planners, and urban managers, as one of the main areas emphasized in sustainability. In this regard, given the current situation and the impending water crises, proposing solutions for optimal water management at the macro level, as well as irrigation and water supply for vegetation at the micro level, are among the most serious challenges in utilizing plants about urban sustainability. Therefore, the present study aims to assess the feasibility of using wastewater, on the one hand, by reviewing the efforts made to explain the importance of this issue and the proposed solutions in Iran and other countries for the utilization of return flows and treated wastewater, and on the other hand, by addressing the research gap in the use of plants, especially from the perspective of architectural and urban design, about the aforementioned issue. The research method used in this study is a descriptive qualitative method using content analysis, which addresses reviewing relevant documents and past experiences.

Keywords: water recycling, vegetation, environmental pollution

Introduction

The urban population in current cities accounts for 55% of the world's population, a figure that is expected to increase to 68% by 2050 (United Nations., 2018). This level of density in cities has led to environmental degradation, which is a threat to urban sustainability (Nitoslawski & et al., 2019). The increasing population density in cities and the growing desire for urbanization, due to the urban lifestyle, have led to a rising production of carbon dioxide, which is one of the main causes of current pollution. These pollutions, along with other environmental pollutions (water and air), have now caused major problems for citizens. These pollutions are the source of many diseases that humans are currently suffering from. Among the side effects of carbon dioxide, one can refer to its impact on stress, various chronic inflammations, kidney failure, bone atrophy, neurological and respiratory disorders, and lung or heart diseases, with physicians believing that carbon dioxide is a severe causative agent or exacerbating factor for these diseases (Bierwirth., 2018). This indicates the growing need for cities to adopt sustainable approaches. If we want to specifically mention the cases where a sustainable city can be the savior of such problems, vegetation cover has always been a major focus and emphasis. In this regard, various types of green roofs, vertical gardens, or other methods can be widely accepted as nature-based solutions in densely populated cities, as we are currently facing a lack of green spaces due to extensive construction. Green roofs provide numerous environmental and social benefits for the built environment, such as reducing building energy consumption and helping to purify the air, thereby improving people's health (Liu & et al., 2021). However, different types of vegetation cover require water, and in the current water crisis, this is a very

critical issue. Although the Earth is sometimes referred to as the "water planet," and this metaphor creates the image of a world with abundant water, in reality, more than 99% of the Earth's water is unusable for humans and many other living beings, and only about 0.3% of freshwater is available in surface waters, lakes, rivers, wetlands, and other watersheds (Posner Ari & et al., 2023). This small amount must be used for agriculture, sanitation, drinking, irrigating plants, and more. Therefore, renewable freshwater makes up a small part of the global water pool, but fresh water is the basis of life in the Earth's ecosystems. In the coming century, climate change and the growing imbalance between water supply, consumption, and population will significantly alter the water cycle. Many regions of the world are currently limited by the amount and quality of available water. In just 30 years, available runoff is unlikely to increase by more than 10%, but the world's population is expected to increase by about one-third. If water use efficiency is improved, the imbalance in freshwater ecosystems may decrease, and the damage or destruction of wetlands, rivers, and deltas, as well as the loss of ecosystems, may be prevented (Jackson & et al., 2001). Now the issue of water has become more important than before, so if we have the power to reuse the used water and think about providing a solution for water recycling, we can make a major contribution to the environmental conditions. This study aims to review the proposed solutions for irrigating plants and various green gardens and other vegetation covers through the reuse of wastewater. By doing this, we will try to recycle water meet the needs of vegetation cover, and also significantly treat the used water. In this way, we will take various actions to help urban sustainability, contribute to meeting one of the needs of a sustainable city, and ultimately help to return water to the natural cycle and reduce pollution, which is the ultimate result of these actions, and most importantly, significantly help to improve the quality of life of citizens in various aspects, which is to save water and help vegetation cover to grow and survive. Nowadays, with the increasing problems of urbanization, we should no longer approach the performance of diverse topics from a single perspective but rather assess the surrounding context and predict their future, because today, given the growing population and limited or slow-renewing resources, there is no room for mistakes to pursue an approach or performance and then try to repair or correct the resulting damages and losses in the future. The main declining resources, the abundantly produced pollution, the critical state of global warming, drought and food shortages, health and disease in dangerous conditions, various endangered animal species, etc. - these problems no longer leave room for trial and error for humans.

Research Method. This research, to reduce carbon dioxide pollution through the use of plants and provide solutions for saving water consumption of plants to improve health, and to clarify the impact of the design approach with the help of vegetation covers, uses a qualitative research method and content analysis to examine the available experiences and works of urban thinkers and managers.

