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Profitability analysis of solar evaporation and cooking as methods of salt production and iodization of refined salt: The case of Dasol and Infanta, Pangasinan, Philippines

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Abstract

This study analyzed the profitability of salt production and iodization in Dasol and Infanta, Pangasinan, Philippines. Production data covering the November 2016-April 2017 production period were obtained through face-to-face interviews with 15 salt farmers each from Dasol and Infanta for a total of randomly selected 30 farmer-respondents. Other industry participants were traced from these farmers. Results revealed that salt production in Pangasinan was done through solar evaporation of seawater and by cooking. Additional practices performed include packaging and handling, storage, transporting, and salt iodization. Farmers in Infanta are practicing salt iodization while those in Dasol do not. Cost and returns and returns of investment analyses per 50-kg cavan salt revealed that cooking is the more profitable method of salt production. In support of the cooking method, which requires base salt to increase seawater salinity, increasing the production of salt through salt area expansion for the solar evaporation method was recommended. Local government units investment in construction of seawater channels to encourage area expansion was further recommended. A partial budget analysis involving farmers and assembler-wholesalers from Infanta who are performing iodization was likewise conducted to determine the profitability of salt iodization. It was found that salt farmers will gain a higher net income if they perform salt iodization of refined salt. Thus, it was also recommended that salt farmers be encouraged to venture into iodization not only for increased income but also for ASIN Law compliance. A study on coarse salt iodization was suggested to be done in consultation with technical experts like food scientists.

Introduction

Salt, locally known as "asin," is a white crystalline compound chemically referred to as sodium chloride (NaCl). It is a naturally occurring substance mostly in areas greatly dominated by seawater and is harvested either from the sea through evaporation or through mining of salt deposits (Salinas Corporation, 2012). The Philippines used to be competitive in salt production and can supply the local demand and meet the annual salt requirement of the country. Although the general trend for local salt production is decreasing over time, there are certain periods when the amount of salt produced annually is increasing. In 2012, the Philippines ranked 35th among 83 countries worldwide in salt production, contributing 725,000 metric tons (0.26%) to the world total. In 2019, the country's salt production reached 1,147.97 thousand metric tons with an average annual growth rate of 3.0%

(Nationmaster, 2020). However, despite the increasing annual production, the Philippines is still unable to meet its local demand. Montojo et al. (2024) reported that the Philippine local salt production amounted to 114,623.29 MT accounting for 16.78% of the country's total salt requirement. Currently, the country's salt industry is dominated by the importation of salt from neighboring countries, despite having much shorter shorelines (Senate of the Philippines 19th Congress, 2023). The Philippines ranked 7th among the top 10 largest salt importers, with $24.4 million worth of imports (Observatory of Economic Complexity, n.d.). According to Arieta (2007), the Philippines primarily imports table salt and industrial salt mainly from Australia, China, India, and Thailand.

Similar to the Philippines, the predominant method of salt production in Australia is basically the solar drying of seawater pumped into a series of shallow ponds where salinity is progressively increased through the natural process of evaporation caused by wind and sunlight (McLean, 2024). Thailand's general salt production process is almost the same as that of the Philippines except that there are some differences in the details of execution. For instance, in Thailand, a common method is to prepare the brine by digging a small basin (about 1-1.5 m in diameter) in the ground or along an embankment and another deeper hole nearby is dug for draining the brine. These pits are typically clay-lined but may now use plastic sheeting or ceramic pots. A bamboo feeder tube is inserted to drain the brine after sufficient dissolution time. Grass bundles, burlap bags, and rice husks serve as filters during the process of draining the brine, resulting in a clear solution. Once brine is ready, it is boiled using metal sheeting placed over an outdoor furnace in batches. The salt crystals formed during the boiling of the brine are collected, drained further in baskets, and stored in large stoneware jars (Yankowski and Kerdsap, 2013). In the Philippines, instead of digging, cemented brining tanks are put up and harvested salt is stored in cemented compartments unpacked.

Resource-wise, the Philippines is expected to at least be able to meet its own demand for salt through local production owing to the fact that it ranks fifth in the world (World Atlas, 2020; WEPA, n.d.) and second in Asia (PhilAtlas, n.d.) in terms of coastline length measured at 36,289 km. The coastline is irregular and dominated by bays, gulfs and islets along the coastlines (World Atlas, 2020) which could have been an advantage also. Since salt plays a very important role in human food consumption and in addressing iodine deficiency disorder (IDD) it is imperative that the reason for its low production in the country be made known for appropriate action and support. Determination of the profitability of its production is thus imperative since an economically rational individual would only continue to do business if there are economic gains (profit) from doing so.

Meanwhile, the cases of IDD in the Philippines have been prevalent for the past 20 years and about 40% of Filipinos, specifically pregnant, lactating mothers and children aged 6-12 years old have this disorder. IDD is a disorder where there is an insufficient amount of iodine present in the body which later on causes or promotes goiter (enlargement of thyroid gland), slowed metabolism, weight gain and fatigue, intolerance of cold, and neurological, gastrointestinal, and skin abnormalities (Arieta, 2007). In line with this, former President Fidel V. Ramos implemented Republic Act 8172 or ASIN Law (an Act Promoting Salt Iodization Nationwide) in 1996 to oversee and prevent the increasing cases of IDD in the country. This act requires all salt producers and manufacturers to produce, manufacture, import, trade, or distribute iodized salt to lessen and further eliminate micronutrient malnourishment particularly IDD in the country. Various government agencies are involved in the implementation and monitoring of the said law including the Department of Health (DOH), Bureau of Food and Drugs (BFAD), Department of Trade and Industry (DTI), Department of Science and Technology (DOST), National Nutrition Council (NNC), and other Local Government units (LGU's) (Official Gazette of the Republic of the Philippines, 2017).

