

Risk Management: Socio-economic Impact of Flooding on Rice Farming in Padang City

Manajemen Risiko: Dampak Sosial Ekonomi dari Banjir pada Sawah di Kota Padang

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ARTICLE INFO

How to cite:

Paloma, C., & Mutiara, V. I. (2025). Risk Management: Socio-economic Impact of Flooding on Rice Farming in Padang City. *Journal of Integrated Agribusiness*, 7(1), 13–28.

DOI: [10.33019/jia.v7i1.6332](https://doi.org/10.33019/jia.v7i1.6332)

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Published: June 30, 2025

ABSTRACT

Flooding is a major natural disaster that substantially risks agricultural productivity, particularly rice cultivation. In Padang city, the severity of flood impacts has increased due to climate change. This study identifies and analyzes flood risk management strategies in paddy farming areas. The research used a descriptive approach supported by quantitative secondary data from government reports, insurance claim records, and climate-related publications. Data analysis involves risk mapping and descriptive statistics to assess patterns of flood impact and response strategies. The results indicate that effective flood risk management involves using flood-resistant rice varieties, constructing and maintaining irrigation and drainage systems, and participating in the Paddy Farming Insurance (AUTP). Risk Mapping shows that floods have the lowest impact compared to other floods or disasters. In Padang City, floods have not impacted 75% of AUTP insurance claims. Strategies that farmers and stakeholders can implement are preventive and mitigations. Preventive strategies include improving drainage systems and using flood-resistant crops, while mitigation involves early warning systems, weather forecasting, crop insurance, and post-flood management. However, barriers like insufficient funding, limited farmer awareness of technology, and poor infrastructure hinder adoption. Government support primarily benefit smallholder farmers—those most vulnerable to climate-related risk by offering technical assistance, financial subsidies, and encouraging AUTP participation. By implementing these strategies, agricultural resilience can be strengthened, contributing to national food security.

Keywords: *Climate Change; Flooding; Insurance; Rice; Risk Management*

ABSTRAK

Banjir merupakan bencana alam utama yang secara signifikan mengancam produktivitas pertanian, khususnya budidaya padi. Dampak banjir di Kota Padang semakin parah seiring dengan pemanasan global akibat perubahan iklim. Penelitian ini bertujuan untuk mengidentifikasi dan menganalisis strategi manajemen risiko banjir di lahan pertanian di Kota Padang. Metode penelitian menggunakan pendekatan deskriptif yang didukung oleh data sekunder kuantitatif yang bersumber dari laporan pemerintah, data klaim asuransi dan publikasi terkait dengan iklim. Analisis data dilakukan dengan pemetaan risiko dan statistic deskriptif untuk menilai pola dampak banjir dan strategi penanganannya. Hasil penelitian menunjukkan bahwa penggunaan varietas padi tahan banjir, Pembangunan dan pemeliharaan infrastruktur irigasi yang memadai, serta keikutsertaan pada program AUTP (Asuransi Usaha Tani Padi) merupakan bagian dari manajemen risiko banjir yang efektif. Pemetaan risiko menunjukkan bahwa banjir memiliki dampak paling rendah dibandingkan bencana lainnya. Di Kota Padang, banjir tidak berkontribusi terhadap 75% klaim asuransi AUTP. Strategi yang dapat diterapkan oleh petani dan pemangku kepentingan meliputi tindakan preventif dan mitigatif. Strategi preventif antara lain perbaikan sistem drainase dan penggunaan tanaman tahan genangan, sedangkan strategi mitigatif mencakup sistem peringatan dini, prakiraan cuaca, asuransi pertanian, dan manajemen pasca banjir. Namun, masih terdapat hambatan seperti keterbatasan dana, rendahnya kesadaran petani terhadap teknologi, dan buruknya infrastruktur yang menghambat penerapan strategi tersebut. Dukungan pemerintah terutama ditujukan kepada petani skala kecil – kelompok yang paling rentan terhadap risiko iklim – melalui bantuan teknis, subsidi keuangan, serta dorongan untuk berpartisipasi dalam AUTP. Dengan menerapkan strategi ini, ketahanan pertanian dapat diperkuat sehingga berkontribusi terhadap ketahanan pangan nasional.

Kata Kunci: Asuransi; Banir; Manajemen Risiko; Padi; Perubahan Iklim

1. Introduction

Rice farming is a vital component of global agriculture, particularly in Indonesia, where it serves as a staple food for millions and represents a primary source of income for rural communities (Salam et al., 2019). Beyond its function in daily sustenance, rice cultivation contributes significantly to national economies and holds substantial potential to increase farmers' earnings (Rahman et al., 2018). The growing demand for rice is reflected in rising domestic consumption levels (Kaleka et al., 2020; Arsani, 2020), particularly for household consumption, which accounts for more than 85.46 percent (Sugiyanto, 2006). To meet this growing demand, rice farming remains critical, especially in regions like West Sumatra (Angraini et al., 2022) (see Figure 1).

