

Factors Affecting The Interaction Between The Population of Lakkang Island And The Activity Center

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Abstract

Population movement is inseparable from interactions from the origin area to the destination location. This population movement is also influenced by the presence of push factors. Interaction is not only determined by physical distance, but also by social, economic, and accessibility factors. The condition of Lakkang Island has limitations in geography. The residents of Lakkang Island have high mobility to areas outside the island which has its own challenges. This study aims to analyze the factors that influence population interaction with activity centers. The sampling technique used is non-probability sampling. The method used is purposive sampling of 122 respondents. Data collection techniques are carried out by distributing questionnaires and interviews. The analysis technique is carried out through descriptive analysis and multiple regression analysis using R Studio tools. The results show that economic factors (X2) are the main contributors that strengthen the interaction of settlements with activity centers, especially in the economic dimension with a coefficient value = +0.2637; p = 0.0001. The social factor (X3) has a significant but negative influence on the social (coefficient = -0.1198; p = 0.0378) and physical (coefficient = -0.0777; p = 0.0384) dimensions. This indicates that the stronger the internal social cohesion, the smaller the physical and social dependence on external factors. The accessibility factor (X1) is only significant on the economic dimension and even shows a negative direction (coefficient = -0.0994; p = 0.0219). The economic factor is the most dominant factor influencing population interaction with activity centers. This means that increasing physical connectivity without increasing local capacity can lead to outflows (economic and social), rather than two-way integration. Therefore, the economic factor is important to support regional integration.

Keywords:

Interaction Factors; Multiple Regression; Economic; Social; Accessibility; RStudio

1. INTRODUCTION

Urban activity centers are a crucial component in urban structure studies, essential for rational planning, traffic flow management, and other practical measures (Kajosaari et al. 2021). These areas become increasingly complex as cities develop. The interaction between residential residents and activity centers is a crucial indicator of the functionality of urban spatial planning, as well as the efficiency of mobility and social welfare.

The stronger the spatial interaction between regions, the greater the opportunity to meet spatial interaction requirements (Syahrir 2025). Population movement is also inextricably linked to interactions between originating regions and destinations. Interregional interaction patterns are also closely related to the movement of goods/services and population mobility (Abdullah, Syam, and Surur 2021; Iyer and Thomas 2020; Mansury and Shin 2015). Several studies have shown that interactions between settlements and activity centers are determined not only by physical distance but also by social, economic, and even environmental factors. It is emphasized that residential location significantly influences the size and patterns of residents' daily activities, even after adjusting for individual residences.

Physical accessibility and ease of public transportation are also key factors in attracting interaction to activity centers. Research by Boratinskii and Tikhotskaya (2021) found that public transportation stations serve

as the primary centers of gravity for urban activity. These public transportation stations create high levels of interaction between settlements and activity centers through social networks and multifunctional facilities.

Three main factors influencing interaction between settlements and activity centers are social, economic, and physical accessibility. Perceptions of neighborhood boundaries, attachment to the surrounding environment, and residential preferences are social factors that negatively impact daily activities and community movement (Pinchak et al. 2021). Social factors include perceptions of neighborhood boundaries, attachment to the surrounding environment, and residential preferences. All of these factors influence daily activities and community movement. The location that aligns with a person's preferences impacts the type and size of recreational spaces available to the community.

Economically, the level of interaction also tends to be influenced by residents' ability to access city facilities. Property prices, transportation costs, and the cost of local services and amenities can influence access to activity centers. Large, affluent shopping centers also tend to encourage people from different residential areas to interact regularly (Zhou et al. 2024).

Physical accessibility is a crucial component to consider in the aforementioned interactions. Train stations are an example of a public transportation system that serves as a city's primary point of contact and facilitates people from various neighborhoods' access to urban activities, according to a study conducted in Tokyo (Boratinskii & Tikhotskaya, 2021). Other studies have shown that public spaces, roads, and public spaces located around residential areas significantly contribute to increasing levels of physical and social activity among the general public (Wang et al. 2024).

Three primary factors influencing the interaction between residential areas and activity centers are social, economic, and physical accessibility. From a social perspective, regional interactions can be seen in the context of urban growth, which has the potential to create regional disparities, where growth centers influence the social distribution of surrounding areas (Yusliana and Devi 2020). From an economic perspective, interactions between residential areas and activity centers can be seen in the context of constrained regional development. Separating areas interacting with more developed activity centers indicate the need for greater attention to economic infrastructure development (Muazir 2019). Other research has highlighted the importance of developing facilities in urban areas to provide economic support that connects villages and cities, strengthening interactions between the two entities (Sari and Mardiansjah 2022).

