

Research article

Peri-urbanisation in Surakarta City and Economic Transformation in the Fast-Growing Region of Sukoharjo Regency

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Abstract

The massive development of Surakarta City, a city with a strategic location, has caused a butterfly effect on its surrounding area. This research explores the economic transformation of Sukoharjo's peri-urban, specifically in five districts, namely Mojolaban, Gatak, Grogol, Kartasura, and Baki, as the area adjacent to Surakarta City. A quantitative approach is employed with descriptive quantitative analysis techniques and scoring analysis. Primary data collection is based on the results of stakeholder's interviews and field observations and secondary data gathered from government documents and literature review. The study results show that in the period 2000 – 2020, there has been economic transformation in Sukoharjo's peri-urban area, especially the changes from rural to urban characteristics. The transformation can be indicated by the changes in population, livelihoods, agricultural land-use, regional investment, and the number of emerging small and medium industries (SMIs) in each peri-urban region in the northern part of Sukoharjo. This research contributes a perspective on the unique characteristics of the diverse economic transformation driven by different patterns of land-use changes. It recommends that policymakers foster the roles of peri-urban areas in creating mutual development and sustainable urbanisation.

Keywords: peri-urban area; land-use change; economic transformation; regional investment; small and medium industries.

1. Introduction

Urbanisation, as a key driver of modernisation and economic growth, will keep having a major influence on the global environment. This process involves complex economic, social, and spatial changes, affecting both urban and rural areas and presenting new challenges for sustainable development (Yang *et al.*, 2020). Farming field functions in urbanizing rural areas experience rapid transition along with urban-rural development (Li *et al.*, 2023). The resulting transition could range from a more complex to a simpler function. The closer the rural areas are to the city, the higher the level of agricultural use. This issue shows how diversified land uses lead to multifunctional rural development (Adam and Dadi, 2023; Long *et al.*, 2022; Tadesse and Baye, 2024). Pre-existing economic activity is growing in tandem with new economic activity. Industrial and service sectors are increasing rapidly, while the agricultural sector, which was originally dominant, has decreased productivity (Sroka *et al.*, 2021). This can be called an economic transformation, a change in the structure of the traditional economy (the agricultural sector) to a modern economy (the industrial and service sectors) (Nguyen *et al.*, 2020; Vicol *et al.*, 2018). Economic transformation is a measuring tool that international institutions use to assess the existence of economic development in a region (Ma *et al.*, 2020; Nguyen *et al.*, 2020). In the process of structural transformation, rural communities will be changed into high-income communities because they work in the non-agricultural sector as farming activities are shifting to a more diverse economy (Chen *et al.*, 2019; Shi and Cao, 2020; Vicol *et al.*, 2018).

One of the impacts of this urbanisation process resulted in the occurrence of a transition area between urban and rural areas (Wilson *et al.*, 2018), which is known as the peri-urban area. The transformation of the peri-urban area is characterized by changes that lead to urban experienced by rural areas adjacent to the city. Peri-urban is a space across the city that extends spatially, socially, and economically. Land is essential for various interests and uses (Friedmann, 2016). Friedmann (2016) states that peri-urbanisation is a process of becoming urban in the peripheral areas of a large city. Large-scale residential and industrial projects have been developed due to cheaper land. Some of them are gated settlements that create social segregation (Wang *et al.*, 2023). Peri-urban areas often experience inequalities, as marginalized groups face competition over land and resources (Marshall *et al.*, 2024).

Research about peri-urbanisation mainly demonstrates the suffering of rural areas in facing rapid urban growth resulting from rural-to-urban migration. It brings complicated issues that drive rural



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transformation, where rural people are attracted to work in the city due to the decreasing agricultural productivity in their home villages. There is a phenomenon called rural hollowing in which rural productivity is depressed and agricultural land is abandoned, caused by out-migration (Ge *et al.*, 2020). Demographic policy and better infrastructure in the city become the significant factors that pull rural-urban migration in China (Huang *et al.*, 2018).

Several investigations about urban-to-rural migration have already been studied with a different focus. The work of Takahashi *et al.* (2021) reveals a lifestyle-driven migration. They analyze the outflow of city residents into Hokuto City, the western border region of Tokyo, in search of a better living environment. The other work comes from Dhaka, where Mortoja and Yigitcanlar (2022) find that rural industries attract young people and jobless groups who seek employment. Da Silva *et al.* (2022) conducted a contemporary study on a forest frontier zone in Brazilian Amazonia to examine the application of agroecology and agroforestry in rural development. They investigate the spontaneous movement of the community in search of well-being in rural peace to avoid violence and crime in the city. The study examines how the migrants create new living spaces and livelihoods and build better social relationships. Another research study is currently being done by Sakketa (2023), who reviews urbanisation and its benefits and costs for rural development. Sakketa (2023) points out several of the most influencing factors that determine the impact of urbanisation to the rural economy, i.e., production and consumption linkages, employment linkages, land market linkages, and social interaction linkages. In addition to the current studies is the work of Yu *et al.* (2024) that explores the migration to remote rural areas for living and doing business. It analyzes the driving forces that push the urban upper-middle income groups to move to the Yangtze River Delta region's rural side and the local dwellers' impacts.

In the national context, recent studies about Surakarta and Sukoharjo have been done by Buchori *et al.* (2020). They analyze urbanisation in Sukoharjo and examine the impact of industrial land use on the welfare of local residents. Large industries have become the target of investigation, unlike home-based enterprises. More recently, they broadened the research area, namely the Semarang-Surakarta Metropolitan development corridor (Buchori *et al.*, 2022). They find that the industrial development does not directly impact poverty reduction. Compared to previous studies, this research of peri-urbanisation in Sukoharjo investigates the different transformation rates and the distinctive characteristics of land use and economic changes among the most urbanizing districts.

We investigate the peri-urban areas in Baki, Gatak, Grogol, Kartasura, and Mojolaban Districts in different times and space to track the transformation dynamics in accordance to the following questions. This study aims to explore peri-urbanisation and its effect on economic transformation in Sukoharjo Regency and analyze migration, population, land use, and livelihood changes in areas adjacent to Surakarta City. This work contributes to the existing literature on urbanisation's effect on economic transformation. First, we reveal the resilience of agricultural sectors in Mojolaban. It can be seen how the small and medium industries (SMIs) are developed in coexistence with farmland, while most of the previous studies show the replacement of agrarian-based livelihood (Guan *et al.* 2018). Secondly, our study contributes to a better understanding of raising diverse economic potentials. On a practical level, this research contributes to the importance of the gap mitigation between urban and rural areas by creating economic opportunity in rural areas while still controlling the influx of urban society into the countryside for a better quality of life. This study implies that it is important to understand which parties are more advantaged or disadvantaged. Besides, it is worth knowing about any opportunities in the peri-urban areas that can be developed.

2. Research Methods

Surakarta Metropolitan is one of Java, Indonesia's most vibrant mega-urban. Sukoharjo Regency, a neighboring region of Surakarta City, has been chosen as the case study since it experiences the fastest spatial and socioeconomic changes due to peri-urbanisation. The five districts, namely Mojolaban, Gatak, Grogol, Kartasura, and Baki Districts are peri-urban areas that are directly adjacent to Surakarta City. Surakarta City is one of the cities in Central Java that is growing rapidly and can affect the development of the surrounding area. This has an impact on the transformation or economic changes that occur in the peri-urban areas of Surakarta City, namely Sukoharjo Regency, especially Baki, Gatak, Grogol, Kartasura, and Mojolaban Districts, which have the most significant growth compared to other districts in Sukoharjo Regency.

This research employs an inductive approach to understand the relationship between urbanisation and economic transformation. It begins by identifying key variables, as shown in Figure 2. Data

is collected through in-depth interviews, field observations, and document analysis. This data undergoes descriptive and quantitative analysis to explore urbanisation patterns and calculate economic transformation rates for different districts. Ultimately, the research seeks to understand population dynamics, livelihoods, regional investment, and industrial development within urbanisation.

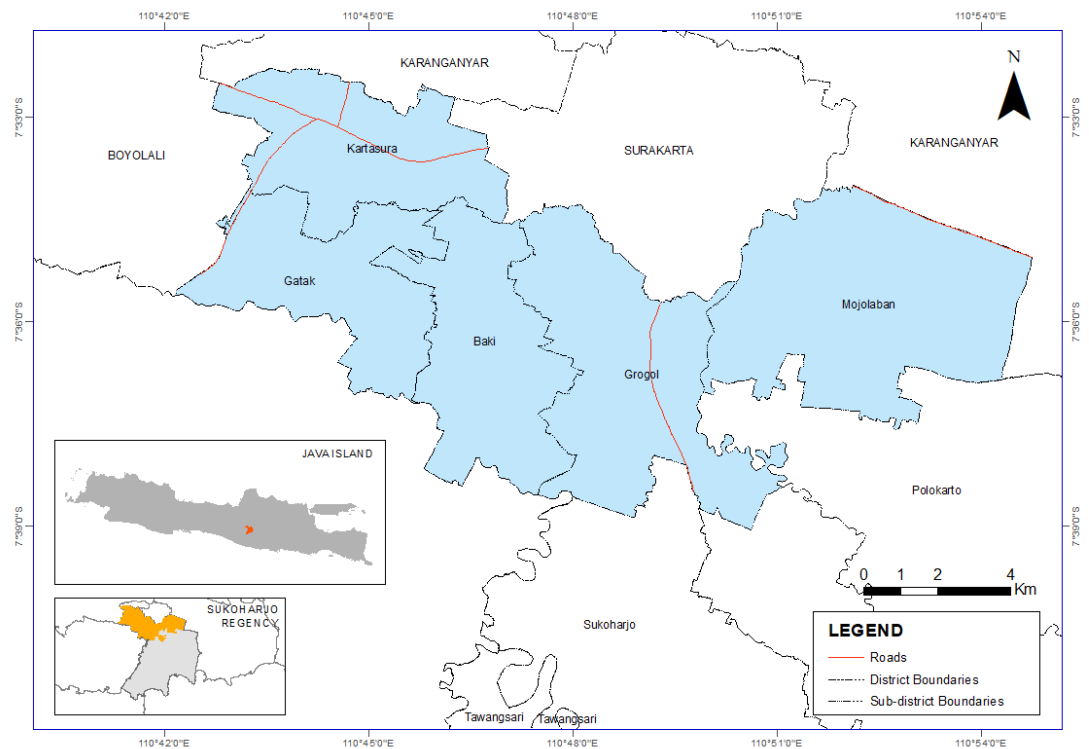


Figure 1. Study Area.

