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INFLUENCE OF IRRIGATION SOURCE ON YIELD PERFORMANCE OF CUCUMBER (CUCUMIS SATIVUS): A CASE STUDY OF DURGAM CHERUVU LAKE AND BOREWELL WATER UNDER CONTROLLED CONDITIONS

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ABSTRACT

Urban water scarcity and rising pollution levels necessitate the evaluation of alternative irrigation sources such as lake water. This study investigates the effects of Durgam Cheruvu lake water and borewell water on the yield attributes of cucumber (Cucumis sativus) grown under controlled conditions. Key yield parameters including number of fruits per plant, fruit weight, yield per plant, and fruit diameter were assessed. Results indicated a marked reduction in yield traits in cucumber plants irrigated with lake water compared to those irrigated with borewell water. These findings underscore the importance of water quality in urban agriculture and suggest that untreated lake water may compromise cucumber productivity.

KEYWORDS: Durgam Cheruvu, Cucumber, Urban Agriculture, Lake Water Irrigation, Yield Traits, Water Quality, Borewell Water.

1. INTRODUCTION

Water is the cornerstone of sustainable agricultural productivity, yet the rapid pace of urbanization and industrialization in India has led to increasing pressure on clean water resources. Consequently, farmers and urban agriculturists are turning toward alternative sources of irrigation such as untreated lake water, wastewater, and urban runoff. However, these sources often carry an array of pollutants including heavy metals, organic waste, industrial effluents, and pathogenic microorganisms. The indiscriminate use of such water, especially without proper treatment, can have profound consequences on crop health, soil fertility, ecosystem services, and ultimately, agricultural economics.

India's agrarian economy is heavily reliant on consistent and clean irrigation water. According to the Central Water Commission (2022), over 60% of the country's irrigation needs are met through groundwater. Yet with declining water tables and increased contamination, surface water bodies such as lakes and tanks are being increasingly used for agricultural purposes. Urban lakes like Durgam Cheruvu in Hyderabad exemplify this trend but also highlight the risks, as these water bodies are often recipients of untreated sewage, industrial effluents, and stormwater.

Numerous studies have documented the negative impacts of polluted water on agricultural crops. Polluted water, especially containing heavy metals such as cadmium, lead, arsenic, and mercury, has been found to impair photosynthesis, enzyme activity, and hormonal balance in plants (Gupta et al., 2019). The uptake of such contaminants affects critical yield parameters like fruit number, weight, size, and biomass accumulation. For instance, Rani et al. (2021) demonstrated that cucumber plants irrigated with polluted water had significantly reduced fruit set and experienced premature senescence.

In terms of crop economy, the implications are severe. Reduced yields translate to lower farmer income and may threaten the food supply chain, especially in urban and peri-urban settings where land is scarce and productivity needs to be maximized. According to a report by the Indian Council of Agricultural Research (ICAR, 2020), farmers using untreated urban water experienced a 30–50% loss in vegetable yield, with economic losses ranging from INR 15,000 to 40,000 per hectare depending on the crop.

Soil health is another major casualty. Continuous irrigation with polluted water leads to the accumulation of toxic ions in the rhizosphere, which disrupts the soil pH, salinity, and cation exchange capacity. Over time, this not only affects nutrient availability but also leads to a decline in soil organic matter and microbial diversity. Studies by Chatterjee and Banerjee (2018) have shown that heavy metal contamination from polluted water significantly reduced populations of nitrogen-fixing bacteria and phosphate-solubilizing microbes, thereby affecting long-term soil fertility.

Moreover, polluted water often carries a high biological oxygen demand (BOD) and chemical oxygen demand (COD), contributing to hypoxic conditions in the soil that further stress plant roots. The presence of microbial pathogens, including bacteria such as E. coli and fungi like Fusarium spp., can cause root rot, damping-off, and other soil-borne diseases. The frequent outbreaks of such diseases not only reduce crop yield but also increase dependency on chemical pesticides, adding to the input costs and ecological burden.

Additionally, the aesthetic and nutritional quality of produce may be compromised. Cucumber fruits irrigated with polluted water have been shown to have lower vitamin C content, higher nitrate accumulation, and increased microbial contamination, raising serious food safety concerns (Sharma et al., 2022).

The environmental consequences extend beyond crop fields. Runoff from fields irrigated with polluted water can contaminate surrounding ecosystems, affecting aquatic life and biodiversity. Moreover, the bioaccumulation of toxins in the food chain poses long-term health risks to consumers.