However, despite its central role in food security, rice farming is increasingly exposed to significant risks, particularly from environmental stressors such as flooding, drought, and climate variability (Aulia & Wulandari, 2022; Lubis et al., 2024). These climatic disturbances can severely affect rice production, threatening the livelihoods of farmers who depend heavily on this sector. Given agriculture's high sensitivity to climatic conditions, climate change is expected to trigger a wide range of impacts, many of which remain uncertain (Antonopoulou, 2022; Karimi et al., 2018).

Paddy fields, which are designed to maintain standing water for optimal rice growth, rely on controlled irrigation systems. These systems, however, are highly vulnerable to extreme weather events, particularly flooding (Rahman et al., 2022). Floods—often intensified by erratic rainfall patterns and climate change—can exceed the designed water management capacity of paddy fields, causing significant crop damage, yield losses, and economic hardship for farming communities. This vulnerability underscores the urgency of comprehensively addressing flood risk in rice farming to safeguard food security and enhance agricultural sustainability.

Flood and drought events are known to impair agricultural productivity and compromise food security (Guan et al., 2021). In evaluating flood damage to rice crops, flood impact models typically consider the depth, duration, and timing of inundation relative to the crop growth stage (Shrestha et al., 2019). Although climate change might bring positive agricultural effects in certain regions, in many others it leads to either water scarcity or surplus, ultimately undermining food availability and agricultural stability (Atanga & Tankpa, 2021). Floods also damage physical infrastructure, disrupt economic activity, and erode key dimensions of food security—including availability, access, utilization, and stability.

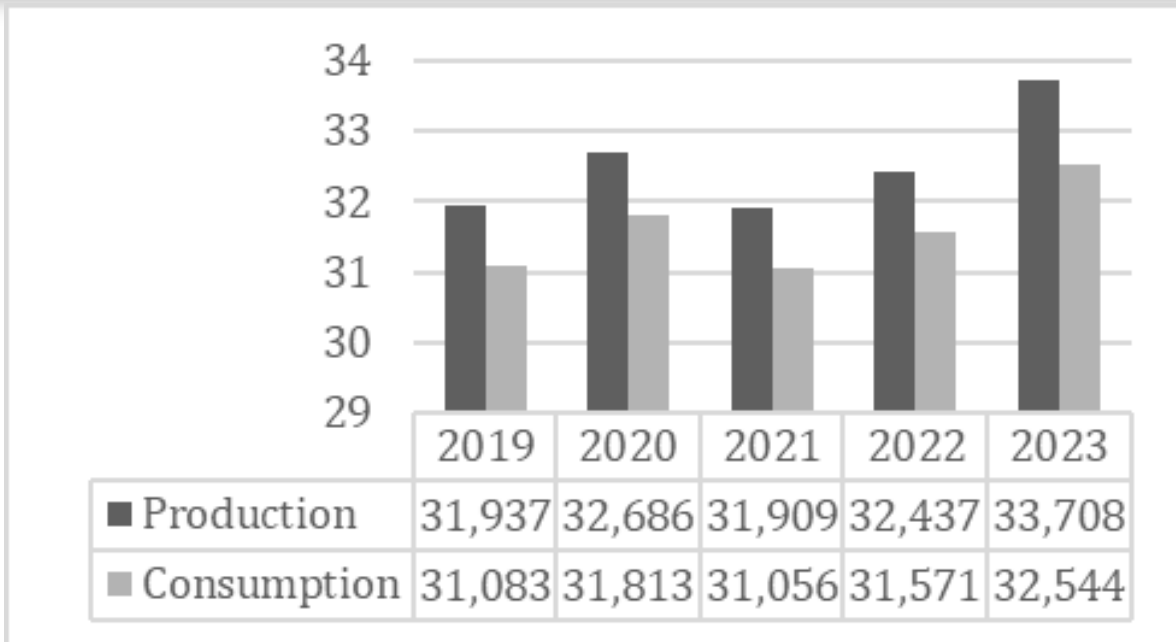


Figure 1. Rice production and consumption in Indonesia (000 tons)

Source: Center for Agricultural Data and Information System (2024)

According to data from Agricultural Extension Centers (*Balai Penyuluhan Pertanian* or BPP), flooding in Padang City during the rice cultivation season affected 10.34 hectares of farmland, of which 7.25 hectares experienced complete crop failure. Most of the affected land comprised nearly mature rice fields, leading to substantial production losses. The largest rice-producing area is Koto Tangah District, with a total harvested rice field area of 4,295.40 hectares, yielding approximately 19,982 tons of rice in 2022 (Badan Pusat Statistik [BPS], 2023). These figures reflect the region's vulnerability to flood hazards, particularly during periods of intense rainfall (Eka Putri et al., 2023).

