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MORALITY BEFORE KNOWLEDGE

Spatial and economic assessment of agropolitan zones with focus on rice and coconut: Implications for sustainable agricultural development

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ABSTRACT

Background: Banyumas Regency is one of the districts that has good potential in the agricultural sector. Banyumas Regency itself since 2011 has been developing the Agropolitan Area listed in the RTRW of Banyumas Regency. However, in reality this policy has not been able to work, both systemically and spatially. Therefore, this study tries to assess how the development of the Banyumas Regency Agropolitan Area will be in the future. **Methods:** By using two commodity bases namely rice and coconut to be developed, this study assesses which locations are suitable for farming areas, production centers, as well as markets and urban centers in the Agropolitan Area of Banyumas Regency. By analyzing the suitability of the village location, namely the suitability of land for farming areas and a composite index with a z score, it can be determined which areas are suitable for the development of the Banyumas Regency Agropolitan Area. By also looking at the characteristics and accessibility, it is also assessed how the connectivity between functional areas in the Agropolitan Area of Banyumas Regency is assessed. **Findings:** The findings indicate that the entire Agropolitan Area in Banyumas is suitable for rice and coconut cultivation, with 11 villages identified as optimal locations for production centers and four villages deemed highly suitable for market and urban areas. **Conclusion:** This study conclude that rice and coconut have good land suitability in the Agropolitan Area of Banyumas Regency, with six villages unsuitable for farming and four villages unsuitable for coconut cultivation. **Novelty/Originality of this article:** This research contributes novel insights into spatial planning and economic development by integrating commodity-based land suitability with accessibility analysis, providing a strategic framework for sustainable agricultural development in Banyumas Regency.

KEYWORDS: agropolitan area; location suitability; rice and coconut.

1. Introduction

Banyumas Regency is one of the regencies in Central Java Province that has developed an agropolitan area as a strategic economic growth zone within its territory. Banyumas Regency itself has an urban area in Purwokerto, where urbanization has been growing rapidly. Therefore, planning is needed for regional expansion that not only improves services to the community but also matches the potential of the region (Sutikno et al., 2024). This local-scale development involves key elements related to natural resources, human capital, and the role of institutional actors and networks (Cavallo & Olivieri, 2022). Therefore to ensure equitable development, the concept of Agropolitan Area development was chosen to prevent urban bias in Banyumas Regency. This is stipulated in Banyumas Regency Regional Regulation No. 10 of 2011 concerning the Banyumas Regency Spatial Plan, which designates four districts—Ajibarang District, Cilongok District, Wangon District,

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and Jatilawang District—located outside the urban area of Purwokerto as the designated agropolitan areas. This strategic area refers to a region whose spatial planning is prioritized due to its significant influence at the regency level in terms of economic, social, cultural, and/or environmental aspects.

Agropolitan area planning, which is closely related to agriculture, has been widely developed in developing countries. This regional development strategy is considered appropriate for regions that are still predominantly rural. However, with the passage of time, research on rural area development has been increasingly marginalized (He & Zhang, 2022). On the other hand, in Indonesia, development planning is often centralized, further widening the gap between urban and rural areas. Therefore, it is hoped that the concept of agropolitan area development can continue to be developed in order to overcome various disparities that may arise. Good agricultural planning is also very important so that it can not only meet urban food needs, but also reduce the adverse effects of climate change and excessive use of energy and resources (Pura et al., 2023).

In this case, the selection of the agropolitan concept is feasible because Banyumas Regency is considered to have significant agricultural potential, making it suitable for agropolitan development. According to a study by Pranoto (2008), Banyumas Regency holds great potential to become a self-sufficient region in agricultural food production. Therefore, the development of an Agropolitan Area is highly plausible as it can promote balanced development and economic activities, preventing excessive concentration in the urban area of Purwokerto. Agricultural activities have long been a specialization of Indonesian society; hence, a specific formula is required when developing such activities in Banyumas Regency, which could also be implemented in other regions. This means that the establishment of Banyumas Regency's agropolitan area must be supported by a strong agricultural culture and a well-structured system to ensure that it functions effectively as a strategic economic zone in Banyumas Regency.

Considering its agricultural culture, the selection of an agropolitan area aligns with the role of agriculture in the overall economy of Banyumas Regency. Based on data from the Banyumas Regency Central Statistics Agency/*Badan Pusat Statistik* (BPS), the agriculture, forestry, and fisheries sector has consistently shown an increasing Gross Regional Domestic Product (GRDP) value each year, even in 2020 when other sectors experienced a decline. The GRDP of the agriculture, forestry, and fisheries sector reached IDR 6,681,389,740,000 in 2020, an increase from IDR 6,470,099,730,000 in 2019. Additionally, the agricultural sector contributes significantly to employment in Banyumas Regency, absorbing approximately 169,695 workers or around 21.38% of the total workforce in the region. This indicates that activities in the agriculture, forestry, and fisheries sector play a crucial role in the economic activities of Banyumas Regency.

In terms of physical conditions, Banyumas Regency also holds great potential in the agricultural sector. As of 2020, approximately 24.05% of the total land area consists of rice fields, while other agricultural land (non-rice fields) accounts for 51.2% of the total area. The regency is situated on the slopes of Mount Slamet, the highest mountain in Central Java, which provides highly fertile soil. In addition to soil fertility, Banyumas Regency has an adequate water supply, sourced from rainfall and numerous rivers, with the Serayu Watershed (DAS Serayu) serving as the primary watercourse.

This study selects two among several commodities developed under Banyumas Regency Regional Regulation No. 10 of 2011, namely rice and coconut. According to the regulation, rice is expected to serve as the primary commodity in Cilongok District and Jatilawang District. Rice, which is processed into the staple food of Banyumas residents and other regions in Central Java, Java Island, and even Indonesia as a whole, holds great potential. This significant potential makes rice an appropriate base commodity for the agropolitan area in Banyumas Regency, with an annual rice surplus of approximately 40,000–60,000 tons. The second commodity, coconut, is the primary raw material for coconut sugar (brown sugar/palm sugar), a signature product of Banyumas Regency. Cilongok District, Ajibarang District, and Wangon District are designated as the main production areas for this commodity. Coconut sugar can be further processed into high-

value crystal sugar, which has even reached export markets with a value of up to 36.7 million US dollars. If properly managed and supported by well-planned regional development, these two commodities can serve as significant economic drivers for Banyumas Regency. Without disregarding the potential of other commodities, the development of the agropolitan area in Banyumas, with rice and coconut as its main commodities, will yield optimal results when accompanied by precise analysis.

The figures mentioned above serve as important references for the Banyumas Regency Government in optimizing the designation of the agropolitan area. It is believed that the establishment of this agropolitan area will enhance agricultural production, which serves as one of the key economic drivers of Banyumas Regency. Agropolitan itself is defined as an agricultural city that grows and develops through the functioning of agribusiness systems and enterprises, facilitating and promoting agricultural development in its surrounding areas (Manik et al., 2013). The Agropolitan concept aims to alleviate extreme poverty and accelerate development in rural areas (Ismail et al., 2025). In addition to optimizing regional development and economic growth in rural areas, agropolitan development can also prevent land-use conversion, which continues to threaten agricultural land. A good regional development policy is one that considers various environmental impacts so that it can be equitable and sustainable (Muhammad et al., 2025). The agropolitan area, structurally divided into three orders, ensures the functionality of each region within the system. Each order has its respective role as an integrated system within the agropolitan area.

Before further exploring the agropolitan area in Banyumas Regency, a comprehensive study is needed to assess its development. This is related to the findings from interviews with policymakers regarding the Banyumas Regency Agropolitan Area, which revealed that, as of 2021, there had been no concrete implementation of the policy. According to Mrs. A, Head of the Evaluation and Development Subdivision at the Regional Research, Development, and Innovation Agency of Banyumas Regency, the lack of a thorough and in-depth study on the designation of the agropolitan area has resulted in significant discrepancies between the planned policies and actual conditions in the field. She stated:

> *"This area was supposed to develop a certain commodity, but it was implemented without proper assessment, which is why revisions are necessary. The changes are based on field observations, or perhaps the initial conditions no longer match current developments. Sometimes, what was considered suitable during earlier studies may not align with current societal shifts"* (Mrs. A, Head of the Evaluation and Development Subdivision at the Regional Research, Development, and Innovation Agency of Banyumas Regency).

A similar view was expressed by Mr. Abdullah Tsani, Head of the Planning Division at Dinperkim Banyumas Regency, who emphasized that the high value and quantity of commodities require comprehensive data collection to ensure a well-structured and systematically planned agropolitan area. He highlighted that the Banyumas Regency Agropolitan Area should be developed by considering local agricultural culture, existing home industries, and utilizing data as the foundation for future agropolitan development. These findings indicate that, overall, the Agropolitan Area policy in Banyumas Regency has not been effectively implemented.

The failure of the Banyumas Regency Agropolitan Area policy is closely related to broader development issues. In Indonesia, development problems often arise due to the lack of comprehensive studies and evaluations in the planning phase, which affects the implementation stage. Specifically for agropolitan development, planning is frequently misunderstood, leading to solutions that, rather than bridging disparities, further reinforce urban bias between metropolitan and agropolitan areas. Therefore, it is crucial to analyze the potential for agropolitan development in Banyumas Regency to ensure that it maximizes regional growth rather than exacerbating inequalities. Infrastructure improvements, such as road networks and systems, economic activities aligned with local potential, and policies governing the agricultural trade system, are essential for the successful development of the Agropolitan Area in Banyumas Regency (Sulistiono, 2008). Thus, this study seeks to explore

the development of the Banyumas Regency Agropolitan Area, focusing on rice and coconut as its primary commodities. The research aims to spatially determine the development potential of these commodities and relate them to local government policies regarding infrastructure planning and the agropolitan system in Banyumas Regency, while also considering the existing conditions in the region.

This study, two main research questions are formulated to analyze the development of the Agropolitan Area in Banyumas Regency, First, where are the suitable locations for farming areas, urban centers, markets, and production centers within the Agropolitan Area of Banyumas Regency? and seceond, how does the existing system operate within the Agropolitan Area of Banyumas Regency?

1.1 Potential and regional characteristics in development planning

Regional development aims to create a better quality of life for humans and their environment, with spatial planning serving as a fundamental process in determining settlement patterns and land use for the future (Haughton & Counsell, 2004). To achieve this goal, an analysis of regional potential is required, encompassing both physical and social characteristics. It can be said that unique differences between regions are an important formulation in regional development policy (Zhang et al., 2025). Additionally, regional potential signifies the possibility of development; however, without proper analysis, development efforts may not be maximized. Therefore, each geographical area, with its distinct characteristics, requires a development concept that aligns with its geographical conditions, socioeconomic factors, and supporting infrastructure.

Furthermore, from a geographical perspective, physical characteristics such as elevation and slope play a crucial role in development planning, necessitating appropriate adjustments to ensure feasible development. For instance, the mountainous regions of Papua, which are not ideal for conventional development, have instead experienced rapid growth in the mining sector due to their vast resource potential. Beyond physical characteristics, socioeconomic factors must also be considered as the readiness and capabilities of the community will determine the success of regional development program (Iskandar & Sarastika, 2023). This specialization and comparative advantages of a community region also important to determine the key economic sectors that define its potential. For example, in the development of agropolitan areas, regions must possess physical characteristics that support agriculture, along with a population skilled in farming. Therefore, accurately understanding and assessing regional potential is essential in designing optimal development strategies. In developing agropolitan areas, it is also hoped that there will be added value from agriculture, so the initial challenge is to transform the culture of the agricultural community into an agro-industrial culture (Sitorus et al., 2015).

In the process of achieving regional development goals, several factors must be considered, one of which is the development basis to be implemented. Regional development typically focuses on potential growth directions that align with its objectives, which are closely related to regional potential. The differences in potential are key factors that prevent the simultaneous and equally strong development of all sectors. Therefore, a well-conducted regional potential analysis can serve as a reference for prioritizing the development of the most promising sectors. As an agrarian country, various regions in Indonesia have high potential in the agricultural sector, such as rice fields for paddy cultivation and coconut plantations that thrive on a regional scale. As such an important commodity, accurate identification of market demand is needed so that production can provide economic benefits for the region (Bala et al., 2017). The development of this sector can support economic activities, making regional development more targeted. So that better regional development can determine suitable locations that benefit the economy, society, and the environment (Yanti et al., 2023).

In line with this, regional development experts continue to study ways to enhance regional potential, one of which is through the agropolitan concept, which emerged in the 1970s. Friedman & Douglas (1978) introduced the district-based agropolitan development

concept to accelerate rural growth by improving the competitiveness of agricultural products. Agropolitan-based regional development can be a solution to the imbalance between rural and urban areas, where rural areas come to play an economic role equal to that of urban areas (Siradjuddin et al., 2023). With technological advancements, this concept is no longer limited to rural areas but extends to other regions with agribusiness systems that support agriculture-based economic growth. According to the Department of Agriculture, an agropolitan area is a city that grows and develops due to an agribusiness system that drives and attracts agricultural activities in its surrounding regions. Agropolitan development is not only limited to agricultural production but can also expand into industrial sectors and agricultural-based tourism. However, its implementation faces several challenges, such as inefficiencies in agricultural activity chains, limited technology transfer to agricultural areas, and weak agribusiness systems, including institutional frameworks, marketing networks, and supporting infrastructure.

