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BIOLOGICAL RISKS OF WASTE WATER FOR IRRIGATION

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Abstract
Increasing activities in the World, enhance the pressure on freshwater resources. The most important solution to reduce this pressure is the use of treated wastewater. The use of wastewater is becoming increasingly common on a global scale. Wastewater used irrigation, especially in agriculture and landscape areas. It can use some industrial activities such as cooling, washing, boiler feeding and fire extinguishing. Wastewater is generally used directly or by creating a wetland after physical pre-treatment. Changes in living standards have diversified wastewater contents. In recent years, domestic wastewater contains substances, which are extremely harmful to living health, that cannot be treated with physical processes, and require expensive and complex treatment techniques. Heavy metals, microorganisms and endocrine disruptors in wastewater pose serious health risks to life. In this study, biological risks in the use of wastewater in irrigation will be evaluated. In the study, the biological risks that the pathogenic microorganisms and endocrine disruptors contained in the wastewater may cause in irrigated areas and suggestions for their solution are given.

Keywords: Irrigation water quality, agricultural production, human health

1. INTRODUCTION

Colorless, odorless, tasteless and pathogen-free water is defined as quality water. Until recently, problems related to water pollution were often overlooked due to the ease of access to quality water resources (Shamsad and Islam 2005). On the other hand, as environmental problems increase in many parts of the world, the qualitative properties of water have become more important than their quantitative properties (Balachandar et al. 2010).

The distribution of water use varies, and generally 70% of the water used in the world is used for agricultural purposes, 20% for industrial purposes and 10% for domestic purposes. If population growth continues in this way, food production must increase by more than 70% in order to meet the food need in 2050. The amount of irrigation water needed for agricultural production will also increase (Ak and Top, 2018). In order to ensure sustainable use of water resources, first of all, the qualitative characteristics of existing water resources should be determined and correct use strategies should be determined (Azaza et al., 2010; Bozdag, 2017).

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UN's Sustainable Development Goal 6 promotes the reuse of treated wastewater to ensure water availability for all. Since the agricultural sector is the largest user of all water resources, using wastewater as irrigation water in agricultural production is a viable option. Waste water should not be seen as a waste to be disposed of, but as a resource to be evaluated (Werner et al., 2003; Tas, 2020). In areas that lack usable water and to avoid high wastewater treatment costs, the reuse of used water is the best option. In addition to providing the input need of increasing agricultural production, the organic materials it contains make the use of waste water attractive. Waste water of sufficient quality in terms of climate, soil and plant characteristics should be used with appropriate irrigation methods. Thus, wastewater rich in plant nutrients can reduce or eliminate the need for fertilizers (Tas, 2020). However, some issues should not be ignored in the use of wastewater. At this point, the risks that the anthropogenic sourced wastes contained in the wastewater should be well evaluated.

The continuation of the human race is closely related to the living standards and environmental quality of our planet. Increasing population, developing industry and technology are putting pressure on soil and water resources. Natural resources are faced with organic and inorganic pollution. Many wastes of anthropogenic origin; consists of chemicals and compounds. The purpose of use of these compounds is to make the society live better and to provide economic benefits. A wide variety of additives are used to preserve the nutritional value of foods and extend their shelf life. Some of these are; persistent organic pollutants (POPs), detergents, disinfectants, antiseptics, cosmetics, pharmaceuticals, endocrine disruptors, heavy metals, nanoparticles, etc. can be listed as

Persistent Organic Pollutants constitute the majority of chemicals used as pesticides for the destruction of harmful insects, weeds and fungi in agriculture and other fields; They are used in industrial production, especially in PVC, plastic and other processes using chlorine, or they are released as waste. Persistent Organic Pollutants are taken into the human body from the environment and through nutrients, accumulate in the adipose tissue and remain in the organism throughout human life, causing many health problems, especially hormonal disorders, immune system disorders, reproductive disorders and cancer (EP, 2016). The circulation of these substances in natural environments is not limited to their consumption by humans. Because after achieving the desired purpose, the return of wastes to the environment creates more serious problems. Often, these substances interact with each other and become more toxic than their original state (Shumbula et al., 2021).

By mixing with soil and water, they are included in the agricultural production chain and cause negativities in plant cultivation. Pollutants that reach the food chain with bioaccumulation can reach levels that threaten human health. The use of wastewater in irrigation is important with its valuable fertilizer additives. However, pollutants such as persistent organic compounds, pathogenic microorganisms, endocrine disruptors, and heavy metals that may be present in wastewater can accumulate in irrigated areas (Gunal, 2019).