The salt industry which used to be an orphan industry (Delos Reyes et al., 2021) is rarely studied and given attention. Recognizing this, Tan et al. (2022) did a salt value chain analysis in the Visayas region in the Philippines where a total of 222 participants in the salt supply chain were interviewed between May and June 2019. These included 107 salt producers, 12 assembler-wholesalers, 6 wholesalers, 13 wholesaler-retailers, 24 retailers, 3 institutional buyers, and 57 household consumers. Data collection was conducted using four sets of pre-tested structured interview schedules and a key informant interview guide. The study included value chain mapping, along with quantitative and descriptive analyses. Findings showed that the common practice of solar evaporation for seawater-based salt production led to seasonal availability, exacerbated by inadequate storage facilities. Farmers found Class A salt more profitable during peak months, while Class B salt yielded higher profits during lean months. Retailers earned the highest profit margins relative to their marketing costs across both peak and lean seasons for Class A salt; however, they did not sell Class B salt during lean months. Also, while there were strong horizontal relationships among supply chain participants, farmers exhibited weaker collaboration with their peers in areas such as price setting, buyer identification, and knowledge sharing on new technologies. In another research, Delos Reyes et al. (2021) did a comparative study of the profitability of salt production between small- and medium-scale salt enterprises in Misamis Oriental in Mindanao.

It is noted that while there were profitability studies already done in the Visayas and Mindanao, none so far has been conducted in Luzon, particularly in Pangasinan. The province of Pangasinan is one of the country's biggest salt producers. In fact, its name means "where salt is made" (pangasinan.gov.ph, n.d.). Dasol and Infanta are the major salt-contributing municipalities. Montojo et al. (2024) reported that Infanta contributes 76.20% of the cooked salt distributed all over the country. In Dasol, 9 out of 18 barangays are considered coastal barangays and are engaged in the salt farming business (Cardinoza, 2017). Dasol is known as the "home of quality salt." It produces salt through the solar evaporation method while Infanta produces salt via the cooking method. In addition, despite the existence of the ASIN Law, there are salt producers who have not been iodizing the salt they are producing. Thus, there is a need to determine why this has been so and one of the ways to do this is through profitability analysis.

The study aimed to determine the profitability of producing salt using solar evaporation and cooking methods, and compute the additional profit that salt farmers may earn from performing salt iodization. The results of this study could help in reviving the country's salt industry and in providing information on how the ASIN Law should be implemented.

Conceptual Framework

The determination of the profitability of salt production and iodization was based on the conceptual framework shown in Figure 1. There are two methods of producing salt in Infanta and Dasol, Pangasinan, the solar evaporation and the cooking method with corresponding costs of inputs that affect the profitability of production because they have different input requirements. The solar evaporation method uses saltwater, and land where salt beds are installed is a necessity. This method produces coarse salt that is sold at a lower price. On the other hand, the cooking method utilizes saltwater, base salt, and rice hull as fuel. This method yields refined salt that is more expensive to sell. The two methods also differ in the cost of investment because the solar evaporation method requires extensive land for setting up of salt beds while the cooking method needs investment on cooking vessels like vats and other implements, although it can be done in a limited space.

The ASIN Law or the Act for Salt Iodization Nationwide (Republic Act No. 8172) requires the addition of iodine to all salt that will be used for human consumption with the intention of eliminating iodine deficiency in the country. However, the performance of salt iodization entails additional costs in terms of inputs (potassium iodate powder) and labor for mixing. Thus, in terms of costs, it is expected that iodized salt will be more expensive relative to non-iodized. Despite this, it is highly possible that producing and selling iodized salt has an advantage due to the price premium consumers are willing to pay for this product, thereby increasing total revenue. The difference in total revenue is expected to more than cover the additional cost of performing iodization thus, increasing the net income generated and therefore overall profitability of producing iodized salt. While salt iodization can be performed for both the coarse and the refined salt, this paper focuses only on the iodization of refined salt because at the time of data collection, iodization was only practiced by some farmers for refined salt.

