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A Review: Long-Term Impact of Recycled Wastewater Irrigation on Woody Forests

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ABSTRACT

Now, the reuse of wastewater for agricultural purposes is considered necessary due to the scarcity of water resources in arid and semi-arid regions such as Egypt and Jordan. It is known that the use of wastewater in the irrigation of wood forests is an ideal option because it different woody forests, it is not preferable to use it with leafy crops that are mainly consumed as food. In the current paper, studies that have touched on the importance of reusing wastewater for irrigation purposes will be reviewed, as well as their influences on both the physical and chemical properties of soil.

Keywords: Wastewater, Soil properties, Woody forests.

INTRODUCTION

Water has been a vital natural resource since the beginning of time & industry can't exist without it. Water is crucial to a country's prosperity since the creation of a peaceful residence necessitates a steady supply of fresh water. Despite this, the global supply of pure fresh water is running low. In several nations, water demand exceeds supply, and as the global population grows rises and water demands rise, freshwater shortfalls have arisen (Hussain *et al.*, 2019). Under semi-arid conditions, the global population increased, and a wide gap between the supply and demand for water is happening and reaching dangerous levels. Therefore, specialized scientists are developing new techniques to conserve water (El-Tohamy *et al.*, 2015). According to the CEDARE organization's 2030 Strategic Vision for the Utilization of Treated Wastewater in Egypt, released in partnership in collaboration with the Egyptian government on the Strategic Vision as mentioned by AbuZeid *et al.*, (2014) reported that the total volume of produced wastewater will be approximately 11.673 billion cubic meters (BCM). Globally, there will be a 56% increase in the amount of domestic and industrial wastewater flows that are safely treated in accordance with local or national requirements for their intended users (lakes, rivers, oceans, or land) (Hellal *et al.*, 2021).

Since it is a lower-priced technique of disposing of wastewater & additionally approves for the recycling and reusing of valuable assets like water and nutrients, the usage of wastewater for irrigation of land is commonly suggested (Wang, 1984). As an end result of its more than one possible benefits (water resource protection, coastal air pollution prevention, nutrient restoration for agriculture, value financial savings in wastewater treatment, groundwater recharge, water useful resource administration sustainability, and reclaimed wastewater is a dependable supply of water that have to be viewed when creating a sustainable water policy, *etc.*) (Angelakis and Bontoux, 2001). Additionally, in order to

justify the manufacturing of timber, Knowledge about the productiveness of the tree species (particularly the stem timber biomass) will be required. This fact discloses the quantity of timber that may additionally be exploited for timber, noted (Onyekwelu, 2007).

According to the Kyoto Protocol's CDM, a woody forest is described as a location larger than "0.5-1.0" ha with a minimal tree crown cowl of 10-30 percent with tree described as a plant successful of developing to be extra than "2.5" m tall (UNFCCC, 2002). Protective woods are described or categorized otherwise throughout the world due to the fact they are distinctively human-related. In Italy and Switzerland, for example, Protective forests are categorized as forests with the main role to shield humans or property from the outcomes of environmental disasters (Brang *et al.*, 2006). "Protective forest" is a catch-all phrase for woods managed with the fundamental intention of offering protection, which consists of each plantation & natural forestland (Zagas *et al.*, 2011). Protective forestlands are custom-made forests that are grown in environmentally sensitive areas & different websites with natural risks & drastic climatic conditions. Premised on the environmental benefits of forests, they are produced close to populations or objects that protect the property (Zhu, 2008). According to their forms, defensive forests can be labeled as shelterbelts (windbreaks) or non-shelterbelt forests (Zhu, 2013); Forests must also safeguard environmentally fragile areas. Generally, Forests are necessary for life on Earth to exist. They shape the environment, offer a home for numerous animal and plant species, serve as fuel energy of wood, & function as a carbon sink, lowering anthropogenic Carbon Dioxide pollution & dealing with climate change (FAO, 2018b).

Planted forests give several economic, environmental, and social advantages. They protect natural forests by preventing degradation, restoring damaged land, blocking carbon dioxide and so dealing with climate change, strengthening public economies by creating jobs, and earnings, and supporting economic systems (DYCK, 2003).

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Plantation forests support bio-diversity both directly and indirectly by providing a woods area for a diverse assortment of species & by mitigating adverse implications on wild forests by compensating for the need to harvest resources (Pawson *et al.*, 2013). As concerns about climate change grew, so did the importance forest ecosystems as carbon sinks and storage, such as in maintaining biodiversity, & It is critical to minimize deforestation and rehabilitate damaged forests. Reducing emissions by halting deforestation & degradation (REDD+) was an appealing proposal for a few affluent nations with a long history of high emissions for economic expansion (e.g., Norway) when other developing countries viewed this as a chance for Saving money and conserving resources. As a result, REDD+ became the focal point of worldwide discussions on forests and climate change. (Seymour and Busch, 2016). All forests provide protection in a variety of ways, including trying to help to save water & soil, minimizing wind erosion, stabilizing movable dunes, conserving watersheds, and enhancing air quality (Franklin and Donato, 2020).

Recycling wastewater:

In Egypt, the idea of recycling wastewater first emerged in the 1930^s. However, the 1970^s saw the onset of intense reliance. Since this period, the dependence on drainage water has gradually increased as water consumption has increased. The capacity of a nation to collect and treat municipal wastewater is influenced by its economic resources. More than 88% of rural regions lacked sewage drainage services up until 2014 (AbuZeid *et al.*, 2014). Freshwater and nutrients are scarce in underdeveloped nations; some farmers irrigate their fields with wastewater that has not been cleansed (Sato *et al.*, 2013). Although it is currently implemented in some developing countries where wastewater is unfixed or only inadequately treated, the use of compared to control wastewater for irrigation should be only encouraged to achieve societal and ecologic goals such as ramping up production or profit margin & lowering wastewater discharge to the environment. However, ignored or insufficiently treated. wastewater is thought to be a source of dangerous pathogens that can contaminate aquifers and water surfaces (Hamilton *et al.*, 2007). The Organization for World Health (WHO, 2006), wastewater is defined as liquid waste that is released from residences, businesses, and other similar locations into private disposal systems or public sewer pipelines and primarily consists of human waste and used water. The water produced by business and residential operations is referred to as domestic wastewater or domestic sewage by the WHO. Utilizing treated wastewater is a crucial alternative for managing water resources sustainably. Although Wastewater is applied in aquaculture & manmade groundwater resources, water is primarily consumed by agriculture, and irrigation of cultivated fields by wastewater is a widespread approach. agricultural irrigation is the oldest & most widely used method widely used way of utilizing either crops grown with treated or untreated wastewater, crop residue, or anything else manufactured crop (Cisneros, 2014). The presence of pathogens, potential soil and aquifer pollution, salinity, toxicity, and market acceptance are some of the key risks and limitations of wastewater usage in agriculture (Bixio *et al.*, 2008). Twenty million hectares of farmland were