It reveals that wastewater with insufficient treatment leads to accumulation of heavy metals and other toxic elements in soil and plants, increasing microbial threats to human and animal health as well as increasing levels of pathogens. However, the reuse of treated wastewater for agricultural irrigation is more accepted than its reuse in other areas (Rizzo et al., 2020; Gehernaout, 2018).

This article focuses on the environmental effects of wastewater to be used in agricultural irrigation. Information about the pathogens that can be found in wastewater and the worrisome pollutants emerging with the developing technology are included. In addition, biological risks that waste water may create in irrigated areas and suggestions for their solution are given.

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2. CONTENT OF WASTE WATER

2.1 Pathogenic Microorganisms

The main sources of pathogenic microorganisms in drinking and utility waters are sewage waters. They also participate in the food chain by consuming agricultural products irrigated with untreated sewage waters (Kesalkar et al., 2012). The term biological properties of water refers to aquatic life and viruses found in the water. The quality of the water is significantly affected by these properties. For example, algae cause taste and odor. Also, some microalgae produce strong toxic substances harmful to living organisms. The wastewater environment is considered an ideal environment for the development of viruses, bacteria and protozoa. The majority are harmless, but sewage also contains pathogenic microorganisms (Glynn et al., 1989).

Since pathogenic microorganisms are carried by water, the quality of the water used should be checked frequently in terms of bacteriology. Sewage water that mixes with the city mains water in any way disperses in a short time and causes epidemic diseases. The biggest threat posed by the use of raw wastewater in agricultural irrigation is the pathogens that cause various diseases. Microbiological life in water such as bacteria, viruses and protozoa can cause different diseases. The most important diseases that can be caused by pathogens in water are; They are viral diseases such as cholera caused by Vibrio cholerae bacteria, dysentery caused by amoeba, hepatitis and diseases caused by parasites such as Helminths (Uyttendaele et al., 2015). Different types and amounts of pathogens in raw wastewater or pre-treated or biologically treated wastewater threaten human health.

In the city of Clermont-Ferrand, France, an area of 1500 ha is irrigated with sprinkler irrigation. Irrigation water is supplied from the city's treatment plant, which consists of activated sludge, phosphorus and nitrogen removal processes. In a study conducted in the region, it was determined that the Hepatitis Virus could not be completely removed after treatment, and it was found in different amounts both in the water and in the air in the irrigated area due to wastewater aerosols (Courault et al., 2017).

Microbiological quality levels of Aksaray Province Karasu irrigation and drainage canal; It was examined seasonally by sampling from 5 different points of the drainage channel. Total coliform, fecal coliform, fecal streptococcus and salmonella counts were made. The total number of coliform bacteria in the surface water was found to be 92-302 CFU (colony unit)/100 mL, the number of fecal coliform bacteria was 16-225 CFU.100 mL^{-1}, and fecal streptococcal bacteria were found to be 2-26 COB100 mL^{-1}. When the values found are evaluated according to the Water Pollution Control Regulation, Inland Water Resources Quality Criteria; Karasu irrigation and drainage canal II. class water quality was determined. (Celebi, 2018).

2.2 Heavy Metals

Heavy metals seriously threaten human health. While the effects of pathogenic microorganisms in wastewater on human health are acute, the effects of heavy metals occur in a longer time. They can be found in different concentrations in the effluent of treatment plants. Wastewaters contain many micronutrients needed by the plant, such as copper, iron, manganese, zinc, boron, molybdenum, cobalt and nickel (Lim et al. 2010). High concentrations of heavy metals in soil or irrigation water, although they are essential or supportive elements of plant growth, are toxic to plants, animals that feed on plants, and humans (Kıran and Ozkay, 2021).

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Heavy metals accumulate over time in the soil, even in low concentrations, in the roots, leaves and fruits of plants. Heavy metals accumulated in the soil infiltrate into the groundwater or accumulate in the leaves and fruits of the plant, threatening the life of the plant as a result of consumption.

Heavy metal accumulation in cabbage plant grown in lands irrigated with urban wastewater in Erzurum province was investigated. Co, Cu, Fe, Mn and Zn analyzes were made in soil samples taken from 0-10 cm, 10-30 cm and 30-60 cm depths. It has been determined that cobalt, which is found in trace amounts in wastewater, does not accumulate in the soil, and metals such as soluble Cu, Fe, Mn and Zn accumulate in a significant amount compared to the control (Kirimhan et al, 1983).

