

ORIGINAL RESEARCH PAPER

Aerotropolis, economic development, and agriculture synergy: International airports' influence on regional growth and SDG achievement

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ABSTRACT

BACKGROUND AND OBJECTIVES: The aerotropolis concept has been increasingly recognized as a driver of regional economic development. However, its impact on social, agricultural, and environmental factors remained underexplored, particularly in regions surrounding newly developed international airports. This study analyzed the influence of the aerotropolis concept, which was reviewed from a regional, social, agricultural, and environmental perspective, on the economy of the Yogyakarta International Airport area.

METHODS: This study examined 10 districts and cities around Yogyakarta International Airport from 2017–2023. The data were analyzed using panel data regression and further analyzed using spatial analysis with Geo-Map Orange Data Mining. The aerotropolis concept was adopted to understand the interaction between these factors in the region's economic development around Yogyakarta International Airport.

FINDINGS: The results revealed that all variables significantly influenced GRDP ($p < 0.01$). A 1% increase in average schooling raised GRDP by 3.23%, population by 1.63%, and agricultural land by 0.70%. Meanwhile, a 1% increase in distance from YIA reduced GRDP by 0.69%, confirming spatial proximity's economic advantage.

CONCLUSION: Implementing the aerotropolis concept in the area around Yogyakarta International Airport created a synergy between education, demographics, and the agricultural sector, which supported dynamic and sustainable economic growth overall.

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INTRODUCTION

Yogyakarta International Airport (YIA) is an international airport in the Special Region of Yogyakarta Province (DIY) and also the Province of Central Java (Fatimah & Rahayu, 2023). The construction of the airport, which began in the last year of 2018, cost approximately Rp 12 trillion on a land of 600 hectares (Suyoto et al., 2022). The construction of YIA aims to increase the capacity of both domestic and foreign flights, which at the previous airport, Adisucipto International Airport, could not accommodate a larger number of passengers (Basuki et al., 2023). YIA International Airport is located in Temon District, Kulon Progo Regency, Special Region of Yogyakarta, which is precisely located in 10 affected districts/cities, namely: Kulon Progo Regency, Bantul Regency, Sleman Regency, Gunungkidul Regency, Yogyakarta City, Klaten Regency, Kebumen Regency, Magelang Regency, Magelang City, and Purworejo Regency. The existence of YIA International Airport plays a role as the main driver in accelerating economic growth in Kulon Progo Regency and its surroundings (Rahmawati, 2022). The presence of the airport increases accessibility to this area, which in turn facilitates the movement of goods and people. The impact directly encourages an increase in trade, investment, and business activities in the region. This

influence can be seen from the increase in regional revenue through the calculation of Gross Regional Domestic Product (GRDP). Several areas that are close to YIA International Airport have an indirect influence or effect on the economy, especially within a radius of 18 – 87 kilometers from the city center to Yogyakarta International Airport. These areas include Sleman Regency, Kulon Progo Regency, Yogyakarta City, Gunungkidul Regency, Bantul Regency, Magelang City, Magelang Regency, Purworejo Regency, Kebumen Regency, and Klaten Regency. The ten regions are located in Central Java Province and Yogyakarta Regional Province, as shown on the map in Fig. 1. In addition to location, according to research by Yenny & Anwar (2020), Desmawan et al., (2023), and Hasibuan & Rukiah (2023), the economic level of an area is influenced by the number of residents of that area. The more people in an area, especially the productive age population, the more the economic level of the area will increase. A large population provides a large workforce that can be used in various sectors of the economy, such as industry, agriculture, and services. This increases productivity and economic output. The population of an area is a potential resource that can contribute to productivity to produce output (Sakkaraeva et al., 2024). Improving the quality of human resources can be done, one of which is

