ECONOMIC POTENTIAL OF SALT MINING IN GHANA

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Abstract

Ghana is endowed with commercial quantities of common salt, which have not been fully exploited to effectively contribute to the country's economic growth. The market potential of salt in Ghana and in the ECOWAS sub-region is enormous and is currently generating about US $62.5 million annually though a market value of over $5 billion is available in the sub- region. When fully exploited the salt industry could help in providing employment for Ghanaians leading to improvement in infrastructural development in communities where the mineral is found. This paper calls for the improvements in the current salt production system and diversification into value addition with the chloro-alkali industry. Suggestions are presented to help solve some of the problems militating against the industry.

1 Introduction

Common salt, NaCl, is an important economic mineral that is widely distributed on all the continents and occurs in large reserves. Animals including humans need salt in their diets. It is also used to season and preserve food and in the soap, glass and oil industries. The most important reserve of common salt is oceanic water where the concentrate ranges from 2.2 to 2.7 wt %.

Apart from bedded or fossil salt domes the most common source of salt production (mining) is from salt winning by evaporation of sea water. In the West African sub-region where there are neither salt domes nor fossil salt deposits the most important source of salt is salt water.

However only Ghana and Senegal (Fig. 1) have favourable coastlines for salt winning in the West African sub-region with a total production of about 350,000 metric tonnes per year, a figure far below the expected demand of 1.5 million metric tonnes per year (Anon., 2008). Of the two countries Ghana has the

best potential. However salt winning is redimentary and burdened with problems.

This article gives an overview of the salt industry of Ghana, presents a market analysis, outlines the problems facing the salt industry, discusses these issues with case studies from similar tropical countries, presents proposals for improving the salt industry in Ghana and propagates the need to establish a chloro-alkali industry in the West African sub-region in the medium term to generate employment for over 100 000 people altogether.

In Ghana salt winning is concentrated in the Central and Greater Accra Regions where climatic conditions, humidity and amount of rainfall are most favourable. The high potential of the industry in Ghana is, however, yet to be realised as current salt production is about 300 000 metric tons per annum which is less than 10 % of the industry's potential estimated at 2.0 - 3.0 million metric tonnes per annum.

The Salt industry could be developed into an internationally competitive one with an enhanced capacity for the production of good quality salt for domestic and export markets, increasing production from 200,000 metric tons in 2004 to 2,500,000 metric tons in 5 years

The industry is however constrained by: obsolescence of technology; lack of local expertise and poor production methods; poor industry infrastructure; lack of economies of scale; low investment and lack of credit; cumbersome land acquisition procedures and land tenure administration systems.

Over the years, Ghana has depended on a few traditional commodities for export revenue thus putting her in a vulnerable position when the prices of these commodities decline significantly. For example in 2005, cocoa beans and related products earned Ghana US$ 815.8 million which represented 30% of total export earnings. Gold fetched the country US$ 918.4 million representing a share of 33.7% while timber and related products brought in US$ 232.3 million for Ghana, a share of 8.5%. Non-traditional exports fetched US$ 754.7 million and constituted 27.7% of export earnings in the same year (Anon., 2008). There should therefore be efforts at expanding and diversifying Ghana's exports to reduce the dependency on a few traditional commodities. It is in this direction that some selected commodities such as salt should be targeted for promotion and development.

2 Conditions conducive to salt winning in Ghana

It is estimated that the productivity of salt works in Ghana averages 1,600 tonnes per year per hectare of crystallising area. This is based on an analysis of climatic factors such as temperature, rainfall pattern, humidity and wind speed and the soil characteristics of the areas for salt production. It is estimated that about 50,000 hectares of land in the coastal region of Ghana can be used for salt production. Land already licensed to be used for salt production is about 28,000 hectares. It is estimated that 40% of this land is being used now for salt production. (Quashie & Oppong, 2006).

2.1 Rainfall

The movement of the Inter-Tropical Boundary (ITB) controls, to a large extent the distribution of rainfall over the West African meteorological region. The ITB oscillates between the coast and latitude 20° N. As it moves north and south, it draws with it the associated weather zones. Thus, in January or February for instance, the region of localised thunder activity and disturbance are south of the Guinea Coast and the whole of Ghana lies in the cold dry North Easterly Trade Winds (Harmattan). The climate of the coastal lands of Ghana has the dry and rainy seasons. The rainy season has two maxima; the main (May/June) and the minor (October). June is the wettest month in Ghana. According to the meteorological information, a narrow coastal belt, receives the lowest rainfall in Ghana during any given year. The total minimum annual rainfall recorded at the western coastal area of Ghana which happens to be the wettest area on the coast and also in the whole country from the Axim meteorological station over the last 15 years is 1,169.2 mm (in 1998) while the highest was 2,337.2 mm (in 1993). The eastern coastal area has the lowest rainfall figures on the coast. Data from the Akatsi meteorological station gives a minimum of 679.6 mm (in 1992) and a maximum of 1136.6 mm (in 1997) over the past 15 years (Anon., 2006).

