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The Use of Geomembrane Technology: A Solution to Increase Hygienic Salt Production

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Abstract

Demand for salt in Indonesia continues to increase, while local production has not kept up and therefore relies on imports. Salt production faces challenges such as weather dependency and the risk of soil mixtures that degrade product quality. This community empowerment program aims to improve the quality and quantity of hygienic salt production in business groups through the application of geomembrane technology, and increase production capacity to meet standards. The program methods include socialization, technical training on geomembrane installation, assistance in production, and evaluation. The results and impacts of the salt production process increased by 20%, salt products produced are whiter, hygienic, and meet SNI standards. In addition, the income of the business group increased by 50%. This production has successfully improved productin efficiency and the welfare of salt farmers. In the future, the group plans to expand the market, improve infrastructure, and submit products for formal certification. Geomemran technology has proven to be an effective and sustainable solution in supporting hygienic salt production.

INTRODUCTION

Salt is a vital commodity that plays an important role in meeting consumption needs and various industrial activities (Syakatera & Purnomo, 2023). Salt is used in various industries such as the chemical industry, food industry, pharmaceutical industry, and petroleum industry. But by the habit of people using salt as a seasoning to flavor food and improve its taste, without salt food is meaningless. The national demand for salt increases every year and cannot be met from domestic salt production (Abdullah & Susandini, 2018; Peni et al., 2023).

Domestic fulfillment of needs is a concern to continue to be developed so as to be able to solve these problems (Siregar, 2023). The utilization of a technology to increase salt production is by using geomembrane technology. Geomembrane is a HDPE coating material as a seawater container that is waterproof and accelerates the salt crystallization process.

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Geomembrane was first introduced by PT Garam (Arwana Gede, 2020; Daulay et al., 2019; Muliana et al., 2022; Peni et al., 2023; Wahyurini & Hamidah, 2020). Of course, the geomembrane method is expected to improve the quality and quantity of salt production. Despite the large amount of salt that has been produced by farmers, the percentage of domestic salt imports is 60% greater than domestic production. This is an interesting phenomenon related to the problem of salt demand in Indonesia that must be studied further. Geomembrane is an excellent method in increasing the rate of salt production which is certainly an advantage for Indonesian salt farmers (Abdullah & Susandini, 2018; Herlina & Rum, 2022; Nazizah & Sustiyana, 2022; Rahmi et al., 2024; Yaqin & Setiani, 2017).

Answering the challenges of the problems that occur in Indonesia so that the Sirana Jaya Salt Business group is a business group formed by the Pulo Nasi community by Pulo Nasi salt business actors with 14 members, members who join the group consist of women and men. Members who joined this group from Gampong Deudap, Gampong Deumit, Gampong Pasi Janeng, gampong Alue Riyeng and Gampong Lamteh. Salt business actors have been producing salt traditionally, so that when producing depends on the weather, if in the rainy season business actors do not produce salt (Batafor, 2020; Ihsannudin et al., 2018; Pratama & Abidin, 2023).

Through the Sirana Jaya group, members are committed to changing management patterns by using Geomembrane technology that can improve the quality and quantity of production, Geomembrane is a type of Synthetic Geo material that functions as a waterproof layer made of synthetic materials such as plastic. So that by using geomembrane salt crystallization can be done without having to come into contact with the ground directly. This Geomembrane can absorb sunlight heat faster than using a salt table made of soil so that in addition to the quality of production results will also experience increased production and product hygiene.

The application of geomembrane technology and production innovation in the Sirana Jaya salt business group has been proven to increase the quality and capacity of salt production by 20% and accelerate production time. In addition, the income of business group members increased by 50%, and the salt products produced were more hygienic and met the established quality standards (Sameto et al., 2024; Utama et al., 2025; Wiraningtyas et al., 2017). This research pays special attention to aspects of production sustainability and the potential for diversification of salt-based products, which have not previously been the main focus. Thus, the proposed innovations not only improve production quality and quantity, but also provide a relevant model for the sustainable development of the local salt industry in Aceh.

METHODS

The implementation method applied in this research is a qualitative method with an action research process approach. The research was conducted in the community in Gampong Deudap Pulo Nasi, Pulo Aceh District, Aceh Besar Regency, Aceh Province, Indonesia. This research has five stages of steps taken. First, the program implementation stage. The steps of the implementation stage of the people's salt production, namely traditional salt owned by the Sirana Jaya salt group, are described in the following process flow.