The research starts by gathering and studying existing information through secondary data collection to build a basic understanding of migration and related topics. Secondary data collection is processed using quantitative descriptives to describe population dynamics, livelihood changes, regional investment, and development of industries. The data was obtained from the Central Bureau of Statistics or BPS at the regional level, specifically Sukoharjo Regency, which includes various data classifications at the sub-district level. This first step gives a general idea of the research area. The study also includes in-depth interviews with important individuals to explore migration in more detail. These interviews are meant to collect detailed information about what drives people to migrate, such as personal reasons, economic activities, land deals, and the pros and cons of moving for living or work purposes.

The data collection method in this study is primary data collection based on the results of interviews with stakeholders and field observations, as well as secondary data derived from documents and literature review. The data used in this study are population data, population density, farmer livelihoods, industrial sector livelihoods, land use, number of developments, large industries, and small and medium industries using data from 2000 and 2020. In addition, the ownership of small and medium industries, the origin of labor, and the main sectors in both large and small-medium industries are considered.

Considering the target in this study that leads to quantitative research, the analytical techniques used are descriptive quantitative analysis and scoring analysis. Descriptive analysis provides a detailed overview of the research subject by summarizing and explaining existing conditions and factors within the study area. This study conducted a quantitative description analysis to see the economic transformation in Baki, Gatak, Grogol, Kartasura, and Mojolaban Districts from 2000-2020.

After using descriptive analysis to explore the economic transformation of each variable, a scoring analysis is performed to investigate how the economic transformation differs. The calculation of the classification of the rate of economic transformation in five districts, namely in Baki, Gatak, Grogol, Kartasura, and Mojolaban districts, is based on the number of scores performed on each variable. The variables used are population size, population density, changes in livelihoods in the

agricultural and industrial sectors, the use of paddy fields, the number of developments, the number of large-scale industries, and the number of small and medium industries. The variable with the slow transformation will be scored 1, the score 2 for the medium transformation, and the fast transformation rate will be scored 3.

A scoring analysis assesses the extent of economic transformation across different sub-districts. Data used in the scoring analysis include population number and density, farmer livelihood, industrial sector livelihood, agricultural land use, development number, and a number of large-scale and small and medium-scale industries. This research quantifies economic progress by assigning numerical values to factors like population, livelihoods, and industrial development. These scores were used to classify districts into economic transformation categories, informing variables with the most significant influence and enabling comparisons between districts.

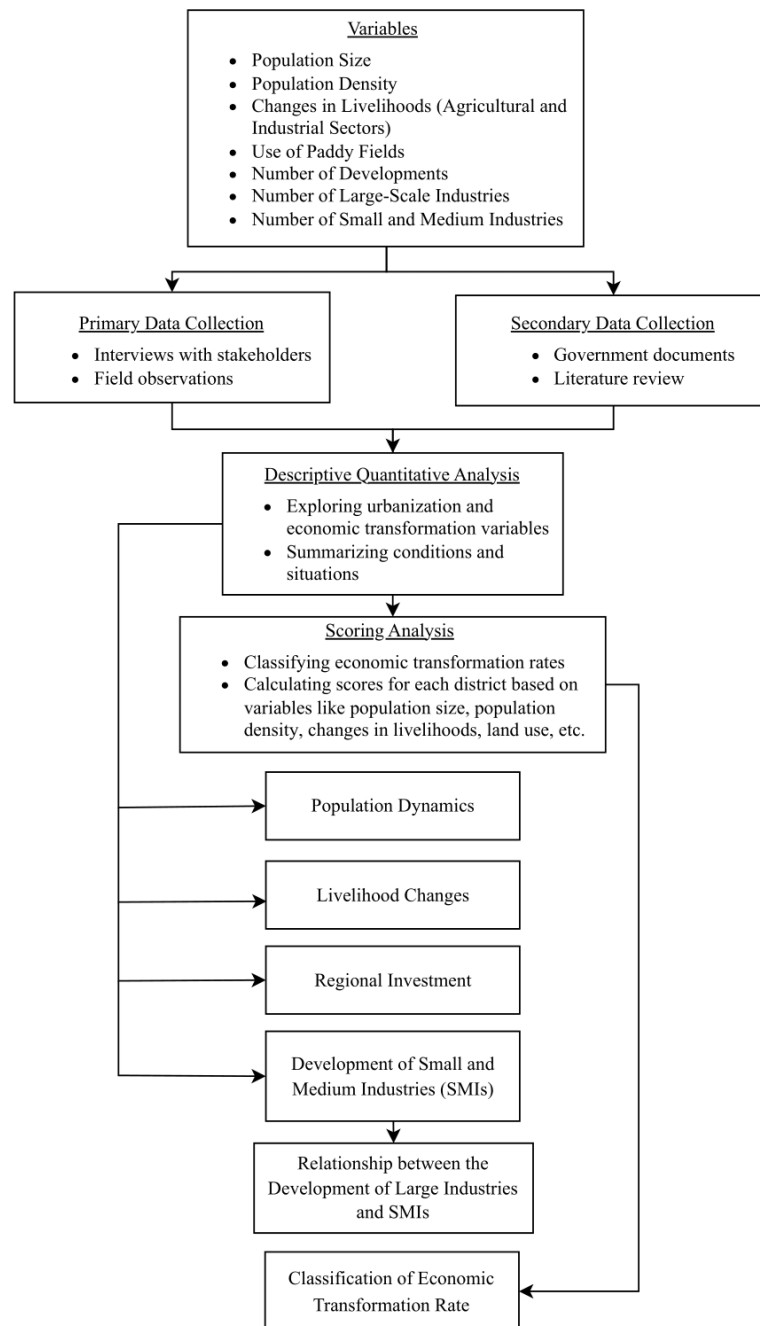


Figure 2. Methodology Diagram.

The economic transformation classification is obtained from the class interval/ range calculation, based on the scoring of each transformation variable. The calculation of the length of the class interval is based on the highest and lowest scores from each district, while the calculation of the interval for the classification of fast, medium, and slow transformation rates is as Equations 1 and 2.

$$\text{Class range} = \frac{\text{Highest value} - \text{Lowest value}}{\text{Number of class}} \tag{1}$$

$$\text{Class range} = \frac{21 - 13}{3} = 2.67 = 3 \tag{2}$$

The class range above is drawn from the scoring results and economic transformation rate classification that can be seen in Table 10. The interval range is divided into three classes based on the class range (2,67). Each class represents the economic transformation rate. They are classified into Slow, Medium, and Fast classes, as shown in Table 1.

Table 1. Classification of Economic Transformation Rate in Each District.

Interval Range	Classification of Economic Transformation Range
13-15	Slow
16-18	Medium
19-21	Fast

3. Results and Discussion

3.1. Migration and Population Dynamics During 2000-2020

One of the things that can affect the phenomenon of regional transformation is population. Population number and density are closely related to the transformation of peri-urban areas. Population density will be positively correlated to a region's transformation level. The increase in population number and density will affect land-use changes, such as the conversion of land use to meet the need for shelter or settlements, impacting land transformation.

The total population in five districts (Baki, Gatak, Grogol, Kartasura, Mojolaban) in 2020 was 492,679 people, which is about 56% of the total population in Sukoharjo Regency amounted to 878,374 people. To examine the transformation or change in the number and population density in the five districts, this study will compare the 20 years between 2000 and 2020. Gatak had the lowest population in 2000 and 2020. Meanwhile, Grogol had the largest population in 2000 and 2020 compared to other districts. As Grogol is the most urbanized district, it can be concluded that urban growth also influences the population size.

Table 2. Total Population in 2000 and 2020.

No	Districts	Year of 2000	The year of 2020	Transformation in percent (%)
1	Baki	48802	81432	66.86
2	Gatak	44798	48778	8.88
3	Grogol	92767	138654	49.46
4	Kartasura	83744	128756	53.75
5	Mojolaban	72054	95059	31.93

As with the increase in number, population density also increases given that the area is fixed, but the population will continue to increase yearly. In 2000, Mojolaban was the district with the lowest population density of 2221 people/km², while Kartasura was the district with the highest population density. In 2020, Gatak District had the lowest density, and Kartasura District was the most densely populated district compared to other districts.

Table 3. Population Density in 2000 and 2020.

No	Districts	2000	2020	Change (%)
1	Baki	2221	3707	66.91
2	Gatak	2301	2506	8.91
3	Grogol	3092	4622	49.48
4	Kartasura	4355	6696	53.75
5	Mojolaban	2027	2657	31.08

Source: Data processed from BPS Sukoharjo Regency, 2021

Based on collective data from 2000 to 2020, Baki experienced the most changes in population density, with an increase of about 67%, while Gatak is the district that experienced the least change compared to other districts, with only around 9%. Changes in population density can be seen in Figure 3.

