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Use Of Waste Water For Irrigation -A Case Study Of Pune Rural Area.

Dr. Devdatta Mokashi [*1], Prof. Snehal Ranesankpal [2], Prof. Reshma Abhang [3], Prof.Sonal Jamdade[4], Prof.Aradhana Thorat[5] ,Prof.Sudarshana Abbad [6] , Mr. Sunny Jadhav[7] , Mr. Prathamesh Marne [8], Mr. Yash Pawar [9].
[1]Asst. Professor, Department of Civil Engineering, Bharati Vidyapeeth College of Engineering Lavale, Pune.
[2]Asst. Prof, Department of C.S.E., Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune.
[3]Asst. Prof, Department of C.S.B.S., Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune.
[4]Asst. Prof, Department of C.S.E., Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune.
[5]Asst. Prof, Department of C.S.B.S., Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune.
[6]Asst. Prof, Department of C.S.E., Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune.
[7,8,9.]UG student, Department of Civil Engineering, Bharati Vidyapeeth College of Engineering Lavale, Pune
*Dr. Devdatta Mokashi, dev.mokashi@gmail.com

ABSTRACT
Background: The availability of fresh water is decreasing day by day because of increase in population & attention of people towards water management. As increase in population needs more fresh water, produced more waste water that is directly thrown into the rivers. Agriculture needs fresh water for irrigation. The supply for irrigation of fresh water decreases as a result agricultural production decrease. A Pune is the one of the most populated cities in Maharashtra. India were population increasing day by day. Mulshi taluka is the one of the main regions who provides fresh water to Pune city. Pune city is developing towards. Mulshi region which is the rich source of fresh water source getting polluter because of development and migration of most of citizen towards the towns like Pirangut, Hinjewadi etc. The 60% people need by this town are dispersed on agriculture or farming they are directly using water from river like Mula, mutha, Pawana etc. This river water contains certain effluent which is harmful for the crop because it contains harmful bacteria and pathogroups by use that water becoming serious issues of citizens health and need people as well as government attention. This project explores the treatment and reuse of wastewater for irrigation purposes. By employing methods like root zone treatment and rapid sand filtration, key parameters such as BOD, COD, and turbidity are significantly improved. The study aims to promote sustainable water management in agriculture.
Keywords*: Effluent, BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), PH, Turbidity, STP (Sewage Treatment Plant), DO (Dissolved Oxygen), Root zone method, Rapid Sand Filter*

INTRODUCTION

Agricultural industry directly lifts water from rivers. The Mula, Mutha river contains wastewater (sewage water) which contains good fertilizer chemical (organic matter), which helps to increase production of food grains. But it also should be infrastructure to treat sewage water to kill harmful bacteria and remove organic matter, make water reusable. This project aims to make wastewater reusable by using simple methods of wastewater treatment and make focus on the issues to be faced while doing the project:
People participation: • This project explores the role of community involvement in the use of wastewater for irrigation, focusing on both rural and urban settings. With increasing water scarcity and the rising cost of freshwater resources, wastewater reuse has emerged as a sustainable solution for agricultural and landscape irrigation. The project aims to assess how people participate in wastewater reuse initiatives, including their awareness, attitudes, practices, and the socio-economic and environmental benefits involved. • The study involves surveys and interviews with local farmers, community members, and relevant stakeholders to understand their level of participation, challenges faced, and potential for scaling up safe wastewater reuse. It also examines case studies of successful community-led wastewater reuse

systems. The findings will help propose strategies to improve community engagement, promote safe practices, and encourage sustainable water management through wastewater irrigation.

Promoting the need of reuse of wastewater: • This project focuses on promoting the need and benefits of using treated wastewater for irrigation, especially in regions facing water scarcity and agricultural challenges. As freshwater resources become increasingly limited, wastewater reuse offers a sustainable, cost-effective, and environmentally friendly alternative for irrigation. The aim of the project is to raise awareness among farmers, local communities, and stakeholders about the potential of wastewater reuse in agriculture, while encouraging their participation in its safe and efficient use. • The project involves researching current wastewater practices, identifying gaps in knowledge and infrastructure, and conducting awareness campaigns, workshops, and demonstrations to educate the public on proper treatment and reuse methods. It also highlights the economic and ecological advantages of using wastewater, such as conserving freshwater, improving crop yields, and reducing pollution. • Through active community engagement, the project seeks to build local support and promote long term adoption of wastewater irrigation as a key component of sustainable water and agricultural management.

