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# Exploring the Potential Utilization of Aquatic Weed as Water Purifier

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**ABSTRACT**

Due to overpopulation the demand of fresh water is much higher and to meet that demand is also a big challenge for whole society. As many as 302 river stretches on 275 rivers across the India have got polluted due to discharge of both municipal and industrial waste water over the years. These untreated waste water when flow back to the river that causes several human health problems, water table contamination and environmental pollution. So when there is so much water is lying in this contaminated areas without any use as polluted can be converted into fresh water with the help of natural purifier. To have sustainable remedy of such problems the duckweed provides a platform from small to large scale purification according to the need and purpose. The cleansing activity of duckweed already proven as toxic elements removal such as nitrates, phosphates, ammonia and turning to colourless and odourless water as final product.

**Keywords:** Aquatic weed, solid waste, sewage sludge, industrial water pollution, water purifier

Duckweed is a smallest flowering plant belongs to a family of Lemnacae. It floats on the surface of water. It grows in contaminated water ponds which contain contaminants like nitrates, phosphates, ammonia etc. It helps in purification of industrial and sewage water. And by covering the water surface, it minimises water losses through evaporation. Duckweed has been under use in Asian farming from many centuries for feed purpose, but the potential of water purification and sewage treatment is barely noticed and mainly promoted for nutritive values and duckweed growth. As far as number of town/cities in those basins along polluted river stretches is concerned, 118 towns are located in the Ganges river basin as against 532 towns in other parts of the country. However, population-wise, it is the river Ganges basin which alone supports 45% of the people living in the India. The Central Pollution Control Board of India (CPCB) report pointed out that these towns collectively generate over 3,636 MLD of sewage as against the treatment capacity of approximately 1,027 MLD of the existing 55 sewage treatment plants (STPs) in these towns/ cities spread over five states. It is quite obvious a large gap exist in infra structure development and pollution awareness among society. To have sustainable remedy of such problems the duckweed provides a platform from small to large scale purification according to the need and purpose. The cleansing activity of duckweed already proven as toxic elements removal such as nitrates, phosphates, ammonia and turning to colourless and odourless water as final product (Kesarwani and Kesarwani, 2017; Bonomo *et al*. 1997).

## MATERIALS AND METHODS

### Sample collection

A preliminary study was conducted at the different location of Bareilly city, Uttar Pradesh. The location

site was chosen on the basis of availability of contaminated waste water i.e., Harunagla and Mahanagar (Fig. 1). The duckweed was collected in close vicinity to the city, where un-disturbed pond was located, near to Satellite Bus stand, Bareilly. These preliminary short and effective result findings can establish a national strategy where a special tank will be developed in industries just before the discharge of untreated waste water to river. This particular tank will have collectively grown duckweed which will rectify the waste water within period of 5-7 days approximately. The duckweed will be cultivated initially for 4-5 weeks in that special tank and at highly vegetative stage; the effluent will be released in this tank.

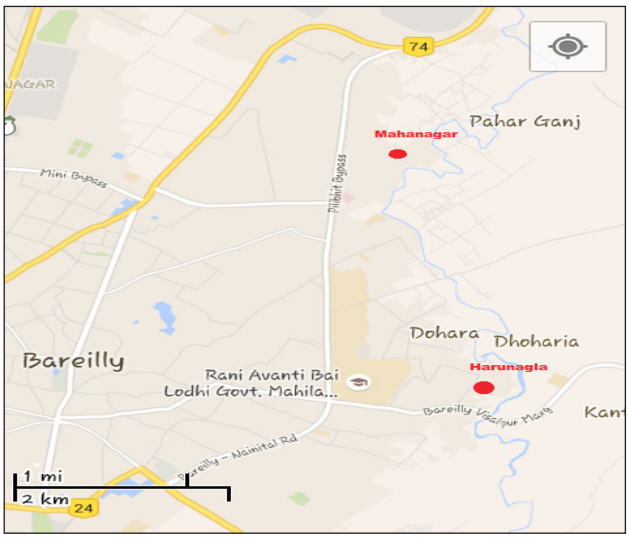


**Fig. 1:** Bareilly city map with sample location

## Methodology

To study different characteristics of wastewater various test was conducted such as pH, visual examination, odour test, total hardness of water, calcium and magnesium hardness, alkalinity, total dissolved solids and ammonia pungency. Details are described below as:

**1. pH test:** The pH of wastewater was tested by a pH paper of both the sites i.e. Site A and Site B wastewater. Then later on duckweed is grown into that contaminated water and again pH test is performed and result is evaluated.

**2. Visual test:** To examine the clarity of any water it has undergo refraction phenomena. A beam of light was passed by a contaminated collected from Site A and Site B and the result observed was noted down. Then again visual test was conducted when duckweed grown water sample is tested.

**3. Odour test:** The odour of contaminated sample water was checked by smelling it with a nose. Then later on it was tested again on purified water made by duckweed.

**4. Hardness and Softness test:** To check for hardness and softness of contaminated water – Take a small test tube and pour small amount of soap into it, then pour a little quantity of contaminated water and shake vigorously to produce a lather or foam. If foam produced it results soft water or else hard water and same test to be conducted for purified water of duckweed., TDS, Total Hardness, Total Alkalinity.

**5. Calcium hardness:** Many indicators such as ammonium purpurate, calson form a complex with only calcium but not with magnesium at higher pH.

**6. Magnesium Hardness :** Magnesium hardness can be calculated by subtracting the hardness of calcium by the Total hardness of water.