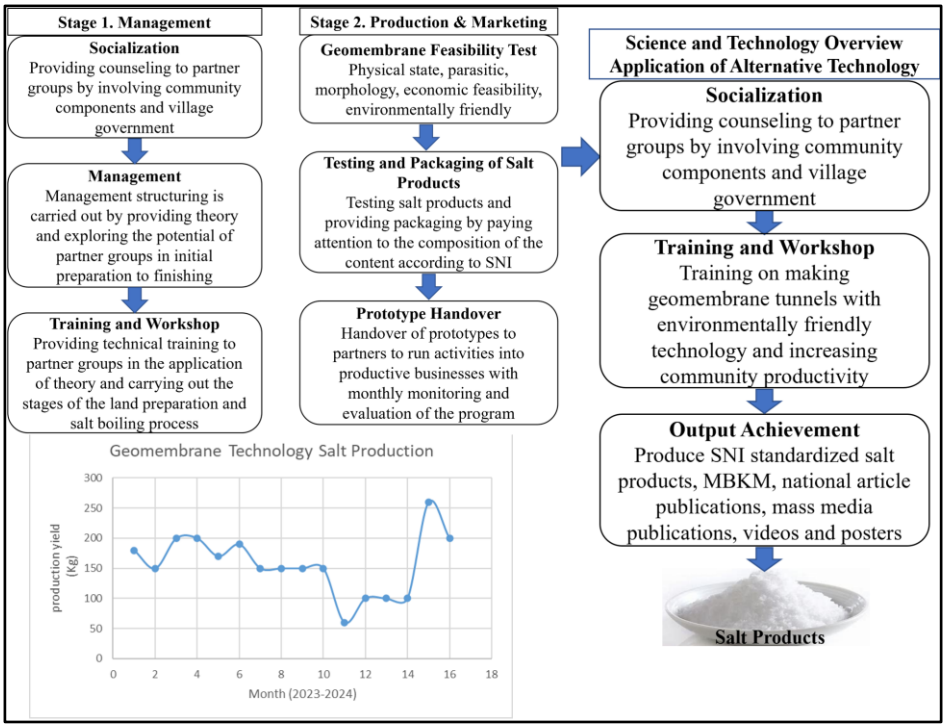


Fig 1. Steps of salt production implementation

Socialization is the first step taken to the Sirana Jaya Salt Business farmer group community. The socialization process provides an overview and application of geomembrane technology that can provide partner solutions in an effort to increase salt production. The form of socialization of this empowerment program can be in the form of training, workshops and capital, production equipment assistance, improvement of facilities or infrastructure and others.

Broadly speaking, the stages of starting the program are divided into two, the first is the pre-implementation stage or the program preparation stage. Some of the pre-implementation or program preparation stages that can be carried out include: i) Preparation of a program planning matrix (MPP) consisting of activities or activities, targets, success indicators and program implementation time. ii) Preparation of a program blueprint (blue print) which is a comprehensive description of the program that is used as a benchmark and general guide in program implementation. In other words, the MPP and blue print are part of the strategic stages in program implementation (Mustofa & Turjono, 2017; Pemasaran et al., 2023).

Second, training. The training began with four steps: i) preparation of the land for the crystallization table, which had to be level, ii) the ground had to be dry and free of other materials such as stones, wood, marine animals, and shells, iii) the size of the crystallization table had to be uniform and precise, and iv) training on the installation of the geomembrane.

Overlay geomembrane sheets on the crystallization field starting from the side of the land one by one neatly so that it is flat with the ground while gluing the joints between geomembrane sheets to avoid leakage. Then clamp the side of the geomembrane sheet on the soil plot (tabun) with boards and pegs from bamboo (Adibrata et al., 2021; Putranto et al., 2024).

Third, the application of technology. The process flow of making salt using Geomembrane goes through six stages, namely: i) The young water channel functions to transport seawater to the salt field. The flow of seawater can use the help of a pump machine or rely on sea tides then assisted by windmills. ii) Seawater from the primary channel is then flowed into the young

water storage plot and then deposited for 7 - 10 days with a water level of approximately 1 meter and a slope of 1: 1. iii) After that the water is flowed into the *peminahan* I plot with a water depth of approximately 40 cm. then precipitated so that evaporation occurs so that the water density from 7 °Be to 10 °Be with a land slope of 1: 1. iv) Then the water is flowed back to the *peminahan* II plot for 2-4 days with a water depth of approximately 30 cm until the water density increases with a land slope of 1: 1. v) Then the water is flowed to the *peminahan* III plot and precipitated again for 2-4 days with a water depth of approximately 20 cm until the water density increases with a land slope of 1: 1. vi) Then water that has a concentration of 18 °Be is flowed into a crystallization table covered with geomembrane media with a land slope of 1: 0.5 and released until it becomes salt and at the age of 4 days the salt can be harvested.

