# PRESENT STATUS AND FUTURE SCOPE OF IMPROVING CRUDE SALT PRODUCTION IN BANGLADESH

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## *Abstract*

Salt production industry plays an important role in the national economy as it supplies one of the most essential ingredients (salt) for our daily diet. Based on a claim of poor quality of our crude salt, salt industries import a significant amount of crude salt from abroad. This issue distracts farmers from getting fair prices and creates a threat in existing of our crude salt industry. This study aims to assess the present status of the crude salt production systems, particularly the critical factors responsible for inferior crude salt quality with possible ways of their improvement and the feasibility of salt cultivation using seawater and sub-surface water in the coastal regions of Bangladesh. A one-time point cross-sectional survey design was adopted for the household survey utilizing both quantitative and qualitative approaches using semi-structured questionnaires, Focus Group Discussion and Key Informant Interviews (KII). A random sampling of crude salt and brines from different location were used for the quality assessment study. Crude salt cultivation practices observed among farmers are unscientific and far away from the principles of gradual natural evaporation and fractional separation of the soluble compounds in the sea brine. Salt samples collected from farmers' salt fields from different salt centers were found to have contained low sodium chloride and high moisture and impurities. Underground brine is often found of almost similar quality to the surface brine but found rich with 'Fe' content and its removal technique eventually increased the cost of production. A wide variation was observed in the cost of salt at its crude state; refined state and edible state during the value chain study. In conclusion, implementation of the recommendations appended in the conclusion and recommendation section by the stakeholders in general and by the government, in particular, may eventually pull up the farmers from extreme poverty and education level and inject the newer technology for high-quality crude salt production in the country.


**Keywords:** Crude Salt, Salt Cultivation, Mohajon, Khash Land, Canal, Salinity, High Tide, Ebb Tide, Brine Pit, Sediment

## Introduction

Salt production is an ancient industry. It plays an important role in our national economy. This industry is the supplier of an essential ingredient (salt), which has diversified use in our daily diet. It has also a great contribution to industrial development and employment generation. The growth of fish farming, livestock farming and the readymade food/food sector has increased than expected. With these increases in population, livestock, fisheries and food industries, the demand for salt is also rising, which is closely associated with the growth of this sector. The growth of the salt industry is also related to the attainment of self-sufficiency in salt to save a huge amount of foreign currency that would be required for importing salt. This industry is the largest labor-oriented cottage industry in Bangladesh and generates a large number of employments. Total workers engaged in the business were 50854 generating an annual income of 20.00 million BDT. Hence, the proper nursing of crude salt production and the producers is very important for the overall development of this sector and for the overall economic growth of the country as well.[1]

The conditions in which salt farmers operate are difficult. They frequently deal with all the risks associated with the sea because they are so close to the ocean. Because there is no storage facility, there are instances when the whole output is washed away by strong rain and coastal surge. They don't receive the proper price, as well. Sometimes intermediaries and traders feign a financial crisis in order to cease buying. To meet their daily needs, however, the farmers must sell the salts even at a lesser price. In addition to this, money is the primary issue facing salt producers.

This industry was developed by people who traditionally specialized in it and was known as Mulunghee. They used to produce salt by evaporating water by boiling the saltwater. Salt Industries are producing salt from saline water of the sea in the coastal areas of Bangladesh, especially in Cox's Bazar and Chittagong districts.[2] According to the Salt Census (2018),[3] about 907 ghona over about 60 thousand acres of land at 8 Upazillas of the 2 districts are under salt cultivation

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[1] MA Al Mamun, M Raquib, TC Tania and SM Rahman, “Salt industry of Bangladesh: A study in the Cox’s Bazar”, Banglavision, vol 14, no. 1, 2014, p.7-17.

[2] D. M Myers and C. W. Bonython,“The theory of recovering salt from sea-water by solar evaporation”, Journal of Applied Chemistry, vol 8, no. 4, 1958, p. 207-219.

[3] A. Hossain, “Salt Farmer’s Census, PRISM Programme – Technical Assistance to BSCIC Component”, A project funded by the European Union, 2018.

where 27526 salt farmers are engaged. The total salt production in 2017-18 was 15 lac M. ton, of which 50% were produced in Moheshkhali and Chokoria Upazila. Despite increasing the demand for salt now a day, the capacity of crude salt production has not been increased due to numerous challenges faced by farmers, farming itself and others.

The difficulties salt farmers face in producing and marketing crude salt include high land rent, limited access to banks and high rates of interest at other sources, high production costs, input supply that is expensively controlled by intermediaries, and selling crude salt to those intermediaries so that they can set the price. Natural limitations, such as a short evaporation season, unexpected storms and rain, a lack of mechanization, and dwindling farmland due to other activities, are some difficulties that agriculture itself encounters. Other difficulties include the tariff structure on Glauber Salt and other salts, as well as the import of sodium chloride under the name of sodium sulfate.[4] Hence, initiatives are necessary to find out the root causes behind the problems and ways to overcome these challenges.

Based on the above background this study is concerned with the assessment of the present status of the crude salt production systems particularly loss of salt during post-harvest production and processing with possible ways of their improvement and feasibility of salt cultivation using seawater and underground water. This study also identifies problems in the value chain management system of salt production and suggests necessary recommendations to reduce the problems.

## Methodology

The study utilized a one-time cross-sectional survey design to assess the present status and further scope of improving crude salt production. Information/data was collected by sample survey with a questionnaire as well as instrumental analyses of crude salt samples and brine water either directly in the field or in the laboratory. For the sample survey, both quantitative and qualitative approaches, as well as instrumental analysis of crude salt and brine, was used. Some distinctive qualitative research methods like FGD and KII were used for the quality assessment of the crude salt.

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[4] M. S. Hossain, M. Z. Hossain and S. R. Chowdhury, "An Analysis of Economic and Environmental Issues Associated with Sea Salt Production in Bangladesh and Thailand Coast", International Journal of Ecology and Environmental Sciences, vol 32, 2006, p. 159-172.

