

Adaptation Mechanism of Salt Farmers in Facing Climate Change: Case Study in Indramayu, West Java

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ARTICLE INFO

Article history:

Received Apr 30, 2025
Revised May 11, 2025
Accepted May 17, 2025

Keywords:

Capacity adaptation
Climate change
Salt production
Livelihood
Indramayu

ABSTRACT

Climate change has become a serious threat to the environment and the society, especially for coastal communities that depend on the fisheries sector for their livelihoods, both fishing and cultivation. Salt production is a livelihood that is sensitive to the impacts of climate change because the salt production process is greatly influenced by natural factors. The impact of climate change affects the livelihoods of salt farmers' households. In dealing with climate change, a series of resilience measures are taken so that household livelihoods can continue to be maintained. To meet household needs, salt farmers carry out several adaptations such as converting pond land, seeking income outside salt ponds, and renting out pond land. The purpose of this study was to examine the adaptation mechanisms of salt farmers' households to the effects of climate change. This study was analyzed using quantitative descriptive analysis to answer the adaptation mechanisms of salt farmers. The adaptive capacity of salt farmers is divided into three types, namely the capacity to learn, buffer capacity, and the capacity to regulate oneself. The results showed that the adaptive capacity of salt farmers who had the highest percentage in the form of past experience inspired new ways to increase household income of salt farmers, knowledge of salt farmers and the interest of salt farmers to participate in training and strong trust between farmers.

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1. INTRODUCTION

Climate change has become a threat to the global environment. The majority of developing countries are located in tropical and subtropical areas that are highly vulnerable to climate change (Budiarmo, 2019). As a region of developing countries, Southeast Asia is experiencing the same thing. Southeast Asia is known as one of the most sensitive and vulnerable regions to the impacts of climate change compared to other regions because of its large and densely populated coastal areas accompanied by various ecological pressures. The large dependence of people's livelihoods on climate such as the agricultural and fisheries sectors exacerbates the challenges and has greater implications (Roland, 2019; Budiarmo, 2019).

The issue of climate change is deeply felt by the majority of Indonesian people. This is because Indonesia is an archipelagic country with a coastline of 108,000 km. Indonesia's geographical location as an archipelagic country means that most of Indonesia's territory has the potential for the maritime sector to support economic growth (Aryanti et al. 2021). Some of the economic potentials of the maritime sector are capture fisheries and aquaculture, processing

industry, mining and marine energy, maritime-based tourism, mangrove management, and management of other non-conventional resources (Bappenas 2021). In addition to fish and seaweed, seawater is also one of the natural resources that has economic value, namely salt.

The impact of climate change forces coastal communities to adapt because many coastal communities depend on marine and coastal ecosystems for their livelihoods (Choirunnisa, 2022). The livelihoods of coastal communities are in the form of capture fisheries and fisheries cultivation such as salt ponds, shrimp ponds, seaweed cultivation, and others that make coastal communities dependent on marine and coastal ecosystems. Climate change can disrupt the availability of marine resources and reduce the income obtained from these sectors. This results in livelihood instability and increases the risk of poverty among coastal communities (Sabarisman, 2017).

Salt production as other aquaculture commodities – such as seaweed production (Yusuf et. al., 2023) is the livelihoods of coastal communities that are easily affected by climate change because the salt production process is greatly influenced by natural factors (Adiraga, 2013). The majority of salt farmers admit that in recent years, temperature and rainfall have been the most fluctuating natural factors (Tran, 2021). More than 70% of the total salt in Indonesia is produced on the island of Java through traditional processes and is dominated by small-scale salt producers (Susanto, 2015; Helmi, 2017). In addition, the salt industry shows sensitivity to climate change and the income of salt farmers is becoming more at risk (Roland, 2019).

One of the leading areas for salt production on the island of Java is Indramayu Regency, West Java with a salt land area of 2,716.96 Ha (BPS Indramayu Regency, 2023). The total salt production of the people of Indramayu Regency in 2019 was 361,106.69 (BPS Indramayu Regency, 2020). The production of people's salt from 2017 to 2022 can be seen in Figure 1.

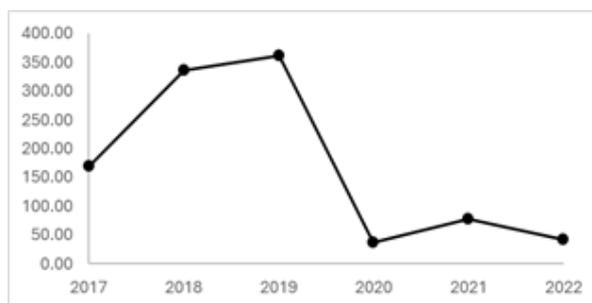


Figure 1. Amount of salt production in Indramayu 2017-2022

In 2020 - 2022, salt production in Indramayu Regency decreased due to uncertain weather. There was a decrease in salt production in 2020 where the decrease reached 90%. Until 2022, there was no significant increase in people's salt production. Small-scale salt farmer production in Indramayu has decreased due to various factors, including: fluctuating production levels, low prices at the farmer level, the impact of the Covid-19 pandemic, and changes in weather.