Fourth, mentoring and evaluation. Assistance is carried out to encourage salt production so as to achieve the target partners' goals in realizing marketing targets. Evaluation of the implementation stage covers all activities at this stage, such as village meetings, registration of workers for physical infrastructure projects, preparation of work plans, preparation of administration, submission of funds, implementation of work, provision of incentives for physical infrastructure projects and submission of activity results. Meanwhile, evaluation at the control stage can include monitoring, supervision and sanctions on the quality and progress of activities, reporting on structural and functional lines, and reporting on financial progress (Agustina, 2023; Defiana, 2024; et al., 2023; Viqriani, 2020; Wanta et al., 2023).

Fifth, program sustainability. Program sustainability by conducting monthly monitoring and resolving any obstacles experienced by target partners. Continuing to target production to be marketed in the local market of Gampong Deudap Pulo Nasi in the form of packaged salt, registering products to be issued by BPOM and SNI salt.

RESULT AND DISCUSSION

Salt production involves the process of evaporating seawater to produce salt crystals. One technology that is now widely used is geomembrane technology, which utilizes impermeable synthetic materials to accelerate the crystallization process while maintaining the quality of the salt produced. This technology requires modification of a flat land area with appropriate elevation, so that it does not require additional equipment to drain water from the water pond or old water pond to the final stage of the crystallization process. One of the innovations in the production process is the use of salt tunnels, which are tunnel-shaped or triangular structures resembling a house made with a frame covered with UV plastic at the top. This tunnel serves as a means to accelerate the drying and crystallization process of salt by optimally utilizing solar heat.

Fig 2. Application of geomembrane technology in quality salt production

Modification of the land area and tunnel with the aim of accelerating the aging process of seawater so that when arriving at the storage plot (old water) has reached the target value interval of 20-30 ◦Be and with the addition of geomembranes able to improve the quality and quantity of salt. The use of Geomembranes is added to improve the quality and quantity of salt. This thread is made in the form of a meandering earthen pond plot with an uneven bottom to create a natural water flow.

The acceleration of production time is that with the screw filter, the aging time of seawater can be accelerated so that the production process is shorter, from 40 days to 25 days. The water level on the screw is very influential on the screw ranging from 10 to 20 cm. The ratio of the area of the bleaching field to the salt table is 65:35 (Wiraningtyas et al., 2019).

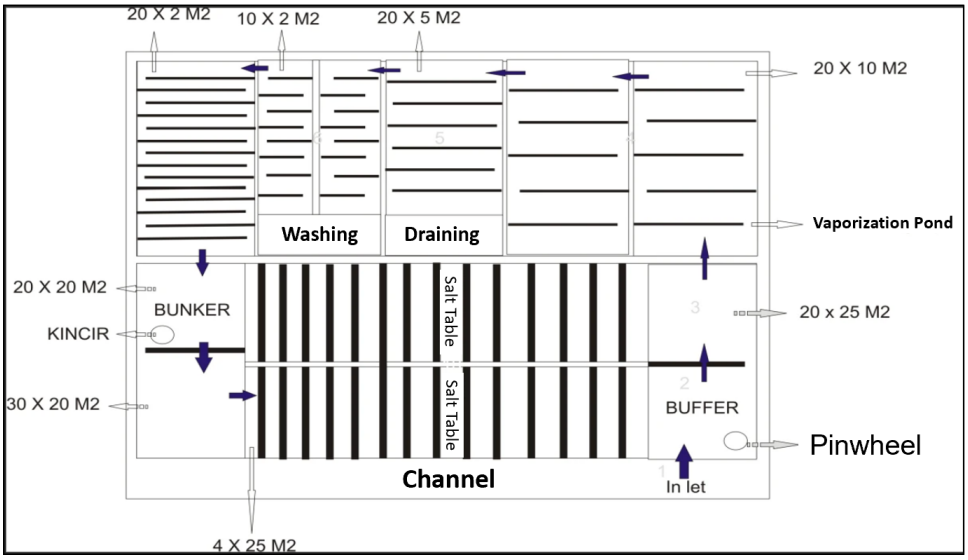


Fig 3. Process flow of salt production using the geomembrane method

The stages of the salt production process can be seen through the following stages: First, seawater collection, seawater is put into the initial reservoir through the primary channel, this reservoir usually has a depth of about 50 cm. Second, oiling, seawater is then flowed through the wheel to

accelerate the evaporation process. The loaned water then enters the second reservoir with a water depth of about 50 cm. Third, the use of geomembranes, geomembranes usually made of high-density polyethylene are placed on the surface of the salt field to limit the soil with other elements that are waterproof. This geomembrane helps speed up the evaporation process because its black color can absorb the sun's heat better.

Fourth, Evaporation, the lent seawater is then flowed through the filter and then to the evaporation table with a water level of about 10-15 cm. This evaporation process takes less time than the conventional method because of the geomembrane that limits the absorption of water by the soil. Fifth, crystallization, After the seawater evaporates, the remaining solution containing certain minerals will form salt crystals. This process is faster due to the geomembrane that limits contact with the soil. Sixth, salt collection, the salt crystals formed are then collected and further processed to produce clean and white salt.