2.2 Air Temperature

The mean temperature along the coastal area has a simple seasonal rhythm, with a February – April crest and in July – August trough. The months with lower mean temperature are July to September, which correspond with the months of higher cloudiness of the year. The range of average temperatures in the dry eastern area is 23.1 °C to 33.4 °C. The average temperature varies from 23.1 °C to 31.2 °C in the wet western area of the coast.

2.3 Relative Humidity

The relative humidity has the lowest values from December to February. During June to August, it records the highest of the year. The average relative humidity in percentage varies from 75% to 88%. The lowest relative humidity records correspond with the months of higher evaporative rates.

2.4 Wind

The prevailing wind direction is from the southwest all around the year (South-Westerly Trades) which is a characteristic feature of all the costal belt of the country.

2.5 Evaporation

The angle of declination for solar radiation is very good in Ghana and this helps to increase the rate of evaporation on less cloudy days to acceptable levels. Those months with less evaporation values, correspond to those of higher cloudiness and thus, have a lower ratio between the total daily radiation onto a horizontal surface and the daily extraterrestrial. The average daily net evaporation is estimated to be 4.8 mm in fresh water and 0.85 mm in saturated brine.

2.6 Seawater Characteristics

Coastal waters are under the influence of the Guinea Counter Current, which flows in a direction parallel to the coast. This characteristic enhances a normal composition of the seawater, especially during the dry season.

The prevailing winds are the south westerly trades, which contribute to improve oceanic characteristics of the coastal water. One important characteristic of the seawater in the coastal belt is the presence of suspended sand particles that occur during the rising tide and from strong waves surfing over the sandy shoreline with wave of over 2 metres. The average density of seawater is 3.5 °Be while that for the lagoons ranges from 5 °Be to 15 °Be depending on whether it is a closed lagoon or an open lagoon. The density of the lagoon also depends on the season; being higher in the dry season and lower in the wet or rainy season (Biney et al., 2004)..

3 Salt Production Potential in Ghana

Ghana has both inland and oceanic sources of salt, although emphasis so far has been more concentrated on the oceanic sources. The conditions for producing this type of salt get better from the west to the east along the coast since there is a decrease in rainfall amounts. The most coherent reason, according to the Ghana Meteorological Service Department is that east of longitude 2° W the coast line is oriented in such a way that, the prevailing moisture-laden winds (south-westerly trades) blow parallel to the shore line. Consequently, the full influence of the onshore winds is not felt inland resulting in less rainfall. However, west of longitude 2° W, the same prevailing winds blow more perpendicularly across the coastline resulting in more rainfall in this region (Dolbear, 2003).

There are four different types of salt recovery namely: Rock Salt Mining, Solution Mining, Solar Salt and Processing of Rock Salt. Of these, the solar salt method is the most widely used in Ghana because of high evaporation rates and low precipitation that exist along the coast. In the solar salt method, sea water is made to enter or is pumped into ponds with dykes to prevent the water from escaping. It is continuously evaporated by solar heating and wind flow. As the water evaporates, its concentration rises and the constituent salt crystallises out. The crystallised salt is then washed to remove the insoluble matter like sand and as well as other impurities. It is then allowed to drain and dry in the sun. This redimentary method used by most of the artisanal salt winners does not help in producing substantial quantities that can earn them sufficient income to reduce poverty in the communities. The redimentary technology accounts for the some output of salt in Ghana. It is estimated that the productivity of salt works in Ghana averages 1,600 tonnes per year per hectare of crystallising area on the climatic factors (Quashie & Oppong, 2006).

Salt Exports for the Period 2000-2005

Year	2000	2001	2002	2003	2004	2005
Quantity in tons	69 016	68689	51689	32540	38547	51150
Value in US$m	2.91	2.35	1.82	1.24	2.18	2.31

Anon., 2006 (source: Ghana Export Promotion Council)

In 2005 Ghana exported 51.150 tons salt and received US$2.31 million, studies have shown that 2.5 million of salt can be produced annually. Market studies also reveal that there is vast market for Ghana's salt especially in neighbuoring Nigeria which imports $1.5 billion worth of salt from Brazil and Australia a year in order to meet domestic demands and feed the oil industry (Quarshie & Oppong, 2006).

Salt production potential in Ghana is conventionally estimated at between two and a half million tonnes to three and a half million tonnes per annum (2 500 000 tonnes to 3 500 000 tonnes per annum) based on the climatic and environmental conditions prevalent in Ghana but all the salt industries in Ghana produce approximately 160 000 metric tonnes of yearly, short of the accepted of 1 000 000 metric tonnes to make Ghana a minimum large-scale operator (Teruel, 2006). According the British Geological Survey in 2006 Ghana produced 250 000 tonnes of salt (Anon., 2008):http://www.bgs.ac.uk/mineralsuk/commodity/world/home.html September, 2008.