Flood events in Padang City typically occur between September and November, coinciding with the peak monsoon season and increased convective activity. The Padang City Disaster Management Agency (*Badan Penanggulangan Bencana Daerah* or BPBD) reports that nearly 45% of annual flood incidents occur during this three-month period (BPBD Kota Padang, 2022). The consequences of such flooding are multi-dimensional. Socially, floods disrupt everyday life, damage public infrastructure—including roads, bridges, and government facilities—and displace residents. In highly affected areas such as Koto Tangah and South Padang, the combination of heavy rainfall and high flood frequency exerts a cumulative impact on communities, particularly farming households (Bana et al., 2025).

Economically, floods reduce harvest yields, diminish farmers' income, and negatively affect regional trade and industry, resulting in considerable economic losses (Rasul & Sharma, 2016). From an environmental perspective, flooding accelerates soil erosion, degrades water quality, and harms both riverine and coastal ecosystems (Balgah et al., 2023). Recurrent flood events also raise public health risks by increasing the prevalence of waterborne diseases such as diarrhea and dengue fever (Alderman et al., 2012).

While the global literature offers extensive discussion on the socio-economic impacts of floods on rice agriculture (Maranzoni et al., 2023), few studies apply a structured risk management framework—particularly in urban agricultural settings such as Padang City. Most

prior research has focused either on post-disaster loss assessment or recovery strategies. What is missing is a more integrative perspective that emphasizes anticipatory risk identification, preventive mitigation, and adaptive strategies aimed at building long-term agricultural resilience.

This study seeks to address this gap by examining flood impacts in rice farming areas through the lens of risk management. It proposes a strategic framework incorporating risk mapping, preventive infrastructure development, farmer participation in crop insurance, and multi-stakeholder coordination. The central aim is to identify and evaluate flood risk management strategies applicable to paddy field areas in Padang City.

2. Research Methods

2.1. Research Location

This research was carried out in Padang City, the capital of West Sumatra Province, Indonesia. The city lies on the western coast of Sumatra Island at 0°44'00" - 1°08'35" S and 100°05'05" - 100°34'09" E, covering approximately 694.96 km². Administratively, Padang consists of 11 districts (*kecamatan*) and 104 urban villages (*kelurahan*). Its topography ranges from coastal lowlands to hilly inland areas, making several neighborhoods prone to flooding. Under the Indonesian National Disaster Risk Index, Padang ranked fifth in overall disaster risk for the 2022–2023 period, yet recorded the highest flood-related economic losses among the top five cities, amounting to IDR 9.27 trillion (see Table 3).

Padang serves as a regional hub for trade, education, public administration, and agriculture. Key agricultural activities include rice cultivation, horticulture, and plantation crops, most of which are concentrated in suburban and peri-urban zones that experience seasonal inundation. The latest census reports a population of roughly 900,000, with a substantial share of households depending on agriculture for their livelihood. Primary data sources for this study were the West Sumatra Office of Plantations, Food Crops, and Horticulture; crop-insurance (AUTP) claims; the National Agency for Disaster Management (BNPB); and prior peer-reviewed studies.

2.2. Data Analysis

This study adopts a mixed methods approach, integrating both quantitative and qualitative techniques to comprehensively analyze flood risk management in paddy farming.

Quantitative analysis was conducted using descriptive statistical methods on secondary datasets. These include records of flood occurrences, damage to paddy fields, and agricultural insurance (AUTP) claims. Data were sourced from the West Sumatra Office of Plantation, Food Crops, and Horticulture; AUTP claims submitted by farmers; and secondary data from the National Disaster Management Agency (BNPB) covering the period from 2019 to 2023. The economic impact of flooding was assessed by analyzing the frequency and intensity of flood events, the total area of rice fields affected, and the monetary value of insurance claims submitted during this period.

Qualitative data were gathered through semi-structured interviews with facilitators involved in the implementation of AUTP. Participants were selected purposively based on their institutional knowledge, hands-on experience, and key roles in facilitating coordination between farmers and government agencies. The interview data were thematically analyzed to

explore farmers’ experiences with flood risk, institutional responses, and barriers to effective risk management practices.

Risk assessment in this study employed the Hopkins Risk Matrix (Hopkin, 2017), which evaluates flood risk along two dimensions: likelihood (the probability of occurrence) and impact (the severity of consequences). As illustrated in Figure 2, this matrix categorizes risk levels into low, moderate, high, and extreme. These categories support strategic decision-making by identifying appropriate risk responses based on objective criteria. The Hopkins framework was selected over other models due to its clarity, practicality, and suitability for agricultural risk contexts. It enables policymakers and stakeholders to prioritize interventions and develop proactive risk management strategies tailored to local farming conditions in Padang City.



Figure 2. Likelihood and Impact Matrix
Source: adapted from Hopkin (2017)

Tables 1 and 2 provide the operational definitions used in the matrix for both likelihood and impact assessments.

Table 1. Likelihood Scale in the Risk Matrix

Risk Level	Scale	Criteria
Low	Rare	The event is expected only under exceptional circumstances, such as extremely low probability or no historical precedent.
	Unlikely	The event could occur occasionally, but is not expected; the probability is low but not negligible.
High	Possible	There is a moderate chance of occurrence; the event may happen under specific conditions.
	Likely	The event is expected to occur in most circumstances based on past trends or patterns.

