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Agricultural Land Use Change and Livelihood Vulnerability in the Expansion Area: Pangandaran Regency

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ABSTRACT

The expansion areas have experienced a decline in agricultural land use and a decrease in the number of farming households, which has an impact on livelihood transformation. The purpose of this study is to analyze changes in agricultural land use and the vulnerability of farmers' livelihoods in the expansion areas, namely Mangunjaya Sub-district and Padaherang Sub-district of Pangandaran Regency. This research uses a quantitative descriptive method with a spatial analysis approach and an interview technique of 378 farmers. The highest land area change in Mangunjaya sub-district was gardens by 44% while in Padaherang Sub-district it was water bodies by 48%. The highest vulnerability is pressure with a value of 4.65 where there are indicators of agricultural land conversion. Changes in agricultural land use show an impact on the vulnerability of farmers' livelihoods as evidenced by disasters on agricultural land, a decrease in agricultural production and diversification of livelihoods other than the agricultural sector. Comprehensive efforts involving the government, community, and private sector are needed.

Keywords: *Land Use Change, Livelihood, Regional Expansion, Vulnerability*

BACKGROUND

Indonesia is an archipelago with diverse geographical conditions, having thousands of islands that create challenges in development. After the reformation in 1998, especially the implementation of Law No. 22 of 1999 concerning Regional Government, it became a response to equitable development with the phenomenon of regional expansion. From 1999, there have been 548 regional expansions in Indonesia up to the regency/city level, even more if added to the expansion up to the village level. The proposal for regional expansion continues to occur 195 times. Regional expansion here is a process of government administration that involves the creation of a new region from an existing region or a change in the boundaries of a region with a specific purpose, such as improving public services, accelerating development, or strengthening regional autonomy. Regional expansion cannot be separated from land as a resource that is increasingly prominent in development because it is used for various competing interests (Abebe et al., 2022; Acero, 2022). Agricultural land is often targeted for conversion to meet development needs (Coelho et al., 2021; Adhami et al., 2018).

The area of agricultural land in the country reported by BPS continues to shrink every year, especially on national paddy fields from 8.07 million ha in 2009 to 7.46 million ha in 2019. In 2023,

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Vol 9 (3): 668 - 682, November 2025

the national paddy field area amounted to 8.02. This data in 2023 does not show a downward trend but instead raises doubts in connection with the rampant conversion of agricultural land. BPS reported that the majority of farmers only own less than 0.5 ha of farmland. The decline in farmers' cultivated land has an impact on farmers' livelihoods (Ahmadisharaf et al., 2017; Abdullah et al., 2019; Chinangwa et al., 2016). The implementation of regional expansion as a form of development acceleration and welfare improvement does not always have a positive impact on farmers' livelihoods.

According to BPS data (2022), the percentage of poor people in Indonesia is 55% in rural areas, where most of the rural population are farming households. West Java is one of the regions that has been divided 7 times and has become the highest land conversion area. From the list of new autonomous regions in West Java, the most prominent agricultural region to expand was Ciamis Regency, which became Banjar City and Pangandaran Regency. The separation of Pangandaran from Ciamis was driven by efforts to enhance equitable development and optimize the economic potential of the southern region. Given the vast administrative area, the community in 10 sub-districts of South Ciamis proposed the formation of a new district to ensure more efficient and accessible public services. This aspiration emerged as early as 2002 and was supported by Pangandaran's prominent potential, particularly in the tourism sector, which is expected to drive economic growth and improve community welfare. These regions still make the agricultural sector a mainstay in their GRDP, but the growth rate is not greater than that of other sectors. This can be driven by the amount of land conversion that occurs (Ahmadisharaf et al., 2017; Han et al., 2021). In general, some of these regional expansion areas have experienced a decrease in agricultural land use and a decrease in the number of farming households (Abdullah et al., 2019). This is the reason why there are impacts and livelihood transformations on the majority of the population who earn a living as farmers in terms of vulnerability, livelihood assets, and the level of sustainability of farmers' livelihoods (Asmamaw et al., 2020; Biscarini et al., 2021). According to BPS data, the percentage of poverty in the expansion area of Ciamis Regency has decreased, but the number of households receiving social assistance has increased. This condition creates a contradiction between efforts to achieve development functions and the livelihoods of people who are still farmers (Addinsall et al., 2019).

The expansion area of Ciamis Regency with the highest agricultural land use change is Pangandaran Regency. One of the causes is the development of government infrastructure in Pangandaran Regency, which is the result of expansion. Since Pangandaran became an independent regency after its division from Ciamis Regency in 2012, the need for land for various public facilities, such as government offices, public service infrastructure, and housing has increased. This has led to the conversion of agricultural land, especially around the government center, into non-agricultural land. In addition, Pangandaran has long been known as a popular beach tourism destination, with tourist attractions. The growth of this tourism industry encourages the development of supporting infrastructure, so that previously productive agricultural land is converted into land for the construction of tourist facilities and commercial properties.