3.1 Salt Mining Methods

The production of salt by solar evaporation is the main method used in Ghana. Three methods of solar salt production have been identified in Ghana, namely:

- Artisanal Salt winning from lagoons during the dry season
- Traditional Solar Salt Production on small scale
- Modern Solar Salt Production on large scale.

Apart from the artisanal salt winning method in which there is virtually no intervention by man in terms of construction of embankments, etc. The two other methods involve the construction of dykes and the use of pumps to control the flow of water.

The salt production areas in Ghana are mainly found in the coastal wetlands which are around the Keta Lagoon, the Songor Lagoon, the Densu Delta area, Nyanya lagoon, Oyibi lagoon, Amisa lagoon and Amwin/Benyah lagoon.

3.1.1 Artisanal Salt Winning

This mode of production is practised mainly in areas where the population has access to the large coastal lagoons of Keta and Songor. The

practitioners of this method basically wait for the dry season when the lagoon dries up and salt crystallises out. The lagoon bed area is then shared amongst the community members and on a given day everyone goes onto the dry lagoon bed to harvest salt. Generally, the unrefined salt from the local salt producers does not meet the standard specification of the Ghana Standard board. Brine and salt samples from the various stages of the traditional process was analysed for calcium, sulphate, magnesium and chloride contents. The brine samples contained low levels of calcium (ranging from 0.14% to 0.015), and high levels of magnesium (ranging from 1.04 to 4.49%). These two elements constitute the two main elemental impurities found in common salt.

3.1.2 Traditional Solar Salt Production on a small-scale

This method is an improvement on the salt winning method. Here the owners have created embankments where they pump in or allow seawater, lagoon water or well water to flow in by gravity through a series of gates. These ponds are known as backwaters. The water is allowed to stand in these embankments for a period of time for the salinity to increase. The water is then pumped or allowed to flow into crystallizers (known as pans) for it to crystallise into salt. This salt is then harvested after which more water is allowed into the crystallisers. This goes on throughout the dry season. It ceases when the rainy season sets in.

3.1.3 Modern Solar Salt Production on a large scale

Producers use the modern solar salt production method which involves the fractional crystallisation of various dissolved salts in lagoon or seawater in various ponds as the water is moved from evaporators through concentrators to crystallisers where sodium chloride is crystallised out. The range of salinity of the water in each of the ponds is regulated and is graded with the lower salinities in the evaporators and concentrators (which incidentally occupy about
90 % of the land surface area). Presently, there are modern solar saltworks in Densu Delta Site and traditional solar salt production units in the Muni-Pomadze site. The largest sites, i.e. Songor and Keta Lagoon Complex are the sites where all salt winning is done in the country. Together, these form about 90% of all the Ramsar sites in the country.

3.1.4 Stoved salt process

In this method, brine is evaporated to almost dryness in metal pans by application of heat. Clear brine is collected from wells near or from lagoons and put into metal pans. The brine is heated by means of steam pipes from boilers, such as those at Pambros Salt Industry, or directly with oil burners, such as the Midland Salt Company at New Ningo. At Elmina and the surrounding villages, the heating is done, using firewood.

3.1.5 The Brine Daboya Type in the Northern Region

Seepages of brine are known in some places underlain by the Voltaian sedimentary rocks from boreholes at Daboya and Tibogona (Northern Region of Ghana). The brine may be suitable for the development of a local industry, which can serve the needs of the northern part of the country. The salt deposits are near the riverbed of the White Volta. In the dry season, women dig the riverbed and collect the saline water. The brine is put into pots and heated with firewood until the water evaporates and the salt crystallises out.

The salt concentration in seawater along the coast, east of Tema is 30 grams per litre. The salt concentration at Daboya is 7 grams per litre. The economics of salt production at Daboya do not therefore compare favourably with those of the production of salt from seawater by solar evaporation (Bates, 1953).

4 Land issues in the salt production industry

Acquisition of land for investment projects is a major obstacle to business development and economic growth in Ghana. Complex land tenure systems exist in the country where ownership is held by a combination of traditional authorities, families, private individuals and public or Government institutions. Public or state lands are compulsorily acquired by government through the invocation of appropriate legislation, vested in the President of the Republic and held in trust by the state for the people of Ghana. In contrast, private lands in most parts of the country are under communal ownership, held in trust for the community or group by a "stool or skin" as a symbol of traditional authority, or by a family. Between the public and private lands, are vested lands, which are held under a form of shared ownership between the state and the traditional owners. The land issues in coastal districts are not different from the national situation. Some of these areas which have great potential for salt production has suffered from protracted land litigation that has made it difficult for entrepreneurs to invest in the industry. In the traditional areas, it is the customary rule of law that guides land tenure among the people. Unlike certain parts of the country, there are no stool lands in the district. Land is owned by clans through families and it is the clan heads that have jurisdiction over lands owned by their clans. Thus the administration of the lands is undertaken by the head in consultation with the elders of the land-owning families.