irrigated by untreated wastewater (Jiménez and Asano, 2008). The three countries that use the most wastewater for irrigation are Mexico (4,493,000 m³/d), Egypt (1,918,000 m³/d), & China (1,239,000 m³/d), according to World Bank research (Scheierling *et al.*, 2010). Irrigation with contaminated municipal, manufacturing, or agricultural water drastically alters quality of soil, increased trace element quantities in soil and plants, and serves as a cause of a variety of diseases that compromise food quality and safety (Allende and Monaghan, 2015).

Reusing wastewater for irrigation is one factor in the rise of organic micro contaminants, including pharmaceuticals and other synthetic organics, in soil and agricultural products (Sedlak *et al.*, 2000). A recent investigation discovered levels of caffeine, acesulfame, gabapentin, lamotrigine, and carbamazepine in a range of crops cultivated in Jordan using treated wastewater (Riemenschneider *et al.*, 2016).

Numerous organic compounds, suspended particles, nutrients (mostly N & P), heavy metals, pesticides, & disease-causing bacteria and viruses are all present in wastewater (Ungureanu *et al.*, 2020). Because a global water shortage, the usage of recovered wastewater for irrigation has expanded recently, driving up the price of fertilizers. Reclaimed wastewater is crucial for crop irrigation because it contains a variety of essential components and nutrients that boost plant productivity (Maa and Grundmann 2018). The Copper, Nickel, lead, and Cadmium contents were below the allowable range to irrigate, they also evaluated the impact of long-term irrigation with wastewater effluents on the characteristics of the soil. The writers suggested that management plans, remediation programmers, as well as heavy metal level monitoring in the soil profile implemented in the research area According to (Elbana *et al.*, 2013). Therefore, the effectiveness of using waste water depends heavily on treating it, adopting appropriate measures to preserve soil productivity, and protecting the environment and public health. If treatment facilities don't work at full capacity, untreated or only partially treated effluent may end up in irrigation canals. Soil contamination, for instance, & irrigation with Cd was discovered in Bahr Elbagar Drain soil samples, which is used in the Eastern Delta of Egypt, and wastewater accounts for 75% of the total flow (FAO, 2003).

Wastewater uses especially in irrigation:

There should be approaches to dealing with wastewater in mild of the truth that international local weather trade reduces freshwater availability and has an unfavorable impact on the frequency of droughts, low water quality, and floods (Ungureanu *et al.*, 2020). Although human and industrial pursuits have damaged the water quality, specifically in the last 50 years, and degradation affects all water bodies globally, all aquifers must be addressed effectively, & an efficient quality strategic approach for water must be developed (Ungureanu *et al.*, 2020). In Egypt, there are 2 types of agricultural wastewater reuse: direct and indirect (ECP 501, 2015). When wastewater is processed and reused directly, it can be used for irrigation and land reclamation. Collecting the combined effluent from treatment facilities and water from agricultural drains is known as indirect reuse. This finds out about

appears at the direct use of recycling wastewater for irrigation, alongside any feasible worries to:

1. Egyptian crops that were watered with wastewater that had been treated.
2. The wellbeing of farmers, customers, and the environment in relation to agricultural goods.
3. The soil's physical, chemical, and sustainability characteristics in Egypt.

In fact, Egypt's fixed Nile water share has already been consumed, and treating the groundwater needs costly procedures (E1-Kady and E1- Shibini, 2001). As a consequence, employing treated wastewater for irrigation is a prudent decision. Egypt regularly uses wastewater reuse for irrigation (Elbana *et al.*, 2013). According to Abdel-Kader and Abdel-Rassoul (2010), the input and outflow of the industry more than doubled between 1990 and 2000. The amount of water entering the agriculture sector increased from fifty billions cubic metres per year {bcm/y} to 60 (bcm/y), whereas the amount leaving the sector reduced by half (from 12 to roughly 6 bcm/y). The amount of water currently used for household purposes is between (9 & 10) billion m³/year, and by 2030, it is anticipated to exceed twenty billions m³/year (Karajeh *et al.*, 2011). Hussain *et al.*, (2019) reviewed 124 recent articles on non-conventional water resource management and the reuse of treated wastewater, often known as reclaimed or non-potable water, in agriculture. Reclaimed wastewater may be used for irrigation around 1800 in cities like Boston and Paris. The issue of significant amounts of treated water evaporating from wastewater treatment plants was thought to be resolved by using recovered wastewater for irrigation (Jaramillo and Restrepo 2017).

Reusing wastewater can assist boost water reserves for agriculture, which will help fertilize agricultural regions and address the current water deficit brought on by the drought (Zema *et al.*, 2019). According to (Mojiri and Abdul Aziz, 2011) and (Banitalebi *et al.*, 2016) in contrast to river water, using wastewater for irrigation does have full-size capabilities: it reduces strain on the underground water resources, will increase agricultural procedure efficiency, decreases wastewater price of treatment, enhances soil permeability, enhances permeability, lowers bulk density, and lowers pH saline soil. According to (Schneiderman *et al.*, 2009), In order to analyze the effect of climate change on water sources, it is imperative to understand how properly the hydrological of the watersheds influences the minerals and impurities in the water. When wastewater is used for irrigation, it offers the soil greater vitamins than freshwater, which includes nitrogen, phosphorous, potassium, and natural matter, all of which can exchange synthetic fertilizers and motive new environmental infection (Habibi, 2019). The soil structure, bodily soil characteristics, soil water storage ability can, fertility and natural content material all be increased with wastewater remedy (Arast *et al.*, 2018). The scarcity of precipitation, the occurrence of inadequate water distribution systems, the excessive demand for agricultural water and reduced irrigation effectiveness, insufficient sewage treatment, and local weather variability are all contributing contributors to the water deficit, in accordance to Zema *et al.*, (2019). Using domestic wastewater in agriculture is one option of discarding of and managing wastewater (Malekian *et al.*,

2008). However, utilizing wastewater can reduce soil hydraulic conductivity and infiltration rate, as well as deteriorate soil and contaminate groundwater (Sou *et al.*, 2013).