Salt farmers make several adaptations to meet household needs. Adaptations made by some salt farmers in the rainy season include converting salt pond land into fish and shrimp ponds. Some farmers seek income outside of salt farming, such as fishing, farming, and carpentry. The limited knowledge of salt farmers regarding weather conditions has an impact on salt production, such as a decrease in production quantity, supply of production equipment, and changes in the welfare of salt farmers. To anticipate these uncertain conditions, salt farmers must carry out certain adaptation strategies, in order to meet their living needs throughout the year. Salt farmers who carry out salt production activities must always pay attention to natural phenomena, especially weather conditions. Based on survey results, the most noticeable climate impacts on pond land are rain, excessive heat, strong winds, tidal waves, and abrasion and landslides.

Based on the land ownership structure, the salt farmer community is divided into land owners, land tenants and laborers. Land is an important means of production for salt farmers because it is on this land that production activities are carried out. Land owners are salt farmers who have ownership rights and control over the use of land whose land comes from purchases or

inheritance from parents. Land tenants obtain land from the rental process either through community land or to salt companies. Labor farmers are farmers who do not own land, but only work or sell labor services (Rochwulaningsih, 2016). Based on this, the purpose of this study is to examine the adaptation mechanism of salt farmer households to the effects of climate change.

2. RESEARCH METHOD

This research was conducted in Indramayu Regency in February-May 2024. Indramayu Regency is located in West Java and is also known as a salt production center with a salt pond area of 27,499.2 Ha (KKP, 2022). Indramayu Regency is a coastal area on Java Island which directly borders the North Java Sea. Salt production absorbs the third largest workforce in the fisheries sector in Indramayu Regency. Apart from being known as a salt production center, Indramayu Regency also relies on capture fisheries and fisheries cultivation for income and livelihood (BPS Kab. Indramayu, 2024).

The data collection method used interviews with a number of salt farmer respondents. Data collection was carried out using a non-probability sampling method with a snowball sampling technique on 35 salt farmers. This is because at the time the interview was conducted, the salt production process had been completed and the salt farmers had switched to other jobs so that it was difficult to interview.

The adaptation capacity of salt farmer households was analyzed descriptively quantitatively by describing the largest adaptation capacity carried out by salt farmer households in Indramayu Regency. Adaptation capacity is calculated using a score of (1) for the answer "Yes" and (0) for the answer "No", after which the data was tabulated using the formula:

$$P = \frac{F}{N} \times 100\% \dots\dots\dots (1)$$

- Description:
- P = percentage of adaptation capacity.
- F = number of salt farmer household answers.
- N = total number of salt farmer households.

The approach used for the objective of household adaptation mechanisms is a descriptive analysis approach to describe or explain the phenomenon of socio-economic symptoms that are currently occurring and related to future conditions related to literature data related to the problem being studied. The adaptive capacity used in this study can be seen in Table 1.

Table 1. Adaptation capacity of salt farmers

No.	Adaptation Capacity
A. Learning capacity	
A. 1	Have the ability to overcome the impact of declining production due to experience in salt cultivation
A. 2	The knowledge gained from colleagues was very helpful in dealing with the situation
A. 3	Have the ability to share knowledge to help colleagues deal with the situation
A. 4	Past experiences made me think of new ways to increase income
A. 5	I am interested in regularly attending training provided by related agencies.
A. 6	I am interested in switching to a more productive cultivation method.
B. Buffering capacity	
B. 1	I have learned other skills outside of salt cultivation and fisheries
B. 2	I do not feel the impact of decreasing cultivation towards income due to access to loans/credit
B. 3	I don't feel the impact of decreasing cultivation because I have savings
B. 4	Family/colleagues continue to help during times of declining crop yields
C. Self-management capacity	
C. 1	Trust between farmers makes it easy to provide loans
C. 2	Trust between farmers is generally strong
C. 3	Join the group of aquaculture farmers
C. 4	Active in the group of aquaculture farmers

3. RESULTS AND DISCUSSIONS

The impact of climate change felt by salt farmers in Indramayu is still quite limited. They still rely on experience and instinct. Salt farmers in Dongoboro Village understand climate change only from two phenomena, namely the delay in the start of the season and the extension of the duration of the rainy and dry seasons. In addition, salt farmers generally do not follow weather and climate developments, so when there is a change of season or certain weather phenomena occur, they can only wait until conditions return to normal to avoid greater losses.