Considering the information presented above, it can be inferred that each district experienced increased population numbers and population density from 2000 to 2020. The massive development of new residential areas causes rapid migration in Baki. Its location between Grogol and Kartasura, the center of commercial activities and social facilities, makes Baki one of the most preferable locations for investment in real estate developers, mainly private enterprises. The con-

tinuing development in Baki brings this district into the densely populated area. The former agricultural field has almost entirely been converted into settlements. Baki is going to be an unhealthy living space due to the increasing density. The experience of Baki represents the common peri-urban areas where many city residents, especially young people, are moving outside the city in search of affordable housing. The location of Baki, which is adjacent to Surakarta City, makes the lower-middle income groups decide to reside there due to the motivation of minimising transportation costs.

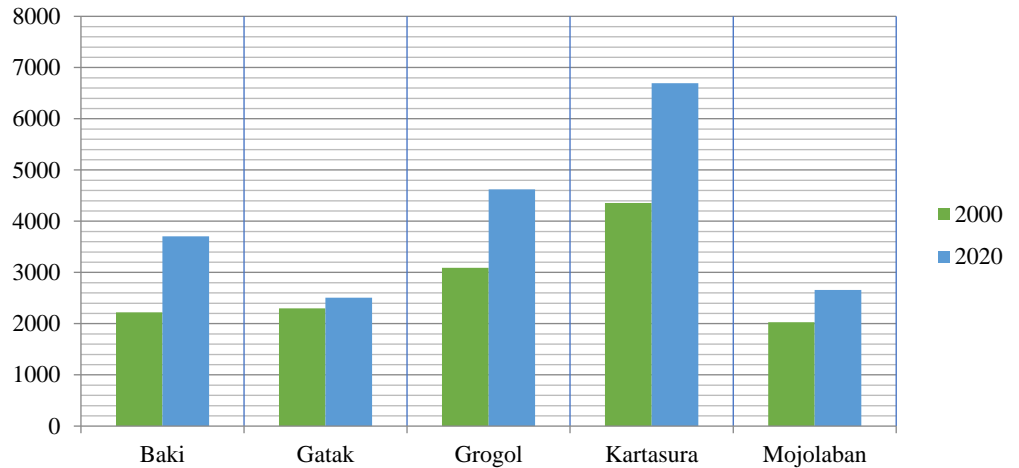


Figure 3. Graph of Changes in Population Density in 2000 and 2020 (Data processed from BPS Sukoharjo Regency, 2022).

3.1. The Changes of Agricultural to Non-Agricultural Livelihoods

Development, including urbanisation, encourages more diverse and dynamic economic activities in a region. There are unique processes through which livelihoods are changed, natural resource uses are shifted and living spaces are restructured in a transforming peri-urban area. This research reveals, that the city does not totally drive the transition, to some extent, rather the rural areas are growing independently by optimizing the utilization of the natural resources to support the rural development.

The livelihoods of residents in five districts (Baki, Gatak, Grogol, Kartasura, and Mojolaban) in the agricultural sector from 2000 to 2020 experienced drastic changes. It can be seen in Figure 4 that each district experiences a change in farmer household population with a very large decrease where the percentage decreased up to 90% in each district.

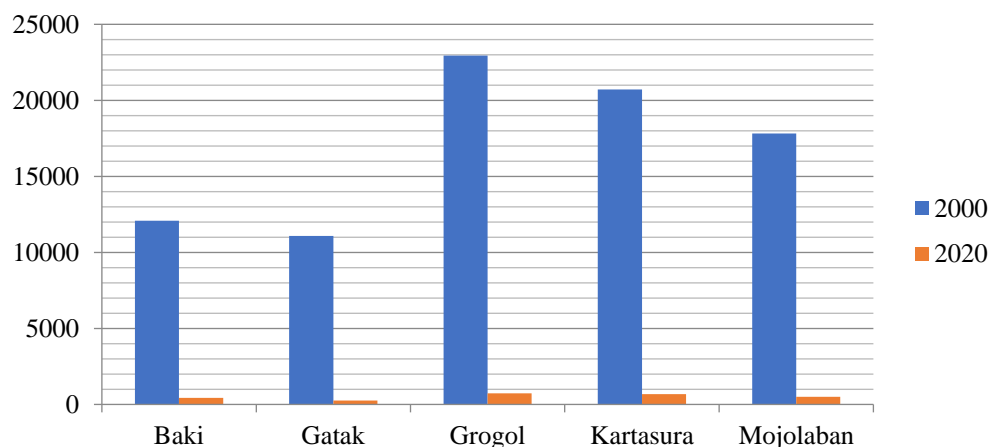


Figure 4. Graph of Changes in Farmers' Livelihoods in 2000 and 2020 (Data processed from BPS Sukoharjo Regency, 2022).

Non-agricultural livelihoods have become the new economy. The industrial sector shows a very significant increase. It can be seen in Figure 5 that each district experienced a change in the number of people working in the industrial sector from 2000 to 2020, which was a very large increase.

Based on these data, it can be seen that the decline in the population with agricultural livelihoods is inversely proportional to the population with non-agricultural livelihoods, especially the

industrial sector. In other words, the increasing number of people working in the industrial sector is followed by a reduction in the number of working as farmers in each district. In 2020, the highest population working in the industrial sector was in Grogol District. However, based on data processed from BPS Sukoharjo Regency, Baki District has experienced the biggest change or transformation of industrial livelihoods compared to other districts.

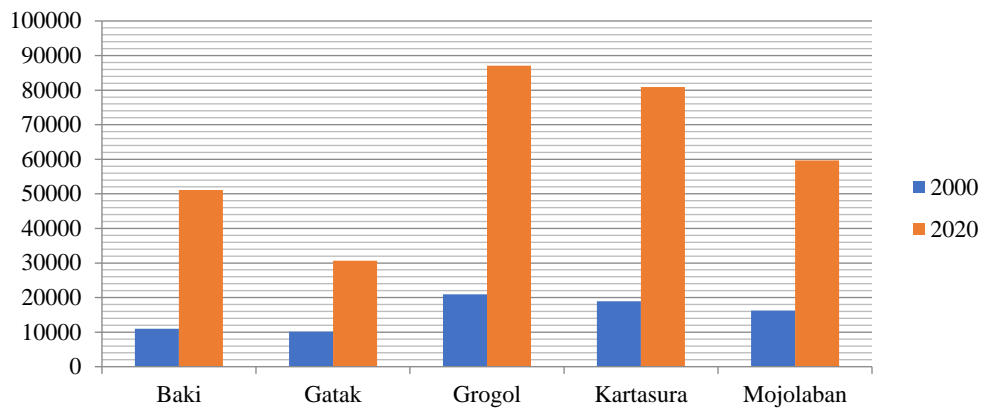
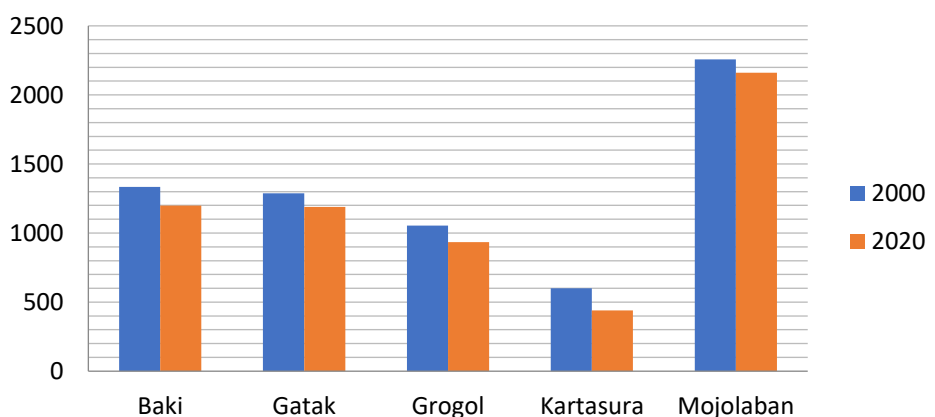


Figure 5. Graph of Changes in Livelihoods in the Industrial Sector in 2000 and 2020 (Data processed from BPS Sukoharjo Regency, 2022).

Overall, it can be seen that each district has shown a peri-urban area transformation, which is marked by a change in the livelihood orientation of the population from agriculture to non-agriculture, in this case, the industrial sector. The districts that show the most significant changes in this livelihood transformation are Baki and Grogol Districts, which have the largest change or transformation of the population with industrial livelihoods compared to other districts. The decreasing agricultural productivity in each district confirms the research done by Ge *et al.* (2020), revealing that out-migration in rural areas impacts the number of rural laborers working on farms. They are attracted to finding new jobs in the city.

The total area of rice fields used in five districts (Baki, Gatak, Grogol, Kartasura, and Mojolaban) has decreased, although not significantly. The biggest change in the paddy field area from 2000 to 2020 was in Kartasura District, which had around 27%. Meanwhile, the district with the least change in paddy field area is Mojolaban District, which is about 4%. The existing paddy fields in Mojolaban express that people are still engaged in farming even though some work in the small and medium industries. This condition presents that Mojolaban, to some parts, is surviving independently by optimizing the utilization of natural resources to support rural development.



Source: Data processed from BPS Sukoharjo Regency, 2022.

Figure 6. Graph of Rice Field Use in 2000 and 2020.

Based on data from BPS Sukoharjo Regency, from 2000 to 2020, Kartasura District has the highest number of development projects compared to five other districts, namely 3643 projects. Meanwhile, Gatak District is the district that has experienced the least development project, which is only 1180 projects. In other words, the high rate of development in Kartasura District is comparable to three times that in Gatak District. In addition, the number of developments in the five districts strengthens the previous analysis, namely the use of paddy fields, which tended to

decline from 2000 to 2020. In other words, the reduction in the total area of paddy field use is influenced by the high development rate that occurred within 20 years in each of these districts.