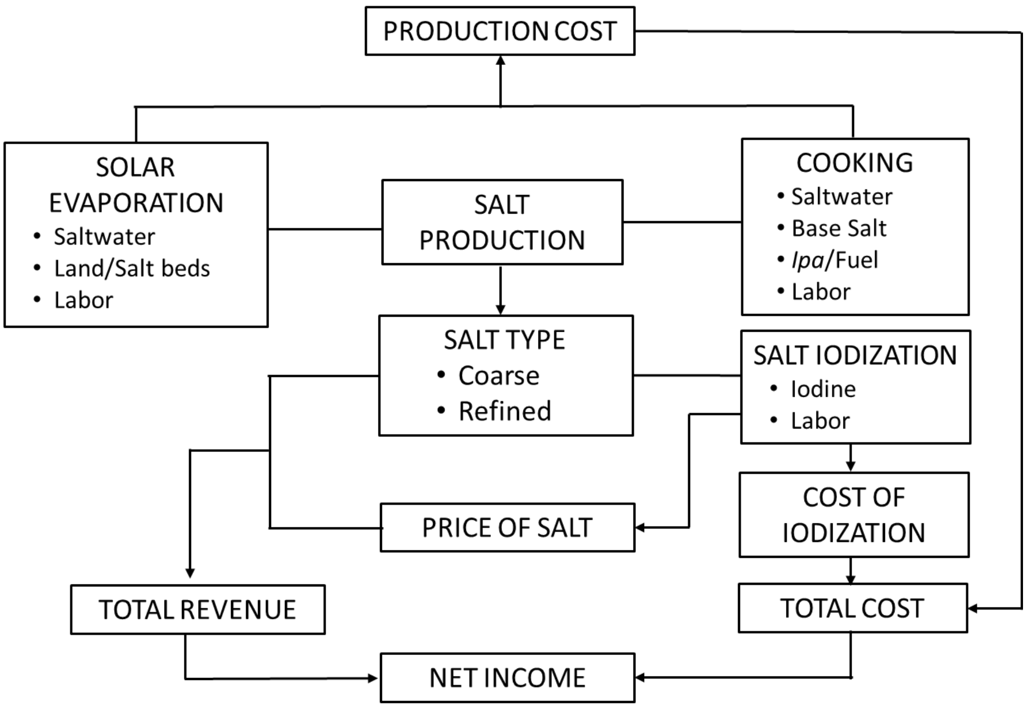

Figure 1. Conceptual framework used in the profitability analysis of salt production and iodization.

Materials and Methods

Sampling sites

The study was conducted in Dasol and Infanta in the province of Pangasinan to determine the profitability of salt production and iodization. Dasol is known for producing rock salt through the solar evaporation method while Infanta produces refined salt using the cooking method. Figure 2 shows the map of Pangasinan Province where the municipalities of Dasol and Infanta are marked as study areas.

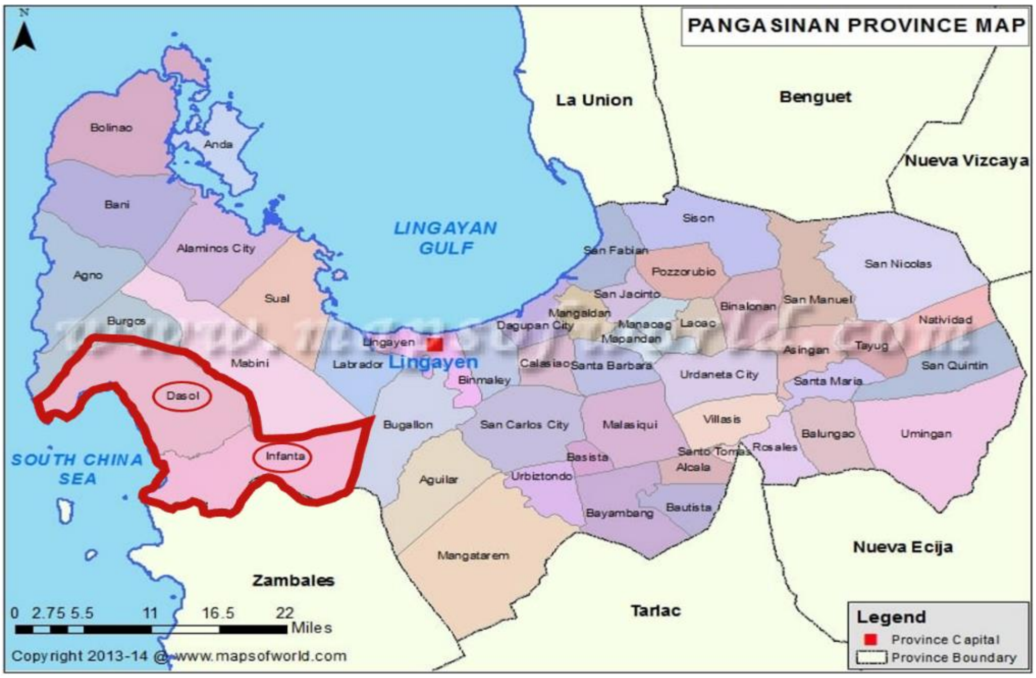

Figure 2. Map of Pangasinan Province with Dasol and infanta in red highlight as study areas.

Respondents

This paper used the evaluative research design as its main aim was to assess the profitability of salt production using solar evaporation and cooking methods and of performing salt iodization. It was developed from a salt supply chain study covering a total of 128 supply chain actors traced from randomly selected 30 farmer-respondents (15 from Dasol and 15 from Infanta) in Pangasinan. For this paper, data collected from said farmers were utilized to analyze the profitability of salt production methods. However, for salt iodization, the analysis was for 8 farmers, and 21 farmers and assembler-wholesalers in Infanta who were found to be performing iodization. It should be noted that the analysis was for the iodization of refined salt and only in Infanta because at the time of the study, iodization was being performed only for refined salt. In contrast, Dasol farmers concentrated more on the production of coarse salt and did not perform iodization.

Data collection

The supply chain actors were personally interviewed using pre-tested interview instrument to collect data covering the production period from November to April 2017. Pre-testing of the questionnaires to determine their reliability, validity, and completeness was done to non-respondents. Data were encoded and analyzed for descriptive statistics such as frequencies, percentages and means.