Purposive random sampling was followed for selecting the respondents for the quantitative data collection at the village level. Two villages from each union were selected randomly. Total respondents 336 were allocated equally among the six unions with a sample of 56 from each union. A sample of 28 respondents in the intervention area from each village was randomly selected and interviewed using a pre-tested questionnaire. A total of 340 microenterprises were visited to collect the quantitative data from all 6 intervention unions. In each union, an FGD was carried out through discussion guidelines and checklists.

**Study Area.** Crude salt quality improvement estimates were obtained from twelve (12) salt-producing areas located in 2 districts. Among the centers, Sorol, Purba and Borguna were in Bash Khali Upazilla in Chattagram district and Chowfoldondi, Dulafulchari and Islampur in Cox's Bazar Sadar Upazilla, Lemsikhali in Kutubdia Upazila, Uttor Nolbila, Moterbari and Gurokghata in Moheshkhali Upazila, Dorbeskata in Chakuria Upazila and Leda in Teknaf Upazila.

**Sample Size.** There are twelve salt development centers under the BSCIC (Bangladesh Small and Cottage Industries Corporation) salt development office, Cox's Bazar. According to the salt census, the total number of farmers involved under the twelve salts development center is 27528. A sample size of 380 has been calculated and sample farmers were selected from three different salt farmer groups based on their land size.

**Sampling Design.** The overview of the sampling design of the crude salt quality assessment and improvement possibility is shown in Figure 1.

**Sampling of Crude Salt.** Consultants visited salt fields and collected crude salts from the field during salt production. Primarily, crude salts were sampled randomly from three salt heaps and then mixed and packed in a polythene bag and marked the crude salt sample with the name of the respective salt center. Accordingly, ten salt samples were collected from ten centers and shifted to the laboratory immediately for analysis.

**Sampling of Brine.** Brines from the salt fields and sub-surface brines were collected for assessing the effect of brine quality on the yield and quality of the crude salt. Water from the Shallow Tube well (STW) and Deep Tube well (DTW) was collected in a similar way for assessing the brine quality and its effect on the yield and quality of the crude salt. About 250 mL of brine samples of water collected from every center were collected and analyzed.

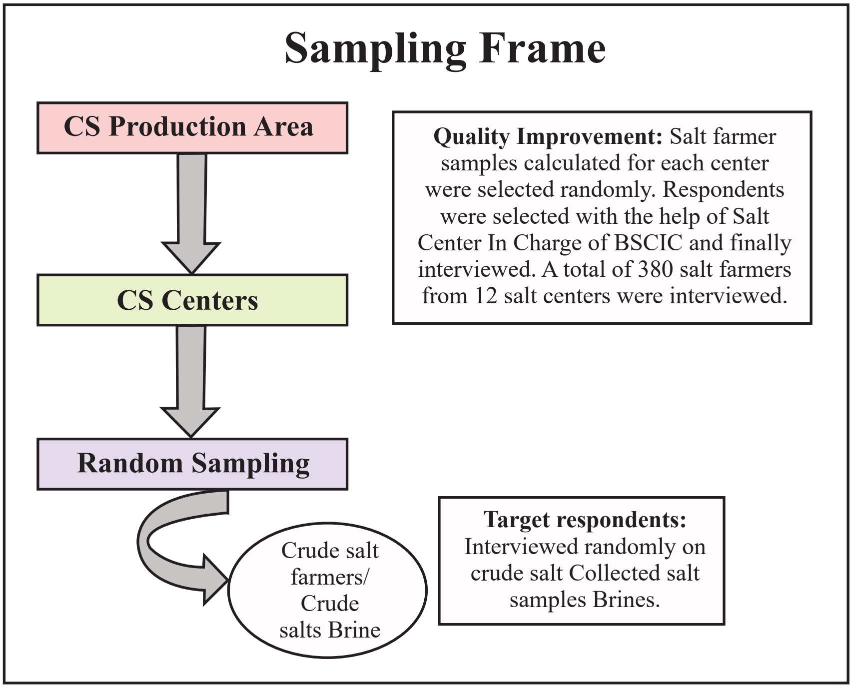


Figure 1: Sampling Frame Used for the Study

**FGD.** FGD was carried out in every salt development center to identify the reasons for low-quality crude salts. Six to eight farmers were invited and interviewed with a pre-tested checklist. In total, ten (10) FGDs were carried out in ten salt centers.

**KII.** Key informants interviewed for the crude salt quality improvement study included DGM Salt Centers, Assistant Monitoring Officers/Supervisors, Coordinators NI/UNICEF/GFA, Salt processing Supervisors/Chemists (Selected Salt Mills) and high officials of BSCIC, Dhaka to obtain their opinions about the causes that resulted in low-quality crude salts.

**Data Generation and Analysis.** Data generation phase for salt quality assessment and improvement of crude salt consists of the development of a questionnaire, check-lists preparation, selection and training of enumerators, field data collection, crude sample collection, laboratory analysis protocol and data management and analysis. Data analyses were carried out by data management software Excel and statistical software SPSS.

## Results and Discussion
## Farmers Characteristics

**Farmer's Age.** The distribution of salt farmers under different age groups is presented in Table 1. It is observed that the highest proportion of salt farmers (30.46%) was from the age group of 31-40 years followed by 26% from 41-50, 19.5% from 51-60, 14.5% from 21-30 while only 2.1% of those were from the group of <20 years old.

| Age Group | No. of farmers (N) | Overall (%) |
|---|---|---|
| <20 | 8 | 2.1 |
| 21-30 | 56 | 14.5 |
| 31-40 | 117 | 30.4 |
| 41-50 | 101 | 26.2 |
| 51-60 | 75 | 19.5 |
| 61-70 | 27 | 7.0 |
| 71-80 | 1 | 0.3 |
| N | 358 | 100 |

Table 1: Age Group of Farmers

**Farmer's Education.** Among all, about 60% of farmers only could sign or be found illiterate. The remaining 40% of crude salt farmers were found educated as shown in Figure 2. However, 22% of the total respondents reported having attended the primary, 8% to the pre-secondary and 5% up to the secondary level. It is also observed from the chart that 3% of the crude salt farmers were found educated up to the graduate or above.