Heavy metal accumulation from sewage sludge was investigated in barley and spinach plants grown by applying 20 tons ha^{-1} sewage sludge for 5 years in a calcareous soil. The cadmium content in barley and spinach increased six-fold and exceeded the toxic limit. Researchers determined that Zn, Cu and Ni contents did not increase as much as Cd and remained below the toxic level (Gardiner et al., 1995).

2.3 Organic Matter

Waste water can contain various pollutants, which are calcium, sodium, potassium, chlorine, phosphate, sulfur, bicarbonate and ammonium salts, acids, alkaline chemical, oil, etc. contains components. These ingredients should be approached with caution as they are so highly concentrated.

In genaraly Waste water provides an economic return by reducing the use of fertilizers due to the organic substances it contains. However, nitrogen and phosphorus compounds in wastewater may be more than the plants need in some cases. Excess nitrogen causes vegetative overgrowth in plants. In addition, faulty irrigation practices can cause contamination of surface and groundwater. Phosphorus compounds are removed by filtration from the soil by adsorption and precipitation, but nitrogen is oxidized by oxygen and turns into nitrate. Nitrate can cause serious problems in groundwater (Ak and Top, 2018).

It is very important which are the climate, soil, plant and irrigation method for reuse of treated watewater. Especially the organic matter loads in the wastewater can cause serious problems according to the specified conditions. For example, the tomato plant needs a high amount of potassium, while the beans show good growth due to its vegetative properties, especially at low nitrogen concentrations. Citrus trees can develop well even at very low phosphorus concentrations relative to the water they require (Kiran and Ozkay, 2021).

It is stated that the nitrogen level of secondary treated wastewater in Taiwan is at the level of 15-20 mgL^{-1} and this value is not suitable for paddy production (Chiou, 2008). When using treated wastewater for irrigation, the type of product and the levels of plant nutrients in the soil are important. Plant nutrients in soil and wastewater should be deducted from the amount of fertilizer needed by the plant.

In research studies with yellow water, positive results were obtained in terms of fertilization function from urine applied directly to the soil (Jönsson, 2003; Vinneras et al., 2003; Pinsem et al., 2004). The results obtained as a result of chemical fertilizer applications and separately collected human urine applications showed similarities (Simons and Clemens, 2003).

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2.4 Biological Risk Parameters

2.4.1 Micro pollutants

Developing technologies and rising living standards prolong life expectancy. To meet the need for food and as an alternative to rapidly consumed natural resources; The use of chemicals in all areas of our lives is increasing day by day. As a result of all these, there is a rapid increase in micropollutant concentrations in nature, especially in aquatic ecosystems.

The U.S. Environmental Protection Agency (EPA) defines micropollutants as new chemicals that do not have legal status and whose effects on the environment and human health are not fully understood (Deblonde et al., 2011). Micro pollutants; It consists of pharmaceuticals, cosmetics, steroid hormones, industrial chemicals, pesticides, polyaromatic hydrocarbons, nanoparticles, microplastics and other compounds. In aquatic environments, these pollutants are usually present in very low concentrations ranging from a few ngL^{-1} to μgL^{-1} (Akkurt and Oğuz, 2019).

While an important part of microplastics is formed as a result of breaking the plastics into small pieces, some of them consist of small pellet-shaped resins (nurdles) used as industrial raw materials in the production of plastic products. These pellets are; They are durable and have the ability to adsorb persistent organic chemicals on them. These properties play an important role in the entry of pollutants into the food chain. Cylindrical or disc-shaped thermoplastic pellets are shipped to plastics processing factories all over the world, and the pellets are; plastic bottles, caps, bags, packaging, etc. It is melted and poured into molds to make products. These pellets can be accidentally spilled into the sea during transportation and processing operations, as well as production spills can be released into the waters uncontrollably.

Microbeads found in most cosmetic products are approximately 1-4 mm in diameter and are considered microplastics. Microbeads generally originate from personal care products and pass into the sewer system through sinks or tubs. 90 percent of the litter floating in the waters originates from plastic. Microplastics ingested by aquatic organisms may undergo biomagnification by passing along the food chain from primary producers to predators. Because they are lipophilic, they accumulate in the fatty tissues of marine organisms. They cause potentially many adverse effects (cancer, impaired immune system and reproductive ability) to wildlife and humans.

