

TROPICAL SOLAR SALT WORKS - INFLUENCE AND CHALLENGES IN THE COEXISTENCE WITH TRADITIONAL POPULATIONS IN THE BRAZILIAN NORTHEAST REGION

R. M. ROCHA¹, D.F.S. COSTA¹, D. H. M. MEDEIROS¹, F. A. M. SANTOS¹, L. F. SILVA¹

¹ Universidade Federal do Rio Grande do Norte, Semi-arid Ecology Laboratory
Rua Joaquim Gregório, s.n. Penedo. CEP. 59.300-000. Caicó. Rio Grande do Norte (Brazil)
E-mail: renatocaico@yahoo.com.br

EXTENDED ABSTRACT

The northern coast of the Rio Grande do Norte (Brazil) state has presented as one of its main characteristics the occupation of the estuary borders by great saltworks companies and cities directly related to that activity. In chronological sequence, the majority of the cities had their expansion and construction near to the old artisan saltworks which were constructed along to the estuaries of the main rivers from the period of the Portuguese colonization (near of year 1500). Nowadays, due to the accentuated growth of the coastal cities, the spaces destined to the salt production has also been acting like limits of the urban zones, causing the use of the saltwork ecosystem by the human populations not only for the production of marine salt (NaCl), but also for the capture of fishing, crustaceans, seafood, and other characteristically associated fauna animals to the Brazilian solar saltworks. This survey was developed in the saltworks located in the northern coast of the state of the Rio Grande do Norte (Brazil), in the coordinates 4° 55' 56" S, and 37°10' to 36°15' W, having as the analysis the relations between the solar saltworks and the human populations located in urban areas of their surroundings. Initially, it was carried out a bibliographical revision as adopted method of survey about the ecology of saltworks and the occurrence of those ecosystems in Brazil. Moreover, it was held an identification of the occurrence areas of saltworks to the length of the analyzed coastal area, by means of the satellite image analysis (CBERS 2), being used digital photography and GPS (Global Positioning System) as complement resource. Another resource used was accomplishment of interviews and survey application between the users of this environment. According to the results of survey, it has shown the opening areas next to the vegetation of mangrove swamps, resulting of accidents of the marine salt transportation of the saltworks located in the estuary. A challenge for the managers of the saltwork companies is the invasion of clandestine collectors of *Artemia* sp., promoting the fall of the populations of that so important crustacean for the production of salt. The artisan fishing in the evaporators of the saltworks is an activity that is being developed from the period of its construction. The saltworks located in the Brazilian coast still face the threat of the contamination for the great

amount of urban waste water discharges that flow to the estuaries. Still, the implementation of effective measures of environmental management in the part of ecosystems located next to the saltworks (cities, shrimp farms, and others) are important for the coexistence of several elements in the landscaping picture of the Brazilian coast.

Key words: management, saltwoks, traditional populations.

1. INTRODUCTION

The high and increasing urbanization rates observed mainly in the last two decades contributed in an alarming way for the increase in the concentration of poverty and the degradation of natural resources, affecting in a negative way the quality of population life (VAN BELLEN, 2004). The absence or lack of planning has caused serious environmental problems, such as air and water pollution, floods, erosion and landslides, removal of vegetation cover, which bring disastrous consequences to the daily life of the population and the rest of living beings

(NAGAGATA, 2006).

The northern coast of the Rio Grande do Norte (Brazil) state has presented as one of its main characteristics the occupation of the borders of its estuaries by great solar saltwork companies and cities directly related to that activity (see Figure 01). In chronological sequence, the majority of the cities had their expansion and construction near to the old artisan salt pans, that were constructed throughout the estuaries of the main rivers from the period of Portuguese colonization (near of year 1600).