Pangandaran Regency is one of the key food production centers in West Java, with Mangunjaya and Padaherang Districts recognized as major rice-producing areas. These districts have agricultural land that significantly contributes to regional food production. However, within the context of regional expansion, there has been a dynamic shift in land use, potentially reducing the extent of productive agricultural land. This shift not only affects food production but also exacerbates environmental risks, such as increased flooding due to the loss of water absorption areas and droughts

ISSN 2580-0566; E-ISSN 2621-9778
http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

that threaten the stability of agricultural irrigation systems. Given these conditions, this study seeks to answer the central research question: How does agricultural land-use change in expansion areas affect farmers' livelihood vulnerability, particularly in terms of access to livelihood assets and economic diversification strategies? Such changes impose significant pressures on farmers' livelihood systems, affecting natural capital (land degradation and declining ecosystem quality), physical capital (disruptions to irrigation infrastructure), and financial capital (decreased income due to reduced harvests) (Agudelo Moreno et al., 2020; Asmare et al., 2019). From the perspective of the Sustainable Livelihoods Framework (SLF), land-use changes not only impact the agricultural sector but also drive farmers to diversify their livelihoods into non-agricultural sectors such as trade, services, and tourism. While diversification may serve as an adaptation strategy, not all farming households possess equal capacity to transition to new economic sectors. Constraints in human capital (education and skills), social capital (access to economic networks), and financial capital (initial investment for non-agricultural enterprises) are key factors influencing the success of this transition. Therefore, a comprehensive understanding of how land-use change affects the balance between ecological risks, agricultural sustainability, and livelihood diversification dynamics is crucial in formulating effective adaptation strategies and mitigation policies (Ghazali et al., 2023; Qiao et al., 2018).

The novelty of this study lies in its integrated analysis of the impact of land-use change on farmers' livelihood vulnerability in the context of regional expansion, highlighting the linkages between ecological risks, access to livelihood assets, and diversification strategies within the sustainable livelihood's framework. This study provides a new contribution to understanding how administrative expansion affects farmers' livelihood systems ecologically, economically, and socially

RESEARCH METHODS

This research design uses quantitative descriptive methods. This research uses spatial analysis methods to understand and identify patterns and changes in land use in Pangandaran Regency. Mangunjaya District and Padaherang District, Pangandaran Regency before and after the expansion of Ciamis Regency. Spatial analysis is an approach that integrates geographic data with analytical methods to extract information from spatial or location-related phenomena. The method used in this research is a survey of farmer households using a questionnaire that involves theory, empirical evidence, facts and reality with an emphasis on finding changes in agricultural land use on farmers' livelihoods. The qualitative method in this research uses the interview method. Data sources in this study used primary data and secondary data. Primary data was obtained through observation, surveys and interviews with various stakeholders. Secondary data was obtained from various sources such as publications, government reports, databases, literature, or existing research.

Data and Data Sources

Primary data was collected directly from farmers in Mangunjaya and Padaherang sub-districts through field surveys and structured interviews. Information collected includes. Farmers' livelihood patterns, including changes in livelihoods, income, and farming strategies before and after land use change. In-depth interviews were conducted to gain a more comprehensive understanding of changes in farmers' social and economic aspects. Secondary data in this study comes from spatial data used to

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Vol 9 (3): 668 - 682, November 2025

conduct spatial analysis. Secondary data sources include: a) Land use maps for 2012 and 2023 obtained from the Geospatial Information Agency (BIG) or related agencies; b) Satellite images or remote sensing results to verify land use changes over time; c) Topographic data and administrative boundaries obtained from local government agencies of Pangandaran Regency.

These spatial data were processed using QGIS software to produce land use change maps, which were then compared with primary data to understand the linkages between land use change and farmers' livelihood patterns. The results of the map processing were also used to identify specific areas that experienced the greatest land conversion, particularly from agricultural land to non-agricultural uses.

Data Analysis

Spatial Data Processing

1. Map Georeferencing: This stage aims to adjust the map position to the appropriate coordinate system so that spatial data can be properly integrated into the QGIS system.
2. Land Use Classification: At this stage, the processed maps or satellite images are classified into several land use categories, namely settlements, water bodies, rice fields, gardens, and fields. The classification process is done by supervised or unsupervised classification. Each land category is assigned a different color symbol to facilitate analysis.
3. Spatial Analysis:
   a) Buffer Analysis: This technique is used to analyze the effect of proximity between land use change and certain elements. Buffers are used to determine the changes that occur around a particular area.
   b) Proximity Analysis: Used to look at the spatial relationship between land use and other factors, such as new infrastructure or development areas. Analysis can be done to see how close agricultural land use changes are to new residential areas.

Zonal Statistical Analysis: This technique is used to calculate the area of land use in each zone or area analyzed. With this technique, area comparisons between land categories (agricultural land area in 2012 and 2023) can be quantitatively calculated.

After the spatial data processing was completed, descriptive analysis was conducted to describe the pattern of land use change detected from the map. Quantitative analysis was also conducted to calculate the change in area of each land type and calculate the percentage of change. Comparison of land use area between two time periods was presented in tables and graphs. The results of the quantitative analysis of the land change map are compared with qualitative data from farmer interviews to gain a deeper understanding of the real impacts of land change in relation to livelihood vulnerability. To answer the research objectives on livelihood vulnerability, descriptive analysis was used through a descriptive statistical analysis approach. Descriptive analysis is an analysis to describe, explain and summarize the facts of field conditions.