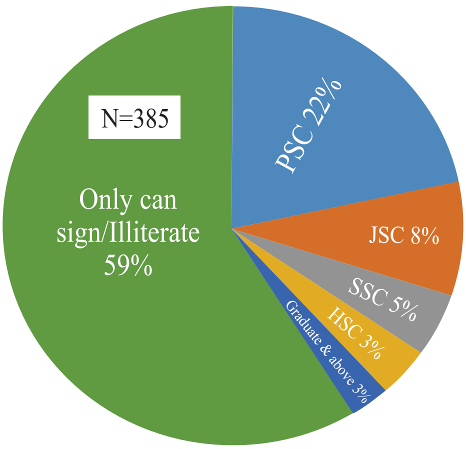


Figure 2: Proportion of Farmers (%) Who Attended School or Pre-School

**Family Members.** It is observed that there is no female member involved in crude salt farming. About 95% of respondents are directly involved in salt farming. Among them, about 65 % of respondents managed the CS production by engaging only their families. However, 30% of respondents found 2 or more members involved in crude salt cultivation. The remaining 5% are secondary farmers.

## Cultivated Land and their Ownership

Generally, farmers possess four types of land for salt cultivation; namely salt production land, cultivable land, household land and water body. Among the total land, about 80% of the land was used for salt cultivation followed by 15.4% reported to use for crop production, 4% in the category of household and less than 1% of respondents reported to have been in the category of a water body.

Among 385 samples, about 90% of the farmers don’t have their own land for salt cultivation. About 65% of them got a lease from landowners, followed by 25% who produced crude salts on the hired land, 11% on their owned land and only 1% of respondents produced salt in the Khasland. It indicates that the lease value of the land is a vital factor to make the salt cultivation business profitable.

However, 38% of farmers reported that they got the lease of their land directly from the land owner whereas more than 40% had it through brokers. With regard to the duration of the lease, salt farming is a seasonal activity and respondents take a lease for every season.

## Inception and Method of Crude Salt Production

Background History: Crude salt production in this area was initiated by the British regime. About 14% of crude salt farmers reported to have involved in this profession right after independence (1975-1985), about 22% between 1985-195, about 31% got involved in 1995-2005 and about 30% of the CS farmers reported to get involved in this profession within 2005-2020. Currently, entire salt cultivation is being carried out on the polythene bed. The use of polythene was initiated in 2000 since this method provides clear salt, high production, and lower labor cost and effort.[5] However, the initial investment is relatively higher in this method.

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[5] Md Shahadat Hossain et al, "Land Use Zoning for Salt Production in Cox’s Bazar Coast of Bangladesh: A Remote Sensing and GIS Analysis", Asian J. Geoinform, vol 3, 2003, p. 69-77.

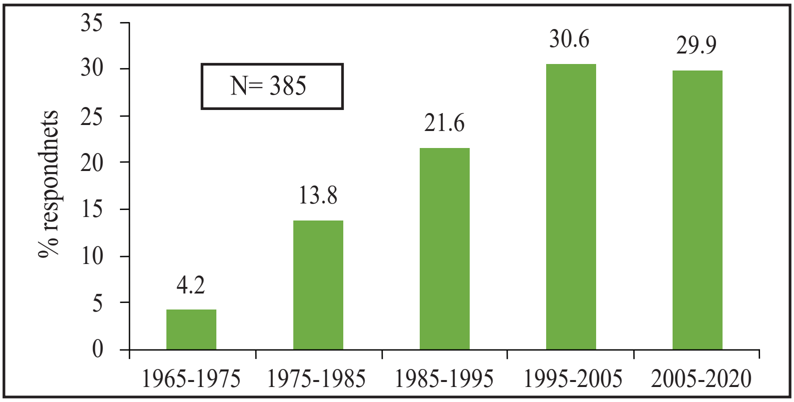


Figure 3: Involvement of Farmers in Crude Salt Production

## Duration and Season of Crude Salt Production

Climate condition influences the production season of crude salt. It also varies with the location and market price. However, most of the crude salt farmers reported that generally mid of November to mid of May is the actual season of salt production.

**Batch Number and Duration of a Batch of Crude Salt.** The findings on the number of batches of crude salt produced and the time required to harvest one batch are presented in Figure 4. According to the chart, about half of the total respondents produced about 26 to 30 batches of crude salts followed by about one-third (32.7%) who reported producing 21 to 25 batches, 15% produced between 31-35 batches, about 3% of farmers produced less than 20 batches and rest 2.3% of the total respondents produced as high as 36 to 40 batches of crude salts. About 80% of the total respondents reported that it took an average of 5-6 days to harvest one batch of crude salt. The first batch took a long time which may be as long as 20 to 24 days and the following batches need less time duration.

**Amount of Crude Salt Production.** Figure 5 represents the distribution of the crude salt farmer with regard to the amount of salt production per batch per acre of land. Three fourth of the total farmers reported that they produced between 500 to 1000 Kg crude salt in a batch on one-acre land followed by about 24% whose production capacity was between 1000 to 1500 Kg and about 2% of the total farmers reported that their production was as low as 400 to 500 Kg per batch per acre land. About half of the respondents reported that the peak salt production month was March and the remaining half proposed it as April. The peak time of salt production also depends on the location and prevailing climatic conditions.