Salt farmers make several adaptations to salt production activities in order to reduce expenses or increase income due to the effects of climate uncertainty. Several forms of adaptation include climate and production workforce adaptation, adaptation by stopping production, adaptation of livelihood strategies and adaptation of technology. Increasing educational participation, arranging permanent housing, training on diversification of income-generating activities and providing financial support are needed to improve livelihood status and reduce poverty (Ahmed, 2021).

Livelihood strategies are seen as adaptation activities to climate change that aim to maintain community resilience by reducing vulnerability caused by negative threats from climate change. Livelihood strategies carried out by actors in response to specific climate impacts (ex-post) are part of reactive adaptation. This adaptation requires actors to be aware of the impacts and be able to react appropriately. Ex-ante strategies are useful because they minimize potential impacts on communities, but because they are developed in an uncertain climate context, they are likely to be more expensive. Ex-post strategies react to an event and have to deal with the impacts after the fact and this can also be more expensive than anticipating. Decision makers have to make decisions under uncertainty (Subair, 2015).

Salt producers in Indramayu are divided into three categories based on land ownership: (1) land owners; (2) laborers; and (3) land renters. Laborers refer to workers who sell their labor based on formal or informal work contracts to produce salt in exchange for a portion of the salt produced on the land. Land owners are the smallest group but receive the largest income from salt ponds. In contrast, laborers are the largest group, but receive less than half of the total income (Helmi, 2018).

In 2019-2021, salt farmers in Indramayu experienced a decline in salt production so that they had to make several adaptations to salt production activities in order to reduce expenses or increase income due to the influence of climate uncertainty. The salt business model in Indramayu Regency still requires stable climate conditions so that the salt table can be dried optimally during production (Astutik, 2019). Salt farmers generally do not follow weather and climate developments, so when there is a transitional season or certain climate phenomena, salt farmers can only wait until conditions return to normal to avoid greater losses (Aldi, 2021).

Adaptation capacity to three components, namely buffer capacity, self-organization, and learning capacity (Speranza, 2014). The components of adaptation capacity consist of learning capacity, referring to the ability built from learning and experience as an effort to increase capacity in earning a living, buffer capacity, including the ability of households to withstand pressure and take advantage of opportunities to escape poverty, and self-organizing capacity, which refers to the internal ability to control actions and freedom of action that affect livelihood output. The magnitude of the adaptation capacity of salt farmers in Indramayu can be seen in Table 2.

Table 2. Results of the adaptive capacity of salt farmer households

Adaptation Capacity		Yes (%)	No (%)
A. Learning capacity			
A. 1	Have the ability to overcome the impact of declining production due to experience in salt cultivation	62.86	37.14
A. 2	The knowledge gained from colleagues was very helpful in dealing with the situation	91.43	8.57
A. 3	Have the ability to share knowledge to help colleagues deal with the situation	88.57	11.43
A. 4	Past experiences made me think of new ways to increase income	94.29	5.71
A. 5	I am interested in regularly attending training provided by related agencies.	91.43	8.57
A. 6	I am interested in switching to a more productive cultivation method.	74.29	25.71
B. Buffering capacity			

Adaptation Capacity		Yes (%)	No (%)
B. 1	I have learned other skills outside of salt cultivation and fisheries	77.14	22.86
B. 2	I do not feel the impact of decreasing cultivation towards income due to access to loans/credit	45.71	54.29
B. 3	I don't feel the impact of decreasing cultivation because I have savings	31.43	68.57
B. 4	Family/colleagues continue to help during times of declining crop yields	71.43	28.57
C. Self-management capacity			
C. 1	Trust between farmers makes it easy to provide loans	60.00	40.00
C. 2	Trust between farmers is generally strong	94.29	5.71
C. 3	Join the group of aquaculture farmers	31.43	68.57
C. 4	Active in the group of aquaculture farmers	34.29	65.71

It can be seen in Table 2 that the highest adaptive capacity is in the capacity to learn, namely for the sub-criteria of past experience capacity that inspires new ways to increase household income of salt farmers. This capacity sub-criteria obtained a percentage of 94.29%. Climate change has encouraged salt farmers to seek other incomes outside of salt production which is highly dependent on the weather. This perception is very important in shaping the adaptive response of small-scale salt producers to pressures outside of their previous experiences and past experiences may be a very useful guide. Livelihood capacity reflects the ability of salt farmers to overcome obstacles that arise in the production process or negative impacts due to environmental change (Tran, 2022).