Data obtained from the field through questionnaires are ordinal scale data with symbols 1, 2, 3, 4, and 5. The data is then transformed into quantitative data into an interval scale using the Method of Successive Interval (MSI). Method of Successive Interval (MSI) is the process of converting ordinal data into interval data so as to obtain the median value (me) and standard deviation (ζ) for each variable. MSI considers the distribution of data and response frequency in the transformation process, making it more accurate compared to simpler approaches like direct scoring. MSI is also

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http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

commonly used in social and behavioral research. Based on both, the class interval is determined as follows:

Very low : (≤median - ζ)
Low : (< median - ζ)
Medium : (median - ζ)
High : (median + ζ)
Very high : (>median + ζ)

As a provision in statistical analysis (parametric statistics), ordinal data transformation is carried out (the lowest score is 1 and the highest is 5 which is adjusted to the calculation of variable and sub-variable data) to interval data. In the indicator index transformation, each indicator has a different value with a range of 1.00 - 5.00. The smallest index value is 1.00 given for the lowest number of scores and an index value of 5.00 given for the highest number of scores for each indicator (Handayani et al., 2024).

Minimum response score per item = 1
Maximum score of responses per item = 5
Range (R) = (Maximum-Minimum)/5

By calculating this formula, the data distribution is converted to a ratio scale with scores ranging from 1.00 - 5.00. Then, for interpretation purposes, based on this data, the average of each sub variable and indicator was calculated. Furthermore, the scores are grouped using five levels, namely 1) Strongly Disagree (Very Low), 2) Disagree (Low), 3) Moderate (Medium), 4) Agree (High), and 5) Strongly Agree (Very High).

Furthermore, it will be further analyzed with interview data, to see how farmers in the region respond and adapt to these changes. With this approach, the research can provide a comprehensive picture of the linkages between land use change and farmers' livelihoods, and offer more appropriate recommendations regarding land management, farmers' livelihood strategies, and sustainable regional development.

RESULT AND DISCUSSION

Spatial Analysis

Land Cover of the Ciamis Regency Expansion Area

Spatial analysis of land cover in the expansion area involves the use of remote sensing and Geographic Information System (GIS) methods to identify land cover changes before and after expansion. The data taken is 2000 data which is defined as the condition area before the expansion and 2020 after the expansion. The method used includes classification of multitemporal satellite images with supervised classification or unsupervised classification techniques to distinguish various types of land cover with 14 classifications, namely Airport/ Port, Primary Dryland Forest, Secondary Dryland Forest, Secondary Mangrove Forest, Plantation Forest, Settlement, Plantation, Dryland Agriculture, Dryland Agriculture Mixed with Shrubs, Rice Fields, Shrubs, Ponds, Open Land, and Water Body.

The steps include collecting satellite images from relevant years, data preprocessing (radiometric and geometric correction), land cover classification, and validation of results with field data or reference maps. Analysis was then conducted to compare the spatial distribution and changes

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http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

in land cover area over time. The results of this analysis can show significant patterns of land use change, such as an increase in residential land or conversion of forest to agricultural land, resulting from the process of regional expansion.

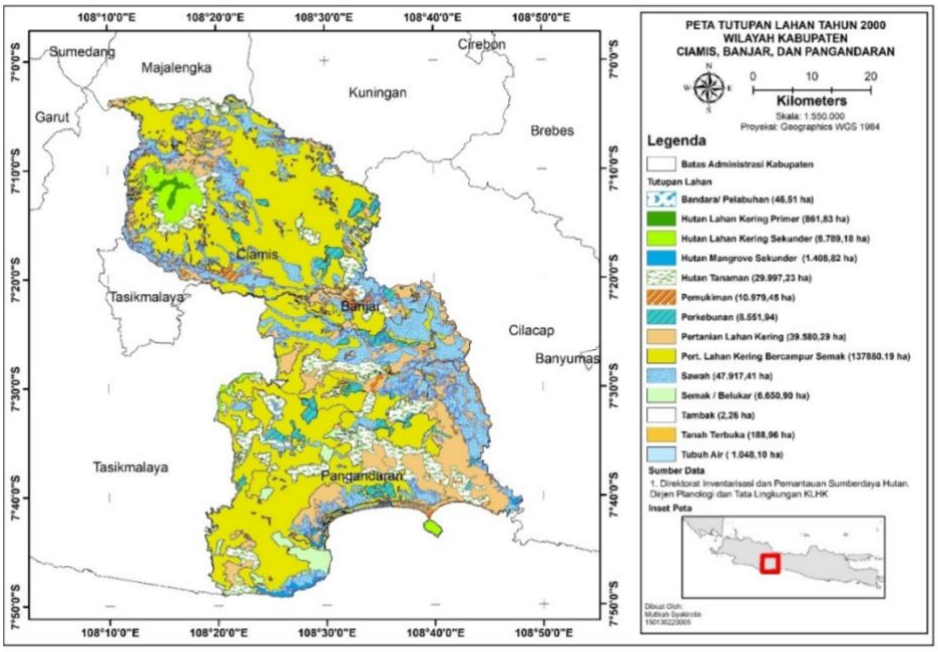

Figure 1. Land Cover Map 2000 of Ciamis, Banjar, and Pangandaran Districts
Source: Ministry of Environment 2024 (processed)