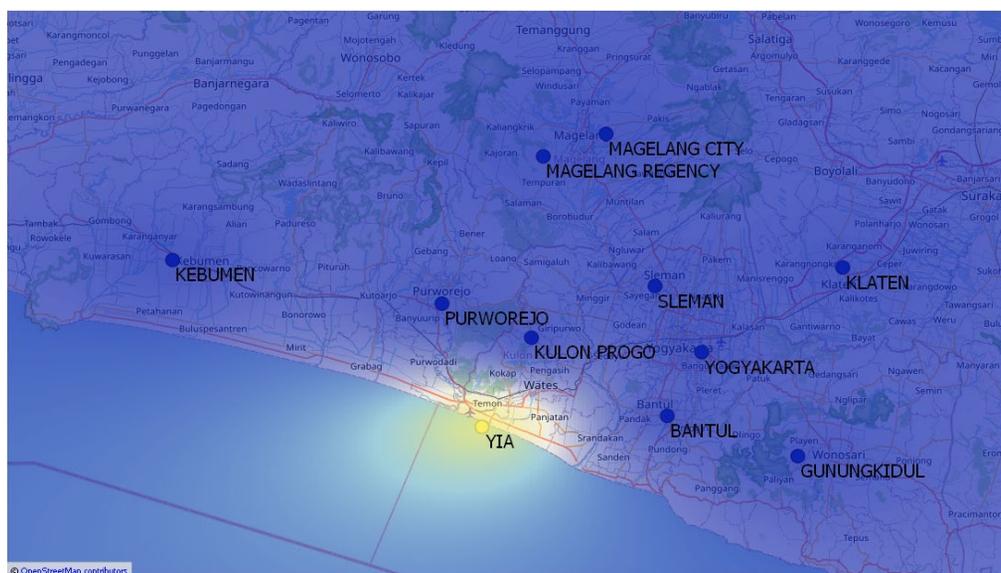


Fig. 1: Map of regency and city locations around YIA airport (Source: Central Statistics Agency of Indonesia processed using Orange Data Mining GeoMap (2025)).

through the implementation of basic education. According to data from the Central Statistics Agency in 2023, as many as 40% of the population aged 15 years and above in Indonesia have the highest high school education or higher. However, as many as 3.4% of the population in Indonesia still have never received formal education at all. Research conducted by [Fatimah & Rahayu \(2023\)](#), [Kevin et al., \(2022\)](#), and [Sitorus et al. \(2024\)](#) raises the fact that areas that have good population quality characterized by a high average level of school length tend to have a relatively better economic level compared to areas with a low average length of schooling. Adequate formal education can support the thinking power and personality influence patterns of a person to have a better economic status. Central Java Province and the Special Region of Yogyakarta are areas that still depend on the agricultural sector, some of which are even included in the agricultural green belt zone. The Agricultural Green Belt Zone is an area planted with various types of crops, functioning as a green open space that separates urban areas from rural areas. The main goal is to control the expansion of land use and reduce activities that can damage the surrounding environment. The contribution of the agricultural sector to the Gross Regional Domestic Bruto (GRDB) in the two provinces is quite high, as much as 14.28% for Central Java and 9-10% for the Special Region of Yogyakarta. Previous research conducted by [Rahmawati & Mulyaningsih \(2019\)](#) stated that agricultural land, especially large irrigated rice fields, can increase agricultural production, so that the level of GRDB in the agricultural sector also increases. However, there are obstacles faced today, one of which is large-scale development that can narrow rice fields. This is also experienced in ten areas located around YIA International Airport. The construction of the airport also increases the attractiveness of the property business, including hotel and housing development. Thus, several agricultural lands have also changed their function into business and property buildings. The existence of YIA not only provides economic benefits but also presents several challenges. The airport construction process often requires the conversion of agricultural land into commercial areas, which can have an impact on decreasing local food production ([Shcherbak et al., 2024](#)). In addition, the existence of airports can cause environmental problems, such as noise and