Physical accessibility is a crucial component, a prerequisite for broader social and economic interactions. Good public transportation access can connect communities to centers of socio-economic activity, creating more dynamic interactions (Priyantono, Aswara, and Rosidi 2022). For example, the level of accessibility in urban Yogyakarta indicates that transportation infrastructure plays a key role in determining the extent to which settlements can integrate with activity centers (Pramana and Efendi 2019).

Research by Diningrat (2016) shows that a region's dependence on its host region is driven by individual history and the need to improve quality of life. This dependence, resulting from individual historical factors, is influenced by factors present in the destination area. Similarly, factors present in the destination area can be positive or negative, affecting various aspects of life. For example, positive factors in the destination area include greater job opportunities, a complete range of facilities and infrastructure with a better quality of life, and so on.

Dependence resulting from the need for improved quality of life stems from residents' desire for higher incomes, newer and more diverse entertainment options, education that better guarantees their children's future prospects, and the desire for higher-quality healthcare. Spatial-wise, the dependency still takes into account the distance from the residence to the center of activity. This indicates that residents still experience dependence on external areas, largely driven by high-economic goals. Distance between residence and the center of activity is still taken into account.

Despite the dominant assumption that improved accessibility and economic opportunities strengthen regional integration, emerging discussions in spatial inequality and peripheral development studies suggest that such relationships may not always be linear or positive. In geographically constrained or island-based settlements embedded within metropolitan systems, improved connectivity may intensify outward flows of labor, consumption, and social interaction toward dominant urban centers, potentially weakening local economic capacity rather than strengthening it.

Similarly, strong internal social cohesion does not necessarily encourage outward mobility. In certain contexts, cohesive communities may rely more heavily on internal social networks, thereby reducing the need for social and physical interaction with external activity centers. These possibilities challenge the conventional assumption that spatial interaction automatically reflects balanced regional integration.

However, empirical studies that examine whether accessibility, economic, and social factors may produce asymmetric or even negative effects across different dimensions of interaction remain limited. This issue becomes particularly relevant in geographically constrained settlements such as delta-island communities that are spatially separated but functionally embedded within metropolitan systems.

In the case of Lakkang Island, which is geographically separated yet functionally connected to Makassar's urban system, the dynamics of population interaction may reflect more complex patterns of dependency and mobility. Therefore, this study aims not only to identify the factors influencing interaction between Lakkang Island residents and urban activity centers, but also to examine whether increased accessibility and social cohesion necessarily strengthen multidimensional integration, or whether they may generate patterns of dependency and selective outward flows.

2. METHODS

2.1 Research Location

Administratively, the research location is Lakkang Island, Tallo District, Makassar City, as shown in Figure 3.1. Lakkang Village is one of 15 villages in Tallo District, with the largest area at 1.15 km², representing 19.73% of the district's total area.

Geographically, Lakkang Island is located in the center of Makassar City. Lakkang Island is a delta because its landmass is formed from sedimentation over a long period of time. Flanked by three rivers: the Tallo River, the Pampang River, and the Hasanuddin University (UNHAS) River, this island appears relatively unknown to the general public. Access to Lakkang Island typically uses several piers: the UNHAS Campus Pier, the pier beside the Ir. Sutami Toll Road, the Pampang Village Pier, and the Tallo Village Pier.

The research object is the residential area of Lakkang Island, located within the urban area of the island. The distinct geographical conditions compared to other areas of Makassar City create a gap between the city center and Lakkang Island. Furthermore, this area is classified as a light slum according to Makassar Mayoral Decree No. 1301/050.13/2021 (Mayoral Decree on Determination of Slum Settlement Locations 2021, 2021).

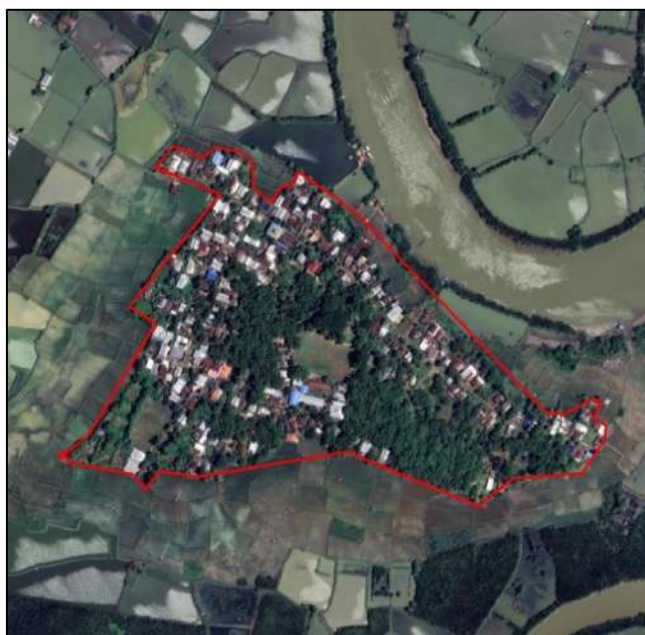


Figure 1. Research Location Map

2.2 Population and Sample

A population is a generalized area consisting of objects with certain qualities and characteristics determined by the researcher to be studied and then conclusions drawn. In this study, the population scope is the entire population of Lakkang Island.