For ethical considerations, the respondents were approached and told the purpose of the study and why and how they were chosen as respondents. They were informed that their participation is voluntary and they can opt to quit the interview if for any reason they do not feel comfortable answering a given question. They were also assured of the strict confidentiality of the treatment of the data they will provide and that their name or any identifying marks will not appear in the reports that will be generated from the data they disclosed. Only those who agreed were interviewed.

Cost and returns and return on investment

Cost and returns and rate of return on investment (ROI) analyses were performed to determine profitability. These were done for solar evaporation and cooking methods of salt production and for those performing iodization. Since solar evaporation and cooking methods have different inputs, materials, and other investment requirements, their investment costs vary. For instance, while the solar evaporation method does not need to invest in cooking vessels and has lesser number of implements, it requires extensive use of land such that the salt farmers have to pay for land rental and also for the preparation of the salt beds. On the other hand, aside from cooking vessels, the cooking method has the added operating cost for fuel (rice hull) and had to invest more on implements for cooking hence would have higher depreciation cost. Both methods are labor-intensive. The formula used for the computation is as follows:

$$\pi = TR - TC$$

where:

π = *Profit*

TR = *total revenue (Ps x Q)*

TC = *total cost (MC + IC)*

Total revenue was computed by multiplying the selling price (Ps) of the good and the quantity sold (Q) while total cost was determined by adding the costs of labor and other inputs used including depreciation.

The ROI shows to what extent an investment is able to generate profit (or loss). While ROI has some limitations (e.g., considering only the financial side), this measure remains among those commonly used by investors in making investment decisions (Zampir et al., 2016; Andru and Botchkarev, 2011). It was deemed appropriate for this study since the main concern here is just financial in nature. Some of the objective reasons for using ROI are its simplicity and ease of understanding, support to practical but detailed financial analysis, promotion of cost efficiency and focus on profitability (Andru and Botchkarev, 2011). Profitability is the main concern of salt production as a business. Similarly, in a separate study, Delos Reyes et al. (2021) used ROI in analyzing the profitability of small and medium scale salt enterprises in Misamis Oriental, Philippines. The authors compared the profitability of using different salt bed flooring materials for salt production by computing the ROI using the formula:

$$ROI = \frac{\text{Average Annual Net Revenue}}{\text{Initial Invest Cost}} \times 100$$

Partial budgeting

In addition, partial budgeting was utilized to determine the change in net income when iodization is performed as against the production of plain refined salt only. According to Aragon et al. (2010) partial budgets are useful aids in making decisions related to small farm changes as they show the costs and benefits of the alternatives faced by a farm business. Through partial budgeting, the gains and losses from performing different practices can be separated enabling the computation of the net change in income. In this study, the partial budget detailed the possible changes in costs and revenues if salt iodization is performed. Partial budgeting for salt iodization was limited to refined salt produced in Infanta because those in Dasol are producing rock or coarse salt and are not performing iodization. Under these circumstances, caution on generalization to other areas of the country with situations very different from the two areas studied should be exercised.

Results and Discussion

Respondents

The majority (63%) of the farmer-respondents and assembler-wholesalers (77%) were male. The farmers were older with average age of 60 years with the oldest noted at 86 while the youngest was 23 years old. In Pangasinan, one of the oldest farming business is salt production which has become a traditional family business that has been transferred from one generation to another. In fact, the root word of the Pangasinan came from "asin" (or salt) because of the plentiful salt production in the area. The assembler-wholesalers were a lot younger with an average age of 41 years. The farmer-respondents have been producing salt for an average of 24 years but there was a lone farmer with more than 50 years salt making experience. True to tradition, there are 8 (26.67%) who are relatively new with 1 to 10 years in the business. If the trend continues, one can expect that one way or the other, salt making business in the area will continue to be transferred from one generation to another since 70% of them are married. The highest percentage of them (33.33%) are high school graduates. The assembler-wholesalers had been into salt trading for only 13 years and 77% percent of them were married with the highest proportion able to reach a college level of education.

Production practices

Solar evaporation

Since the solar evaporation method is the one practiced in Dasol, salt production in the area is highly weather-dependent and is done only during the dry season (November-April). In the wet season (May-September) salt beds are converted into fish ponds. During salt production, the entry of water from the sea/river towards the water reservoir (*imbakan*) is critical and must be carefully overseen. The opening and closing of the water gate must be done manually. Most farmers try to fill in their *imbakan* during high tide but there is a need to ensure that the water gate of the reservoir is closed when the tide is low to prevent the outflow of water. Seawater collection is a challenge during low tide thus, a water pump is needed to fill in the reservoir. The farmers use a calendar with indicators of high and low tides because missing the high tide means additional cost in terms of cost of fuel/energy for pumping water.

The seawater from the water reservoir (*imbakan*) is distributed to the evaporation compartments (*paalatan*) via a connecting polyvinyl chloride (PVC) pipe (Figure 3). Figure 4 shows the layout of a typical salt farm utilizing the solar evaporation method. The *paalatan* is divided into three sections, with each section sequentially filled with varying depths of seawater. Three-inch deep water is placed in the first section, 2-inch and an inch deep into the second and third sections, respectively. The flow of water from one section to another takes a day. This means that the entire paalatan will be filled up in 3 days. Eventually, the salt water will be deposited to the salinity compartment (*bandiha)* prior to distribution to the salt beds (*banigan*). *Bandiha* is a salinity compartment within the salt production set-up that receives saltwater from the evaporation compartment for measurement of salinity before actual distribution to the actual salt beds. A salinometer is used to measure the salinity of the water in the *bandiha*. A salinity level of 75% to 80% is the standard concentration to allow faster formation of salt crystals. In cases where salinity level is below 75%, farmers sprinkle an average of 1 to 2 bamboo basket (*tiklis*) of salt per section of the *paalatan*.