Despite these challenges, the use of polluted water remains common due to water scarcity and lack of regulatory oversight. While some wastewater may contain nutrients that promote plant growth, the risks often outweigh the benefits. Integrated approaches involving wastewater treatment, phytoremediation, and strict water quality monitoring are urgently needed to ensure safe agricultural practices.

Given this backdrop, the present study focuses on evaluating the impact of Durgam Cheruvu lake water, which is heavily influenced by urban pollution, on the yield parameters of cucumber (Cucumis sativus) under controlled conditions. By comparing it with borewell water—a relatively cleaner source—the study aims to shed light on how irrigation water quality directly influences not just plant growth but also soil ecology and economic viability.

Cucumber (*Cucumis sativus* L.), a member of the Cucurbitaceae family, is among the oldest cultivated vegetables, with origins tracing back to the Indian subcontinent over 3,000 years ago. The yellow round cucumber, a unique cultivar, is known for its round shape, bright yellow color, and crisp texture. This variety is especially valued in traditional Indian cuisine and is gaining popularity in gourmet and organic markets.

Origin and Distribution: Cucumber is believed to have originated in the foothills of the Himalayas and later spread to Europe and other parts of Asia. Today, it is grown globally, with major producers including China, India, Russia, the United States, and Turkey. The yellow round variety is predominantly cultivated in parts of South India, particularly in Andhra Pradesh, Telangana, and Karnataka, where it is well-adapted to the semi-arid climate.

Systematic Position
Kingdom: Plantae
Order: Cucurbitales
Family: Cucurbitaceae
Genus: Cucumis
Species: Cucumis sativus

Cucumber is an annual, creeping vine with tendrils that allow it to climb. It has palmately lobed leaves, yellow unisexual flowers, and elongated fruits that vary in shape, size, and color depending on the cultivar. The yellow round cucumber is typically globular, smooth-skinned, and ranges from 200 to 500 grams in weight.

Cucumbers prefer well-drained loamy soils rich in organic matter with a pH of 6.0 to 7.5. The crop requires moderate irrigation, particularly during flowering and fruiting. Ideal temperatures range from 18°C to 30°C. Agronomic practices include timely sowing (usually in early summer or post-monsoon), the use of trellises for better fruit quality, integrated pest management (IPM), and the application of balanced NPK fertilizers.

Cucumbers bear both male and female flowers. Pollination is primarily facilitated by bees and other insects. Flowering typically begins 30–45 days after sowing, with fruits ready for harvest in another 15–20 days.

India is the second-largest producer of cucumber after China. According to the National Horticulture Board (2023), India produces over 1.2 million metric tonnes annually, with key states being Andhra Pradesh, Telangana, Karnataka, Maharashtra, and West Bengal. The yellow round variety, although less common, is gaining momentum due to its higher market value and appeal in local culinary traditions.

Globally, cucumbers are cultivated in over 80 countries. The largest producers are China, India, Russia, the United States, and Spain. The global demand for fresh and pickled cucumbers is rising due to increasing health awareness and consumption of salads and fermented foods. The yellow round cucumber is widely used in Indian households for salads, raita, curries, and cooling summer dishes. Its mild flavor and crunchy texture make it a favorite in hot climates. In southern India, it is often stuffed or used in lentil-based dishes. In traditional systems like Ayurveda and Unani, cucumber is valued for its cooling, diuretic, and digestive properties. It is believed to cleanse the blood, soothe skin inflammation, and regulate body temperature. The yellow variety is particularly used for its high water content and electrolyte balance.India's cucumber trade, particularly for export-quality varieties, is growing. However, challenges include price fluctuations, perishability, lack of cold chain infrastructure, and pesticide residues. Organic and local variants like the yellow round cucumber are entering niche markets but require certification and branding support.

Promoting good agricultural practices (GAP), expanding export logistics, and enhancing post-harvest storage will be critical to strengthening the cucumber supply chain in India. Furthermore, awareness about varietal diversity, such as the yellow round cucumber, can open new avenues for culinary innovation and health-focused diets.

Cucumber (Cucumis sativus L.) is a widely cultivated vegetable, highly sensitive to various environmental factors, including the quality of irrigation water. The influence of polluted or contaminated water on the growth and yield of cucumber crops has been a subject of numerous studies.