Risk Level	Scale	Criteria
	Almost Certain	The event is anticipated in nearly all circumstances; the probability is very high or inevitable.

Table 2. Impact Scale and Criteria in the Risk Matrix

Risk Level	Scale	Criteria
Low	Insignificant	Negligible impact; issues are easily managed and do not affect operations or outcomes materially.
	Minor	Minor disruptions or delays; no significant operational or financial consequences.
High	Moderate	Noticeable disruption to operations; may lead to financial, reputational, or logistical impacts.
	Major	Severe disruption, significant financial losses, or reputational damage may occur.
	Catastrophic	Operations may cease entirely, posing significant risks to financial viability, institutional credibility, or safety.

This combined quantitative–qualitative framework provides a structured basis for developing flood risk management strategies that are responsive to local vulnerabilities and institutional capacities.

3. Results and Discussion

3.1. The Economic Impact of Disaster in Padang City

In developing countries, the economic consequences of natural disasters tend to be more pronounced, often resulting in both substantial financial losses and significant human casualties (Panwar & Sen, 2019). According to the Indonesian National Disaster Risk Index (*InaRISK*) published by the National Agency for Disaster Management (BNPB), Padang City ranks fifth nationally in terms of disaster risk. The red-coded classification in the risk map indicates Padang’s high disaster potential. Among cities in West Sumatra, Padang has the largest administrative area, which further amplifies its exposure to natural hazards.

Based on BNPB data, the estimated economic loss from disasters in Padang reached IDR 84.87 trillion. The area classified as disaster-prone spans approximately 33,616 hectares, with an affected population totaling over 6.3 million (see Figure 3).

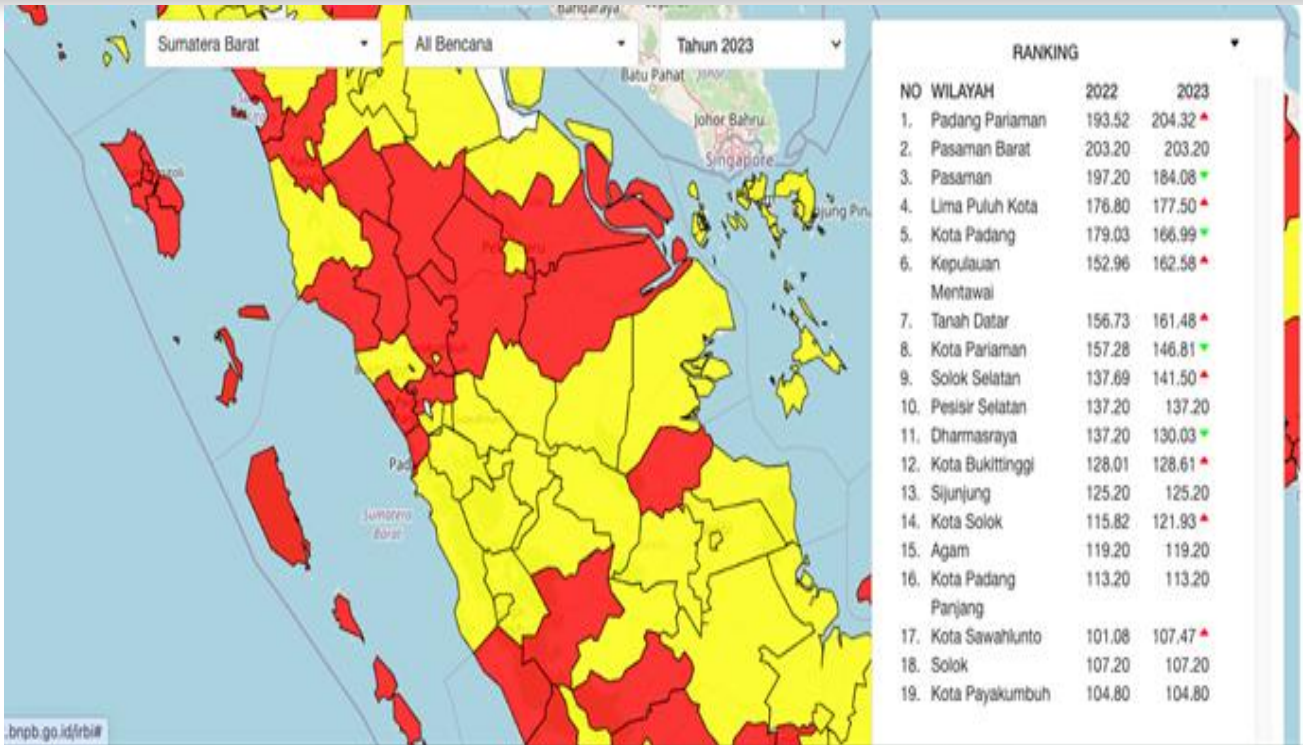


Figure 3. Disaster Risk Areas in West Sumatra

Source: BNPB (2023)

The agricultural sector in Padang is particularly vulnerable to disaster impacts, especially flooding. Such events threaten rice yields, livestock production, and the livelihoods of rural households. The largest rice-producing area in Padang is the Koto Tengah District, where more than 10.34 hectares of rice fields have been affected by flood events. Various disaster types have been recorded in West Sumatra, including earthquakes, tsunamis, floods, flash floods, landslides, volcanic eruptions, forest fires, droughts, extreme weather, coastal abrasion, and liquefaction (see Table 3).