Apart from encroachment on hectares of lands by building houses for settlement, residents of the encroached lands pollute the crystallising pans meant for the salt production.

4.1 GIS and the salt industry in Ghana

The 2008 production of salt of 250 000 metric tones falls far short of her potential for commercial production estimated at 2.5 to 3.0 million metric tones per annum. To salvage the situation, the authorities can establish the

National Geographic Information Systems (GIS) to provide the right information needed for an accelerated growth of the industry. The salt industry has been identified as one of the strategic industries in which the country can have high growth potentials and the GIS can transform the Ghanaian salt industry into an internationally competitive one. The GIS system, can tap both unexploited and underexploited salt deposits, would be capable of providing one of the best quality salts for the people in the sub-region and beyond. Benefits to be derived from the GIS include an information gateway for investors, a database for the salt industry, and contours on producing areas in Ghana, detailed information on towns where there is salt and pictorial presentation on the salt industry in Ghana.

One of the very first steps development organizations needed to carry out is to identify the locations of small producer salt sites. In large, uncharted rural areas the most efficient way to do this is through aerial photographs and GPS mapping. This step allows numerous new salt production locations, previously unknown by stake holders, to be discovered. It also aids existing and potential producers, with whom the information is shared, by revealing potential land for expansion or investment; the capacity and suitability of that land for production; the existence of road networks; and the layout and density of the local populations needing salt.

5 Small producer co-operatives

Once the small producer sites are located, contact with producers should be made and, where they do not exist, assistance should be offered to establish cooperatives to farm the salt and receive development assistance. In Senegal, for instance, the growth of co-operatives is supported by government agencies such as Chambers of Commerce and the Internal Trade Bureau. In their favour, co-operatives are more likely to be profitable, with their ability to collectively negotiate higher prices from traders, manage price fluctuations, take advantage of economies of scale and access new markets. However, their firm establishment often requires difficult changes in perception and behaviour regarding such issues as competition, self-reliance and group functioning.

6 Child labour in salt mining

In addition to the strain of the physical effort required in salt mining and harvesting, constant exposure to salt is unhealthy for children. Salt is corrosive. It causes skin on the hands to crack and discolouration of the iris that can damage vision. Some of the common hazards associated with salt mining include:

. injuries from improper use of tools designed for adults and carrying heavy loads;

. fatigue, exhaustion, muscle pain (from bending over/standing up when gathering salt in hot weather);

. severe dizziness, particularly in hot weather;

. cracked skin and hands and feet from handling salt and walking on it barefoot; and

. blisters from walking on salt flats.

7 Salt Productions in the ECOWAS Sub-Region

Salt production in the ECOWAS sub-region is located in Senegal, Ghana, Sierra Leone and Cape Verde. Due to the wide uses of salt and the fact that its production is limited to few areas and subject to weather fluctuations, the demand for salt has always been very high. In the ECOWAS sub-region for instance, the demand for industrial salt is estimated at over 3 million metric tonnes per year for industrial use and over 1.5 million metric tonnes for human and animal consumption, thus making a total of 4.5 million metric tonnes per year. The two countries (Ghana and Senegal) which have the natural facilities for producing salt on commercial basis, together, are able to produce only about 350 000 metric tonnes per year, leaving a very wide gap to be filled by imports from Brazil, Australia and Europe.

Ghana can develop a salt industry capable of satisfying a greater part of the salt demands of her neighbouring countries. The markets of Nigeria, Togo, Benin, Burkina Faso and La Cote D'Ivoire are natural export potential for the Ghanaian salt industry. The Government of Ghana could therefore formulate policies that will allow the private sector to develop the salt industry in order to generate more foreign exchange for the country.