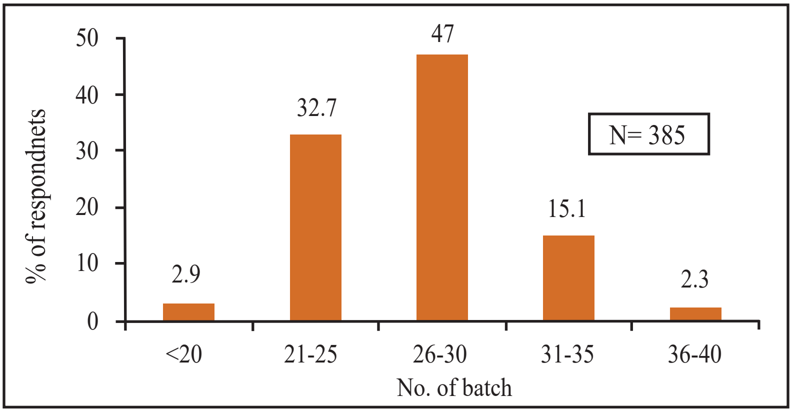


Figure 4: Distribution of Respondents (%) Based on the Number of Batches CS Produced

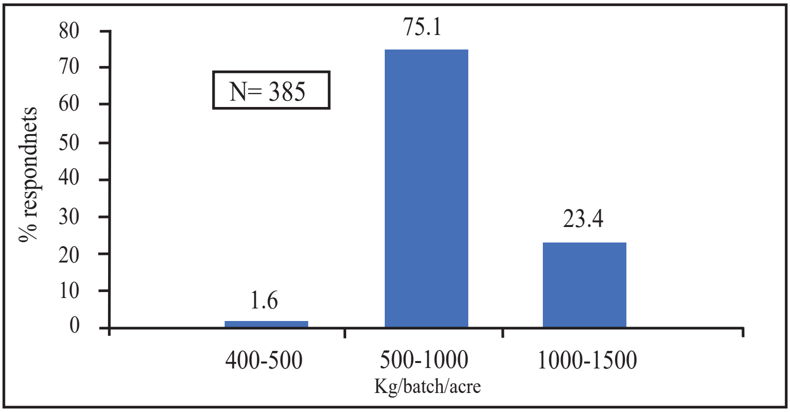


Figure 5: Distribution of Respondents (%) Based on the Amount of CS Production

## Factors related to Crude Salt Price

All the farmers (100%) confess the variation in price in the market. The potential reason for such a variation was due to over/low production which was mainly because of the weather condition of that particular season. The demand for refined salt in the retail market also influences the demand for crude salt. This price variation is crucial for farmers. Furthermore, the import of crude salt in the name of sodium sulfate also affects the price of the local salts.

Farmers prefer selling their crude salt directly to the millers or BSCIC authority for a credible price. However, investors and land owners are the main market actors who control the market price of crude salt. About 61% of the total crude salt farmers reported that they have an idea about the market linkages and about 63% of them mentioned the name of Mohajon as the main market linker. About 76% of the total CS farmers reported having contact agreements with different groups for the marketing of their salt. Nevertheless, contact salt farming and land lease contact were the two most important agreements maintained by crude salt farmers.

## Market Price of the Crude Salt

The respondents were asked about the existing selling price of the crude salt and found that more than half of the total respondents (about 53%) reported having the price of 44 Kg crude salt was between Tk. 150-200, followed by about 42% who reported to have the price of 44 Kg crude salt was between Tk. 100-150 and only 5% said it between Tk. 200-250. A negligible proportion of salt farmers (<1%) mentioned the existing crude salt price was between Tk. 250-300 or Tk. 300-350.

## Surface Brine Source and Strength

In most salt-producing areas, brine is drawn from canals that are located far away from the sea. The strength of the canal water is influenced by the seasons and tides. At the beginning of the salt season; specifically in December, the salinity of the canal water is found to be low (2.2) and the value gets higher when the production season approaches the peak. The variation in salinity of the canal water at different times of the production season in Islampur is presented in the chart. However, drainage of fresh water through the canal also results ina lower degree of brine in the canal at the beginning of the season.

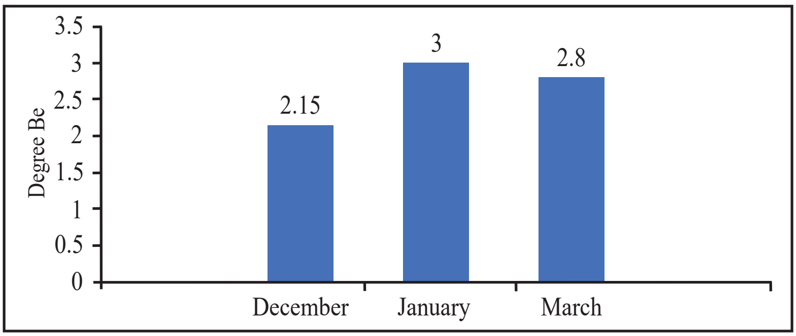


Figure 6: Brine Density Influenced by Season

The presence of salt in the seawater during high and low tide was observed to be different. The average degree of salinity of the canal water during high tide and ebb tide over the three different months is presented in Table 2.

| Condition | Degree Be During | | |
|---|---|---|---|
| | December | January | March |
| Flooding | 2.1 | 3 | 3 |
| Ebb | 1.0 | 3 | 2.5 |

Table 2: Brine Density Jointly as Influenced by Season and Tidal Time

Brines in terms of better quantity and quality were obtained during high tide. As shown in bar Figure 7, degree Be is higher during high tide than that of in the ebb. As mentioned in the earlier section, the season is an important factor in the case of getting high-strength brines.

A variation in the brine density in degree Baume used for the CS cultivation in different salt-producing centers was also observed and presented in the Figure 7.