Findings. Carbon dioxide (CO₂) is a colorless gas with a weak pungent odor and sour taste and is one of the most important greenhouse gases (greenhouse gases are gases that have the property of absorbing infrared (net heat) radiation emitted from the Earth's surface and reflecting it to the surface. Carbon dioxide, methane, and water vapor are the most important greenhouse gases) (Mann., 2023). This gas is produced by the combustion of carbon-containing materials, fermentation, respiration of living beings, and so on (Britannica., 2023). Given that carbon dioxide is a very important gas among greenhouse gases and is essential for the existence of life on this planet, but has a specific amount, if it increases and the balance is disturbed, it can cause environmental degradation and be

harmful to health. Some of the damages it inflicts on the environment include exacerbating the greenhouse effect, which causes the Earth's temperature to rise, or some of the harms it inflicts on human health, such as dizziness, increased heart disease, increased blood pressure, and increased arrhythmia (Straub., 2021).

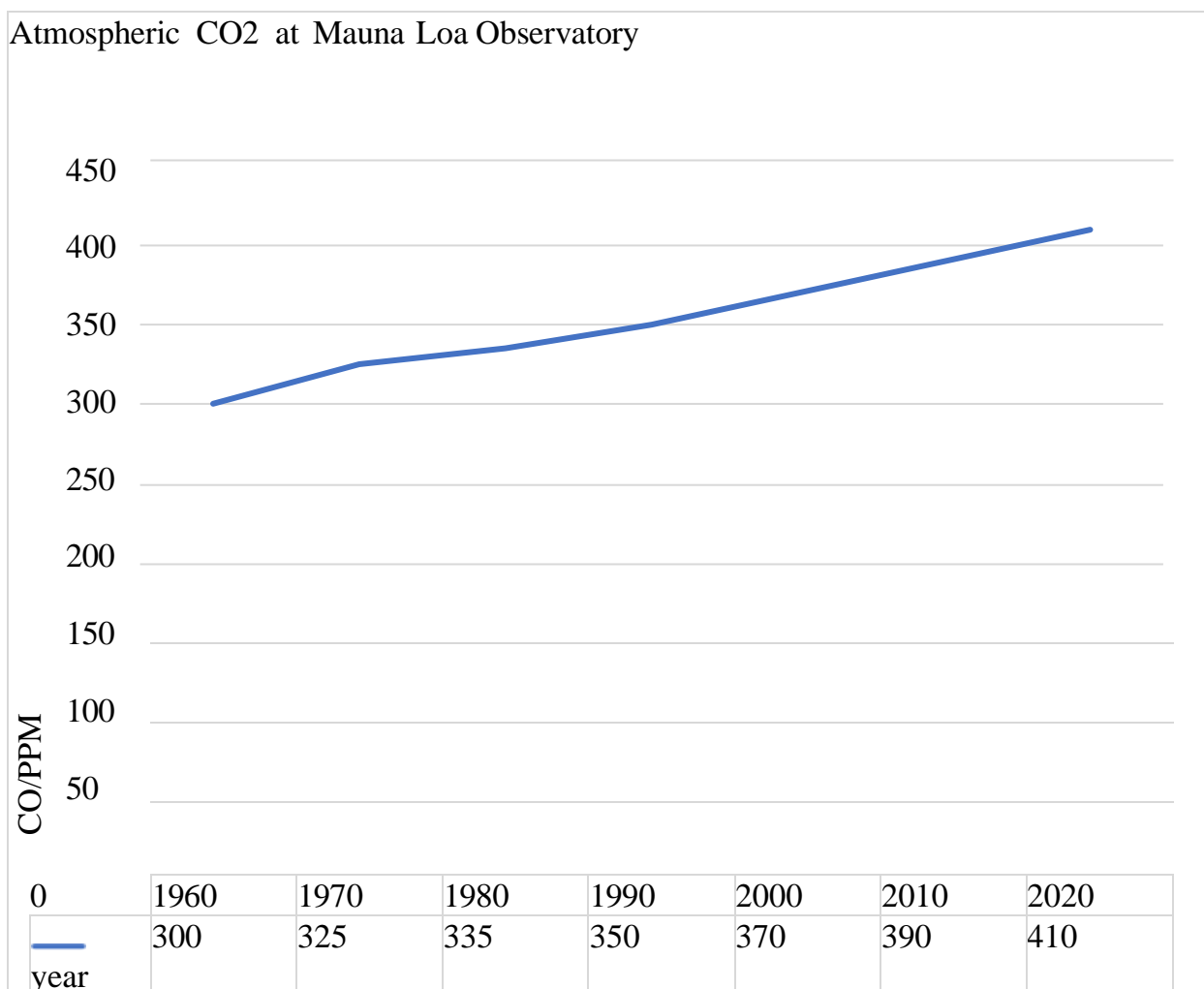


Chart 1 - Atmospheric CO2 at Mauna Loa Observatory (NOAA 2019)