In the agropolitan concept, agribusiness is the main focus for developing leading commodities with the aim of creating local economic growth (Diani et al., 2023). A well-structured understanding of agribusiness ensures that agricultural activities align with the expected economic growth. Agribusiness itself is a series of interconnected agriculture-based activities, ranging from production, processing, and distribution to marketing and various supporting activities (Pranoto, 2008). As a system, agribusiness that successfully absorbs labor across different activity units will enhance economic growth and contribute to food security. An effective agribusiness system must integrate all stages of activity, from upstream to marketing, beginning with pre-planting support, cultivation, post-harvest processing, and marketing networks. Several factors, such as seed storage facilities, agricultural equipment, post-harvest processing centers, and sales markets, must be well-integrated. Additionally, the success of an agribusiness system is highly dependent on the quality of human resources and financial capital, as pricing mechanisms, added value, and market-driven marketing strategies heavily rely on these two aspects.

The development of multiple commodities without any particular leading commodity will result in suboptimal resource allocation and economic conditions (Mufarrij et al., 2025). It is necessary to determine priority commodities in order to reduce competition, which actually hinders optimal production. The identification and determination of these commodities is very important because each region has different physical characteristics and human resources (Purba eta al., 2023). The value of this commodity is not only good in terms of production quantity but also has a price that can drive economic growth. The production value of commodities calculated based on production volume can be used as a basis for determining leading commodities (Oksatriandhi & Santoso, 2014). Therefore, based on that assessment, rice and coconut were chosen as leading commodities in the agropolitan area of Banyumas Regency.

Rice is one of the most commonly cultivated crops in Indonesia, serving as the primary food source for the population. After harvesting, rice in the form of paddy is milled into rice grains, which are then cooked into rice as a staple food. The term "agrarian country" is closely associated with the series of agricultural activities related to rice farming. Indonesia possesses an abundant capacity and potential for rice cultivation, as evidenced by the increase in rice production from 20.2 million tons in 1971 to over 54 million tons in 2006 (Sembiring, 2008). Unfortunately, rice cultivation faces several significant challenges, including low farmer welfare, the conversion of rice fields for non-agricultural purposes, the establishment of new rice fields in unsuitable locations, an ineffective marketing system, and rice import policies. As the primary staple food, rice is of great importance to the Indonesian population, making the effectiveness of its production a critical concern. Additionally, rice has a relatively long supply chain, from harvesting and milling to distribution through wholesalers and retailers before reaching consumers. By-products from rice milling, such as rice bran and husks, can also be utilized, while the financial flow within this supply chain moves from consumers back to farmers.

Unlike rice, coconut is a plantation crop that is widely cultivated across Indonesia. As a plantation commodity, coconuts is a versatile plant and has high economic value with every

parts parts can be utilized (Lestari et al., 2021). Coconuts require specific growing conditions and specialized care, particularly in land preparation and seedling development, with fertilization ideally conducted twice a year. Each coconut tree can produce between 90 and 140 coconuts annually, and its utilization extends beyond the fruit to include the leaves and trunk. One of its derivative products is coconut sugar, which is extracted from coconut sap. Although coconut sugar is primarily produced by home industries and rural communities, it holds significant economic potential. According to the Communication and Information Office of Banyumas Regency, well-processed and hygienically produced coconut sugar is favored by European consumers due to its perceived health benefits and low-calorie content. Furthermore, the supply chain management from coconut farmers to the production of coconut sugar—whether for export or domestic markets—constitutes a system that can serve as a foundation for regional development based on coconut commodities. The distribution channels in coconut sugar marketing greatly influence prices and can drive increased consumer demand (Suyono et al., 2021).

In the process of regional development planning, a regulatory framework is required to outline the direction of development. This regulation can be established as a government policy in development planning, serving as the implementation of development planning management and providing a legal framework for the government and relevant stakeholders. Effective regional planning management is essential, as a nation's ability to regulate and manage its territory is the causa prima of its own progress (Nugraha, 2012). Therefore, this policy holds a central role and must be safeguarded from the influence of personal interests.

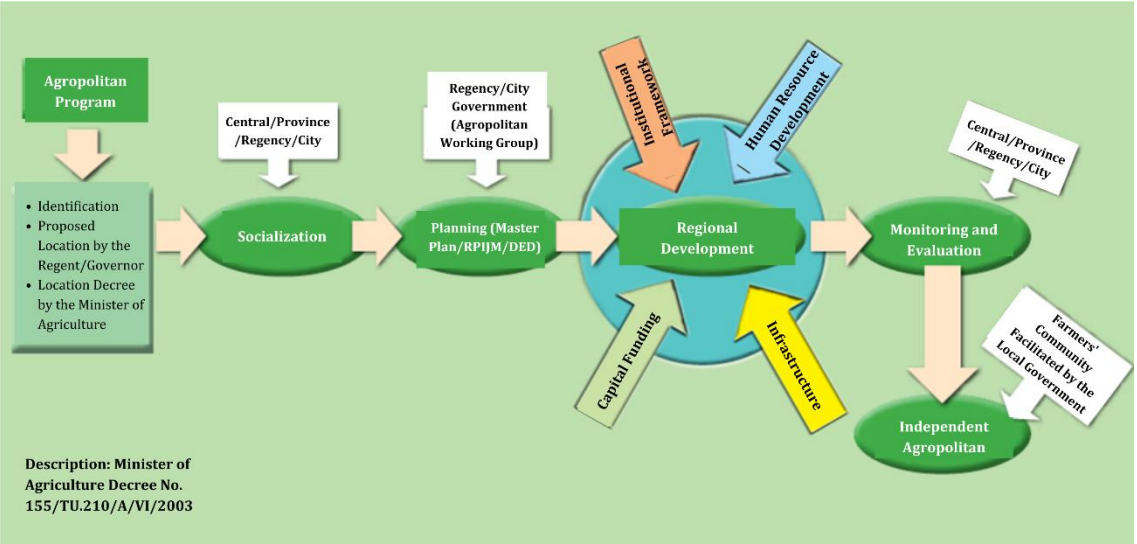

Fig. 1. Agropolitan area development scheme
(Idrus, 2012)

Within Indonesia's bureaucratic system, decentralization and regional autonomy enable local governments to determine their own regional development policies. These policies are outlined in the Spatial Planning Regulation/*Rencana Tata Ruang Wilayah* (RTRW), which is formulated based on regional potential and the desired direction of development. Banyumas Regency has designated an agropolitan area under Banyumas Regency Regulation No. 10 of 2011, identifying four districts as strategic areas for economic growth. Additionally, the Banyumas Regency Government has accommodated infrastructure development through the Regional Medium-Term Development Plan 2018–2023. These policies are not merely written regulations but also require supervision and evaluation, especially considering that field conditions may change at any time, such as in response to natural disasters, making adjustments to the RTRW policy essential.

1.2 Regional development strategy

To achieve a goal, the right strategy is required to ensure its successful realization. Likewise, regional development necessitates specific strategies to achieve its objectives. Strategies in regional development planning can be formulated through comprehensive studies, where policymakers must openly accept input for the collective interest as part of an effort to develop regions based on actual field conditions. Regional planning is expected to serve as a framework for development, which can be established through public hearings and public examinations (Haughton & Counsell, 2004). It can be said that the level of local community participation will determine the success of rural area development (Hanafiah & Nuraini, 2025). The better the level of local community involvement, the more optimal the planned regional development strategy will be.

Both local communities and local governments must pay attention to working together to maximize the potential of available resources (Zulhafandi et al., 2024). Additionally, as a multidimensional concept, the geographical approach—through spatial-temporal contexts and human activity relationships—plays a crucial role in regional development (Nijkamp & Abreu, 2009). Geography, with its holistic analytical capabilities, enables a more comprehensive regional development approach, considering not only sectoral perspectives but also various factors such as economics, social welfare, and transportation. This approach also enables regional development to be planned optimally and sustainably based on such comprehensive analysis (Shawon et al., 2025).

In regionally oriented economic development, this can be seen from both the demand and supply sides. In demand-driven development, focuses on increasing the production of goods and services and in supply-driven development, aims to attract investment, both in the form of capital and technology. However, the essence of this regional development strategy is to boost economic growth and reduce disparities with other regions (Panutan & Rustam, 2024). These strategies must align with an analysis of regional potential to ensure the optimal development of key sectors. However, regional development strategies are dynamic, requiring new approaches to adapt to changing times (Wannop & Cherry, 1994). Regional potential assessments may also evolve over time, necessitating continuous evaluation of development plans to ensure their relevance in practical implementation. Therefore, an appropriate regional development strategy must be tailored to the distinct characteristics of each region.

In the development of an agropolitan area, strong integration and support among various elements—such as natural resources, human resources, facilities and technology, and existing systems—are essential. This integration enables the optimal development of agropolitan areas; without it, the development model would merely result in conventional agricultural productivity without connectivity between core agricultural activities and supporting agribusiness sectors. This challenge arises from the deeply rooted agricultural culture in Indonesian society, meaning that without systemic changes, biases in agropolitan area development may occur. One of the key elements that must be developed is farming enterprises or agricultural science, which serve as the backbone of agropolitan areas. This multidisciplinary approach encompasses crop and livestock production, agricultural technology, agricultural economics, and policies and innovations related to food systems and food security, ensuring sustainability and resilience to climate change and other global challenges (Santeramo, 2024). In this study, farming areas are defined as regions designated for intensive agricultural activities, where development efforts focus on optimizing the use of available agricultural land.

However, farming enterprises require proper mastery of agricultural knowledge to maximize productivity. The total factor productivity of agricultural commodities is mainly influenced by several factors including agriculture capital, technology, labor ability, land area, research and development, government policy, natural resources, market, and other social factor (Dhehibi et al., 2014). In agriculture, land suitability evaluation analysis is crucial for land effectiveness and sustainability (Xue et al., 2023). This analysis helps identify potential farming areas, ensuring that development and supporting infrastructure

construction proceed effectively. Moreover, farming areas must also be sustainable, meaning they should not only exhibit high land suitability but also consider the long-term availability of agricultural land. As regions oriented toward agricultural productivity, farmland should be more dominant than built-up areas and residential zones.

A production center is developed with the aim of optimizing and increasing the productivity of the products being produced. In the context of this study, a production center refers to a centralized location for processing agricultural products rather than the agricultural sites themselves. Within an agropolitan area, production centers are closely linked to the existing agribusiness system. The presence of production centers ensures that agricultural commodities are well-absorbed into the market while also increasing their value. Furthermore, production centers can be understood as industrial clusters. This cluster is an agglomeration (concentration of activity) for producing products in line with the Agropolitan development plan (Bahasoan et al., 2023).

In production centers, it is very important to have good infrastructure and facilities that can connect economic activities within and outside the agropolitan area (Febriansyah & Zulfikar, 2024). This is expected to become an economic driver, a generator of employment, and a provider of services for the community.Therefore, the development of regions based on agricultural commodities requires precise location analysis to ensure that production centers operate optimally. A strategically chosen location can reduce production costs and enhance productivity, as explained in Weber's location triangle theory, which states that the best industrial location is one that minimizes costs. The selection of a location depends on the availability of raw materials and market access, making the analysis of various operational variables essential for production centers. Through the centralization or clustering of production centers, the synergy between upstream and downstream activities can be better integrated, leading to a more efficient agribusiness system.

In regional development with a specific planning model, construction progresses dynamically in response to regional needs and growth. The development model of an agropolitan area, which refers to a city that emerges from agricultural activities, requires a central hub that serves as the primary driver of development. This agropolitan center is an urban area that positively influences the growth of the entire agropolitan region. Unlike conventional urban areas, the city within an agropolitan system also functions as a marketing hub for agricultural commodities, ensuring that harvests are efficiently distributed to surrounding areas. This market must have good access so that economic activities in this agropolitan area can be sustainable (Qomariyah & Hayati, 2024).

However, determining the location of markets and urban centers within an agropolitan area requires in-depth analysis to prevent urban bias. Accurate market location assessments will play an optimal role in boosting economic activity (Savitri et al., 2019). According to World Bank data, the Gross Regional Domestic Product (GRDP) of urban areas in Indonesia is projected to reach 86% by 2030, indicating excessive urban dominance that may marginalize rural areas. Java has grown into a mega-urban area with 70% of its population living in urban area (Pravitasari et al., 2023). Unplanned urbanization can lead to cities expanding without adequate supporting infrastructure, ultimately resulting in the emergence of slum areas. Therefore, in the context of agropolitan areas, the designation of market locations and urban centers must consider various criteria and variables to ensure that the agropolitan center is developed according to its intended purpose. With proper analysis, the agropolitan center can function optimally—not only as an urban hub but also as a catalyst for the overall growth and development of the agropolitan region.

1.3 Previous studies

In Sulistiono's (2008) study, Regional Development Model with an Agropolitan Approach: A Case Study of Banyumas Regency, the contribution of agropolitan potential to the economic development system of Banyumas Regency is elaborated. This research was conducted in response to the increasing urban bias and backwash effect, which have gradually left rural areas behind. Agropolitan areas are considered a balanced regional

development solution that can enhance local economic growth. The implementation of agropolitan regional development models in other areas of Java has also served as an impetus for Banyumas Regency to develop a similar area to stimulate its economic development performance. This study utilized 120 variables derived from secondary data to analyze the performance of the agropolitan system and regional economic performance, as well as the relationship between the two. However, further research involving primary data collection is required to better understand real conditions and direct implementation in the field. Additionally, the study produced three typologies of relationships between the agropolitan system and the regional economic development performance of Banyumas Regency. It also proposed five development models to enhance the effectiveness of the agropolitan system, maximizing its contribution to the local economy.