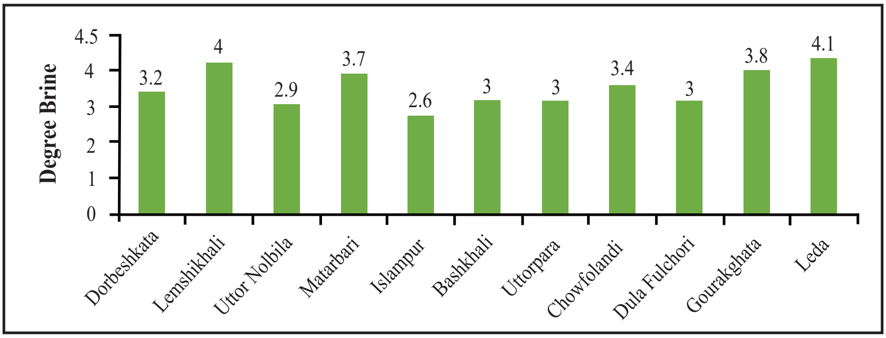


Figure 7: Different Salt Center's Brine Density

## Salt Cultivation Methods

Farmer's practices of crude salt production were found similar in all the crude salt-producing centers. BSCIC has demonstration fields with improved practices according to the recommendation made by a consultant who worked for UNICEF. One NGO, PADEKHEP, has also demonstration fields with slightly modified practices. A distinct difference was observed between the salt production practices of farmers and the demonstration of BSCIC and NGO in Chawfalandi Salt Center. Major differences were observed in the number of salt field beds, reservoir size, the ratio of the condensing and crystallizing area, water flow path, the presence of a brine pit and the use of polythene in the crystallization chamber. The effect of these factors on the production of quality crude salts is described with scientific reasons under the following sub-headings.

**Salt Bed Number and Size.** Farmers normally divide a salt-producing unit into 4 to 5 small compartments. Each compartment has a unique local name. The compartment is charged with brines at a shallow height (1-4 inches) and allowed to flow the brines to the next. Finally, the salt is collected on polythene in the crystallization chamber. In the BSCIC demonstration field, the number and size of the compartments are many compared to the farmer practices. NGO's demonstration plots are almost similar to that of farmer's practice except having no polythene in the crystallization chamber. The salt bed arrangement in the farmers' practice and improved practices are shown in Table 3.

| Practices | Reservoir Numbers (avg) | Reservoir sizes (avg) | Brine height in the reservoir (inch) | Degree attained in the last reservoir |
|---|---|---|---|---|
| Farmers Practice | 3-4 | Small | Shallow | 4 |
| BSCIC | 7-8 | Large | Deep to shallow | 7 |
| NGO | 3-4 | Medium | Shallow | 4 |

Table 3: Different Salt Bed Arrangement Practices Observed in the Field

It is evident from the above table that with the increase in reservoir numbers brines got enough time to attain the desire degree. The large size of the reservoir and deep brine height resulted in high-degree brines due to wind ripples that increase the evaporation surface as shown in the table. The higher number of reservoirs also increased the crystallization-to-condensation ratio.

**Ratio of the Crystallizing to Condensing Area.** The average ratio of the crystallizing to the condensing area in the farmers' fields was found 1/3 to 1/4 which was nearly 1/10 in the BSCIC field. In the case of NGO field practice, the ratio was close to that of farmers' practice as shown in the Figure 8. The standard ratio of the crystallizing to condensing area for a brine having an initial density of 2 to 3 Be is about 1/10. This is totally absent in the farmer's field. This ratio allows better gradual evaporation and fractional separation of the soluble compounds in the sea brine and thereby attained the desired density for crude salt production.

**Brine Flow Path.** Farmers shifted brine from one compartment to another using channel in a straight direction whereas BSCIC demonstrated in a zigzag pattern. This pattern is more scientific for attaining concentrated brines due to longer exposure to solar radiation since it allows brines to travel longer distances in a given area.[6]

[6] Venkatesh Mannar, "Guidelines for the establishment of solar salt facilities from sea water, underground brines and salted lakes" UNIDO, UNO, 1982.

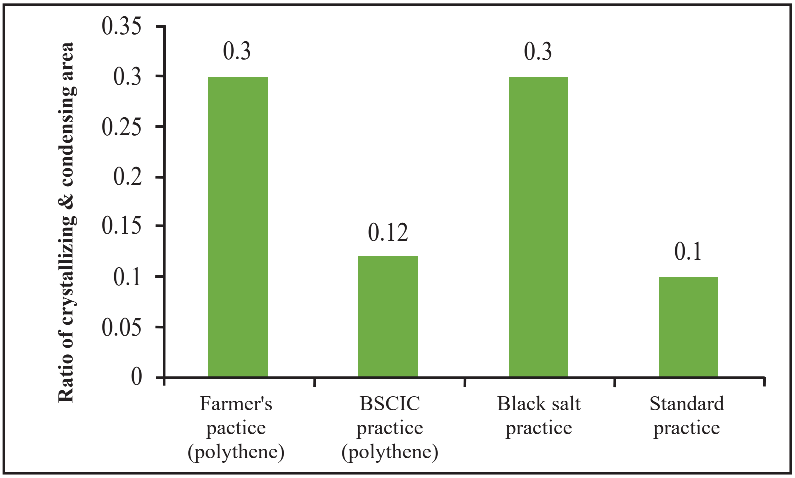


Figure 8: Crystallizing to Condensing Ratio Found in the Field

**Sprinkling of Brine from Brine Pit.** The presence of a brine pit in the semi-crystallization chamber was observed in the farmers' salt field. The density of the brine in the pit varies from 9-10Be. This weak brine is sprinkled over the saturated salt on the polythene. In the BSCIC salt bed, no such brine pit was observed. Scientifically, this practice resulted in immature and highly impure and hygroscopic salt. Seawater is a mixture of different salts and they got separated at the different densities of the brine. When this weak brine is sprayed over the saturated brine on polythene, sodium chloride gets crystallized along with other salts like calcium, sulfite and magnesium etc. These chemicals have different solubility in water and get separated when brines are gradually evaporated.