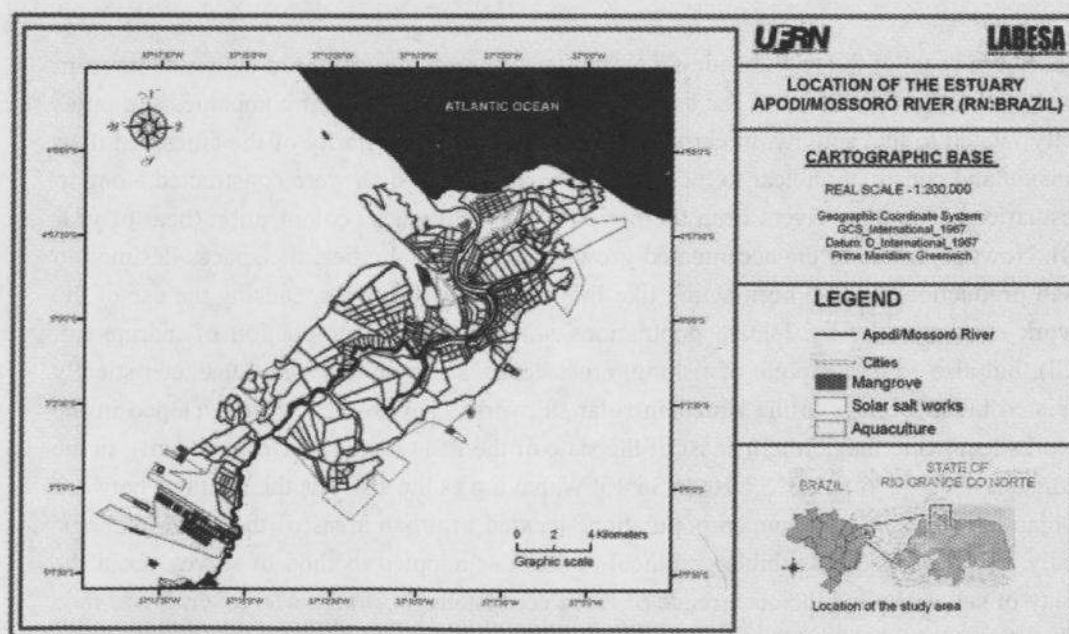


Figure 01 – Intensive occupation of Apodi/Mossoró river estuary border by solar saltworks (RN – BRAZIL).

Source – Collection of Semi-Arid Ecology Laboratory

According to KOROVISSIS *et. al.* (2006), humans found salt in coastal concavities or in lagoons where seawater was trapped, evaporated in the sun and deposited its salt content. It is deduced that after a long period of observation and knowledge-building, humans eventually copied nature and began producing salt

quantities to meet their personal and social needs, thus moving away from nature's production rates. Therefore, this is the initial stage and constitutes the first form of the solar sea salt production process.

The location of these companies

throughout the estuaries of the main rivers in that coast is due to the conjuncture of environmental factors, such as semi-arid climate, high temperatures ($> 28^{\circ}\text{C}$), low precipitation (< 800 mm/year) and high evaporation rates, with water availability of the estuary. In that coast, the major solar saltworks of the country are installed, being responsible by 95% for the produced and exported marine salt.

Nowadays, the accentuated growth of the coastal cities, spaces have destined to the production also acting as limits of the urban zones (ROCHA, 2005), this has caused the use of the solar saltwork ecosystem by human populations not only for the production of marine salt (NaCl), but also for the capture of fishing, crustaceans, seafood, and other characteristically fauna animals associated with this Brazilian ecosystem.

The solar saltworks as representative wetland ecosystems have high vulnerability due to natural processes and human interventions in the coastal zone (DAVIS, 2000; MOOSVI, 2006). This fragility is higher mainly in located areas in the Brazilian northeast portion, where adverse weather conditions and an accelerated occupation process of the coastal zone, which includes shrimp and urban sprawl, among other activities, resulting in permanent environmental pressures on these ecosystems. Inserted in this context, the saltworks located in northern coast of the state of Rio Grande do Norte (Brazil), due to its proximity to urban areas, have been targets of a range of anthropogenic pressures.

Furthermore, the salt industry of Rio Grande do Norte has been going through a gradual process of modernization, requiring an increasingly competitive product in international market, particularly in relation to their degree of purity and quality. Moreover, the current concern is to get a product that is the result of an appropriate environmental management and according to environmental standards.

To change this scenario, it has become a relevant role the development of a

strategy for the environmental management strengthening at municipal level, with the creation of municipal environmental protection programs and environmental policies (environmental education, for example).

The survey shown in this study was developed in the solar saltworks located in the northern coast of the Rio Grande do Norte (Brazil) state, having as analysis to this, the relations between ecosystems and the human populations located in urban areas of their surroundings.