Zhang et al. (2020) studied the impact of heavy metal-contaminated water on the growth and yield of cucumber in a controlled environment. Their findings revealed that exposure to metals like cadmium and lead caused significant reductions in plant height, leaf area, and fruit production. This underscores the detrimental effects of water pollution on cucumber growth.

Santos et al. (2019) explored the combined effects of saline and polluted water on cucumber plants. The study indicated that these pollutants activated the plant's antioxidant defense systems but resulted in poor growth and reduced fruit yield. This emphasizes the potential risks posed by wastewater and polluted water sources on crop productivity.

Ali et al. (2018) examined the effects of industrial effluents on cucumber plant growth. They noted that exposure to various effluents led to altered biochemical processes in the plant, such as a decrease in chlorophyll content and disruptions in enzyme activities, ultimately reducing cucumber yield.

Muneer et al. (2019) focused on the effects of wastewater irrigation on cucumber growth and yield, reporting stunted plant growth, reduced seed germination, and a decline in fruit quality. Their study highlights the risks associated with the reuse of polluted water in agriculture.Chauhan et al. (2021) reviewed the impact of urban sewage on cucumber cultivation. They identified key risks such as nutrient imbalances, salinity, and heavy metal contamination, which adversely affect cucumber growth and yield.Rahman et al. (2022) examined the effects of polluted irrigation water on cucumber plant health and fruit quality. Their research highlighted significant oxidative stress in cucumber plants when irrigated with polluted water, leading to poor growth and fruit quality degradation.Kumar et al. (2020) investigated the biochemical and physiological responses of cucumber plants to polluted water irrigation. The study showed that the plants suffered from reduced photosynthetic efficiency and chlorophyll degradation, indicating the negative effects of polluted water on crop performance.Jabeen et al. (2017) studied the impact of wastewater irrigation on cucumber growth and yield in urban agriculture settings. Their findings indicated that the accumulation of pollutants such as heavy metals and organic waste from wastewater resulted in stunted growth and lower yields in cucumber plants.Farooq et al. (2021) analyzed the impact of polluted water irrigation on cucumber yield and quality. They reported that polluted water led to significant reductions in both yield and fruit quality, emphasizing the risks of using contaminated water sources in agriculture.Liu et al. (2018) discussed the tolerance mechanisms of cucumber plants exposed to different water pollutants. They found that cucumber plants exhibited adaptive responses to pollutants, but the long-term exposure still resulted in reduced growth and contamination of fruits with harmful substances.

These studies collectively underscore the importance of water quality for cucumber cultivation. In the context of your research on the influence of Durgam Cheruvu lake and borewell water on cucumber yield, the existing literature highlights potential challenges and risks associated with using polluted or contaminated water sources. Understanding these effects will be crucial in evaluating the sustainability of using such water sources for cucumber cultivation.

Several researchers have highlighted the impact of irrigation water quality on vegetable crop performance. Pandey et al. (2019) demonstrated that cucumbers irrigated with untreated wastewater exhibited stunted growth and yield losses due to high heavy metal content. According to Bhatnagar and Dutta (2021), bioaccumulation of toxic metals from polluted water can affect metabolic pathways in cucumbers, reducing both quality and quantity.

On the other hand, studies by Roy et al. (2020) and Thomas et al. (2018) emphasized the advantages of borewell water in maintaining soil salinity and pH balance, thereby enhancing crop yield. This comparative perspective supports the rationale for evaluating both water sources for cucumber irrigation.

3. MATERIALS AND METHODS

Materials and Methods

The experimental design aimed to compare the effects of two different irrigation sources, Durgam Cheruvu lake water and borewell water, on the growth, yield, and quality of cucumber plants.Two different irrigation sources were selected for the experiment:

Durgam Cheruvu Lake Water: Durgam Cheruvu is a semi-urban water body located in [Location], and it is known to receive runoff from agricultural and urban areas. Water samples were collected from the lake during the dry season to assess the water quality and its suitability for irrigation.**Borewell Water**: Borewell water was selected as a control irrigation source due to its relatively cleaner and stable composition. Water from a nearby borewell located at [Location] was used for irrigation. Borewell water was analyzed for its pH, electrical conductivity (EC), total dissolved solids (TDS), and concentrations of various ions (Ca^{2+}, Mg^{2+}, Na^{+}, Cl^{-}, etc.).