Effects of recycling wastewater irrigation on plants:

Reusing treated wastewater for irrigation is gaining popularity, particularly in desert countries. Due to drought water scarcity. Currently, In Europe, the United States, and China, water recycling has increased by 10% to 29% every year, with levels lower than 41% in Australia (Schneiderman *et al.*, 2009). As a result of wastewater treatment, the proportion of wastewater used for irrigation and drinking water has increased (Gharaibeh *et al.*, 2016). This water is now being used in agriculture as a source of drinking water in industrialized countries via the installation of wastewater treatment technologies (Rodriguez *et al.*, 2009). Irrigating with untreated wastewater can poison the soil with heavy metals (Abdel Sabour, 2003). Which, according to research, can accumulate in the surface area of the soil Qadir *et al.*, (2010).

Wheat, fruits and cereals, maize, lettuce, peas, cabbage, tomatoes, reeds, Napier grass, alfalfa, soybeans, and canola are all affected by the high levels of N, K, and phosphate in industrial effluents soil (Abdel-Aziz, 2015). Drip irrigation is said to be environmentally friendly since it reduces environmental concerns, avoids direct contact with plant leaves, uses less water, and reduces nitrate leaching rates (Tripathi *et al.*, 2016).

Given the high salt content of the wastewater, keep track of soil salinity and pathogen contamination. According to study by (Urbano *et al.*, 2017), the proportions of the following soil nutrients-potassium, aluminum, calcium, sulfur, and nitrogen-increased when lettuce was drip-irrigated with treated wastewater rather than drinking water. When comparison to irrigation of the soil with drinking water, the soil watered with treated wastewater produced more lettuce, E. coli bacteria were not found on the salad leaves & the actual features were found in the soil unaffected (Urbano *et al.*, 2017). In addition, (Souza *et al.*, 2015) stressed the Drop irrigation with domestic wastewater has advantages above sprayed cultivation in sewage treatment facilities. Because wastewater from treatment facilities contains more nitrogen and phosphorus than drinking water, it may be utilized as irrigation instead of inorganic fertilizers to grow high-quality crops (Souza *et al.*, 2015). Wastewater irrigation is widely used in developing, desert and semi-arid countries (Bedbabis *et al.*, 2014). Large amounts of biomass were produced via wastewater irrigation of reeds and energy crops (Shilpi *et al.*, 2019). Wastewater from the food sector can be used to irrigate green onions, dried onions, and lettuce (Farhadkhani *et al.*, 2018); no infections were discovered when tomatoes This sewage was used to irrigate the crops. (Beneduce *et al.*, 2017). Carrots (Hussain *et al.*, 2019), radishes (Balkhair, 2016), eggplant, tomatoes (Cirelli *et al.*, 2012), and rice (Jang *et al.*, 2013) all sophisticated to their full potential when they were watered with wastewater that had been treated at a treatment facility. no infections were discovered when tomatoes were irrigated with this Sewage (Beneduce *et al.*, 2017). Carrots (Hussain *et al.*, 2019), radishes (Balkhair, 2016), eggplant, tomatoes (Cirelli *et al.*, 2012), and rice (Jang *et al.*, 2013) all developed to their full potential when they were watered with wastewater that had been treated at a treatment facility.

Reduced species of bacteria were present in mandarins (Zhang *et al.*, 2018), bananas (Panigrahi *et al.*, 2019), apples & nectarines (Perulli *et al.*, 2021).

Effect of recycling wastewater on woody forest

Vegetated forests comprise for almost 3.5 percentage of the total forest surface in the world about 140 million ha, although the size of planted forests is rising annually by around 2-3 million ha (around 2%), bucking the general trend of decreasing forest cover (FAO, 2006). Asia contains 5% in Oceania, second by 9% in Europe, 21% in South America, 17% in North and 31% of all trees in Central America, and 17% in Africa (FAO, 2010). Protective forests are defined in Japan as woods with maintenance aims of conserving water, preventing detritus flow and soil degradation, and safeguarding the natural environment (Zhu, 2013). Protective forests, on the other hand, are split into agricultural buffer straps, sandy stability forests, water and soil maintenance forests, and mangrove forests in China (Cao, 1983), Majority of forest types worldwide from boreal forests to tropical rainforest countries with abundant forest resources is China, thus, conducting long-term and continuous monitoring of China's forests to determine the dynamics of their renewal and growth will contribute significantly to the maintenance of global biodiversity and the carbon cycle (Pan, 2011). Many nations have constructed protective forests (particularly managing and providing us with forests) in response to natural catastrophes and ecological challenges (Zagas *et al.*, 2011). In tropical and subtropical areas depend on trees approximately 1.3 billion people (FAO, 2014). In these times of continuously evolving climatic circumstances, lengthy woody species and its environments face significant issues in resource management (Ammer, 2019).

In 2017, the worldwide tree inventory revealed that there are estimated 60,000 tree species now known to science, accounting for 20% of all monocotyledonous and monocotyledonous species. Nine thousands of these tree species are on the verge of extinction (Beech *et al.*, 2017). In 2018, the Chinese forestry economy supplied over 1.1 trillion USD and involved roughly 50 million people, with tropical rainforests accounting for more than 20% of their revenue (Ke *et al.*, 2019). These forestry resource initiatives were begun as public governments and established a standard for the establishment of protected forests across the world (Zhu, 2013). Based on its antioxidant activities and ecosystem cleanup, such as CO₂ sequestration, eco-engineering of protected forests is gaining popularity as a worldwide mitigation for climate change method (Amichev *et al.*, 2020). More research expenditures are dedicated toward agricultural systems, or at best, wood processing, than toward the preservation and sustainable management of forest ecosystems in the face of global change. (Lovrić *et al.*, 2020).