In addition, plastics in the seas; It contains additives such as plasticizers, antioxidants, anti-static agents and flame retardants. Some additives and additive-based chemicals (for example, nonylphenol, bisphenol A) cause endocrine disruption in the body through hormones. These potential damages include impaired brain development, learning and behavior, trunk and limbs, normal sexual development (including feminization of men and masculinization of women) and increased cancer events (eg, breast and prostate cancers) (Anonymous, 2022a).

Micropollutants are stable and resist biological treatment. For this reason, they cannot be treated in conventional wastewater treatment plants and are continuously discharged into receiving environments. They can reach higher living things by accumulating in the receiving environments and interacting with other chemicals, joining the food chain with irrigation and/or drinking water. This continues in a cyclical manner and causes genetic changes, especially health problems, on living things.

2.4.2 Disinfectants

Disinfectants are used to reduce the amount of potentially pathogenic microorganisms on inanimate objects with chemical substances to an acceptable level. Disinfectants; Microorganisms are classified in different ways according to their degree of effect, mechanism of action, chemical

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structure and usage areas. To be protected from infections; Especially disinfectants used in the field of health are evaluated within the scope of Biocidal Products Regulation. Disinfectants are widely used in hospitals for surface, instrument and skin disinfection. Discharged disinfectant concentration is between 2-200 mgL^{-1}, depending on the hospital bed capacity and consumption (Boillot et al., 2008).

In treatment plants, easily degradable alcohols and aldehydes and chlorine-containing compounds such as chlorophenols, which are more difficult to decompose, are used as disinfectant active agents. Although glutaraldehyde-containing solutions are still used in some hospital departments to disinfect fiberoptic endoscopes, there is generally a trend to use other compounds with lower environmental impact (Kummerer, 2001; Verlicchi et al, 2010).

Sodium hypochlorite (NaOCl) contains 12.5-25% active chlorine gas (Cl_2). It is a disinfectant used due to its biocidal activity against bacteria, viruses and fungi in a wide range of areas such as domestic, industrial, scientific and biomedical. Organic chlorine compounds formed when applied to water and wastewater are mostly toxic, stable and lipophilic in the aquatic environment. In addition, this disinfectant is also used in medical diagnosis and research in hospitals, and it mixes with wastewater after application (Emmanuel et al., 2004). These substances, which are mixed with wastewater and cannot be treated, reach people from aquatic environments through the food chain and pose health risks.

2.4.3 Pharmaceuticals

As of 2014, six hundred and thirty-one drug residue has been found above the detection limits in soil, seas, lakes, rivers and underground waters on the earth's surface (Beek et al., 2016). Drugs have potential adverse effects on the ecology of surface waters, both in the short and long term. Although these effects are known, only a few drug groups, such as antibiotics and hormones, have currently been extensively studied (Heijnsbergen and Schmitt, 2008).

Personal care products and drugs are used more and more to improve the quality of life and to treat diseases, especially cancer (Qin et al., 2015). In OECD (Organization for Economic Cooperation) member countries, it was determined that there was a two-fold increase in the daily dosage of anti-hypertensive, cholesterol-lowering, anti-diabetic and anti-depressant drugs between 2000 and 2013 (Tiwari et al, 2017). Since most of the drug components used cannot be absorbed by the body, they are thrown into the sewer with urine. Wastewater treatment plants, most of which are operated in a conventional manner, are designed for the removal of nutrients such as nitrogen and phosphorus, but are not designed to treat micro pollutants. For this reason, these pollutants can be mixed with surface waters and underground waters without being treated, and reach drinking water. They are included in the food chain with agricultural irrigation. Wu et al. (2012) five crops commonly consumed pharmaceutical and personal care products (PPCPs); documented the transfer of pepper, kale, lettuce, radish, and tomato into their tissues.

Recently, the increase in drugs used in the treatment of cancer diseases has become a major environmental threat. Its main sources are hospital wastewater, domestic discharges and pharmaceutical manufacturers. Since these compounds cannot be removed with sufficient efficiency during wastewater treatment, they are present in surface and ground waters at the level of 2.12×10^{-4} mgL^{-1}. The available information on their harmful effects on humans specifically points to certain risk groups (children and lactating women). Anticancer drugs at detected concentrations can cause chronic toxicity in aquatic organisms. It can have a detrimental effect on the genetic material of living things. Acute toxicity effects are less likely (Jureczko and Kalka, 2019).