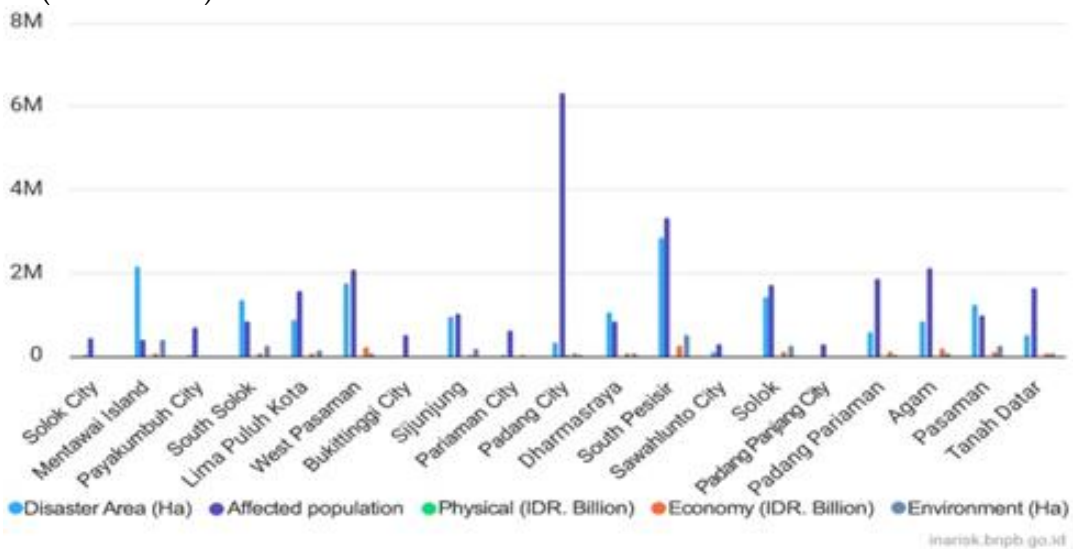


Figure 4. Disaster Potential in West Sumatra (2022–2023)

Source: InaRISK BNPB (2023)

Flooding is one of the qualifying indicators for insurance claims under the Crop Farming Insurance Program (*Asuransi Usaha Tani Padi* or AUTP) (Jenderal Prasarana dan Sarana Pertanian, 2022). Under this scheme, farmers are eligible to claim compensation if crop damage exceeds 75 percent per hectare. The insurance coverage allows payouts of up to IDR 6 million per hectare per planting season in the event of floods, droughts, or pest outbreaks (organisme pengganggu tumbuhan/OPT). However, in Padang City, recent flood events did not meet the minimum claim threshold, resulting in the absence of officially recorded insurance claims for flood-related damage.

Agricultural insurance serves as an essential mechanism for managing the inherent risks in farming, offering financial protection against uncertain environmental shocks. Farmers' perception of and response to these risks often depend on the type and frequency of hazard events, as well as their understanding of insurance benefits (Paloma et al., 2024). Natural disasters fall under the category of **pure risk**, which is characterized by binary outcomes: either a loss occurs, or it does not. Unlike speculative risk, pure risk is insurable, particularly when it involves unpredictable hazards that can be partially mitigated through insurance programs (Darmawi, 2022).

Table 3. Types of Disasters in West Sumatra Province (2022–2023)

Disaster Type	Affected Area (ha)	Affected Population	Physical Loss (IDR billion)	Economic Loss (IDR billion)	Environmental Damage (ha)
Earthquake	3,280,878	5,193,169	45,778.03	36,872.90	0
Tsunami	74,809	165,665	1,378.95	711.24	1,133
Flood	524,803	1,829,258	9,271.86	8,394.30	9,706
Flash Flood	191,157	741,525	5,534.91	2,822.64	1,907
Landslide	2,642,136	567,339	4,592.26	19,528.67	216,663
Volcanic Eruption	30,265	21,087	88.64	121.47	17,765
Forest Fire	79,111,210	0	0	709,049.95	6,285,084
Drought	159,625,884	248,389,612	0	967,551.98	35,020,681
Extreme Weather	68,733,681	226,329,236	1,962,997.40	781,335.48	-
Extreme Waves & Abrasion	19,380,978	31,355,125	153,873.15	153,800.49	1,804,464
COVID-19	4,615,650	173,830,014	0	0	0
Liquefaction	12,952,131	77,370,182	208,655.72	143,220.26	1,343,000

Source: BNPB (2023)

This section highlights that flood events, though recurring, are not always formally compensated due to procedural or eligibility limitations. Consequently, enhancing insurance literacy and revisiting the policy thresholds could significantly improve the utility of agricultural insurance schemes in disaster-prone regions like Padang.