Figure 3. Seawater flowing from one compartment to another (arrow) through the PVC pipe.

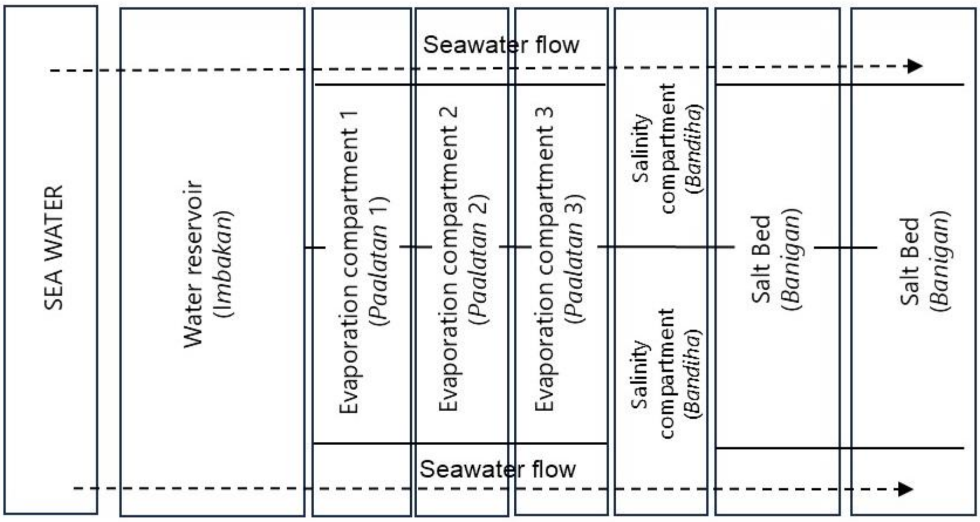

Figure 4. Typical farm layout for solar evaporation method of salt production.

The actual salt production process can take place within a day if there is sufficient sunlight. In the morning at around 7:00 o'clock, farmers flood all the *banigan* with about an inch deep seawater from the *bandiha*. The heat of the sun evaporates the excess water such that salt crystals start to form by mid-afternoon. During harvesting, two farmers are usually needed - one scrapes the salt crystals using a scraper (*pangkayod* or plihi) (Figure 5), a rake-like material made of metal with a wooden handle to push the salt in one place for easy collection later. The other farmer collects the salt using a ladle or sandok (Figure 6) and transfer it to a bamboo basket (*tiklis)* (Figure 7). An average of 2 to 3 tiklis can be harvested per *banigan* every day, with each *tiklis* weighing 15 kg, on average. The same process is followed every day given a favorable weather condition. However, in case it rains, salt production will not proceed since the initially forming crystals will be immediately dissolved and salinity level will be reduced.

Figure 5. Scrapper (*Plihi)*

Figure 6. Ladle (*Panilid)*

Figure 7. Basket (*Tiklis)*

Cooking method

Unlike the solar evaporation method, the cooking method is not dependent on weather conditions but on the amount of stock salt that will be used for production. Presumably, through cooking, salt farmers can produce refined salt all year round since it does not require sunlight for production. However, they need to have enough supply of reserved (base) salt to increase the salinity of seawater before cooking. Enough supply of rice hull (*ipa*) as cooking fuel must be ensured also. The initial procedure for the cooking method is to fill with seawater the brining tank (*tabagan*), a rectangular compartment made of cement (Figure 8). This is where the base salt, which can either be mud salt, rock salt, imported rock salt, or a combination of the mud salt and imported rock salt, will be added and soaked for an average of 1 to 2 hours. Adding base salt in the *tabagan* intensifies the salinity of the seawater while the 1 to 2 hours waiting time is to allow the mud, dirt and other impurities that come with the base salt to settle at the bottom and be left behind during transfer to the *kawa,* a rectangular vessel made of metal, used for cooking. This part of the process is equivalent to the *paalatan* section in the solar evaporation method. After 2 hours, the seawater is passed through a filter to guarantee that dirt and other impurities are removed before distribution to the *kawa* (Figure 9).

Figure 8. Brining tank (*tabagan)* for the cooking method

Figure 9. Setup for cooking method

Similar to solar evaporation, the cooking method is also labor-intensive as the cooking proper lasts for 12 hours, on average. The whole cooking process must be supervised since the fuel used by the farmers is rice hull (*ipa*), which only lasts for a short period of time, hence, periodic addition using a *dudugsol* is needed for continuous cooking. A *dudugsol* is a wooden material used to push the burning rice hull underneath the *kawa*. Once the water boils, the farmer strains the refined salt out of the *kawa* using a *pangadaw* (a net with a wooden handle), then transfers it to the *tiklis* which is placed directly above each kawa to facilitate catching of the drip. Dripping takes an hour or two before the harvested salt can be placed in the storage area. The choice of what specific base salt to use depends on the price and the desired quality of the product upon harvest. The use of mud salt (Figure 10), with an average price of PhP120 (USD 2.40) per cavan produces an off-white colored salt. On the other hand, local coarse salt (Figure 11), with an average price of PhP194 (USD 3.88) per cavan, produces a much better quality and whiter salt compared to that of mud salt. The use of imported rock salt (Figure 12) provides a certain texture that makes the quality of the salt even better than when the local coarse salt is used. In fact it gives the best quality among all the choices, however, only few salt farmers used this because it is much more expensive at an average price of PhP260 (USD 5.20) per cavan.