The sample is a subset of the population and its characteristics. The sampling technique used was non-probability sampling. Non-probability sampling is a sampling technique that does not provide an equal opportunity for each element (member) of the population to be selected as a sample (Sugiyono, 2016). The method used was purposive sampling, a technique for determining a sample from the population based on certain considerations. The population of Lakkang Island is 1,219 people (Lakkang Village Data, 2024). In determining the sample size, a 10% sample size was used for populations with a population size above 1,000 (Sugiyono 2017).

$$\begin{aligned} N &= 1219 \times 10\% \\ &= 121.9 \\ &= 122 \text{ people} \end{aligned}$$

Based on the type and method of sample selection, several considerations served as the main criteria. The following are indicators for sample selection considerations:

1. Residents with regular activities, both outside and within residential areas.
2. Respondents' age stratification is based on the productive age group, according to the Central Statistics Agency (BPS), which is 15-64 years.

2.3 Data Collection Techniques

This second topic examines the factors influencing the integration of settlements with activity centers, obtained through a literature review and questionnaire distribution. The literature review serves as a step in analyzing indicators that influence settlement integration. The questionnaire distribution serves as a form of statistical data collection from respondents.

2.4 Data Analysis Techniques

To answer the second research objective, namely the factors influencing the integration of residential areas with activity centers, statistical regression analysis and descriptive analysis were conducted. The regression analysis aims to answer the statistical and descriptive analysis of influencing factors to explain the results of

the analysis of factors influencing population interaction with activity centers. This regression analysis uses the R Studio application as a tool.

3. RESULT AND DISCUSSION

3.1 Populaton Movement Factors

To determine the analysis of factors influencing the interaction of residential residents with activity centers, multiple regression analysis was used. This study required the determination of the dependent (Y) and independent (X) variables. The Y variable represents population integration, divided into three dimensions: social, economic, and accessibility.

Factors influencing population interaction with activity centers are not only influenced by the region's geography but also by social and economic interactions. These three variables in measuring population interaction with activity centers are the main driving factors (Cao et al., 2018).

As an area with limited geographical conditions, the residents of Lakkang Island establish economic interactions as a means of connecting with the central area of Makassar City. Initially, the majority of Lakkang Island residents were fishermen operating around the island area. However, due to river pollution, Lakkang Island residents shifted to work in urban areas of Makassar City. This shift in professions has significantly impacted population movement, initially confined to the inner region of Lakkang Island, shifting to the main island area of Makassar City. Economically driven population interaction also occurs in Central Sulawesi Province. The high level of interaction between the two regions is influenced by economic factors and accessibility. Economic interaction, in the form of trade activities and relatively short travel distances, is the primary factor driving the interaction between the two regions (Aqshah, 2013).

Ekawati et al. (2023) similarly explained that the elements forming slum settlements in coastal areas are divided into physical integration and socio-economic integration. Integration of marginal areas such as slums or coastal settlements is not only about infrastructure but also involves social, economic, and spatial factors.



Figure 2. Literature Synthesis of Dominant Factor Variables

Figure 2 shows the results of the literature synthesis, resulting in three dominant variables used. The following is the distribution of indicators for measuring each variable:

Table 1. Table of Variables and Regional Interaction Factors

No.	Variables	Indicator
1	Accessibility	Public Transportation Access Security Condition network road Cost transportation

No.	Variables	Indicator
2	Economy	Facility
		Availability
		Opportunity Work
		Activity
3	Social	Shop
		Reach failure economist
		Degree of kinship
		Health Facilities
		Education
		Educational Opportunities
		Government Services

3.2 Assumption Testing

This assumption testing was obtained through multivariate normality, linearity, and homoscedasticity tests.

