Published by University of Muhammadiyah Makassar

DOI: 10.26618

e-ISSN 2686-5467 | p-ISSN 1858-2192
Balance: Jurnal Ekonomi
journal homepage: https://journal.unismuh.ac.id/index.php/jeb

Strategy Adaptation Farmer Paddy in Facing the Flood Rob in Village Market Seluma District, South Seluma Regency Seluma

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ARTICLE INFO

Keywords:
adaptation strategy; rice farmers; tidal flooding; climate resilience; coastal agriculture

Article History
- Received: 15 December 2025
- First Revision: 20 February 2026
- Second Revision: 05 April 2026
- Third Revision: 10 May 2026
- Accepted: 30 May 2026

ABSTRACT

This study examines the adaptation strategies implemented by rice farmers in responding to recurrent tidal flooding in Pasar Seluma Village, South Seluma District, Seluma Regency, Indonesia. Increasing sea-level rise and climate variability have intensified the frequency and duration of tidal flooding, threatening agricultural productivity, household income, and local food security. Employing a qualitative research design, data were collected through in-depth interviews, field observations, documentation, and triangulation involving rice farmers, village officials, and agricultural extension officers selected through purposive sampling. The findings reveal that farmers primarily adapt by modifying planting schedules to avoid peak flooding periods. However, this traditional strategy has become increasingly ineffective due to the unpredictability and greater intensity of tidal inundation during 2024–2025. The study also identifies limited awareness and accessibility of flood- and salt-tolerant rice varieties, constraining farmers' capacity to implement technology-based adaptation. Institutional responses, including embankment construction, agricultural extension services, and training on alternative crops, have provided partial support but remain insufficient to address long-term climate risks. The research highlights that effective adaptation requires an integrated approach combining climate-resilient agricultural technologies, strengthened extension services, infrastructure development, community capacity building, and participatory governance involving local stakeholders. By providing empirical evidence from a vulnerable coastal farming community, this study contributes to the growing literature on climate change adaptation and offers practical policy recommendations for enhancing the resilience and sustainability of rice-based farming systems in coastal regions exposed to recurring tidal flooding.

1. Introduction

Indonesia is a country rich in natural resources, yet highly vulnerable to various natural disasters, both anthropogenic and environmental in origin. Among these disasters, flooding has become a central concern of research due to its increasing frequency and impact. Floods in Indonesia are classified into several types: inundation floods, which occur when high-intensity rainfall exceeds drainage capacity in flat or urban areas, leading to prolonged water accumulation that disrupts daily life; river floods, resulting from the overflow of river water due to upstream rainfall, sedimentation, or loss of watershed areas; flash floods, which are sudden and severe, typically occurring in mountainous regions or when dams collapse, bringing mud and debris; and tidal floods (locally known as *rob*), where seawater intrudes into low-lying coastal areas during high tides, exacerbated by rising sea levels.

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As an agrarian country, Indonesia relies heavily on its agricultural sector, particularly rice farming, which serves as both the primary food source and main livelihood for much of the population. In recent years, climate change and rising sea levels have significantly increased the intensity and frequency of tidal flooding in coastal regions. These floods not only inundate agricultural land for prolonged periods but also disrupt planting cycles, lower productivity, and damage critical agricultural infrastructure. Coastal areas such as northern Java, parts of Sumatra and Kalimantan, and particularly Pasar Seluma Village in Seluma Regency, have begun to experience the severe effects of such floods on crops and income sources.

In response, adaptation strategies have become essential to sustaining agricultural productivity. These include altering cropping patterns, adopting flood- and salinity-resistant rice varieties, constructing basic embankments, and diversifying livelihoods. Research suggests that the success of such adaptation measures depends not only on physical factors such as land type and infrastructure but also on socioeconomic determinants including education level, access to agricultural information, and support from government policies (Setiawan et al., 2021).

The consequences of climate change and geomorphological vulnerabilities have resulted in significant losses, particularly for rice farmers in flood-prone coastal areas. Tidal floods are not a new phenomenon in Indonesia, but recent years have witnessed their increasing severity due to extreme rainfall, rising sea levels, and the naturally low elevation of certain regions (BMKG, 2022). These challenges necessitate the implementation of comprehensive and sustainable adaptive strategies by farming communities.

Rice farming plays a crucial role in the national economy. For many Indonesians, especially in rural areas like Pasar Seluma Village, rice cultivation is not only a primary food source but also a key component of household income. Disruptions such as extreme weather, pest infestations, and tidal floods threaten this livelihood. The majority of rice farmers in Pasar Seluma Village rely heavily on their harvests, and frequent tidal flooding has resulted in significant income reduction. As such, strategic adaptation and robust governmental support are necessary (BPS Seluma Regency, 2021).

Farmers located near coastal zones, such as those in Pasar Seluma, often experience tidal flooding, which severely damages soil structure and compromises agricultural viability. To sustain their livelihoods, farmers have implemented adaptive strategies such as adjusting planting schedules, selecting water-resistant and saline-tolerant rice varieties, and elevating farmland to reduce seawater intrusion. Nevertheless, the effectiveness of these strategies is hindered by limitations including lack of capital, inadequate access to information, and insufficient government involvement in supporting smallholder farmers (Sari, 2021).

Tidal flooding is not exclusive to Seluma; it also affects regions in West and South Sumatra. For example, BMKG warned that during April–May 2024, tidal floods with heights ranging from 1 to 2.8 meters were expected. In early May, more than 15,000 houses were submerged, with water depths reaching 2.7 meters, resulting in substantial economic and social losses. Similarly, in Bengkulu Province—including South Bengkulu, North Bengkulu, and Seluma Regency—flood impacts continue to endanger coastal livelihoods, especially in Pasar Seluma Village where most residents work as farmers or fishermen on both private and communal lands.

