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PROJECTION OF SALT WAREHOUSE CAPACITY FOR SALT PRODUCTION CENTRE AREAS IN PASURUAN REGENCY, INDONESIA

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Abstract: Salt is one of the strategic commodities of Indonesia and East Java is the main producing area. Pasuruan Regency contributes 38.5% of East Java's salt production. Salt farmers in the Pasuruan Regency face various obstacles such as warehousing capacity. The inadequate storage encourages them to sell their harvests without considering prices. Therefore, an analysis of warehouse capacity is very important for developing a salt business. This study examines salt warehousing capacity in the Pasuruan Regency. The methods used in this study were analysis of the Storage Space Requirement following the Indonesian National Standard (SNI) for the Salt Warehouse (SNI 8446: 2017) and the ARIMA method to predict the salt price. This study projects that salt production in Pasuruan Regency will continue to increase with an average annual growth of 13%. The production will reach 18,093 tonnes, equivalent to 482,476 sacks of salt in 2030. Hence, the need for storage space for salt in Pasuruan Regency in 2030 is 18,093 m^2. According to the results of this study, improving the capacity and quality of salt warehouses is fundamental to develop a salt business in Pasuruan Regency.

Keywords: Salt warehouse, salt commodity, Pasuruan, salt production, warehouse capacity.

Introduction

Salt is one of the strategic commodities in Indonesia. It cannot be substituted by other commodities and political commodities because it sustains the livelihood of many people (Amin *et al.,* 2021). Over the past few years, there have been three main problems in the Indonesian salt industry: (1) Production problems, (2) distribution problems and price certainty, and (3) warehousing capacity and management (León-Peña, 2008). The problem of salt production is caused mainly by the season or weather and the low technology used (Aulia & Jasilah, 2019). The limitations of technology are also often obstacles to increasing the quantity and quality of salt production (Guntur *et al.,* 2018). As a seasonal commodity, salt is very vulnerable to price pressures (Nurwadjedi *et al.,* 2018). Prices tend to drop drastically during the harvest period and increase relatively slowly even after the harvest season has passed.

Indonesia's national salt production cannot meet domestic needs (Mahasin *et al*., 2020). Approximately 50% of national salt needs are met yearly through imports (Wedari & Sukadana, 2020). In 2016, the national salt production decreased due to the La Nina weather anomaly (Wedari & Sukadana, 2020). Salt production only reached 4% of the production target and this condition continued until the middle of 2017.

Indonesia is an archipelagic country with the second longest coastline after Canada (Jamil, 2020). The Indonesian Sea is vast and the sun shines all year round. Therefore, the three main production factors for salt have been met and are adequate: Seawater, coastline, and sunlight. Based on this condition, Indonesia may become one of the largest salt producers in the world but the country still imports salt every year.

The main problems the national salt industry often faces are distribution and price certainty (Setywati, 2015). The length of the supply chain for salt and the lack of a marketing network have hindered market penetration. However, each element in the salt distribution chain has a critical role between salt farmers and consumers, and can provide added value for the participants. The distribution chain is a combination of elements and actors that can continuously build a mechanism for the movement of salt from farmers to consumers at an efficient cost and can prosper all actors. In addition, the high price volatility at the level of salt farmers and the market structure tends to have an oligopoly impact on the solid salt market domination of the traders, thus, indicating the emergence of a cartel (Ihsannudin *et al*., 2018).

Capacity and warehousing management problems are significant obstacles to Indonesia's salt production. The unavailability of adequate salt warehouses encourages salt farmers to immediately sell their harvests without considering salt prices (Sudaryana & Pramesti, 2018). Inadequate salt storage at the level of salt farmers also decreases the quality of salt if it is stored until the rainy season passes. The condition of the salt storage warehouses is generally still in the form of huts in elementary conditions, with tiles and walls often left damaged. In this condition, maintaining the quality of salt is challenging during the rainy season and is one of the main reasons why salt farmers quickly sell their products.

The warehouse is a particular facility that is permanent, designed to achieve the target level of service with the lowest cost (Richards, 2011). As one of the essential factors in the salt business, the warehouse requires effective and efficient management (Muysinaliyev & Aktamov, 2014). Similar to warehouses for other commodities, salt warehousing management is designed to minimise costs, and efficient retrieval and entry of goods, as well as ease and accuracy of inventory information (Lalit, 2014).