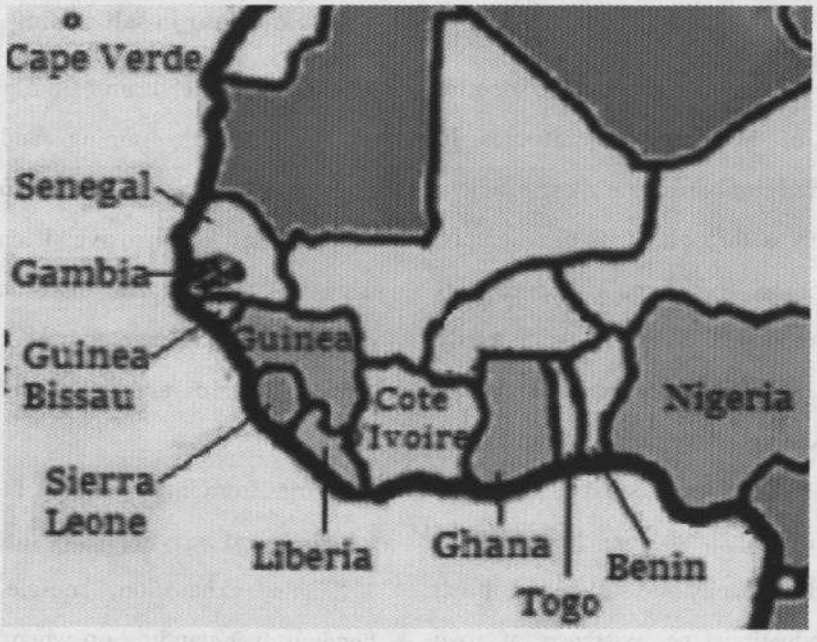

Fig1 Salt Producing ECOWAS countries

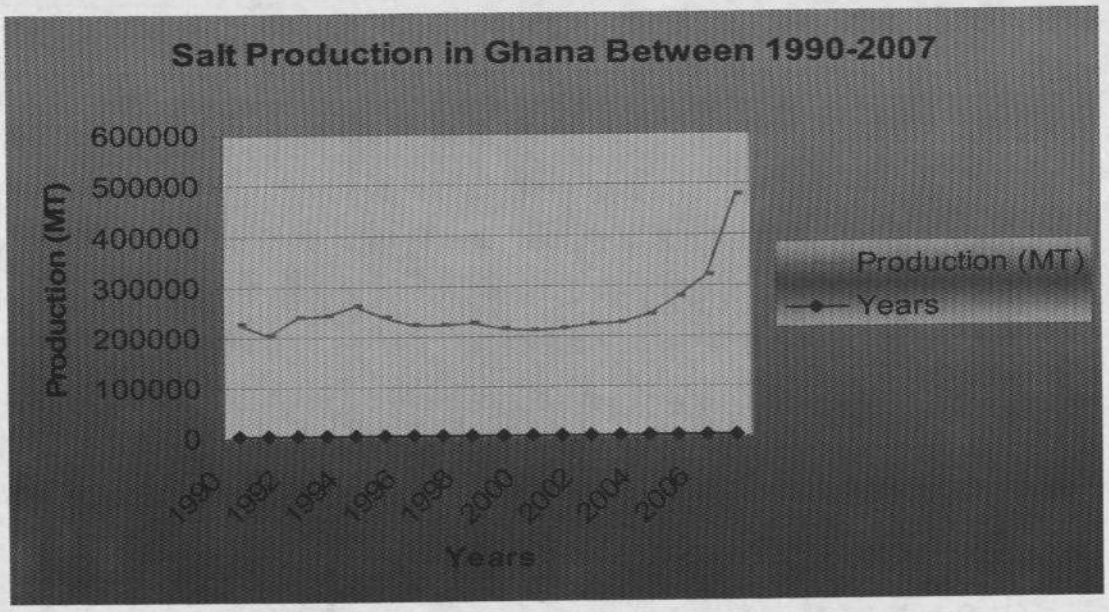

Fig2 Salt Production in Ghana (modified after Anon., 2004)