air pollution, as well as the risk of flooding. From a social perspective, these changes can trigger population migration and change social dynamics in local communities. Overall, Yogyakarta International Airport makes a significant contribution to the economy of the surrounding area. However, it is very important to manage the negative impacts that may arise so that this economic development can take place sustainably and inclusively. This discussion will be further studied to determine the influence of demographic factors calculated through the population, social factors through the average length of schooling, the area of agricultural land, and the distance between the city center and YIA International Airport on GRDP. The data used is secondary data covering ten districts/cities, namely Sleman Regency, Kulon Progo Regency, Yogyakarta City, Gunungkidul Regency, Bantul Regency, Magelang City, Magelang Regency, Purworejo Regency, Kebumen Regency, and Klaten Regency, within a period of 6 years, namely 2017 – 2023. The data was processed using panel regression and then further analyzed using GeoMap Orange Data Mining spatial analysis. Although the aerotropolis model has been studied in various contexts, empirical research on its comprehensive impacts, particularly integrating demographic, educational, agricultural, and locational factors, remains scarce in the Indonesian setting. Specifically, the economic implications of the newly developed YIA have not been thoroughly examined. Therefore, this study aims to analyze the impact of YIA on regional economic growth by examining the influence of population size, education levels, agricultural land, and proximity to the airport. The aerotropolis concept has been widely recognized as a catalyst for regional economic development by integrating transportation hubs with urban and economic activities. However, empirical studies that comprehensively examine its impact on demographic, educational, agricultural, and locational factors remain limited, particularly in the context of newly developed airports such as YIA. Most existing research focuses only on general economic outcomes, leaving a gap in understanding the multidimensional influences of aerotropolis development. This study addresses this gap by providing empirical evidence on the economic dynamics in the regions surrounding YIA. To achieve these objectives, this research examined 10 districts and cities around YIA, Indonesia, from 2017 to 2023.

MATERIALS AND METHODS

The data used in this study is secondary data sourced from the Central Statistics Agency (BPS) of Indonesia in the range of 2017 – 2023. The determination of the period was taken into consideration because the concept of aerotropolis at YIA Airport had begun to be launched and compiled since the initial construction of the airport in 2017. The range was also chosen because of the latest data available until 2023. There are two types of variables used, namely the dependent variable in the form of GRDB and the independent variable, namely demographic and distance factors, namely the population, the average length of schooling, the area of agricultural land, and the distance between YIA Airport and the city and district centers. The following (Table 1) are operational definitions of variables and data sources.

The data was then processed using two methods, namely panel data regression and Orange Data Mining Geo Map analysis. Panel data regression analysis is a statistical approach used to evaluate data that has two dimensions, namely the time dimension (time-series) and the individual dimension (cross-sectional). The data panel consists of repeated observations coming from the same individual or unit over time. According to Kurniawati & Sugiyanto (2021), there are three main approaches in panel data regression analysis, namely the Pooled Least Square (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM). PLS integrates all panel data into one large dataset and estimates the regression model using the usual least squares method. On the other hand, FEM assumes that each unit has unique characteristics that remain constant over time, using dummy variables for each unit in estimating those characteristics.

Meanwhile, REM assumes that the differences between individual units are random and do not correlate with independent variables, making it more efficient in terms of the number of parameters estimated because it does not require a dummy variable for each unit. The choice between FEM and REM should be based on assumptions regarding the correlation between independent variables and individual differences; if this assumption is met, REM is more appropriately used, while if not, FEM is more appropriate. This approach assists researchers in dealing with individual heterogeneity and time dynamics, which ultimately improves the efficiency and validity of estimates in panel data analysis. The following is the equation of the regression analysis of panel data in this study:

$$LnPDRB_{it} = \alpha_{it} + LnLHP_{it} + LnJP_{it} + LnRRLS_{it} + LnYIA_{it} + e_{it} \quad (1)$$

Where the $LnPDRB_{it}$ is GRDP, $LnLHP$ is the area of agricultural land, $LnRRLS_{it}$ the average length of schooling, and $LnYIA_{it}$ the distance between YIA airport and the city/district center, where all variables are in natural logarithmic units. The next analysis is the mapping of factors that affect GRDB using the Orange Data Mining Geo Map. This method is used to see the distribution of data based on the average economic, social, agricultural, and environmental factors that affect GRDB in 10 districts and cities around YIA. $LnPDRB_{it}$, $LnLHP_{it}$, $LnRRLS_{it}$, $LnYIA_{it}$ (Ratnadewati et al., 2024). The distribution can be seen from the dots and also the colour, which illustrates how much influence it has on the amount of GRDB. The analysis is illustrated in Fig. 2.