Meanwhile, Manik et al. (2013) conducted a study titled Assessment of Agropolitan Area Development in Seroja, Lumajang Regency, which examined the development of agropolitan areas as strategic economic zones. This study identified eight villages as strategic agropolitan areas based on the 2008–2028 Spatial Planning (RTRW) of Lumajang Regency. The researchers applied descriptive analysis to various statistical and institutional data, along with LQ (Location Quotient), growth share analysis, and SWOT analysis, to evaluate and assess the development of the area. The findings indicate that government policies outlined in the RTRW need to be reviewed in determining key commodities. Based on LQ and growth share analysis, bananas, durians, and breadfruits were identified as the most promising commodities for further development. Furthermore, this study examined the upstream-to-downstream linkages within the agropolitan system, as well as infrastructure conditions and supporting facilities. The researchers concluded that improved strategies and directives are needed for the development of the area. They also recommended further studies on additional potential commodities beyond the identified key products, including more specific analyses of agribusiness sub-systems and spatial directives to intensify activities within the agropolitan area.

2. Methods

2.1 Research framework and location

Banyumas Regency is one of the regencies in Central Java Province with significant potential in agricultural activities. Therefore, based on Regional Regulation No. 10 of 2011 concerning the Spatial Planning (RTRW), four districts—Ajibarang, Cilongok, Jatilawang, and Wangon—were designated as the Agropolitan Area of Banyumas Regency. Among the various commodities planned for development, this study focuses on rice and coconut as the primary commodity bases. Rice was selected because it is a staple food crop that plays a crucial role in food security, while coconut was chosen due to its high economic value derived from processed products, which contribute significantly to the economy of Banyumas Regency.

As an agricultural-based regional development concept, proper spatial planning is essential to support activities within the agropolitan area according to their respective functions. To determine the most suitable areas for rice and coconut cultivation, a land suitability analysis was conducted. This suitability analysis was performed through an overlay of variables representing the growth requirements of each crop. The growth requirements include rainfall, temperature, slope, and elevation. However, the intensification of both rice and coconut farming areas faces constraints due to the presence of existing built-up land. Through this overlay analysis, it is possible to identify which areas are designated for rice farming intensification and which areas are suitable for coconut cultivation intensification.

By analyzing the regional infrastructure capacity within the Agropolitan Area of Banyumas Regency, the location of the agropolitan center—comprising the marketplace and urban core—can be determined. The selection of this location is based on a composite index analysis using the Z-score method. The composite index consists of four dimensions

divided into eight indicators. Through this selection process, the villages with urban characteristics and supporting facilities can be identified based on the established indicators.

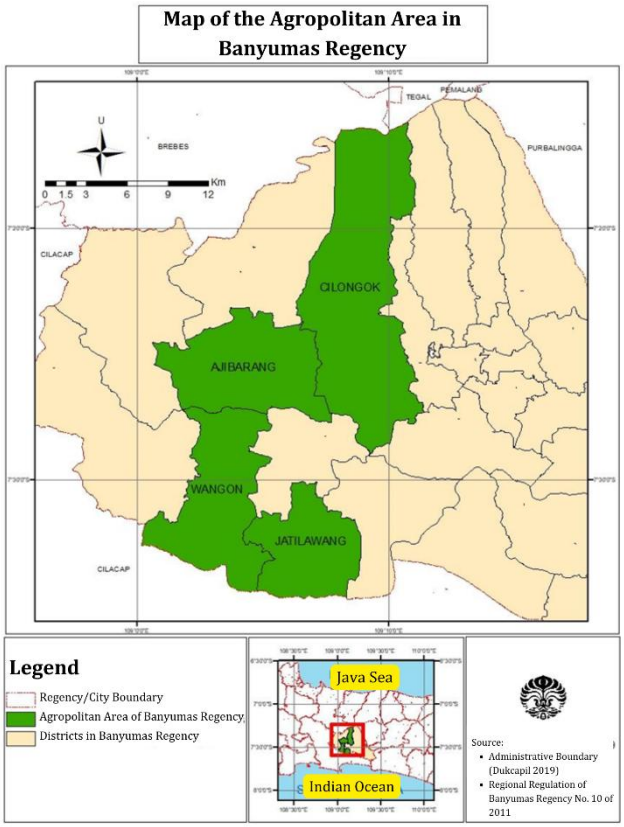

Fig. 2. Map of the research area, agropolitan area, Banyumas Regency

Furthermore, an essential spatial directive in the Agropolitan Area of Banyumas Regency is the establishment of production centers. These centers serve as processing locations where raw materials are transformed into higher-value commodities. The determination of production center locations is based on five indicators, which form a composite index for selecting the sites of coconut sugar processing industries and rice production centers within the agropolitan area. After identifying the most suitable locations for farming areas, production centers, marketplaces, and urban centers, the characteristics of each functional region can be analyzed. Using both secondary data and primary data obtained through interviews and direct observations, the spatial characteristics and marketing flows can be examined, which in turn will become crucial factors in shaping the overall system within the Agropolitan Area of Banyumas Regency.

This study was conducted in the Agropolitan Area of Banyumas Regency, which encompasses four districts: Cilongok, Ajibarang, Wangon, and Jatilawang. Cilongok District is the largest among them, with its northern region situated on the slopes near the peak of Mount Slamet. To the west, Cilongok District directly borders Ajibarang District. In the southern part lies Wangon District, which connects to Ajibarang District in the north and Jatilawang District in the east. Jatilawang District, located in the southeastern part of the Agropolitan Area of Banyumas Regency, is the smallest among the four districts. In this study, the unit of analysis used is the village. There are a total of 58 villages across the four districts within the Agropolitan Area of Banyumas Regency. These villages within the Agropolitan Area of Banyumas Regency will receive structured spatial guidance according to their respective functions. Figure 3 below presents the village map of the Agropolitan Area of Banyumas Regency.

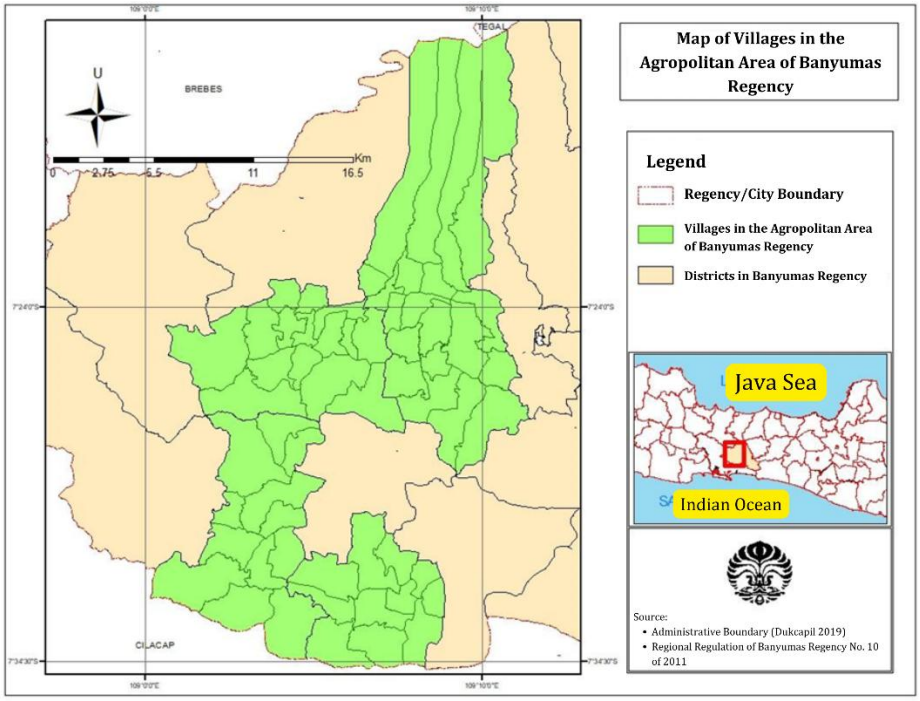

Fig. 3. Map of agropolitan villages of Banyumas Regency

2.2 Data collection

In this study, data collection methods were derived from both primary and secondary data, which were subsequently processed. The primary data in this research were obtained from Landsat 8 OLI imagery from the year 2020, as well as through observations and interviews with farmers. Meanwhile, the secondary data were collected from various sources, including Banyumas Regency Regulation No. 10 of 2011 on the Spatial Planning of Banyumas Regency, Data and Information on the Agricultural Sector of Banyumas Regency in 2019, as well as statistical reports such as Banyumas Regency in Figures 2021, Wangon District in Figures 2021, Ajibarang District in Figures 2021, Jatilawang District in Figures 2021, and Cilongok District in Figures 2021, all published by the Banyumas Regency Statistics Agency (BPS). Additionally, secondary data also included information from the Banyumas Regency Office of Industry and Trade, RBI BIG maps, Google Earth Pro, the 2019 Administrative Boundaries from the Civil Registration Office/*Dinas Kependudukan dan Pencatatan Sipil* (Dukcapil), and the National DEM data from BIG.

2.3 Data processing and analysis

The collected data is then processed for further analysis. The data processing is divided into four stages, including the analysis of land suitability for rice and coconut cultivation, the determination of market and urban center locations, the identification of production center locations, and the analysis of the system and regional connectivity.

2.3.1 Farming area analysis

In this study, the first analysis aims to assess the land suitability for rice and coconut cultivation in the Agropolitan Area of Banyumas Regency. This land suitability analysis focuses on identifying locations with positive characteristics related to successful agricultural production. The purpose of this method is to determine which areas within the Agropolitan Area of Banyumas Regency have high potential and suitable land for rice and coconut cultivation without conflicting with actual field conditions. The analysis involves evaluating the growth requirements of rice and coconut crops. Several variables derived

from secondary data collection are used as assessment criteria for these growth requirements. The processing is carried out by creating land suitability maps based on classification within each variable for both rice and coconut commodities. Once the spatial data on land suitability for each variable is generated, an overlay analysis is conducted to determine the overall suitability for rice and coconut cultivation in Banyumas Regency. Areas where more than 50% of the land falls under the "suitable" or "highly suitable" classification can be developed as farming areas, while areas where more than 50% of the land is classified as "less suitable" or "unsuitable" are considered inappropriate for agricultural purposes. The table below presents the variables used in the overlay process for determining land suitability for rice and coconut cultivation.

Table 1. Variables of suitability for plant growing conditions

Commodities	Variable	Highly suitable	Suitable	Less suitable (Marginal)	Not suitable	Data source
Rice	Rainfall (mm^3/year)	>1500	1200-1500	800-1200	<800	Agency
	Temperature (°C)	24-29	29-32 & 22-24	32-35 & 18-22	>35 & <18	Landsat 8 OLI Imagery
	Slope	<3%	3-5%	>5-8%	>8%	National DEM by BIG
Coconut	Rainfall (mm^3/year)	2000-3000	1300-2000 & 3000-4000	1000-1300 & 4000-5000	>5000 & <1000	Banyumas Regency Statistics
	Temperature (°C)	25-27	28-32 & 21-25	15-21 & 32-36	>36 & <15	Landsat 8 OLI Imagery
	Elevation (MASL)	400-600	0-400	600-1000	>1000	National DEM by BIG

In processing the rainfall map, the first step involved digitizing the locations of rainfall measurement stations obtained from the Banyumas Regency Statistics Agency using Google Earth. Based on this data, the recorded rainfall values from each station were processed into a rainfall map using ArcGIS. For temperature mapping, Landsat 8 OLI data, which contains thermal bands, was utilized. This processing involved the Land Surface Temperature (LST) analysis using the Envi application. The generated map was then further processed in ArcGIS to classify suitability levels based on crop growth requirements. Meanwhile, the elevation and slope maps were created by integrating National DEM data, which was then processed accordingly for both elevation and slope using ArcGIS. Each of these maps was classified according to plant growth requirements and then overlaid. The overlay weighting factors for rice cultivation were 35% for rainfall, 35% for temperature, and 30% for slope, whereas for coconut cultivation, the weight distribution was 40% for rainfall, 30% for temperature, and 30% for elevation. The results of the crop growth suitability overlay were then further overlaid with existing land use data, including built-up areas, rice fields, and plantations. This land use data was sourced from RBI BIG maps and the subdistrict statistical data. After completing the entire overlay process, the final step was determining, at the village level, which villages could be designated as agricultural development zones.

The classification of agricultural zones for rice farming consists of four categories. First, "unsuitable areas" are defined as areas where built-up land exceeds 35%, and rice fields cover less than 50% of the total area, or where more than 50% of the land falls under the "less suitable" and "unsuitable" classes with rice field coverage below 10%. Second, "less suitable areas" refer to regions where more than 50% of the land is classified as "suitable" or "highly suitable," but rice fields cover less than 10%, or where over 50% of the land falls under the "less suitable" and "unsuitable" categories, while rice field coverage exceeds 10%. Third, "suitable areas" are regions where over 50% of the land is categorized as "suitable" or "highly suitable" for rice cultivation, while rice fields cover less than 50% of the area.

Fourth, "highly suitable areas" are defined as regions where over 50% of the land falls under the "suitable" or "highly suitable" classification for rice cultivation, with rice fields covering more than 50% of the total area.