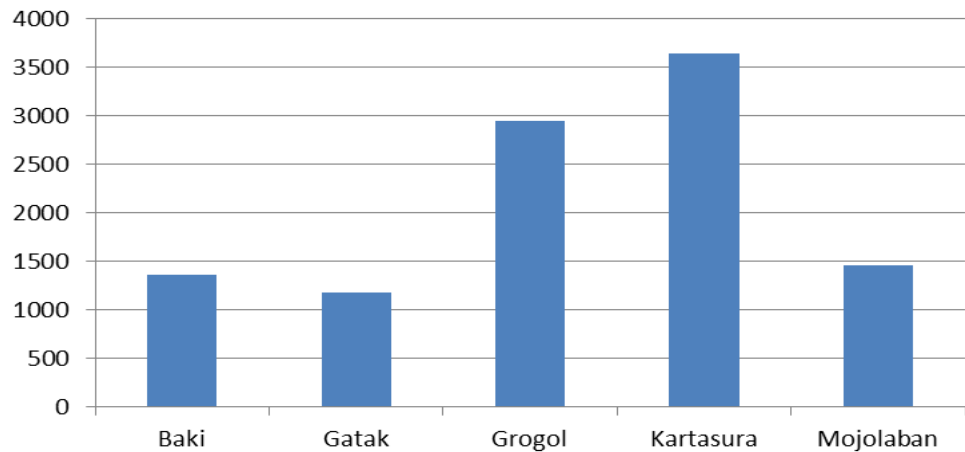


Figure 7. Graph of Total Development in 2000 and 2020 (Data processed from BPS Sukoharjo Regency, 2022).

The existing spatial policy also influenced one of the developments in Sukoharjo Regency. Based on the RTRW of Sukoharjo Regency in 2011-2031, Kartasura District is designated as a Local Activity Center (PKL), serving activities on a Regency scale. Mojolaban, Gatak, and Baki Districts are designated as Regional Service Centers (PPK), serving district-scale activities. Meanwhile, Grogol is designated as a Promotional Local Activity Center (PKLp), which has the same function as the Regional Service Center (PPK) but shows more development than other districts, so Grogol District is promoted to PKL. In addition, Kartasura and Grogol Districts are also designated as strategic areas for the economy. So, the two districts get more priority in improving facilities and infrastructure as well as in spatial planning because they have an influential role in the economic development of Sukoharjo Regency.

3.2. Regional Investment as the Driver of Economic Growth and Transformation

In their research Yeboah and Jayne (2017) state that investment has great economic growth and transformation prospectss. In other words, the development of investment in an area can be used as a driving factor in the occurrence of economic transformation. Based on data from the 2020 Sukoharjo Regency government agency performance report, the realization of Foreign Investment (PMA) and Domestic Investment (PMDN) in 2020 has increased from the previous year with a very good category supported by regional conduciveness and ease of investment. The investment climate in Sukoharjo Regency from 2009 to 2020 fluctuated, decreasing from 2011 to 2015 but increasing again from 2016 to 2020. The types of investment in Sukoharjo Regency are diverse, such as the textile, real estate, pharmaceutical, food, and trade and repair sectors.

Investment in Sukoharjo Regency in 2020 reached IDR 16 trillion (USD 1,028,627,200.00), with the highest investment contribution being in five districts: Kartasura, Grogol, Mojolaban, Gatak and Baki (Suragolbantaki) Districts. Based on data obtained from the Office of Investment and One Stop Integrated Services, Sukoharjo Regency, Grogol District is the district with the largest investment value among other districts, namely with an investment value of IDR 5,714,456,456,677 (USD 367,377,834.03) in 2020. The high investment in Grogol District is in line with the district's rapid growth, especially in the new Solo area, which is currently the business center of Sukoharjo Regency. The distribution of investment value in each district in the study area, namely Mojolaban, Grogol, Baki, Gatak, and Kartasura can be seen in Table 3.

Table 4. Distribution of District Investment Value in 2020.

Districts	Investment (IDR)	Equivalent in USD
Mojolaban	18,358,992,000	1,180,284.91
Grogol	5,714,456,456,677	367,377,834.03
Baki	1,500,000,000	96,433.80
Gatak	15,672,228,000	1,007,555.00
Kartasura	900,028,737,000	57,862,127.48

Source: Data processed from DPMPTSP Sukoharjo Regency, 2022.

The sector or type of investment found in each district in Sukoharjo Regency, especially in the five districts which are the focus areas of the study, are dominated by the textile industry, rubber and plastic industries, printing industries and pharmaceutical industries. The distribution of investment types in the five districts can be seen in Figure 8.

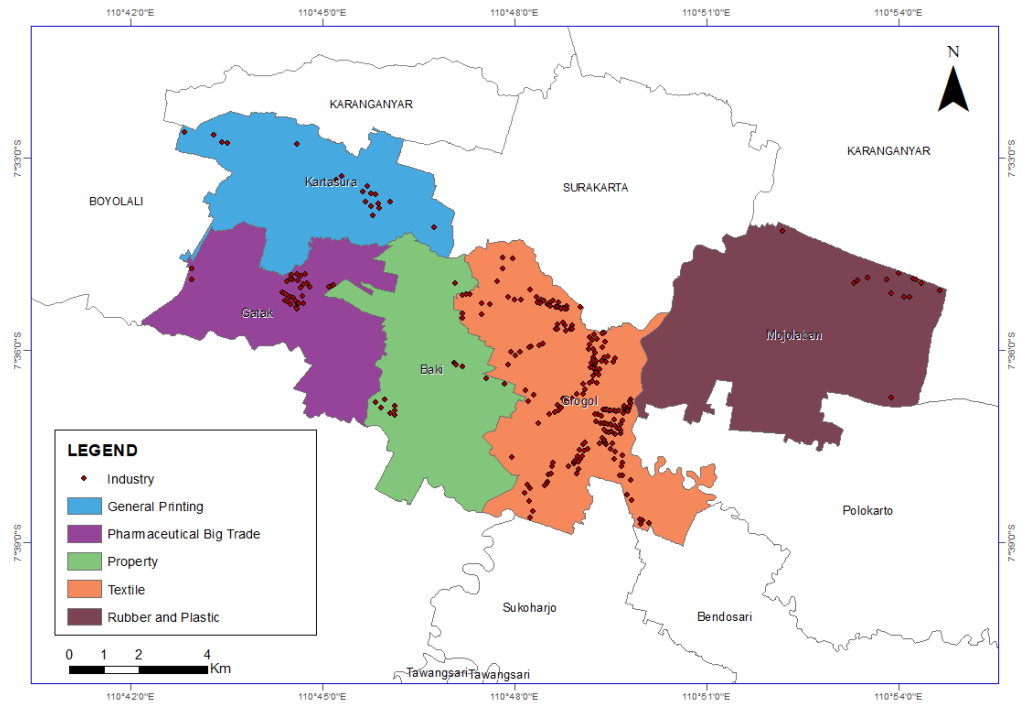


Figure 8. Distribution of Investment Types in Five Districts (Baki, Gatak, Grogol, Kartasura, Mojlaban Districts) (Data processed from DPMPSTP Sukoharjo Regency, 2022).

In 2000 the district with the largest number of large companies was in Kartasura District, and the district with the least number of large companies was in Baki District. In 2020, the district with the largest number of large companies was Grogol District, and the least was Baki District. The number of large companies in each district from 2000 to 2020 can be seen in Figure 8.

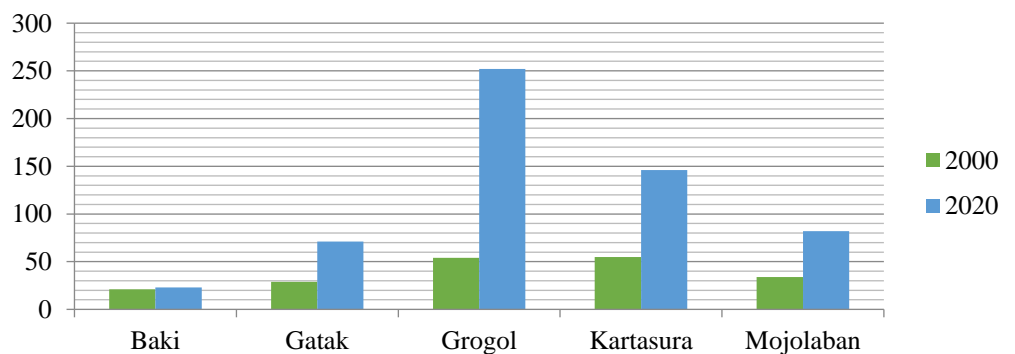


Figure 9. Graph of the Number of Large Companies in 2000 and 2020 (Data processed from DPMPSTP Sukoharjo Regency, 2022).

Overall, each district experiences an increased number of large companies from 2000 to 2020. This shows a process of regional economic transformation which is marked by a growth or an increase in the value of investment in the area, although not all districts experience a significant increase. From Figure 9, it can be seen that Grogol District is a district that has undergone the most transformation in terms of the number of large companies among the other four districts. This is related to the amount of investment in Grogol District, where, in 2020, Grogol District had the largest investment value compared to other districts.

Based on regional investment in the study areas, we can see the development capacity of each district. Scholars state that regional development follows two models based on production factors: exogenous and endogenous. Exogenous development or modernisation development is development through several factors from outside the region (tends to occur in the city center) (Vicol *et al.*, 2018) as happened in Grogol and Kartasura District. Endogenous development is

related to local companies, which requires local community capacity, as shown in the evidence we can observe in Mojolaban. From this perspective, development factors include land, capital, and labor demand from other regions, such as Grogol and Kartasura districts or even Surakarta City, for commodities produced by an area like Mojolaban.