Based on demographic data, Pasar Seluma Village has a population of 1,005 people, comprising 287 farmers, 183 fishermen, 123 traders, 10 civil servants, and 402 unemployed individuals. This data indicates that a large portion of the community depends on agriculture, particularly rice farming. As such, the frequent occurrence of

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tidal flooding poses a significant threat to household income and food security. In Indonesia, farmers are protected under Law No. 19 of 2013 on the Protection and Empowerment of Farmers, which aims to enhance farmer welfare through rights protection, economic empowerment, and improved access to agricultural resources. At the local level, the Regent Regulation (Perbup) of Seluma Regency No. 19 of 2019 addresses the provision and distribution of staple food reserves, especially rice, to vulnerable agricultural communities. The effective implementation of this regulation is essential to safeguard the welfare of coastal farmers in areas such as Pasar Seluma Village.

Through a clear, targeted, and participatory framework, local government policies—alongside technology transfer, farmer training, and institutional development—can significantly contribute to the resilience of farming communities. Strengthening such policies will help ensure that farmers can protect their livelihoods and exercise their rights, particularly during climate-induced crises. The income generated by rice farmers is essential to sustaining household needs such as purchasing food, electricity, and paying for education. However, this income is often delayed or uncertain, as harvested rice must still undergo post-harvest processing and market transactions. These realities highlight the vulnerability of farmers' economic positions and the importance of state and village-level support. According to Law No. 6 of 2014 on Villages, a village is a legal community entity with the authority to manage its governance and development based on traditional rights and community initiatives. This includes the authority to develop village economies that utilize local resources and are aimed at improving community welfare. Article 78 further emphasizes the importance of local economic potential in driving village development. Therefore, strategic village development planning—especially in disaster-prone areas like Pasar Seluma—must be grounded in local strengths and community resilience efforts.

The escalating severity of tidal floods in recent years, particularly through 2024, demands an in-depth exploration of how Pasar Seluma Village, both through government and community actions, is addressing the issue. Researchers seek to examine the specific adaptation strategies employed by this village, assess their effectiveness, and identify areas for policy and community-level improvement to enhance resilience against tidal flooding.

2. Literature Review

2.1 Conceptual and Theoretical Foundations

2.1.1 Foundation Theory

a. Agricultural Economics Concept

Agricultural economics is a field of study focused on optimizing the decisions made by agricultural producers in managing resources to improve economic outcomes in agriculture, which includes crop cultivation, livestock, and the use of microorganisms in agricultural processing (Destiana, 2021). Thus, agricultural economics is not limited to technical aspects such as planting and pest control but is a multidisciplinary field encompassing all aspects of agricultural activity, including plantations, livestock, and agri-business.

The discipline of agricultural economics involves the analysis of economic relationships in the production, processing, and distribution of agricultural goods. It investigates the interaction between production factors and output within agricultural systems. In the context of national development, the enhancement of the agricultural sector forms the initial and foundational stage for broader industrial growth. Among the various agricultural branches, plantations represent one of the fastest-growing sectors (Arifin, 2015).

Although relatively young compared to other branches of economics, agricultural economics emerged from classical economic theories developed by Adam Smith in his seminal work *The Wealth of Nations* (1776).

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The formal study of rural and agricultural economics began in the United States in 1892 at Ohio University and was later expanded at institutions such as Cornell University (1901) and the University of Wisconsin-Madison through the efforts of scholars like Henry C. Taylor.

According to Suni, Jumardi, and Mustamin (2021), agriculture holds a significant role in Indonesia's economic structure, particularly in its contribution to Gross Domestic Product (GDP). In both developing and developed nations, agriculture is vital in the early stages of economic growth by generating employment and economic surplus, which can be used to develop agro-industrial sectors. Indonesia, as an agricultural nation, continues to rely heavily on agriculture as a major source of employment and economic output.

Muta'ali (2019) further identifies agriculture's contribution to national development through its impact on markets, production, foreign exchange, and production factors. These contributions highlight the importance of integrating both the technical and socio-economic dimensions of agriculture in higher education and policy-making.

2.1.2 Adaptation Strategies

a. Awareness

Awareness is a fundamental element in human understanding of the environment and their role within the broader ecosystem. According to Wattimena (2023), awareness can be categorized into several levels—from subject-object consciousness to integrated awareness with the universe. This awareness plays a crucial role in understanding environmental challenges and the benefits of taking adaptive action.

Notoadmojo (2003) explains that awareness is shaped through three primary processes: knowledge, attitude, and behavior. Knowledge involves cognitive processes at varying levels such as comprehension, application, analysis, synthesis, and evaluation. Attitude refers to internal responses toward external stimuli, including receiving, responding, valuing, and accepting responsibility. Behavior is the final stage, representing the actual response or action, ranging from perception to adoption.

b. Changes in Cropping Patterns

One effective strategy in agricultural adaptation is modifying cropping patterns to suit changing environmental conditions. Adjusting planting schedules and rotation systems can mitigate the impact of climate-related threats such as tidal flooding (*rob*). This strategy helps in preventing disease outbreaks and increasing land use efficiency (Kuntari & Rasid, 2021).