Similarly, the classification of agricultural zones for coconut farming also consists of four categories. First, "unsuitable areas" are those where built-up land exceeds 35%, and plantations cover less than 50% of the area, or where over 50% of the land is classified as "less suitable" or "unsuitable," with plantation coverage below 10%. Second, "less suitable areas" are regions where more than 50% of the land is classified as "suitable" or "highly suitable," but plantation coverage is less than 10%, or where more than 50% of the land falls under the "less suitable" and "unsuitable" categories, while plantation coverage exceeds 10%. Third, "suitable areas" refer to regions where over 50% of the land is classified as "suitable" or "highly suitable" for coconut cultivation, while plantation coverage is below 50%. Fourth, "highly suitable areas" are those where over 50% of the land falls under the "suitable" or "highly suitable" classification for coconut cultivation, with plantation coverage exceeding 50% of the total area.

2.3.2 Market and urban center location analysis

In an agropolitan area, an agropolitan center should be established to serve as the primary marketing hub for the region. This urban and marketing center is a designated area within the Agropolitan Region of Banyumas Regency that is equipped with adequate facilities and supporting infrastructure to facilitate urban activities and marketing operations. The assessment for determining the location of markets and urban centers in this study utilizes secondary data and is conducted using a composite index evaluation. The composite index was selected as it measures multiple aspects and is constructed by combining individual indicators into a single unified index (Mazziotta & Pareto, 2013). In this composite index, the determination of urban and market locations is based on four dimensions, which are further divided into eight indicators. These indicators are evaluated using the z-score method, as represented by the equation below.

$$Z = \frac{x - \mu}{\sigma} \quad \text{(Eq. 1)}$$

X represents the numerical value or data of the assessed indicator, while μ denotes the mean of the indicator data used in the calculation. Meanwhile, σ refers to the standard deviation of the data, which indicates the distribution or variation of values relative to the mean. Subsequently, Table 2 below presents the indicators used in the composite index for determining the location of the agropolitan center.

Table 2. Market and urban location composite index indicator

Dimension	Indicator	Data source
Economic facilities	Bank	Districts in numbers
	Market	Districts in numbers
	Cooperation	Districts in numbers
Demographics	Population density	Districts in numbers
Land use	Commercial complex	Districts in numbers
	Built-up area	Districts in numbers
Transportation and communication	Terminal	Google earth
	Post office	Districts in numbers

Based on the z-score calculations for each indicator in the villages, the scores are then summed to produce a composite index value for the location of markets and agropolitan centers. The results of this composite index scoring yield either positive or negative values. A positive value indicates that the village has above-average facilities, while a negative value suggests that the village has below-average facilities. Therefore, three classifications are established: villages with high values are classified as highly suitable, villages with positive

values are categorized as suitable, and villages with negative values are considered unsuitable.

2.3.3 Production center location analysis

The analysis for determining the location of production centers is used to identify areas that can serve as growth hubs and industrial activity centers within the Agropolitan Area of Banyumas Regency. These production centers are expected to become areas of intensification aimed at processing rice commodities into rice and coconut-based commodities into coconut sugar. The assessment of production center locations is conducted using a composite index evaluation with the z-score method. The composite index for determining production center locations utilizes five indicators.

X represents the value or data of the evaluated indicator, while μ denotes the average of the indicator data used in the calculation. Meanwhile, σ is the standard deviation of the data, which indicates the distribution or variation of values relative to the mean. Table 3 below presents the indicators that will be used to construct the composite index for determining the production center locations in the Agropolitan Area of Banyumas Regency.

Table 3. Production center location composite index indicator

Indicators	Information	Data source
Availability of raw materials	Rice fields and gardens	Districts in numbers
Road density	The length of the road compared to the area	Dukcapil administration data and RBI BIG map
Distance to road transport node	Distance to the nearest terminal	Dukcapil and google earth administration data
Distance to market	Distance to the main market in each sub-district	Dukcapil and google earth administration data
Region topography	Potential rural statistics types of terrain conditions	Potential village statistics of Banyumas Regency

The five indicators above were selected based on Weber's theory of industrial location and the characteristics of rice and coconut commodities. Each indicator has a different unit of measurement; therefore, the use of a composite index can accommodate these differences to produce a value representing the level of infrastructure support in villages within the Agropolitan Area of Banyumas Regency. In the data processing stage, road density and distance measurements—both to the market and to transportation hubs—were analyzed using ArcMap 10.8 software. The distance measurement was based on the centroid of each village relative to the location of the market and transportation hubs. The composite index for determining production center locations will yield both positive and negative values, which serve as the basis for four classifications: highly suitable, suitable, less suitable, and unsuitable.

In this analysis, a spatial descriptive approach is used to explain the characteristics and connectivity models of agricultural business areas, urban and market centers, and production hubs. This analysis is derived from primary data obtained through observation and interviews, as well as secondary data, using two dimensions: physical characteristics and social characteristics. Secondary data is primarily used to examine regional characteristics; therefore, Table 4 presents the variables used to analyze the regional characteristics of the Agropolitan Area of Banyumas Regency.

Meanwhile, primary data collection is used to validate the findings from secondary data and to assess the accessibility system model between functional areas within the Agropolitan Area of Banyumas Regency. The observation process involves selecting one sample from each sub-district, including rice fields, rice mills, coconut plantations, and crystal coconut sugar processing facilities. During these observations, the study examines the conditions and characteristics of the area, along with the state of the road infrastructure. Additionally, interviews are conducted with farmers to evaluate accessibility by analyzing

the marketing flow of rice and coconut. Three key assessment indicators are used in these interviews: agricultural location, production process, and marketing location.

Table 4. Variables of regional characteristics analysis

Physical characteristics	Social characteristics
Climate	Population
Topography	Economic activities
	Historical and cultural aspects

3. Results and Discussion

3.1 Land suitability

In the land suitability analysis for rice and coconut, each crop utilizes three variables. These variables represent the classified growing requirements of the plants. Figure 4 below illustrates the mapped conditions of each growing requirement variable within the Agropolitan Area of Banyumas Regency.

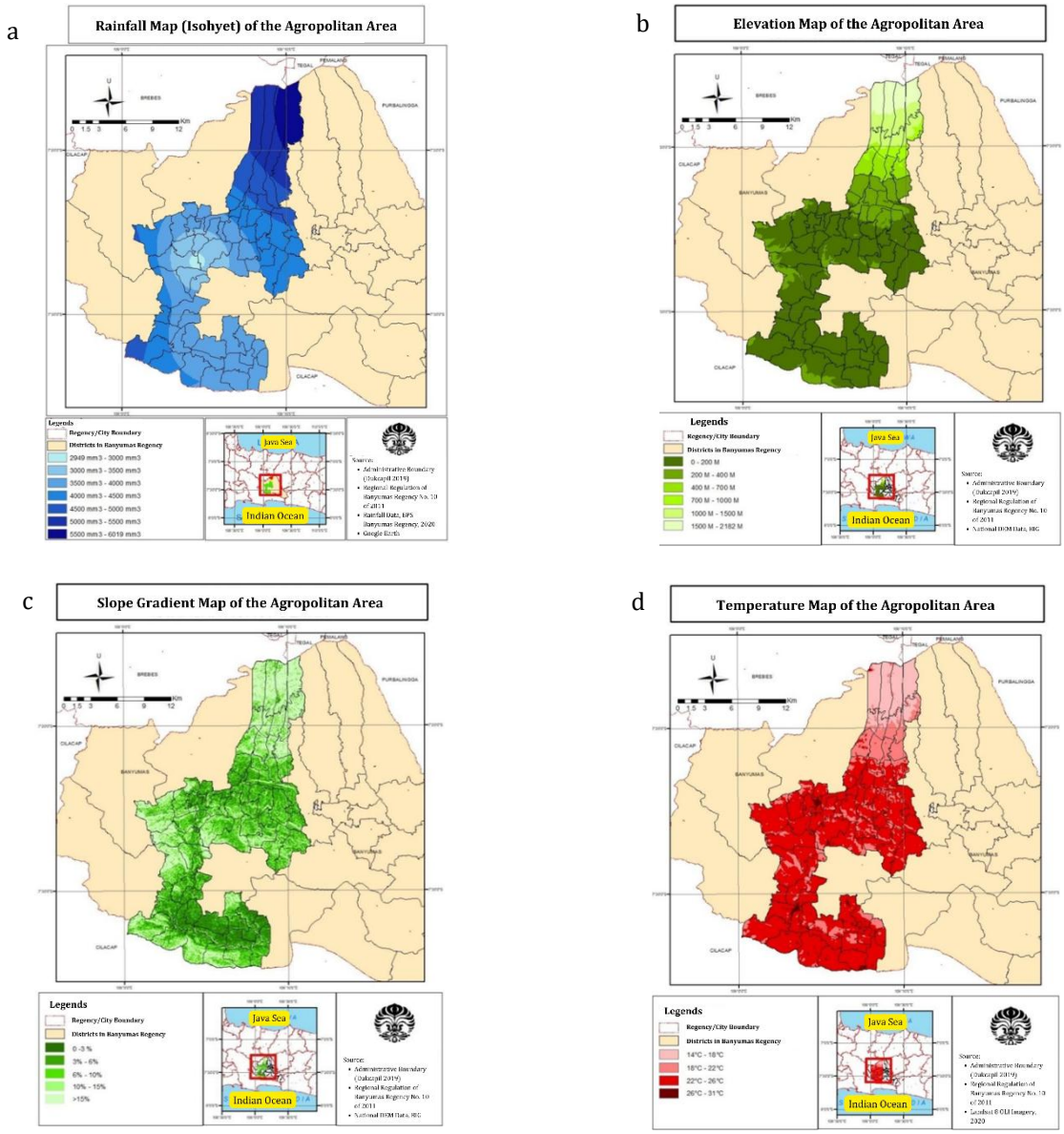

Fig. 4 (a) Rainfall map of the agropolitan area of Banyumas Regency; (b) Map of the altitude of the agropolitan area of Banyumas Regency; (c) Slope map of the agropolitan area of Banyumas Regency; (d) Temperature map of agropolitan area of Banyumas Regency

The four maps above illustrate the conditions in the Agropolitan Area of Banyumas Regency. The rainfall map is derived from data collected from 14 rainfall measurement stations across Banyumas Regency. It shows that rainfall levels increase towards the north, while the lowest rainfall is observed in the central part of the Agropolitan Area. Regarding the elevation map, it indicates that the Agropolitan Area of Banyumas Regency is predominantly at an altitude of 0–200 meters. Elevation increases progressively towards the northern region. The slope gradient map aligns with this pattern, showing steeper slopes in the north, moderate slopes (0–10%) in the central part, and predominantly gentle slopes (0–6%) in the southern region. The temperature map reveals that the Agropolitan Area of Banyumas Regency is primarily characterized by temperatures ranging from 22°C to 26°C, with temperatures decreasing as the elevation increases towards the north.

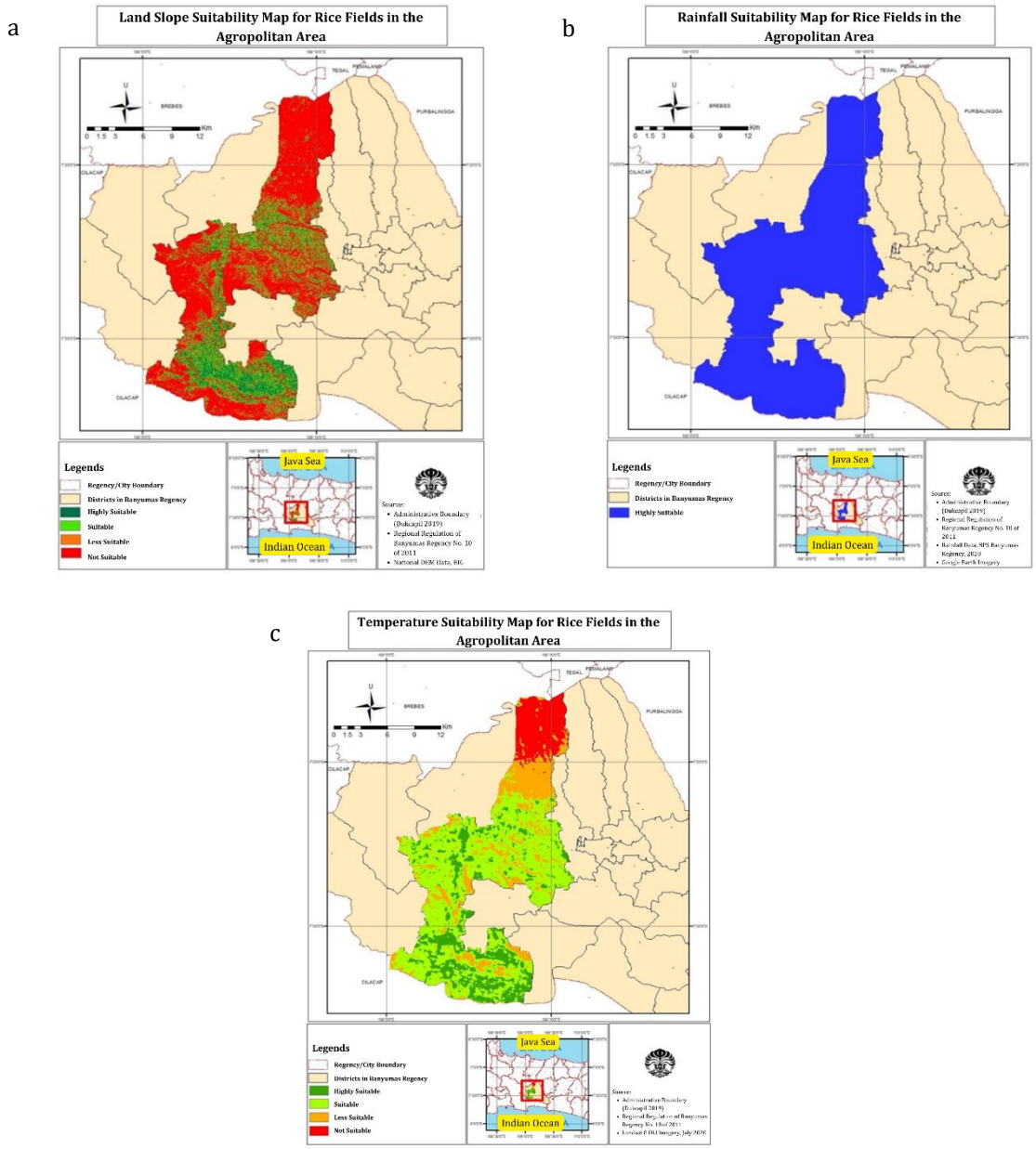

Fig. 5 (a) Map of rice slope suitability in agropolitan area, Banyumas Regency; (b) Rice rainfall suitability map of the agropolitan area of Banyumas Regency; (c) Rice temperature conformity map of agropolitan area, Banyumas Regency