3.2. Small and Medium Industries (SMIs) as the Emerging Development Potential

Sukoharjo Regency and Surakarta City have been building a more intensive relationship. People and capital mobile across the bigger region in a more dynamic pattern. Evolving new urbanizing area show the rapid changing of economic and social conditions. Some Central Asian countries experience an influx of migrants seeking jobs in peri-urban industries, which contributes to local economic activity and can alleviate poverty (Mortoja and Yigitcanlar, 2022). The existence of small and medium industries that grow rapidly in rural area can alleviate poverty. Sujoharjo’s peri-urban areas have also become the target of a huge amount of investment, especially in residential and industrial areas. Each district (Baki, Gatak, Grogol, Kartasura, Mojolaban) has the most dominant sector or type of IKM (Small and Medium Industry) dominated by brick production, convection, furniture, and guitar production. The distribution of IKM types in five districts can be seen in Figure 10.

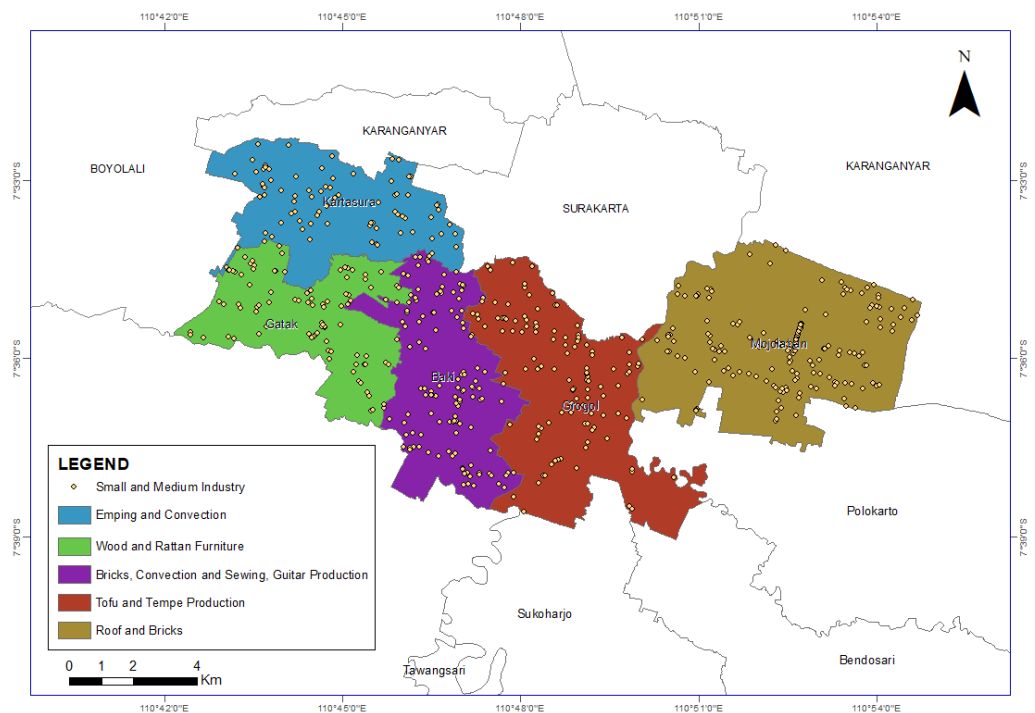


Figure 10. Distribution of Small and Medium Industries in Five Districts (Baki, Gatak, Grogol, Kartasura, Mojolaban Districts) (Data processed from DPMPSTP Sukoharjo Regency, 2022).

The development of large- and small and medium-scale industries attracts workers, both local and migrants. Likewise, small and medium-scale industries are located in five Sukoharjo Regency districts: Baki, Gatak, Grogol, Mojolaban, and Kartasura. These SMEs not only absorb local workers but can also attract workers from outside Sukoharjo Regency. Based on the survey results, the area of origin of workers outside Sukoharjo Regency is from Solo City, Wonogiri Regency, Klaten Regency, Boyolali Regency, and Gunung Kidul Regency.

Table 5. Origin of Small and Medium Industry Labors in Five Districts (Baki, Gatak, Grogol, Kartasura, Mojolaban Districts).

Districts	Origin of Labor
Baki	From same district, Solo
Gatak	From same district, Sragen, Wonogiri, Klaten
Grogol	From same district, Solo, Wonogiri, Klaten
Mojolaban	From same district, Baki, Polokarto, Gunung Kidul
Kartasura	From same district, Solo, Boyolali, Wonogiri

Source: Data processed from DPMPSTP Sukoharjo Regency, 202.

The number of SMIs in five districts (Mojolaban, Grogol, Baki, Gatak, and Kartasura) decreased from 2000 to 2020. In 2000 and 2020, Mojolaban District had the highest number of SMIs, while

Kartasura District had the least. However, when viewed from the magnitude of the change in the number of SMIs from each district, Mojolaban District is the district with the most or the largest decline in the number of SMIs. Meanwhile, Gatak District is the district that experiences the least reduction in the number of SMIs.

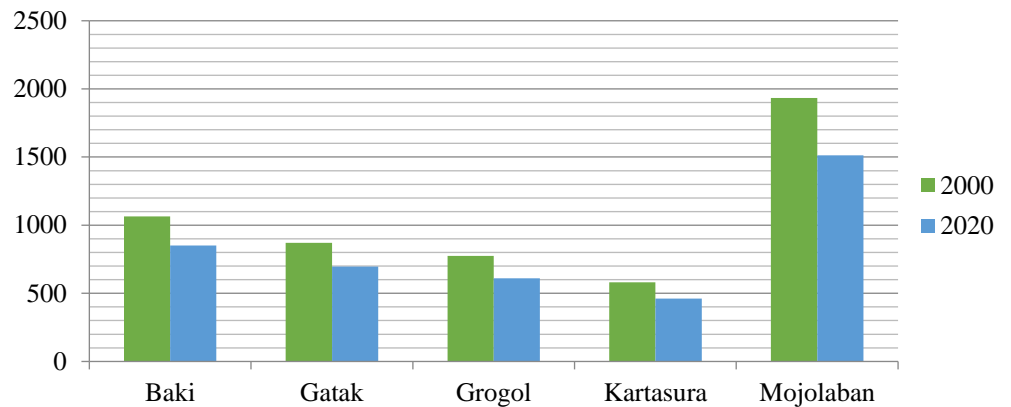


Figure 11. Graph of Changes in the Number of SMIs in 2000 and 2020 (Data processed from DPMPSTP Sukoharjo Regency, 2022).

In contrast to the increase in the amount of investment by industry and large companies, the transformation of the number of small and medium industries in the five districts actually decreased from 2000 to 2020. The district that experienced the most significant change or reduction in the number of IKM is Mojolaban District. This is partly influenced by the presence of business actors on a small and medium scale who choose to establish new businesses in the industrial sector in the five districts (Baki, Gatak, Grogol, Kartasura, and Mojolaban).

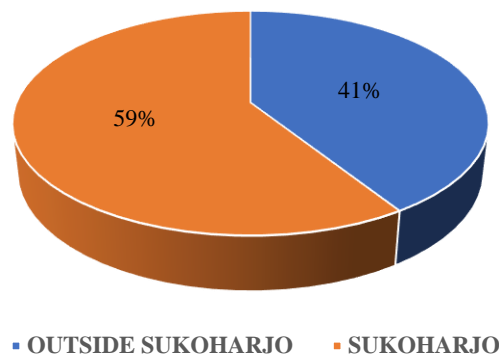


Figure 12. Graph of SMI Ownership (Data processed from DPMPSTP Sukoharjo Regency, 2022).

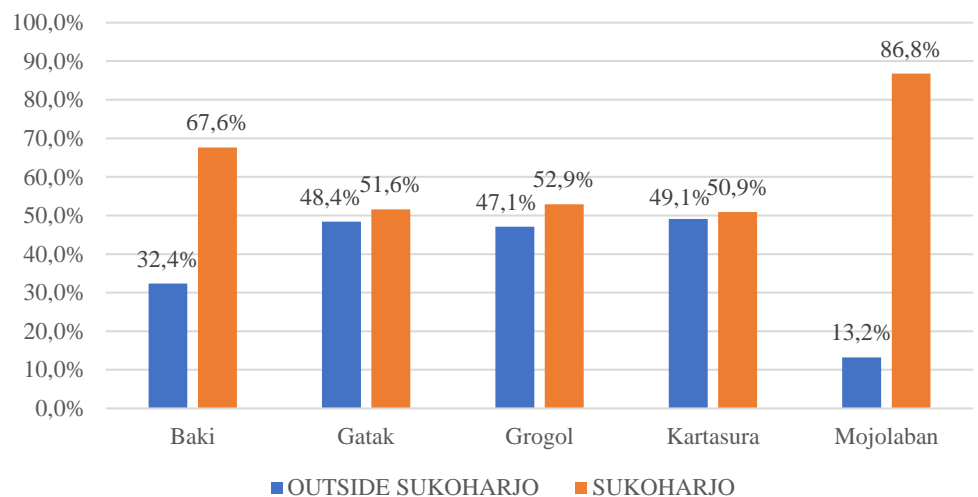


Figure 13. Graph of IKM Ownership in each District (Data processed from DPMPSTP Sukoharjo Regency, 2022).

Based on Figure 12 and Figure 13, it can be seen that the ownership of small and medium industries in the Districts of Baki, Gatak, Grogol, Kartasura, and Mojolaban, as much as 59% of the total ownership of small and medium industries comes from the Sukoharjo area. Mojolaban District has a high percentage of small and medium industry ownership from Sukoharjo, as much as 86.8%. Then there are Baki and Grogol Districts, with the percentage of IKM ownership from the Sukoharjo area of 67.6% and 52.9%, respectively. Gatak and Kartasura districts have almost the same percentage of IKM ownership from within and outside the Sukoharjo area, namely 51.6% and 50.9% from the Sukoharjo area. Mortoja and Yigitcanlar (2022) also reveal that local residents' industrial ownership affects income growth. However, based on the ownership of IKM, Mojolaban's becoming the highest has not affected the value of the investment entered in this district. Its investment value is lower in comparison to other districts. This fact shows that Mojolaban has not been the most attractive region in terms of investment, however, it has huge potential for a new economy as it contains valuable natural resources, especially agricultural potential. Agribusiness and food processing are the ones that would be prospectively developed in Mojolaban. It is encouraged by its neighbouring urbanized districts, which demand higher food supply and other goods. Small and medium enterprises are seen as the proper sector in terms of local labor skill qualification. Migrants with better capacity in business venture and management will hopefully strengthen the industrial development in Mojolaban, but still in a conservative way to maintain the existence of farmland.