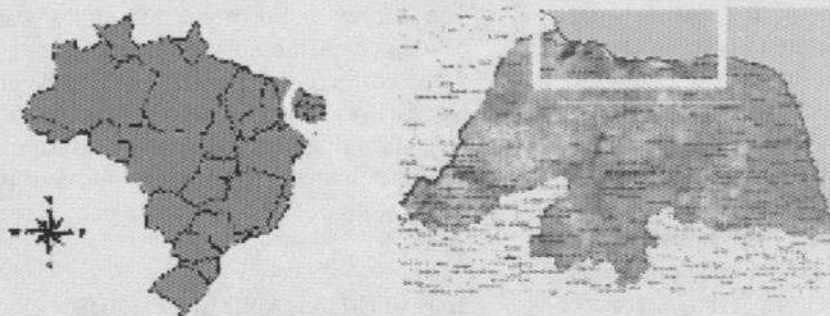
2. MATERIAL AND METHODS

The northern coast of the state of Rio Grande do Norte - Brazil, where salt businesses are situated, is located between $4^{\circ} 56' 509'' 30''$ south latitude and $37^{\circ} 09' 37'' 17''$ west longitude (see Figure 02).

Initially, as adopted methods of survey, a bibliographical revision about the ecology of saltworks and the occurrence of those ecosystems was carried out in Brazil. Associated with documentary survey, it also was developed an identification of the occurrence areas of saltworks to the length of the analyzed coastal area, by means of the satellite image analysis (current CBERS 2), being used digital photography and GPS (Global Positioning System) as complement resource.

Those areas have been analyzed from 1973 by means of field visits, with a view to identifying the anthropogenic aggressions that threaten the operation and preservation of the saltwork ecosystems, as well as the environmental recovery of hit areas.

Another resource used is accomplishment of interviews and survey application between the users of this environment (mainly local fishermen and people that works in the saltworks), obtaining the information about the people profile and relation with the preservation and operation in the ecosystem of the solar saltworks.



Location of the study area

Figure 02 – Location of salt areas in state of do Rio Grande Norte (BRAZIL).

Source –Collection of Semi-Arid Ecology Laboratory.

3. RESULTS AND DISCUSSION

It is examined an advanced stage of degradation of plant components in studied areas, with stretches of low or even zero occurrence of plant species on the shores of estuaries, these facts from a number of past and current activities that contribute to the occurrence of this panorama.

According to results of survey, the opening areas have shown next to the vegetation of mangrove swamps, result of accidents of the marine salt transportation of the saltworks located in the estuary. That vegetation plays a protective and natural role to saltworks against the tidal action, can be evaluated as a possible indicator of commitment and sensitivity of the site to external events, whether natural or anthropogenic in origin.

Mangroves are halophytes which can grow in coastal mudflats and estuarine conditions. Halophytes are called in the sense that they possess physiological and anatomical adaptability to grow in salty environments. The mangrove plants too contribute to coastal ecosystem in many ways. In addition to reducing coastal

erosion, serving as natural barriers against storm surges, they also contribute to the marine food chain through the production of detritus produced by litter fall (DUKE *et. al.*, 1998).

Integrated ecosystems are of high importance because they provide the opportunity for the flora and fauna co-existence. Mangroves and solar saltworks together form a highly relevant ecosystem where mangroves are generally adjacent to salt ponds.

In Brazilian saltworks, these ecosystems play a relevant role mainly in the containment of the salt walls against erosion. Being located in areas of mesotides (2 to 4 meters), saltworks depend on these ecosystems as depreciation areas of the tidal action.

The occurrence of these areas with no vegetation on the banks of the estuary is reflected in a concern way, since the presence of the plant component is important to minimize the degree of saline vulnerability to outside events. The mangrove vegetation provides a natural protection against the erosive forcing produced by the tidal and wind action on

the walls of saltwork. It is worth noting that the falling of the rest of the mangrove vegetation on the banks of the estuary can generate irreversible damages to the structural development of vegetation at these impacted sites (DUKE *et. al.*, *op. cit.*).

Another anthropogenic aggression identified in that ecosystem has shown the great quantity of urban trash within the evaporators of the saltworks. These wastes are brought of urban area by tides along the estuaries. This is highly disturbing to saltworks, since the deposition of waste occurs near the eastern limit of the venture. The accumulation of material not only increases the export of contaminant substances to waters of the estuary, but also is a potential contaminant of water captured by saltworks, because of estuarine hydrodynamics. Therefore, it is of utmost urgency to transfer the material to appropriate areas, so that will not compromise the salt activity and the environment as a whole.

These saltworks located in the Brazilian coast still face the threat of the contamination for the great amount of urban waste water discharges that flow to estuaries. The growth of the cities next to the solar saltworks and in the edge of estuaries, sending their water effluents into the estuaries, changing the ecological quality of waters used for the salt production.

Another aspect to be taken into account concerns the challenge for the managers of the saltwork companies is the invasion of clandestine collectors of *Artemia* spp. This action has been promoting the fail of the populations of that so important crustacean for the production of salt because its activity as natural filters of impurities.