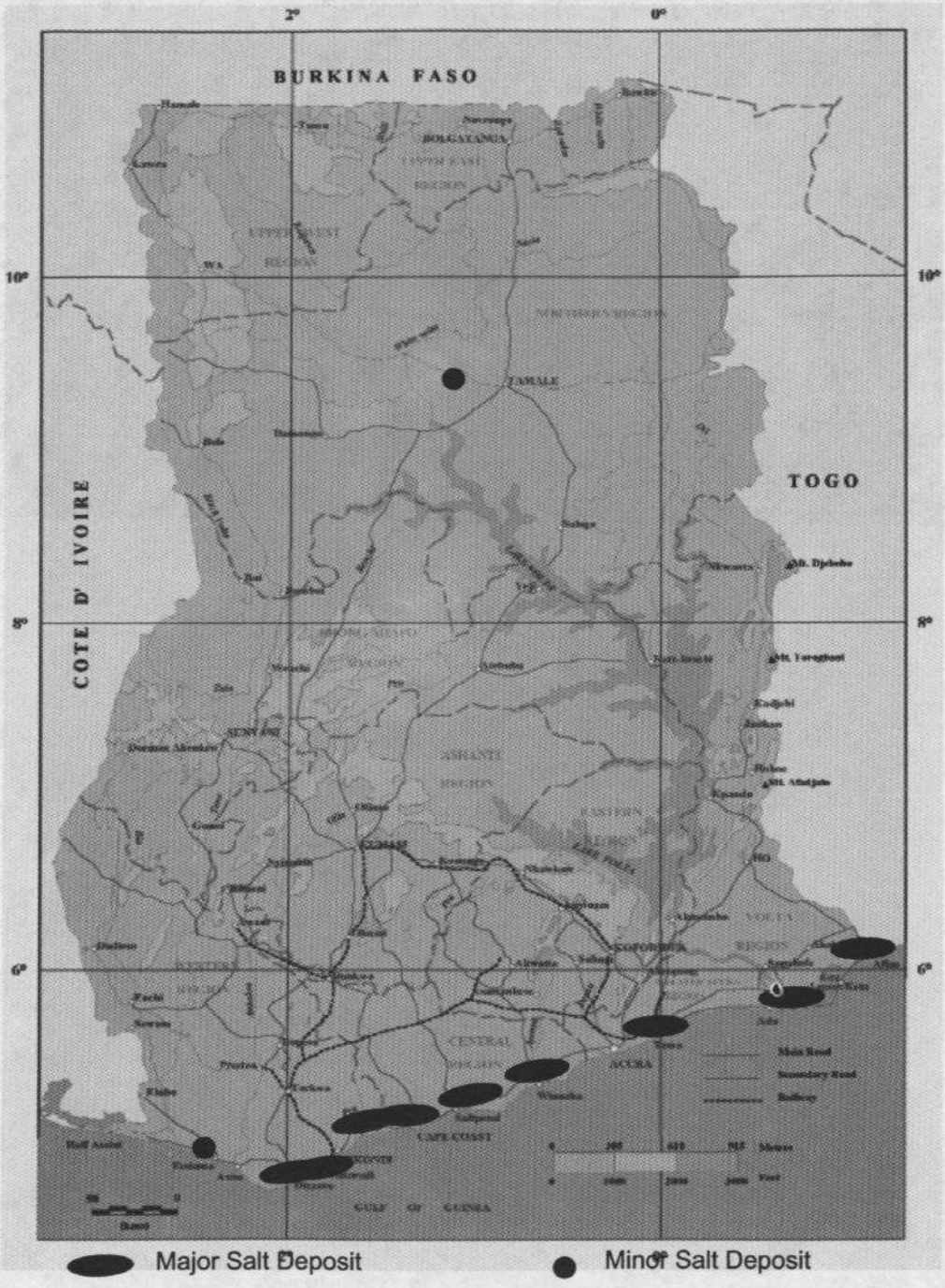

Fig3 Map of Ghana showing Salt Deposits, (Anon, 2004d)

8 The Geology of the Coastal Sedimentary Basins

The landscape of the coastal belt of Ghana is generally undulating dominated by lagoons and wetlands of the largest of which include the following: Anlo-Keta lagoon complex, Densu delta, Muni, Owabi, Sakumo and Songor Lagoons. These areas are used for salt mining hence it is essential to look at the geology of these areas.

According to Kesse (1985), the coastal salt producing areas of Ghana are underlain at several places by Mesozoic to Tertiary flat-lying sedimentary formations, which superimpose on the stable Precambrian Birimian and Dahomeyan basement rocks. From the south west of Ghana to the south east along the coast the following formations are identified:

1. Appolonian (Tano Basin) Formation
2. Sekondian Series
3. Amissian Formation
4. Accraian Series
5. Keta Basin sedimentary rocks

The Keta Basin covering an area of about 3 755.50 square kilometers is made up of mainly sand, gravel, siltstones, shales, siltstones and clays of fossiliferous limestone.

The Accraian Series uncomformably overlies the Dahomeyan basement complex and consists of quartz grits, sandstone, shales and mudstones.

The Amissian Formation, which outcrops between Winneba and Saltpond, comprises interbedded soft, pebbly grits, conglomerates, micaceuos sandstone, arkose and greenish grey clay. The Sekondian series consists of sandstones and shales with conglomerates, pebbly beds and mudstones. Rocks of the Appolonian formation also consist of alternating sands, clays and limestone.

9 Market Analysis

Current salt production is between **200 000 and 300 000 tonnes per year**. This is less than the 10 % of the industry's potential that has been estimated at 2-3 million tonnes per annum. It is estimated that the current total installed capacity of solar evaporated salt production in Ghana is about 1.2 million tonnes per year. Actual production has consistently been below the installed capacity over the years due to rain water dilution, salt pan leakage, refining losses and salt transfer handling losses. **Figure 1.1 illustrates salt production trend from 1990-2004**. The salt industry has markets for table/edible and industrial salt. Using World Health Organisation (WHO) guidelines for salt consumption and Ghana's exports, the amount of salt being imported into the ECOWAS sub-region or traded between the 16 member countries is estimated to be 729 000 tonnes per year. The major importing nations are Nigeria, Cameroon, and La Cote D'Ivoire. Ghanaian exports go to Burkina Faso, Togo, Mali, Benin and Niger (Dolbear, 2003).

Ghana can target the ECOWAS salt market especially Nigeria which imports about $1.5

billion worth of salt a year for its domestic demand and its oil industry. This salt is imported mainly from Brazil whilst Ghana's salt deposits remain untapped.

Production from solar salt works in the sub-region exceeds 400 000 tonnes per year and the producing countries export some surplus in the region. Across the Atlantic, there are a large number of solar salt works from Brazil to the Bahamas, which supply washed bulk solar salt to Nigeria at US $25 per tonne. Further south of Africa, Angola is self-sufficient and Namibia and South Africa are major exporters of solar salt.