Figure 10. Mud salt

Figure 11. Rock salt

Figure 12. Imported salt

Market participants and marketing practices

The farmer-respondents were evenly distributed in the two major salt producing areas in Pangasinan. Those in Dasol produce coarse salt or "rock salt" locally termed as *barara* while those in Infanta produce refined salt. Figure 13 summarizes the salt marketing channel and participants. Assembler-wholesalers known as *viajeros* are those who buy rock salt and refined salt directly from the producers, pack them into sacks, and deliver them to the institutional buyers within Pangasinan or market centers in nearby provinces of Bulacan, Pampanga, Mapandan and Mangaldan in Pangasinan, Tarlac, and Nueva Ecija. The assembler-wholesalers who purchased refined salt in Infanta, Pangasinan also do the iodization process before packaging and distribution. Wholesalers buy salt in bulk directly from the farmers and assembler-wholesalers and sell them to wholesaler-retailers and retailers. Wholesaler-retailers also buy salt from farmers and assembler-wholesalers. Commonly, wholesaler-retailers in Dasol who bought directly from the farmers sell salt along the road while wholesaler-retailers in Pampanga, Mangaldan, Cavite, Tarlac, and Nueva Ecija who bought from assembler-wholesalers sell salt in major market centers within the area.

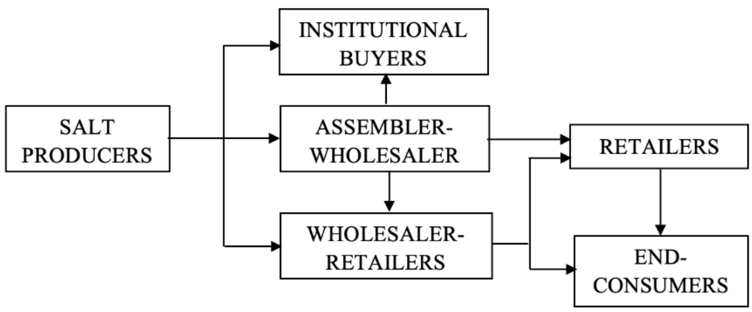

Figure 13. Salt marketing channel and participants, Dasol and Infanta, Pangasinan.

Salt retailers are those participants who buy salt either from assembler-wholesalers or wholesaler-retailers for sale in major market centers. Retailers are selling refined salt, which can either be iodized or not. In Dasol, only a few retailers are selling rock salt. Institutional buyers are the usual buyers of rock salt in Dasol for use as an input to their business of fish paste (*bagoong*) and fish sauce (*patis*) making, and drying of fish. They are commonly found within Pangasinan specifically in Lingayen, Alaminos, Dasol, Dagupan, and San Fabian. Others are in Bataan, Bicol, and Nueva Ecija.

The market participants employ different marketing practices including storage, packaging and handling, transporting, and iodizing. However, not all of them perform all of the marketing practices mentioned. Marketing practices are employed to ensure that the quality of the product is maintained as it reaches the consumers. More often, the buyers have control over what specific marketing practices will be done/employed for the product. The performance of marketing practices depends to a large extent on the quality of the product and for what purpose it will be used. Each salt type (coarse and refined salt) has its own intended use which is dictated by its quality - coarse salt is for food processing while refined salt (iodized or non-iodized) is for home consumption. It should be noted that while there were many market participants interviewed for the study, this paper focused only on the farmers as producers of salt including assembler-wholesalers who also perform salt iodization.

Packaging and handling

Immediately after harvest, salt is placed in *tiklis*, a temporary container to allow the remaining water in the salt to drip before transferring to the storage area. These bamboo baskets are placed under the sun for a faster drying process, which takes about 2 to 3 hours.

At the farm level, salt farmers do not perform any packaging practice since the buyers are the ones doing this during purchase. Other market participants purchase and sell salt on per sack basis except for the retailers who sell on retail basis. Sacks used by the traders are not labelled since they regard this practice as unimportant because even without labels, they can still sell the salt. Also, putting labels will add to their cost. At the retail level, salt retailers repack the salt using plastic bags of one-fourth to one-half kilo which they sell at PhP5 (USD 0.10) and PhP10 (USD 0.20) per pack, respectively. Just like the traders, retailers do not put label in their packaging materials as well. Re-packed salts are placed either in a plastic basin or *bilao* (winnowing basket), and are usually displayed in front of the owner's store together with other products.

Storage

Storage facilities for the harvested salt differ depending on the type of salt produced. After harvest, coarse salt or rock salt is stored in a warehouse made of bamboo mat with a galvanized roof covered with palm leaves, and sand as flooring. The sand absorbs the remaining water as the harvested salt is not yet completely dry. The salt can be stored for a long period or until purchased by the buyers which is usually not later than three days after harvest. On the other hand, refined salt is placed in a cemented warehouse with tent as roof and bamboo (*buho*) as flooring material. This *buho* also facilitates dripping. Storing refined salt lasts up to three days, on average as they are easily sold. Stores of the sellers in major market centers and retailers' houses serve as their own salt storage area.