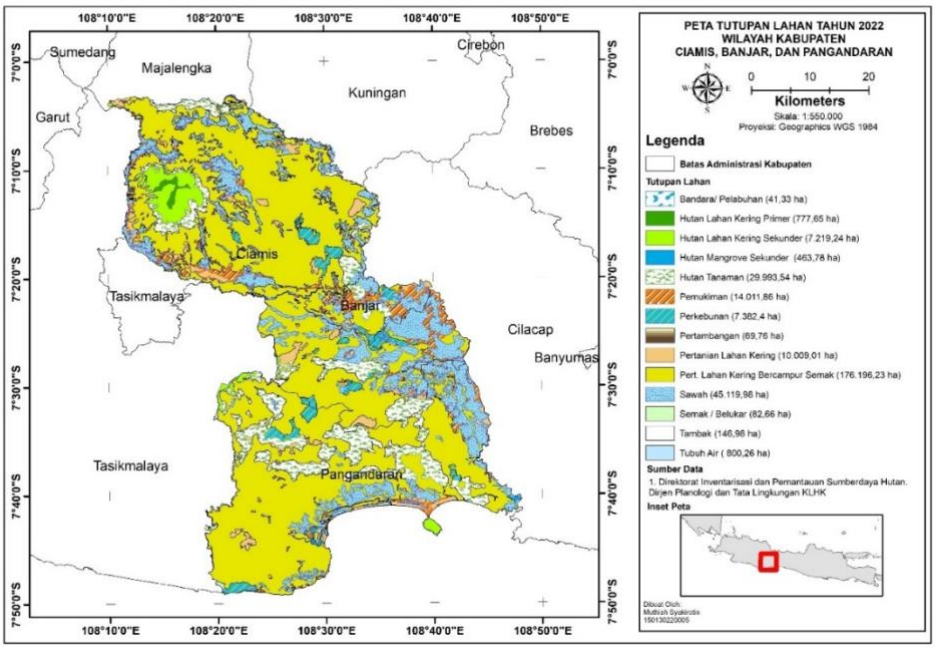

Figure 2. Land Cover Map 2022 of Ciamis, Banjar, and Pangandaran Districts
Source: Ministry of Environment 2024 (processed)

ISSN 2580-0566; E-ISSN 2621-9778
http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

In the results of making maps in 2000 and 2020 there are changes in land use. There is an increase in land use in Settlements, Mining, Dry Land Agriculture Mixed with Bushes, Shrubs, and Ponds. Meanwhile, land use that is mostly used for agricultural land has decreased. The largest decrease occurred in Dry Land Agriculture of approximately 29,000 ha and rice fields of approximately 2,078 ha. Most of the changes that occurred were in Pangandaran Regency. Pangandaran Regency was officially established on October 25, 2012 which was the result of expansion from Ciamis Regency, making it the youngest Regency in West Java. The capital is located in Parigi District which has an area of 1,011.04 km.

According to interviews with the local government, land use change occurs due to the drive for more intensive economic and infrastructure development. Regional expansion is usually accompanied by an increase in population and the need for housing and other supporting facilities, which leads to the conversion of agricultural land into settlements and ponds (Abebe et al., 2022; Acero, 2022). The use of natural resources through mining often requires massive land conversion from agrarian functions to more intensive and commercial uses. Mining activities in Pangandaran Regency occur in Kalipucang Sub-district, and only one has a license. There are several C excavation activities that do not have permits. Mining in Pangandaran Regency is currently not a priority for tax revenue because it is an activity that is associated with environmental damage.

Dryland agriculture mixed with shrubs and bushes is increasing due to the change from traditional farming practices to more intensive practices or land conversion due to lack of sustainable land management (Dai et al., 2013). Meanwhile, previously dominant agricultural lands experienced a significant decline as they were converted to meet new development needs (Coelho et al., 2021). The largest declines in dry and paddy fields indicate a shift from food production to more economically profitable but possibly less ecologically sustainable land uses, caused by policy changes or market pressures in the expansion region (Adhami et al., 2018). One of the shifts in the use of paddy fields in the Padaherang sub-district area is flood and drought areas. During floods, rice is not planted, but during droughts there are rice fields that are used for horticultural cultivation, including chilies and cucumbers.

Protection of Sustainable Food Agricultural Land (LP2B) has been regulated by Pangandaran Regency Regional Regulation No. 14/2018 to be protected and developed consistently to produce staple food for regional food independence, security, and sovereignty. LP2B supports the protection of food production through the designation of Sustainable Food Agricultural Land areas, restoration and rehabilitation of agricultural land, and the utilization of agricultural zoning maps. However, according to the results of interviews with Bappeda, the implementation of LP2B in Pangandaran Regency has not been implemented. If the LP2B program is not implemented, there is a high risk of conversion to non-agricultural land since Pangandaran Regency is known as a tourism area. LP2B has not been implemented in Pangandaran Regency.

Land Cover of Pangandaran Regency Expansion Area

Land use classification is a reference in the interpretation process when land use mapping data using remote sensing imagery. Classification is done with the aim of facilitating the identification or interpretation process. Grouping objects into classes based on similarities in their nature, or the relationship between these objects is called classification. The classification of land use in the spatial

ISSN 2580-0566; E-ISSN 2621-9778
http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

analysis of Mangunjaya Sub-district and Padaherang Sub-district is settlements, bodies, water, rice fields, gardens, fields.