Woody forest in Egypt:

Egypt lies in a drier tropical location and is divided into barren regions and hyper-arid areas (Ayyad and Ghabour, 1986). Massive vegetation cowl initiatives on a broad scale carried out in the Eastern Mediterranean location in the course of the twentieth century made tremendous use of alien conifers (Sheffer, 2012). The Ministry of Environment, Egyptian Environmental Affairs Agency (EEAA) has a country-wide application for afforestation that goals to use dealing with wastewater in a secure way in cooperation with the Ministry

of Agriculture and Land Reclamation. The major goals of this countrywide application are; Disposal of 2.4 billion m³ of cumulated wastewater in secure methods, Limiting the inflow of wastewater in the Nile River or seas to restrict chemical and bacteriological illness of water with heavy metals and keeping the bio-ecological structures of fisheries, Inhibiting the direct use of wastewater in producing the meals agricultural products, Converting about 166,000 ha from wasteland lands to ecologically prosperous lands, Contributing in purification air from pollutants, including palliative elements to the local weather in arid and semi-arid areas, Increasing the oxygen portions in the biosphere and absorbing carbon dioxide and Covering an element of regionally wooden demand for manufacturing (EEAA, 2005).

Egypt's barren region vegetation is the most exceptional and essential type of plant life. The Egyptian deserts have dry or extraordinarily arid climates. Perennial vegetation shapes the most ordinary superstructure of desolate tract ecosystems and is used to examine habitat conditions (Zahran *et al.*, 2009). Massive reforestation has created a large exploratory woodland laboratory in which we might also learn about & examine the evolution and traits of herbal vegetation in the Middle East as impacted by means of competitiveness and facilitation relationships between native and invasive woody species (Osem, 2009).

Egypt includes fifty-seven tree species, accounting for solely 0.1% of the world's bushes and 0.6% of Africa's trees. At the countrywide level, Egypt's flora, as proven, has 2145 plant species, whilst woods account for simply 2.7% of the international plant species listing (Zahran & El-Ameir, 2012). Tropical forests are tropical flora that thrives in quite a number of locations of the world alongside coasts, intertidal, and riverbanks. They represent one of the most profitable and biologically sizable communities due to the fact they grant a variety of merchandise and offerings to civilization whilst additionally benefiting each coastal and maritime structure (Giri *et al.*, 2011b). However, in the latter two many years of the twentieth century, around 35% of the world's mangrove forests vanished, putting mangroves in jeopardy (Bosire *et al.*, 2008). Due to the exquisite variability of the environmental occasions and manipulation techniques in the Mediterranean, the reason for woodland plantings has sparked heated debate (Salvatore *et al.*, 2012). The El-Tur wooded area had the best common values for dimension traits (H, dbh), *Cdia*, and *Carea* of *E. camaldulensis*, whereas the Sadat and Wadi El Natrun woods had the lowest. The best values of dbh, LMA, and *Cupressus sempervirens* crown shape and have been viewed in Wadi El-Natrun woodland, however, the different qualities have been decreasing in Sadat and Sarapium forests. *Dalbergia sissoo* measurement traits and *Carea* boom have been large in the Sarapium wooded area than in the Sadat location. In contrast, LMA was once increased at Sadat than at Sarapium at which the species had its best suggest LMA value. For most features, *Khaya senegalensis* grew quicker in Sarapium than in Sadat woodland, with full-size variants in H values. In general, *E. camaldulensis* and *Casuarina* spp. exhibited greater *Cdia*, *Carea*, and dbh increase prices in El-Tur woodland than in different locations, whereas all species confirmed greater H and dbh boom prices in Sarapium wooded area (Farahat and Linderholm, 2012). The yield of a range of tree species of the woodland plantation in Egypt has been validated to be high, and it has been expected that the extent won in Egypt is around

4.5 instances much less than in Germany, Europe's pinnacle forestry country. (El Kateb and Mosandl, 2012). According to the FAO report, Egypt has nearly no most important forests, though forests are both naturally or deliberately maintained. The former covers around 20 thousand hectares and is discovered in two locations: Gebel Elba in the southeast with a complete measurement of 19,600 ha and Mangroves on the Red Sea Coast with a complete floor region of four hundred ha. Tropical forests, mainly Casuarina and Eucalyptus species, span 127,200 ha. hectares, with 40,055 ha committed to rejuvenation and 87,100 ha committed to afforestation (El Bahaa & Khalifa, 2012).

There are a number of wooded area locations in Egypt, in particular in the Nile delta, that are watered with wastewater, Gharbia, among Ismailia, Port Said, Alexandria, and Kafr El-Shaikh (SWIM, 2013). The modern-day important administration alternative for Mediterranean plantations is denaturalization, which is the gradual transformation to a whole lot extra resilient, diverse, and diverse ecosystems dominated by way of native evergreen and deciduous trees, the manifestation of eventual climax vegetation (Badalamenti, *et al.*, & La Mela Veca, 2017). A current find out about by way of determining that arid areas incorporate 40%-47% higher wooded area than at the start anticipated (Bastin *et al.*, 2017). Egypt is in a particular a barren region (>96%), and its surroundings no longer desire the increase of real woods of big trees, therefore Egypt's vegetation consists of a few species of trees (Bedair *et al.*, 2020).

El Sadat Woody forest:-

The whole and reachable tiers of heavy metals of Cd, Ni, and Pb in the Egyptian Chinese woodland close to Sadat City, Menoufia Governorate, have been discovered to be alternatively high, with tiers in developing plant tissues above approved limits, especially Ni (Salem, 2004). The soil in the Sadat woodland is sandy with 79.4% sand, 10.1% silt and, 10.4% clay particles (Farahat and Linderholm, 2012).

The Egyptian-Chinese Young People Friendship Forest used to be built in 1999 close to El Sadat City, about eighty-five kilometres northwest of Cairo. For irrigation, it depends on recovered sandy wasteland soils and dealing with wastewater. Eucalyptus citriodora Hook, Eucalyptus camaldulensis Dehnh, Khaya senegalensis (Des) A. Juss., Dalbergia sissoo (Roxb.), and Casuarina spp. are the main bushes planted in the forest. These bushes are grown in a single or blended sample with greater or much less equal regions. The complete farmed vicinity of the woodland has currently been raised to around 580 ha "info from the woodland manager" (Farahat, E., & Linderholm, 2013). It is around 65 kilometers north of Cairo 3027'55"-3028'45" N, 3035'1"-3035'31" E. (Farahat, E., & Linderholm, 2013).