Transporting

Transportation is not performed by the farmers since salt is picked up by the buyers from the farm. The majority of the market participants who bought salt directly from the producers, such as the assembler-wholesalers and institutional buyers, transport the product using truck since they buy in bulk. The buyers bring their own sacks for the primary packaging of salt before they are placed inside the truck for delivery to different market outlets. A sack costs PhP6 to PhP7 (USD 0.12-0.14), while the string used to sew it is PhP75 (USD 1.50) per roll which can be used to tie up to 500 sacks. The buyer (assembler-wholesaler and retailers) transportation costs per transaction include the fuel costs, food, permits, and pass card paid per municipality along the route. On the other hand, the wholesalers, wholesaler-retailers, and retailers who picked-up the salt from the seller within their area usually use tricycle.

Salt iodization

Not all the producers and traders in Pangasinan perform salt iodization or the application of potassium iodate in salt. It is done only by the farmers and assembler-wholesalers from Infanta and not by those from Dasol. The choice of whether to iodize or not depends on: 1) the nature/kind of buyer; 2) the intended use of salt; and 3) the governing policy within the area. For instance, in Infanta checkpoints are strategically located to ensure that only iodized salt leaves their municipality. Only five salt farmers (33%) from Infanta iodized their salt because mostly, the traders or *viajeros* are the ones performing iodization upon purchase. In Dasol, the salt farmers do not iodize their salt since they already have ready markets majority of whom are institutional buyers making use of salt for processing *bagoong* and fish sauce (*patis*), and drying of fish.

Profitability of salt production

Cost and returns

The profitability of salt production was determined using cost and returns analysis. Comparability values were standardized for a cavan containing 50 kg of salt. A cavan of coarse salt (via solar evaporation) was sold at PhP194, on average. A total cost of PhP129.78 (USD 2.60) composed of cash costs (PhP64.02 or USD 1.28) and non-cash costs (PhP65.76 or USD 1.32) were incurred which when deducted from the total revenue generated an average net income of PhP64.22 (USD 1.28) per cavan. However, the net income from iodized salt was higher at PhP69.38 (USD 1.38) than the non-iodized which was only PhP5.62 (USD 0.11) per cavan of refined salt (Table 1). Notably, the net income from iodizing cooked salt is also higher than that produced through the solar evaporation method suggesting the income advantage of the cooking method combined with iodization.

The improvement in income from producing refined salt was due to relatively higher selling price at PhP408 (USD 8.16) and PhP323 (USD 6.46) per cavan for refined and non-iodized salt, respectively (Table 1). The large difference between the selling prices can be explained by the fact that refined salt is for household consumption and that they are of better quality because they easily dissolve and are whiter in color with minimal visible impurities. In the interest of food safety, households are willing to pay a premium price for these qualities of refined salt. Also, iodized salt is sold at a higher price due to the additional cost incurred for potassium iodate, depreciation of equipment and cooking tools, and additional labor required for iodization.

Table 1. Cost and returns of coarse and refined (iodized and non-iodized) salt per cavan (50 kg).

Item	Amount (PhP/ cavan)		
	Solar evaporation	Cooking method (Refined)	
	Coarse/Rock salt	Iodized	Non-iodized
Total returns	194	408	323
Salt sales	194	408	323
Cash cost			
Cost of rice hull	-	92	92
Cost of base salt	-	166	166
Cost of potassium iodate	-	10	-
Production/Marketing costs			
Labor cost	64.02	32	28
Vehicle rental cost	-	1.44	-
Land tax	0.61	0.30	0.30
Land rental	0.50	0.30	0.30
Business permit	0.22	0.40	0.40
Non-cash cost			
Unpaid family labor	64.02	35	29.50
Depreciation	0.41	1.18	0.88
Total cash cost	64.02	301.44	286
Total non-cash cost	65.76	37.18	31.38
Total cost	129.78	338.62	317.38
Average net income	64.22	69.38	5.62
Average ROI (%)	5.21	69.67	

1USD = PhP50

Rate of return on investment

The solar evaporation method requires a larger land area since production volume for coarse salt is greatly dependent on the number of salt beds (*banigan*) constructed which in turn depends on the size of the land. For the cooking method, the production level of refined salt is dictated by the number of *kawa* for simultaneous cooking and not necessarily by the size of the land. Despite this, land is still needed to contain the building where the *kawa* will be housed, thus land comprises a large proportion of the capital investment (PhP700/sqm) for both methods to initially operate. As can be seen in Table 1, the rate of return on investment (ROI) using the cooking method is higher (69.67%) compared with those using the solar evaporation method (5.21%). While the salt farmers using the cooking method have higher investments in additional tools like wooden basket or *tiklis, pangadaw, dudugsol, kawa, tabagan*, water pump, sprayer, and warehouse, their relatively smaller land area, gave then the advantage of having higher ROI (69.67%). This means that for every one peso of investment in the salt farm, the business can generate 69.67 centavos earnings. On the other hand, the low 5.21% ROI of those salt farmers using the solar evaporation method was caused primarily by the huge sizes of the salt farms which ranged from 2 to 27 hectares, and the number of fixed investments such as wooden basket or *tiklis*, *plihi*, *panilid*, water pump, warehouse, flooring material, wood, and sand. This group generated 5.21 centavos income from every peso of investment in the salt farm (Table 2).