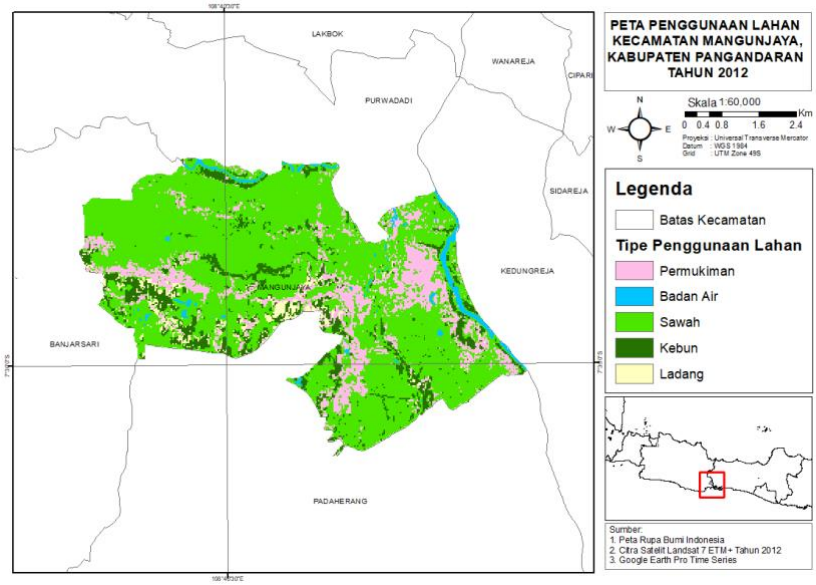

Figure 3. Land Cover Map 2012 Mangunjaya Sub-district, Pangandaran Regency
Source: Ministry of Environment 2024 (processed)

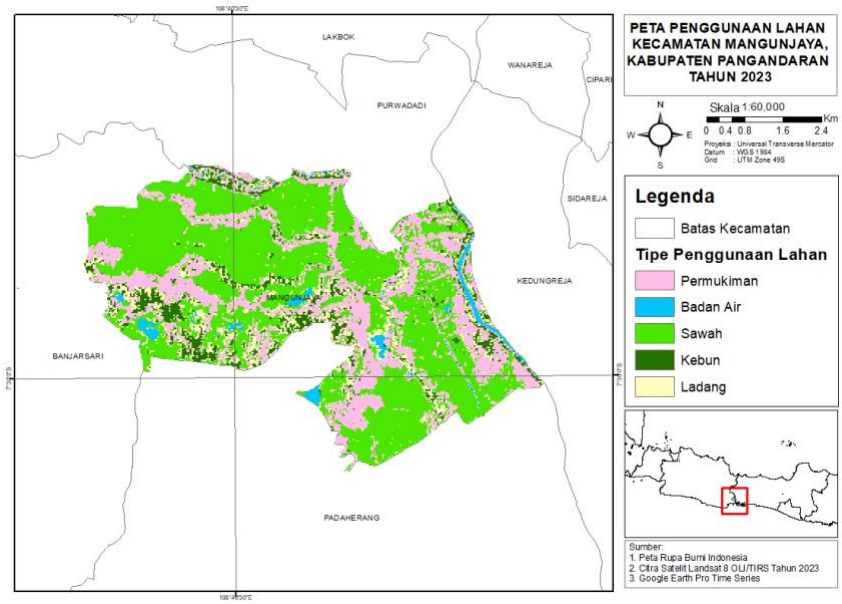

Figure 4. Land Cover Map 2023 Mangunjaya Sub-district, Pangandaran Regency
Source: Ministry of Environment 2024 (processed)

Based on the map of agricultural land use change in Mangunjaya Sub-district analyzed in five classifications. The area of water bodies decreased by 1.6% from 2012 to 2023. The change in land use for water bodies, indicates that this natural element tends to be poorly maintained, both for irrigation and local natural resources. It is also caused by the sedimentation process or the impact of land conversion around water bodies. Paddy fields decreased in size by 24% in 2023 compared to

ISSN 2580-0566; E-ISSN 2621-9778
http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

2012. This is an indication that some paddy fields have been converted into settlements or gardens due to regional expansion that requires land for economic activities or facility development. This decline in paddy fields could have implications for local agricultural production and potentially reduce food security, depending on the extent of the decline.

Table 1. Changes in Land Cover Area of Mangunjaya Sub-district, Pangandaran Regency in 2012 and 2023

No	Land Classification	Area (ha)		Percentage (%)
		2012	2023	
1	Water Body	72,72	71,55	-1,6
2	Rice Fields	2291,85	1837,62	-24
3	Settlement	518,49	912,24	43
4	Farm	348,57	241,11	-44
5	Field	89,28	258,39	65

Source: Ministry of Environment 2024 (processed)

In the area of settlement land, there was an increase of 43% in 2023 compared to 2012. This is indicative of regional development, where more land that may have previously been agricultural (paddy fields, fields, or gardens) turns into residential areas as the population increases due to expansion. The increase in residential land usually focuses around centers of socio-economic activity, such as sub-district centers or near main road access. The area of garden land also decreased by 44% in 2023. This change may be due to changes in farming patterns where farmers prefer to plant other than perennials or plantations which may be more profitable or more in line with economic conditions after the expansion of the region. The decline in farmland is also an effort to diversify the agrarian economy in the area. Unlike other agricultural land, field land experienced a 65% increase. Some arable land is preferred because it is more in demand. This increase is most likely related to increased urbanization and changing land needs that are more focused on commercial activities.