Inadequate warehouse capacity and quality make it difficult to implement a warehouse receipt system (Otchere *et al.,* 2013). On the other hand, Pasuruan Regency has become a location for the development of salt processing with the support of the Ministry of Maritime Affairs and Fisheries. Hence, the existence of a salt warehouse and its management is an essential factor to be developed. To the best of our knowledge, this is the first study that analyses the salt warehouse capacity needed to develop a salt business based on production predictions and salt price projections in Pasuruan Regency, East Java, Indonesia.

Materials and Methods

Research Location

This research was conducted from April to October 2021 in Pasuruan Regency, East Java, Indonesia. The salt ponds in Pasuruan Regency cover 332.5 Ha spread over three subdistricts. The subdistrict with the most salt ponds is the Kraton Subdistrict, with 189.5 Ha (57%), followed by Bangil District, with 138.3 Ha (41.6%), and Lekok District, with 4.7 Ha (1.4%). Regency Pasuruan is one of the salt business centres in the East Java region. In addition, its strategic location is adjacent to the Java Sea, giving this regency the potential to produce salt.

Research Methods

The required storage capacity of salt is analysed by calculating the capacity of the salt warehouse and the minimum volume of salt that must be kept so that the farmers can pay the fee of the warehouse receipt system (i.e., quality testing, insurance, safekeeping, and administration) without losses. The salt warehouse's capacity analysis was conducted in several stages. In the first stage, the prediction of salt production is used to estimate the Storage Space Requirement following the Indonesian National Standard (SNI) for the Salt Commodity Warehouse (SNI 8446: 2017). Furthermore, the ARIMA method was used to predict the price of salt in Pasuruan Regency as a research location.

Data Analysis

This study also estimates the future price of salt in Pasuruan Regency. Primary salt price data were obtained from the Pasuruan District Fisheries Service from 2015 to 2020. The data were analysed using R software to fit the best model using an Autoregressive Integrated Moving Average (ARIMA).

ARIMA is one of the methods of non-stationary time series analysis. This model describes time series by past values or lagging and the stochastic error term. This study used autoregressive combination (AR) and integration (I)-referring to the reverse process difference to generate forecasts and moving averages (MA). The following general approximations of equality represent ARIMA (p, d, q) models:

$$Yt = \mu + \sum_{i=1}^{p} \Phi_i Y_{t-i} + \sum_{j=1}^{q} \theta_i \varepsilon_{t-j} + \varepsilon t$$

where Yt is the price, μ is the average of the series, $\varphi_1,\dots \varphi_p$ is the model parameter AR, the $\theta_1, \dots \theta_q$ is the parameter of the MA model, and εt, εt-1,…, εt-q is the noise error term. p stands for autoregressive process sequence, d is the stationary data sequence, and q is the moving average process sequence. Seasonal ARIMA models are denoted by ARIMA (p, d, q) (P, D, Q), where P denotes the seasonal amount for autoregressive component, D denotes the number of seasonal differences needed to induce stationarity, and Q denotes a number term for seasonal moving average as discussed in Box *et al*. (1994). After the appropriate model is identified, the next step is forecasting. The ARIMA analysis method determines the minimum capacity carried out by salt farmers in a certain period.

Table 1: Projection of salt production capacity Pasuruan Regency

Year	Production (tonne)
2016	784
2017	14.891
2018	22.930
2019	25.144
2020	1.082
2021	20.555
2022	31.652
2023	34.708
2024	1.494
2025	**28.373**
2026	43.691
2027	47.910
2028	2.062
2029	39.166
2030	**60.310**

Results and Discussion

Salt Production and Projection of Salt Production

To estimate salt capacity in Pasuruan Regency, salt production projections for 2025 to 2030 were analyzed based on production data from 2016 (Table 1). The projected results of salt production show positive growth with an average annual growth of 13%. This projection was carried out to determine fluctuations in salt production in Pasuruan Regency, one of the main salt-producing areas in East Java, Indonesia. The development of salt production has made Pasuruan Regency one of the national salt production centres in Indonesia (Sukesi, 2011).

Handling of Salt Commodities in Warehouse

The stacking of salt sacks in the warehouse is planned to be carried out alternately so that the pile is strong enough and does not collapse easily. The type of stack used is a five-key system, namely the arrangement of 5 x 5 pallets. The piles in the warehouse are planned not to be assembled but to be made in groups or stacked blocks (staple). For example, 1 pallet will contain two sacks of salt arranged in parallel (Warman, 1995). An illustration of the type of stack of five keys is shown in Figure 1 and the stacking of salt sacks can be seen in Figure 2.