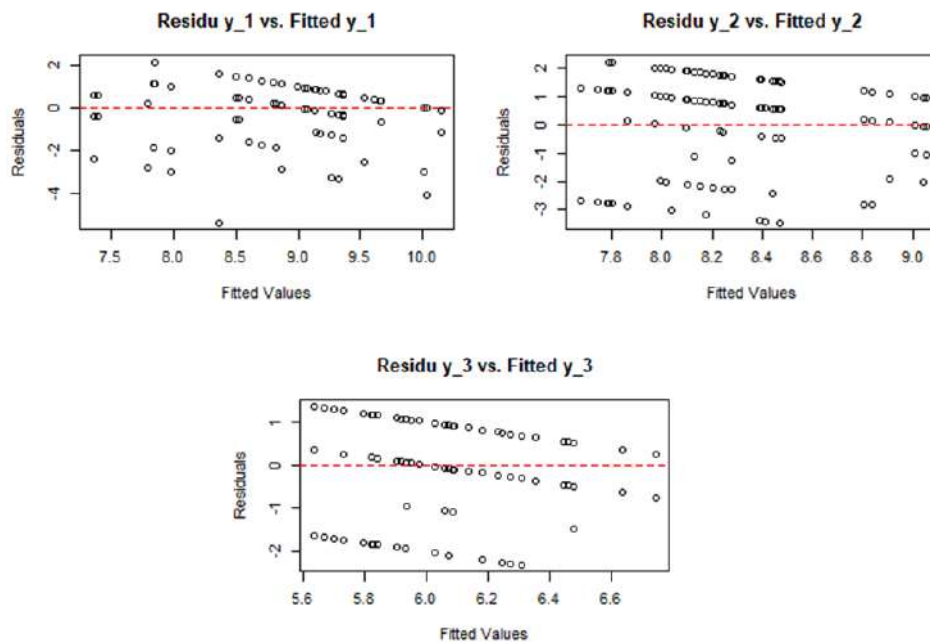


Figure 3. Residuals vs. Fitted Values (Homoscedasticity and General Pattern)

Figure 3 shows the constant residual variance (homoscedasticity) and systematic patterns in the errors. This figure displays a scatterplot between the residuals and the predicted values (fitted values) for each model Y1, Y2, and Y3. The points appear to be randomly distributed around the zero horizontal line without any particular pattern. The absence of a curved, centralized, or spread pattern indicates that the homoscedasticity assumption is met. The absence of a systematic pattern in the residuals also indicates the absence of a general violation of linearity.

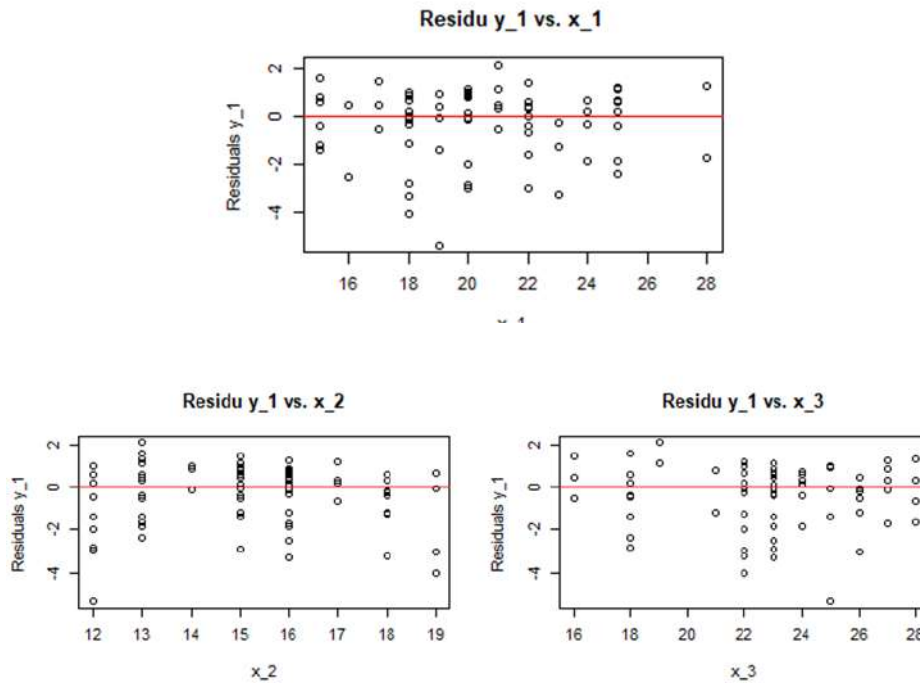


Figure 4. Residuals of y_1 vs. Predictors x_1, x_2, x_3 (Linearity)

Figure 4 assesses the relationship between each independent variable and Y1. These three graphs show the residuals of Y1 against each predictor, with X1 being accessibility, X2 being economic, and X3 being social. The random distribution of residuals indicates that the relationship between variables X1, X2, and X3 with Y1 is linear. There is no indication of a non-linear relationship such as a U-shape or curve. The relationship between all predictors and the economic dimension (Y1) meets the assumption of linearity.