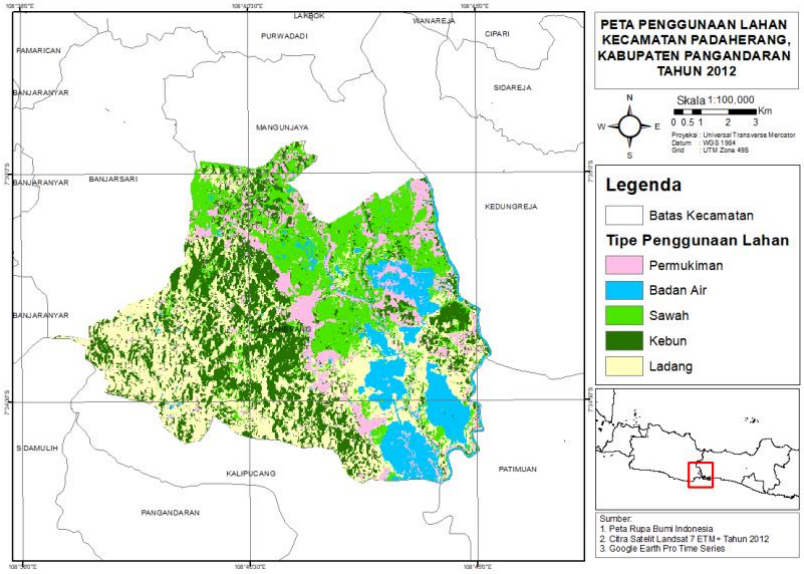

Figure 5. Land Cover Map 2012 Padaherang Sub-district, Pangandaran Regency
Source: Ministry of Environment 2024 (processed)

ISSN 2580-0566; E-ISSN 2621-9778
http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

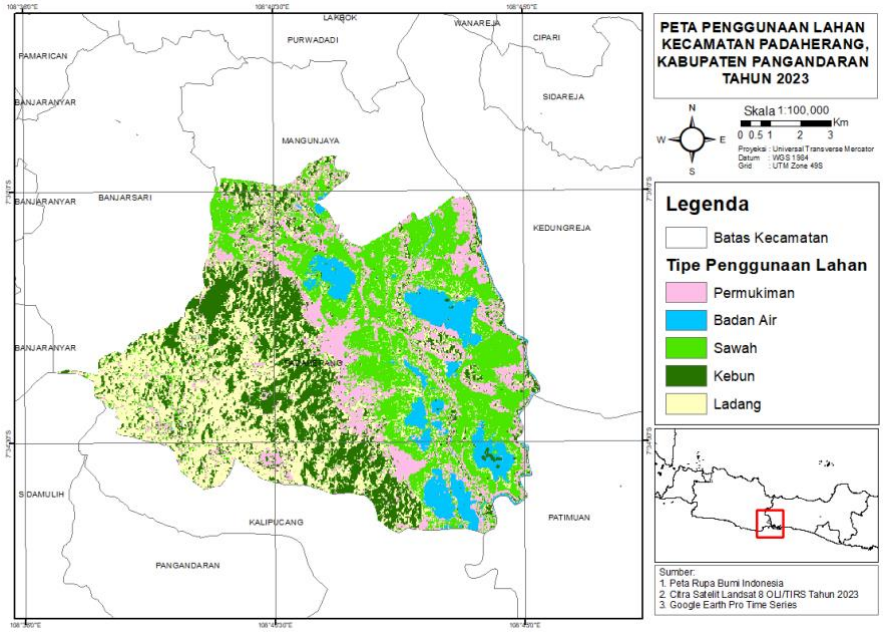

Figure 6. Land Cover Map 2023 Padaherang Sub-district, Pangandaran Regency
Source: Ministry of Environment 2024 (processed)

Table 2. Changes in Land Cover Area of Padaherang Sub-district, Pangandaran Regency in 2012 and 2023

No	Land Classification	Area (ha)		Percentage (%)
		2012	2023	
1	Water Body	1320,93	888,39	-48%
2	Rice Fields	1493,55	2099,16	28%
3	Settlement	2402	3148,38	23%
4	Farm	2774,61	2299,14	-20%
5	Field	3423,42	2979,54	-14%

Source: Ministry of Environment 2024 (processed)

Based on the map of agricultural land use change in Padaherang Sub-district, which is analyzed in five main classifications: settlements, water bodies, rice fields, gardens, and fields, it can be seen how the changes between 2012 (before expansion) and 2023 (after regional expansion). The 28% increase in settlement land indicates significant regional development. Regional expansion is followed by the development of infrastructure such as housing, public facilities, and centers of socio-economic activities. This increase in residential land may have occurred on land previously used for agriculture (gardens or fields) or other open land.

The 48% decrease in the area of water bodies was caused by a reduction in the capacity and quality of the surrounding environment. This decrease in the area of water bodies in the long term has significant negative impacts, including damage to ecosystems, increased risk of flooding, pollution of water sources, and changes in microclimate. Padaherang sub-district has always been a unique location that is heavily influenced by the seasons. During the rainy season, rice fields must be flooded until they become like swamps that cannot be planted.

In Padaherang Sub-district, there was an increase in the area of rice fields after the expansion of the region. This indicates an effort to expand rice production and local food security. Usually,