Given the emergence of many diseases and severe destruction resulting from the increase in carbon dioxide, this gas continues to rise but the lack of attention to the amount of carbon dioxide present in the atmosphere and the disruption of the balance of carbon dioxide levels causes the greenhouse effect mentioned above to be exacerbated as the amount of carbon dioxide increases, meaning that carbon acts like insulation, preventing the escape of heat from the Earth's surface. The warming of the Earth, which has been a fundamental problem around the world since the 19th century, has various reasons, but carbon dioxide is considered one of the most significant of them, which is produced by human activities, especially in industries. The sum of these activities, which constantly lead to an increase in greenhouse gases in the atmosphere, is ultimately considered one of the main reasons for the increase in the Earth's temperature. Various greenhouse gases are released into the atmosphere, the most common of which are carbon dioxide, methane, nitrous oxide, and ozone. The release of carbon dioxide usually occurs naturally through plants in the dark, through human respiration, and the natural carbon cycle, but due to human activities, significant amounts of carbon dioxide are released into the atmosphere, which is higher than

the normal threshold. The high concentration of carbon dioxide is now one of the main reasons for global warming. Global warming, in turn, disrupts the natural carbon cycle, releasing more carbon dioxide into the environment. Therefore, this cycle is continuously being implemented with more destructive effects on the natural environment of the Earth. The natural carbon cycle usually occurs through the decomposition of organic carbon in the soil by various microbes and other chemical reactions that then release carbon dioxide into the atmosphere, but due to the reduction of organic carbon in the soil, a large amount of carbon dioxide is released into the environment. This process has not only detrimental effects on humans but also the entire wildlife (Mehmood & et al., 2020)

