

## ***Salicornia*: The Green Gold of Saline Lands**

**Abhay Thakur<sup>1\*</sup> and Arti Devi<sup>2</sup>**

<sup>1</sup>M.Sc. Student, Department of Social Sciences, COHF, Neri, Dr. YSPUHF, Nauni, Solan, Himachal Pradesh, India

<sup>2</sup>M.Sc. Student, Department of Basic Sciences, COHF, Neri, Dr. YSPUHF, Nauni, Solan, Himachal Pradesh, India

\*<sup>1</sup>Corresponding author email- [abhayysp@gmail.com](mailto:abhayysp@gmail.com)

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### **Introduction**

The agricultural landscape of the 21<sup>st</sup> century stands at a precarious crossroads. We are witnessing a convergence of crisis: the rapid depletion of freshwater aquifers, the salinization of arable lands due to climate change and anthropogenic mismanagement and the rapidly increasing nutritional demands of a growing global population. Conventional crops such as rice, wheat and maize are highly sensitive to salinity stress, resulting in yield losses and land degradation. In this context, halophytes which are the plants naturally adapted to saline environments, are gaining attention as alternative crops for sustainable agriculture. Among them, *Salicornia* spp., commonly known as glasswort, sea asparagus or pickleweed, has emerged as a promising climate-resilient plant with multiple agricultural, nutritional and environmental benefits. The shift from viewing saline soils as “wastelands” to regarding them as “opportunity landscapes” requires a paradigm shift. *Salicornia* represents the vanguard of this shift as it is a plant that drinks sea water and yields food, fuel and fodder.



## 1. Botanical Characteristics and Distribution

*Salicornia* spp. is a succulent, leafless annual halophyte belonging to the family Amaranthaceae. The plant typically grows up to 25–35 cm in height and is characterized by jointed, fleshy green stems that turn reddish during maturity due to increased salt accumulation. It is widely distributed across coastal regions of Europe, Asia, North America, Africa, and the Mediterranean basin, thriving in salt marshes, estuaries, and saline flats where most conventional crops fail to survive (Patel, 2016; Abd El-Maboud, 2023).

Unlike glycophytes, *Salicornia* requires salinity for optimal growth and can tolerate extremely high salt concentrations, sometimes exceeding 1,000 mM NaCl. This unique physiological adaptation makes it an ideal candidate for cultivation in degraded and salt-affected soils (Katel et al., 2023).

## 2. Physiological Adaptations to Salinity

The exceptional salt tolerance of *Salicornia* is attributed to several adaptive mechanisms, including ion compartmentalization, osmotic adjustment and enhanced antioxidant defence systems. The plant stores excess sodium ions in vacuoles, thereby preventing cellular toxicity and maintaining metabolic stability. Additionally, the accumulation of osmolytes and antioxidant compounds helps mitigate oxidative stress induced by salinity (Dzhoglova et al., 2024).

These mechanisms not only enable survival under harsh conditions but also result in the synthesis of valuable bioactive compounds, enhancing the plant's nutritional and medicinal value.

## 3. Nutritional Composition and Bioactive Properties

Glasswort is increasingly recognized as a functional food due to its rich nutritional profile. The tender green shoots are edible and contain essential minerals such as sodium, potassium, calcium, magnesium and iron. The plant is also a good source of dietary fiber, polyunsaturated fatty acids, vitamins, and phytochemicals including phenolic compounds and flavonoids (Castagna et al., 2022).

Several studies have reported strong antioxidant, anti-inflammatory, antimicrobial, and hepatoprotective activities of *Salicornia* extracts. These bioactivities are primarily linked to the presence of polyphenols, saponins, sterols, and flavonoids, which are produced in higher concentrations as adaptive responses to environmental stress (Dzhoglova et al., 2024; Patel, 2016).

Traditionally, *Salicornia* has been used in folk medicine to manage conditions such as diabetes, hypertension, obesity, and liver disorders. Recent research also highlights its potential role in developing nutraceuticals, functional foods, and herbal pharmaceuticals.

#### 4. Agricultural and Economic Potential

From an agricultural perspective, *Salicornia* represents a non-conventional crop suitable for seawater agriculture. It can be cultivated using saline water, brackish water or even aquaculture effluents, thereby reducing pressure on freshwater resources. Experimental studies indicate that moderate salinity levels (200–400 mM NaCl) enhance biomass production and branching in *Salicornia*, making it economically viable (Abd El-Maboud, 2023).

The crop has multiple uses:

- **Vegetable:** Fresh shoots are consumed as salads, pickles, or cooked vegetables.
- **Oilseed:** Seeds contain high-quality edible oil rich in linoleic and oleic acids.
- **Animal feed:** Biomass can be used as a salt-tolerant fodder supplement.
- **Industrial use:** Historically used in glass and soap making due to high soda content.

With increasing interest in alternative livelihoods for coastal and arid communities, *Salicornia* cultivation offers new income opportunities while utilizing otherwise unproductive lands.