Table 1: Variable operational definition (Source: Processed from Indonesian Central Statistics Agency, 2025)

No	Types of Variables	Variable	Information
1.	Dependent	Gross Regional Domestic Bruto	GRDB based on the price valid for the year 2017 – 2023 in Billion Rupiah
2.	Independent	a. Number of Population	The population from 2017 – 2023 is in millions of people.
		b. The average length of school.	The average length of schooling for residents in 2017 – 2023 in units of years.
		c. The area of agricultural land.	Total area of agricultural land in 2017 – 2023 in units (Ha)
		d. Distance between YIA airport and the city/district center.	Distance between YIA airport and the city/district center in km

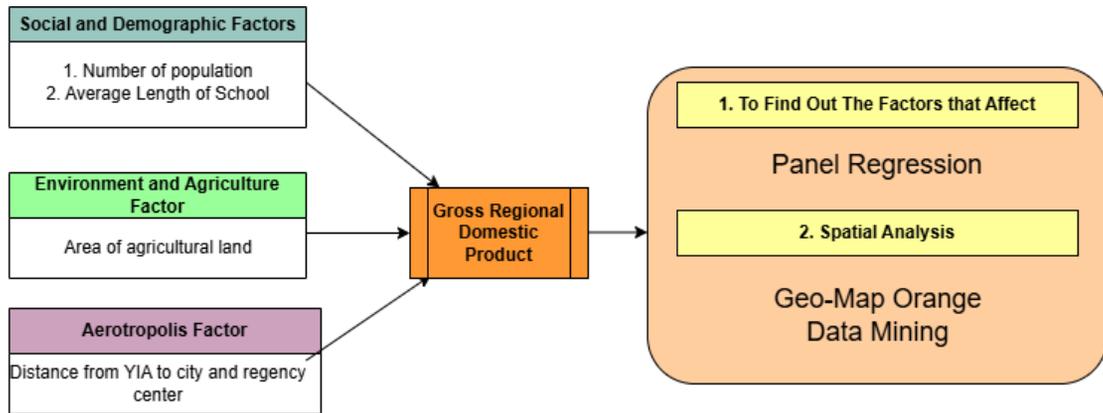


Fig. 2: Steps of research

RESULTS AND DISCUSSION

Factors affecting GRDP

- *Chow test*

It is a tool used to determine the most accurate model between fixed effect and common effect (Anugerah & Nuraini, 2021). The hypothesis used in the Chow test is H0 if the chi-square > 0.05, then the selected model is a common effect, and H1 if the chi-square is < 0.05, then the selected model is a fixed effect. The results show that the chi-square value < 0.05 means that the selected model is a fixed-effect model.

- *Hausman test*

It is a test used to determine the right model between fixed effect and random effect. The hypothesis used is that if H0 is if the chi-square probability value is more than > 0.05, then the model chosen is fixed effect, and H1 is if the chi-square probability value is < 0.05, then the model chosen is random effect. The results show that the probability value is > 0.05, so the appropriate model is a fixed effect model.

Classical assumption testing

To ensure the validity and reliability of the panel data regression analysis, classical assumption tests were conducted. The results are as follows:

- **Normality Test:** The Jarque-Bera test indicated that the residuals were normally distributed, with a p-value of 0.128 (> 0.05), suggesting no violation of the normality assumption.
- **Heteroskedasticity Test:** The Breusch-Pagan test yielded a p-value of 0.217 (> 0.05), indicating the

absence of heteroskedasticity across the dataset.

- **Multicollinearity Test:** The Variance Inflation Factor (VIF) values for all independent variables were below 3, confirming that multicollinearity was not present.

Based on these tests, the model fulfills the classical assumptions, ensuring that the estimated coefficients are unbiased, consistent, and efficient.

Results of panel data regression analysis

The regression analysis of panel data was used to determine social, demographic, environmental, agricultural, and aerotropolis factors that affect the GRDP. The results are seen from the probability value of each variable with an error tolerance rate of 5%. The test results from ten districts and cities around YIA from 2017 – 2023 are shown in Table 2.