**7. Total Alkalinity:** Alkalinity of water is its capacity to neutralize a strong acid and it is characterized by the presence of all hydroxyl ions capable of combining with hydrogen ions. Alkalinity in natural water is due to free hydroxyl ion and hydrolysis of salts formed by weak acid and strong bases measurement process use as given by Maiti.

**8. TDS (Total Dissolved Solids):** Total dissolved solid or simply solids are mainly the inorganic mineral and some organic matter. There are large unity of state such as Cl-, $CO_3^-$ $HCO_3^-$, $NO_3^-$, $PO_4^{-3}$ and $SO_4^{-2}$ of Ca, Mg, Na, K, & Fe etc which import certain taste to water measurement.

**9. For Ammonia:-**The contaminated water sample was tested for ammonia smell i.e. pungent.

## RESULTS AND DISCUSSION

The preliminary results had shown the improvement by duckweed which omits the foul smell of contaminated sewage and industrial effluent, neutral pH, reducing nitrate, phosphates, and colourless appearance after few hours of aquatic weed treatment (Table 1). Duckweed grows both in sunlight and in shade. Duckweed grows best in shallow nutrient-rich pools (e.g., with decaying vegetation), sheltered from wind and current. The characteristics that

**Table 1:** Analytical results shown changes in chemical properties of water using duckweed

| Sl. No. | Test | Site A (Before) | Site B (Before) | Site A (After) | Site B (After) |
|---|---|---|---|---|---|
| 1 | pH | 8.0-8.5 | 7.5-8.0 | 7.5-8.0 | 7.0-7.5 |
| 2 | Colour | Dark grey, muddy, brown | Black, muddy and greish | Slight grey | Light brown |
| 3 | Visual | Do not refract light. | Slightly refract the light | Refracting light | Refracting light |
| 4 | Odour | Strong, pungent intolerable | Strong,pungent intolerable | Negligible | Tolerable |
| 5 | Hardness and Softness | Do not produce lather/ foam | Do not produce lather/ foam | Producing foam | Producing light foam |
| 6 | Calcium Hardness | 253 ppm | 268 ppm | 178 ppm | 186 ppm |
| 7 | Magnesium Hardness | 10 ppm | 12 ppm | 7 ppm | 8 ppm |
| 8 | Ammonia | Presence of ammonia seen | Presence of ammonia seen | Absence of ammonia seen | Absence of ammonia seen |
| 9 | TDS (Total Dissolved Solids) | 528 ppm | 530 ppm | 365 ppm | 358 ppm |

make this plant grow rapidly in polluted waters make it an ideal candidate for large-scale application for nutrient removal and water purification. Duckweed has the highest growth rate of any higher plant. In ideal conditions (high levels of nitrates and phosphates), the surface area covered by duckweed can double in less than 2 days (Harvey and Fox, 1973). Duckweed absorbs nutrients from the water. Thus it has a useful role in controlling the growth of algae, both by removing nutrients and by shutting out sunlight as the Duckweed covers the water surface. Algae absorb oxygen and as it decays, it further reduces oxygen levels. Algal blooms can thus severely affect aquatic life (Bonomo *et al.* 1997). By shading the water, Duckweed also keeps it cool and thus allow for more dissolved oxygen.

### Cost of Duck weed production in new pond

Pond digging cost (1 ha) – ₹ 22, 50,000.00 (Table 2).

**Table 2:** Estimation of 1 hectare size ponds development for duckweed management

| Particular | Expenses (₹) |
|---|---|
| Pond & its maintenance | 77500.00 |
| Fertilizers expenses (N & P) | 13,050.00 |
| Expenses on water | 33750.00 |
| Miscellaneous expenses | 5500.00 |
| Total | 129800.00 |
| Pond liner (₹ 45/Sq.M) (Optional) | 45000.00 |

Pond life (Approximately) -30 years (Annual maintenance required)

In villages, many ponds are found in sizes 250 $m^2$. Duck weed can grow after maintenance of the ponds. In this condition expenses for producing duck weed will be ₹ 20503.00 in a year (Table 3). Under the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) 50% subsidy provides to the farmers for digging the pond in size 22 × 20 × 3 meters and 35 × 30 × 3 meters. The subsidies direct transfer to the farmer bank accounts (Kesarwani *et al.* 2020).

**Table 3:** Estimation of village size ponds development for duckweed management

| Particular | Expenses (₹) |
|---|---|
| Pond maintenance (250 Sq. M.) | 5625.00 |
| Fertilizers expenses (N & P) | 3262.00 |
| Expenses on water | 10116.00 |
| Miscellaneous expenses | 1500.00 |
| **Total** | **20503.00** |

Under the situation when subsidy provided to farmers then cost will be reduce for growing the duckweed. Duck weed may grow as many times in a year and with each harvest, the cost of management reduces and return increases.

## CONCLUSION

Traditional practice of sewage treatment is not largely accepted by industries where legal compliance and regulations are complicated. However, development of aquatic weed such as duckweed unit in peripheral could match the sophisticated sewage treatment unit without compromising the effluent contamination releasing in water bodies. This sustainable practice of duckweed multiplication and development can be a game changer of water recycling and contaminated sewage water pollutants in poor resources zone.

There is large amount of fresh water is wasted in laundry, cleaning purposes, irrigation and many other tasks. Similarly, if polluted water made into purified water with the help of duckweeds that can lead water recycling aside and we will be able to give our next generation a useful resource.

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