The variables used in the land suitability analysis for rice cultivation in the Agropolitan Area of Banyumas Regency include temperature, slope, and rainfall. Figure 5 below presents the resulting land suitability map based on these growth requirement variables for rice in

the Agropolitan Area of Banyumas Regency. Based on the slope suitability requirement, areas classified as highly suitable and suitable are those with a slope of <3% and 3-5%, which predominantly cover the southern central and western regions. Meanwhile, areas marked in red on the map tend to be unsuitable due to their relatively steep slopes exceeding 8%. Regarding the rainfall suitability requirement, the entire Agropolitan Area of Banyumas Regency receives more than 1500 mm^3/year of rainfall, which classifies the entire region as highly suitable. The temperature suitability variable is dominated by the suitable class, which includes areas with temperatures ranging from 22°C to 24°C and 29°C to 32°C. Meanwhile, the highly suitable class, with a temperature range of 24°C to 29°C, is found in the southern part of the Agropolitan Area of Banyumas Regency.

Figure 6 below presents the processed data results to determine which areas are suitable for rice cultivation based on the three previously discussed growth requirement variables. In the map, rice land suitability in the Agropolitan Area of Banyumas Regency is categorized into three classes: highly suitable, suitable, and less suitable. Generally, the regency is dominated by suitable land areas. Less suitable land is mainly found around the peak of Mount Slamet and in the southeastern hilly areas due to unfavorable slope and temperature conditions. In the designated Agropolitan Area of Banyumas Regency, the suitable category also dominates. In the southern region, particularly in Wangon and Jatilawang Districts, a considerable amount of land is classified as highly suitable for rice cultivation. In the northern region, specifically in Cilongok District, areas near the peak of Mount Slamet are categorized as less suitable for rice cultivation.

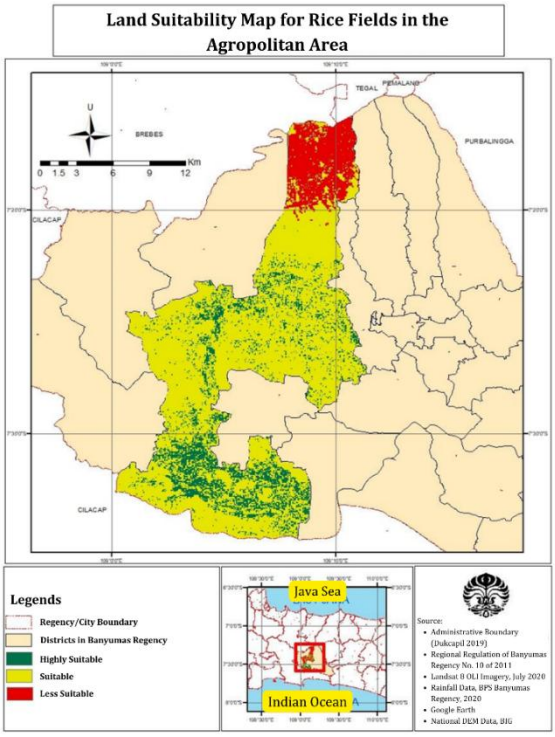

Fig. 6. Map of rice land suitability in agropolitan area, Banyumas Regency

In the processing of land suitability data for coconut cultivation in the Agropolitan Area of Banyumas Regency, the variables used include rainfall, temperature, and elevation. Figure 7 below presents the processed suitability maps for coconut growth requirements in the Agropolitan Area of Banyumas Regency.

Based on the elevation variable, the "suitable" category dominates the Agropolitan Area of Banyumas Regency, with elevations ranging from 0 to 400 meters. The "highly suitable" category is found only in a small portion of the northern area, where the elevation ranges from 400 to 600 meters. As the elevation increases further north, the land gradually becomes less suitable and even unsuitable. For the rainfall variable, areas receiving 3,000–4,000 mm^3/year and 4,000–5,000 mm^3/year, which fall under the "suitable" and "less

suitable" categories, dominate the Agropolitan Area of Banyumas Regency. The "suitable" areas are mainly located in the central region, surrounded by "less suitable" areas. Regarding temperature, the dominant temperature range in the Agropolitan Area of Banyumas Regency is 21°C–25°C and 28°C–32°C, which fall under the "suitable" land category. Areas with "highly suitable" temperatures, ranging from 25°C to 28°C, are scattered throughout the central and southern parts of the Agropolitan Area of Banyumas Regency.

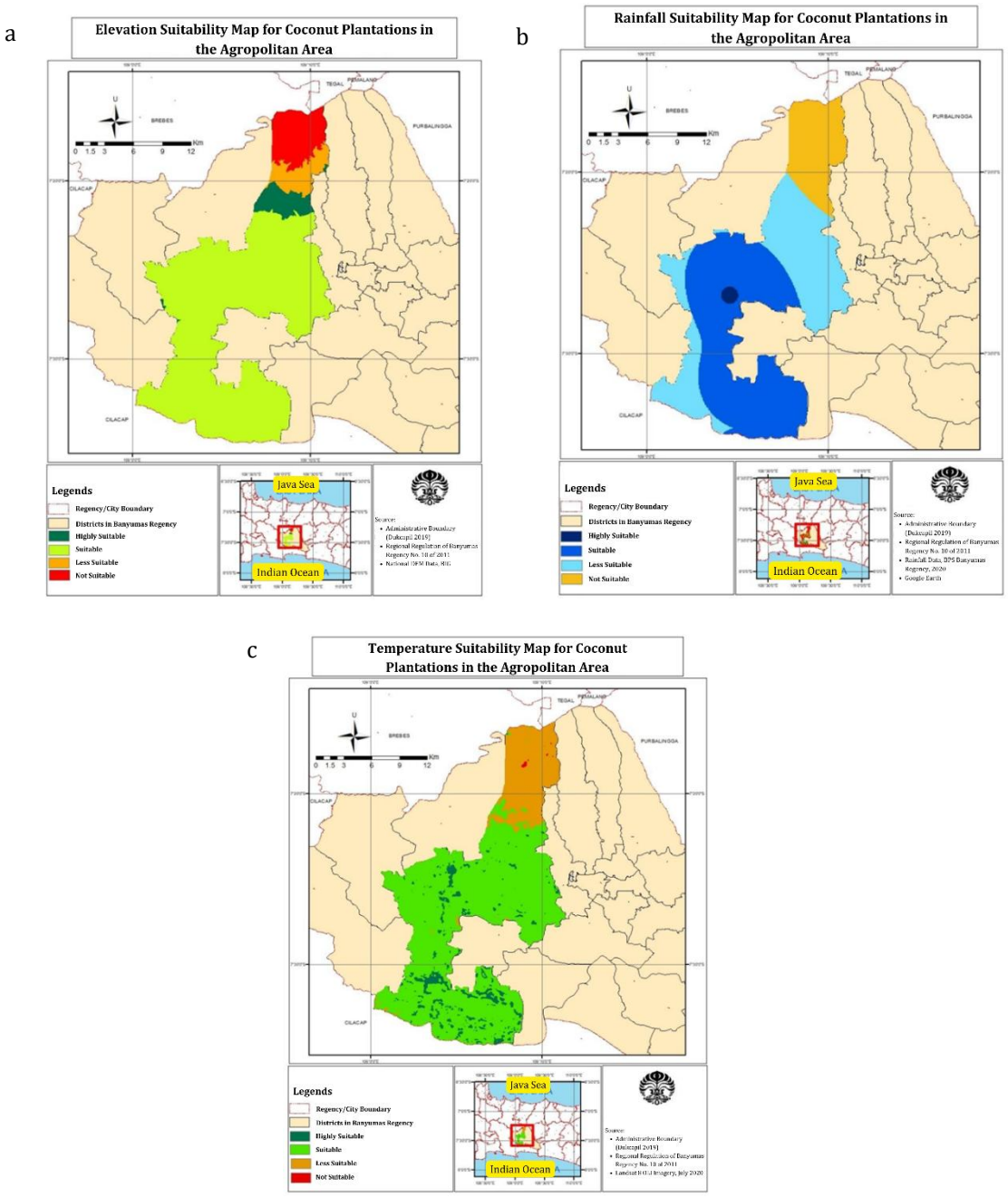

Fig. 7 (a) Coconut height suitability map of the agropolitan area of Banyumas Regency; (b) Coconut rainfall suitability map of agropolitan area, Banyumas Regency; (c) Coconut temperature suitability map of the agropolitan area of Banyumas Regency

In Figure 8 above, based on the overlay analysis of coconut plant growth requirements conducted in the Agropolitan Area of Banyumas Regency, four land suitability categories were identified: highly suitable, suitable, less suitable, and unsuitable. The "suitable" category dominates the Agropolitan Area of Banyumas Regency. Only in the northern

region, where elevation increases and temperature decreases, does the land fall into the "less suitable" and "unsuitable" categories for coconut cultivation.

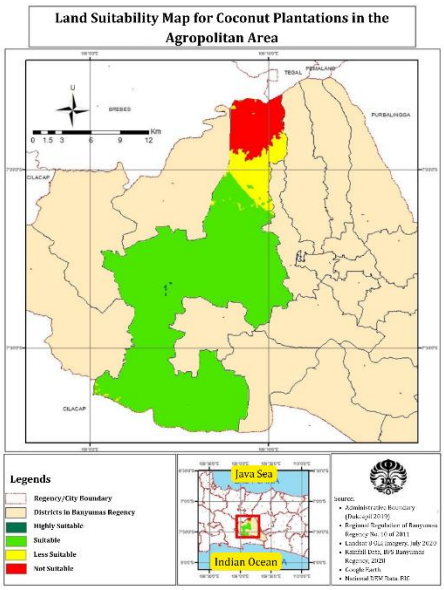

Fig. 8. Map of coconut land suitability in the agropolitan area of Banyumas Regency

3.2 Urban and market location

In determining suitable locations for markets and urban centers, the assessment employs a composite index using the z-score method. This evaluation is conducted for each village within the Agropolitan Area of Banyumas Regency. The table below presents the processed results of the composite index for market and urban center locations.

Using the composite index, 18 villages were identified as having above-average infrastructure support for market and urban center locations. These 18 villages were further categorized into 14 suitable villages and four highly suitable villages for markets and urban centers, as shown in Table 6. The four highly suitable villages have a composite index score greater than 10, making them the most appropriate choices.

Table 5. Market and urban location composite index values

Village	Economic facilities			Transportation and communication		Demographics
	Market	Bank	Cooperation	Terminal	Post office and expedition services	Population density
Ajibarang Wetan	1.97	4.04	1.88	5.25	1.22	2.17
Banteran	4.48	4.04	5.40	5.25	-0.42	0.68
Ajibarang Kulon	1.97	2.94	1.88	-0.19	2.86	1.87
Pernasidi	0.71	1.83	2.46	-0.19	2.86	1.10
Tunjung	0.71	1.83	1.29	-0.19	2.86	-0.52
Wangon	-0.54	0.17	0.11	-0.19	1.22	1.02
Klapagading Kulon	-0.54	0.72	-0.48	-0.19	2.86	2.10
Klapagading	-0.54	0.17	0.70	-0.19	1.22	1.74
Cilongok	0.71	1.28	0.70	-0.19	-0.42	0.99
Tinggarjaya	0.71	0.17	1.29	-0.19	-0.42	0.42
Pandansari	-0.54	-0.38	-0.48	-0.19	1.22	0.96
Pancasan	-0.54	-0.38	-0.48	-0.19	-0.42	2.52
Gentawangi	0.71	-0.38	0.70	-0.19	-0.42	0.37
Kedungwringin	1.97	-0.38	0.70	-0.19	-0.42	0.25
Kalisari	0.71	-0.38	0.11	-0.19	-0.42	0.79
Margasana	0.71	0.17	-0.48	-0.19	2.86	-0.77

