SAMBHAR LAKE A WETLAND – AN ASSESSMENT

DWARKESH SHUKAL [1] AND ABDUL A. RAHAMAN[2]

[1]General Manager (Tech), Hindustan / Sambhar Salts Limited,
Jaipur – 303017 (India)
[2]Resource Bio-Techs Pvt. Ltd.,
21 Vidhya Nagar, Erode – 638 009 (India)
e-mail: rahaman@eth.net

EXTENDED ABSTRACT

Sambhar Lake, one of the largest inland saline depressions in western desert of India was declared a Ramsar site in 1990 due to its biological and biotic importance. It is situated west of Jaipur, Rajasthan, and this salt lake forms a vast saline wetland, which constitute the most important area for the flamingos outside Rann of Kutch. In 1982 –83, over 5 lakhs flamingos were counted in addition a large number of Pelicans. Despite its importance, water fowl habitat, Sambhar is known as a source of salt producing 2.5 lakh MT annually by Government sector and over 15 lakh to 20 lakh MT in private sector by sub-soil brine by making bore wells. Due to depression in the middle, the water collected there and three processes such as percolation, evaporation and salt production are being carried out in this lake. In 1985 and in 1992, a flood like situation in Sambhar, which resulted in increasing the fishery resources, and later the resources were threatened due to increase in brine density and had no commercial value. With an increase in density, the periphery of the salt lake was exploited for salt production and bittern was discharged into lake and the quality of salt has decrease. It was the original status of Sambhar Lake because of the perpetual drought condition; most of the rivers have filled with sand due to wind action. The following factors have been attributed for the threatening of wetland eco-system of Sambhar lake: -

(1) The path of the fresh water has been restricted.
(2) Because of the drought, the Government made a policy to stop the water flow by making checked dams and anicuts for agriculture or to improve water table for water harvesting. Because of this, the water flow to the lake was completely stopped from the catchments area.
(3) With the low rainfall, percolation became lesser and sub-soil brine reached 18 to 24°Be.
(4) When the lake is filled with the rainwater, the fresh water gets percolated in the sub-soil resulted in salinity gradient and conversion of rainwater into high-density brine takes place.
(5) Dead algae in the brine contributed to the total organic carbon in the salt.

To revive the present condition, the rainwater should reach to the lake from the catchments area. However, during summer, the lake will completely become dry and the salt deposited In the lakebed will also be dried. In Rajasthan, in that particular area, there is lot of gale, storms, and heavy stormy wind during the month of May & June, which will take the salt through wind to nearby area, and that area will also become salty. These observations are discussed in the light of available field data on Sambhar salt lake.

Keywords: Sambhar lake, Algae, Algae percolation, evaporation and crystallization Processes, salt production in saline lake.

INTRODUCTION

Saline lake is the most extreme type of ecosystem, which can be divided into two sub-ecosystems i.e., brine area and surroundings salt marsh ecosystems. The modern increase of climatic dryness in arid zone lead to lowering of lake level and increase of water mineralization (Egorov, 1994). Li Wenpang and Liu Zhenping 1994 studied the ground water flow system and brine movement in salt lake. The author concludes salt is the result of geologic historical accumulation that is the water recharged under certain climatic conditions transports the salt accumulated during the geological history to form a new salt layer. The evolution of salt lakes is related to climatic condition. Dry and cool climate indicates under optimum climate, the peripheral region of salt lake is marked by developed vegetation. The lake at that time fresh water the dominant deposit is mud and detrital sand because of seasonal winds. There is dark and organically rich mud layer underlining the saline layer. The mud sediment contains salt minerals and the content differed in the different lakes. The lake water is concentrated when the evaporation increased. With an increase of brine concentration and density, the condition at the lake bottom is characterized by sluggish water circulation and poor in oxygen so the organic materials were reserved in the mud layer (Jianmin and Qingtang, 1994). The saline lakes associated agriculture is the modern agriculture where there is an integration of agriculture, industry, trade and contemporary science and technology. It is stated that "SLA" is abbreviated form of "saline lakes for agriculture" would become a prospective industry in the 21st century (Zheng Mianping *et al*, 1994).

China is one of the countries that has many salt lakes which are widely distributed having different geological, geochemical and hydrochemical compositions. According to incomplete statistics, there are about 1000 salt lakes in China, covering an area of more than 50,000Km^2 totally. Salt lakes in China are divided into three zones. The carbonate-type, sulphate type, and chloride-type being smallest one (Chen, Kezao *et al* 1994).

