# Potential of Utilizing Microalgae Grown in Wastewater Within the Agriculture Industry

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## Introduction

- The agriculture industry can significantly contribute to climate change, and specifically the "Agriculture, Forestry and Other Land Use" industry can result in around 13-21% of all greenhouse gas (GHG) emissions worldwide.[11]
- Microalgae have the ability to sequester $CO_2$, take up nutrients from wastewater, while simultaneously treating various wastewaters.[14, 16]
- Microalgae biomass can then be utilized within the agriculture industry for products such as biofertilizers, biostimulants, and animal feed.[1,19]

## Research Question / Objectives

**What is the potential of utilizing microalgae grown in wastewater within the agriculture industry?**

### Research Objectives

- Determine Technical Feasibility
- Analyze Environmental Impacts
- Investigate Social & Economic Viability

## Methodology

- Literature review
- Fifteen studies utilized for analysis – eleven specifically looking at microalgae growth in wastewater for plant growth & 4 life cycle assessment studies. Other literature was also incorporated.
- Data was collected through excel and tables on word.
- This data was then compared, and various tables, and figures were employed.

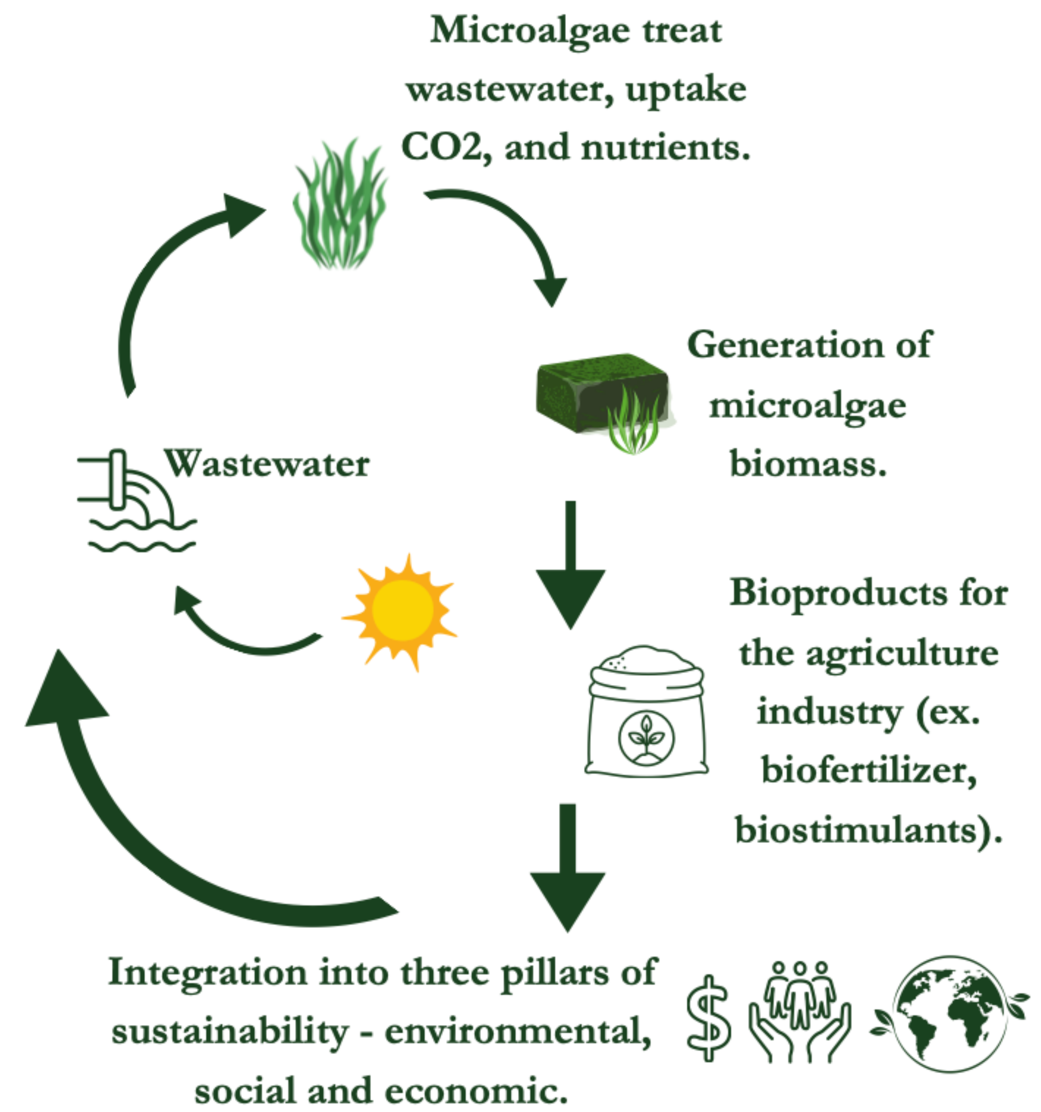


**Figure 1.** *Circular Bioeconomy Example*
Icons from Canva Pro.

Microalgae Product Applied & Plant Types

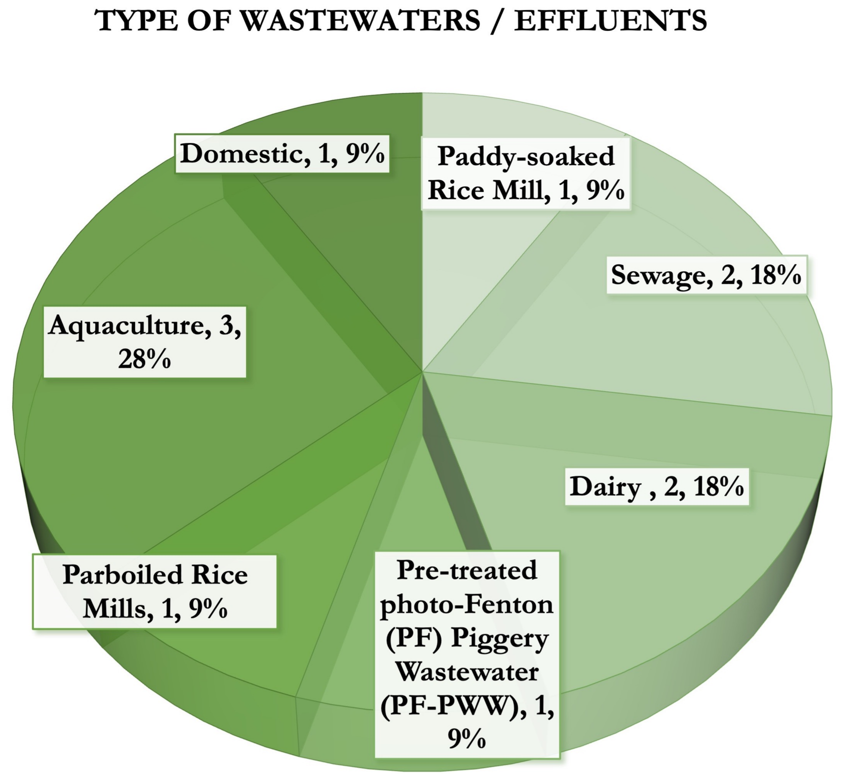


**Figure 2.** *Type of Wastewaters / Effluents*
All literature listed in Table 2.[1,18,8,7,9,15,10,19,13,20,5]

**Table 1.** *Greatest Microalgae Wastewater Removal Efficiencies*
Greatest removal efficiencies out of all the studies in Table 2.[7,10,19]

| Type of Removal Efficiency | Greatest Removal Efficiencies by Microalgae |
|---|---|
| Chemical Oxygen Demand | 97.7%[10] |
| Biological Oxygen Demand | 99.1%[10] |
| Biological Oxygen $Demand_5$ | 99.7%[19] |
| Nitrogen | 100%[19] |
| Phosphorus | 100%[19] |
| Phosphates | 100%[7] |