c. Use of Flood-Resistant Rice Varieties

The adoption of flood- and salinity-resistant rice varieties is critical for farmers in flood-prone areas such as Pasar Seluma Village. Varieties such as *Inpari Unsoed 79 Agritan*, *Inpari 35*, and *Biosalin* have shown tolerance to saline water. Similarly, salt-tolerant rice varieties developed in Japan—such as *Mantaro*, *Kanto 51*, *Hama Minoru*, *Chikushiqing*, and *Lansheng*—have demonstrated positive performance under stress conditions. According to Safrizal et al. (2023), different rice varieties respond differently to submergence duration, and prolonged inundation that covers the entire plant canopy can lead to severe physiological damage. Thus, careful varietal selection is essential.

d. Capacity Building

Capacity building is a strategic approach to empowering communities to adapt to environmental and socio-economic changes. According to Puspitasari et al. (2019), capacity building involves three main components: human resources development, organizational strengthening, and institutional reform. Empowerment activities such as seminars and community training programs are instrumental in enhancing public participation and resilience. Organizational restructuring and the alignment of empowerment strategies with

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community values can facilitate the successful adoption of adaptation measures.

e. Tidal Flooding (Rob Flood)

Tidal flooding, or *rob*, refers to the intrusion of seawater into coastal land areas, often caused by rising sea levels and low coastal elevations (Ekawati, 2018; Pelling, 1967). Law No. 24 of 2007 on Disaster Management classifies tidal flooding as a natural disaster with the potential to disrupt human life and cause environmental degradation.

Syafitri and Rochani (2021) emphasize that tidal flooding primarily occurs in low-lying coastal areas and is driven by high sea tides. The inundation typically recedes with the tide, but frequent occurrences can result in prolonged economic losses. In areas such as Pasar Seluma Village, communities face significant hardship as tidal floods destroy crops, damage infrastructure, and disrupt livelihoods. These impacts are intensified during heavy rainfall when river overflow combines with seawater surges (Suryati, 2009).

In recent years, tidal flooding has increasingly affected the region of Pasar Seluma, resulting in the loss of income and economic decline among its residents. The need for integrated flood management and community-based adaptation is becoming ever more urgent.

2.1.3 Rainfall and Precipitation

Rainfall is one form of atmospheric precipitation, defined as the fall of liquid water from the atmosphere to the earth's surface. Precipitation includes various forms such as rain, snow, and drizzle but excludes phenomena like dew and frost that do not fall from the atmosphere. In Indonesia, rainfall is the most relevant form of precipitation and is measured as the depth of water accumulated over a flat surface without evaporation, infiltration, or runoff (Zahra et al., 2023).

Rainfall intensity and distribution are critical factors influencing agricultural productivity, hydrological balance, and flood risk. In coastal agricultural areas, extreme rainfall often exacerbates tidal flooding, particularly when drainage systems are inadequate or compromised by sedimentation.

2.2 Review of Empirical Studies

Previous empirical studies consistently demonstrate that agricultural adaptation to environmental change requires an integrated approach combining technical, social, institutional, and economic dimensions. Studies by Kuntari and Rasid (2021) show that adjustments in cropping patterns represent one of the most effective adaptation strategies for reducing agricultural losses caused by environmental disturbances such as tidal flooding. Likewise, Safrizal et al. (2023) report that the utilization of flood- and salinity-resistant rice varieties significantly improves crop survival under prolonged inundation, although varietal responses differ depending on flood duration and physiological tolerance.

Community capacity has also been identified as a critical determinant of successful adaptation. Puspitasari et al. (2019) emphasize that capacity building through human resource development, organizational strengthening, and institutional reform enhances community resilience and supports the adoption of adaptive agricultural practices. In addition, studies by Syafitri and Rochani (2021) reveal that recurring tidal flooding generates substantial socio-economic impacts in coastal communities by damaging agricultural land, reducing productivity, and disrupting livelihoods. These findings complement earlier observations by Suryati (2009), who notes that tidal flooding becomes increasingly severe when high tides coincide with heavy rainfall and river overflow.

From a broader economic perspective, Suni, Jumardi, and Mustamin (2021) highlight the continuing importance of agriculture in Indonesia's economic development through its contribution to employment generation and Gross Domestic Product (GDP). Their findings support the agricultural economics perspective

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presented by Destiana (2021) and Muta'ali (2019), emphasizing that sustainable agricultural development requires both technical innovation and socio-economic adaptation.

Although previous studies provide valuable insights into agricultural adaptation, most focus on specific adaptation measures or individual aspects of community resilience. Comparatively fewer studies integrate awareness, changes in cropping patterns, the adoption of flood-resistant rice varieties, capacity building, tidal flooding, and rainfall conditions within a single contextual analysis of farmers' adaptation strategies in vulnerable coastal agricultural areas.

2.3 Identification of the Research Gap

Based on the theoretical and empirical literature, several research gaps remain evident. Existing studies generally examine individual adaptation strategies, such as changes in cropping patterns (Kuntari & Rasid, 2021), the use of flood-resistant rice varieties (Safrizal et al., 2023), or community capacity building (Puspitasari et al., 2019), without comprehensively examining how these strategies interact within communities experiencing recurrent tidal flooding.

Moreover, previous research has predominantly emphasized technical or institutional dimensions separately, whereas limited attention has been devoted to integrating farmers' environmental awareness, adaptive farming practices, community capacity, tidal flooding conditions, and rainfall variability within a single analytical framework. This limitation is particularly apparent in vulnerable coastal agricultural regions such as Pasar Seluma Village, where environmental, social, and economic challenges occur simultaneously.