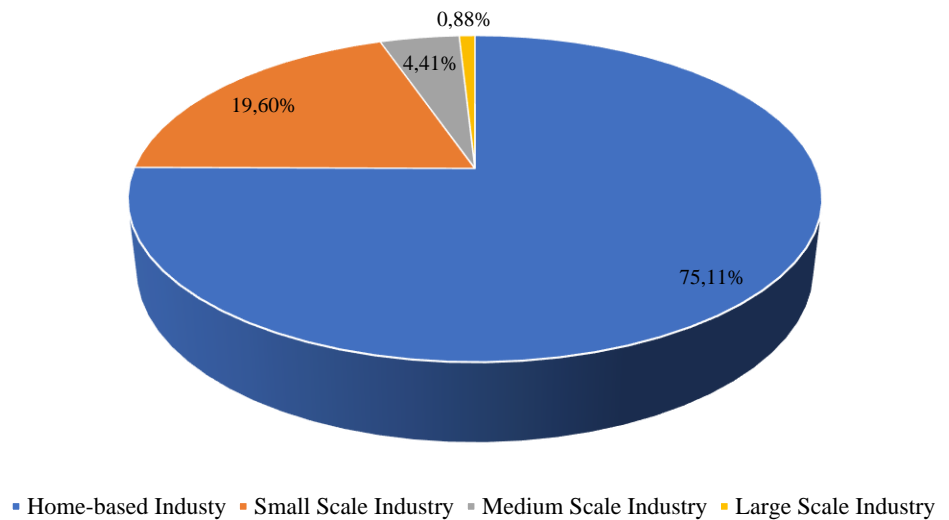


Figure 14. Industrial Scale in Sukoharjo (Data processed from DPMPSTP Sukoharjo Regency, 2022).

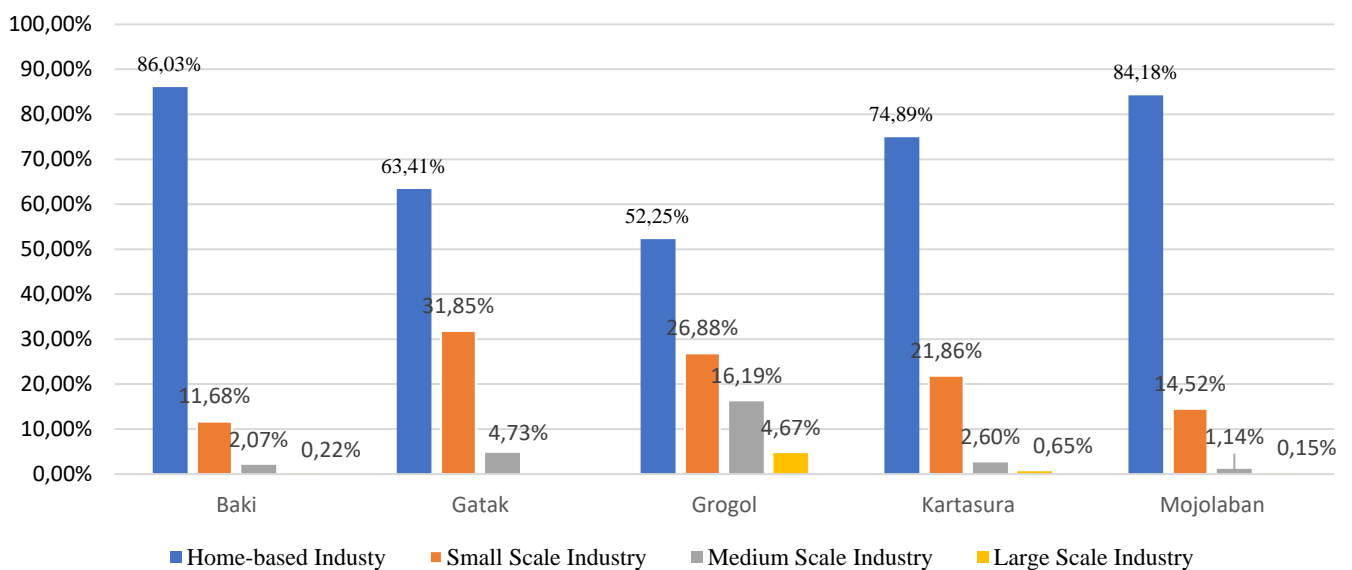


Figure 15. Industry Scale by District in Sukoharjo (Data processed from DPMPSTP Sukoharjo Regency, 2022).

Based on the number of workers, SMIs in five districts in Sukoharjo are categorized into four categories, namely home industries (1-4 workers), small industries (5-19 workers), medium industries (20-100 workers), and large industries (more than 100 workers). From the data obtained from the 2021 Sukoharjo Regency DPMPTSP in Figures 14 and 15, overall IKM in Baki, Gatak, Grogol, Kartasura, and Mojolaban districts are home industries. As many as 75.11% of SMIs in Sukoharjo are home industries with a workforce of 1-4 people.

3.3. Relationship Between the Development of Large Industries and Small and Medium Industries

Based on the data on investment value in each district (Baki, Gatak, Grogol, Kartasura, and Mojolaban) from 2007 to 2020, there was an increase in the number of large industrial companies compared to small and medium industries. Data from DPMPTSP Sukoharjo Regency shows that the number of small and medium industries in five districts has decreased while the number of large companies has tended to increase. In other words, large companies in the Districts of Baki, Gatak, Grogol, Kartasura, and Mojolaban are supposed to affect the development of existing small and medium industries directly. Data on developing large-scale industrial sectors and small-medium scale industries can be seen in Table 6.

Table 6. Development of the Large Industry Sector and Small and Medium Industries.

No.	Districts	Large Industries	SMIs
1.	Baki	Property	Bricks, Convection, Guitar
2.	Gatak	Pharmaceutical industry	Wood and Rattan Furniture
3.	Grogol	Textile industry	Tofu and Tempe Production
4.	Kartasura	Printing Industry	Emping and Convection
5.	Mojolaban	Plastic and Rubber Industry	tiles and bricks

Source: Data processed from DPMPTSP Sukoharjo Regency, 2022.

Based on the results of an interview with the Head of the MSME Empowerment Division, the Office of Trade, Cooperatives, Small and Medium Enterprises, Sukoharjo Regency, it is known that, unfortunately, the large industries in Sukoharjo Regency have not been able to cooperate with existing small industries yet. This condition is partly because large industries already have a large number of workers and sophisticated production equipment. They also have certain standards for meeting production goods' needs. Meanwhile, most of the existing small industries have not been able to meet the standards set by these large industries.

“...But the relationship between MSMEs and big industries doesn't seem to click that much, so small and medium-sized industries are still independent because big industries here are already high-tech manufacturers, so they already have their own tools and labor, while SMEs usually only produce products. -a certain product and the problem is usually a big industry that has high standards...” (Head of MSME Empowerment).

3.4. Classification of Economic Transformations

Table 7 is the result of the economic transformation analysis that has been carried out. Calculation of class intervals for each variable of economic transformation in Baki, Gatak, Grogol, Kartasura, and Mojolaban districts is based on the change value of each variable, namely the population number, population density, changes in livelihoods from agricultural to industrial sectors, the use of farmland, the number of development project, the number of large-scale companies as well as small and medium ones. These variables are categorized into three class intervals and scores, as seen in Table 7.

Table 7. Economic Transformation Analysis Results.

Districts	Variables							
	Total Population	Population Density	Farmer Livelihood	Industrial Sector Livelihoods	Agricultural land Use	Number of Development	Number of Large Industries	Number of SMIs
Baki	66.86	66.91	96.45	364.27	10.12	1369	9.52	20.11
Gatak	8.88	8.91	97.68	202.95	7.69	1180	144.83	19.93
Grogol	49.46	49.48	96.82	315.86	11.47	2947	366.67	21.03
Kartasura	53.75	53.75	96.73	327.78	26.96	3643	165.45	20.39
Mojolaban	31.93	31.08	97.19	267.07	4.25	1465	141.18	21.78

Source: Author's Analysis Results, 2022.

To simplify classifying each district's transformation rate, each variable will be weighted or scored. Where the variable with the slow transformation class will be given a score of 1, the class

with the medium transformation will be given a score of 2, and the class with the fast transformation rate will be given a score of 3.

Table 8. Classification of Economic Transformation Variables.

Variables	Economic Transformation					
	Slow		Medium		Fast	
	Class of Interval	Score	Class of Interval	Score	Class of Interval	Score
Total population	8.88 - ≤27.21	1	>27.21 - ≤46.54	2	>46.54 - ≤66.87	3
Population Density	8.91 - ≤27.24	1	>27.24 - ≤46.57	2	>46.57 - ≤66.91	3
Farmer Livelihood	96.45 - ≤96.86	1	>96.86 - ≤97.28	2	>97.28 - ≤97.70	3
Industrial Sector Livelihoods	202.95 - ≤255.72	1	>255.72 - ≤309.49	2	>309.49 - ≤364.27	3
Agricultural land use	4.25 - ≤11.82	1	>11.82 - ≤19.40	2	>19.40 - ≤26.98	3
Number of Development	1180 - ≤2000	1	>2000 - ≤2821	2	>2821 - ≤3643	3
Number of large industries	9.52 - ≤127.57	1	>127.57 - ≤246.62	2	>246.62 - ≤366.67	3
Number of SMIs	>21.18 - ≤21.81	1	>20.55 - ≤21.18	2	19.93 - ≤20.55	3

Source: Author's Analysis Results, 2022.