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When the contribution of hospital wastewater to the treatment plant in terms of pharmaceutical wastes is examined, it has been determined that the contribution of domestic wastewater to the load is much higher. According to this result, it would be a good solution to add processes that are effective in the treatment of pharmaceutical compounds and micro-pollutants to existing WWTPs, instead of separately processing hospital wastewater and reaching the wastewater treatment plant (WWTP), ensuring higher removal of these compounds (Akkurt and Oğuz 2019).

2.4.4 Endocrine Disruptors

Endocrine disrupting chemicals (EDC) are chemicals that are very common in the environment. According to the definition of the International Chemical Safety Program of the World Health Organization, EDCs are exogenous substances or mixtures of substances that change the function of the endocrine system and cause adverse consequences in a healthy organism, its descendants or subpopulations (Anonymous, 2022b).

An example of endocrine disrupting compounds are parabens. Paraben is a preservative chemical used in the pharmaceutical and cosmetic industry. These compounds and salts are especially used for their bactericidal and fungicidal effects. It is a substance known especially for mimicking estrogen. As a result of research, it has been revealed that parabens, methyl, propyl and butyl forms interfere with the functioning of the endocrine system. Parabens are endocrine disruptors that are stored in body tissue and interfere with gland formation and hormone production. These protective chemicals can cause learning problems, developmental disorders, immune system problems and reproductive disorders in infants and children. If the product you use contains more than 25% Paraben, these effects are likely to occur (Anonymous, 2022c).

Endocrine disrupting chemicals can cause negative effects on the individual or the next generations by changing the normal functioning of the endocrine system. Humans are exposed to endocrine disrupting chemicals from many different sources. Foods, packaging materials, cosmetics and medicines are the leading sources of these resources.

Their environmental dispersal is extensive, persistence over a long period of time, some are universally dispersed by air transport. They are resistant to degradation and can be transported over long distances. They are lipophilic-lipid soluble, so they accumulate in adipose tissue and are rapidly absorbed through cell membranes. They cause bioconcentration and biomagnification. Although the toxic effect mechanisms of most endocrine disrupting chemicals are not fully known, it can be said that they can cause toxic effects through one or more of many different effects such as oxidative stress, genotoxic and/or epigenetic effects, interaction with nuclear receptors and increasing sensitivity to endogenous hormones (Fendoglu et al., 2019). .

The biggest reason why EDC have come to the fore in developed countries in recent years is that scientific studies on EDCs have revealed some frightening results. EDCs can mimic natural hormones in the living body and disrupt the reproductive system. It is claimed that endocrine disruptors cause sex disorders, asexual births, decrease in sperm counts, masculinity in female organisms and femininity in male organisms in some fish, birds, mammals and crocodiles in nature. Endocrine disruptors; atmospheric events, direct emissions from point sources, domestic industrial and agricultural wastes. Apart from the aquatic environment, they can also be held by aquatic plants or bottom mud (Gunal, 2019).

They can be detected at ppm and ppb levels in surface waters, drinking water and even underground waters. Despite its ecological and economic importance, little is known about the contamination of transitional waters, particularly coastal lagoons, with endocrine disrupting chemicals. Endocrine

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disruptors are found in the effluent of the wastewater treatment plant, where the wastewater is treated. Because the pollutants in question cannot be removed in the conventional wastewater treatment plant and are detected in the effluent. For this reason, it is necessary to determine the concentration of endocrine disrupting substances in the wastewater treatment plant effluent.

Endocrine disruptors are mixed into wastewater and surface waters from drugs used by humans, detergents and pesticides. Endocrine disruptors pose a problem if the streams from which waste water is discharged are used as drinking water later. Although the problem is still known, standard values have not yet been determined.

When 21 samples taken from surface waters were analyzed in a study conducted in the United States, one or more phthalate compounds were detected in 19, triclosan in 9, bisphenol A in 5, and tris (2-chloroethyl) phosphate in 4. These compounds are endocrine disrupting chemicals that are mixed into the channels through discharge from wastewater treatment plants. These results and future specific studies can be used to develop pollution prevention strategies to reduce endocrine disrupting chemicals in wastewater (Jackson and Sutton, 2008).