Accordingly, the present study seeks to address this gap by providing a comprehensive analysis of farmers' adaptation strategies toward tidal flooding in Pasar Seluma Village, considering multiple adaptation dimensions within their local environmental context.

2.4 Development of the Conceptual Framework

This study does not employ a formal conceptual framework consisting of interrelated research variables, as it is designed to provide a descriptive analysis of farmers' adaptation strategies toward tidal flooding rather than to examine causal relationships among measurable constructs.

Instead, the study is guided by several interconnected concepts derived from the literature, including agricultural economics, environmental awareness, changes in cropping patterns, the adoption of flood-resistant rice varieties, capacity building, tidal flooding, and rainfall conditions. These concepts collectively provide the analytical foundation for understanding how farming communities respond to environmental challenges and maintain agricultural productivity in coastal areas.

2.5 Hypotheses or Research Propositions

This study does not formulate research hypotheses or formal research propositions because it is not intended to test causal relationships between variables. Instead, the research adopts a descriptive qualitative approach aimed at exploring and describing farmers' adaptation strategies in response to tidal flooding in Pasar Seluma Village.

The study is therefore guided by its research objectives and research questions, which focus on understanding the forms of adaptation implemented by farmers, the environmental conditions influencing these adaptations, and the role of community capacity in strengthening resilience against recurring tidal flooding.

3. Research Methodology

3.1 Research Design

This study adopts a qualitative research approach, which is commonly applied in the fields of social sciences and cultural studies to explore human behavior and the meanings behind such behaviors that are difficult to

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quantify (Abd. Hadi, 2021). Qualitative research is rooted in post-positivist philosophy and seeks to understand phenomena in natural settings, where the researcher serves as the primary instrument of data collection. Sampling is conducted purposively and snowball techniques are utilized, while data collection involves triangulation through a combination of observation, interviews, and documentation. The analysis is inductive and prioritizes meaning over generalization (Sugiyono, 2015).

According to Dwidjowijoto (2007), qualitative research focuses on the subjective interpretation of social phenomena through inductive reasoning, progressing from individual cases to broader generalizations. This method is particularly suitable for capturing the complexity of social realities in Pasar Seluma Village.

3.2 Research Context and Setting

The research was conducted in Pasar Seluma Village, which consists of three hamlets. The village was selected because agriculture is the dominant economic sector and tidal flooding has become a recurring environmental challenge affecting rice cultivation. Agriculture represents the primary livelihood of the local community, followed by fishing and trading.

The village has a total population of 1,005 residents, of whom 287 work as farmers. The study focuses on understanding how rice farmers develop and implement adaptation strategies to minimize the impacts of tidal flooding while maintaining agricultural productivity. The research context provides an appropriate setting for examining local adaptation practices within a rural agricultural environment.

3.3 Population and Sample / Research Participants

The population includes all individuals or groups possessing specific traits relevant to the research. In Pasar Seluma Village, which comprises three hamlets, the total population is 1,005, with 287 individuals working as farmers. Agriculture is the main source of livelihood, followed by fishing and trading.

Qualitative sampling is purposive and aims to select individuals who are well-informed and directly involved with the issue being studied (Creswell, 2013; Patton, 1990; Miles & Huberman, 1994). In this study, the sample consists of farmers and village officials who meet the following criteria:

a. Physically and mentally healthy
b. Have agricultural knowledge
c. Actively involved in rice farming for at least 15 years
d. Village officials serving for more than 5 years
e. Willingness to participate as informants

Table 1. Sample Informants

No	Name	Occupation	Initial
1	Dedi Kurdianto, SP, M.Si	Agricultural Supervisor	Mr. Dk
2	Ibn Hajar	Village Secretary	Mr. Ib
3	Rustam Efendi	Farmer	Mr. Rs
4	Dian	Farmer	Mr. D
5	Zalam	Farmer	Mr. Z
...	...	...	...

Source: Processed by authors, 2026

3.4 Data Sources and Data Collection

3.4.1 Types of Data

Sugiyono (2017) explains that qualitative data are descriptive and expressed in words rather than numbers. Such data capture the qualities, characteristics, and conditions of phenomena under study and are commonly collected through

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interviews, observations, and documentation.

3.4.2 Sources of Data

Lexy J. Moleong (2018) categorizes data sources in qualitative research as words, actions, and documents that provide relevant and comprehensive insights into the research topic. Accordingly, this study utilizes both primary and secondary data. Primary data were obtained directly from research participants through interviews with farmers and village officials. Secondary data were collected from academic journals, government reports, and previous studies relevant to agricultural adaptation and tidal flooding.

3.4.3 Data Collection Techniques

According to Sugiyono (2020), qualitative data collection techniques include observation, interviews, documentation, and triangulation. Observation was conducted directly in the research setting to understand the context of rice farming and the environmental conditions associated with tidal flooding. In-depth interviews were conducted with village government officials, agricultural officers, and farmers using structured interview guides designed to explore their roles, adaptation strategies, and experiences in responding to tidal flooding. Documentation involved the collection of official village documents, photographs, and historical records obtained from the Village Office. Furthermore, triangulation through the combination of observation, interviews, and documentation was employed to validate information obtained from multiple sources.

3.5 Measurement of Variables and Research Instruments

Since this study employs a qualitative approach, it does not measure variables using quantitative scales. Instead, the research focuses on operationalizing the central concept of adaptation strategies implemented by rice farmers in response to tidal flooding. The operational definition of adaptation strategy refers to farmers' efforts to cope with tidal flooding, including planting regulation, the use of salt-tolerant rice varieties, and support provided by the local government. Data were collected through observations, interviews, and document analysis involving farmers and village officials in Pasar Seluma Village. The study involved 287 farmers from a total population of 1,005 residents, with participants selected through purposive sampling. The primary research instruments consisted of the researcher as the main instrument, supported by interview guides, observation sheets, field notes, and documentation records.