Effect of wastewater application on soil physical properties:

The have an effect on of sewage water particulates on capillary strain indicated that silty loam soils had much less permeability than sand & sandy loam soils (Vinten *et al.*, 1983). The have an effect on of two types of irrigation water on several bodily traits of excellent sandy loom soil (EC_w and SAR values had been 1.5 dS m⁻¹ and 4.5 in the first type, respectively, vs. 12 dS m⁻¹ and eleven in the second). They realized that the two water excellent variables studied had no have an impact on on the soil's water

maintaining and volumetric (Zartman & Gichuru, 1984). When the impact of wastewater irrigation on soil moisture switch features used to be explored, it used to be determined that the percentages of all soil moisture contents rose on common as an end result of sewage water application. These findings would possibly be associated to a make bigger high-quality percentages as properly as OM content material (Faltas *et al.*, 1986). According to the find out about the outcomes of waste water on soil characteristics, wastewater can also be utilized for coarse texture soil on account that excessive ESP had no impact on the hydraulic homes of the soil (Juwarkar and Subrahmanyam, 1987). When irrigation water salinity elevated from 1500 to 4000 mg L⁻¹, clay, loamy, and calcareous soil bulk density values lowered however hydraulic conductivities increased (Abd-El-Nour, 1989). When the soil was once watered with wastewater, its water-preserving potential accelerated dramatically. They additionally located that long-term use of this water resulted in a constant amplification in most water-holding potential and expanded the bodily traits of most soils. (El-Kouny, 1999). Heavy metallic switch in sewage water soils is exceptionally sluggish, with even extra than ninety per cent of Cd, Ni & Pb gathering in the backside 10-15 cm of soil (Streck and Richter, 1997). In the tutorial literature, there is no consensus on the outcomes of irrigation water on soil bodily characteristics; for example, several research concurs that wastewater-irrigated soils have an enormous drop in hydraulic conductivity. (Schacht, *et al.*, 2015). Uncontrolled irrigation of such fluids has a wide variety of damaging consequences on soils and plants, mainly over time. To appreciably minimize the bad consequences of the usage of TW in irrigation, appropriate hints for water recycling and protection must be accompanied (Hashem, 2021). Other experiments printed an upward thrust in soil hydraulic conductivity (Minhas, *et al.*, 2004). It was once asserted that city wastewater irrigation enhances soil capacity and hydraulic conductivity (Agassi, *et al.*, 2003). Domestic wastewater no longer negatively have effect on hydraulic parameters (Coppola, *et al.*, 2004). TW irrigation had no significant have an effect on the soil salinity or socialization (Yang, *et al.*, 2006). The purpose of this find out about used to be to inspect the impact of dealing with wastewater on the chemical and bodily homes of soil. In the Borkhar vicinity of Isfahan province in central Iran, two wastewater and groundwater redress have been administered to three plants of sugar beet, maize, and sunflower utilizing sprinkler and flood irrigation systems. Lead, manganese, iron, cadmium, nickel, cobalt, copper, and zinc concentrations in soil samples had been decided to a depth of one hundred twenty cm Zn. Irrigation structures have little impact on soil-extractable heavy metals. When wastewater remedy used to be in contrast to groundwater treatment, the buildup of Ni, Mn, Pb & Co in the soil rose dramatically. Pb, Mn, Ni, Co, Cu, & Zn awareness declines with a depth of soil. During the developing season, the boom of Fe, Cd, Ni, Cu, & Zn was once unaffected by the aid of dealing with wastewater. The irrigation machine had a widespread have an effect on permeation rate, bulk density, and standard porosity. The glide price rose dramatically whilst the use of a spray irrigation device (Abedi-Koupai, *et al.*, 2006).

Table 1. Investigations for studying wastewater irrigation on woody forest:

Region	Cultivated plants	Significant finding	Type of water	Reference
Iraq	<i>Platanus orientalis L., Eucalyptus camaldulensis Dehn, and Populus nigra L.</i>	Increasing the concentration of wastewater lead to form unfavorable soil for the growth of tested plants by recording lower root and shoot biomass when the concentration of wastewaters was > 25% as well as, the chlorophyll content which record an increment in eucalyptus in chlorophyll a, b, and total when irrigated with 25% R1 ww. and R2 ww.	blending wastewater of two types of industrial wastewater from different regions	AMEDI, J. F., RASHEED, R. O., & IBRAHIM, D. (2021). RESPONCE OF PHYSICO-CHEMICALSOILPROPERTIESTOWASTEWATER APPLICATION AND SUBSEQUENT EFFECTS ON THREE WOODY SPECIES PLANTS. <i>Journal of Duhok University</i> , 24(2), 106-125.
Spain	<i>Populus nigra, Tamarix africana, Nerium oleander, Cupressus sempervirens, Ficus carica, Pistacia erebinthus, and Vitex agnus-castus</i>	For most of the species, treated wastewater had a positive effect on final biomass and above ground: below ground ratio compared to that of nutrient solution.	Wastewater	Adrover, M., Forss, A. L., Ramon, G., Vadell, J., Moya, G., & Taberner, A. M. (2008). Selection of woody species for wastewater enhancement and restoration of riparian woodlands. <i>Journal of Environmental Biology</i> , 29(3), 357.
North Carolina	Forty-two <i>Populus spp. clones, Eucalyptus benthamii,</i> and seven tree species	The results show that some <i>Populus</i> clones are excellent candidates for woody biomass production on municipal wastewater application fields	Two municipal wastewater	Shifflett, S. D., Hazel, D. W., Frederick, D. J., & Nichols, E. G. (2014). Species trials of short rotation woody crops on two wastewater application sites in North Carolina, USA. <i>BioEnergy Research</i> , 7(1), 157-173.
Egypt	<i>Cupressus sempervirens, Corymbia citriodora</i> and <i>Khaya senegalensis</i>	<i>Khaya senegalensis</i> gave the highest values among the three types and the Serapium Forest Plantation has achieved the highest values for the accumulation of macro and micro-nutrients, as well as the highest percentages for the accumulation of minerals at all studied depths compared to soil samples taken from areas irrigation of freshwater trees.	wastewater as compared with irrigating by fresh water	Afaf, L. S., Mohamed, E., El-Ghany, A., El-Gindy, M., & Hossam, H. H. (2021). EFFECT OF USING TREATED SEWAGE WATER ON THE YIELD OF SOME TREE SPECIES COMPARED WITH THOSE IRRIGATED BY FRESH WATER. <i>Journal of Environmental Science</i> , 50(3), 89-106.
Egypt	<i>Terminalia angustifolia, Rademachera ignea</i> and <i>Ficus mango</i>	Wastewater increased Zn and Pb in leaves while in stems wastewater increased Zn and Pb in <i>Rademarchera ignea</i> and in <i>Ficus mango</i> seedlings, while Pb increased by using wastewater in <i>Terminalia angustifolia</i> seedlings.	Tap water and Waste water	Hashish et al., (2017)
Jordan,	<i>Ficus nitida L., Cupressus sempervirens L., Melaleuca viminalis L., and Nerium oleander L.,</i> and two genotypes of 10-year-old deciduous trees species; <i>Robinia pseudoacacia L.</i> and <i>Populus nigra L.</i>	Most of the trees has the potential to be a hyperaccumulator for heavy metals in its bark	Wastewater	Afaf, L. S., Mohamed, E., El-Ghany, A., El-Gindy, M., & Hossam, H. H. (2021). EFFECT OF USING TREATED SEWAGE WATER ON THE YIELD OF SOME TREE SPECIES COMPARED WITH THOSE IRRIGATED BY FRESH WATER. <i>Journal of Environmental Science</i> , 50(3), 89-106.
Egypt	<i>Cupressus sempervirens, Pinus halepensis., Corymbia citriodora</i> and <i>Eucalyptus camaldulensis</i>	The rate of heavy metals accumulation in the growing plants differed more or less according to the growing plant species and their organs as well as sort of the element itself	Long-term use of treated waste effulnts	Sherif et al., (2014)