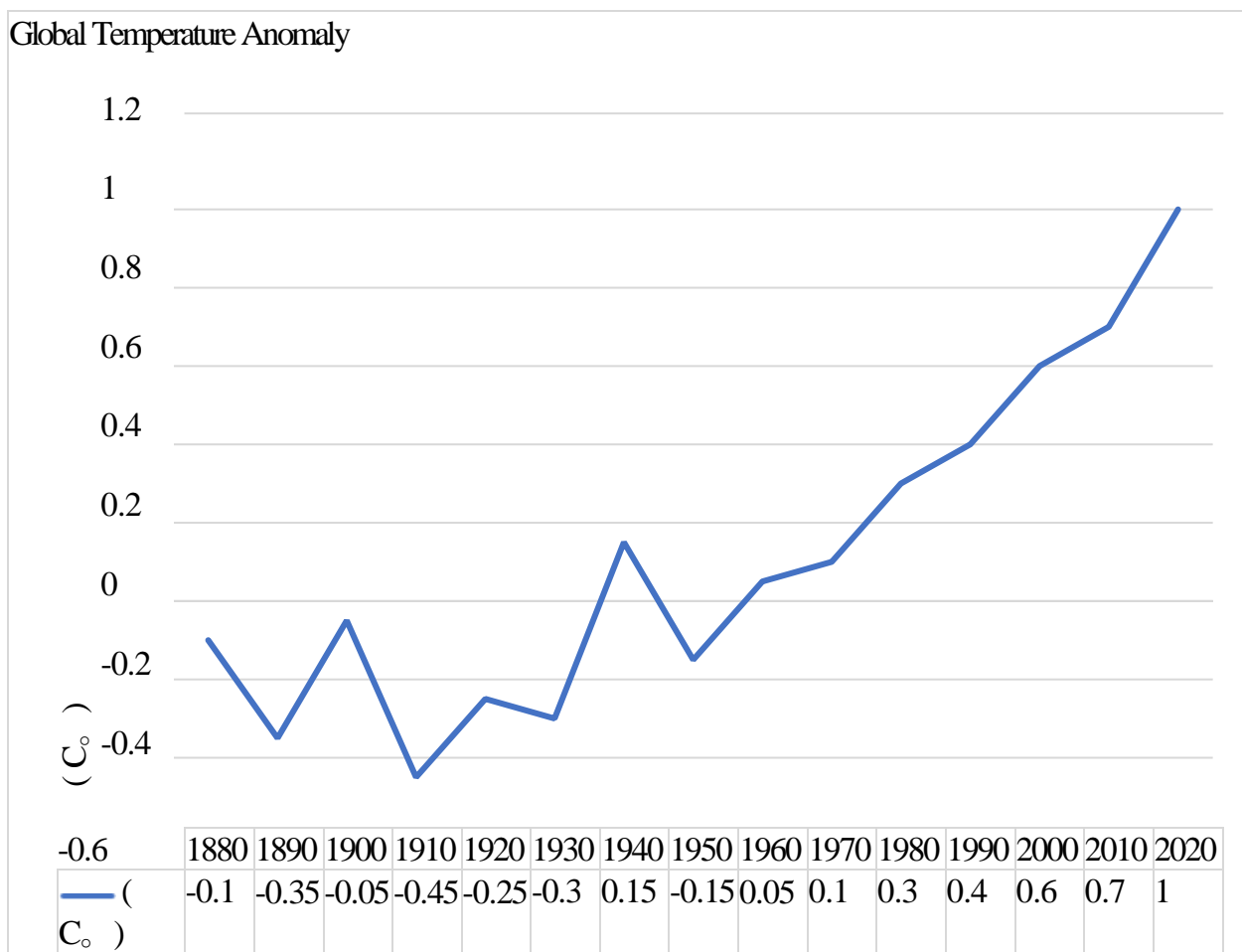


Chart 2 - Global Temperature Anomaly (NOAA 2020)

The green roof can be referred to as an efficient design that reduces the flow of floodwater, increases oxygen production, and is considered one of the main factors in reducing the carbon dioxide present in the atmosphere. On the other hand, it leads to an increase in the quality of runoff, which can reduce the load on water treatment facilities. In addition, green roofs are an effective treatment for the heat island effect due to the use of moist vegetation cover. Urban vegetation covers or green roofs provide refuge for animals, prevent noise pollution, and can be used as part of the design to reduce traffic noise. In addition, energy designers and urban planners are highly interested in the effective use of green roofs due to their contribution to improving the quality of urban environments and their ability to reduce energy consumption (Hashemi & et al., 2015). If implemented correctly, urban vegetation covers can save human lives, given the pollution in cities due to the ever-increasing production of carbon dioxide. We urgently need a solution to reduce

carbon dioxide and produce oxygen. Vegetation covers can be the solution to today's crisis, but they need water, and the shortage of water in the world due to the increase in carbon dioxide and the resulting droughts is becoming scarcer day by day. Another main factor in droughts is the rapidly progressing environmental pollution, but studies show that the increase in carbon dioxide is a more important factor in global warming and the consequent recurring droughts (Qaderi & et al., 2006). Therefore, if carbon dioxide is not controlled as soon as possible, we will face various problems. The world's population is expected to grow by 1 billion in the next decade and 2 billion in the next two decades, a growth that will create a lot of demand for water resources in developing countries. The extent of these demands in the face of time, water, and budget constraints, and the lack of planning for drought management, indicates that the world is facing a serious water crisis (Frederiksen., 1996). The amount of fresh water available per person in the world has decreased and continues to decrease due to a combination of factors, including population growth, water pollution, inadequate planning and management of transboundary and other shared waters, and inefficient performance of water supply and distribution systems. As a result, if the current trend in water consumption and management continues, there is an increasing potential for water scarcity, crisis, and related conflicts around the world, especially in developing regions, and this is increasing (Sivakumar, 2011). Recent years' forecasts by major international organizations have been consistently dire. For example, in 2009, the 2030 Water Resources Group predicted that the world would face a 40% water deficit under a normal climate scenario. In 2016, UNEP claimed that by 2030 nearly half of the world's population will suffer from severe water stress. In 2017, UN Secretary-General Ban Ki-moon stated that by 2030 "the world may face a 40% water shortfall". The World Bank has claimed that by 2050, around 1.8 billion people will live in areas of acute water scarcity. In 2018, the World Bank and the United Nations claimed that 36% of the world's population lives in water-scarce areas. The World Resources Institute (WRI) claimed that 33 countries will face "extremely high" water stress. Based on WRI's analysis, seven countries will jointly rank first in terms of countries facing the highest water stress in the world, all of which except Singapore are in the Middle East, highlighting the attention this region deserves (Biswas & Tortajada., 2019). For the first time in human history, human use and pollution of freshwater have reached a level where water scarcity potentially limits food production, ecosystem performance, and urban supply in the coming decades (Jury & Vaux., 2007). The water crisis has progressed to the point where in many scientific and political circles, future wars over water are being discussed. This is natural, as the life-giving liquid of the earth, with its scarcity, becomes more valuable, with rich countries trying to maintain it and crisis countries trying to seize it. A war over something that is directly related to health, well-being, and survival in general - water is considered the second most vital human need after oxygen, both of which are now in danger. The danger to these means the danger to the entirety of humanity and living beings. Now, experts and policymakers believe that the water scarcity crisis is very acute, and in the Mediterranean and Middle East regions, this crisis is rapidly progressing, placing these regions at risk of the destruction of large parts of their environment. They also agree that the water crisis must be addressed immediately, as the rapid progress of this crisis and its dangerous consequences mean that the time and resources available are rapidly running out, and this is an issue that "cannot wait" (Angelakis & et al., 1999).