#### 5. Role in Climate-Smart and Sustainable Agriculture

Soil salinization is projected to affect nearly 50% of irrigated agricultural land by 2050, posing a serious threat to global food security. In this scenario, *Salicornia* fits well within the framework of Climate-Smart Agriculture (CSA). Its cultivation contributes to land reclamation, carbon sequestration, biodiversity conservation, and reduced greenhouse gas emissions (Katel et al., 2023).

Moreover, *Salicornia* plays a significant role in phytoremediation, as it can accumulate salts and heavy metals, helping to restore degraded ecosystems. Its use in intercropping systems

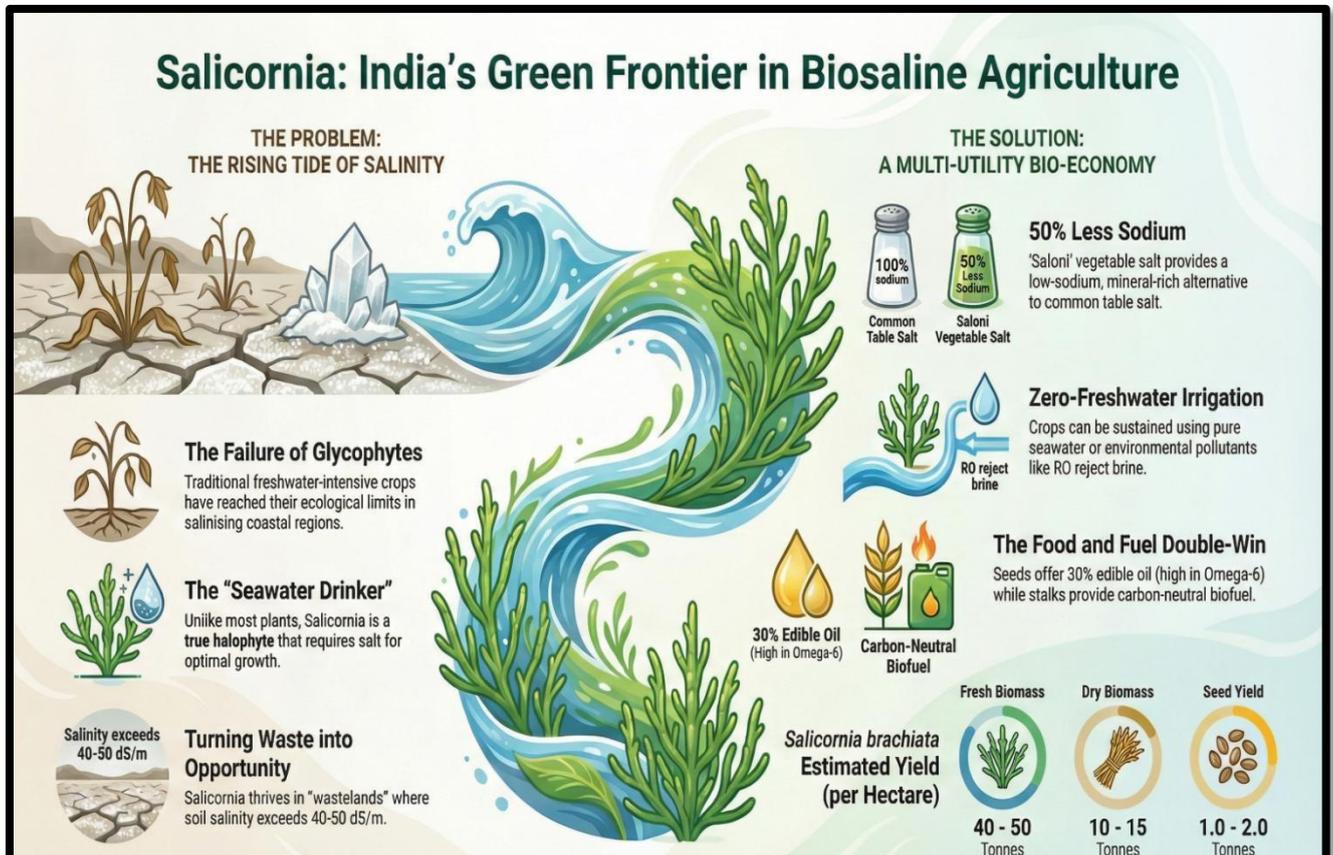


Figure 1: *Salicornia*- India's Green frontier in Biosaline Agriculture

has also shown potential to improve soil conditions and productivity of salt-sensitive crops grown alongside it (Castagna et al., 2022)..

## 6. Future Prospects

Despite its immense potential, large-scale adoption of *Salicornia* is still limited by gaps in agronomic practices, market awareness, and processing technologies. Future research should focus on developing improved cultivars, optimizing cultivation techniques, and promoting value-added products to enhance farmer adoption.

In conclusion, *Salicornia* stands out as a future crop capable of addressing the intertwined challenges of salinity, climate change, and food insecurity. By integrating this halophytic plant into mainstream agriculture, especially in coastal and arid regions, sustainable and resilient food systems can be developed for the coming decades.

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