3.6 Data Analysis Techniques

Data analysis in qualitative research involves organizing, categorizing, and interpreting data to identify patterns and draw conclusions. According to Sugiyono (2017) and Kaelan (2012), this process includes organizing field notes, interview transcripts, and documents into meaningful analytical units. The analysis was conducted inductively to identify themes related to adaptation strategies among rice farmers in dealing with tidal flooding. The emphasis of the analysis was on developing a comprehensive understanding of participants' experiences rather than producing statistical generalizations. Key informants selected through purposive sampling provided insights into how local farmers adapt to tidal flooding in Pasar Seluma Village.

3.7 Validity, Reliability, and Trustworthiness

To ensure the trustworthiness of the findings, this study employed triangulation throughout the data collection process, combining observation, interviews, and documentation as suggested by Sugiyono (2020). Information obtained from different sources was compared and cross-checked to

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improve credibility and reduce potential bias.

Dependability was supported by maintaining systematic documentation of the research process, including interview transcripts, field notes, and document analysis. Confirmability was strengthened by ensuring that the interpretation of findings was grounded in empirical evidence collected from participants rather than the researcher's personal assumptions. These procedures contribute to the credibility and trustworthiness of the qualitative findings.

3.8 Ethical Considerations

Ethical principles were maintained throughout the research process. All participants voluntarily agreed to participate in the study after receiving an explanation of the research objectives. Informed consent was obtained before interviews were conducted.

The confidentiality of participants was protected by using initials rather than full identities in the presentation of research findings where appropriate. All collected data were used solely for academic purposes and stored securely to protect participants' privacy and maintain research integrity.

3.9 Research Procedure

The research procedure consisted of several sequential stages. First, the researcher conducted preliminary observations and identified research problems related to tidal flooding in Pasar Seluma Village. Second, relevant literature was reviewed to establish the conceptual foundation of the study. Third, research participants were selected using purposive sampling based on predetermined criteria. Fourth, data were collected through observations, interviews, documentation, and triangulation. Fifth, the collected data were organized, coded, categorized, and analyzed inductively to identify emerging themes. Finally, conclusions were drawn based on the interpretation of findings and verified through data triangulation.

3.10 Methodological Limitations

As a qualitative study, the findings are context-specific and primarily reflect the experiences of farmers and village officials in Pasar Seluma Village. Consequently, the results are not intended for statistical generalization to other geographical areas. In addition, the use of purposive sampling limits participant selection to individuals who possess relevant knowledge and experience regarding tidal flooding adaptation. Nevertheless, this sampling approach is appropriate for achieving an in-depth understanding of the phenomenon under investigation and is consistent with the objectives of qualitative research.

4. Results and Discussion

4.1 Research Results

4.1.1 Sample Description and Descriptive Statistics

This study employed a qualitative research approach using in-depth interviews with key informants who possess direct knowledge and experience regarding tidal flooding and agricultural adaptation in Pasar Seluma Village, South Seluma District, Seluma Regency. The informants consisted of rice farmers, village government representatives, and agricultural extension officers. Rice farmers were selected because they have experienced the direct impacts of tidal flooding over an extended period, while village officials and agricultural extension personnel provided institutional perspectives on adaptation strategies and community capacity-building initiatives.

The informants included Mrs. Zalam, Mrs. Yuli, Mrs. Desri, Mrs. Yus, Mr. Rustam Efendi, Mr. Selan, Mr. Bustami, Mr. Suhai, Mr. Dian, Mr. Syomian, Mrs. Erna, Mr. Dedi Kurdianto, SP., M.Si., and Mr. Ibnu Hajar. Their diverse roles enabled the study to obtain comprehensive information regarding community awareness, agricultural adaptation practices, utilization of salt-tolerant rice varieties, and institutional support in responding to the increasing frequency of tidal flooding.

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Because this research adopted a qualitative design, descriptive statistical measures such as means, standard deviations, frequencies, and percentages were not employed. Instead, the findings are presented through thematic analysis based on the interview data collected from the selected informants.

4.1.2 Data Quality and Preliminary Analysis

This study utilized qualitative data collected through in-depth interviews. Consequently, preliminary statistical analyses such as tests of normality, multicollinearity, reliability, validity, or model fit were not applicable. To ensure data quality and credibility, the researchers conducted systematic data reduction, organization, and thematic categorization of interview transcripts. The findings were then interpreted according to the research objectives while maintaining consistency across the responses provided by different informants.

4.1.3 Main Analytical Results

The thematic analysis identified four major findings concerning community adaptation strategies in responding to tidal flooding in Pasar Seluma Village, namely: (1) awareness of tidal flooding, (2) changes in cropping patterns, (3) utilization of salt-tolerant rice varieties, and (4) capacity-building efforts.

a. Awareness

The concept of awareness maps the inner human condition in relation to the universe. This theory classifies awareness into several forms and levels, ranging from subject-object awareness, environmental integration, to unity with the universe (Wattimena, 2023). This awareness aims to help the community understand the causes of problems and the benefits of mitigation strategies.