Table 2 is the result of the regression analysis of panel data shown through the following equation:

$$\begin{aligned} \text{LnPDRB}_{it} = & -8,44_{it} + 0,70\text{LnLHP}_{it} + \\ & 1,63\text{LnJP}_{it} + 3,22\text{LnRRLS}_{it} - 0,69_{it} + e_{it} \end{aligned} \quad (2)$$

Table 2: Results of panel data regression analysis (Source: Processed from Indonesian Central Statistics Agency, 2025)

Variable	Coefficient	Probability
C	-8.44	0.0002
LNLHP	0.70	0.0000
LNJP	1.63	0.0000
LNRRLS	3.23	0.0000
LNZIA	-0.69	0.0000

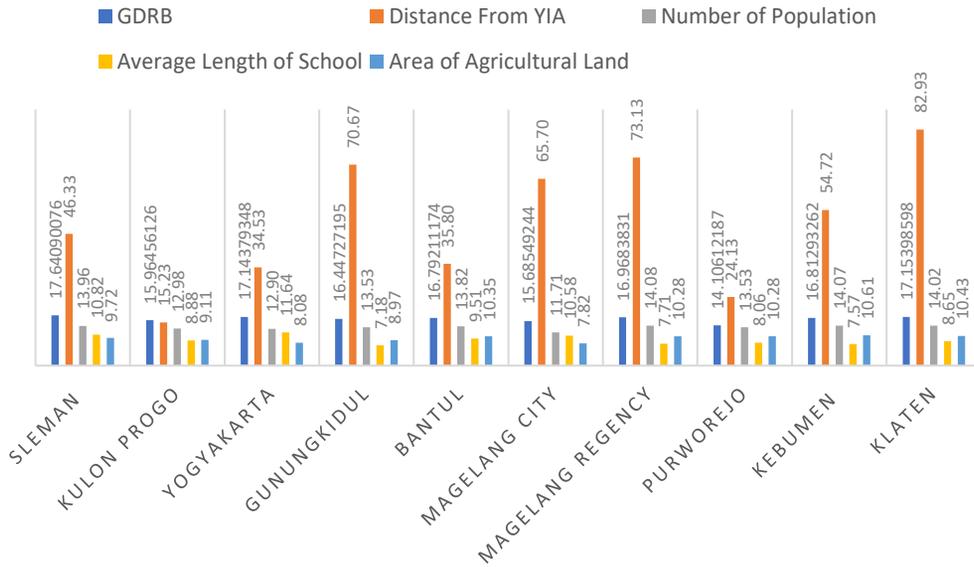


Fig. 3: Average dependent and independent variables in 10 cities and regencies around YIA in 2017 – 2023 (Source: Processed from Indonesian Central Statistics Agency, 2025.)



Fig. 4: Average GRDP in 10 cities and regencies around YIA In 2017 – 2023 (Source: Central Statistics Agency of Indonesia, Processed Using Orange Data Mining Geomap, 2025.)

The equation shows that the economic condition in Sleman Regency, Kulon Progo Regency, Yogyakarta City, Gunungkidul Regency, Bantul Regency, Magelang City, Magelang Regency, Purworejo Regency, Kebumen Regency, and Klaten Regency will decrease by -8.44% if other variables are worth 0. Table 2 shows that the probability value of all independent variables < 0.05, so it shows that the

area of agricultural land influences the GRDB value of these areas, the population, the average length of schooling, and the distance between YIA Airport and the city center or district.

In the period from 2017 to 2023, the ten regions show an increasing trend in the average GRDP, as in Fig. 3. The city of Yogyakarta recorded an increase in GRDP from IDR 150 billion in 2017 to IDR 200

billion in 2023. Meanwhile, the Bantul Regency experienced growth from Rp 80 billion to Rp 100 billion, and the Sleman Regency increased from Rp 90 billion to Rp 120 billion. Gunungkidul, Kulon Progo, Purworejo, and Kebumen Regencies also showed a significant increase in GRDB. In addition, Magelang City, Magelang Regency, and Klaten Regency also experienced GRDB growth in the same period as in Fig. 4. This increase reflects a faster pace of economic development in urban areas compared to rural areas, as well as the contribution of sectors such as education, tourism, and agriculture to regional economic growth. Furthermore, this increase in GRDB contributes to the achievement of the Sustainable Development Goals (SDGs) by creating jobs, improving people's welfare, and supporting sustainable economic growth (Alfaris & Rustam, 2023; Nandita *et al.*, 2019; Hidayah & Tallo, 2020; Putra & Suharto, 2024). The economic condition in these areas is still supported by the agricultural sector, especially rice paddy areas that produce rice as a staple food. This is the result of the regression analysis of panel data, which shows that if there is an increase in agricultural land area by 1%, the GRDP will increase by 0.70%. The area of agricultural land has a significant impact on the GRDP in the area around YIA (Pradana *et al.*, 2020). The agricultural sector makes a substantial contribution to GRDB, especially through the production of food crops and horticulture. With the increase in agricultural land area, food production can be increased, which in turn supports