Lesmana	-0.54	-0.38	0.11	-0.19	-0.42	1.79
Pancurendang	-0.54	-0.38	0.11	-0.19	-0.42	0.46
Karanglo	-0.54	0.17	-0.48	-0.19	-0.42	0.64
Sudimara	0.71	-0.38	-0.48	-0.19	-0.42	0.87
Cikidang	-0.54	-0.38	0.70	-0.19	-0.42	0.19
Cikakak	1.97	-0.38	-0.48	-0.19	-0.42	-1.13
Karanganyar	-0.54	-0.38	-0.48	-0.19	1.22	-0.19
Panembangan	-0.54	-0.38	-0.48	-0.19	-0.42	0.42
Adisara	-0.54	-0.38	0.11	-0.19	-0.42	0.05
Kalibenda	-0.54	-0.38	-0.48	-0.19	-0.42	0.03
Panusupan	-0.54	-0.38	0.11	-0.19	-0.42	-0.79
Ciberung	-0.54	-0.38	-0.48	-0.19	-0.42	0.24
Cipete	0.71	-0.38	-0.48	-0.19	-0.42	-0.26
Banjarsari	-0.54	-0.38	-0.48	-0.19	-0.42	0.22
Pageraji	-0.54	-0.38	0.11	-0.19	-0.42	0.09
Wlahar	-0.54	-0.38	-0.48	-0.19	-0.42	-0.06
Karangbawang	-0.54	-0.38	-0.48	-0.19	-0.42	0.14
Pejogol	-0.54	-0.38	-0.48	-0.19	-0.42	-0.14
Sokawera	0.71	-0.38	-0.48	-0.19	-0.42	-1.05
Karangtengah	1.97	-0.38	-0.48	-0.19	-0.42	-1.39
Rancamaya	-0.54	-0.38	-0.48	-0.19	-0.42	0.37
Bantar	-0.54	-0.38	-0.48	-0.19	-0.42	0.75
Gununglurah	0.71	-0.38	-0.48	-0.19	-0.42	-0.95
Langgongsari	-0.54	-0.38	-0.48	-0.19	-0.42	0.31
Windunegara	-0.54	-0.38	-0.48	-0.19	-0.42	-0.51
Pekuncen	-0.54	-0.38	-0.48	-0.19	-0.42	-0.82
Jambu	-0.54	-0.38	-0.48	-0.19	-0.42	-0.51
Kracak	-0.54	-0.38	-0.48	-0.19	-0.42	0.08
Tipar Kidul	-0.54	-0.38	-0.48	-0.19	-0.42	-0.87
Batuanten	-0.54	-0.38	-0.48	-0.19	-0.42	-0.55
Jurangbahas	-0.54	-0.38	-0.48	-0.19	-0.42	-1.04
Pengadegan	-0.54	-0.38	0.11	-0.19	-0.42	-1.07
Jatisaba	-0.54	-0.38	-0.48	-0.19	-0.42	-1.02
Jingkang	-0.54	-0.38	-0.48	-0.19	-0.42	-0.99
Sawangan	-0.54	-0.38	-0.48	-0.19	-0.42	-0.89
Rawaheng	-0.54	-0.38	-0.48	-0.19	-0.42	-0.99
Kasegeran	-0.54	-0.38	-0.48	-0.19	-0.42	-1.10
Karanglewas	-0.54	-0.38	-0.48	-0.19	-0.42	-1.39
Gunungwetan	-0.54	-0.38	-0.48	-0.19	-0.42	-1.09
Randegan	-0.54	-0.38	-0.48	-0.19	-0.42	-1.14
Damarkradenan	-0.54	-0.38	-0.48	-0.19	-0.42	-1.05
Sambirata	-0.54	-0.38	-0.48	-0.19	-0.42	-1.35

These villages include Ajibarang Kulon in Ajibarang District, with a score of 14.05, and Ajibarang Wetan in Ajibarang District, with a score of 22.53. Additionally, Pernasidi Village in Cilongok District has a score of 12.22, while Banteran Village in Wangon District has a score of 21.9. Among these four villages, Ajibarang Wetan has the highest composite index score, making it the most suitable location for a market and urban center.

Table 6. Market and urban location composite index values (continued)

Village	Land use		Composite index
	Shop complex	Percentage of built land	
Ajibarang Wetan	2.79	3.22	22.53
Banteran	0.53	1.95	21.90
Ajibarang Kulon	2.79	-0.06	14.05
Pernasidi	0.53	2.91	12.22
Tunjung	0.53	1.03	7.54
Wangon	3.93	0.22	5.94
Klapagading Kulon	-0.61	1.75	5.63

Klapagading	0.53	1.95	5.58
Cilongok	1.66	-0.82	3.90
Tinggarjaya	1.66	0.10	3.74
Pandansari	0.53	2.58	3.70
Pancasan	1.66	0.75	2.92
Gentawangi	0.53	0.44	1.75
Kedungwringin	-0.61	0.10	1.42
Kalisari	0.53	0.21	1.36
Margasana	-0.61	-0.42	1.29
Lesmana	0.53	0.04	0.93
Pancurendang	0.53	0.72	0.28
Karanglo	0.53	0.07	-0.21
Sudimara	-0.61	0.02	-0.47
Cikidang	0.53	-0.73	-0.85
Cikakak	0.53	-0.78	-0.88
Karanganyar	-0.61	-0.14	-1.30
Panembangan	-0.61	0.75	-1.45
Adisara	-0.61	0.31	-1.66
Kalibenda	0.53	-0.25	-1.70
Panusupan	0.53	-0.04	-1.73
Ciberung	-0.61	0.45	-1.93
Cipete	-0.61	-0.44	-2.07
Banjarsari	-0.61	0.30	-2.09
Pageraji	-0.61	-0.22	-2.16
Wlahar	-0.61	0.32	-2.36
Karangbawang	-0.61	0.09	-2.38
Pejogol	-0.61	0.20	-2.55
Sokawera	0.53	-1.33	-2.60
Karangtengah	-0.61	-1.14	-2.64
Rancamaya	-0.61	-0.40	-2.64
Bantar	-0.61	-0.91	-2.78
Gununglurah	-0.61	-0.68	-2.99
Langgongsari	-0.61	-0.68	-2.99
Windunegara	-0.61	-0.03	-3.16
Pekuncen	-0.61	0.13	-3.30
Jambu	-0.61	-0.38	-3.51
Kracak	-0.61	-0.98	-3.52
Tipar Kidul	-0.61	-0.15	-3.64
Batuanten	-0.61	-0.59	-3.75
Jurangbahas	-0.61	-0.20	-3.86
Pengadegan	-0.61	-0.77	-3.87
Jatisaba	-0.61	-0.57	-4.20
Jingkang	-0.61	-0.61	-4.22
Sawangan	-0.61	-0.79	-4.29
Rawaheng	-0.61	-0.75	-4.36
Kasegeran	-0.61	-0.67	-4.38
Karanglewas	-0.61	-0.62	-4.62
Gunungwetan	-0.61	-1.00	-4.70
Randegan	-0.61	-0.97	-4.73
Damarkradenan	-0.61	-1.18	-4.84
Sambirata	-0.61	-1.36	-5.32

3.3 Production center location

The selection of production center locations in the Agropolitan Area of Banyumas Regency aims to identify the most suitable sites for both rice and coconut sugar production centers based on composite index calculations. A total of five indicators were used to determine the most appropriate locations for both rice production centers and coconut

sugar processing industries. The table below presents the results of the composite index analysis for rice production centers and coconut sugar processing industries.

Table 7. Composite index value of production center location

Village	Availability of raw materials	Road density	Distance to transport node
Tinggarjaya	3.39	0.79	0.45
Pengadegan	0.22	5.06	0.13
Klapagading	0.80	1.28	1.20
Karanglo	2.61	0.65	0.17
Klapagading Kulon	0.36	1.62	1.09
Kedungwringin	1.77	1.30	-0.51
Jambu	1.93	-0.70	1.16
Ajibarang Kulon	-0.01	0.01	1.39
Gentawangi	0.86	0.88	-0.45
Banteran	-0.98	0.87	1.37
Ajibarang Wetan	-1.00	-0.10	1.52
Pancurendang	-1.18	0.35	1.21
Cikidang	0.34	-0.06	0.15
Bantar	0.44	0.49	0.18
Cikakak	-0.01	0.82	0.48
Batuanten	0.51	0.54	-0.04
Pandansari	-0.44	-0.34	1.00
Banjarsari	-0.16	0.44	0.58
Sawangan	-0.41	-0.07	0.89
Karangbawang	-0.82	-0.19	1.04
Ciberung	-0.21	-0.64	0.90
Cilongok	-0.94	0.60	-0.45
Cipete	-0.64	0.16	0.04
Pernasidi	-1.60	0.75	-0.23
Kalibenda	-1.16	-0.03	0.94
Wangon	0.44	0.33	1.10
Kalisari	0.24	-0.36	0.22
Panusupan	3.45	-0.17	-1.58
Tipar Kidul	0.58	-0.71	0.47
Tunjung	-0.34	-0.60	-0.02
Jurangbahas	-0.60	-1.14	1.06
Rancamaya	-0.35	0.03	-0.65
Damarkradenan	-0.11	0.21	0.27
Pancasan	-0.86	0.63	1.34
Kracak	0.77	-0.40	1.03
Panembangan	-0.15	-0.53	-0.32
Lesmana	-0.42	0.65	0.98
Karanganyar	-0.01	0.20	-1.22
Sudimara	-0.90	-0.09	-0.47
Randegan	0.34	-1.22	0.34
Jingkang	-0.25	-0.35	0.22
Adisara	0.16	0.71	-0.75
Rawaheng	0.00	-1.39	0.38
Karanglewas	0.00	-1.01	-1.30
Margasana	0.09	0.07	-0.94
Windunegara	-0.76	-1.00	0.22
Pejogol	0.02	-0.55	-1.49
Kasegeran	-0.60	-1.08	-0.56
Pekuncen	-0.66	-1.19	-0.88
Jatisaba	-0.82	-0.33	-1.06
Wlahar	-0.12	-0.61	0.27
Langgongsari	-0.44	0.33	-1.27
Pageraji	-1.19	0.28	-0.94
Gunungwetan	-0.55	-0.75	-0.45

Gununglurah	0.01	-0.71	-2.15
Sokawera	-0.27	-0.86	-2.49
Sambirata	0.19	-1.46	-1.95
Karangtengah	-0.58	-1.41	-1.64

Based on the composite index analysis for determining the production center locations, 11 villages were identified as highly suitable for production centers, each scoring above one. The 11 villages are Tinggarjaya, Pengadegan, Klapagading, Karanglo, Klapagading Kulon, Kedungwringin, Jambu, Ajibarang Kulon, Gentawangi, Banteran, and Ajibarang Wetan. Among these, eight villages are located in the southern part of the region, with five villages in Wangon District and three villages in Jatilawang District. Meanwhile, the remaining three villages are situated in the northern part, with two villages in Ajibarang District and one village in Cilongok District.

Table 8. Production center location composite index value (continued)

Village	Distance to market	Region topography	Composite index
Tinggarjaya	0.06	0.51	5.20
Pengadegan	-0.90	0.51	5.02
Klapagading	0.85	0.51	4.63
Karanglo	0.38	0.51	4.31
Klapagading Kulon	0.68	0.51	4.27
Kedungwringin	0.72	0.51	3.78
Jambu	0.69	0.51	3.59
Ajibarang Kulon	1.18	0.51	3.07
Gentawangi	1.05	0.51	2.86
Banteran	1.05	0.51	2.82
Ajibarang Wetan	1.42	0.51	2.34
Pancurendang	0.82	0.51	1.70
Cikidang	0.75	0.51	1.69
Bantar	-0.12	0.51	1.50
Cikakak	-0.44	0.51	1.37
Batuanten	-0.17	0.51	1.34
Pandansari	0.57	0.51	1.31
Banjarsari	-0.22	0.51	1.15
Sawangan	0.20	0.51	1.11
Karangbawang	0.46	0.51	1.00
Ciberung	0.40	0.51	0.96
Cilongok	1.23	0.51	0.95
Cipete	0.69	0.51	0.76
Pernasidi	1.31	0.51	0.74
Kalibenda	0.37	0.51	0.63
Wangon	0.65	-1.94	0.59
Kalisari	-0.10	0.51	0.51
Panusupan	-1.72	0.51	0.49
Tipar Kidul	-0.48	0.51	0.38
Tunjung	0.82	0.51	0.37
Jurangbahas	0.53	0.51	0.36
Rancamaya	0.72	0.51	0.25
Damarkradenan	-0.74	0.51	0.13
Pancasan	0.93	-1.94	0.10
Kracak	0.54	-1.94	0.01
Panembangan	0.46	0.51	-0.04
Lesmana	0.48	-1.94	-0.25
Karanganyar	0.26	0.51	-0.27
Sudimara	0.34	0.51	-0.62
Randegan	-0.60	0.51	-0.64
Jingkang	-0.89	0.51	-0.77
Adisara	0.94	-1.94	-0.89
Rawaheng	-0.50	0.51	-1.00

Karanglewas	-0.13	0.51	-1.93
Margasana	0.65	-1.94	-2.07
Windunegara	-1.09	0.51	-2.13
Pejogol	-0.79	0.51	-2.31
Kasegeran	-0.57	0.51	-2.32
Pekuncen	-0.14	0.51	-2.36
Jatisaba	-1.22	0.51	-2.92
Wlahar	-0.78	-1.94	-3.17
Langgongsari	0.06	-1.94	-3.26
Pageraji	0.37	-1.94	-3.42
Gunungwetan	-0.63	-1.94	-4.33
Gununglurah	-2.55	0.51	-4.90
Sokawera	-2.87	0.51	-5.98
Sambirata	-2.55	-1.94	-7.71
Karangtengah	-2.44	-1.94	-8.02

3.4 Agropolitan location suitability in Banyumas Regency

3.4.1 Farming area

Table 9 below presents a comparative analysis of land suitability, built-up areas, and rice field areas, which are key factors in determining rice farming areas within the Agropolitan Region of Banyumas Regency.