Physical separation of different compounds present in seawater with the progress of evaporation is given in Table 4. The changes in the brine density in different compartments of the farmers, BSCIC and NGO practices are shown in Table 5.

| Serial No | Compounds separated during evaporation | Ranges of density (Be) |
|---|---|---|
| 1 | Clay and other organic matters | Upto 3.5 |
| 2 | Iron (in the form of hydroxide) | 3.5-10 |
| 3 | Carbonates of calcium | 10-17 |
| 4 | Sulphate of calcium | 17-23 |
| 5 | Sodium or Potassium chloride | 23-29 |

Table 4: Physical Separation of Seawater Compounds During Concentration[7]

[7] D. M Myers and C. W. Bonython, "The theory of recovering salt from sea-water by solar evaporation", Journal of Applied Chemistry vol 8, no. 4, 1958, p. 207-219.

| Practices | Location | Density of brine (Be) at | | | |
|---|---|---|---|---|---|
| | | Reservoirs | Condenser | Semi-crystalizer | Crystallizer |
| Farmers Practice | Chawfalandi Salt Center | 2-4 | 3-6 | 9 | 26-29 |
| BSCIC | Chawfalandi Salt Center | 2-8 | 9-10 | 16-17 | 26-29 |
| NGO | Chawfalandi Salt Center | 2-4 | 4-10 | 9-10 | 26-29 |

Table 5: Brine Density in Different Compartments of the Salt Work)

When Table 4 and Table 5 are compared, it is observed that the spraying of weak brine by the farmers over the crystallization bed, resulting the drying of the salt with all present soluble chemicals coming from the pit brine. This practice increased the total salt yield but reduced the sodium chloride content in the salt. Finally, the salt with other chemical compounds like calcium and magnesium salt make the product hygroscopic which allows containing high moisture and eventually productivity goes down.

**Use of Polythene.** Field data indicated that most of the crude salt farmers (99.7%) reported having used polythene in the crystallization pan. This helps to produce clear salt but charging of weak brine results in impure and hygroscopic crude salt.

**Compaction of the Salt Bed.** Desire compaction of the salt bed was found another factor that affects the quality of the produced salt. The local name of the compaction apparatus is called Khora. Its average weight ranges from 20-25kg which is not sufficient to get the desired compaction of the salt bed.

## Composition of the Cultivated Salt

The crude salts collected from different salt centers are analyzed for moisture, Sodium, Calcium, Magnesium, sulfates, suspended solids and insoluble solids. The findings of the analyses are presented in Table 6.

Table 6 shows that sodium chloride content in most of the crude salts collected from different salt centers ranged from 80% to 90%. Apparently, the higher the sodium chloride content in salt the lower the moisture and other impurities content. Crude salts of Gourapghata and Teknaf (Leda) centers area contained the highest amount of sodium chloride with the least amount of moisture and other impurities. On the other hand, Gomaloti's crude salt contained the highest amount of moisture and other impurities. Significant amounts of unidentified compounds were also found in the crude salts of different centers. Crude salts from Dorbeshkata and Gomatoli showed the highest content of magnesium and calcium and hence the least quality crude salt. There is no standard for crude salt in Bangladesh. But it is authorized that, Indian crude salt has better quality than that of Bangladesh. So, the collected crude salt's quality can be compared with Indian crude salt.[8]

| Name of the Centre | Name of Guna | Attributes assessed (% wet basis) | | | | | |
|---|---|---|---|---|---|---|---|
| | | NaCl | Moisture | Insoluble matter | Ca++ | Mg++ | Undetermined |
| Uttar Nolbila | Tettaghona | 86.29 | 8.83 | 1.84 | 0.74 | 1.72 | 2.14 |
| Gourakghata | Boro, Hattalia | 89.15 | 5.71 | 1.10 | 0.54 | 0.45 | 3.75 |
| Matar Bari | Sonakhali | 83.70 | 11.36 | 1.76 | 0.2 | 1.65 | 2.35 |
| Dula - Fulchori | ShilkhaliGona | 85.16 | 10.04 | 1.04 | 0.87 | 1.05 | 3.16 |
| Saral Salt Centre | SoniarBaperGona | 80.35 | 12.65 | 1.20 | 0.86 | 1.54 | 4.95 |
| Lemsikhali (kutubia) | GoinneaGona | 83.54 | 10.52 | 1.22 | 0.2 | 1.69 | 3.97 |
| Dorbeshkata | Septakhali, Mognamma | 82.23 | 14.01 | 1.12 | 0.44 | 2.71 | 1.44 |
| Teknaf (Leda) | Mong Bazar | 87.12 | 9.01 | 1.50 | 0.27 | 0.89 | 1.93 |
| Choufoladondi | Khamarpara, MohorirChora | 81.32 | 13.74 | 1.68 | 0.2 | 1.53 | 2.58 |
| Gomatoli (Islampur) | Boroghona | 81.32 | 14.91 | 1.15 | 1.79 | 2.96 | 1.02 |
| Indian Salt | | 92.03 | 4.50 | 0.74 | 0.11 | 0.07 | 2.38 |

Table 6: Crystallizing to Condensing Ratio Found in the Field

## Underground Brines and Salts

Underground brine and salt were collected from two villages in the Chawfolondi area. Brines density and the quality of the salts produced from the brines are assessed in Figure 9.

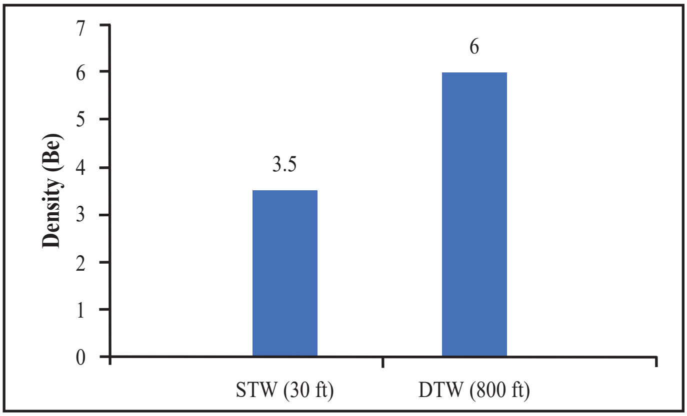


Figure 9: Brine's Degree of Sub-Surface Brines

[8] Mohammad Anas Ansari,"A report on Bangladesh Salt Industry: Current practice of production, preservation & further improvements", A project funded by UNICEF, 2018.