The Sambhar salt lake in India is considered as alkaline type. It is situated in latitude 26^{0}58'N and longitude 75^{0}5' E on the east of the Aravalli hills in Rajasthan, India. The lakebed varies from 1181 feet to 1196.76 feet above the sea level. It is one of the largest inland saline depressions in western desert of India and was declared a Ramsar site in 1990 due to its biological and biotic importance. It is situated west of Jaipur, Rajasthan, the lake along with Phulera and Didwana salt lake forms a vast saline wetland, which constitutes the most important area for the flamingos outside Rann of Kutch. The area about 7500 sq.kms. leading to salt lake through many rivers however out of them 3-4 rivers drain their water into the lake in addition to small rivulets. To continue the biology of the blue-green algae of the Sambhar lake salt works was studied (Subbaramanian, K 1972). Lall, 1987 recorded the algae problem in Sambhar salt works. The algae appear in the brine and impart different courses like light green, yellow, dark brown and pink. This aspect has been confirmed in the chemical composition of salt produced in the Sambhar salt where the colour appearance of salt differed from inherently pink colour (Kyar salt) pink colour (Reshta salt) off-white with greenish tinch (Jonwal, 2006 Personal communication). Finally the algae appear on the surface as scum, which suggests that at higher concentrations the algae have been destroyed. The normal crystal growth has been adversely affected; besides, the production of salt has also declined, which appears to be largely due to algal contamination of ponds (Lall, 1987). In 1982 –83, over 5 lakhs flamingos were counted at Sambhar Lake in addition a large number of Pelicans also congregated at this lake during winter. Despite its importance, waterfowl habitat, Sambhar is known as a source of salt. It is the amongst the largest producers of salt in India, about 2.5 lakh MT is being extracted annually by Sambhar Salts Limited from surface water of lake and over 15 lakh to 20 lakh MT in private sectors by sub-soil brine by making bore wells. Almost 8,000 ha. Area of the lake has been appropriately given to saltpans. The plans to increase the salt production threaten to further disturb the lake's eco – system.

The lake in the desert of Rajasthan is something like a bowl depression in which rainwater is stored. Due to depression in the middle, the water collected is used for salt production. In 1985, a flood situation occurred in Sambhar, which resulted in increasing the fishery resources thus, inviting winged visitors to this lake.

The following migratory avian fauna were recorded.
1. Greater flamingo
2. Common shelduck
3. Red shank
4. Common sand piper
5. Black wing stilt
6. Kentish plover
7. White cheeked Bulbul
8. Ruff
9. Ringed plover
10. Sociable Lapwing from Siberia

Later on the situation was remained for a year and due to high productivity, fishery resources were increased and also marketed. In 1992, again the lake experienced a very heavy rain. The fishery resources were again increased and after survival in the first stage when the salinity increased to 1 to 1.2 ^{0} Be The fisheries were threatened and ultimately died and it had no commercial value. With the lapse of time, the salt content increased and diversity of the organisms decreased. The green algae, which were dominating initially in the fresh water, have completely disappeared. The flamingos, which were visiting lake during the season, have migrated to the other feeding ground. When the river water increased in salinity, the density also increased with a result the leading salt manufacturers were tapping the resource and some low and marginal salt producers were also drawing the brine at the periphery of the salt lake from sub-soil for salt production. The salt production became a lucrative business with a production capacity of 2.5 lakh MT by Sambhar Salts limited by surface water of lake and about 15 to 20 lakh MT by private sector by tapping sub-soil brine on the periphery of lake.
The irony of the situation is that whatever is being done, ultimately salt as product. Effluent in the form of bittern instead of draining outside or using for another activity either biological or chemical is recycled in the resource itself and the quality of salt gradually decreased. In addition, the lake is contaminated with the other organic compounds, which get mixed with the fine silt of the lake decreasing the quality of salt. It is attributed that an increase in salinity in the reservoirs and condensers it was the original status of Sambhar Lake because of the perpetual drought condition, most of the rivers have filled with sand due to wind action. The following factors have been attributed for the threatening of wetland eco-system of Sambhar Lake.

Figure 1: Shows a view of the Sambhar lake comprising collection of River water (left) and storage area (foreground) and supply channel to the salt production area.