3.2. Agricultural Insurance Program (AOTP) to Manage Pure Risk

In 2015, the West Sumatra Office of Food Crops, Horticulture, and Plantations introduced the Rice Farm Business Insurance Program under the Agricultural Insurance Scheme (AOTP) (Azriani et al., 2018). Although the AOTP is available to help farmers manage risks associated with agricultural production, participation rates remain low. This limited engagement can be attributed to several factors. In some areas, farmers do not operate in pest-endemic zones or regions classified as disaster-prone, such as those affected by floods, droughts, or landslides. As a result, they often perceive insurance coverage as unnecessary.

Additionally, there is a persistent perception among farmers that the insurance claim process is complex and burdensome. This view contributes to a lack of trust in the system and acts as a deterrent to enrollment. These challenges underscore the importance of targeted outreach to address geographic and perceptual barriers and to enhance farmer participation in agricultural insurance programs.

Table 4. Types of Agricultural Insurance Claims (AOTP) in West Sumatra Province, 2021-2023

Type of Claim	2023				2022				2021			
	Amount of Claim (Ha)	Area of Land Claimed (Ha)	Total Premium Paid (IDR. 000)	Insurance Claim received (IDR. 000)	Amount of Claim	Area of Land Claimed (Ha)	Total Premium Paid (IDR. 000)	Insurance Claim received (IDR. 000)	Amount of Claim	Area of Land Claimed (Ha)	Total Premium Paid (IDR. 000)	Insurance Claim received (IDR. 000)
Flood	3	23,55	4.239	19.500	2	15	2.700	16.500	0			
Drought	14	64,06	11.540,3	79.500	2	15,7	3.150	25.620	3	24,89	4.480	33.720
Plant pests - Golden apple snail	2	17,53	3.333,6	9.000	1	39	7.020	10.560	2	10,35	1.863	9.360
Plant Pest-Rats	33	281,34	50.641,2	389,1	50	612,6	110.268	850.740	17	206,38	37118,4	244.980
Plant Pest-Tungro	1	5,01	901,8	9.180	1	17,5	0,315	2.580	1	11	1980	12.960
Plant Pest-Blast	2	23,57	4.357,8	1.920	5	42,5	9.450	34.740	3	28,25	5.085	47.460
Plant Pest-Brown Spot					1	11,75	2.115	9.120				
Plant Pest-Stem Rot									5	66,4	11.953	251.100
Plant Pest-Kresek									1	10	1.800	9.720
Plant Pest-Stem Borer									1	2,75	495	12.060
Plant Pest-Stinging Grasshopper					1	8,75	1.575	5.220				
Plant Pest-Brown Planthopper	1	13	2.340	21.480					10	97	17460	312.960
TOTAL	56	428,06	77.354	140.969	63	762,8	136.278	955.080	43	457,02	82.235	934.320

Source: AOTP Claim Report, West Sumatra Agricultural Office (2024)

Insurance claim data provide important insight into how well agricultural insurance mitigates financial losses. Based on Table 4, the majority of AOTP claims from 2021 to 2023 were related to plant pest outbreaks (PPO), comprising over 90 percent of total claims in 2021 and 2022. By contrast, flood-related claims were minimal, accounting for only 3–5 percent of total claims in 2022 and 2023, and no claims were recorded in 2021 (see Figure 5).

These findings lead to several key interpretations. First, the limited number of flood-related claims may suggest that flood events, while present, did not reach the damage threshold required for insurance compensation. Alternatively, existing infrastructure and farming practices may have been effective in mitigating the impact of such events. Second, it may indicate that awareness and uptake of AOTP specifically for flood risks remains low among farmers. Many may perceive pest-related risks as more immediate or threatening than floods or may lack knowledge about eligibility and procedures for filing flood claims. Third, the absence of data does not necessarily imply the absence of loss. Gaps in reporting, documentation, or access to insurance services—especially in flood-prone or remote areas—may result in underreporting of legitimate claims.

This low claim frequency suggests an urgent need to strengthen risk communication, enhance insurance literacy, and provide greater technical support to farmers in both understanding and accessing insurance schemes. Furthermore, policymakers should evaluate whether current insurance products and claim requirements adequately reflect the actual risk profiles faced by farmers. Adjusting insurance thresholds and offering more responsive coverage for flood-related losses may improve both the relevance and accessibility of the AOTP.