**Brines Quality.** The density (Be) of the underground brines collected from two different types of sources is presented in Figure 9. The sub-surface brine density at STW (Shallow Tube well) was found low compared to the DTW (Deep Tube Well) brines. The freshly extracted brine was slightly turbid and within 24 hours of storage, red-colored materials settled at the bottom of the container and the water became transparent. This sediment is likely to be the oxide or hydroxide of iron.

## Quality of Underground Brine's Salt

The crude salts from sub-surface brines collected from two different sources are analyzed for moisture, Sodium, Calcium, Magnesium, Sulfates and insoluble solids. The sub-surface brine was colorless at the time of discharge and its color turned red after a few hours of storage due to oxidation in presence of air. It indicated a high iron concentration in the brine. However, the brine became colorless after 24-48 hours of storage and formed reddish sediment at the bottom of the container. When colored and clear brines were evaporated in the lab, the salts obtained were different (salts in the left and right Petri dishes). Salt in the middle Petri dish was the salt collected from farmer's fields prepared from sub-surface brine.

The salt collected from two sources was analyzed and the findings of the analyses are presented in Table 7. A slight variation was observed between the salts concerning chemical compounds. Moisture content was reasonably high and sodium chloride content was only about 80%. However, the overall quality of the sub-surface salt is found close to the salt quality produced by farmers in many salt centers from surface brines. Furthermore, using sub-surface brine needs abundant area for the stock pile of brine and relatively modern technology that will increase the cost of CS production further.

| **Compositions** | **Underground Brines' Salt** | |
|---|---|---|
| | STW (50 ft) | DTW (800ft) |
| NaCl | 80.30 | 80.18 |
| Moisture | 11.14 | 10.5 |
| K+ | 0.33 | 0.41 |
| Ca++ | 0.84 | 0.88 |
| Mg++ | 2.1 | 2.2 |
| Sulfate | 1.37 | 1.4 |
| Insolble matter | 4.33 | 4.50 |

Table 7: Quality of Crude Salts from Underground Brines Collected from Chawfolondi

## KII & FGD Findings

KIIs were carried out among high officials of BSCIC, salt mills owners, NGOs and development partners working in this field. Key informants involved in salt refining termed the local salts inferior to Indian salt in terms of NaCl and impurities contents. The major issue in connection to crude salt production as claimed by the farmersis the low selling price. They also made opinions related to CS farming, storage, quality improvement, maturity gain, impurities, cost of production, sale and so on. FGD findings were found inline with the household interview findings of the individual crude salt farmers. Key issues obtained from the KII and FGD have been included in the recommendation section.

## Value Chain Study

Five primary activities are observed in the value chain analysis. They are inbound logistics, operations, outbound logistics, marketing and sales services. Support activities were illustrated in a vertical column over all of the primary activities. These are procurement, human resources, technology development, and firm infrastructure. The following diagram shows salt price variation from production to retailer end and a wide variation in prices of salt was noticed. At the farmer's end, it shows loss whereas processors made profit up to 55% and at dealer and retailer end, these profits were around 7% and 14% respectively. Overall, the salt prices became double at the retailer's end. In the Diagram 1, a wider variation in prices of salt produced in traditional salt mills from producers to retailers as well. At the farmer's end, it shows loss whereas processors made profit up to 60% and at dealer and retailer end these profits were around 15% of each. Overall, the salt prices became double at the retailer's end.

**Production Cost of Farmers.** For producing salt from seawater, a farmer needs to expense money in the different stages including land lease fees, labor costs, polythene costs, brokers, transport, etc. Overall, for farming per kg crude salt, a farmer needs to expense 5.50 tk. This is shown in the flow chart of diagram 1 & diagram 2.

**Processing Cost of Salt.** In processing plants for crushing, washing and drying crude salt expense is different in a different types of mills like traditional, mechanical and vacuum mills. Overall, the cost of salt rises to 10 tk per kg from the field to processing in the mechanical mills. The detailed cost can be observed in the flow chart of diagram 1 & diagram 2.