Table 2 also shows that there are other sub-criteria for learning capacity that have the second highest percentage, namely the knowledge of salt farmers and the interest of salt farmers to participate in training related to salt production with a percentage of 91.43%. The knowledge of salt farmers is obtained informally in the form of the transfer of salt processing culture from previous generations and the experience of processing salt as a form of daily relationships and interactions. The level of education of salt farmers in Indramayu is mostly only elementary school/equivalent. Salt production technology in Indonesia which still relies on climate and low productivity makes the majority of salt farmers switch to shrimp and fish cultivation when the dry season ends or another option is to rent pond land to others while pursuing other businesses (Helmi, 2022).

The methods commonly used by salt farmers in Indramayu are traditional and geomembrane methods. The traditional method is carried out using a multi-stage evaporation method and utilizing sunlight. Geomembrane technology is a method used to produce salt by lining the bottom of the pond with geomembrane plastic. The main characteristics of geomembrane as a coating on salt ponds are that it is economical, durable, and resistant to biological, chemical, and ultraviolet (UV) degradation. The advantages of salt production through geomembrane technology are increased salt productivity, shorter evaporation processes, better completion times, increased harvest yields and salt quality, and long geomembrane life will reduce preparation work (Guntur, 2018). The productivity of geomembrane technology can reach 80 tons/ha/cycle, with whiter and cleaner salt quality and higher salt purity (NaCl) than traditional methods, so the selling price of salt is also higher.

The productivity and quality of tunnel salt are also higher when compared to traditional methods (Iswanto, 2019), so that the price of salt using the tunnel method can be sold at a higher price than the traditional method. Glass tunnel technology is suitable for producing salt in Indonesia to achieve the national salt production target. The purity of salt (NaCl) produced using the tunnel method is 95%, higher than the purity of salt using the traditional method of 85%. The purity of the salt is influenced by the filter located in the filtering pond, so that the NaCl produced using the tunnel method has a much higher purity than the traditional method. Therefore, salt production technology using tunnel technology has a significant impact on the quality and quantity of the product. In addition, salt production using the tunnel method has several advantages, such as faster harvest time, weather resistance, easy to use, and higher profits than traditional methods.

Furthermore, it is known that the buffer capacity has the lowest percentage when compared to the other two capacities. The condition of salt farmers also mostly has a relatively low buffer capacity value (Aldi, 2021). The impact of the decline in salt production is greatly felt by salt farmers even though there are savings and access to loans, both formal and informal. The ownership of salt farmer savings is also still relatively low, namely 40.00%. The majority of salt farmers' access to

loans is usually through loans to banks by applying for people's business credit (KUR) and also loans to middlemen.

Trust of pond owners in providing loans to salt farmers when experiencing financial difficulties (Sofian, 2021). Other skills possessed by salt farmers outside of fisheries cultivation are useful for meeting household needs when salt cultivation is not taking place. The majority of skills possessed by salt farmers are rice farming, vegetable and fruit gardening, and building construction.

Lastly, for self-management capacity, it can be seen that the capacity of trust between farmers that has been well established and has the highest percentage in the capacity to manage themselves. This capacity is in the capacity to manage themselves and obtains a percentage of 95.65%. Trust between farmers includes actions towards access to information, communication, and social. Several studies have shown that salt farmer households have strong trust and strong informal social networks (Sakaria, 2019). Informal social networks indicate trust and reciprocal relationships that are more intimate and personal. The relationship of personal intimacy makes social relationships between households even closer. Salt farmers use relationships or social networks as a means to exchange information related to salt cultivation and job diversification. Thus, this social relationship will be useful for exploring collective efforts to optimize existing resources to improve the welfare of small-scale salt farmer households (Helmi, 2018).

4. CONCLUSION

The overall adaptive capacity of salt farmers is quite high in the capacity of willingness to learn (average percentage of learning capacity is 83.8%). Past experiences inspire new ways to increase household income of salt farmers, knowledge of salt farmers and interest of salt farmers to participate in training related to salt production are components of adaptive capacity that have the highest percentage in this capacity. In addition, there is one more component outside of this capacity, namely, strong trust between farmers. These four things, if elaborated, can be a mainstay for overcoming the economic uncertainty of salt farmers due to climate change.

Although the adaptive capacity of salt farmers in the capacity to learn and the capacity to regulate themselves is quite high, it still needs to be improved in other indicators that have lower capacity values. For the low buffer capacity, it is necessary to consider issuing policies that can increase the welfare of salt farmer households.

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