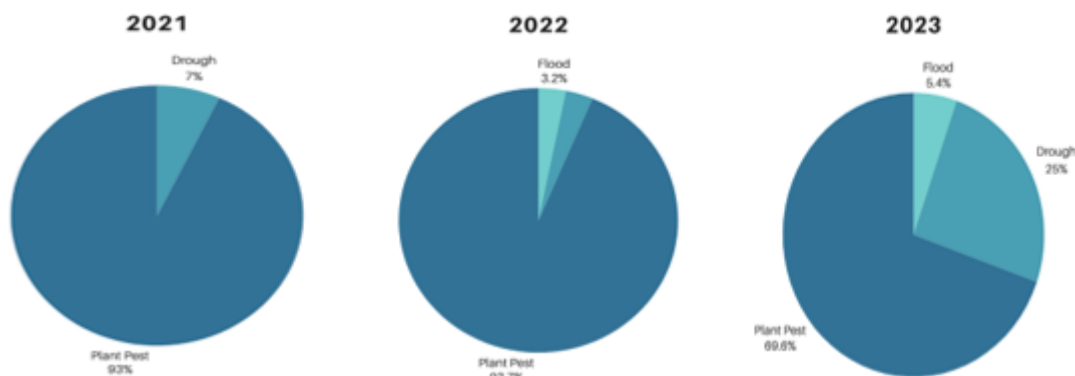


Figure 5. Types of Agricultural Insurance Claims in West Sumatra (2021–2023)

Source: Processed from Table 4, AOTP Data (2024)

Beyond short-term mitigation, claims data also offer a lens into regional variations in vulnerability and the longer-term role of insurance in post-disaster recovery. Farmers who receive timely payouts are more likely to resume farming, reinvest in production, and maintain household income stability (Insyafiah & Wardhani, 2014). Agricultural insurance, therefore, plays not only a financial role but also a social one, supporting recovery and resilience in rural communities facing increasing climate-related uncertainty.

3.3. Strategic Implications of Risk Mapping

Developing a risk matrix based on Hopkin’s framework offers a systematic method for visualizing and assessing agricultural risks. According to Hopkin (2017), risk is classified along

two dimensions: likelihood (the probability that a risk will occur) and impact (the severity of its consequences). This study employs Agricultural Insurance (AUP) claim data from the West Sumatra Provincial Agricultural Office to construct the matrix, as data from Padang City did not meet the 75 percent damage threshold required to trigger insurance compensation. Consequently, Padang did not report any flood-related claims during the study period, despite its known vulnerability.