Wastewater Types & Greatest Removal Efficiencies by Microalgae

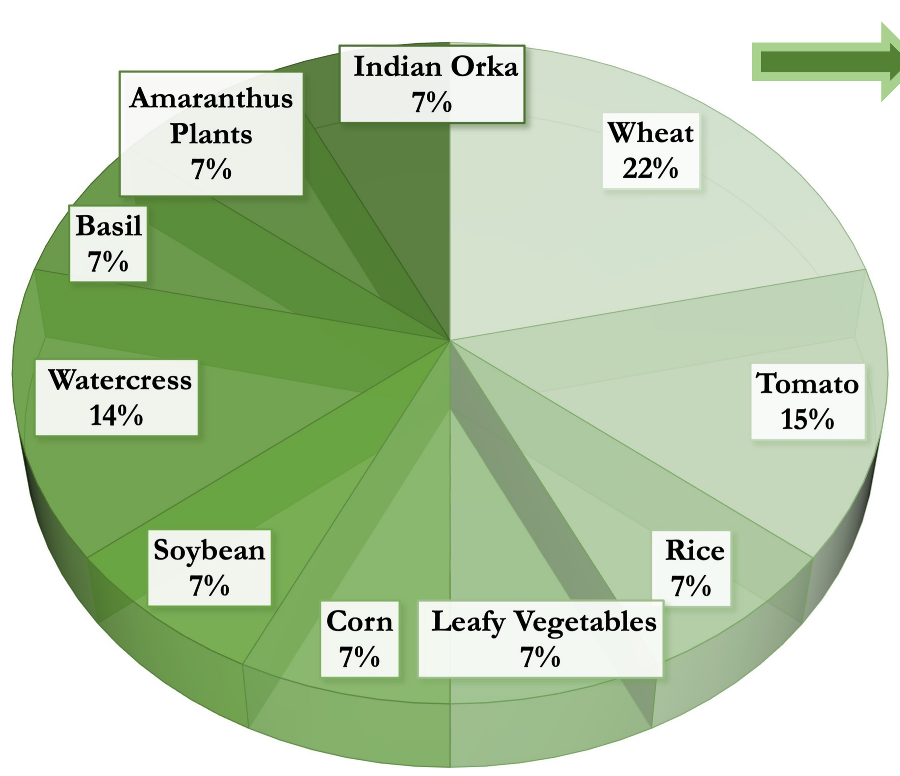


**Figure 3.** *Plant Species Grown with Microalgae*
All literature listed in Table 2.[1,18,8,7,9,15,10,19,13,20,5]

**Table 2.** *Microalgae Product Applied*
Literature looking at microalgae grown in wastewater for plant growth.

| Type of Agricultural Product |
|---|
| **Biofertilizer** - microalgae biomass (mainly *Scendesus*).[1] |
| **Biofertilizer** - *Chlorella pyrenoidsa.*[18] |
| **Biofertilizer** - "microalgae, biosolids, and reclaimed water."[8] |
| **Supernatant, microalgae biomass and PF precipitate.** [7] |
| **Biofertilizer** - *Chlorella Variabilis, Scenedesmus obliquus* and a microalgae consortium.[9] |
| **Biofertilizer** - microalgae consortia, mixed with a carrier of compost/vermiculite.[15] |
| **Biostimulant** (from supernatants) - *Microalgae Spirulina sp. LEB 18 & Chlorella fusca LEB 111.*[10] |
| **Biostimulant** - *Chlorella vulgaris (Cv)* and *Scenedesmus obliquus (Sc).*[19] Biochar as **biostimulant** - *Cv* and *Sc.*[19] |
| **Phosphorus Biofertilizer** (slow release) - microalgae biomass and cyanobacteria.[13] |
| Spirulina for **agricultural fertilizer.**[20] |
| **Organic slow-release fertilizers** – "microalgal bacterial flocs" and *Nannochloropsis oculate.*[5] |

## Results & Discussion

### Environmental Impacts

Growing microalgae in wastewater to generate bioproducts can – **lower GHG emissions, improve soil quality, treat wastewater, and advance the circular bioeconomy.**[2,3,12,14]

Microalgae has been shown to **improve the growth of different plant types.**[1,18,8,7,9,15,10,19,13,20,5] When compared directly to chemical fertilizers, microalgae has the potential to **improve some plant growth parameters.**[1,18]