Table 1 - Area, population, and annual renewable freshwater availability for 1990, 2025, and 2050 in the Mediterranean countries (Angelakis & et al., 1999).

Country	Area(km ²)	Amount of renewable water per year (km ³)	The amount of fresh water available in cubic meters per year					
			1990		2025a		2050a	
			population ×1000	Available water volume (m ³)	population ×1000	Available water volume (m ³)	population ×1000	Available water volume (m ³)
Albany	27.531	21.00	3289	6385	4668	4499	5265	3989
Algeria	2.380.000	17.20	24935	690	45475	378	55674	309
Cyprus	9.250	0.90	702	1282	927	971	1006	895
Egypt	1.000.500	58.90	56312	1046	97301	605	117398	502
France	544.000	185.00	56718	3262	61247	3021	60475	3059
Greece	132.000	69.00	10238	5763	9868	5979	8591	6868
Israel	20.700	2.15	4660	461	7808	275	8927	241
Italy	301.300	187.00	57023	3279	52324	3574	43630	4286
Jordan	37.300	1.31	4259	308	12039	109	16874	78
Lebanon	10.360	4.98	2555	1949	4424	1126	5189	960
Libya	1.760.000	4.62	4545	1017	12885	359	19109	242
Malta	320	0.03	354	85	422	71	439	68
Morocco	445.000	28.00	25334	1151	40650	689	47858	585
Portugal	92.400	66.00	9868	6688	9685	6815	9140	7221
Spain	504.800	111.00	39272	2826	37571	2954	31756	3494
Syria	185.000	25.79	12348	2089	33505	770	47212	546
Tunisia	126.000	4.36	8080	540	13290	328	15607	279
Türkiye	780.000	203.00	56098	3619	90937	2232	106284	1910

To eliminate carbon dioxide, we need plants, and for plants, we need water. The increase in carbon dioxide has destroyed countless water resources. To solve this equation, we need a critical key that can provide the necessary water while minimizing the extraction from the limited existing water resources. This will allow us to address the needs of

vegetation covers, thereby reducing carbon dioxide, correcting the environment, moderating temperature, supporting existing water resources, increasing oxygen, and ultimately improving community health. One of the main and important solutions is the recycling of water and returning the used water to the natural cycle, which seems to be an appropriate solution. If we refer to the various methods of water reuse, we can use water recycling to reduce water consumption while addressing the needs of vegetation covers. Today, the use of treated wastewater in agriculture has had positive results. This includes the use of treated effluent in agriculture, which has reduced water use and significantly helped to manage wastewater. The use of treated wastewater for plant irrigation also reduces irrigation costs and the use of chemical fertilizers in agriculture due to the presence of nutrients such as potassium, nitrogen, and micronutrients, and it is accompanied by a reduction in the pollution of groundwater and surface water (Aiello & et al., 2007). Proper utilization of urban wastewater reduces the problem of surface water pollution, not only saving water but also being effective in plant growth due to the presence of 45 beneficial nutrients. The use of treated wastewater can also be very effective in arid and semi-arid regions, where the limited amount of available water makes treated wastewater a suitable alternative for plant irrigation (Irandoost & Tabriz., 2017). Today, we are witnessing the use of treated urban wastewater for the irrigation of forests and horticultural products, and this reuse is visible and observable in many countries (Mousa., 2009).