In this sense, it is intended to create an establishment of a collecting cooperative of *Artemia*, properly registered along with the saltworks. These people would have permission to perform the collection periodically and under prior study of environmental supportive capacity, not to cause a substantial population fall of that crustacean so important to the ecosystem.

In another sphere, associated with the entrance of fish in the saltworks by means of the pumping stations, the artisan fishing in the evaporators of the saltworks is an activity that have been developing from the period of its construction. Several families who live near the saltworks depend directly on that activity for their survival. Thus, they also act controlling the populations of fishes that are being inserted within the feed chain on the salt-work ecosystems in Brazil.

It is worth highlighting that this activity has clearly demonstrated the direct relation between the semi-artificial ecosystem of saltwork (DAVIS, 2000) with the local fishermen. These people also fish in the estuary and tidal channels, but the catch of most species occurs in a faster and greater quantity way in the initial evaporator of saltworks.

Looking in a clear way, the vast majority of fish do not survive the gradual increase of salinity over the production, then dying after the transfer of water in initial evaporators. Accordingly, the fishermen act as important elements of population control, since the fish is not caught; they die to be deposited on the banks of evaporators, causing a strong odor.

In relation to the economic aspect, great part of the human populations that are located near to the saltworks interact direct or indirectly with that activity, mainly by the job generation and taxes payment of the main factors that move the local economy. Due to the enormous production of these companies, over the years it has arisen several waves of hiring labor to work mainly during the harvesting of salt. The bulk of employment generation serves as a master spring for the local markets, taking place a chain of direct and indirect jobs related to salt activity.

Along with the generation of jobs, taxes paid by the saltworks are largely responsible for annual revenues of the cities where they are located. Thus, the indirect economic circuit connected to the salt production process involves and manifests itself as one of the most important agents of articulation and survival of a large population that inhabits the nearby cities to Brazilian

saltworks.

4. CONCLUSIONS

There is a close relationship between the production of marine salt located in the Brazilian coast and the human populations that live there. Those relations are specifically visible in the economy field, where the job generation and tax payments are a preponderant factor of saltwork-man association. In this relation are even observed critically the survival of the families that capture some animals in the saltworks.

Still, the implementation of effective measures of environmental management in the part of ecosystems located next to the saltworks (cities, shrimp farms, and others) has a relevant role for the coexistence of several elements in the landscaping picture of the Brazilian coast. The urgency in the environmental control is also translated in the predatory action of clandestine collectors of *Artemia*, which interfere in the operation of that ecosystem, being able to change all the production system. Therefore, correct use and viable handling of activities are important for ecosystem, observing that these ecosystems are located in areas of permanent preservation.

REFERENCES

1. DAVIS, J. S. Structure, function, and management of the biological system for seasonal solar saltworks, *Global Nest*, v. 2, n. 3, p. 217-226, 2000.
2. DUKE, N. C.; BALL, M. C.; ELLISON, J. C. Factors influencing

in mangroves biodiversity and distributional gradients, *Global Ecology and Biogeography Letters*, v. 7, 1998, p. 27-47.

3. KOROVISSIS, N. A.; LEKKAS, T. D. Solar saltworks production process evolution - wetland function. In: *Proceedings of the 1st International Conference on the Ecological Importance of Solar Saltworks* (CEISSA 06), Santorini Island, Greece, 20-22 October 2006. (KOROVISSIS & LEKKAS, 2006).
4. MOOSVI, S.J. Ecological importance of solar saltworks. In: *Proceedings of the 1st International Conference on the Ecological Importance of Solar Saltworks* (CEISSA 06), Santorini Island, Greece, 20-22 October 2006.
5. NAGAGATA, Elizabeth. A importância da educação ambiental como ferramenta adicional a programas de conservação. In: ROCHA, C. F. D.; BERGALLO, H. G.; SLUYS, M. V.; ALVES, M. A. S. *Conservation biology*. São Carlos/SP: RiMa, 2006, p. 563-585.
6. ROCHA, A. P. B. Expansão urbana de Mossoró/RN (período de 1980 a 2004): geografia, dinâmica e reestruturação do território. *Dissertação de mestrado em Geografia*. Universidade Federal do Rio Grande do Norte, Natal/RN, 2005.
7. VAN BELLEN, Hans Michael. *Indicadores de sustentabilidade: uma análise comparativa*. Rio de Janeiro: Fundação Getúlio Vargas, 2006.
8. _____. Sustainable development: presenting the main measurement methods. *Environment and Society*, Campinas, v.7, n.1, p.67-87, jan./jun., 2004.