

Potential and limitations of using sewage water for irrigation

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In India, the largest user of water is the agricultural industry. Millions are being spent on irrigation projects to meet the water demand and lessen reliance on precipitation. Additionally, the problems with food security brought on by a growing population necessitate the need for cultivation in water-scarce areas. Even water of marginal quality should be taken into consideration as an alternative option in such conditions. Sewage effluent irrigation provides crops with water and nutrients. At the same time, it offers a convenient method of sewage disposal via land treatment, avoiding potential risks to human health and the environment from the unchecked flow of waste water. Effluent is especially important in areas where there are few other water sources, and using it for irrigation frees up high-quality water for other applications.

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AROUND 11% of the global land surface is used for crop production, out of which only 20% is irrigated area and the rest depends on rainfall for water requirement required for crop production. The net sown area of India is around 143 mha out of which only 68.4 mha is under irrigation. A large area of Indian agricultural land depends on rainwater for crop production. To bridge the gap between the present irrigated area and irrigation requirements for fulfilling the food demand of the ever-growing population, there is a need to adopt new irrigation techniques that will enhance irrigation efficiency and/or minimize the loss of water in an irrigation system. The other way to achieve this goal is through the exploration of alternate water sources other than the common practices i.e., tube well, well, tanks, rivers, canals etc. One such alternate option can be the utilization of wastewater or sewage water.

In addition, the rising contamination of freshwater sources

raises questions about water security. The freshwater supply for other industries decreases as drinking water takes precedence. By 2050, it is predicted that every industry will almost triple its demand for fresh water. In the next 50 years, a quarter of the global population will experience water scarcity issues. Because sewage is 99.9% water and is also rich in nutrients that may be helpful for crops, the reuse of waste water specifically sewage water for irrigation purposes has always been a matter of choice for dealing with such situations. Further, water contamination can be decreased by using sewage water for irrigation instead of dumping it into freshwater sources. Additionally, the value of effluent as a source of irrigation water is equal to the need for its disposal in arid and semi-arid environments where irrigation is a must for agricultural development.

Advantages of using sewage water for irrigation

- **Soil fertility:** One of the

main reasons that sewage water is recommended for irrigation is because it contains higher amounts of nitrogen, phosphorus, and potassium. Other important elements like sulphur, calcium, and magnesium are also found in sewage water in their salt forms, which increases the fertility of the soil. The use of untreated sewage water for irrigation carries a risk of toxicity due to the high nitrate content and a larger risk of salinity increase due to the excess Ca and Mg.

- **Metal content:** Iron, copper, nickel, and zinc are among the nutrients that can accumulate when sewage water is used, in addition to hazardous substances like lead, cadmium, and chromium. Because metals are chelated to reduce leaching and increase availability for plants, there is a positive relationship between metal content and soil organic carbon.

- **Physiochemical properties of soil:** When used for irrigation, sewage water's pH can change the pH of the soil. The soil solution's EC increases significantly after irrigation with sewage water. This increases the nutrients' availability in the root zone. Sewage water contributes to soil organic carbon. Due to the high carbon-to-nitrogen ratio in sewage water, which serves as a substrate for microbial communities, organic carbon increases microbial activity in the soil.
- **On growth parameters of plants:** The nutrient concentrations in plants are found to be higher if grown on sewage water irrigated soil.

Application methods

- The first one is conjunctive use of water which includes either using sewage water with good quality water (canal or groundwater) or mixing both in a ratio that is below the threshold level to avoid any harm to plants.
- The second method is using the sewage water after proper treatment which may include physical, chemical, and/or biological treatment.

Treatment methods

- Physical methods include filtration of big and suspended particles present in the sewage water.
- Chemical methods include the treatment with certain chemicals such as lime, acids, pH neutralizing agents, anti-foaming agents, coagulants and flocculants etc. which minimizes or removes the toxic elements and bad odour.
- Biological treatment includes three basic methods i.e., the trickling filter, activated sludge process, and the oxidation pond which ultimately reduces the anaerobic bacteria population and biological oxygen demand. Oxidation ponds are used for reducing the biochemical oxygen demand (BOD) of wastewater.