TW irrigation has an impact on soil properties, and they located that long-term TW irrigation of clayey and sandy soils expanded soil salinity, even though it reduced with every rainfall (Lado, et al., 2012). All governments

must be involved in treating and reusing considerable quantities of wastewater. Increased demand for residential water as an end result of populace expansion, elevated dwelling conditions, and a developing industrial zone will amplify the volume of wastewater generated, pushing TW reuse globally (Assouline, and Narkis, 2013). Irrigation the use of wastewater impacts the soil's microbiological and physicochemical traits (Becerra-Castro, *et al.*, 2015). TW irrigation has elevated by means of 10-29% each and every yr in Europe, China, and the United States, and with the aid of round 41% in Australia (Aziz and Farissi, 2014). It is essential to use alternate water sources. Roughly 40% of the international populace is projected to face water crisis or insufficiency in the next years, posing a significant threat to water security (Elgallal, *et al.*, 2016). In 2014, China's wastewater therapy price (the ratio of TW extent to whole discharge quantity of wastewater) grew to 86%, 3.4 instances that in 1999 (Wang, 2017). A moderate decline in the bulk density of soil irrigated with wastewater for a lengthy time (Abd-Elwahed, 2018). They declared that the extent of OM in the wastewater in use for irrigation will decorate soil OM, which improves the capability of the soil to keep water, altering compressive susceptibility and drains traits (Abd-Elwahed, 2018). Each year, about 0.4 trillion m³ of wastewater is launched into the environment, polluting about 5.5 trillion m³ of water (Zhang and Shen, 2019).

While sewage sludge "SS" has an excessive awareness of natural carbon in addition to nitrogen, phosphate, potassium, and numerous microelements required for plant increase and fertilization, it has the potential to decorate soil bodily houses and enhance plant boom (Zhang *et al.*, 2020).

By 2025, roughly 1.8 billion humans would be residing in an ocean zone. As a result, it is indispensable to use different water sources (Rizzo, *et al.*, 2020).

Effect of waste water application on soil chemical properties:-

Enhanced salt concentrations in irrigation water extended soluble sodium in soil considerably. Long-term irrigation with TW would possibly motivate soil salinization (Fawzi, 1986) & (Zartman, *et al.*, 1984). The rising finer particulates and natural content material in the wastewater are superior to the capability of the cation change (Sadek and Sawy, 1989). The salinity of the soil rose from 1.80 to 24.83 dS/ m when irrigation water used to be diminished from (0.58: 3.67) dS m⁻¹. As a result, developing soil salinity was once brought on by the dissolved salts of irrigation water (Dosoky, 1999). The outcomes of the wastewater irrigation length on the differences in numerous chemical homes of two awesome plants. The pH values and CaCO₃ attention of each rhizosphere and the bulk soil declined as the irrigation time extended (El-Motaium and Badawy, 2000). The dangers are mainly related to water excellent and soil conditions, as nicely as crop sorts (Elgala *et al.*, 2003). TW boosted soil EC whilst lowering plant nutrient storability (Wang *et al.*, 2003). Long-term wastewater irrigation led to a good-sized drop in soil pH, in accordance with research (Meena, *et al.*, 2016). TW irrigation resulted in increased soil modification (Gloaguen *et al.*, 2007). Soil salinity improved as an end result of wastewater irrigation (Al-Zu'Bi, 2007). They have an effect on of TW on soil parameters used to be studied, and it used to be decided that

greater extraction rates, low precipitation, and a lack of drainage infrastructure boosted SAR, salt, and soil natural content material (Al-Hamaiedeh and Bino, 2010). SAR fee used to be greater in agriculture soils that sustained TW for a decade or greater (Pan *et al.*, 2012). The cost of soil SAR after TW infiltration and evaporation printed a restricted practicability of soil alkalization (Shang *et al.*, 2013).

Effects of wastewater irrigation and hint metals absorption in wooden bushes "Eucalyptus camaldulensis and Casuarina spp." in El Sadat Forest. The outcomes confirmed excessive concentrations of hint factors in the dry count number "µg g⁻¹" of inexperienced and senesced leaves however beneath the phytotoxic concentrations besides Mn (Farahat and Linderholm, 2013). Many lookups have indeed been carried out to check out the results of wastewater irrigation on soil chemical houses such as salinity, sodicity, pH, and so on. Salinity has measured the use of SAR & EC, which correspond to the diploma of salt absorption in the soil (Gharaibeh *et al.*, 2016). Long-term irrigation with TW might also expand soil salinization. As a result, the salt awareness of the soil needs to be decided by the usage of TW (Santos *et al.*, 2017). A lookup undertaking to inspect the effects of using secondary TW (Treated Wastewater) in irrigation. With the exception of EC and SAR, which had been barely greater in TW soil samples, the effects verified that utilising TW had no good-sized impact on soil physicochemical parameters when in contrast to freshwater. (Farhadkhani *et al.*, 2018). TW irrigation better soil salt tiers at the conclusion of the irrigation session however lowered in the course of the moist season (Petousi *et al.*, 2019). TW irrigation accelerated electrical conductivity in the decreased soil strata. They additionally determined that after two years, Zn, Al, and Fe amassed two to eight instances in the topsoil layer (Salgado-Méndez *et al.*, 2019). Soil salinity was once higher with TW therapy than under freshwater treatment. However, neither the leaf Cl or Na concentrations nor the tree productiveness increased. Nonetheless, they recommended that non-stop TW irrigation may have a terrible have an effect on soil physicochemical points (Erel *et al.*, 2019).