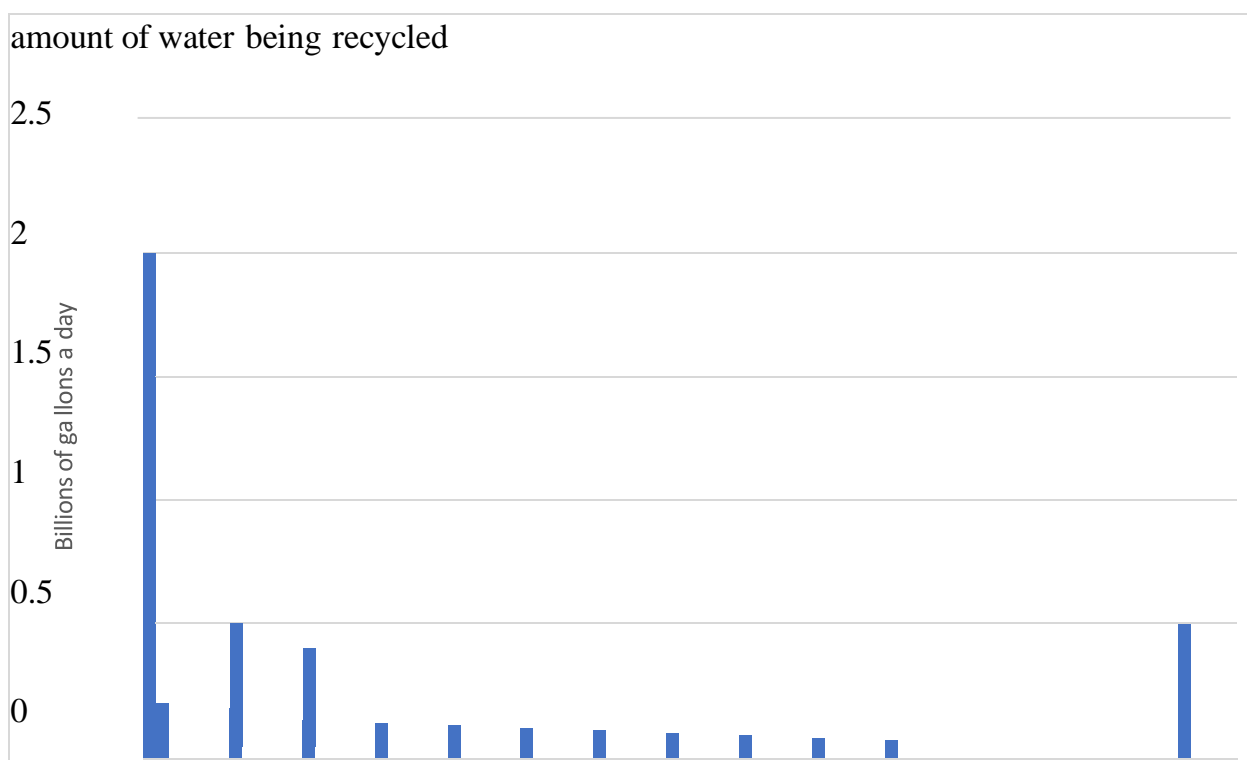


Chart 3 – amount of water being recycled (Khan., 2018)

Today, in most countries, the main problem may not be a shortage of water in terms of average per capita, but rather the high cost of making water available in the right place, at the right time, and with the required quality. An integrated approach to water resources management, including wastewater reclamation and local reuse, is needed. As a result, wastewater treatment is expected to increase significantly in the next decade, and wastewater reclamation and reuse will become an important aspect of integrated water resources management. Significant projects are being developed, and wastewater