Government support: • Government support plays a crucial role in promoting the safe and effective use of wastewater for irrigation.

development programs aimed at encouraging the treatment and reuse of wastewater in agriculture. This includes funding decentralized wastewater treatment plants, providing technical training to farmers, and establishing guidelines for safe reuse practices. Additionally, awareness campaigns and collaboration with local bodies, NGOs, and research institutions are often supported to educate communities on the benefits and safety of wastewater irrigation.

Increase crop production: • The use of treated wastewater for irrigation has been shown to significantly increase crop production, especially in water-scarce regions. Wastewater often contains essential nutrients such as nitrogen, phosphorus, and potassium, which can act as natural fertilizers and enhance soil fertility. This reduces the need for chemical fertilizers and lowers input costs for farmers. With a consistent and reliable water supply, crops can be cultivated throughout the year, improving yield and productivity. Studies have shown that vegetables, grains, and fodder crops respond particularly well to wastewater irrigation when managed properly. However, proper treatment and monitoring are essential to avoid health risks and ensure sustainable use. Overall, wastewater irrigation not only supports agricultural productivity but also contributes to food security and rural livelihoods.

Decrease the use of harmful chemical fertilizers: • One of the key benefits of using treated wastewater for irrigation is the reduction in the need for harmful chemical fertilizers. Wastewater often contains organic matter and nutrients like nitrogen, phosphorus, and potassium, which are essential for plant growth. When properly treated and applied, these nutrients can supplement or even replace synthetic fertilizers, reducing both costs and environmental damage. This leads to healthier soil, improved microbial activity, and minimized risk of groundwater contamination caused by excessive chemical fertilizer use. By decreasing reliance on chemical inputs, wastewater irrigation supports more sustainable and eco-friendly agricultural practices while maintaining or even improving crop yields.

LITERATURE REVIEW

The reuse of wastewater for irrigation has gained increasing attention over the past few decades due to growing water scarcity, urbanization, and the rising demand for food production. This section reviews previous studies, key findings, and relevant concepts associated with wastewater reuse in agriculture.

According to Toze (2006), treated wastewater offers a reliable and consistent source of water, especially in arid and semi-arid regions. As freshwater resources become increasingly scarce, using wastewater for irrigation can enhance water security and reduce pressure on freshwater sources (Qadir et al., 2010). The integration of wastewater into agricultural systems is considered a sustainable approach to wastewater management and food production.Wastewater often contains valuable nutrients such as nitrogen, phosphorus, and potassium, which are beneficial for plant growth (Pedrero et al., 2010). Several studies (e.g., Jiménez, 2006) have demonstrated improved crop yields when wastewater is used, particularly in nutrient-poor soils.The dual benefit of water and nutrients can reduce the need for synthetic fertilizers, lowering production costs.Despite its advantages, the use of untreated or poorly treated wastewater poses

significant health and environmental risks. Wastewater can contain pathogens, heavy metals, and organic contaminants that may accumulate in the soil or crops, posing risks to consumers and farm workers (Ayers and Westcot, 1985; WHO, 2006). Long-term use of untreated wastewater can also degrade soil quality and reduce agricultural productivity.Effective treatment processes, such as primary sedimentation, biological treatment, and disinfection, can significantly reduce the risks associated with wastewater reuse (Asano and Levine, 1998). The implementation of guidelines and monitoring systems is crucial to ensure the safe use of wastewater in agriculture. Decentralized treatment systems and natural treatment methods like constructed wetlands have been proposed as cost-effective solutions in developing countries.
Numerous case studies highlight successful implementations of wastewater reuse in countries such as Israel, India, and Mexico. In Israel, for instance, over 85% of wastewater is treated and reused, primarily for agriculture (Friedler, 2001). In India, informal reuse of wastewater by peri-urban farmers is common and often supports livelihoods, albeit with limited regulation (Scott et al., 2004).

AIM & OBJECTIVE

Aim

To make waste water reusable for irrigation & increase the people as well as government participation on waste water treatment.

Objective:

To provide simple techniques to treat waste water & reuse waste water.
Conservation of aquatic life among the river which get polluted.

METHODOLOGY: PROPOSED SYSTEM

Algorithm:

Identify zones where most waste water is generated. In the context of wastewater reuse for irrigation, it is essential to identify and understand the zones where the highest volumes of wastewater are generated. These zones are typically characterized by dense human activity, industrial operations, and insufficient or overburdened sanitation infrastructure. The primary zones contributing to significant wastewater generation are as follows:

Urban Residential Areas: Urban residential zones are among the largest contributors to wastewater production due to their high population density. Daily household activities such as bathing, cooking, laundry, and sanitation generate large volumes of greywater and blackwater. The concentration of multi-story housing, apartments, and urban housing complexes increases the volume of wastewater output per unit area. These areas offer great potential for wastewater collection and treatment for reuse in irrigation, especially for urban landscaping, public parks, and peri- urban farming.