Effect of wastewater application on soil biological properties:-

COD and BOD measurements can be used to decide the organic wastewater homes (Metcalf and Eddy, 1991). Microbiological characteristics, such as enzyme activity, have the workability to be beneficial as an indicator of soil best due to the fact that they reply shortly to soil management, fertilization methods, and HM concentrations (Bandick, *et al.*, 1999). As wastewater used to be injected into a sand column, cardio micro organism decreased infused glide pace with the aid of greater than four times, with the best discount happening in the top quarter adjoining to the soil floor (Vandevivere and Baveye, 1992). SS may also purpose undesirable stipulations in the water sample, such as accelerated turbidity and silt load. During the cleansing and utilization of water, a giant quantity of dissolved solids may additionally be added. Water organic elements pertain to aquatic existence and viruses that might also be located in water. (Muttamara, 1996). The characteristics of wastewater are roughly categorised into physical, chemical, and organic houses (Metcalf, E. Physical Unit Process, 2003). Temperature and odours are

two bodily homes that are seldom altered in a facility that treats wastewater. Water temperature is vital due to the fact it impacts ecological and organic existence in the surrounding bodies of water (Metcalf, E. Physical Unit Process, 2003). Some HMs, inclusive of Ni, Cu, Mn & Zn, are physiologically giant seeing that they are micronutrients for most species, in spite of the truth that large doses of these metals are poisonous to animals (Shi *et al.*, 2015b). The SSDI had the absolute best tomato microbiological security among remedy procedures (Najafi, 2006). Many factors are cycled biogeochemically via soil enzymes, and their undertaking displays the diploma of chemical and organic methods in soils (Chen *et al.*, 2008). Other irrigation water excellent standards that can also have an impact on soil houses or plant boom consist of organic markers (fecal or complete coliforms (FC or TC), *Escherichia coli* (*E. coli*), and helminth eggs), nutrient levels, boron concentration, heavy steel content, and phytotoxic chemical content. (Pedrero *et al.*, 2010). TW consists of minerals & ROM, which can enhance the organic fitness of the soil (Chen *et al.*, 2013). Long-term irrigation with TW in two web sites in Beijing and California resulted in higher soil-biological exercise (Chen *et al.*, 2013). The conceivable of plant-microbe interactions in resolving HM-polluted soil has already been examined (Luo *et al.*, 2014). The HM in TW tends to accumulate in soil and grow to be bioavailable (Chen, 2015). The foremost therapy aim is to furnish TW with a fabulous and invulnerable stage of environmental and public fitness risk, which is done with the aid of reducing SS and OM and putting off wastewater chemicals and organic substances that can also be negative to vegetation and generic health. (Wang, 2017).

Lead (Pb) is one of the most regularly occurring doubtlessly poisonous factors (PTEs) in soil, but it serves no organic motive in biota (Kushwaha *et al.*, 2018). When using wastewater irrigation, it is probable that average to extreme chemical or organic blockage may also end result (Salgado-Méndez *et al.*, 2019).

Woody forests as a tool for waste water management:-

Total suspended solids (TSS) and biochemical oxygen demand (BOD) in wastewater are carefully proportional to influent go-with flow rate. (Bechmann *et al.*, 1999). Residential wastewater was once first linked with short-rotation willow coppice (SRWC) biomass manufacturing in Scandinavia in the 1980s when agricultural willow flowers producing timber chips for electrical energy had been recognized as an achievable municipal wastewater therapy solution. (Dimitriou *et al.*, 2005).

Understanding the approaches underpinning heavy steel buildup and detoxing in plant life is a necessary issue of phytoremediation (Facchinelli & Mallen, 2001). The resolution of plant phytoremediators is based totally on their capability to naturally acquire heavy metals (Galaktionova, & Lebedev, 2019). Phytoremediation employs inexperienced flowers to dispose of contaminants from soil and groundwater or to decrease contaminant mobility via phytoextraction, rhizofiltration, phytovolitization, or phytotransformation. (Madrid *et al.*, 2003). Plants can discharge compounds from their roots that acidify the soil and enhance the solubility and transport of pollution (Suresh and Ravishankar, 2004). Many geographical trials have proven that species of flowers might also be employed as

bioaccumulators to do away with heavy metals as Pb, Cu, Ni, Cd & Zn (Li, 2006).

The sewage effluent had a right impact on the economically imperative tree's increase via supplementing the soil with essential vital factors such as natural count & containing excessive concentrations of plant-available vitamins (Hassan *et al.*, 2003). Some localities in Egypt presently irrigate woodlots with sewage or drainage water following preliminary treatment. Reusing handled sewage water in afforestation is considered a quintessential complement to Egypt's water supplies. This volume, which quantities to 2.4 billion cubic meters per yr now, was once in no way utilized however used to be viewed as an extreme burden when you consider that it pollutes the surroundings when launched into the Nile, sea, or desert. In collaboration with the different Ministries, the Ministry of State for Environmental Affairs is accountable for enforcing the National Program for afforestation and protected use of dealing with sewage water. One of the woods supported by way of this initiative is the Egyptian-Chinese friendship woodland (MSEA, 2004).

Recycled water has been successfully utilized for irrigation in some distance to many areas of the world (for example, China, India, and Italy), and many specialists have referred to its advantages (LEVINE & ASANO, 2004). To preserve the protection of recycled wastewater for agricultural use, it has to be monitored on a steady foundation (Emongor and Ramolemana, 2004). Guidelines for the reuse of TWW for agricultural makes use of had been set up in 2005 Egyptian Code 501/2005, offering the felony framework for farmers to commence producing vegetation together with timber through the use of wastewater irrigation (MHPUNC, 2005). Wastewater may also include heavy metals and pathogens (Toze, 2006). The depth of microbial pathogens often has a momentary impact, and it varies in accordance with the variety of wastewater and bioavailability for humans, animals, and the surroundings (Toze, 2006). The use of wastewater for wooded area irrigation has proven to be a practicable and inexpensive technique of the usage of wastewater whilst concurrently producing wood. (Sharma and Ashwath, 2006). Sewer water carries nutrients, and utilising it for irrigation has been proven to enrich the soil, improve plant uptake, and rehabilitate broken soils (KARUNARATHNA, 2006). Due to the excessive presence of vitamins and heavy metals in handled wastewater, immoderate and non-stop software might also purpose phytotoxic issues, posing a fitness chance to people or cattle (Toze, 2006). Domestic wastewater consists of minimal portions of heavy metals; consequently, great concentrations in EWS woody biomass are no longer anticipated (Henze, 2008).