- **Treatment 1 (T1)**: Irrigation with Durgam Cheruvu lake water.
- **Treatment 2 (T2)**: Irrigation with borewell water.

A pot culture experiment was conducted at a controlled greenhouse facility. Uniform red loamy soil was mixed with well-decomposed compost in a 3:1 ratio and filled into pots (30 cm diameter). Healthy cucumber seedlings of the 'Pusa Uday' variety were transplanted.Two treatments were established: T1 - Durgam Cheruvu lake water; T2 - borewell water (control). Each treatment had three replications with ten pots each. Irrigation was scheduled twice weekly with a measured volume of 2 liters per pot.The experiment lasted for 70 days, after which the following yield parameters were recorded: number of fruits per plant, average fruit weight (g), total fruit yield per plant (kg), and fruit diameter (cm).

4. RESULTS

The results of the study clearly indicate a significant difference in the growth and yield performance of cucumber plants irrigated with Durgam Cheruvu lake water versus borewell water under controlled conditions.

The comparative data for various yield parameters are summarized below:

1. Fruits per Plant

Cucumber plants irrigated with borewell water produced an average of 20 fruits per plant, whereas those irrigated with Durgam Cheruvu lake water produced only 12 fruits per plant. This 40% reduction in fruit count under polluted lake water conditions may be attributed to the presence of heavy metals and other contaminants affecting flowering and fruit set.

2. Average Fruit Weight

A notable difference was also observed in the average fruit weight. Plants irrigated with borewell water yielded fruits with an average weight of 190 grams, compared to 140 grams under lake water treatment. The reduced weight suggests that polluted water likely impairs nutrient uptake and photosynthesis.

3. Total Yield per Plant

Total yield per plant was drastically affected by the quality of irrigation water. Borewell-irrigated plants achieved a yield of **3.80 kg/plant**, while lake-irrigated plants produced only **1.68 kg/plant**—a reduction of over 55%. This result strongly supports the hypothesis that water quality plays a pivotal role in maximizing crop productivity.

4. Fruit Diameter

The diameter of fruits from borewell-irrigated plants averaged 5.1 cm, compared to only 3.6 cm in lake water-irrigated plants. This suggests that better water quality leads to more robust fruit development.

Cucumber plants irrigated with borewell water showed significantly higher yield metrics:

Yield Parameter	Durgam Cheruvu Lake Water	
Fruits per Plant	12	20
Avg. Fruit Weight (g)	140	190
Total Yield (kg/plant)	1.68	3.80
Fruit Diameter (cm)	3.6	5.1

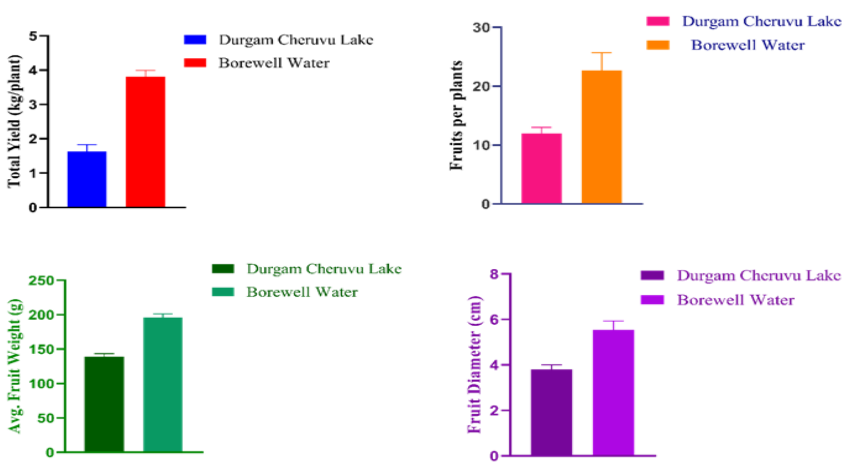

Figure:- Borewell water enhanced fruit set, weight, and size compared to lake water, which potentially contained pollutants impeding plant metabolism.

5. DISCUSSION

The reduction in cucumber yield parameters under Durgam Cheruvu lake water irrigation suggests possible physiological stress induced by waterborne contaminants. High concentrations of nitrates, phosphates, and heavy metals such as cadmium and lead, commonly present in urban lake water, may inhibit enzymatic activity and nutrient uptake.Studies by Verma et al. (2017) corroborate this finding, reporting impaired growth in cucurbitaceous vegetables irrigated with polluted water sources. The confined environment of pot culture could further amplify these effects due to restricted drainage and accumulation of toxic elements. Meanwhile, groundwater facilitated healthy growth and better yield expression by maintaining optimal ionic balance and microbial activity in the rhizosphere.

