ECOLOGICAL IMPORTANCE OF SOLAR SALTWORKS

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EXTENDED ABSTRACT

It is a global concern that the area of wetland is decreasing day by day. Wetlands include lakes, lagoons, rivers, coastal mudflats and solar saltworks. Wetlands are the cradles where human civilizations have developed. They provide most valuable environment for biological diversity including plants, animals, birds, reptiles, fish and invertebrates.

Wetlands play a very important role in our life. They prevent floods by retaining excess rain water, preserving water quality, and increasing biological productivity for both aquatic life and human communities. Wetlands ecosystems are interconnected and interactive within a watershed. In India, unplanned urbanization and a growing population have taken their toll on wetland.

Solar saltworks are one of the most important constituent of wetlands and represent an exemplary ecosystem. Salt is an essential commodity which is not only being consumed by all humans but also used by several industries as a raw material. It is a unique saline ecosystem which provides a balance between salt production process and the biological process that develops as a result of increasing salinity gradient in condensers and crystallizers spread over a large area of land. Microorganisms belonging to *Planktonic* communities develop red color and it helps in better solar energy absorption and water evaporation. These biological processes help in producing high quality salt more economically at a rated design capacity.

The salt works are environmentally friendly and it is very difficult to calculate its ecological value. They act as foraging sites for waders and many species seek refuge and breed only in these specialized ecosystems. It is a heaven for resident and migratory birds and invertebrates. Salt works retain a high degree of integrity and is authentic in use, character and identity. Since it is a complex interaction between human activity and the natural environment, the process has remained nearly the same for more than a century

Keywords: Halophytes, *Avicennia*, *Sonneratia*, germplasm, *Benthic*, Planktonic, Artemia, *Slender Bill*, heronries, *Salvadora persica*

1. INTRODUCTION

Salt is a commodity which known to mankind since ages. Preservative ability of salt was a foundation of civilization. It eliminated dependency on the seasonal availability of food and allowed travel over long distances; it was also a vital food additive.

Annual consumption of salt in the world is about 200 million tonnes and 33% of it is produced in solar salt works. It is beyond doubts that saltworks not only produce salt, but they also function as integrated saline wetlands. It is a fact that their ecological importance comprises of the characteristics of both regular and hyper saline wetlands.

2. SOLAR SALT- AN ECOFRIENDLY PROCESS

2.1. Solar saltworks a man made wetland

Solar saltworks are the plants where salt is produced by natural process. This process requires water from the ocean, sunlight and wind. Solar saltworks require a very large area of land which constitutes a man made wetland. A series of connected shallow ponds where salinity gradient is well maintained throughout the ponds, provide a favorable environment for the growth of variety of microorganisms in the water as well as on the ponds floors.

This is a unique saline ecosystem in parallel with the salt production process, but the ecological importance of solar saltworks has not been well understood by the industries involved in producing salt.

2.2. Tata Chemicals coastal ecosystem

India is the 3rd largest producer of salt in the world with an average annual production of about 19.00 million tonnes and Tata Chemicals alone produces about 2.6 million tones/ annum. Tata Chemicals salt works are situated on the coast of Gulf of Kutch, Gujarat, India. Out of 145 Km^2 of total wetland owned by Tata Chemicals, 100 Km^2 comprises of condensers and crystalizers.

Generally solar salt works are being operated purely on commercial basis and the importance of coastal ecosystem takes the last priority. Of late, as a consequence of globalization and highly competitive environment, some parts of the salt works are being abandoned by the industries in order to reduce the high cost of logistics.

Okhamadi saltworks owned by Tata Chemicals is about 50 Km from the works. Consequently, company has to spend a considerable amount of money on logistics. Though it is not economically viable to transport salt from such a long distance in spite of alternatives available within a radius of 20 Km, But Tata Chemicals has not abandoned the operations in this saltworks in order to sustain a well established ecosystem.