Table 2. Invest cost, net returns, and rate of return on investment per production method per season.

Production method	Net return (PhP)	Investment cost (PhP)	Rate of return on investment (%)
Solar evaporation (1 hectare or 38 salt beds)	10,403.59	199,685	5.21
Cooking (1 *kawa*)	12,786.54	18,353	69.67

1USD = PhP50

Partial budgeting (Profitability of iodization)

In support of the ASIN law, the municipality of Infanta is implementing strict compliance such that salt produced in the area is being iodized directly at the farm either by the farmer or the buyer before packaging. Checkpoints are strategically located in exit points of the municipality and vehicles containing salt had to stop for random testing of salt iodine content using the commercially available rapid test kit. This kit contains 10 to 50 ml of stabilized starch-based solution which when dropped to salt crystals will cause them to turn deep bluish purple when iodine is detected (World Vision, 2012).

Partial budgeting was used to see the financial changes if salt farmers ever shift from the production of non-iodized to iodized salt. The changes in the revenue, cost, and net income were calculated. This was done for refined salt only because nobody among the respondents is performing iodization for coarse salt. It was seen in Table 1 that iodized salt is sold at a relatively higher price (PhP408 or USD 8.16/cavan) than non-iodized salt (PhP323 or USD 6.46/cavan) resulting in a price advantage of PhP85 (USD 1.70) or 26.32% per cavan. Given this price premium, partial budget analysis proved that the farmers would have a higher income of PhP65.15 (USD 61.30) per cavan if they progressed to producing iodized salt (Table 3). This is despite the additional requirement of the sprayer, potassium iodate, labor, and depreciation of equipment for iodization, the costs of which were more than covered by the price advantage resulting in a positive effect on the net income.

Table 3. Partial budget of shifting from non-iodized to iodized refined salt production (per 50-kg cavan).

Gains (USD)		Losses (USD)	
Added returns		Added costs	
Salt sales	85	*Sprayer*	0.05
		Cost of potassium iodate	10.00
		Cost of depreciation	0.30
		Labor cost	9.50
Subtotal	85		19.85
Reduced costs		Reduced returns	
Subtotal	0	Subtotal	0
Total gains	85	Total losses	19.85
Change in net income (PhP)			65.15

1USD = PhP50

Problems encountered

While salt production has been profitable for both solar evaporation and cooking methods, some problems continue to hamper the industry and therefore its expansion. Critical among these problems are the erratic climatic conditions in both areas. Salt production is highly seasonal mainly because rainfall lasting even just for a few minutes greatly affects the amount and quality of salt produced. The salt crystals that are starting to harden have the tendency to melt and once melted the salinity of the seawater decreases such that no salt can be harvested for the day. This is crucial in Dasol where solar evaporation is being practiced. Meanwhile, even though the cooking method is being used in Infanta, salt farmers are also dependent on the available stock of salt which they regularly use to enhance the salinity of the seawater to be cooked. During dry months, this is not a problem for them but come rainy months, their level of production is also reduced because of lack of supply of "base" salt for cooking. There is also a concern for the supply of "*ipa*" as fuel for cooking as there might not be enough supply due to the prevailing lackluster interest of many rice farmers in continuing with rice production due to a number of disincentives.

Conclusion and Recommendations

For its objectives, the study determined the profitability of producing salt using solar evaporation and cooking methods, and computed the additional profit that salt farmers may earn from performing salt iodization. Based on the results presented, the farmers generated more net income from cooking salt, therefore it can be concluded that the cooking method is more profitable. This was further proven by the higher ROI for this method. Similarly, it was found that there was a positive net change in income when salt iodization was done, thus, it can also be concluded that producing iodized is more profitable than non-iodized salt.

It has been found that salt production is indeed profitable whichever method is used although the cooking method is the more profitable, it is therefore recommended that more farmers be encouraged to venture into salt production and those already into it should increase their production scale. It is particularly important that during dry season area expansion is highly encouraged by providing more incentives or support for solar evaporation production. In this way, more salt can be stored for use as "base" such that even during the rainy season when salt production through solar evaporation cannot be done, the cooking method could still be performed and even expanded. Currently, the Bureau of Fisheries and Aquatic Resources (BFAR) is engaged in the distribution of plastic sheets for use as salt beds during solar evaporation. Also, alternative fuel for cooking salt should be explored such that farmers will not be dependent on *ipa* alone and be hampered by its shortage since it also seasonally available. Supporting both production methods should help increase local production and stabilize local supply so that the industry will no longer be dominated by imported salt.

In relation to the above, it is high time that LGUs in the coastal communities should consider salt as one of their priority commodities and therefore more public lands should be allotted to this endeavor. This can be made possible by investments in seawater channels by the LGU to provide farmers with access to more lands that are located farther from the coastlines. This should not be a big problem now that the Mandanas-Garcia ruling effectively increased the Internal Revenue Allotment (IRA) for LGUs. IRA is a sustainable source of income for the LGUs since it is their share in the revenues generated by the national government through taxation.

Furthermore, since it was revealed in the study that iodized salt is priced higher resulting to more income generated, salt farmers should be encouraged to venture into salt iodization. Not only will they improve their income, they will also be compliant with the ASIN Law. In addition, since iodization for coarse salt iodization has not been covered by this study, a study on this should also be done in consultation with technical experts like food scientists.

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No potential conflict of interest was declared by the authors.

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