Brazil exporters have been extremely aggressive in expanding export to the ECOWAS sub-region. The leading salt importer in Nigeria is Union Dicon importing 200 000 – 300 000 tonnes per year in bulk from its Brazilian partner, Salina Diamante Branco (SDB). The commercial arrangement with the Brazilians includes joint marketing to the West Africa market. A delivered cost of less than US $25 per tonne is expected for bulk imports from SDB. The second leading Nigerian importer is Dangote Industries which imports up to 250 000 tonnes per year from different countries such as Israel, Egypt, Tunisia, Senegal and Brazil.

To penetrate into an import market of 700 000 – 900 000 tonnes per year, Ghana needs to install modern low-cost, high production facilities capable of producing 200 000 – 300 000 tonnes per year and incrementally increasing production by doubling every five years. The initial phase of this entry would largely be achieved by displacement of marginal and inefficient production in Ghana. This would, however, not have a significant impact on importation from Brazil and other low-cost exporters with established relationship in the ECOWAS sub-region. It is estimated that an investment of over $200 million would be enough to start winning trade contacts with Nigeria and other land locked ECOWAS countries (Dolbear, 2003)

10 Prospects for a Chloro-Alkali Industry in the West African Sub-region

Today, only 5% of the world annual salt production is directly used for human consumption, the remaining 95% being consumed mainly by chemical industries. Salt is one of the 'Big Five' chemicals, which form the backbone of the chemical industry. The others are sulphur, coal, limestone, and petroleum (Stepcon, 2003). The Chloro-alkalis Industry is the largest industrial consumer of salt. Chloro-alkalis consist of chlorine, caustic soda (sodium hydroxide) and soda ash (sodium carbonate). The largest consumers of caustic soda are soaps and detergents factories, plastics, paints and pharmaceutical industries. Large quantities of caustic soda are used in the textiles, paper and metallurgical industries and in the production of synthetic fibres. As the frontiers of the chemical industry grow, new applications for salt and its derivatives are constantly being discovered. Salt will therefore continue to play important role in the future. Hence the demand for salt and its

derivatives will continue to be in higher quantities.

Ghana has a potential solar salt production base for establishing a regional plant to produce basic chemicals such as caustic soda, chlorine, hydrogen, petrochemicals and other related products. The plant will have the potential to integrate with the manufacture of these chemicals and other products in West Africa. The largely import based chemical industry in Ghana produces paints, varnishes, drugs, soaps, detergents, cosmetics, rubber and plastics as well as insecticides, mosquito coils, candle, glue, industrial starch, etc. The industry is heavily import dependent for raw materials such as caustic soda, chlorine, etc except for local inputs namely palm oil for soaps and natural rubber for rubber products. As a result of import constraints, the sector is characterised by low capacity utilisation with only 17% of firms operating between 69- 79% installed capacity and 33% firms operating under 20% installed capacity (Acquah, 1998).

Export trade in common salt could combine with the production of caustic soda, chlorine, hydrochloric acid, bleaching powder and other chemicals by the electrolysis of brine to meet the demand for basic chemicals in the ECOWAS countries. Foreign trade statistics for Africa show that between 1982 and 1991, ECOWAS countries imported $16.8 billion of chemicals and related products of .the chemical and allied process industries (Anon., 1992, 93).

The supply of natural gas from Nigeria to Ghana and the recent discovery of of-shore oil deposit at Cape Three Points in Ghana give brighter prospects for an integrated chemical complex plant. Ghana's natural gas deposits could also further enhance the development of the chemical industry. High demand for basic chemicals in the ECOWAS justifies for the establishment of a chloro-alkali and related chemical industries in Ghana.

In Ghana, the soap industries are the major importers of caustic soda. For the period 1992-1996, about 36 395 tonnes of caustic soda costing $17 million was imported by the process industries. In the ECOWAS, Nigeria imported 112 443 tonnes of caustic soda costing $55 172 million in the period 1984-1987. The caustic soda imports of Senegal were also significant, averagely $4.2 million annually. Cote d'Ivoire, for instance, spent over $1.2 billion on imports of various chemicals and related products during the period 1986-1989 representing about 8% of ECOWAS imports.

Imports of hydrochloric acid in Ghana have also increased significantly. In 1981 the import of hydrochloric acid was only 109 tonnes. In 1996 the country imported 2 194.74 tonnes of hydrochloric acid costing over one million dollars. The gold mining boom and gold refineries will create more opportunities for the production of this chemical in Ghana.

Another product, which is based on chlorine, is bleaching powder. It is used extensively in the textiles and paper industries, water

treatment, laundries and general sanitation. Ghana Water Company imports over 300 tonnes chlorine gas and 800 tonnes of bleaching powder annually. A large potential exists for the utilisation of chlorine in the manufacture of ethylene dichloride, vinyl chloride, polyvinyl chloride, (PVC), hexachloro benzene, dichloro benzene and phenol in the ECOWAS (Acquah et al., 1998).