Based on interviews conducted in Pasar Seluma Village, South Seluma District, Seluma Regency, the following findings were obtained:

1) **Mrs. Zalam**, a rice farmer with over 15 years of experience, stated that tidal flooding has long been a challenge. She adapts by modifying rice planting patterns to avoid crop loss. She explained that flooding often occurs at the end of the year, thus planting is commonly done at the beginning of the year. However, the increasing frequency of tidal floods—occurring weekly in 2025—has rendered rice cultivation unsustainable.
2) **Mrs. Yuli** emphasized that although the community has maintained the use of local seed varieties, the flooding has worsened in recent years, particularly in 2025, making rice farming nearly impossible.
3) **Mrs. Desri** added that farmers historically planted at the beginning of the year to avoid year-end flooding, but due to severe flooding in 2024 and 2025, rice farming has ceased entirely.
4) **Mrs. Yus** confirmed these findings, noting that farmers have yet to adopt salt-tolerant rice varieties and are instead only adjusting planting schedules.

b. Changes in Cropping Patterns

Cropping pattern modification is a critical adaptation strategy in response to tidal flooding. Timely planting can prevent crop loss due to flooding (Kuntari & Rasid, 2021).

1) **Mr. Rustam Efendi** and **Mr. Selan**, both rice farmers, noted that they adjusted planting schedules to early-year periods to avoid end-of-year flooding. However, by 2025, weekly flooding has made such adjustments ineffective.
2) **Mr. Bustami** stated that even with adjusted planting, frequent flooding rendered rice farming unfeasible, leading to significant income reduction.
3) **Mr. Suhai** highlighted a lack of knowledge among farmers regarding saltwater-tolerant rice varieties. He confirmed that severe weekly flooding has completely halted rice farming.
4) **Mrs. Desi** reiterated that past adaptations through cropping pattern changes are now ineffective due to intensified flooding, resulting in a loss of income.

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c. Utilization of Salt-Tolerant Rice Varieties

Utilizing salt-tolerant rice varieties offers a potential solution to tidal flooding impacts. However, limited knowledge and access remain barriers:

1) **Mr. Dian** and **Mr. Syomian** both stated that the community relies solely on adjusting planting patterns. They noted a lack of knowledge regarding available salt-tolerant rice varieties.
2) **Mrs. Erna** emphasized that no initiatives have yet introduced these specialized seeds to the farming community. She also noted the worsening frequency of tidal floods.

d. Capacity Building Efforts

Capacity building is vital in equipping communities to face environmental changes (Puspitasari et al., 2019). Three main aspects include human resource development, organizational strengthening, and institutional reform.

1) **Mr. Dedi Kurdianto, SP, M.Si**, an agricultural extension officer, reported that the local agricultural office has encouraged farmers to transition to oil palm cultivation, which is more resilient to weather changes. Training sessions have also been provided.
2) **Mr. Ibnu Hajar**, the Village Secretary, reported that the village government has constructed embankments to prevent seawater intrusion, especially due to the decreasing land elevation and rising sea levels.

4.1.4 Key Findings

Based on the thematic analysis, the study identified four principal findings.

a. Community awareness of tidal flooding has increased as farmers recognize recurring flooding patterns and attempt to adapt through modifications in planting schedules. Nevertheless, the increasing frequency and intensity of tidal flooding have rendered these traditional adaptation strategies ineffective (Wattimena, 2023).
b. Adjustments in cropping patterns were initially considered an effective adaptation strategy (Kuntari & Rasid, 2021). However, continuous weekly flooding during 2025 has significantly reduced the effectiveness of this approach, resulting in the discontinuation of rice cultivation and substantial income losses among farming households.
c. The utilization of salt-tolerant rice varieties has not been implemented because of limited knowledge, insufficient dissemination of agricultural innovations, and the absence of institutional support in introducing adaptive seed varieties to local farmers.
d. Capacity-building initiatives have been undertaken through agricultural extension services and village government interventions. These efforts include promoting alternative agricultural commodities such as oil palm cultivation and constructing embankments to reduce seawater intrusion, reflecting institutional responses to increasing environmental risks (Puspitasari et al., 2019).

4.2 Research Discussion

4.2.1 Interpretation of Key Findings

The findings of this study demonstrate that tidal flooding has significantly influenced the sustainability of rice farming activities in Pasar Seluma Village, South Seluma District, Seluma Regency. The results reveal that although the farming community has developed awareness regarding tidal flooding patterns and implemented several adaptation strategies, the increasing frequency and intensity of flooding have exceeded the capacity of traditional adaptation mechanisms. The findings answer the research objective by demonstrating that community adaptation responses remain limited and require stronger institutional support and agricultural innovation to address long-term environmental changes.

The first key finding indicates that community awareness of tidal flooding has

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developed through farmers' experiences in recognizing seasonal patterns and adjusting agricultural activities. Farmers have historically adapted planting schedules by cultivating rice at the beginning of the year to avoid flooding that commonly occurs at the end of the year. This condition reflects the existence of environmental awareness, where communities develop knowledge based on direct interaction with their surrounding ecosystem. As explained by Wattimena (2023), awareness represents the human understanding of relationships between individuals, environmental conditions, and broader ecological systems. However, the findings also indicate that awareness alone is insufficient when environmental pressures exceed community adaptation capacity. The occurrence of weekly tidal flooding in 2025 demonstrates that farmers' existing knowledge can no longer effectively mitigate agricultural risks.

The second finding concerns changes in cropping patterns as an initial adaptation strategy. Adjusting planting periods was previously considered an effective approach to reducing crop losses caused by tidal flooding (Kuntari & Rasid, 2021). However, this study reveals that such adaptation has become ineffective because flooding no longer follows predictable seasonal patterns. The transition from seasonal flooding to frequent tidal inundation has disrupted agricultural cycles, reduced productivity, and ultimately forced farmers to discontinue rice cultivation. Therefore, the findings indicate that climate-related environmental changes require adaptation strategies beyond conventional agricultural practices.