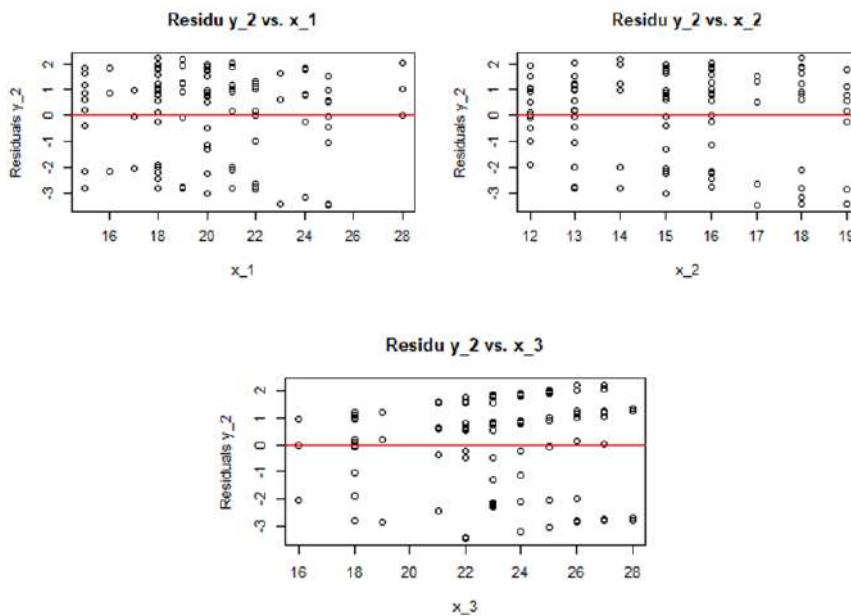


Figure 5. Residuals y_2 vs. Predictors x_1, x_2, x_3 (Linearity)

Figure 5 shows a linearity test for the social dimension (Y2) against the three X factors. In this figure, the distribution of points appears random, not forming a curved or angular pattern. The points are evenly distributed above and below the horizontal line, indicating that there is no non-linear pattern in the relationship between X and Y2. In this assumption test, the linearity test for the Y2 model is met.

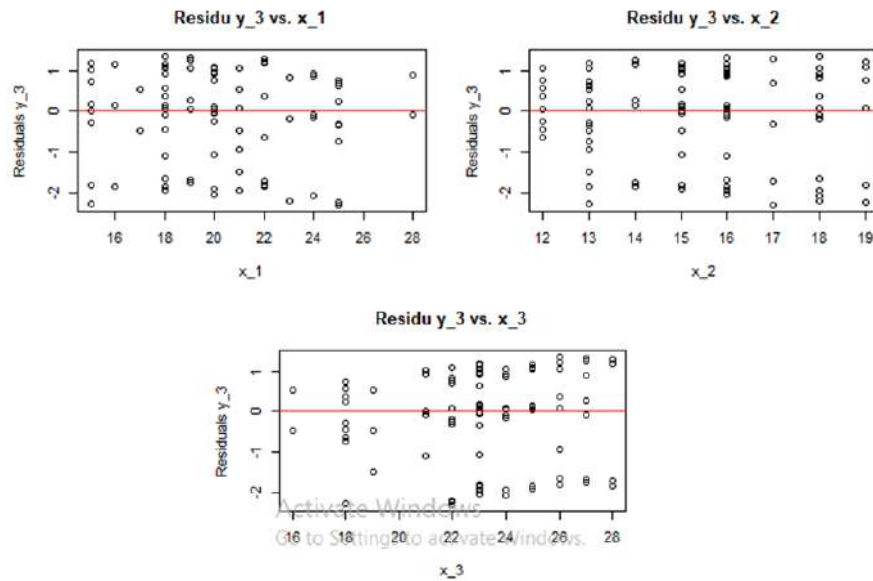


Figure 6. Residuals of y_3 vs. Predictors x_1 , x_2 , x_3 (Linearity)

Source: Author's Analysis, 2025

The third dimension is physical, testing all X variables using the physical dimension. Figure 6 shows that the residuals for X_1 , X_2 , and X_3 also appear randomly distributed. There is no indication of a curvilinear or angular relationship. This indicates a valid linear relationship for all variables with Y_3 . Therefore, the Y_3 regression model meets the linearity assumption.