food security and the local economy (Susanto, 2021). In addition, this sector also functions in creating jobs and improving people's welfare. However, it is important to note that the conversion of land from paddy fields to non-paddy fields also affects GRDP. Changes in economic structure, population growth, and industrial development also contribute to changes in the area of agricultural land and GRDB. The distribution of agricultural land can also be seen from the mapping results in spatial analysis using Geo-Map Orange Data Mining in Fig. 5.

Fig. 5 shows that Kebumen Regency, Klaten Regency, and Bantul Regency are the areas with the largest agricultural land area of these areas. The agricultural sector plays a role as one of the important economic pillars, especially in rural areas. With an increase in land area, agricultural production can increase, which has the potential to increase regional GRDB (Nilawati, 2019). However, although the area of agricultural land has a significant role, collaboration with other factors is urgently needed to encourage an overall increase in GRDB (Ahmad *et al.*, 2023; Anggreani *et al.*, 2023; Raihan *et al.*, 2023).

The second factor that affects the population is that every 1% increase in the number of people will increase the value of GRDB by 1.63%. Population growth often contributes to an increase in the value of the GRDB. As the population increases, the consumption of goods and services in a region generally increases, which in turn drives economic activity (Astuty *et al.*, 2025). In addition, a larger

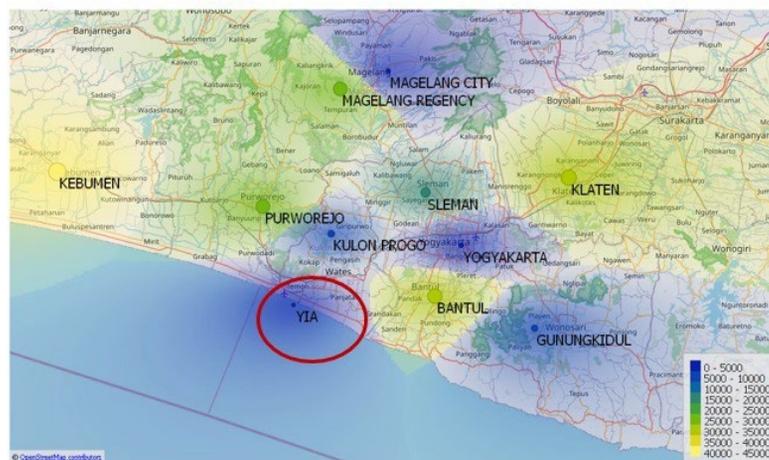


Fig. 5: Average agricultural land in 10 cities and regencies around YIA in 2017–2023 (Source: Central Statistics Agency of Indonesia, processed using Orange Data Mining GeoMap, 2025.)

population provides a larger workforce that can be utilized in various industrial and service sectors, potentially increasing productivity and economic output. However, this effect is greatly influenced by a variety of other factors, such as education levels, workforce skills, investment in infrastructure, and economic policies implemented (Pooja & Bhavani, 2025). Therefore, effective human resource management and appropriate investment are essential to ensure that population growth has a positive impact on economic growth and GRDB improvement. Thus, a larger population can be one of the main drivers of economic growth if managed properly. One of them is shown in Fig. 6, where Kebumen Regency, Sleman Regency, Klaten Regency, and Bantul Regency are the areas with the largest populations.

The third variable that affects GRDB is the Average Length of School symbolized by RRLS where every 1% increase in RRLS will increase GRDB by 3.23%. The average length of education has a significant impact on the GRDB in the area around YIA. Research indicates that an increase in the average length of education can improve the quality of the workforce, which in turn contributes to economic growth and an increase in GRDB. Better education strengthens

the capabilities of human resources, increases productivity, and encourages innovation, all of which have a positive effect on GRDB (Hepi & Zakiah, 2018). Yogyakarta City, Magelang City, and Sleman Regency are the areas with the highest RRLS, which is 11 years old or at the Senior High School level. This result is also evidenced by the high level of GRDB of the three regions, which can be seen in Fig. 7.