Storage Area

The salt warehouse capacity is calculated using several assumptions to meet the Indonesian National Standard (SNI) No. 8446: 2017 related to the provisions for Salt Commodity Warehouse. Based on the results of this study, the assumptions used are as follows:

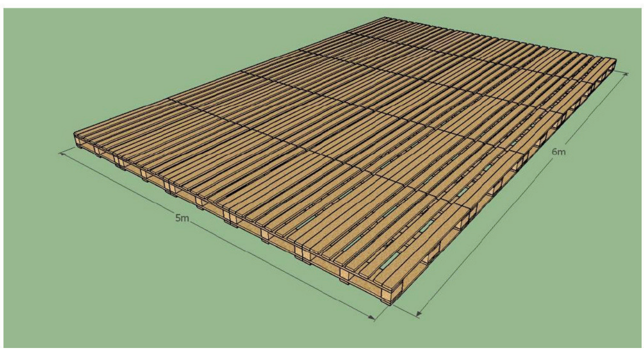

Figure 1: Overview of the salt stacking pallet

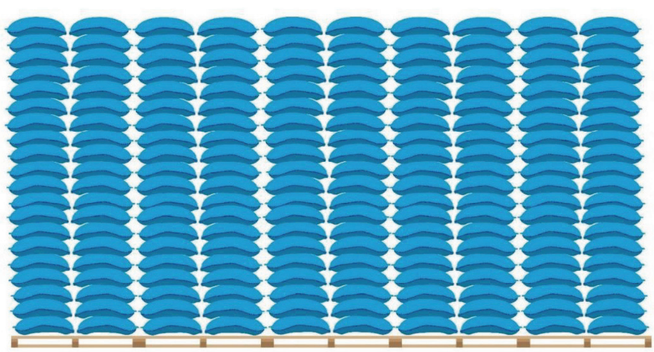

Figure 2: Overview of the pallet position as the base for salt storage

1. Dimensions of the salt sack : 0.9 cm x 0.6 cm
2. Weight of salt per sack : 50 kg
3. Type of stacks used : 5 lock system (5 x 5 pallets per staple/block)
4. Pallet size : 100 cm x 120 cm
5. Number of sacks per pallet : 2 parallel sack
6. Number of layer stacks : 20 layer
7. Number of sacks per layer : 50 sack
8. Area per staple : 37.5 m^2

In order to measure the need for warehouse space in implementing the Warehouse Receipt System, the storage area is obtained based on predictions of salt production in the Pasuruan Regency (Table 1). Salt that can be stored in warehouses is industrial salt with a NaCl content of 97% with a small amount of sulfate (SO_4), magnesium (Mg), potassium (K), and other impurities (Rathnayaka, 2013). The need for salt, which tends to increase every year, must be balanced with the availability of salt. However, national salt production is unstable (Dharmayanti *et al*., 2014). Therefore, a salt storage warehouse area is planned for 2025 and 2030 in Pasuruan Regency (Table 2).

In the 2025 planning, the storage area needs in Pasuruan will be projected to reach 170 blocks for 8,512 tonnes of salt, equivalent to 170,241 50 kg salt sacks. So, it is projected that the storage area needed in Pasuruan Regency will reach 6,384 m^2.

The projected need for salt commodity warehouses in 2030 in Pasuruan Regency can be seen in Table 3. The storage area requirement in 2030 was projected at 482 blocks or staples. Based on the assumption that 30% of salt production follows the Warehouse Receipt System (WRS), the need for storage space for salt commodities in Pasuruan Regency, the number of products in 2030 will reach 482,476 sacks or the equivalent of 18,093 tonnes, so, a storage space of 18,093 m^2 is needed.

Analysis of the Minimum Volume of Salt Storage in the Warehouse

The Warehouse Receipt System program aims to provide goods storage facilities for salt farmers. However, before salt farmers think

Table 2: Requirements of storage area for 2025 planning

Description	Value
Salt production assumption for Warehouse Receipt System (30%)*	8,512 tonnes
Number of products (sack)	170,241 unit
Storage area requirement (block/staple)	170 m
Storage Space Requirement (m^2)	**6,384 m^2**

Notes: *It is assumed that 30% of total production follows the Warehouse Receipt System.

Table 3: Requirements of storage area for 2030 planning

Description	Value
Salt production assumption for Warehouse Receipt System (30%)*	18,093 tonnes
Number of products (sack)	482,476 unit
Storage area requirement (block/staple)	482 m
Storage Space Requirement (m^2)	**18,093 m^2**

Notes: *It is assumed that 30% of total production follows the Warehouse Receipt System.

about getting the maximum benefit from the Warehouse Receipt System program, the main thing that must be considered is the minimum quantity (volume) of salt that can be stored in the warehouse.