reclamation and reuse facilities have been constructed. These projects have followed local or national guidelines where they exist, such as in Israel, France, Tunisia, or Cyprus. Regulations related to wastewater reclamation and reuse are essential. They help protect public health, increase water accessibility, prevent coastal pollution, and increase water resources and nature conservation policies. The integration of wastewater reclamation and reuse laws helps facilitate safe economic and tourist exchanges (Angelakis & et al., 1999). The current results are encouraging and reassuring, recommending the use of treated wastewater as an alternative option for plant irrigation. However, apart from atmospheric pollution caused by the presence of carbon dioxide produced by humans and human activities due to ever-increasing urbanization and urban living, the growing urban population is a major producer of large volumes of wastewater, which, along with other environmental pollutions, is considered a significant and dangerous threat. This large volume of wastewater that is discharged into the environment is often partially or not at all treated, and this act can pose very significant risks to the environment (Sdiri & et al., 2023). Untreated wastewater directly causes water pollution and environmental degradation due to the presence of pollutants such as pathogenic microorganisms, phosphorus and nitrogen, hydrocarbons, heavy metals, endocrine disruptions, and organic matter, and damages human health. Most water-related infections, such as cholera, typhoid fever, diarrhea, etc., are caused by the presence of pathogenic microorganisms in the water. Diseases caused by bacteria, viruses, and protozoa are the most common health risks associated with untreated wastewater. The main sources of these microbial pollutants in wastewater are human and animal feces, and the presence of excessive phosphorus and nitrogen can lead to the eutrophication of water sources, which can also create environmental conditions that promote the growth of toxic cyanobacteria. Chronic exposure to some of the toxins produced by these organisms can cause many other diseases. In addition, the risk of non-biodegradable and resistant pollutants in water, their ability to persist for a long time in natural ecosystems, and their ability to accumulate in successive levels of the biological food chain, further exacerbate pathogenic factors (Akpore & et al., 2014). Heavy metals, also known as rare metals, are one of the most persistent pollutants in wastewater. Discharging large amounts of heavy metals into water bodies leads to various environmental and health effects. Human exposure to heavy metals can occur through inhalation of dust or vapor, evaporation, and ingestion through food and drink. Some of the negative effects of heavy metals on aquatic ecosystems include the death of aquatic organisms, algal blooms, habitat destruction due to sedimentation, waste, increased water flow, and other short-term and long-term toxicities from chemical pollutants. Abundant amounts of heavy metals in the soil reduce the quality and quantity of food, preventing plant growth, nutrient absorption, and physiological and metabolic processes. Severe effects on animals may include reduced growth and development, cancer, organ damage, nervous system damage, and in severe cases, death (Akpore & et al., 2014). Given the damage caused by wastewater and the growing need for treatment, greywater is more easily usable and treatable. Greywater refers to wastewater without input from toilets, meaning wastewater generated from baths, showers, hand basins, washing machines, and kitchen sinks in homes, office buildings, schools, etc. The chemical composition of greywater comes from household chemicals, cooking, washing, and plumbing. In general, greywater contains lower levels of organic matter and nutrients compared to regular wastewater, as it does not include urine, feces, and toilet paper. However, heavy metal levels are in the same concentration range. The possibility of reusing greywater has received special attention, as this fraction of

wastewater, in the absence of feces, urine, and toilet paper, has lower pollution and is, therefore, easier to recycle back into the environment at a lower cost. These factors have made greywater a hot topic in many countries today, with some even starting to collect greywater separately and try to separate it from municipal wastewater (Eriksson & et al., 2002).

In Iran, this topic also has a long history and significant importance. Iran, as one of the Middle Eastern countries, has been facing water scarcity and a decline in renewable water resources. In this regard, the authorities have paid attention to the purification and reuse of municipal and industrial wastewater, as well as return flows, as new resources to compensate for some of these shortages. Available information shows that in the 10th century AD, wastewater was used for agriculture in the suburbs of Isfahan. In the past, the use of wastewater was mainly to fertilize the land, while currently, water scarcity is the main motivation. The first urban wastewater treatment plant using the activated sludge method with a capacity of 480 cubic meters per day was built in 1961 in the Sahebqaraniyeh region. The second urban wastewater treatment plant in the country was built in 1973 using the stabilization pond method in Fooladshahr, Isfahan. Currently, most major cities in the country have wastewater collection and treatment systems or are in the planning or implementation stage. Extensive areas, especially on the outskirts of large cities and provincial centers, are irrigated with reclaimed wastewater, return flows, and urban runoff. In most cases, this use is improper and has been used for the cultivation of vegetables and fruits, causing environmental pollution, accumulation of pollution in the soil, and its transfer to the produced crops. Considering the level of acceptance and the need to use reclaimed wastewater and return flows in agriculture, most of the wastewater treatment plants across the country are now designed and implemented to reuse the effluent in agriculture. The irrigation of green spaces is one of the reuses of reclaimed wastewater and return flows. The main limitations of using these resources are the dispersed distribution of green spaces in the city and the cost of transporting the effluent from the treatment plants to these areas, which significantly limits the use of these resources. From a qualitative perspective, the important limiting factor in the use of treated wastewater for green space irrigation is its health standard, which requires high quality in terms of coliforms, fecal coliforms, and nematode eggs. These issues are less pronounced in the irrigation of green spaces and afforestation outside the city. Given that agricultural lands are concentrated outside the city and relatively far from the city, the use of agricultural drainage for urban green spaces faces difficulties, but the possibility of using these resources in afforestation and the establishment of green belts around cities exists. Industrial effluents, due to their point-source nature and the dispersed distribution of industries, do not have the possibility of being used for urban green space irrigation but have the potential to be used in the green spaces of the factories and industrial complexes themselves. This has been successfully implemented in many industries in different cities. In this context, attention to the quality of the effluent, especially the electrical conductivity, the concentration of heavy metals, and recalcitrant organic matter, due to their impact on soil texture, is of high importance. Regarding water quality, the most important and primary criterion considered is the electrical conductivity of the water, which is a good indicator of the total dissolved salt concentration. This parameter determines the water's absorption capacity and accessibility for the plant, and the main objective of irrigation is to increase the plant's available water.