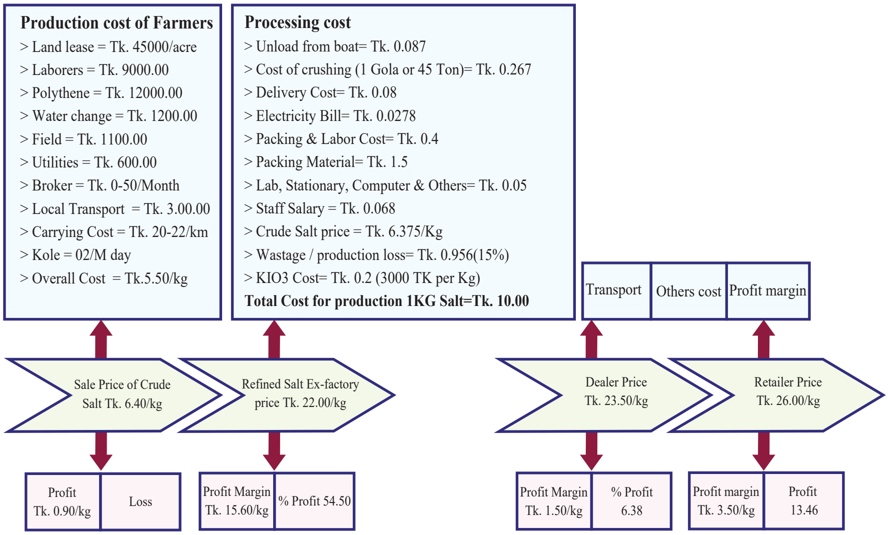


Diagram 1: Value Chains for Mechanical Salt Factory

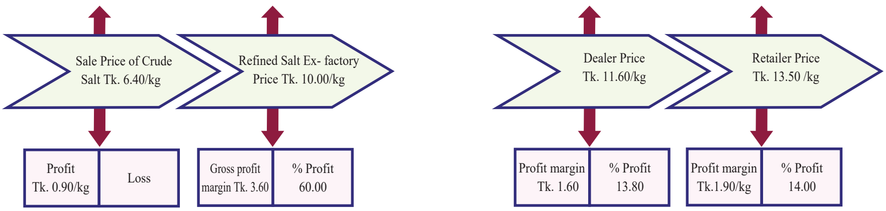


Diagram 2: Value Chains for Traditional Salt Factory

## Conclusion and Recommendations

Salt production is an ancient industry and plays an important role in our national economy. This industry is the supplier of an essential ingredient (salt), which has diversified use in our daily diet. The process of obtaining salt (sodium chloride) and other substances which are dissolved in seawater is entirely one of the gradual evaporation and fractional separation of solids at different degrees of concentration. However, the scientific principles in the current practices of crude salt production by farmers in the polyethylene method are not followed which resulted in salts with high impurities and hygroscopic properties. On the other hand, recently, it has been witnessed that demand for salt has increased but the production of crude salt farmers has not increased. Crude salt cultivation practices observed among farmers are unscientific and far away from the principles of gradual natural evaporation and fractional separation of the soluble compounds in the sea brine. Salt samples collected from farmers' salt fields from different salt centers were found to have contained low sodium chloride and high moisture and impurities. Underground brine is often found almost similar in quality to surface brine. Moreover, sub-surface brine was found rich with ‘Fe’ content that needs to be removed by using ‘turbid’ tools. Furthermore, stockpiling of sub-surface water will eventually increase the cost of production. Besides, extracting groundwater is not a good idea in terms of geological perspectives. Therefore, the production of CS from sub-surface water in this region will not be feasible technology. However, implementation of the following recommendations of this study by the stakeholders in general and by the government, in particular, may eventually pull up the farmers from extreme poverty and education level and inject the newer technology for high-quality crude salt production in the country.

**Production Issues**

- Provision of Bank loans for CS farmers at low interest will benefit the farmers and increase production;
- The major impediments to CS production are the price of inputs, laborers’ cost; land lease cost, rainfall and middlemen harassment;
- CS production is still dependent on farmer’s traditional technology;
- Development of protocol is necessary to reduce the ratio between Ca and Mg (safe- Ca:Mg = 1: 2, existing ratio 1 : 3). Besides, sulfate contents in CS are increasing day by day;
- The prospect of the use of groundwater may be evaluated for the production of CS;
- The rainfall, storms, sunshine, etc are important factors for CS production;
- Intensive training on the production and marketing promotion of CS is required;
- Most of the CS farmers inherited salt cultivation from their parents;
- New CS farming land should be identified to increase production; and
- Sand, mud, etc. reduced and white colour CS was obtained due to the use of polythene in the salt bed.

## Quality Issues

- Improved technology for quality CS production using a uniform process is desirable;
- The demand for local CS is decreasing due to quality reasons. So, strengthening quality control/quality assurance is required;
- The polythene used in CS production should be of foodgrade;
- Due to the use of polythene in salt bed, accumulation of Mg and Sulphate in CS increased;
- The wastage during the refining of local crude salt is 16 – 20%, which seems to be very high; insoluble solids in brine water should be minimized; and
- The CS maturing time in the field should be optimized through studies.

## Price Issues

- High lease money of land directly affects the price of CS;
- A minimum price for the CS may be fixed considering the production cost of the farmers;
- Brokers sometimes make very high-profit margins (Tk 70/bag of 86 Kg) which seem to be un-ethical;
- The high transportation cost of CS should be minimized;
- The production cost of CS varies from Tk 5.00 to Tk 7.00/kg;
- GoB may buy CS at a fixed price to serve the interest of the farmers; and
- The price of polythene may be reduced through subsidies for its production. Also, the quality of polythene should be improved to facilitate and ensure reuse it.

## Cross-border Issues

- Salt millers claimed that refining loss was more (sometimes 20%) when they used local CS in their mills;
- A survey may be conducted to assess the total annual quantity of salt used for the industrial purpose;

- Import of sodium sulfate should be assessed by evaluating the need;
- It is reported that NaCl is being imported in the name of Sodium Sulphate ($Na_2SO_4$), packed and sold that should be checked and legal action may be taken to stop it;
- The farmers may be motivated to repay the loan because the loan repayment culture of the farmers is very much disappointing;
- Unemployment will be a serious problem in salt farming areas if CS cultivation is closed;
- A value chain study (crude salt to refined salt) may be conducted to assess the profit margins by different stakeholders and optimize the profit of each actor through corrective actions.

## Policy Issues

- Proper implementation of salt law is not in place;
- A buffer stock of two lac ton of CS may be made to address the emergency crisis;
- Import of crude salt and refined salt should be discouraged;
- Sodium Sulphate may be imported in liquid form (if it serves the purpose) to control the import of NaCl in its name;
- A standard for different grades of CS should be formulated and approved by BSTI;
- Systematic research to increase yield and improve quality of CS is required; The land lease should be controlled by the Government to benefit the CS farmers;
- BSTI (Bangladesh Standards and Testing Institution) should establish a new section to analyze the salt/crude salt and formulate the standards;
- Salt Farmers Cooperative may be formed to serve their common interest; and
- A Salt Development Board may be constituted for maintenance of smooth running of CS production by the farmers, refining and iodizing of salt, bysalt millers.

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