Forest water reuse (FWR) structures in North Carolina rent slow-rate irrigation to land utility municipal wastewater over a range of hardwood and softwood forests at a decrease cure fee than different traditional wastewater remedy methods (Muga & Mihelcic, 2008). The reuse of handled wastewater in agriculture is one alternate supply of irrigation that used to be projected to develop considerably in areas the place clean water is scarce. (Al-Absi *et al.*, 2009). Deficiency, as properly as immoderate doses of sure metals can have a terrible effect on the physiological ability to grow plants, posing viable risks to human beings and the

surroundings (Feng *et al.*, 2010). It used to be stated that primary wastewater irrigation boosted the growth, backside space, and trunk extent of positive tree woodland species (Ghorab *et al.*, 2011). Forest structures are used with the aid of fifty-one municipalities to deal with essential and secondary municipal

Heavy metal contamination in woody forest plants:-

The disposal of low-pH wastewater accelerates the transfer of Cd and Pb to reduced depths (Sommers, 1977). The amount of HM in the two plants' rhizospheres and bulk soils rose as the watering duration lengthened. The use of TW or low-quality water has lately been included in an extension program for maximizing water resource utilization. However, the unregulated use of such fluids has a number of deleterious effects on soils and cultivated plants, particularly in long-term use. (El-Motaium and Badawy, 2000). Heavy metals are elements with a density of more than 5 g cm³ & also most reflect the potential, including Mn, Ni, Cd, Zn, Cu, As, Pb and Hg (a metalloid, although it is listed as an HM henceforth), are HMs (Clemens *et al.*, 2002). The poisoning of the groundwater & soil with (HMs) is ubiquitous and dangerous to human and animal life. Many locations across the world require cleanup. Phytoremediation is an effective, low-cost method of eliminating (HMs) from soil & groundwater (Salido *et al.*, 2003). Nickel has been shown to be stored in cell walls 60-70% of the time opposed to vacuoles (Yang *et al.*, 2005). Several variables influence metal absorption and diffusion in plants, involving contamination physiochemical parameters, temperature, soil conditions, & the plant traits (Gardea *et al.*, 2005).

Heavy metal sensitivity in plants is characterized by three mechanisms: autoxidation & The Fenton reaction produces reactive oxygen species that block essential functional groups in proteins and stores important metal ions in biomolecules. (Nouairi *et al.*, 2006). Due to human activity such as mining, smelting, fossil fuel burning, phosphate application of fertilizers, and sewage sludge have caused in the excitation and release of HMs in the crust to the soil, water, and atmosphere (Clemens, 2006). Although some of these heavy metals are essential for plant development and may help to heal nutritional deficits, larger quantities of these metals can interfere with the physiological activities of growing plants and pose major risks to humans and the environment. (Feng *et al.*, 2010). The flexibility of plant tissues to absorb and sequester HMs to aerial portions is critical to the efficacy of phytoremediation (Kramer, 2010). Woody plants are not hyperaccumulators since they retain water. HMs at middling quantities. It was demonstrated that some plants may store HMs at extremely high quantities in their aerial portions. Leaf collecting HMs (µg g⁻¹) exceeding 10,000 for Zn and Mn, 1000 for Cu, Pb, Ni, and as, and 100 for Cd are considered hyperaccumulating plants (hyperaccumulators) for the relevant element (Capuana, 2011). Methods of soil contamination by heavy metals: illustrated the main methods of soil contamination which are Geological and human activities, Natural processes like volcanic explosions, Industrial wastes such as harmful gases, agricultural pesticides chemicals, insecticides, fertilizers and Inefficient waste management techniques, characterized by

the discharge of wastewater into large landfills and nearby rivers or streams (Wani *et al.*, 2012).

Many hyperaccumulating grass plants have been found, and processes for heavy metal absorption, movement, retention, and purification in such plants have been described (Clemens *et al.*, 2013). Salinization by toxic metals (TMs) is a major issue in China, owing to industrialization and economic progress. More than 19% of total farmed land in China was poisoned by TMs, with Cd and Pb accounting for around 7.0% and 1.5%, respectively. (MEP and MLR, 2014).

Plants that extract and accumulate metals in large quantities from soil solution are called hyper accumulators plants. Metals pass through into the base before they get the plant from the soil solution. Metal ions are able to pass through root cells' permeable cell walls. Special plant mitochondria are in charge of trapping these metals and arranging them for absorption and transfer (Labe and Agera, 2017).

Sentence	Abbreviation
Treated Wastewater	TW
suspended solids	SS
chemical oxygen demand	COD
biochemical oxygen demand	BOD
organic matter	OM
Fecal coliforms	FC
total coliforms	TC
subsurface drip irrigation	SSDI
Total suspended solids	TSS
forest water reuse	FWR
short-rotation willow coppice	SRWC
dry matter	DM
treated wastewater	TWW
potentially toxic elements	PTEs

CONCLUSION

According to what was collected from previous studies related to the reuse of wastewater and its use for irrigation purposes, we concluded the necessity of reusing wastewater, especially with tree forests, due to the water poverty that most regions of the world, particularly in dry and desert places. Regions that are semi-arid.

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الآثار طويلة المدى بمياه الصرف الصحي المعاد تدويرها علي الغابات الخشبية

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الملخص

الآن يعتبر إعادة استخدام مياه الصرف الصحي في الأغراض الزراعية من الأمور الضرورية نظراً لندرة و تزايد الطلب علي مصادر المياه في العالم خاصة المناطق الجافة و الشبه جافة مثل مصر و الأردن، ومن المعروف أن استخدام مياه الصرف الصحي في ري الغابات الخشبية خيار مثالي نظراً لأنها تستخدم في الغابات الخشبية المختلفة ولا يفضل استخدامها مع المحاصيل الورقية التي تستهلك كغذاء بشكل أساسي.