Results

Due to people's interest in urbanization, severe crises have significantly impacted our lives today, as if we are constantly destroying and depleting the Earth through these crises - crises that humans themselves have caused. Lack of foresight, excessive resource consumption, increasing carbon dioxide production, and constructing the necessities of modern life based on creating various types of pollution, polluting infrastructure, cities with horrifying pollution, and energy consumption, are all in the process of destroying the environment. Pollution is like a cancer to the environment - a cancer that not only remains untreated but can no longer be effectively addressed through short-term or one-sided remedies as time is running out. To put it succinctly, carbon dioxide, water, and sewage pollution are the critical problems of our time. We must think of solutions that can help in these areas, as we no longer have the luxury of addressing problems one by one. For example, if we focus solely on eliminating carbon dioxide, water will be put at greater risk. Therefore, we must seek solutions that can assist various aspects of the environment. To reduce carbon dioxide, we can propose expanding vegetation cover. However, the irrigation of plants is also a fundamental challenge, as the water resources we depend on are increasingly scarce and precious, and cannot be used for plant irrigation. On the other hand, if we do not attempt to reduce carbon dioxide, the intensification of the greenhouse effect will lead to global warming and recurring droughts. In simple terms, one of the fundamental causes of today's water crisis is carbon dioxide and global warming. Therefore, a suitable solution could be water recycling. We must expand vegetation cover to reduce carbon dioxide, and attempt to recycle water for plant irrigation, thus addressing two crises simultaneously. But water recycling has another positive impact - sewage is a crisis and a scourge on the environment and human health on its own. Millions of cubic meters of untreated sewage are released annually, polluting underground water tables, rendering land unsuitable for growth, and becoming a breeding ground for harmful and pathogenic bacteria, depleting soil fertility and turning it into a source of disease transmission. Sewage not only causes pollution and disease but also compromises agricultural productivity and food production for humans, which in turn leads to increased carbon dioxide emissions in the effort to compensate for food shortages. Therefore, it can be said that by treating and recycling water, we are attempting to reduce environmental pollution, and can also provide the water needed for vegetation - through which we can combat carbon dioxide, prevent atmospheric pollution, and prevent further global warming. Increasing the available water supply will also lead to expanded cultivated areas, creating new employment opportunities and increased food production, which in turn will contribute to the sustainability of human communities and a greater sense of security and well-being. Previous research has indicated that treated wastewater can assist agricultural products, providing nutrition and irrigation for plants. By recycling water and returning it to the natural cycle, we can take positive steps in both plant irrigation and water conservation. Treated wastewater may also apply to urban vegetation. Green spaces and the urban environment are considered factors essential for social and human sustainability. Water scarcity in the country is one of the limiting factors in developing green spaces. One of the ways to expand green spaces is the reuse of effluents and return flows. International experience shows that effluents and return flows can be used to irrigate parks and green spaces, lawns, non-fruit-bearing trees, orchards, recreational gardens, and playgrounds. On the other hand, the growing sludge from sewage, due to the increasing population density

in cities, when discharged into the environment, causes serious pollution. Recycling these wastes for agricultural use is a useful alternative, as they can act as a source of nutrients for agricultural products due to their organic and mineral content. Urban vegetation can also utilize greywater. The conclusion of this article indicates that water treatment and recycling are beneficial in various domains and mandatory for various issues. On the other hand, vegetation cover is essential for environmental protection and effective in reducing pollution. Vegetation cover also can assist humans, or more precisely, the environment, with the main goal of reducing carbon dioxide - the carbon dioxide that has targeted various aspects of living beings' existence. Undoubtedly, the conditions for using effluents and return flows will vary in different climates and geographical conditions. For example, these resources having a lower freezing point and higher temperature leads to delayed freezing, allowing for their use for a longer period during the year. In warm regions, due to the high evapotranspiration rate, they have a higher potential for increased salinity or aerosol release, and the growth power of microorganisms in effluents that have only undergone primary and secondary treatment is higher than in conventional water. Therefore, informing consumers of these environmental changes will be beneficial. In our country, the aforementioned factors have a profound impact on the utilization of these resources, and the management committees responsible for public education and awareness must, within the framework of a strategic plan, take action to locally study and address them through relevant programs. From the review of the presented materials regarding the potential uses of effluents and return flows, it is concluded that the most important applications are agricultural uses and the irrigation of green spaces and afforestation around cities, which can enable the use of these resources with minimal adverse environmental impacts.

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