11 Constraints in Salt Production and Distribution:

i. Acquisition of land for salt production
ii. Salt producers are often a heterogeneous group consisting of co-operatives and individuals who may be operating outside any legal or administrative framework
iii. Multiple small salt producers and erratic distribution patterns making management of .the programme difficult
iv. Primitive methods of production and low degree of mechanization which lead to poor salt quality; for example, visible impurities prompt householders to wash salt before cooking
v. Inadequate packaging, for example in jute rather than high-density polyethylene, which aggravates losses during transport, handling and storage.

12 Conclusions

Ghana possesses one of the largest proven renewable solar salt production potential along the entire coastline stretching over a distance of over 500 km and effective exploitation would enable the country to supply the needs of the entire sub-region.

The Salt Industries include Songor Salt Project Ltd, Ningo Salt Ltd, Savannah Salt Company Ltd, Sege Salt Works Ltd, Dangbe Salt, Nyanyano Salt Association, Panbros Salt, Elmina and U-2 Co. Ltd. The rest are Adjua Salt Mining Company, Travevco Salt and Trading Ltd, Petua Salt and Company, John Haris, Modern Salt, Pakat Salt, Zam Salt Company Ltd, Trans Volta Salt and Sastin Salt Ltd.

Ghana has good climatic conditions for salt production and has the potential to become a large scale producer if government and bankers would help financially, to expand the companies.

It is envisaged the salt industry can be transformed into an internationally competitive one with an enhanced capacity for the production of good quality salt for domestic and export markets, increasing production from 250,000 metric tons in 2008 to 1 000 000 metric tons in 5 years. It is also expected that a viable chloro-alkali industry will be developed in the medium term to generate employment for over 50,000 people altogether. The industry is however constrained by: obsolescence of technology; lack of local expertise and poor production

methods; poor industry infrastructure; lack of economies of scale; low investment and lack of credit; cumbersome land acquisition procedures and land tenure administration systems.

The research has led to a tenable conclusion that salt production is technically feasible and financially viable. If properly developed and managed, the salt industry would impact positively on Ghana's social and economic settings as follows:

i. Ghana stands a chance of earning about US $62.5 million annually from salt using the current price of US $25 per tonne if the industry's potential of 2-3 million tonnes is exploited.

ii. Effective exploitation would enable the country to supply the needs of the entire sub-region. Government can carry out a study to identify and demarcate areas that will be suitable for salt winning. Such salt land banks will be made available for investors.

iii. Potential exists for the utilisation of part of the salt to produce caustic soda which is a raw material for the soap and detergent industry; and bauxite/alumina production. The chlorine co-product can also be used as water treatment chemical and also serve as raw materials for the production of various health and sanitation chemicals.

iv. An Audit of the Salt Industry in Ghana indicated that about 99 per cent of the industries do not have good management of their operations resulting in low salt production.

v. The impact of the expansion in the salt industry on the ecology is expected to be immense because of the corresponding increase in wetlands likely to occur.

vi. 13 Recommendations

The following recommendations are made to fully utilise the salt industry to contribute to the economic growth of this country:

i. Salt harvesting must be mechanised. To facilitate this, the crystallising pans must be designed with a high length-to-width ratio to promote harvesting by mechanical means.

ii. Ghana needs to attract large-scale investors. This can be done by developing a land use plan that will spell out the areas suitable for salt production in the country.

iii. Land can be made accessible by involving land owners as equity share holders in companies with their land as their equity to check land litigation.

iv. The product can be shipped to the interior destinations of other West African countries from Ghana by utilising low capacity vessels via

river systems such as the Volta Lake..

v. A port should be constructed at Ada to serve as the collection point from other salt works for shipment since this is where salt production is concentrated.

vi. Salt refinery must be established to add value to the product for greater financial returns.

vii. The salt industry can produce the big and transparent crystal salt, which does not contain much impurity and sold better on the international market. Government with the support of the financial institutions should make the best efforts to explore avenues for the needed financial interventions to ensure the transformation of the salt industry in Ghana.

viii. Strategic alliance can also be established with major world producing countries such as Brazil, Venezuela and Spain to facilitate the acquisition of technology and technical know-how in salt production.

ix. In line to boost salt production, six main production zones should be identified - Keta; Ketu; Dangbe East; Dangbe West; Weija; Gomoa-Awutu-Effutu; Mfansiman and Ahanta areas.

x. There must be a policy for the salt industry so as not to destroy the environment in the areas where they operate.

xi. There is the need to set up a demonstration site where experts could provide services on good salt production techniques and environmental preservation

xii. Government can carry out a study to identify and demarcate areas that will be suitable for salt winning. Such salt land banks will be made available for investors.

xiii. On the need to increase production, Ghana needs not base its estimate on the current demand alone but rather it should take into consideration the fast growing population if it wanted to dominate the region in the near future. Besides, it is equally important that we add value to the salt and think of converting it into other chemical products to enable us meet international competitors like Brazil and Australia who have dominated the West African market, capacity of production is low, sometimes we must involve partnership, which would be of interest to the nation

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