3.INTEGRATED ECOSYSTEMS

3.1. Role of mangroves in coastal ecosystem

Integrated ecosystems are of high importance as they provide the opportunity for the co-existence of flora and fauna. Mudflats and salt works together form a highly pronounced ecosystem. The tidal mudflats are generally adjacent to salt ponds. Mangroves are halophytes which can grow in coastal mudflats and estuarine conditions. Mangroves are called halophytes in the sense that they possess physiological and anatomical adaptability to grow in salty environments. Some mangroves have salt-excreting glands on the leaves whereas the others reject salt at the roots itself. The mangrove plants contribute to coastal ecosystem in many ways. Apart from reducing coastal erosion, serving to dampen storm surges, they also contribute to the marine food chain through the production of detritus produced by

litter fall. The dominating species belong to such genera as *Avicennia, Rhizophora, Bruguiera and Sonneratia*. India has a mangrove cover of 4827 Km^2 consisting of 50 species and in Gujurat alone 9 species have been reported growing. The major regions of mangrove formation in Gujurat are Gulf of Kutch and Saurashtra coast.

3.2. Save the rich bio-diversity

Saltworks owned by Tata Chemicals host six species of mangrove, *Avicennia marina, Avicennia officinalis, Rhizophora mucronata, Bruguiera gymnorhiza, Ceriops tagal and Sonneratia alba* in Gulf of Kutch region. There is a continues decline in mangrove across the globe during the last five decades. Mangroves are being used by human beings in innumerable ways. Products like charcoal, incense sticks, hair oil and honey are derived from mangrove trees. Today mangrove forests are one of most threatened habitats disappearing at an accelerating rate mainly because of reclamation, industrialization and human encroachment and natural calamities are contributing to a great extent in some parts of the world. There are some examples where due to above mention factors some species of mangroves and birds have become “vulnerable” or even endangered.

Saltworks are being hit by natural calamities like cyclones and heavy rains very frequently. Sincere efforts are being put by Tata Chemicals and the government to preserve, rehabilitate and carryout plantation of mangrove to abate destruction of such a rich biodiversity. Since *Avicennia officinalis* and *Avicennia marina,* both the pioneering species capable of withstanding wide fluctuations in the physical conditions, plantation of these two species on a large scale is underway. In this regard priority is being given to use of local germplasm for mangrove propagation rather than importing the seeds.

4. BIOLOGICAL PROCESSES

4.1 Biological process in harmony with the production process

The micro-organisms found on the surface of the mudflats are a source of food for marine invertebrates. These invertebrates in turn are a prey base for shore birds thus tidal mudflats are also important in bird’s conservation. Apart from the physiochemical process in the salt works, biological process is also of great importance for the process of salt production. If the care is taken at the design stage itself, encouraging results in this regard can be achieved as biological process is in admirable harmony with the production process of salt works. Biological Systems of the ponds in the saltworks, comprises of a large variety of organisms, and produce the most biomass.

4.2 Higher production and better quality salt

The *Planktonic* community which includes algae, bacteria and protozoa, remain suspended in the water and provide organic nutrients for the entire saltworks. They are responsible giving colors to the water which in turn helps in increasing the evaporation rate, and allows light to reach pond floors. The *Benthic* community which mats on the floors of the condensers. and permanently remove important quantities of combined nitrogen and phosphate from the overlying water, remain permanently attached to pond floors, and maintain desired thickness in all ponds. The mat also helps in reducing the seepage and preventing infiltration through pond floors to a great extent and maintains desired thickness.

5. A BIRDS HABITAT

5.1 Solar saltworks- A complex ecosystem

The ecological value of the saltworks stems from their shallow ponds whose floors produce highly suitable food for birds, shellfish, and other animals. Several

commercially important species of prawns and fish breed and spend a part of their life cycle in this environment. They form complex ecosystems and help sustain a diverse life form including marine, avian and terrestrial fauna. They also provide nesting sites for the aquatic birds and salt works for feeding. Basic organisms of the biological system constitute excellent food for the birds and their diet is mainly *Artemia Salina*. *Artemia salina* has a remarkable resistance to change and is able to survive in a wide variety of water salinity. Because of this unique characteristic they inhabit solar evaporation ponds. *Artemia* is also a part of diet of beautiful flamingos and it is the main reason for the orange color of their feathers

The birds are attracted by saltworks as they constitute a large wetland complex. It provides a combination of many positive and favorable factors like feeding, nesting and breeding sites and constant protection which directly or indirectly benefit the birds.