b) Industrial Zones: Industrial zones produce considerable amounts of wastewater due to various manufacturing and processing activities. Industries such as textiles, food processing, tanneries, and chemical manufacturing discharge large volumes of wastewater that, when properly treated, can be repurposed for non-potable uses like irrigation. However, industrial wastewater may contain hazardous pollutants, so it requires advanced treatment before being safely applied to crops.

c) Commercial Areas: Commercial zones, including hotels, restaurants, shopping centers, and office buildings, also contribute significantly to wastewater generation. The wastewater from these sources is primarily greywater, which is relatively easier to treat and reuse. These zones are especially important when considering water reuse systems in urban agriculture and rooftop farming.

Identify the requirement of treated water. Requirement of Treated Water in the Use of Wastewater for Irrigation: The reuse of wastewater in irrigation has emerged as an effective and sustainable solution to address water scarcity in agriculture. However, the use of untreated or poorly treated wastewater poses significant health and environmental risks. Therefore, the treatment of wastewater before its use in irrigation is a crucial requirement to ensure safety, sustainability, and agricultural productivity. Treated wastewater must meet specific quality standards to be safely used for irrigation. The level of treatment depends on the type of crops being irrigated, the method of irrigation, and the potential exposure of humans and animals to the water. For example, crops that are eaten raw require higher-quality treated water compared to those used for industrial purposes or animal feed. Properly treated wastewater should be free from harmful pathogens, excessive salts, heavy metals, and toxic chemicals. This ensures that it does not harm plant growth, contaminate soil, or pose health risks to farmers and consumers. Moreover, treating wastewater prevents the contamination of groundwater and preserves the fertility of agricultural land. The type of treatment required can include physical, biological, and chemical processes such as sedimentation, filtration, aeration, chlorination, and advanced oxidation. The choice of treatment depends on the quality of the raw wastewater and the intended use of the treated water. In conclusion, the requirement for treated wastewater in irrigation is essential to protect public health, ensure food safety, maintain soil quality, and comply with environmental regulations. Implementing effective wastewater treatment systems is a vital component of any successful wastewater reuse project in agriculture.

Development of infrastructure for STP. The reuse of wastewater in irrigation has emerged as an effective and sustainable solution to address water scarcity in agriculture. However, the use of untreated or poorly treated wastewater poses significant health and environmental risks. Therefore, the treatment of wastewater before its use in irrigation is a crucial requirement to ensure safety, sustainability, and agricultural productivity. Treated wastewater must meet specific quality standards to be safely used for irrigation. The level of treatment depends on the type of crops being irrigated, the method of irrigation, and the potential exposure of humans and animals to the water. For example, crops that are eaten raw require higher-quality treated water compared to those used for industrial purposes or animal feed. Properly treated wastewater should be free from harmful pathogens, excessive salts, heavy metals, and toxic chemicals. This ensures that it does not harm plant growth, contaminate soil, or pose health risks to farmers and consumers. Moreover, treating wastewater prevents the contamination of groundwater and preserves the fertility of agricultural land. The type of treatment required can include physical, biological, and chemical processes such as sedimentation, filtration, aeration, chlorination, and advanced oxidation. The choice of treatment depends on the quality of the raw wastewater and the intended use of the treated water. In conclusion, the requirement for treated wastewater in irrigation is essential to protect public health, ensure food safety, maintain soil quality, and comply with environmental regulations. Implementing effective wastewater treatment systems is a vital component of any successful wastewater reuse project in agriculture.

Use of Rapid sand filter having reverse osmosis system. In wastewater treatment for irrigation, combining a Rapid Sand Filter with a Reverse Osmosis (RO) system offers an effective method to ensure high-quality treated water that is safe for agricultural use. This integrated approach improves the efficiency of removing contaminants and supports sustainable irrigation practices, especially for crops sensitive to water quality.

Rapid Sand Filter: A rapid sand filter is a physical filtration system that removes suspended solids, turbidity, and some pathogens from wastewater. It consists of layers of course and fine sand through which water passes at a relatively high rate. As water flows through the filter bed, particles are trapped in the sand, resulting in clearer water. This step is often used as a pre-treatment process to reduce the load on the RO system and prolong its lifespan.

Reverse Osmosis (RO) System: Following sand filtration, the partially treated water enters the reverse osmosis system. RO is a membrane-based technology that removes dissolved salts, heavy metals, organic pollutants, and microbial contaminants from water. It forces water through a semi-permeable membrane under high pressure, leaving behind impurities. RO-treated water meets the high standards required for sensitive crops and soils and ensures the prevention of salinity build-up in agricultural fields.