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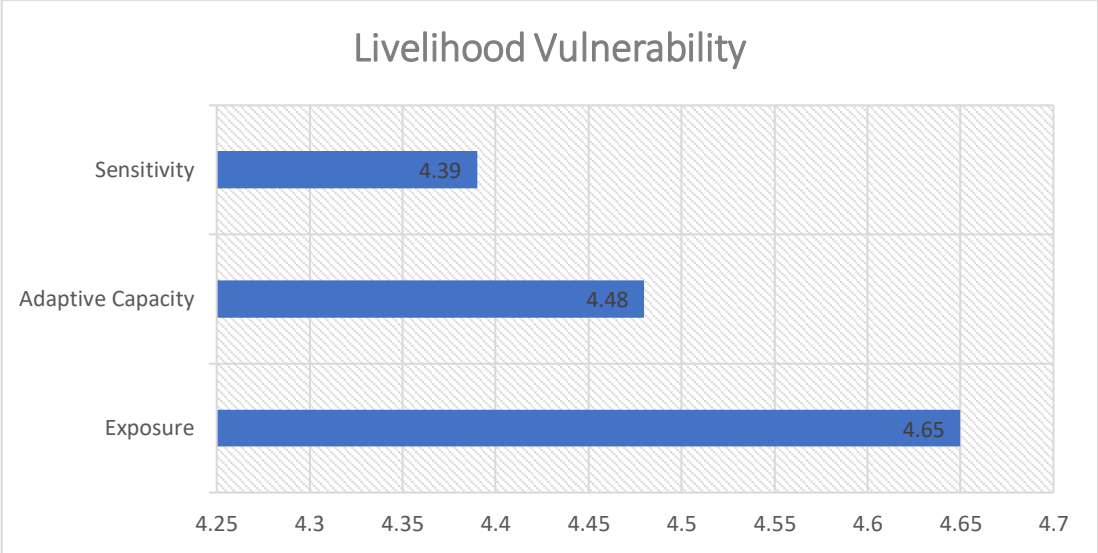
http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

expansion is associated with land conversion to residential or industrial areas. But in some cases, there is actually an increase in the area of paddy fields. This can be caused by several factors, such as local government policies that focus more on the agricultural sector, the potential of land that has not been optimally utilized, and the development of better agricultural infrastructure. Meanwhile, the decrease in the area of gardens and fields indicates the conversion of garden land into other uses, such as settlements or rice fields. This can be driven by the diversification of agricultural commodities due to climate change and changes in demand in the community.

Livelihood Vulnerability

Livelihood vulnerability analysis is an approach to understanding how individuals, households or communities face risks and pressures that may affect their ability to fulfill their basic needs. According to Ye et al. (2022), livelihood vulnerability includes two main dimensions: vulnerability to risk and resilience. According to the Intergovernmental Panel on Climate Change (IPCC), livelihood vulnerability is the degree to which systems, populations, or individuals are susceptible to the impacts of climate change, as well as their ability to anticipate, respond to, and recover from those impacts (Lee and Choi 2019). The IPCC emphasizes that livelihood vulnerability is strongly influenced by three main components: exposure, sensitivity, and adaptive capacity (Lee and Choi 2019).



Notes:
Very low (0-1.90), Low (1.91-2.80), Medium (2.81-3.70), High (3.71-4.61), Very high (4.62-5.51).

Figure 7. Level of livelihood vulnerability of farmers in Mangunjaya Sub-district and Padahereng Sub-district, Pangandaran Regency
Source: Primary data (processed)

Figure 7 shows that the highest level of vulnerability in farmers' livelihoods in Mangunjaya Sub-district and Padaherang Sub-district in Pangandaran Regency is in the exposure indicator. For the sensitivity indicator, the level is also high at 4.39. Sensitivity reflects how vulnerable a system is to the negative impacts of change, influenced by social, economic, and environmental factors (Azmeri and Isa 2018).

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http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

The sensitivity indicator includes water, food, and health, as these three factors determine the level of vulnerability of a system to environmental, social, and economic changes (Lyddon et al. 2020). Water is essential for basic needs, sanitation, and agricultural productivity, while food affects nutritional security, accessibility, and economic stability. Public health depends on medical services, sanitation, and nutrition, all of which can be exacerbated by water and food crises (Ahmadisharaf, Kalyanapu, and Chung 2017). These three aspects are interconnected, meaning that disruptions in one can increase the risk of social and economic instability. Changes in agricultural land use have a significant impact on the vulnerability of community livelihoods in terms of sensitivity (Abebe et al. 2022). The conversion of agricultural land into non-agricultural areas such as residential or industrial zones can lead to a decline in water quality and quantity, increase the risk of disasters such as floods and droughts, and reduce food production. This, in turn, affects public health, both directly and indirectly. A decrease in food production can lead to malnutrition, while poor water quality can trigger various diseases. Furthermore, ecosystem changes due to land-use conversion can also lead to the emergence of new diseases (Tufa and Megento 2022).

In Mangunjaya and Padaherang Sub-districts, the availability of clean water for sanitation is not a major issue; however, irrigation for agriculture, especially rice fields, is highly dependent on rainfall. Since Pangandaran Regency is located in the southernmost region, if Ciamis Regency and Tasikmalaya Regency, which are situated at higher elevations, experience heavy rainfall, rice fields in Pangandaran Regency are likely to be flooded. Most rice fields in Padaherang Sub-district are categorized as disaster-prone areas, increasing the risk of crop failure. Regarding the food indicator, these two Sub-districts are not significantly affected by changes, as they can still rely on their own agricultural production to meet their food needs. Before selling their rice, households set aside a portion for household consumption and reserves and have already agreed with middlemen on the amount of rice to be sold. For the health indicator, these two Sub-districts are not directly affected by land-use changes. Based on interviews and discussions with informants, household health and well-being are generally good.