Figure 2 Showing the vast area of Sambhar salt lake and storage of water (Summer season)

1. The path of the fresh water has been restricted.
2. Because of the drought, the Government made a policy to stop the water flow by making check dams and anicuts for agricultural purpose or to Improve water table for

water harvesting. Because of this, the water flow to the lake was completely stopped from the Catchments area.
3. Now for the water, the lake has to depend on the local rainfall. This resulted in the very low water availability in the lake. Because of less available water in the lake, it is presumed that the percolation became lesser or in other words, the availability of water in sub-soil area particularly in the form of brine formed having 18 to 24 Be.
4. When the lake is filled with rainwater, the fresh water gets percolated Into the sub-soil. Because of the percolation of fresh water in the sub-soil where already brine of higher concentration exists which resulted in the salinity gradient; as it is known that the salt in higher concentration diffuses in the lower concentration, which resulted the fresh water, gets converted Into brine. This is the just the way the fresh water of the surface gets converted into brine. It is attributed that percolation, evaporation and diffusion are processes that are responsible for the conversion of the rain water into high-density brine.
5. The algae which were grown in the low saline medium which formed the feeding ground for the migrating birds gradually decreased in productivityd ue to increase in salinity and probably due to scum formation (Lall, 1987). The salt is contaminated with dead algae and the organic content in the salt .Has increased resulting in the decrease in quality of salt.

Any revival of the condition provided that:
1. Rain water should reach to the lake from the catchment area, which was restricted previously as the rain water is being harvested for the other economical activity such as drinking water supply, agricultural purpose and to increase the water table. There is no water in Rajasthan and water scarcity existed. The only hope is to depend on the localized heavy raiin which is the possibility. The State experiences heavy rain once in 10 years. It means that no or very less production of salt from lake water when there is no water in let into the lake.
Irrespective to the above it is forecasted that hydro, geochemical cycles are to take place naturally such as:
1. Water necessarily will percolate to the sub-soil brine and
2. Water will get evaporated and
3. Salt will be crystallized the lakebed.

These three phenomena will take place. However, during summer, the lake will completely become dry and the salt deposited in the lakebed will also get dried In Rajasthan, in that particular area, there are lot of gale, storms, heavy stormy wind during the month of May and June are prevalent. The stormy wind takes away the salt to nearby area and that environment may also become salty In other words, salt production is not must, it is not harmful. If the salt is produced, it is not harmful and it saves the fertile land. Hence, salt production is forced to practice in that area from surface water of lake. If the water is withdrawn from the lake and it is converted into the salt and salt gets harvested. Thus it saves the fertile land. This peculiar phenomena has been observed over the last few decades and it is now recommended to the paper recommends, to make a study on the geochemistry of the soil and biologically manage the salt works for quality and quantity production of salts and its byproducts.

ACKNOWLEDGEMENT.

The facilities provided to Abdul A.Rahaman by the Chairman and Managing Director of Hindustan /Sambhar salt Limited is gratefully acknowledged.

REFERENCE

Aggarwal, S.C.,(1956) *Salt Industry in India*. 195:272

Aharon, Oren *et al.(*1994), Interrelationships between *Dunaliella* and Halophilic rchae in hypersaline lakes. Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing,China.

Chen, Kezao and Xu Zhiqing (1994), The general characteristics of Salt Lakes in China. Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing, China.

Egorov, A.(1994), The ecological problems of some salt lakes: Russia, Middle and central ASI. Abstracts of the *6th International Symposium on Saline lakes*, Scientific Committee of 6th ISSL Beijing, China.

Jianmin, Zhou and Qingtang, Yang (1994), The deposition features of salt lakes in Inner Mongolia And their implication for paleoclimate. Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing, China (17).

Lall, S.B.(1987), Note on Sambhar salt works and algae problem. *In:Artemia Newletter*, Number 5:5-6.

Li Wengpeng & Liu Zhenying (1994), Ground water flow system in golmud river valley and Intercrystal brine Movement in the area of qarhan salt lake. Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing, China (55).

Subbaramanian, K (1972), The biology of the blue-green algae of the Sambhar Lake Salt works. In: Desikachary, T.V (Editor) Taxonomy and biology of blue green Algae. *First International Symposium on Taxonomy* and biology of blue green Algae held at Madras, January 8-13, 1970.University of Madras, Madras 339- 441.

Yang Qian *et al.*, (1994), The recent study of the Qarhan Lake. Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing, China.

Zheng Mianping *et al.*, (1994), Concept and prospect of saline lakes associated agriculture. Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing, China.

Zheng Mianping (1994), Paleoclimatic evolution of the qinghai-Tibet plateau since 38 Ka B.P. evidence from saline lake deposits. Abstracts of the 6th International Symposium On Saline Lakes, Scientific Committee of 6th ISSL Beijing, China (2).

Zhu Lixiang *et al*., (1994), Artemia resources in inland salt lakes in Peoples Republic of China, Abstracts of the *6th International Symposium on Saline Lakes*, Scientific Committee of 6th ISSL Beijing, China.