The last variable, namely the distance between YIA Airport and the city center or district that is affected, namely the district or city with a closer distance from the airport, will increase the GRDB value by 0.69%. YIA, located in Kulon Progo, can be linked to the concept of aerotropolis, which is closely related to the GRDP. This concept describes the airport as the economic center and infrastructure of the city that can attract various businesses and economic activities around it. The closer an area is to the YIA, the greater the potential for integration with the aerotropolis ecosystem, which includes commercial, industrial, and logistics areas (Alif & Nugroho, 2021). This contributes to increased connectivity and accessibility, which is crucial for trade and investment. The proximity to the airport makes it easier to transport goods and passengers, speeds up business processes, and encourages the

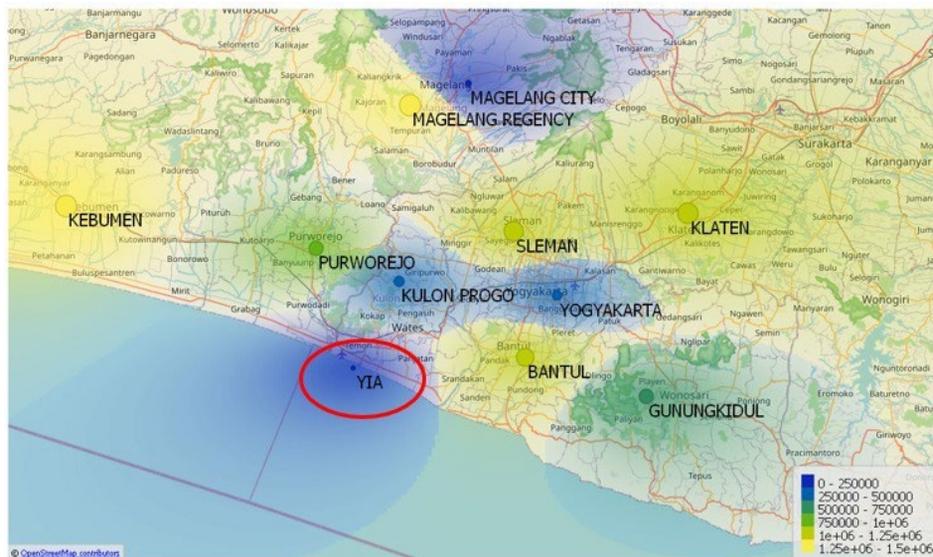


Fig. 6: Average number of populations in 10 cities and regencies around YIA in 2017 – 2023 (Source: Central Statistics Agency of Indonesia, Processed Using Orange Data Mining GeoMap, 2025.)