The adaptive capacity indicator is also considered high, with a score of 4.48. Adaptive capacity measures a system's ability to adjust to changes, reduce negative impacts, and take advantage of new opportunities. Adaptive capacity consists of livelihood strategies, social networks, and socio-demographics (Abdollahzadeh et al. 2023). The adaptive capacity indicator includes livelihood strategies, social networks, and socio-demographics because these three factors determine the ability of individuals, households, or communities to cope with and adapt to external changes or pressures (Chaudhary and Mishra 2022). Livelihood strategies reflect income diversification and access to assets, enabling economic resilience during crises (Habib, et al., 2023). Social networks provide support, information, and resources that strengthen community resilience against shocks. Meanwhile, socio-demographics include factors such as education level, skills, and population structure, which influence individuals' and communities' ability to access opportunities and adapt to social, economic, or environmental changes. These three factors complement each other in enhancing the flexibility and resilience of a system in facing challenges.

Changes in agricultural land use can increase the adaptive capacity of communities in the long term, although they may present challenges initially. Land conversion often forces people to seek new livelihoods, develop new skills, and build different social networks (Nguyen 2021). In Mangunjaya and Padaherang Sub-districts, farmer households have diverse livelihoods, both in the agricultural

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http://ejournal2.undip.ac.id/index.php/agrisocionomics
Vol 9 (3): 668 - 682, November 2025

and non-agricultural sectors. Based on interviews with respondents, more than 50% of farmers have other income other than in the agricultural sector as indicated by the existence of additional sources of income outside of their agricultural activities. Agricultural livelihood diversification includes growing commodities such as bananas, albizia trees, and coconut trees on plantation land, as well as grapes, cucumbers, and eggplants. Non-agricultural livelihood diversification includes selling side dishes, working as drivers, tailoring, and running small shops. This illustrates the increasing economic pressure faced by households as they lose their primary sources of livelihood due to reduced access to productive land. This leads to income instability, rising living costs, and dependence on informal sectors or non-agricultural jobs, which are often more precarious. However, this adaptation process can strengthen the resilience of farming households in facing future changes. In the short term, land-use changes can weaken existing social networks and trigger social conflicts (Getz, 2008).

The conversion of agricultural land into industrial or residential areas leads to forced migration, the loss of communal spaces, and reduced social interactions, thereby weakening social networks and community solidarity. Social conflicts may arise due to competition for resources, unfair distribution of benefits, and differing interests between landowners, investors, and affected communities. These tensions can result in social unrest and distrust toward the government or authorities. In Padaherang Sub-district, a social conflict previously occurred due to competition over irrigation water during drought periods. Different groups competed for water access, leading to tensions and disputes.

The exposure indicator is considered very high, with a score of 4.65. Exposure measures how frequently and intensely a community experiences extreme events or slow-onset climate changes. It is assessed based on natural disasters, climate variability, and agricultural land conversion. Natural disasters such as floods, landslides, and droughts pose direct threats to livelihoods, infrastructure, and farming households, particularly those reliant on natural resources. Climate variability, including shifts in rainfall patterns and temperature changes, affects agricultural productivity, water availability, and increases the frequency of extreme weather events, further exacerbating ecological and economic instability. The climate conditions in Pangandaran from the end of the year to mid-year are fluctuating but predominantly characterized by high rainfall intensity. BPS reported that the total annual rainfall in Pangandaran Regency is 439.4 mm. About 50% of farmers in Padaherang District experienced crop failure during the first planting season due to heavy rains or runoff from the northern region. Meanwhile, agricultural land conversion into residential or industrial areas reduces the availability of productive land, disrupts local food systems, and increases dependency on imports or other sectors that are more vulnerable to external shocks. These three factors heighten the risks and uncertainties faced by communities in both the short and long term.

As previously mentioned, Padaherang Sub-district and parts of Mangunjaya Sub-district have disaster-prone agricultural areas, particularly flood- and drought-prone regions. When floods or droughts occur, farming households adjust their agricultural practices by switching to different crops. If flooding affects rice fields, farmers continue to replant multiple times, driven by their cultural heritage and strong belief that the land can still be cultivated despite recurring floods. This unique practice reflects local wisdom and traditional resilience. Additionally, farming households shift their focus to plantation crops and horticulture. In a typical year, they can plant two to three times, but in unfavorable climate conditions, they may only be able to plant once per year. As a result, farmers' incomes often fail to cover their production costs. Many farming households may not realize that

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Vol 9 (3): 668 - 682, November 2025

these challenges are long-term consequences of changes in spatial planning, regulatory shifts, and a shift in development priorities

CONCLUSION AND SUGGESTION

The largest reduction in land area occurred in Mangunjaya District, with a 44% decrease in plantation areas, while in Padaherang District, the largest reduction was in water bodies, with a 48% decrease. The highest vulnerability is found in the exposure indicator, with a value of 4.65. Although this value is not significantly different from other indicators, such as sensitivity at 4.39 and adaptive capacity at 4.48. Analysis of agricultural land use change shows a significant impact on the vulnerability of community livelihoods evidenced by disasters on agricultural land, a decrease in agricultural production and diversification of livelihoods other than the agricultural sector. The conversion of agricultural land into non-agricultural areas, whether for housing, industry or infrastructure, reduces the availability of productive land and threatens food security. This results in decreased food production, increased food prices, and reduced income for farmers. In addition, the loss of agricultural land also leads to environmental degradation, such as soil erosion, decreased water quality, and loss of biodiversity. To address this problem, a comprehensive effort involving the government, the community and the private sector is needed. Some steps that can be taken include: (1) Strict law enforcement against land use changes that are not in accordance with spatial plans; (2) Providing incentives to farmers to maintain agricultural land; (3) Development of environmentally friendly agricultural technology; (4) Diversification of community livelihoods around agricultural areas; and (5) Increasing public awareness of the importance of preserving agricultural land.

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