Table 9. Classification of Economic Transformation.

Districts	Variables								
	Total Population	Population Density	Farmer Livelihood	Industrial Sector Livelihoods	Agricultural land Use	Number of Development	Number of Large Industries	Number of SMIs	Transformation
Baki	Fast	Fast	Fast	Slow	Fast	Slow	Slow	Slow	Fast
Gatak	Slow	Slow	Slow	Fast	Slow	Slow	Slow	Moderate	Fast
Grogol	Fast	Fast	Fast	Slow	Fast	Moderate	Fast	Fast	Moderate
Kartasura	Fast	Fast	Fast	Slow	Fast	Fast	Fast	Moderate	Fast
Mojolaban	Moderate	Moderate	Moderate	Moderate	Moderate	Slow	Slow	Moderate	Slow

Source: Author's Analysis Results, 2022.

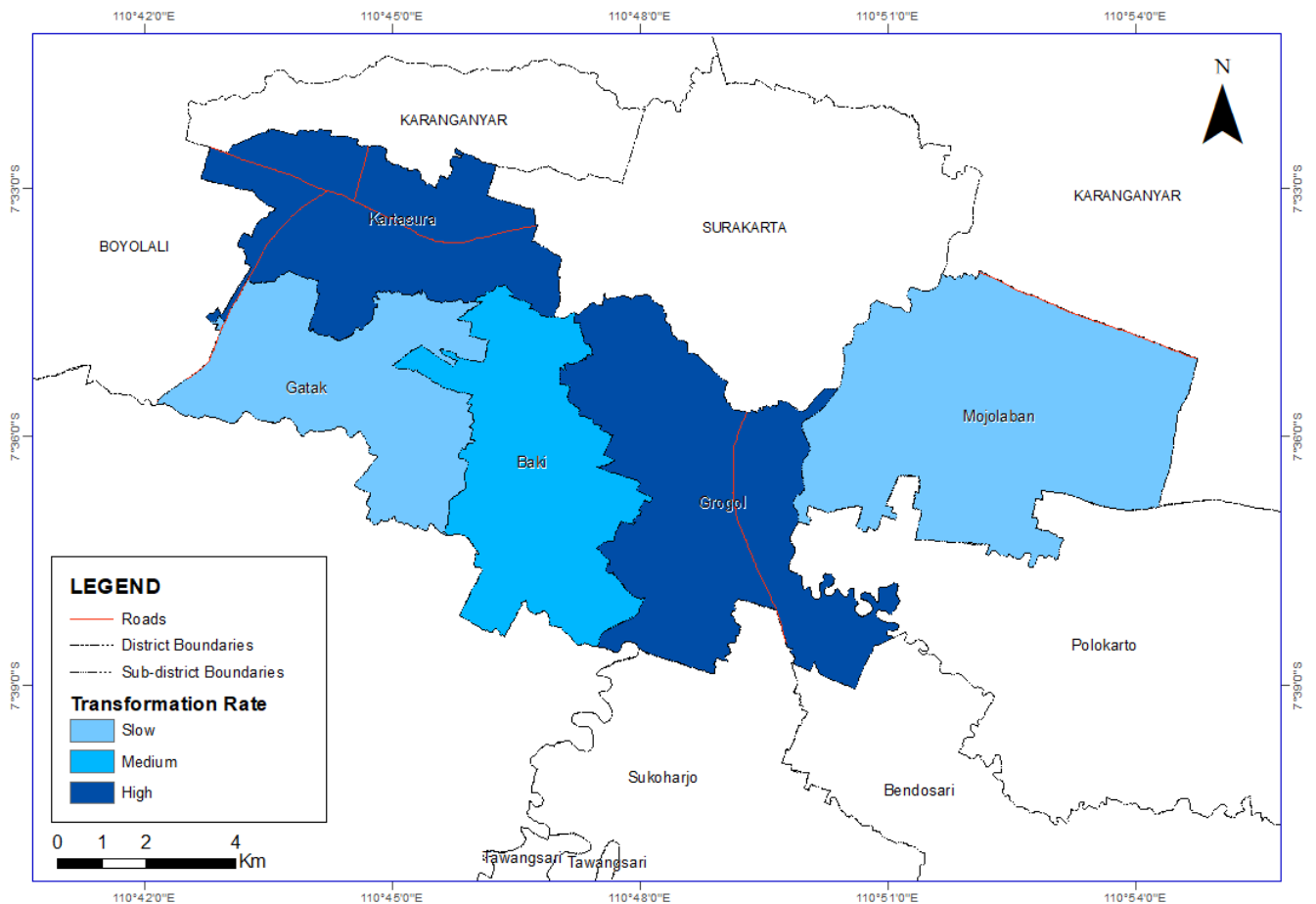


Figure 16. Distribution of the Transformation Rate in Five Districts (Baki, Gatak, Grogol, Kartasura, Mojolaban Districts) (Data processed from DPMPSTP Sukoharjo Regency, 2022).

The scoring calculations and the classification of the economic transformation of the five districts are presented in Table 10. Kartasura District has the highest score compared to other districts,

with a total score of 21, followed by Grogol District, with a total score of 19. Based on this scoring, Kartasura and Grogol Districts are classified into fast transformation rates. The only district with a medium rate is Baki, which has a total score of 16. Lastly, districts with the slow transformation rate classification are Gatak and Mojolaban, scoring 13.

Table 10. Scoring Results and Economic Transformation Rate Classification.

Variables	Districts				
	Baki	Gatak	Grogol	Kartasura	Mojolaban
Total population	3	1	3	3	2
Population Density	3	1	3	3	2
Farmer Livelihood	1	3	1	1	2
Industrial Sector Livelihoods	3	1	3	3	2
Agricultural land use	1	1	1	3	1
Number of Development	1	1	3	3	1
Number of large industries	1	2	3	2	2
Number of SMIs	3	3	2	3	1
Total	16	13	19	21	13
Economic Transformation	Medium	Slow	Fast	Fast	Slow

Source: Author's Analysis Results, 2022.

The fast rate of economic transformation in Kartasura and Grogol Districts is possibly supported by their status as Local Activity Centers (PKL) and Local Promotional Activity Centers (PKLp), which play as activity service centers on a district scale. In addition, Kartasura and Grogol districts are also designated as strategic district areas for economic purposes. So that the two districts get more priority in terms of improving facilities and infrastructure as well as spatial planning policy. The distribution of the rate of economic transformation in the Districts of Baki, Gatak, Grogol, Kartasura and Mojolaban can be seen in Figure 16.



Figure 17. Radar Diagram of Sukoharjo's Economic Transformation.

It is known that the variables of population, population density, industrial sector livelihoods, and the number of small and medium industries have the greatest influence on economic transformation in Sukoharjo as shown in Figure 17. In addition to these variables, fast economic transformation in Grogol District is also influenced by other variables, namely the number of new development projects and the number of large industries, while the use of paddy fields influences Kartasura District, the number of new development projects, and the number of large industries. Variables that affect economic transformation in each district can be seen in the radar diagram in Figure 18 below.