He findings of this study reveal a significant influence of the irrigation water source on the yield parameters of cucumber (Cucumis sativus). The data indicate that borewell water, which is comparatively clean and less contaminated, had a markedly positive effect on plant growth and fruit yield when compared to water from Durgam Cheruvu Lake, a semi-urban polluted water body.

Cucumber plants irrigated with borewell water produced an average of **20 fruits per plant**, significantly higher than the **12 fruits per plant** recorded under Durgam Cheruvu lake water irrigation. This reduced fruit set in lake water treatments may be attributed to the presence of pollutants such as heavy metals, high electrical conductivity (EC), and nutrient imbalance, which can impair flower formation and fruit development. Previous studies have similarly reported reduced reproductive output in crops subjected to water stress or pollution (e.g., Gupta et al., 2014; Shaikh et al., 2020).The **average fruit weight** under borewell irrigation was **190 g**, while that under lake water was only **140 g**. Likewise, the **fruit diameter** was **5.1 cm** for borewell-irrigated plants compared to **3.6 cm** for those irrigated with lake water. These differences point to restricted nutrient uptake and impaired cell expansion in plants subjected to polluted water. Heavy metals such as cadmium and lead are known to inhibit enzymatic activity and disrupt physiological processes such as photosynthesis, which directly affects fruit development (Kumar et al., 2016).The **total yield per plant** showed the most significant disparity: **3.80 kg** for borewell water and only **1.68 kg** for lake water—representing a reduction of over **55%**. This drastic reduction suggests that prolonged exposure to contaminated water not only limits nutrient uptake but also induces oxidative stress in plant cells, which ultimately lowers productivity. These findings are consistent with those of Tiwari et al. (2020), who reported yield reductions in vegetables irrigated with industrial wastewater.Plants exposed to polluted irrigation sources often experience **osmotic stress**, **toxicity from metal ions**, and **hormonal imbalance**, which hinder growth and yield. While this study focused on yield parameters, it is likely that cucumber plants irrigated with lake water also experienced elevated levels of lipid peroxidation, reduced chlorophyll content, and changes in antioxidative enzyme activity—common indicators of stress response in plants (Sinha et al., 2018).The results clearly highlight the risks of using polluted urban water bodies for irrigation. While such sources may appear sustainable due to year-round availability, their quality is often compromised due to runoff, sewage discharge, and industrial effluents. Continuous use of such water can deteriorate soil health, reduce crop productivity, and pose health risks due to the bioaccumulation of toxic elements in edible parts of the plant. Thus, **regular monitoring** and **pre-treatment of water sources** are essential before using them for agricultural purposes.

CONCLUSION

This study evaluated the impact of two distinct irrigation sources—**Durgam Cheruvu Lake water** (polluted) and **borewell water** (clean)—on the yield performance of **cucumber (Cucumis sativus)** under controlled environmental conditions. Key yield parameters assessed included **number of fruits per plant**, **average fruit weight**, **total yield per plant**, and **fruit diameter**.

Results showed a marked improvement in all yield traits when plants were irrigated with borewell water compared to lake water. Specifically, borewell-irrigated cucumber plants produced:.**20 fruits per plant** (vs. 12 with lake water),.**190 g average fruit weight** (vs. 140 g),**3.80 kg total yield per plant** (vs. 1.68 kg),.**5.1 cm fruit diameter** (vs. 3.6 cm).

These differences indicate that the polluted lake water negatively affected plant growth and productivity—likely due to the presence of contaminants such as heavy metals and organic pollutants that impair nutrient uptake and physiological functioning.The findings emphasize the crucial role of **irrigation water quality** in determining crop performance and suggest that using untreated polluted water for irrigation poses risks to agricultural productivity and food safety. The study advocates for **regular monitoring** and, if necessary, **treatment of irrigation water** to ensure sustainable and safe crop cultivation, especially in urban and peri-urban agricultural systems.This study clearly establishes that borewell water significantly outperforms untreated Durgam Cheruvu lake water in terms of supporting cucumber crop productivity under controlled pot conditions. While lake water may offer a supplementary source, its use without treatment poses agronomic and health risks.

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