**Significant optimization** of this process (ex. drying) is required, if microalgae biomass for biofertilizer is to be environmentally beneficial.[4]

### Technical Feasibility

Life cycle assessment studies, and the *Sabana* project, showed the **potential of this process to be beneficial** in the future.[2,3,12,17]

Most promising wastewater types are likely – **food industry and aquaculture wastewater / effluent.** Wastewater from the **food industry** for microalgae treatment, and bioproduct generation - is likely the most optimistic.[2]

Most prominent microalgae out of all studies in Table 1 was ***Chlorella.***

Various types of microalgae can result in some **wastewater removal efficiencies greater than 97.5%** (Figure 3).[7,10,19]

### Social & Economic Viability

One social barrier is the presence of **heavy metals** in various wastewaters.[12]

Economically, the ability to **generate profit from the bioproducts** associated with this process, can be beneficial.[3]


**Figure 4.** *Environmental Benefits*
Icons from Canva Pro.

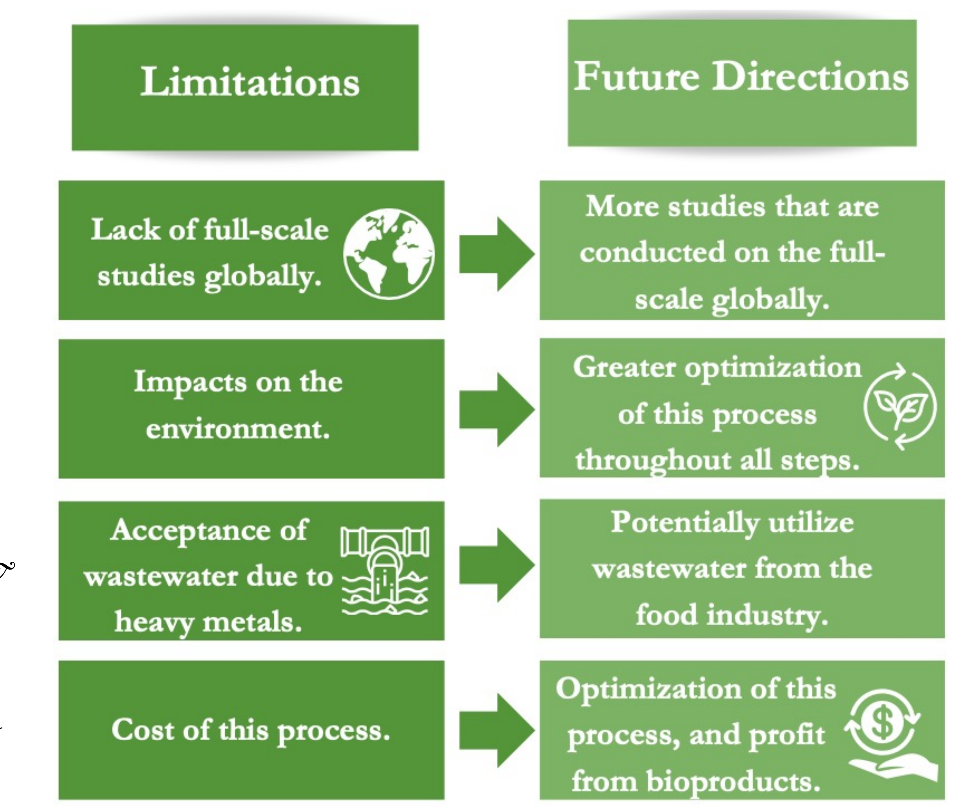


**Figure 5.** *Limitations & Future Direction*
Icons from Canva Pro.

## Conclusion

- Microalgae have the **potential to be beneficial for the treatment of wastewater, growth of plants,** and **generation of bioproducts** for the agriculture industry.
- There is promising potential for this process to be notable within the **circular bioeconomy**, integrate within all **three pillars of sustainability**, and align with various **Sustainable Development Goals**.
- There are many areas that must be **improved** to ensure the ability of this process to be **cost friendly, socially acceptable, and environmentally friendly** - to work toward a more sustainable future.

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