Table 9. Percentage of assessment of rice farming business area

Village	Percentage of areas according to rice	Percentage of built land	Percentage of rice field area
Adisara	100%	32%	56%
Ajibarang Kulon	100%	16%	45%
Ajibarang Wetan	100%	36%	31%
Banjarsari	100%	15%	31%
Bantar	100%	26%	48%
Banteran	100%	36%	21%
Batuanten	100%	13%	26%
Ciberung	100%	7%	48%
Cikakak	100%	3%	19%
Cikidang	100%	33%	44%
Cilongok	100%	31%	17%
Cipete	100%	17%	30%
Damarkradenan	100%	8%	9%
Gentawangi	100%	33%	57%
Gununglurah	54%	4%	16%
Gunungwetan	100%	15%	11%
Jambu	100%	17%	41%
Jatisaba	100%	5%	15%
Jingkang	100%	28%	12%
Jurangbahas	100%	12%	29%
Kalibenda	100%	0%	34%
Kalisari	100%	29%	22%
Karanganyar	100%	25%	59%
Karangbawang	100%	24%	18%
Karanglewas	100%	18%	23%
Karanglo	100%	25%	58%
Karangtengah	57%	6%	8%
Kasegeran	100%	2%	11%
Kedungwringin	100%	34%	55%
Klapagading	100%	49%	45%
Klapagading Kulon	100%	37%	43%
Kracak	100%	18%	29%

Langgongsari	100%	23%	10%
Lesmana	100%	43%	43%
Margasana	100%	24%	72%
Pageraji	100%	14%	7%
Pancasan	100%	41%	30%
Pancurendang	100%	33%	30%
Pandansari	100%	22%	46%
Panembangan	100%	19%	52%
Panusupan	100%	10%	32%
Pejogol	100%	6%	11%
Pekuncen	100%	15%	13%
Pengadegan	100%	11%	16%
Pernasidi	100%	22%	3%
Rancamaya	100%	22%	27%
Randegan	100%	7%	13%
Rawaheng	100%	8%	17%
Sambirata	53%	3%	7%
Sawangan	100%	27%	13%
Sokawera	54%	5%	9%
Sudimara	100%	14%	31%
Tinggarjaya	100%	30%	59%
Tipar Kidul	100%	10%	16%
Tunjung	100%	31%	4%
Wangon	100%	27%	38%
Windunegara	100%	5%	17%
Wlahar	100%	10%	36%

In the table, as explained in the methodology, four classifications of rice farming areas can be identified. The "highly suitable" category includes villages such as Ajibarang Kulon, Banjarsari, Bantar, Bataunten, Ciberung, Cikakak, Cikidang, Cilongkok, Cipete, Damarkradenan, Gununglurah, Gunung Wetan, Jambu, Jatisaba, Jingkang, Jurangbahas, Kalibenda, Kalisari, Karangbawang, Karanglewas, Kasegeran, Kracak, Langgongsari, Pageraji, Pancurendang, Pandansari, Panusupan, Pejogol, Pakuncen, Pengadegan, Pernasidi, Rancamaya, Randegan, Rawaheng, Sawangan, Sudimara, Tipar Kidul, Tunjung, Wangon, Windunegara, and Wlahar.

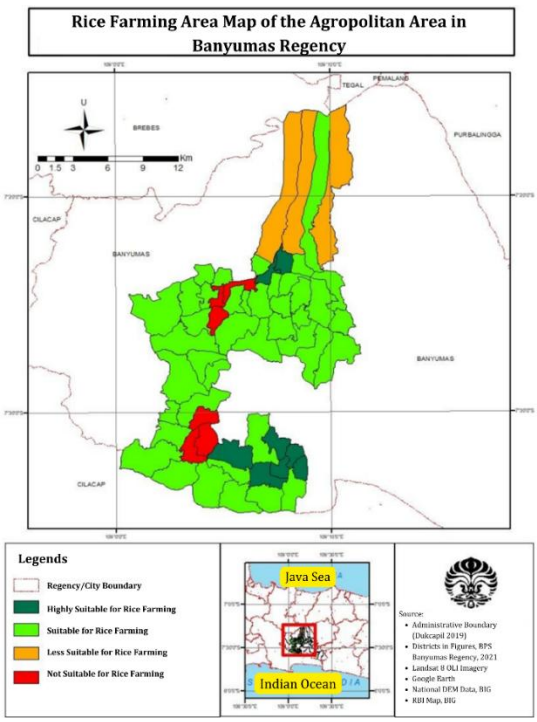

Fig. 9. Map of rice farming business areas in agropolitan area, Banyumas Regency

The "suitable" category includes villages such as Gentawangi, Karanganyar, Karanglo, Kedungwringin, Margasana, Panembangan, and Tinggarjaya. Meanwhile, the "marginally suitable" category consists of Karangtengah, Sambirata, and Sokawera. Lastly, the "unsuitable" category includes Klapagading, Klapagading Kulon, Lesmana, and Pancasan. Figure 9 below presents a map illustrating the rice farming areas based on land suitability analysis within the Agropolitan Region of Banyumas Regency.

Based on the table and the map above, it can be observed that eight villages are classified as highly suitable for rice farming areas. The map shows that six of these villages are located in the southern part, specifically in Jatilawang District, while the remaining two villages are in the northern part, in Cilongok District. Overall, areas classified as suitable dominate the Agropolitan Region of Banyumas Regency, while less suitable areas are mainly found in the northern part, where land suitability is lower, but the existing rice fields are still relatively extensive. On the other hand, unsuitable areas are primarily located around the sub-district capitals of Wangon and Ajibarang, where built-up areas have become predominant. Next, Table 10 below presents a comparative analysis of land suitability, built-up areas, and plantation areas, which are key factors in determining coconut farming areas within the Agropolitan Region of Banyumas Regency.

Table 10. Percentage of assessment of coconut farming business areas

Village	Percentage of areas according to coconut	Percentage of built land	Percentage of coconut plantation area
Adisara	100%	32%	10%
Ajibarang Kulon	100%	16%	11%
Ajibarang Wetan	100%	36%	3%
Banjarsari	100%	15%	11%
Bantar	100%	26%	34%
Banteran	100%	36%	27%
Batuanten	100%	13%	6%
Ciberung	100%	7%	21%
Cikakak	100%	3%	35%
Cikidang	100%	33%	7%
Cilongok	100%	31%	6%
Cipete	100%	17%	13%
Damarkradenan	100%	8%	42%
Gentawangi	100%	33%	3%
Gununglurah	34%	4%	6%
Gunungwetan	100%	15%	63%
Jambu	100%	17%	36%
Jatisaba	100%	5%	14%
Jingkang	100%	28%	17%
Jurangbahas	100%	12%	42%
Kalibenda	100%	0%	10%
Kalisari	100%	29%	4%
Karanganyar	100%	25%	18%
Karangbawang	100%	24%	44%
Karanglewas	100%	18%	47%
Karanglo	100%	25%	2%
Karangtengah	47%	6%	1%
Kasegeran	100%	2%	1%
Kedungwringin	100%	34%	16%
Klapagading	100%	49%	15%
Klapagading Kulon	100%	37%	13%
Kracak	100%	18%	22%
Langgongsari	100%	23%	20%
Lesmana	100%	43%	28%
Margasana	100%	24%	5%
Pageraji	100%	14%	8%
Pancasan	100%	41%	24%

Pancurendang	100%	33%	1%
Pandansari	100%	22%	1%
Panembangan	100%	19%	1%
Panusupan	100%	10%	7%
Pejogol	100%	6%	32%
Pekuncen	100%	15%	64%
Pengadegan	100%	11%	49%
Pernasidi	100%	22%	14%
Rancamaya	100%	22%	5%
Randegan	100%	7%	53%
Rawaheng	100%	8%	64%
Sambirata	38%	3%	2%
Sawangan	100%	27%	10%
Sokawera	35%	5%	3%
Sudimara	100%	14%	17%
Tinggarjaya	100%	30%	19%
Tipar Kidul	100%	10%	46%
Tunjung	100%	31%	27%
Wangon	100%	27%	33%
Windunegara	100%	5%	35%
Wlahar	100%	10%	34%

In the analysis of coconut farming areas, it can be observed that there are ten villages classified as unsuitable, including Ajibarang Wetan, Banteran, Gununglurah, Karang Tengah, Klapa Gading, Klapagading Kulon, Lesmana, Pancasan, Sambirata, and Sokawera. Six of these villages are unsuitable due to the dominance of built-up land, similar to rice farming areas, while the remaining four villages have land conditions that are inherently unsuitable for coconut cultivation.

On the other hand, suitable and highly suitable areas still dominate the overall landscape. There are four villages categorized as highly suitable for coconut farming, namely Gunung Weta, Pakucen, Randegan, and Rawaheng. Meanwhile, marginally suitable areas are found in 14 villages, including Batuanten, Cikidang, Cilongkok, Gentawangi, Kalisari, Karanglo, Kasegeran, Margasana, Pageraji, Pancurendang, Pandansari, Panembangan, Panusupan, and Rancamaya. Figure 10 below presents the map of coconut farming areas within the Agropolitan Region of Banyumas Regency.

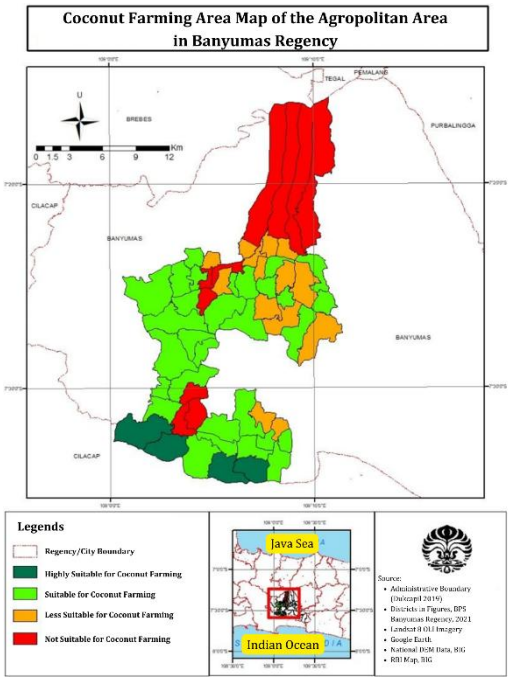

Fig. 10. Map of coconut farming areas of agropolitan area, Banyumas Regency

Based on the coconut farming area map in the Agropolitan Region of Banyumas Regency, it is evident that land suitability varies significantly. As previously explained, 10 villages are classified as unsuitable, while 14 villages fall into the less suitable category. The highly suitable areas are located in the southern part, specifically in four villages, with two villages in Jatilawang District and two villages in Wangon District. These four villages, along with other villages classified as suitable, indicate that coconut farming can still be developed and serve as a key commodity in the Agropolitan Region of Banyumas Regency. However, since coconut-suitable areas are less extensive compared to rice-suitable areas, greater attention is required to ensure the sustainability of coconut production, allowing it to remain a key agricultural commodity in the region.

From the land suitability analysis, it is evident that both rice and coconut farming have significant potential for development across the entire Agropolitan Region of Banyumas Regency. However, in the northern part, coconut farming is not suitable due to unfavorable conditions. Additionally, built-up land poses a constraint in two specific districts, Ajibarang and Wangon, where each district has three villages that are unsuitable for farming due to more than 35% of their land being developed. These six villages are located around the urban areas of Ajibarang and Wangon Districts, making them less ideal for agricultural expansion. Given this land suitability analysis, strategic agricultural land development can be implemented in alignment with land classifications and availability within the Agropolitan Region of Banyumas Regency. This approach can also prevent the conversion of agricultural land—a crucial issue, as an agropolitan area remains an agriculture-based urban region that still requires dedicated agricultural land. The analysis also identifies two clusters, or six villages, where built-up land dominates. These unsuitable areas indicate that spatially, agricultural expansion remains feasible in other villages where both rice and coconut farming can be developed comprehensively. Meanwhile, the two separate built-up clusters can be repurposed for urban development and production centers, making them more effective in serving the entire Agropolitan Region of Banyumas Regency.

3.4.2 Markets and urban centers

The selection of market and urban center locations is crucial in an agropolitan area, as these centers serve as the core hubs for governance, economic activities, services, and trade. In the Agropolitan Region of Banyumas Regency, these locations will function as the main centers that support the entire region while also serving as market hubs for rice and coconut commodities, both within and beyond the agropolitan area. By applying the composite index analysis, the most suitable locations for markets and urban centers can be objectively determined, as this method allows for a multicriteria evaluation. Figure 11 (referenced below) illustrates a map displaying the suitability of locations for markets and urban centers within the Agropolitan Region of Banyumas Regency.

Based on the composite index analysis on the Figure 11 below, the suitability of locations for the agropolitan center in the Banyumas Regency Agropolitan Area is classified into three categories. A total of 14 villages are considered fairly suitable for establishing market and urban centers. However, selecting any of these 14 villages as the location for market and urban centers would require higher costs and greater effort. The most feasible option is to designate one of the four villages classified as highly suitable as the location for market and urban centers.