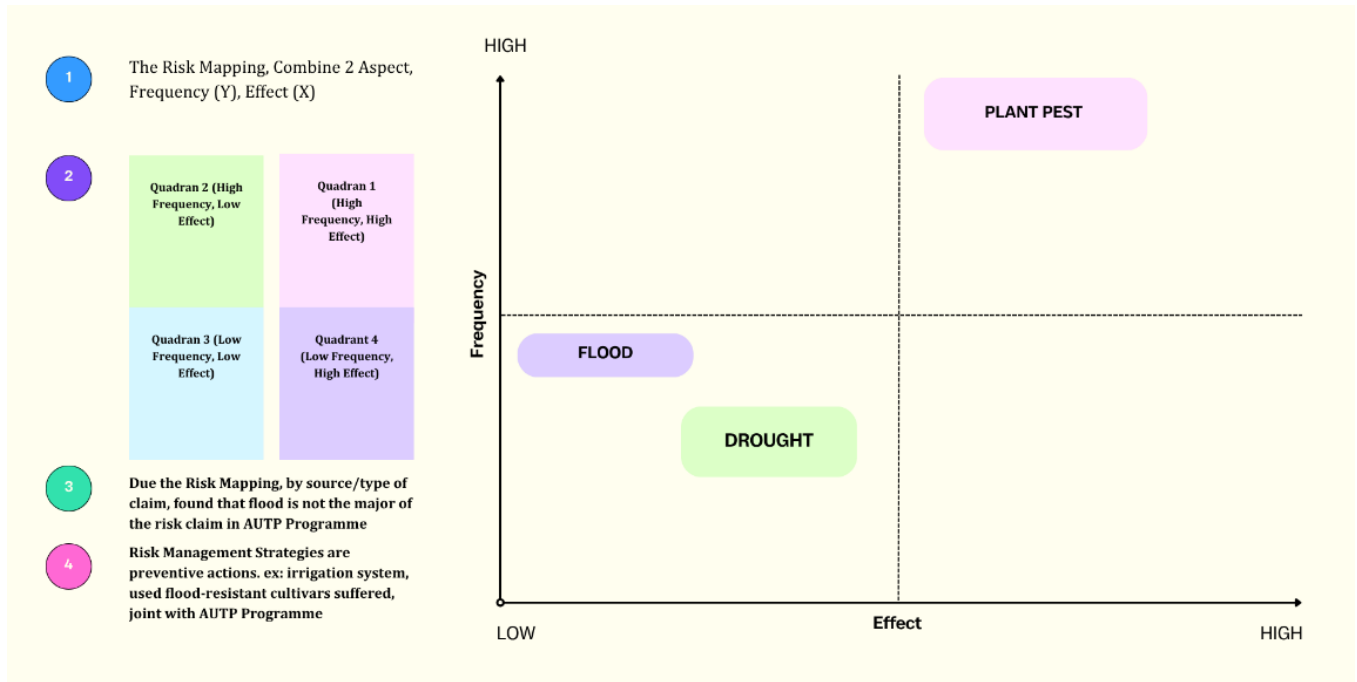


Figure 6. Risk Mapping of Type of AUP Insurance

Figure 6 illustrates the risk mapping derived from Table 4, which captures both the economic value of insurance claims and the area of land affected. The matrix is divided into four quadrants, reflecting different combinations of probability and impact. The data reveal that plant pest outbreaks—such as rat infestations, golden apple snails, and tungro—occupy the high-likelihood, high-impact quadrant. These types of risks dominate AUP claims between 2021 and 2023, accounting for more than 90 percent of reported cases. By contrast, flood and drought risks, though present, are relatively underreported. This discrepancy suggests several possibilities: that flood events in the region have not consistently met the claim threshold, that they have been effectively mitigated through local agricultural practices, or that farmers are unaware of or discouraged by the insurance claim procedures (Azriani et al., 2018). In some cases, farmers opt for passive mitigation strategies such as accepting seasonal inundation without pursuing formal compensation.

Risk mapping is particularly valuable for prioritizing action in agricultural risk management. In Padang City, flood risk remains a recurring and serious hazard, particularly during the peak rice cultivation season. The quadrant-based matrix enables stakeholders to identify which risks require urgent attention. Based on the placement of flood risk in the high-likelihood, high-impact quadrant, both preventive and mitigation strategies are needed. Preventive efforts may include improving irrigation and drainage systems, constructing flood barriers, applying land-use zoning, and utilizing agro-climatic forecasts to anticipate seasonal

vulnerabilities. Mitigation efforts can involve expanding access to AOTP, promoting flood-resilient rice varieties, establishing early warning systems, and ensuring timely post-disaster assistance such as replanting support and credit access. Moreover, embedding these risk management strategies into local development plans, while fostering cooperation between the disaster management agency (BPBD), agricultural departments, and municipal governments, is essential for enhancing the resilience of farming communities.

This study contributes to the broader literature by offering a structured and empirical framework for addressing flood risk in urban agricultural contexts. Agricultural households often respond to climate-related risks through a mix of ecological, economic, and social adaptations (Usamah, 2022). Structural approaches such as levees, dams, and improved drainage systems have proven effective in reducing flood risks and enhancing productivity (Rizaldy et al., 2023). Risk mitigation is also supported by early warning systems, crop insurance, and post-flood interventions like soil rehabilitation and replanting. The influence of peer groups further shapes farmers' willingness to engage in insurance programs (Wu et al., 2022).

Urban paddy fields can serve a dual function: as sites of food production and as water-retention systems that reduce flood intensity (Osawa et al., 2021). Nonetheless, accurate measurement of agricultural losses remains a central challenge. The AGEAD methodology, developed by Shokoohi et al. (2018), addresses this issue by accounting for spatial and temporal variations in flood exposure. Their findings show that paddy fields across different zones can experience a wide range of damage, from zero to total crop loss. Integrating the AGEAD approach into Indonesia's agricultural insurance system could improve the accuracy of risk assessments, enable fairer premium rates, and enhance the targeting of insurance interventions. By combining Hopkin's matrix with empirical insurance data and advanced risk assessment models, Indonesia's agricultural risk governance could become more adaptive, inclusive, and capable of supporting long-term economic resilience among vulnerable farming populations.

4. Conclusion

Flooding remains a significant natural hazard affecting rice production; however, based on the risk mapping analysis, it ranks as a lower-impact threat compared to other agricultural risks, particularly pest outbreaks, which dominate insurance claims under the AOTP scheme (Quadrant 2). Empirical evidence from Padang City shows that flood events have not consistently triggered the 75 percent damage threshold required to qualify for compensation, with some years reporting no insurance claims at all. While this may reflect limited measurable damage, it also raises concerns about farmers' awareness of claim procedures, the rigidity of eligibility thresholds, and the broader accessibility of agricultural risk protection mechanisms.

Effective flood risk management in paddy farming therefore requires a dual approach involving both **preventive** and **mitigative** strategies. Preventive measures, such as upgrading drainage infrastructure, adopting flood-resilient rice varieties, and improving land-use planning, are essential to reducing exposure and vulnerability prior to flood events. Mitigation strategies, including the implementation of early warning systems, access to accurate weather forecasting, participation in crop insurance programs such as AOTP, and timely post-flood recovery assistance, are critical to minimizing long-term losses and promoting adaptive capacity.

These efforts must be supported by targeted government interventions, particularly for smallholder farmers who are most at risk from climate-related hazards. Enhancing institutional capacity, improving insurance literacy, and tailoring AUTF policies to reflect localized risk conditions are necessary steps to ensure that available tools are both accessible and effective. In the long term, mainstreaming risk management into agricultural development planning will be crucial for strengthening the resilience of food systems and sustaining rice production in flood-prone areas such as Padang City.

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