European Union Water Framework Directive 2000/06/CE; has published in Annex X the groups of substances containing metals, phthalates, pesticides, PAHs and endocrine disruptors. It is stated that these substances must be removed within the framework of ecological protection of water until 2015 (Deblonde et al., 2011).

2.4.5 Pesticides

Chemicals used to kill and control organisms harmful to plants during agricultural activities are called pesticides. They are classified as insecticide, herbicide, fungicide, bactericide, rodenticide, acaricide, algicide according to their intended use. DDT (Dichlorodiphenyl trichloroethane), aldrin and dieldrin, endrin are some of the synthetic pesticides used. DDT was one of the most widely used pesticides until it was reported that it is estrogenic and accumulates at the top of the food chain and affects the reproductive system in mammals and birds (Denizli et al, 2013).

Microorganisms are very important in the aquatic ecosystem as they are primary producers, take part in the food chain and help decomposition. The excess amount of pesticides in the aquatic system affects the microorganisms negatively and disrupts the balance of the ecosystem. It has been shown that herbicides are especially toxic to some aquatic microorganisms and impair photosynthesis. In a study on sex hormones of carp, it was stated that pesticides can change the estrogen/testosterone ratio in male and female fish, and abnormalities may occur in the endocrine system (Denizli et al., 2013).

Chemical residues are created when pesticides are used in fields, gardens, parks and other areas. These residues are carried into streams, lakes and rivers. Similarly, when pesticides are used on lawns in urban and rural areas, rain can carry some of it onto the sidewalks of the streets. Water contaminated with pesticides can reach nearby streams and rivers through drains and pipes. Some of the pesticides can also leach from the soil and reach the groundwater. A small amount can also evaporate in the atmosphere and fall back on land as precipitation. As a result, pesticides can be commonly found in rivers, streams, lakes and even drinking water (Glaser, 2006).

As a result of various factors, the hydrolysis, oxidation, biodegradation and photochemical degradation of pesticide residues that enter the surrounding waters and soil cause the formation of pesticide conversion products. Much of the environmental research done in recent years has been on these conversion products, because these conversion products can be just as toxic or even more toxic than pesticides. However, the effects of many of them are unknown. For this reason, EPA has

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added these chemicals (for example, acetochlor ethanesulfonic acid, 3-hydroxycarbofuran) to the pollutant candidate lists it has published (Shinbrot, 2012).

The amount of pesticides in the waters varies both geographically and seasonally, depending on the land use and pesticide use method. The pesticides most commonly found in streams and groundwater are herbicides in agricultural areas and insecticides in urban areas. As an herbicide, atrazine targets specific enzymes involved in photosynthesis in C3 plants and is widely used (Johnsen et.al., 2001). In addition, it is used in the control of broad-leaved weeds in corn and sugar cane fields around the world and has been reported to be one of the most detected chemicals in water resources near agricultural areas. It has been found that Atrazine is toxic to many aquatic organisms, even at low concentrations, and causes hermaphroditism in frogs (Kocak, 2020).

95% of the antibacterial pesticides triclosan and triclocarban are used in residences. Sewage systems provide a basic medium for their entry into the wider environment. Triclosan and triclocarban are found in high concentrations in biosolids. While triclosan is not completely removed from the water during the treatment process, it accumulates in sewage sludge in municipal wastewater systems. As a result of the use of sewage sludge in agriculture, triclosan may leach from the soil and mix with the surface water from the fields. Triclosan has been shown to remain in runoff from treated areas for 266 days after biosolids application and remains in sediment for a long time. EPA reports in its Targeted National Sewage Sludge Investigation Report that triclosan was detected in 79 of a total of 84 sludge samples used in the study (Shinbrot, 2012).

2.5 Parameters to be Considered in the Use of Waste Water in Irrigation

The use of waste water for irrigation provides the water needed, but the points to be considered are; taking measures against negative environmental effects, providing health assurances for producers and consumers. Long-term irrigation of agricultural lands with wastewater causes deterioration in the physical and chemical structure, morphology and quality characteristics of the soil, as well as polluting groundwater.

Good design of the drainage system in the areas where irrigation will be done with treated wastewater; It will ensure that the pollutants that will accumulate over time are washed away from the plant root zone by washing them through these drainage systems. Otherwise, as a result of contamination of groundwater, the use of this water as a clean water source will be limited and cause health problems. Waste waters, depending on their source and the treatment method applied; It may contain pollutants such as organic and inorganic substances, toxic compounds, micro pollutants, salts, suspended solids, pathogens, heavy metals.