The third finding shows that the utilization of salt-tolerant rice varieties has not yet been implemented in Pasar Seluma Village. Although such varieties represent an important technological adaptation for agricultural areas affected by salinity and tidal flooding, farmers have limited knowledge regarding their availability and application. This condition indicates a gap between agricultural innovation development and its dissemination at the community level. The absence of technology adoption suggests that adaptation capacity is influenced not only by farmers' willingness but also by accessibility, institutional support, and knowledge transfer mechanisms.

The fourth finding highlights the importance of capacity-building initiatives in strengthening community resilience. Agricultural extension services and village government interventions have contributed through training programs, promotion of alternative agricultural commodities, and infrastructure development such as seawater protection embankments. These efforts demonstrate that adaptation to environmental change requires collaboration between farmers, government institutions, and agricultural stakeholders. Nevertheless, existing initiatives remain focused on short-term responses and have not fully addressed the long-term transformation required for sustainable agricultural adaptation.

4.2.2 Comparison with Previous Studies

The findings of this study are consistent with previous research emphasizing that climate-related environmental changes require adaptive responses from agricultural communities. Kuntari and Rasid (2021) found that modifying cropping patterns can reduce agricultural losses caused by flooding by adjusting planting schedules according to environmental conditions. Similarly, farmers in Pasar Seluma Village initially applied this strategy by shifting planting periods to avoid tidal flooding. However, this study extends previous findings by demonstrating that cropping pattern adjustments become ineffective when flooding frequency increases beyond historical patterns.

Unlike previous studies that often emphasize farmers' adaptation capacity through behavioral adjustments, this research highlights the limitation of individual-level adaptation strategies when facing structural environmental changes. The experience of

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farmers in Pasar Seluma Village shows that repeated tidal flooding has transformed from a seasonal challenge into a continuous threat that requires technological and institutional interventions. Therefore, this study contributes by showing that adaptation strategies must evolve from reactive approaches toward more systematic and integrated resilience-building mechanisms.

The findings regarding limited adoption of salt-tolerant rice varieties are also aligned with previous studies indicating that agricultural innovation adoption depends on farmers' access to information, extension services, and institutional facilitation. The absence of knowledge regarding adaptive rice varieties among farmers suggests that technological solutions cannot generate significant impacts without effective dissemination mechanisms. This condition strengthens the argument that agricultural adaptation requires not only innovation availability but also community empowerment and institutional support.

Furthermore, the findings regarding capacity-building efforts support the perspective of Puspitasari et al. (2019), who emphasized that strengthening community capacity involves human resource development, organizational strengthening, and institutional transformation. The initiatives conducted by agricultural extension officers and village government reflect these dimensions; however, the findings indicate that further strengthening is required to ensure that adaptation strategies correspond with the increasing severity of environmental risks.

4.2.3 Theoretical Contributions

This study contributes theoretically by extending the understanding of community adaptation theory in the context of agricultural vulnerability caused by tidal flooding. The findings confirm that environmental awareness is an important foundation for adaptation behavior, as demonstrated through farmers' recognition of flooding patterns and their attempts to modify agricultural practices. However, the study also challenges the assumption that awareness automatically leads to effective adaptation outcomes. The case of Pasar Seluma Village demonstrates that awareness must be supported by technological access, institutional capacity, and adaptive governance.

From the perspective of environmental adaptation theory, this research expands the understanding that adaptation is not merely an individual response but a collective process involving interactions between communities, institutions, and ecological systems. Farmers' inability to sustain rice cultivation despite possessing experience and environmental knowledge indicates that adaptation effectiveness depends on broader socio-institutional conditions.

Furthermore, the findings strengthen Wattimena's (2023) conceptualization of awareness by demonstrating that environmental awareness develops through continuous interaction between humans and nature. However, this study extends the concept by showing that awareness must be accompanied by transformative actions and institutional interventions to produce meaningful adaptation outcomes. Therefore, the research provides theoretical insight into the importance of integrating ecological awareness with adaptive capacity development.

4.2.4 Practical and Policy Implications

The findings provide several practical implications for farmers, agricultural institutions, and policymakers. For farming communities, the results indicate the necessity of transitioning from traditional adaptation strategies toward more resilient agricultural practices. Farmers require access to information, training, and technological support regarding salt-tolerant rice varieties and other climate-adaptive agricultural innovations.

For agricultural extension agencies, this study highlights the importance of strengthening technology dissemination programs. Extension activities should not only

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focus on introducing alternative commodities but also provide continuous assistance regarding adaptive agricultural technologies suitable for tidal flood environments. The introduction of salt-tolerant rice varieties, improved drainage systems, and integrated coastal farming practices can become potential strategies to maintain agricultural productivity.

For village governments and policymakers, the findings emphasize the need for integrated adaptation policies involving infrastructure development, agricultural transformation programs, and community empowerment. The construction of embankments, as implemented in Pasar Seluma Village, represents an important physical adaptation measure; however, it should be complemented with long-term environmental management policies and sustainable livelihood programs. Policymakers should consider collaborative approaches involving local communities, agricultural experts, and government institutions to strengthen resilience against future climate-related risks.