5.2. Tata Chemicals saltworks- A bird's heaven

About 121 species of birds which include 43 species of migratory birds have been observed on Tata Chemicals saltworks. Some birds like *Slender Bill* and *Caspian Tern* nest on the ground. Apart from these two species most of the native aquatic birds are colonial nesters. They either build their nest on the trees or on the ground.
Tata Chemical salt works at Charakala is the only known place in India with active nesting colony of these species. The reason behind it is the construction of islands at 3 to 4 feet elevation in nurse ponds. The size of these islands is about 200 feet long and 35 feet wide. The central portion is raised and edges are sloping into the water. Since Gypsum is a by-product of solar salt, it can be used for constructing these islands. This has helped in preventing the erosion of islands as Gypsum gets cemented with the soil over a period of time. It has attracted ground nesting birds to nest on these islands as they find these sites more secured for roosting and nesting, being inaccessible to most land predators. Artificial nesting sites have been built by constructing dykes which prevent these birds from flying to some awkward and unsafe places for nesting and breeding.

6. POLLUTION FREE INDUSTRY

Yet there is one more important aspect of solar saltworks which adds to the environmentally friendliness of the process. Usually almost all chemical manufacturing units produce large quantities of solid or liquid waste. But solar salt process generates a small amount of effluent. The waste produced is commonly known as bittern which is hardly 5% of the sea water pumped into the saltworks. Generally most of the large scale saltworks don't release bittern into the sea. Instead it is left for further solar evaporation in a special pond and Potassium Sulphate, Magnesium Sulphate and Magnesium Chloride is recovered from the pond which having some commercial value. Since bitten is rich with Magnesium Bromide, bittern can be discharged to the special pond after stripping off Bromine which is an extremely valuable product. Hence, unlike other chemical industries solar saltworks are having a very little adverse impact on the environment.

7. MEASURES TO IMPROVE AND SUSTAIN ECOSYSTEM IN SALTWORKS

In order to sustain and improve ecosystem in salt works measures are being taken to conserve the environment as well as making the salt business commercially viable the following measures are being taken.

a.A well designed drainage system is being constructed to collect seepage brine which is generally highly saline, is diluted with sea water before it is drained out. In this process mangroves don't get exposed to high salinity brine.

b.Check dams are being constructed to reduce salinity ingress.

c.It is observed that poachers are involved in hunting birds. Efforts are being put to prevent poaching by deploying security and imposing stringent laws.

d.Heronries: Tree nesting birds like herons, egrets, ibis, storks, and spoonbill come down to saltworks for feeding and nest on the islands which are five Kilometers away from the saltworks Heronries are being developed in the large condensers. The central portion of this condenser is free from human interference. Moreover, as there is regular displacement of seawater, there is hardly any variation in salinity. This provides the ideal condition for the propagation of mangrove.
It would be an earthen island in the middle of the condenser having about 100 feet diameter and planting *Salvadora persica* on it. This plant is a halophyte and can withstand drought conditions. This island would be surrounded by three peripheral islands made of muck which is suitable for raising mangroves. Mangrove thickets on the peripheral islands will serve the purpose of providing a cover to the nucleus island and makes it free from visual disturbances.

e.Designing the salt works is the most important aspect. In old salt works environmental aspects were not taken into consideration. The salinity gradient needs to be well maintained to achieve the desired leaf shedding rate of mangrove. This can be achieved only if the salt works are designed properly. Modernization of salt work will help us to have a healthy and stable ecosystem. Since modernization and expansion of saltworks secure the existence of those really valuable saline ecosystems Tata Chemicals is planning to modernize saltworks in future.

f.Encroachment into Salinas for personal economic gains is a very common scene in most of the saltworks. To bring a change in the attitude of the local communities, public and private sectors jointly can play a major role. Private sectors can contribute by motivating and educating the local communities about importance of saltworksi in nature conservation, sustainable economic opportunities through ecotourism and value added natural products from the wetland.

8. CONCLUSIONS

As producing salt is essential for the survival of the industries, maintaining an efficient ecosystem in the saltworks is essential for conserving environment. Finally I would like to conclude with our slogan that "**We produce salt and conserve the environment.**

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