Large quantities will give lower ordering costs. Buying in larger quantities often means ordering costs will be less than smaller orders (Sulaiman *et al*., 2018). Conversely, the cost of holding goods for extended periods will be more significant. Inventory is divided into raw materials, finished goods, and goods in the process (Baihaki, 2013). The minimum volume of salt commodities that can be stored in the warehouse is known using the simulation method. The simulation is carried out by calculating the volume of salt that can be stored to achieve a storage Break Even Point (BEP) during the Warehouse Receipt System period. The Warehouse Receipt System period is the time that can be used to store goods in the Warehouse Receipt System warehouse for a maximum of 6 months. Optimizing land area production and the number of harvest days affect the total salt production. Salt storage time is affected by the selling price of salt and the amount of harvest (Hidayat, 2016).

The price data used in the simulation is the result of calculating the development of salt commodity prices using the ARIMA method. The analysis results show that the average price of salt in Pasuruan Regency showed a slow decline in 2023. At the simulation's end, the projected salt price in Pasuruan is Rp343/kg. The price of imported salt influences the price of local salt, the amount of salt produced, and the quantity of salt consumed (Rochwulaningsih, 2012). Factors will always be related if production decreases. Alternative storage of salt in the warehouse can support the results of maximum production and effectively stabilize the market circulation of salt (Santoso & Sulistio, 2020).

The minimum quantity of salt needed to be stored to reach the BEP condition can be seen in Figure 3. However, the factors of production are carried out by salt farmers technically and economically efficiently (Wati *et al*., 2015; Hidayaturrahman *et al*., 2017). The analysis results showed that the minimum amount of salt stored is 1,260 kg at a price level of Rp350/kg. The results of calculating the minimum volume of stored salt commodities to achieve the BEP storage conditions are intended so that the salt farmers have guidelines in considering their decisions to follow the Warehouse Receipt System for salt commodities.

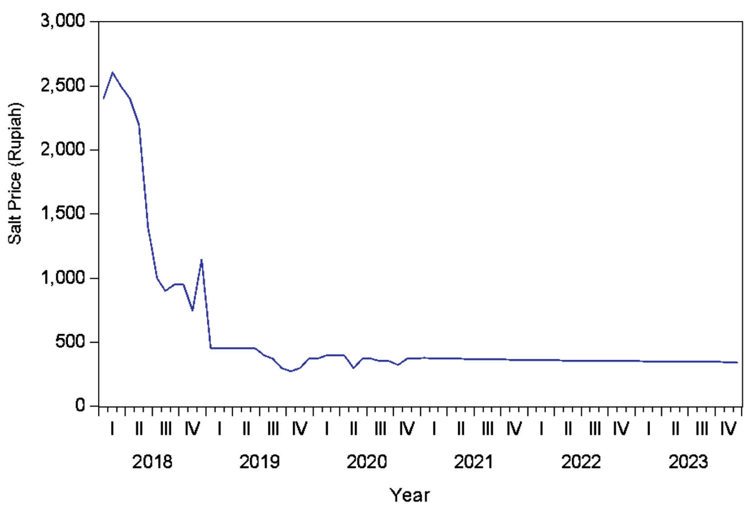

Figure 3: The estimated average price of salt in Pasuruan Regency

Conclusion

This study estimated the salt production capacity in the Pasuruan Regency based on projections for 2025 and 2030. The projected results of salt production show positive growth, with an average annual growth of 13%. The Pasuruan Regency in 2025 is predicted to produce 8,512 tonnes of salt, equivalent to 170,241 50 kg salt sacks. Thus, in 2025, the storage area needed in Pasuruan Regency will reach 170 blocks or staples, with a storage space requirement of 6,384 m^2. The need for long-term storage areas (2030) for Pasuruan Regency is projected to reach 482 blocks or staples. Based on the assumption that 30% of salt production in the Pasuruan Regency follows the Warehouse Receipt System (WRS), the need for storage space for salt commodities in the Pasuruan Regency will increase. This study makes vital theoretical and practical contributions to projecting salt warehouse capacity in Pasuruan Regency, Indonesia.

Theoretically, it fills gaps by revealing novel insights into East Java's salt commodity warehousing management. The result of this study forms a basis for understanding coastal small and medium industry development, particularly in salt commodities. Practically, it informs optimal utilization of salt commodity warehouses for local farmers, aiding efficient storage and distribution. The projected capacities provide input for policies enhancing farmers' welfare. Additionally, it guides quality improvement and management of warehouses, aiding productivity, and cost reduction. According to this study, developing the capacity and quality of salt warehouses is important to develop the salt business in the Pasuruan Regency during the 2025-2030 period.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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