Sewage treatment plants

It is a very effective and simple technology, consisting of a ring-shaped channel equipped with mechanical aeration devices. This equipment circulates the waste water at a rate of 0.25 to 0.35 milliseconds while screening and aerating it.

- **Anaerobic ponds:** Here, wastewater's biodegradable components are broken down by naturally occurring microbes. Under anaerobic conditions, these bacteria can eliminate significant BOD and COD concentrations. The organic matter in the effluents is broken down by the anaerobic bacteria found in these ponds, releasing CH_4 and CO_2 in the process. Sludge is deposited at the bottom, and the crust forms on the surface.
- **Aerobic ponds:** In the aerobic treatment of wastewater, bacteria and algae are used that maintain aerobic conditions throughout its depth. Aerobic ponds treat sewage water by leveraging the natural process of aerobic decomposition, where

bacteria utilize dissolved oxygen to break down organic matter into less harmful substances. Sunlight and oxygenation promote the growth of these bacteria and algae, which further oxygenate the water and absorb nutrients.

Suitable crops

Sewage water is suitable for almost all crops if treated well before its application as the elements present in this water are within range of safe limits. The productivity of *rabi* crops, when irrigated with groundwater in combination with fertilizers, showed improved results compared to the use of wastewater with a suggested amount of fertilizer. The seed test weight of *rabi* crops such as wheat, gram, spinach, fenugreek, and clover were noticeably greater with sewage treatment, varying between 1.40–16.70, while with groundwater irrigation, the range was 1.23 to 16.23.

These crops were grown without the application of any organic or inorganic fertilizers.



Onion crop



Potato crop



Bottle guard crop



Spinach crop

Chilli crop

Crops grown under irrigation with treated sewage water

Limitations in using sewage water for irrigation

One of the main issues with using sewage water for irrigation is heavy metal accumulation. Based on many studies, alternating irrigation

with clean water and waste water can not only lower the heavy metal load but also improve soil microbial activity, hence will increase soil fertility.

Table 1. Indian standard for use of sewage water as an irrigation source

Parameter	Standard for irrigation (max.)
Suspended solids	200 ppm
pH	5.5-9
Temperature	Shall not exceed 5°C above the receiving water temperature
Oil and grease	10 ppm
Biochemical oxygen demand (3 days at 27°C)	100 ppm
Arsenic	0.2 ppm
Cyanide	0.2 ppm
Radioactive materials (alpha emitters)	10 ⁻⁸ ppm
Radioactive materials (beta emitters)	10 ⁻⁷ ppm
Bioassay test	90% survival of fish after 96 hours in 100% effluent
Manganese	2 ppm
Iron	3 ppm

Regulations in the use of sewage water

The World Health Organisation (WHO), the US Environmental Protection Agency (USEPA), and the World Bank have reviewed the public health implications of using treated wastewater for crop irrigation and have prepared recommendations for its microbiological quality. It is recommended that the maximum number of microorganisms in sewage water used to irrigate crop plants is 1000 fecal coliforms/100 ml. Similarly to this, the concentration of other dangerous compounds in sewage water should be kept to a minimum. State-to-state and country-to-country differences exist in the laws and rules governing the usage of sewage water.

CONCLUSION

Using sewage water for irrigation increases yield of field and horticultural crops by 10-50% while lowering the price of chemical fertilizers. The utilization of sewage water for irrigation has become significant globally because of scarce water resources and the expensive process of treating wastewater for disposal. If there's land with appropriate topography, soil properties, and drainage, sewage effluent can be effectively used as both an irrigation source and for providing nutrients to plants. In India, given the challenges of water shortage and the expensive nature of fertilizers, sewage can be efficiently employed for irrigation purposes. Studies shows that using physically treated sewage water can augment irrigation water supplies, potentially enhancing agricultural yield.

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Protect environment.**