1. **Multivariate Normality:** The Henze-Zirkler test results (p -value = 0) indicate a significant violation of the multivariate normality assumption. Univariate normality for each of y_1 , y_2 , and y_3 was also violated (p -value < 0.001 for the Anderson-Darling test). Although this assumption was violated, given the sample size ($N=122$) and the robustness of MANOVA to moderate violations, the analysis proceeded with this limitation.
2. **Linearity:** The residual plot against the fitted values and against each predictor (x_1 , x_2 , x_3) shows a random distribution of points around the zero line, indicating that the linearity assumption is met for all relationships.
3. **Homoscedasticity (Constant Error Variance):** The residual plot also shows consistent residual variance across the range of fitted values and predictors, thus the homoscedasticity assumption is met.
4. **No Severe Multicollinearity:** The Variance Inflation Factor (VIF) values for all predictors ($x_1=1.054$, $x_2=1.078$, $x_3=1.095$) are well below the threshold of 5 or 10. This indicates no severe multicollinearity issues among the independent variables.
5. **No Multivariate Outliers:** The Mahalanobis Distance Test (with a critical value of 16.266 at $\alpha=0.001$) did not identify any multivariate outliers in the dependent data. This means that no extreme observations substantially affect the model.

From the residual visualization results, it can be concluded that all regression models meet the assumptions of homoscedasticity and linearity. This strengthens the model's validity for use in analyzing the influence of factors on interactions between settlements and activity centers.

3.3 MANOVA Analysis

MANOVA analysis was used to identify the combined effect of three independent variables: accessibility (X_1), economic (X_2), and social (X_3), on three dimensions of settlement interaction: economic (Y_1), social (Y_2), and physical (Y_3). The test results showed that overall, these three factors significantly influenced settlement interactions with activity centers.

Multivariate Analysis of Variance (MANOVA) was conducted to identify how accessibility, economic, and social factors collectively influence three important aspects: economic, social, and physical dimensions.

Table 2.1 Combined Effects Test (MANOVA) Results

Predictor	Df	Wilks Lambda	Approx F	Num Df	Den Df	p-value
X1 (Accessibility)	1	0.9322	2.8134	3	116	0.0424
X2 (Economy)	1	0.8618	6.1979	3	116	0.0006
X3 (Social)	1	0.9323	2.8096	3	116	0.0426

In general, the three factors studied have a significant influence on all dimensions tested. As seen in Table 2, the economic factor (x2) is the most influential combined (p-value = 0.0006), followed by the accessibility factor (x1, p-value = 0.0424) and the social factor (x3, p-value = 0.0426) which is also significant. A p-value <0.05 indicates that all three factors have a significant combined influence on all dimensions (economic, social, physical). X2 (economic factor) has the smallest p-value (0.0006) and the highest Approx F (6.1979) indicating that this factor provides the largest and most significant combined influence. The lowest Wilks Lambda value is 0.8618. This value states that the smaller the value, the greater the combined influence, which confirms that the economic factor is the strongest overall.

Table 3. Results of the Influence of Each Factor on Each Dimension

Dependent Variable	Predictor	Estimate	Std. Error	t value	p-value
Y1 (Economic Dimension)	(intercept)	4.7294	1,3581	3.4820	0.0007
	X1 (Accessibility)	-0.0994	0.0428	-2.3230	0.0219
	Y1 X2 (Economy)	0.2637	0.0637	4.1370	0.0001
	X3 (Social)	0.0943	0.0445	2.1200	0.0361
Y2 (Social Dimension)	(intercept)	10.9384	1.7405	6.2850	0.0000
	X1 (Economics)	0.0247	0.0549	0.4510	0.6529
	Y2 X2 (Accessibility)	-0.0267	0.0817	-0.3270	0.7445
	X3 (Social)	-0.1198	0.0570	-2.1010	0.0378
Y3 (Accessibility Dimension)	(intercept)	7.3775	1.1334	6.5090	0.0000
	Y3 X1 (Economics)	0.0470	0.0357	1.3150	0.1910
	X2 (Accessibility)	-0.0313	0.0532	-0.5880	0.5574

Dependent Variable	Predictor	Estimate	Std. Error	t value	p-value
	X3 (Social)	-0.0777	0.0371	-2.0940	0.0384

Source: Author's Analysis, 2025

Based on Table 3, the influence of each factor on each dimension separately is as follows:

1. Economic Dimension (Y1); The results of the regression analysis show:
 - a) Economic factors (X2) have a positive and significant influence on the economic dimension (coefficient = +0.2637; p = 0.0001). This indicates that the higher the economic opportunities and activities, the greater the economic integration between the residential population and the activity center.
 - b) Social factors (X3) also show a significant positive influence (coefficient = +0.0943; p = 0.0361), which indicates that good social relations, such as networks between individuals or local institutions, also strengthen cross-regional economic activities.
 - c) The accessibility factor (X1) showed a significant negative effect (coefficient = -0.0994; p = 0.0219). This can be interpreted as meaning that even if physical access increases, without strengthening the local economy, this access can actually encourage economic dependence on other islands.
2. Social Dimension (Y2); For the social dimension, the results show:
 - a) Social factors (X3) were the only variables with a significant effect (coefficient = -0.1198; p = 0.0378), but the direction of the effect was negative. This could mean that increasing local social quality or independence could reduce the need for social interaction outside the region.
 - b) Accessibility (X1) (p = 0.6529) and economic (X2) (p = 0.7445) factors did not show a significant influence.
3. Physical Dimension (Y3); In the physical dimension, the results show:
 - a) The social factor (X3) was again the only significant factor (coefficient = -0.0777; p = 0.0384). This negative effect may indicate that strengthening internal social ties reduces the need for physical interaction (transportation, dock access, etc.) to the activity center.
 - b) Accessibility (X1) (p = 0.1910) and economic (X2) (p = 0.5574) factors did not show a significant influence.

Table 4. Summary of the Influence 2Factors on Each Dimension

Factor	Influence Combined	Dimension (Y1)	Dimension (Y2)	Dimensions Physical (Y3)
X2 – Economy	Most significant (p=0.0006)	Significant positive (p=0.0001)	Not significant	Not significant
X1 – Accessibility	Significant (p=0.0424)	Significant negative (p=0.0219)	Not significant	Not significant
X3 – Social	Significant (p=0.0426)	Significant positive (p=0.0361)	Significant negative (p=0.0378)	Significant negative (p=0.0384)

3.4 Interpretation and Implications

The results of multiple regression show that:

1. Economic factors (X2) are the main contributors that strengthen the interaction of settlements with activity centers, especially in the economic dimension.

2. Social factors (X3) have a significant influence, but the direction is negative on the social and physical dimensions, indicating that the stronger the internal social cohesion, the smaller the physical and social dependence on outside areas.
3. The accessibility factor (X1) is only significant in the economic dimension and even shows a negative direction. This means that increasing physical connectivity without increasing local capacity can lead to outflows (economic and social), rather than two-way integration.

The results of the regression analysis indicate that economic factors are the most influential variables affecting the interaction between the residents of Lakkang Island and activity centers. The positive and significant coefficient of the economic factor on the economic dimension suggests that employment opportunities, commercial activities, and access to economic facilities play an important role in shaping residents' interaction patterns. This finding supports previous studies which state that economic motivation is often the primary driver of spatial interaction and population mobility, particularly in areas located near urban centers (Mansury & Shin, 2015; Abdullah et al., 2021). In the case of Lakkang Island, the shift in residents' livelihoods from traditional fishing activities to urban-based employment has further strengthened the economic orientation of population movement toward Makassar City.

However, an interesting finding of this study is the negative influence of accessibility on the economic dimension of interaction. In conventional spatial interaction theory, improved accessibility is generally expected to increase economic integration between regions by facilitating the movement of people, goods, and services (Borger & Russo, 2017). Nevertheless, the results of this study suggest a different pattern. Improved accessibility from Lakkang Island to the main urban areas of Makassar may encourage residents to conduct economic activities outside the island, such as working, shopping, and accessing services in the city center. As a result, rather than strengthening local economic activities, improved connectivity may contribute to the outflow of economic resources from the island (Raynsford, 2023; Jin et al., 2021). This phenomenon can be interpreted as a form of economic leakage, where economic benefits generated by improved accessibility are captured by external urban centers rather than the local community (Mansury & Shin, 2015; Zhou et al., 2024). Similar conditions have been observed in peripheral or island settlements located near major cities, where improved transportation connections increase outward commuting and consumption outside the local area (Tse & Chan, 2003).

The results also show that social factors have a significant negative influence on both the social and physical dimensions of interaction with activity centers. This finding suggests that strong internal social cohesion within the Lakkang Island community may reduce the need for residents to establish social and physical interactions with external urban centers. Strong kinship relations, close community networks, and locally embedded social interactions may create a self-sustaining social environment in which residents rely more on internal community relations than on external networks (Saxon, 2020; Maya & Ramos, 2015; Zahnow et al., 2021). Previous studies have shown that neighborhood attachment and strong local social ties can significantly shape individuals' daily activity spaces and mobility patterns (Pinchak et al., 2021; Kajosaari et al., 2021). In this context, the negative influence of social factors may reflect the relatively strong internal social structure of Lakkang Island, which reduces residents' dependence on social interactions beyond their residential area.