Benefits of the Combined System • Improved water quality: Ensures removal of both suspended and dissolved contaminants. • Protects soil and crops: Prevents accumulation of salts and harmful substances in the soil. • Extends system life: Using rapid sand filtration before RO reduces membrane fouling and maintenance costs. • Supports efficient irrigation: Clean water allows for the safe use of drip or sprinkler irrigation systems.

Use of SCADA (Supervisory Control and Data Acquisition) system for operating project. This project focuses on the integration of a SCADA (Supervisory Control and Data Acquisition) system in the treatment and reuse of wastewater for agricultural irrigation. The aim is to design and implement a smart monitoring and control system that automates the process of wastewater treatment and ensures its safe and efficient use in irrigation. The SCADA system is used to monitor various parameters such as pH,

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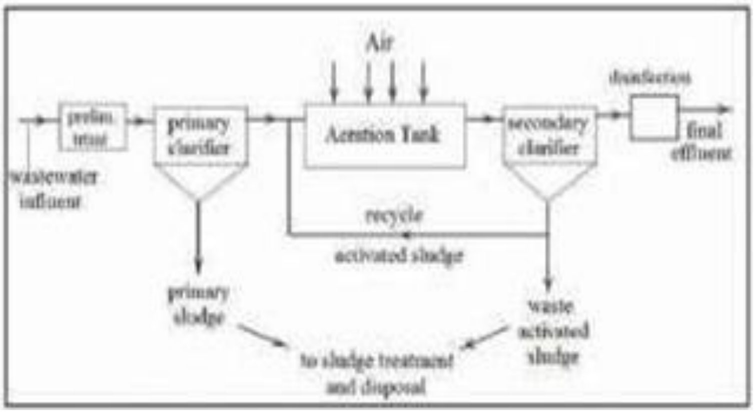
turbidity, temperature, flow rate, and chemical dosing levels in real-time. Data acquisition from sensors enables continuous assessment of water quality, and actuators are controlled to manage treatment processes accordingly. The system also allows remote monitoring and control through a centralized interface, improving operational efficiency and reducing manual intervention. The use of SCADA in this context enhances water conservation efforts, supports
sustainable agriculture, and ensures compliance with environmental standards. The project demonstrates a practical and scalable solution to address water scarcity by reusing treated wastewater safely and efficiently in irrigation.
Use of ozone method for treating waste water. This project explores the use of the zone method as an efficient and environmentally friendly approach to treat wastewater for use in agricultural irrigation. The zone method involves dividing the wastewater treatment process into distinct zones such as sedimentation, biological treatment, filtration, and disinfection each designed to target specific contaminants and progressively improve water quality. The system is designed to be cost-effective and sustainable, making use of natural and engineered processes in each zone. For example, initial zones may include sedimentation tanks for removing large solids, followed by biological zones like constructed wetlands or bioreactors for organic breakdown, and finally filtration and chlorination zones to remove pathogens and fine particles. The treated water is then tested to ensure it meets the standards for agricultural use. This multi-zone approach ensures a higher level of control and adaptability in treating various types of waste water, making it suitable for rural and semi-urban irrigation needs.
By implementing the zone method, this project promotes the reuse of wastewater, reduces freshwater demand for agriculture, and supports sustainable water management practices.

Fig. (1): Activated Sludge Wastewater Treatment Flow Diagram



RESULT

The reuse of wastewater for irrigation offers a sustainable and efficient solution to tackle water scarcity, particularly in agricultural regions. This project has shown that, when adequately treated—especially through advanced (tertiary) processes—wastewater can safely support crop growth without compromising soil health or food safety. Treated wastewater contains essential nutrients like nitrogen and phosphorus, which can reduce the need for chemical fertilizers and lower agricultural costs. Furthermore, using wastewater helps conserve freshwater resources and promotes circular water management practices. Wastewater reuse in irrigation is not only environmentally beneficial but also economically practical. With proper treatment, monitoring, and regulatory support, it can be a key strategy for sustainable agriculture and long- term water resource management.

CONCLUSION

Using untreated or inadequately treated wastewater containing harmful bacteria for irrigation poses significant dangers that surpass any possible advantages. It can harm human health, pollute agricultural produce and soil, damage natural ecosystems, and contribute to the growth of antibiotic-resistant microorganisms. In contrast, when wastewater is properly treated, it can serve as a useful water source for farming, particularly in drought-prone areas. However, to use it safely, strict treatment standards must be met, and it should be applied carefully, depending on the crop type and irrigation technique. This approach is crucial for maintaining both food production and environmental and public health.

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