4.2.5 Integration with the Research Gap

This study addresses the research gap identified in previous literature regarding the limited understanding of how rural agricultural communities adapt to increasing tidal flooding conditions. Previous studies have extensively discussed climate adaptation strategies, but fewer studies have examined the transition from traditional adaptation mechanisms toward more comprehensive adaptation systems in villages experiencing increasingly frequent tidal flooding.

The originality of this research lies in its examination of adaptation dynamics at the community level, particularly how farmers' awareness, cropping pattern adjustments, technological adoption, and institutional capacity interact in responding to tidal flooding. The findings reveal that existing adaptation strategies are insufficient when environmental changes occur beyond historical experiences. Therefore, this study contributes to the literature by demonstrating the importance of combining community-based adaptation, agricultural innovation, and institutional intervention in addressing climate-related agricultural vulnerability.

4.2.6 Acknowledgement of Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in a single village context, namely Pasar Seluma Village, which may limit the transferability of findings to other agricultural communities experiencing tidal flooding with different environmental and socio-economic characteristics. Second, the findings primarily reflect the perspectives and experiences of selected informants, meaning that variations in adaptation experiences among broader farming populations may not be fully represented.

Additionally, this study focuses on qualitative exploration of adaptation strategies and does not quantitatively measure the economic impact of tidal flooding, agricultural productivity changes, or the effectiveness of specific adaptation technologies. Future research may expand this study by incorporating comparative analysis across different coastal agricultural areas and evaluating the effectiveness of technological and policy interventions through quantitative approaches.

5. Conclusion

5.1 Summary of Key Findings

This study reveals that the primary adaptation strategy implemented by rice farmers in Pasar Seluma Village is the adjustment of planting schedules. Farmers modify their planting periods by cultivating rice at the beginning of the year to avoid tidal flooding that generally occurs toward the end of the year. However, this strategy has become increasingly insufficient due to the rising frequency and severity of tidal flooding, particularly during 2024 and

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2025, when flooding events occurred almost every week.

The findings also indicate that rice farmers have not yet adopted more advanced adaptation measures, such as the utilization of salt-tolerant and flood-resistant rice varieties. Although local government interventions have been initiated through infrastructure development, such as embankment construction, and agricultural training involving alternative crops such as oil palm, these efforts remain limited in scope. Therefore, stronger intervention, continuous education, and improved knowledge transfer are required to support long-term agricultural sustainability in tidal flood-prone areas.

5.2 Theoretical Contributions

This study contributes to the understanding of agricultural adaptation theory by demonstrating that local farming communities' responses to environmental change are shaped by both traditional knowledge and the availability of external support systems. The findings extend existing perspectives on climate adaptation by showing that farmers' adaptive capacity is not solely determined by their willingness to adjust agricultural practices but also by access to technological innovation, institutional support, and environmental infrastructure.

Furthermore, this study highlights the importance of integrating community-based adaptation approaches with technological and institutional interventions. The limited adoption of adaptive rice varieties indicates that knowledge accessibility and dissemination mechanisms represent important factors influencing farmers' adaptation decisions. Thus, this research enriches the discussion on climate resilience by emphasizing the interaction between local experience, agricultural innovation, and governance support in developing sustainable adaptation strategies.

5.3 Practical and Policy Implications

The findings provide several practical implications for farmers, village governments, and agricultural authorities. For the farming community, adaptation strategies should be expanded beyond planting schedule adjustments by incorporating more resilient agricultural practices, including the adoption of flood- and salt-tolerant rice varieties, diversification of agricultural activities, and the application of climate-resilient farming techniques.

For village governments and agricultural institutions, the study emphasizes the need to strengthen community-based education and outreach programs. Training activities, demonstration plots, and direct assistance in implementing adaptive agricultural technologies are necessary to improve farmers' capacity to respond to tidal flooding. Collaboration with agricultural research institutions should also be encouraged to introduce farming innovations that are suitable for local environmental conditions.

In addition, infrastructure-based interventions such as embankment construction should be integrated with ecosystem-based approaches, including coastal ecosystem restoration efforts such as mangrove rehabilitation. Participatory planning involving farmers, government institutions, and agricultural stakeholders is essential to ensure that adaptation strategies are practical, sustainable, and aligned with community needs.

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5.4 Limitations of the Study

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in a single geographical location, namely Pasar Seluma Village, South Seluma District, Seluma Regency, which may limit the generalizability of the findings to other coastal agricultural communities with different environmental and socio-economic conditions. Second, this study relied primarily on qualitative interview data obtained from farmers, village government representatives, and agricultural extension officers. While this approach provides in-depth insights into farmers' experiences and perceptions, it does not quantitatively measure the effectiveness of each adaptation strategy or the economic impacts of tidal flooding on agricultural productivity. Third, the study focused on current adaptation practices and institutional responses without examining long-term climate projections or broader regional agricultural policies. Therefore, further studies are needed to provide a more comprehensive understanding of adaptation dynamics in coastal farming systems.

5.5 Directions for Future Research

Future research is encouraged to expand the geographical scope by involving multiple coastal agricultural areas to enable comparative analysis of adaptation strategies across different environmental and socio-economic contexts. Further studies may also employ mixed-method approaches by combining qualitative insights with quantitative measurements of crop productivity, economic losses, and adaptation effectiveness.

Future research should also investigate the adoption factors influencing farmers' decisions to implement climate-resilient agricultural technologies, including salt-tolerant rice varieties, improved irrigation systems, and ecosystem-based adaptation approaches. In addition, studies examining the role of government policies, agricultural extension services, and institutional collaboration in strengthening farmers' adaptive capacity would provide valuable contributions to the development of sustainable agricultural adaptation frameworks.

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