If the effluent of a domestic treatment plant is intended to be used for irrigation on agricultural lands; First of all, both the quantity and quality of the waste water should be known, and the appropriate treatment method should be determined by taking into account the needs of the product to be grown and the region. In addition to the conventional treatment chosen as the purification method, the use of microfiltration or ultrafiltration processes instead of the sand filter in the filtration stage will provide significant gains in the long term in irrigation purposes, although the initial investment cost is high.

The collection of waste water with a separate system is important in terms of facilitating the use of rain water. In addition, the use of gray water separation and recycling in new residential areas in the form of housing estates should be expanded and encouraged. Yellow water, which consists of decomposed human urine at the source, may limit the use of chemical fertilizers in agriculture because it contains the majority of the nutrients in domestic wastewater.

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It is not necessary to use first quality water in the gardens and siphons of our houses. It is important to encourage innovative technologies by making legal arrangements for the use of separately collected gray water for this purpose. First of all, waste water recovery should be evaluated in areas where there is a potential for water shortage.
It is important to determine the physical and chemical properties of soil and groundwater in agricultural areas where treated wastewater will be used. The characterization of wastewater should be well known in terms of determining the nutrients needed by the plants to be grown in these areas. With an appropriate treatment, irrigation and drainage method to be selected in line with the economic and social situation of the region and climate data, the treated wastewater can be safely used for sustainable agricultural irrigation.
Depending on the characterization of the wastewater, the treatment method should be selected. For example, some pharmaceuticals such as ibuprofen from wastewater under aerobic conditions; Pharmaceuticals such as clofibric acid and diclofenac were removed under anaerobic conditions. Halogen compounds, on the other hand, require high anoxic conditions. In addition, it is stated that photodegradation processes with high retention times occurring in surface flow systems are effective in eliminating pollutants from the aquatic environment (Verlicchi et. Al. 2010).

3 Conclusion and Recommendations

Controlling environmental pollution, controlled use of natural resources and recycling/reuse issues have taken their place in the concept of sustainability in recent years. The United Nations' Sustainable Development Goal 6 promotes the reuse of treated wastewater to ensure water availability for all.
In the reuse of treated wastewater, the discharge limits for the pollutants contained in the wastewater should be reviewed. Discharge limit values for pollutants are not only primarily for receiving environments; wildlife, nature and human health should be protected. While legally determining the discharge limits of pollutants; In addition to the effects they create alone, their synergistic effects should also be taken into account. For this reason, more research (experiment, measurement and observation) should be conducted to determine the environmental effects and legal limits should be established by taking these studies into account (Luo et.al. 2014).
The high living standards have diversified the substances and compounds consumed for vital activities. This diversity also manifests itself in waste. Conventional treatment techniques have lost their usability for all types of waste. For example, considering the inadequacy of conventional methods for the removal of micro-pollutants, other alternative treatment methods including coagulation – flocculation, activated carbon adsorption, advanced oxidation processes, membrane processes and membrane bioreactor should be applied for better removal efficiencies.
Thanks to the developing technologies, it has become possible to rehabilitate or partially clean the polluted natural areas. Physical, chemical, biological and thermal processes are used in the recovery of contaminated areas. Precipitation using chemicals, ion exchange, stabilization, reverse osmosis, membrane filtration techniques, absorption, UV, H_2O_2 and ozone applications are widely used methods. With biological treatment methods, pollutants in soil or groundwater can be treated with effective microorganisms, bioremediation and phytoremediation techniques. Another example of safe use of wastewater is cultivated wetlands. The macro and micro nutrients in the wastewater are used by the wetland plants and other polluting components can be treated.
The use of contaminated wastewater for agricultural purposes, the spread of pathogenic microorganisms in nature, the consumption of food products by weak individuals with low

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immunity, children and the elderly may cause food-borne infections. Producers and consumers should be informed about potential biological risks that may occur in terms of public health by relevant public institutions and organizations.

Since all remediation methods involve the solution of a multi-component equation such as the size of the degraded area, the characteristics of the pollutant, the soil, water or atmosphere where the pollution is active, and since it is not possible to fully recycle, it is necessary to take the necessary precautions before polluting and to give more importance to the reduction processes at the source. With economic and environmentally friendly measures, it will be possible to leave a natural habitat, safe food and a clean atmosphere to future generations.

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