From a broader theoretical perspective, these findings contribute to the discussion on regional interaction and spatial integration. Many spatial interaction theories assume that increased accessibility and stronger social networks will naturally enhance interaction between regions and promote more balanced integration (Condeco et al., 2011; Martinez et al., 2021). However, the results of this study suggest that the relationship between accessibility, social structure, and spatial interaction can be more complex. Improved accessibility does not always lead to mutually beneficial integration, but may instead reinforce dependency on external urban centers (Goldmann & Wassel, 2020). At the same time, strong internal social cohesion may function as a mechanism of community resilience that reduces the need for outward social interaction (Blečić et al., 2023). Therefore,

spatial interaction in peripheral settlements such as Lakkang Island may reflect adaptive strategies of local communities rather than purely economic integration processes.

Despite these findings, several limitations should be acknowledged. The variables used to measure interaction in this study are primarily based on respondents' perceptions obtained through questionnaires, rather than on actual mobility or travel behavior data. Consequently, the analysis reflects how residents perceive accessibility, economic opportunities, and social relations, rather than measuring the actual frequency and intensity of their movements toward activity centers. Previous studies have suggested that combining perception-based surveys with empirical mobility data such as travel surveys, transportation records, or GPS-based movement data can provide a more comprehensive understanding of spatial interaction patterns (Kajosaari et al., 2021; Wang et al., 2024). Future research is therefore recommended to integrate behavioral mobility data in order to better capture the dynamics of population movement between Lakkang Island and the activity centers of Makassar City.

In terms of practical implications, the findings of this study indicate that improving physical connectivity alone is not sufficient to strengthen regional integration. Infrastructure development should be accompanied by strategies to strengthen the local economic capacity of peripheral settlements such as Lakkang Island. Without local economic development, improved accessibility may primarily benefit external urban centers rather than the local community. Therefore, development policies should focus not only on transportation infrastructure but also on creating local economic opportunities that allow residents to benefit more directly from regional connectivity.

Despite the important findings of this study, several limitations should be acknowledged. First, the variables used to measure interaction are primarily based on respondents' perceptions obtained through questionnaires. As a result, the analysis reflects how residents perceive accessibility, economic opportunities, and social relations rather than measuring the actual frequency and intensity of their movements toward activity centers. Perception-based data may not always fully capture real mobility behavior.

Second, this study does not incorporate empirical mobility data such as travel surveys, transportation records, or GPS-based movement data that could provide a more detailed representation of population mobility patterns. Integrating such data could allow future research to examine the relationship between perceived accessibility and actual travel behavior more accurately.

Third, this research focuses on a single case study, namely Lakkang Island, which has unique geographical characteristics as a delta-island settlement within the Makassar metropolitan area. Therefore, the findings should be interpreted cautiously when applied to other island or peripheral settlements with different socio-economic and spatial contexts. Future studies are recommended to compare multiple peripheral or island-based settlements in order to better understand the diversity of spatial interaction patterns

4. CONCLUSIONS

This section will present the analysis results based on the previously determined methods. The results section comprises six subsections: mixed land use, density analysis, public transport services, design (accessibility), building intensity analysis, and a comparative analysis of the three stations.

This study examined the factors influencing the interaction between residents of Lakkang Island and urban activity centers in Makassar. The results indicate that economic factors are the most dominant drivers of interaction, particularly in the economic dimension, while accessibility and social factors show more complex and sometimes negative relationships with external interaction patterns. Based on the residual visualization results, it can be concluded that all regression models meet the assumptions of homoscedasticity and linearity. Although the multivariate assumption test violated some assumptions, given the sample size (N=122) and the robustness of MANOVA to moderate violations, the analysis continued with this limitation. This strengthens

the validity of the model for use in analyzing the influence of factors on the interaction of settlements with activity centers.

The most influential factor in determining the factors is the economic factor. Economic factors are the main variable that strengthens the interaction of settlements with activity centers. Economic factors (X2) are the main contributors that strengthen the interaction of settlements with activity centers, especially in the economic dimension with a coefficient value = +0.2637; $p = 0.0001$ Social factors (X3) have a significant influence, but the direction is negative on the social dimension (coefficient = -0.1198; $p = 0.0378$) and physical (coefficient = -0.0777; $p = 0.0384$). This indicates that the stronger the internal social cohesion, the smaller the physical and social dependence on outside areas. Meanwhile, the accessibility factor (X1) is only significant in the economic dimension and even shows a negative direction with a coefficient value = -0.0994; $p = 0.0219$. Based on this, increasing physical connectivity without increasing local capacity can cause outflows (economic and social), not in the form of two-way integration. Therefore, economic factors are important to support regional integration. Developing an area like Lakkang Island is not enough just by building physical infrastructure, but must be accompanied by strengthening the local economy and internal social services so that connectivity with activity centers is more productive and balanced

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