This method provides better salt quality because it is not mixed with soil and utilizes solar heat efficiently (Hoiriyah, 2019; Suriawanto et al., 2022). the following stages of the salt production process by the Salt Sirana Jaya Business group as described in the following figure.

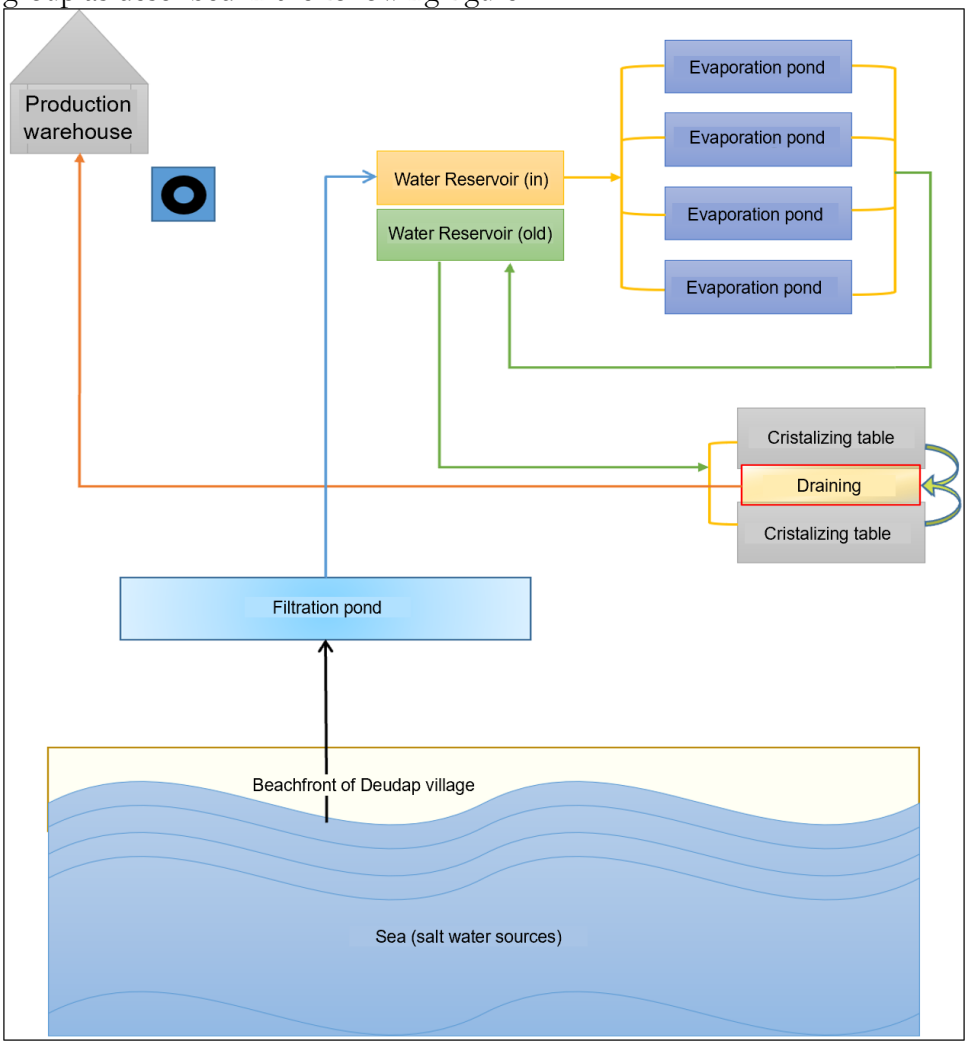
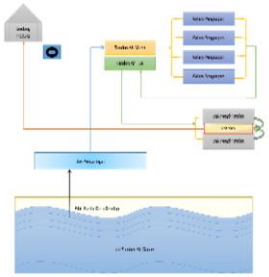


Fig 4. Landscape production house of Sirana Jaya Pulo Nasi Salt group

Table 1. Salt production of Sirana Jaya Pulo Nasi group in the last three years

2022	2023	2024
		
		

CONCLUSION

Based on the production results that have been obtained from improving the process at Sirana Jaya Salt Business by using geomembrane technology where the production process increases with very good time efficiency. The crystallization process is also influenced by air circulation in the salt tunnel to get this efficiency it is recommended to add holes to the tunnel so that the saturated steam in the tunnel comes out and the crystallization process becomes better. Pay attention again to the process of forming old water, where the old water to be processed must have a viscosity degree value in the interval 25-30 Be°. The process of making deep wells as raw water becomes the next alternative application to get old water so that it can cut the time that has been running.

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