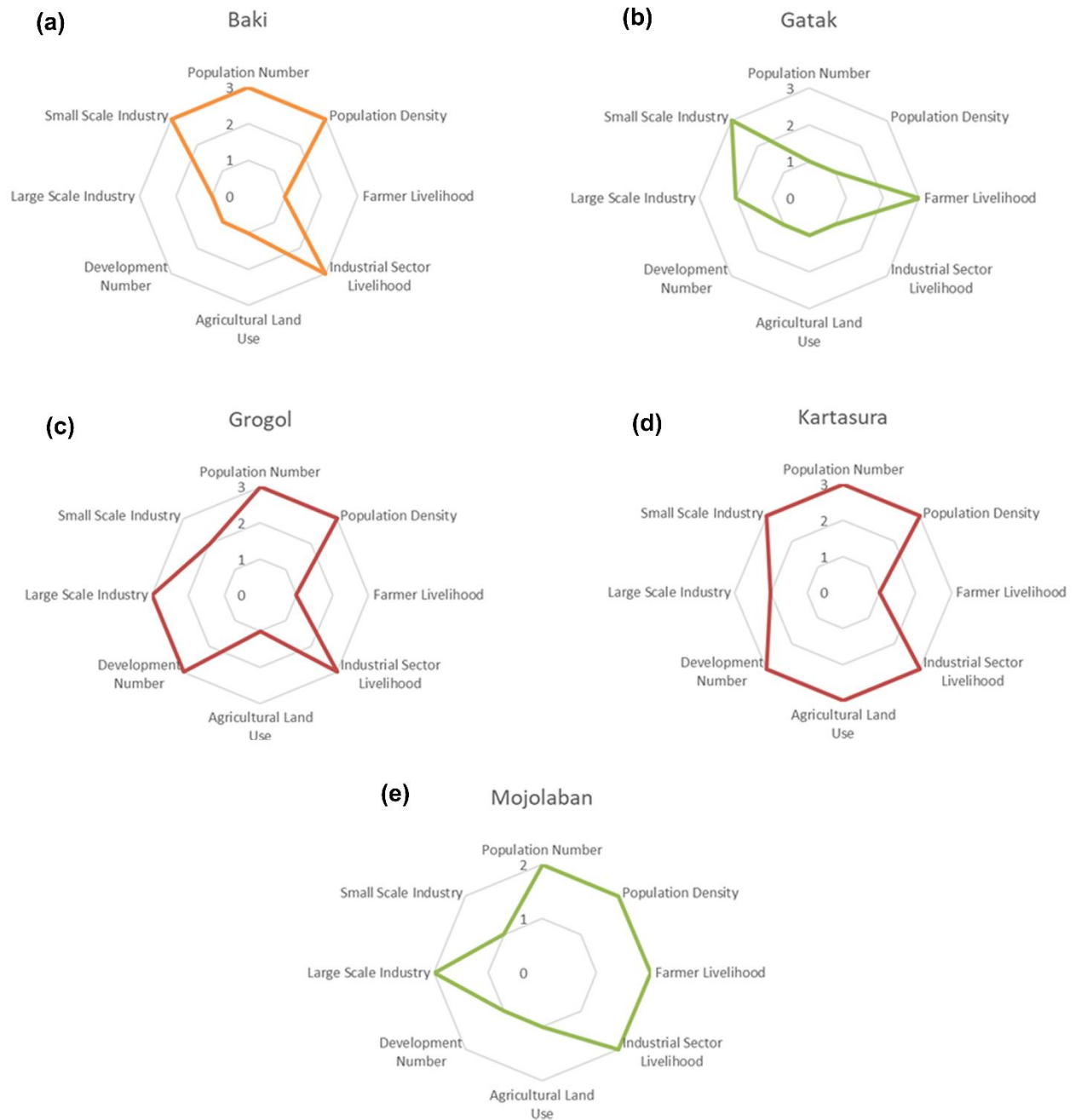


Figure 18. Radar Diagram of Economic Transformation (a) Baki District, (b) Gatak District, (c) Grogol District, (d) Kartasura District, and (e) Mojolaban District.

3.2. Discussion

Empirically, the study finds that the change in livelihoods is affected by the dynamics of the interplaying roles of each district. The supply-demand mechanism and complementary functions goes along with diverse interests of each district in peri-urban Sukoharjo. This is actually similar with the work of Li *et al.* (2023) and Veretekhina *et al.* (2017). There is no doubt that livelihood change is determined by rural-urban connections (Jamshed *et al.*, 2021). Differences in the economic transformation rate correlate with the area of agricultural land that is converted. The resulting transition could range from a more complex to a simpler function. In contrast to the research of Long *et al.* (2022) which proves that proximity to the city is a determinant of the degree of transformation, this study proved that accessibility and location to the main corridor are the main determinants Peri-urban Sukoharjo as a transition area resulting from rural-urban transformation demonstrates the gradual changes. The work of Li *et al.* (2023) about the spatiotemporal differentiation of urbanizing areas in Hangzhou, China shows the diverse urban-rural gradients. They examine respectively from the urban core to rural-urban transition and further to rural areas. They

find empirically that agricultural space uses that perform a comprehensive function and composite function show dominant input, while agricultural area with single function shows dominant output. Large-scale residential and industrial projects have been developed due to cheaper land. Some of them are gated settlements that create social segregation (Wang *et al.*, 2023). These areas often experience rapid changes due to urban expansion, leading to a mix of agricultural, residential, commercial, and industrial uses (Tadesse and Baye, 2024). They often experience a blend of urban and rural lifestyles, leading to diverse land use patterns, including residential, commercial, agricultural, and industrial activities. The governance of land in these areas is crucial, as it must accommodate the competing interests of various stakeholders while promoting sustainable development. Peri-urban areas often blend urban and rural characteristics, leading to diverse land uses such as residential, commercial, agricultural, and industrial activities. This mixture reflects the transitional nature of these spaces, where urban and rural lifestyles coexist. Rapid urbanisation drives the conversion of agricultural land to urban uses, resulting in significant changes in land tenure and property rights. This pressure can lead to land access and usage conflicts as various stakeholders compete for limited resources (Adam and Dadi, 2023).

The influx of migrants with diverse income levels to Sukoharjo's peri-urban in search of housing actually creates economic opportunities. Kartasura, Baki, and Grogol are the most developed regions, while Mojolaban and Gatak are extremely few. This is a similar condition experienced by Hokuto City, Tokyo's neighbour district, researched by Takahashi *et al.* (2021). The land-use intensification that triggers the increasing population density in Baki represents the rural-urban transformation. Respectively, a spatial integration process between Surakarta City and Baki District will gradually occur. Population flow from both sides either temporarily or permanently, are the phenomenon that reflects the space connection that will be intensified along with socio-economic interdependence among them (Yang *et al.*, 2020). However, such a situation offers a possible complementary relationship. The densely populated districts become the potential market to be supplied with goods and services that the predominated rural areas can produce. This distinctive role among peri-urban in this study is quite different in comparison to other studies that demonstrate a mixture of urban-rural uses. The coexistence of residential and agricultural creates social segregation that gradually decreases habitat quality (Adam and Dadi, 2023; Li *et al.*, 2023; Tadesse and Baye, 2024).

Regarding the livelihoods change, Grogol and Baki represent the farming to non-farming transformation that is driven by urbanisation. This condition is different from the study done by Ge *et al.* (2020) which explores the out-migration of rural people to the city to find new jobs in trading and service sectors. In Grogol and Baki, the local people who formerly worked in the agricultural sector enter the large industries that are massively built in the surrounding areas of their neighborhoods rather than move to Surakarta City. In the meanwhile, the development of small and medium industries in Mojolaban represents the transforming local economy led by the availability of paddy fields as the natural resources (supply factors) vis-à-vis the gradual extension of new residential projects (demand factors), which is still less intensive in compare to those in Grogol and Baki. In this matter, urbanisation in Mojolaban triggers the development of local industrial sectors. They produce goods to deliver to the new inhabitants in many exclusive residences built in Grogol and Baki. Those populations become the potential market.

The phenomenon of Mojolaban is somewhat similar to that of Dhaka, as studied by Mertoja and Yigitcanlar (2022). Emerging local industries benefit from their strategic location, which allows them to access urban markets and rural resources. Peri-urban industries provide employment opportunities for local residents that contribute to local economic activity and can alleviate poverty. It can be seen how the farmer households in Mojolaban can earn additional income. A member of the family works in small and medium industries while the others still cultivate the paddy field. Even though the unique experience of Mojolaban District is totally different to some evidence revealed by other scholars. Many research mostly highlight the increasing poverty among farmer households due to the intensifying pressures of urbanisation. The economic transformation in Mojolaban to some extent is different from the previous research conducted by Wang *et al.* (2023) who track the out-migration of rural people to Changchun City in China due to extensive farmland occupation. The other work that also demonstrates the different findings is done by Tadesse and Baye (2024) who investigate the impacts of urban expansion and land expropriation on agricultural communities in Gashena and Kon towns, Ethiopia. Their investigation reveals significant challenges such as loss of agricultural productivity, food insecurity, and economic displacement. This research is even distinguished from the former study about urbanisation in Surakarta and Sukoharjo by Buchori *et al.* (2020). They find a negative relationship between the development of large scale industries and the improvement of local people's wealth.

Based on the experience of Kartasura, Baki and Grogol in comparison with Mojolaban, this study contributes to the knowledge of SMIs development that fosters rural-urban linkages. The remaining farmland in Mojolaban demonstrates the significance of enhancing regional development through financial flows and mobility, while also highlighting the interdependence of urban and rural economies. This study reveals that peri-urbanisation in Sukoharjo is not followed by the huge number of out-migrations to Surakarta City. Urbanizing districts are gradually improving their development by utilizing their resources even at different growth levels of economic transformation.

4. Conclusion

The research reveals that economic transformations in peri-urban Sukoharjo are triggered by migration, bringing effect to the increasing population number and density, livelihood change, and the development of small and medium industries that each of those effects has spatial implications. The investigation proves the opposite fact, namely that spatial utilization changes impact economic structure. Service and trade economies have been developed in urban areas dominated by residents. Meanwhile, industrial activities grow in areas dominated by agricultural activities. The growth of trade and service activities follows the massive housing development in Kartasura, Baki, and Grogol Districts. Access to national and provincial roads, the highest road hierarchy, is the main supporting factor. Meanwhile, the development of small and medium industries in Mojolaban and Gatak is driven by the high demand for goods due to the growth of urbanizing districts in neighboring areas, namely Kartasura, Baki, and Grogol Districts.

There is a mutualistic symbiosis between economic actors in trade and services and industrial actors, where the trade and service sector acts as an outlet for industrial products. This mutually beneficial relationship proves that the benefits of peri-urbanisation are even greater when farming households do not switch to the trade and service sector because they do not have the competence to pursue such a business.

This exploratory work provides insights into the complexities of peri-urbanisation, a phenomenon that is widely experienced by the urbanizing world, particularly in the global South. Transformations of rural spaces into peri-urban areas due to rapid urbanisation and urban sprawl are characterized by complex interactions between urban and rural activities. The emerging social, economic, and environmental issues reflect inadequate planning that needs for policy reform. Rural economy resilience and equity distribution of benefits are the common challenges that should become a global concern as the world becomes more urban.

For future research, this study suggests an investigation into the dynamics of peri-urban areas that address rural resilience and inequities, which is still under-explored. It is quite relevant with the forthcoming urbanisation that will be concentrated in the lower-middle-income nations. This research has significant limitations due to a lack of innovative methodological approaches. It could not analyze the neighborhood-level data that would give insights about the spatial and socioeconomic characteristics that benefit from peri-urbanisation. Examining the possibility of peri-urban area becoming a counter-urbanisation should be interesting.

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Author Contributions

Conceptualization: Pradoto, W., Setiyono, B., Wahyono, H., & Choi, M. J.; **methodology:** Pradoto, W., & Choi, M. J.; **investigation:** Pradoto, W., & Setiyono, B.; **writing—original draft preparation:** Pradoto, W., Setiyono, B., Wahyono, H., & Choi, M. J.; **writing—review and editing:** Pradoto, W. **visualization:** Pradoto, W., Setiyono, B., Wahyono, H., & Choi, M. J. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data is available upon Request.

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