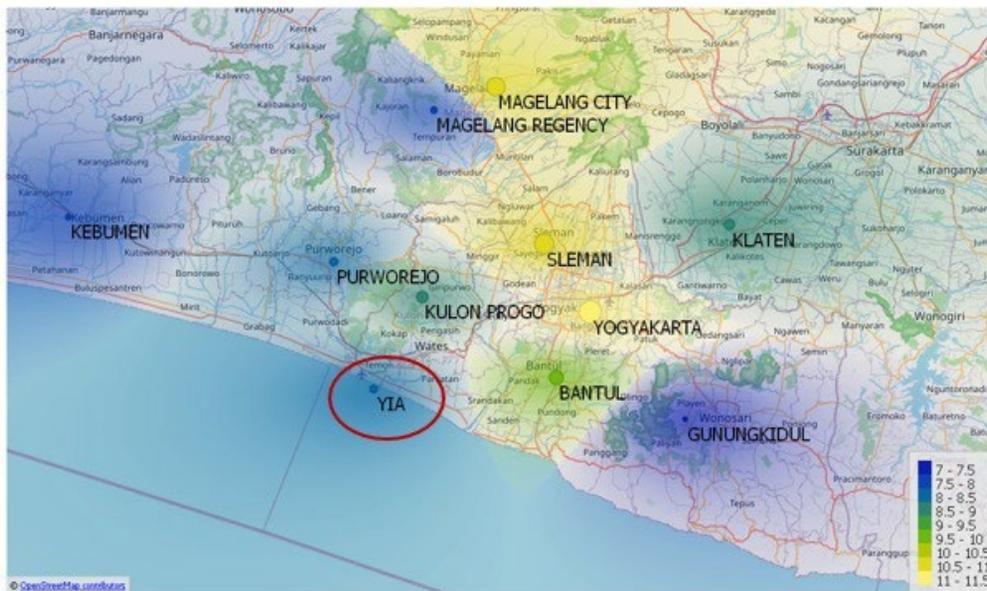


Fig. 7: Average school length in 10 cities and regencies around YIA in 2017– 2023 (Source: Central Statistics Agency of Indonesia, processed using Orange Data Mining GeoMap, 2025.)

growth of sectors such as tourism, real estate, and services (Yu & Santos, 2025). Therefore, areas located closer to YIA have a greater opportunity to attract investment and economic development, which will ultimately increase the value of GRDB. Integrated infrastructure around airports also supports increased productivity and efficiency, as well as encourages innovation and competitiveness at the regional level. The concept of an aerotropolis shows how modern airport infrastructure can serve as a key catalyst for economic growth and regional development, with YIA as a real example of improving the regional economy by increasing the value of GRDB. Integration with the concept of an aerotropolis can maximize this potential, making the area around YIA a center of dynamic and sustainable economic growth.

CONCLUSION

The findings of this study confirm that the aerotropolis development surrounding YIA has generated a dynamic synergy among education quality, population growth, agricultural sustainability, and regional economic performance. Higher levels of education, larger populations, expansive agricultural land, and proximity to the airport were identified as significant drivers of GRDB growth,

emphasizing the multifactorial nature of regional development in the context of new infrastructure investments. The study further demonstrates that in regions where agriculture remains a critical sector, the aerotropolis model can be adapted to integrate both traditional agricultural strengths and emerging commercial opportunities. This reveals the necessity for development strategies that do not solely focus on industrialization, but also protect and enhance agricultural productivity as a foundation for sustainable growth. To ensure balanced development, policymakers should adopt integrated planning approaches that safeguard agricultural zones, invest in educational advancement, and strategically manage urban expansion surrounding airports. Special attention should be directed toward mitigating potential negative effects such as land conversion, environmental degradation, and social displacement through the establishment of regulatory frameworks and participatory planning processes. Moving forward, longitudinal studies are needed to evaluate the long-term impacts of aerotropolis-driven growth, particularly regarding social equity, environmental sustainability, and regional resilience. Future policies should not only aim to maximize economic output but also to promote inclusive, sustainable development

that benefits diverse community groups across urban and rural settings. Thus, the aerotropolis approach can optimize the economic potential of the average length of schooling, the number of residents, the area of agricultural land, and the proximity to the YIA airport to encourage sustainable economic growth in the region.

AUTHOR CONTRIBUTIONS

All authors contributed significantly to the completion of this study. Tri Yuni Iswati was responsible for the conceptualization, methodology design, and overall supervision of the research. Evi Gravitiani contributed to data analysis, validation, and funding acquisition. Prabang Setyono provided methodological guidance and participated in the review and editing process. Ofita Purwani handled the spatial analysis and data visualization. Ainina Ratnadewati conducted the investigation, managed data curation, and prepared the original manuscript draft. All authors reviewed and approved the final version of the manuscript.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy, have been completely witnessed by the authors.

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ABBREVIATIONS (NOMENCLATURE)

α_{it}	Constant
e_{it}	Error term
$LnJP_{it}$	Logarithm of Population
$LnLHP_{it}$	Logarithm of Production Forest Area
$LnPDRB_{it}$	Logarithm of Gross Regional Domestic Product (GRDP)
$LnRRLS_{it}$	Logarithm of Average Years of Schooling
$LnYIA_{it}$	Logarithm of Employment in Agro-Industry
%	Percentage
Ha	Hectares
Km	Kilometre
YIA	Yogyakarta International Airport
GRDB	Gross Regional Domestic Bruto
PLS	Pooled Least Squares
FEM	Fixed Effect Model
REM	Random Effect Model
VIF	Variance Inflation Factor
SDGs	Sustainable Development Goals

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