The composite index analysis enables the identification of these four highly suitable villages due to their existing urban characteristics and infrastructure support. Among these, Ajibarang District has two villages classified as highly suitable, namely Ajibarang Wetan and Ajibarang Kulon. Meanwhile, Wangon District and Cilongok District each have one highly suitable village. When linked with the land suitability analysis for agricultural activities, two villages are found to be unsuitable for agricultural expansion but highly suitable for market and urban centers. These villages are Ajibarang Wetan in Ajibarang District and Banteran in Wangon District. Despite not being district capitals, these villages can be developed as agropolitan centers due to their high suitability for markets and urban centers in the

Banyumas Regency Agropolitan Area. Among the four villages identified, Ajibarang Wetan has the highest composite index score, making it the most suitable location for market and urban centers.

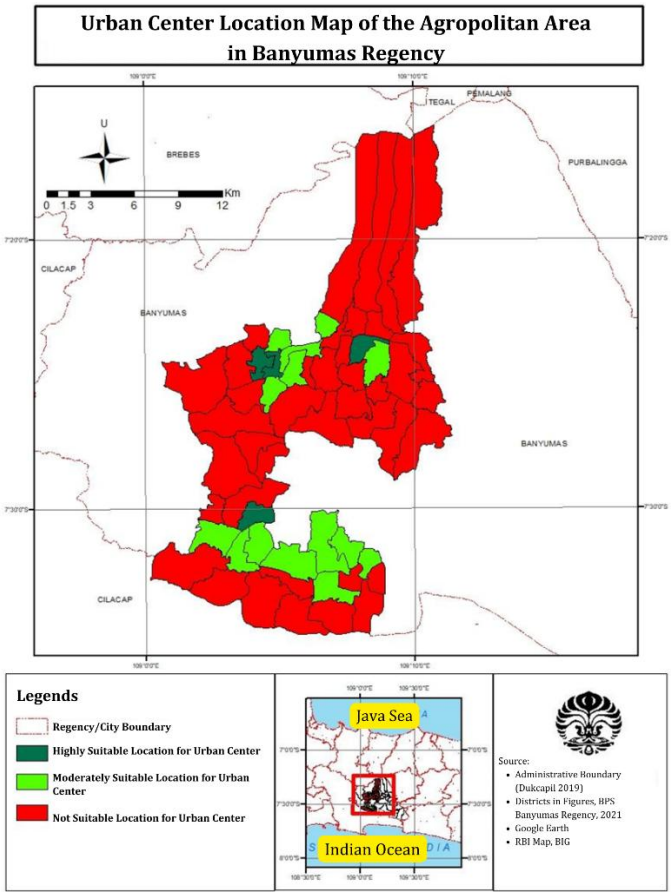

Fig. 11. Map of market and urban locations of the agropolitan area of Banyumas Regency

Additionally, Pernasidi Village, located in the western part of the map and serving as the district capital of Cilongok District, is also classified as highly suitable for market and urban center development. This indicates the strong infrastructure support and urban characteristics present in this largest district within the Banyumas Regency Agropolitan Area. On the other hand, the presence of two non-capital villages that are suitable for market and urban centers highlights the potential for market and urban center development in strategic locations based on the composite index values.

3.4.3 Production centers

In this study, the development of the Banyumas Regency Agropolitan Area focuses on two main commodities, namely rice and coconut. To enhance the added value of these commodities and establish them as key drivers of economic activities in the region, the development of production centers is essential. This involves processing rice into milled rice and coconuts into coconut sugar and crystal sugar.

The processing activities must be agglomerated, and the most suitable locations for these production centers must be identified. For the rice milling industry, the location of rice milling facilities does not incur significant costs; therefore, the supporting industrial criteria play a crucial role in determining their placement. In contrast, for the coconut sugar industry, proximity to raw materials is a critical factor in selecting the location for the coconut sugar production center, although proximity to markets is also an important consideration. Figure 12 below presents a map illustrating the suitability of production center locations in the Banyumas Regency Agropolitan Area.

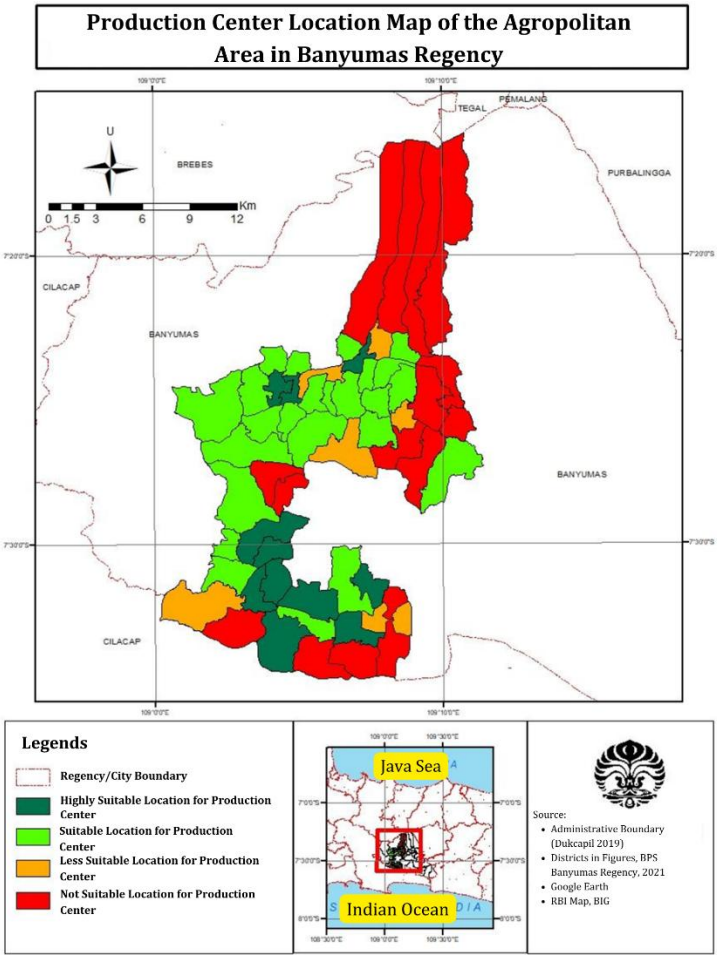

Fig. 12. Map of the location of the production center of the agropolitan area, Banyumas Regency

Based on the map above, the production center locations are classified into four suitability categories, with a considerable number of areas classified as suitable and highly suitable within the Banyumas Regency Agropolitan Area. The highly suitable category includes 11 villages, with eight of them located in the southern part, particularly in Jatilawang and Wangon Districts. Meanwhile, suitable areas are more evenly distributed across the Banyumas Regency Agropolitan Area. This distribution is possible because production centers, particularly those for rice milling, do not require extensive special treatment. The most important factor in determining the location of production centers is to foster agglomeration, both for rice milling industries and the crystal coconut sugar industry. This agglomeration is expected to reduce costs and increase productivity in processing these commodities. Furthermore, establishing production centers is expected to enhance connectivity between farming areas and urban centers in the Banyumas Regency Agropolitan Area, aligning with the core objectives of the agropolitan development concept. On the other hand, the substantial number of villages classified as suitable or highly suitable, compared to those classified as less suitable or unsuitable, indicates that rice and coconut commodities have significant potential to be developed as key economic drivers in the Banyumas Regency Agropolitan Area.

3.5 System and regional connectivity

To understand the system and regional connectivity within the Banyumas Regency Agropolitan Area, it is essential to analyze the existing conditions in the region. Based on the collected data, both physical and social characteristics that influence agricultural activities and development in the agropolitan area can be examined.

3.5.1 Physical characteristics

In terms of climatic conditions, the Banyumas Regency Agropolitan Area exhibits a relatively uniform climate. The central and southern regions demonstrate the highest uniformity, as reflected in the dominant temperature range of 22°C to 26°C. The presence of built-up land and the concentration of human activities contribute to higher temperatures. In Ajibarang and Wangon Subdistricts, where built-up land is more intensively utilized, the temperature tends to be higher than the average in other parts of the Banyumas Regency Agropolitan Area. Indirectly, the accumulation of human activities, which increases temperature levels, can affect the suitability of land for agriculture, in addition to the physical limitations posed by built-up land. In terms of rainfall patterns, the Banyumas Regency Agropolitan Area, located on the southern slopes of Mount Slamet, experiences relatively high annual rainfall. Moving northward, closer to the peak of Mount Slamet, the rainfall intensity increases. This has a significant impact on agricultural activities, as many rice fields in the area rely on rain-fed irrigation, which aligns with the high rainfall levels throughout the year.

The elevation in the Banyumas Regency Agropolitan Area varies significantly, with higher altitudes found in the northern regions. The southern and central regions, characterized by relatively flat terrain, serve as primary settlement areas and built-up land concentrations. Meanwhile, areas with steeper slopes are less inhabited and less suitable for agricultural expansion. This is reflected in population density patterns, where higher population densities are observed in lowland areas compared to hilltop villages. Additionally, the Banyumas Regency Agropolitan Area shares borders with several neighboring regencies. The southern border with Cilacap Regency is considered strategic. The four subdistricts within this area are traversed by major roads, which play a crucial role in regional connectivity. In the central region, Cilongok and Ajibarang Subdistricts are crossed by a major route connecting Banyumas Regency to the northern coastal area (Pantura), while in the south, Wangon and Jatilawang Subdistricts are connected by a cross-regional highway linking Banyumas Regency to Cilacap Regency. These road networks have influenced the linear expansion of built-up areas along transportation corridors. Conversely, in the northern highland regions, there is minimal human activity concentration, particularly along the border areas, which are predominantly covered by forest. This pattern highlights that the physical characteristics of the Banyumas Regency Agropolitan Area tend to be homogeneous in the central and southern lowlands, while the northern highlands become increasingly less suitable for both settlement and agricultural activities.

3.5.2 Social characteristics

Agriculture remains the primary economic activity for residents in the Banyumas Regency Agropolitan Area. Rice farming is prevalent throughout the region, with agricultural practices being passed down through generations. Historical records indicate that since the 16th century, when Banyumas Regency was still part of the Pajang Sultanate, the local community had already developed expertise in farming. However, declining farmer incomes have led to a decrease in young farmer regeneration within the Banyumas Regency Agropolitan Area. This trend has also contributed to the conversion of agricultural land into built-up areas. Based on interviews conducted with local farmers, it was found that most farmers do not own the land they cultivate but rather lease it. Consequently, they do not always sell their harvests directly, as middlemen (tengkulak) often visit farms—particularly in the southern part of the Banyumas Regency Agropolitan Area—to purchase crops at the farm level.

A similar pattern is observed in coconut farming. Traditionally, coconut sap tapping families possess inherited expertise in processing coconut sap into coconut sugar. In this family-based production system, fathers and sons are responsible for tapping coconut sap, while mothers and daughters handle the processing of the sap into coconut sugar. This

traditional family structure is commonly found in the Banyumas Regency Agropolitan Area, particularly in Cilongok Subdistrict. In recent years, higher levels of education have contributed to improvements in processing techniques, allowing for the production of crystal coconut sugar, which holds higher market value and export potential. Additionally, technological advancements in agriculture have been facilitated by greater openness and accessibility, further supporting agricultural innovation within the Banyumas Regency Agropolitan Area. The suitability of locations for production centers is also strongly influenced by accessibility, which remains a key factor in determining optimal sites for agro-industrial development.

3.5.3 Accessibility

The accessibility assessment in the Banyumas Regency Agropolitan Area primarily focuses on the road network. In terms of density, the road network in this area is relatively well-developed. There are two main roads: a primary arterial road in the southern region, passing through Jatilawang and Wangon Subdistricts, and a primary collector road in the northern region, passing through Ajibarang and Cilongok Subdistricts. Additionally, another primary collector road runs north to south, connecting Ajibarang and Wangon Subdistricts. These roads are part of the national road network, which provides high accessibility. Moreover, all four subdistricts are already served by public transportation, including buses and other public transport modes. Therefore, accessibility along these primary roads is well-established across the four subdistricts.

The well-developed primary road network is further supported by a secondary road network that connects villages. Observations indicate that the road network effectively links villages both within subdistricts and between subdistricts in the Banyumas Regency Agropolitan Area. According to interviews with local stakeholders, agricultural products from farming areas are directly connected to production centers within the Banyumas Regency Agropolitan Area, including rice milling facilities and coconut sugar processing industries. However, not all processed agricultural products are sold exclusively within the local markets of the Banyumas Regency Agropolitan Area. This indicates strong accessibility, facilitating high functional connectivity not only within the agropolitan area but also beyond its boundaries. Based on interview findings, three models have been developed to illustrate the system and connectivity within the Banyumas Regency Agropolitan Area. The table below presents these three models.

Table 11. Model of marketing system for agropolitan area, Banyumas Regency

Indicator	Model 1	Model 2	Model 3
Rice field location	Located on the sub-district road	Located on the sub-district road	Being on the village road
Production process	Bought by middlemen	Bought by middlemen	Ground and sold in-house
Marketing locations	Within the Banyumas Regency	Outside the Banyumas Regency Region	Within the Banyumas Regency
Sub-district area	Wangon District Cilongok District	Jatilawang District	Ajibarang District

4. Conclusions

This study concludes that rice and coconut generally have good land suitability for development in the Agropolitan Area of Banyumas Regency. Out of 58 villages, six are unsuitable for farming due to built-up land, along with four villages unsuitable for coconut farming. Additionally, four villages are highly suitable for markets and urban centers, with two located in Ajibarang District and one each in Wangon and Cilongok Districts. For production centers, 11 villages are identified as highly suitable for development. In terms of regional characteristics, farming areas are primarily located in the central and southern lowlands, supported by population concentration in these areas. Furthermore, accessibility

analysis indicates that the connectivity and commodity supply chain among functional areas are well integrated.

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