International Journal of Sustainable Development and Planning
Vol. 19, No. 12, December, 2024, pp. 4765-4773
Journal homepage: http://iieta.org/journals/ijsdp

The Impact of Center-Hinterland Spatial Interaction on Regional Income in West Timor Indonesia

Werenfridus Taena[1*], Anggelina Delviana Klau[2], Marce Sherly Kase[2], Fried Markus Allung Blegur[3], Felisisima Afoan[4], Febrya Christin Handayani Buan[3]

[1] Agribusiness Program, Faculty of Agricultural, Science, and Health, Timor University, Kefamenanu 85614, Indonesia
[2] Economic Development Program, Faculty of Economics and Business, Timor University, Kefamenanu 85614, Indonesia
[3] Mathematic Program, Faculty of Agricultural, Science, and Health, Timor University, Kefamenanu 85614, Indonesia
[4] Management Program, Faculty of Economics and Business, Timor University, Kefamenanu 85614, Indonesia

Corresponding Author Email: weren_ntt@yahoo.co.id

https://doi.org/10.18280/ijsdp.191223

Received: 6 July 2024
Revised: 1 November 2024
Accepted: 10 December 2024
Available online: 30 December 2024

Keywords:
spatial interaction, central-hinterland, West Timor Indonesia, regional income, geographically weighted regression

ABSTRACT

The research's goal is to examine the pattern of spatial dependency among center and hinterland in West Timor, as well as the influence of center-hinterland interaction on regional income for the center and hinterland. Both secondary and primary data are utilized for the research. The secondary dataset is derived from the GRDP for all regencies/cities in West Timor, Indonesia. Obtaining primary data was done by gathering data from agricultural commodity traders in the center (Kupang City) and hinterland (Kupang, TTS, TTU, Belu and Malaka Regencies), as well as producers and consumers. Snowball sampling was used to select 100 respondents, starting with traders in the hinterland and centers, and ending with consumers and farmers as producers. Data analysis is carried out using the Moran Index and geographically weighted regression. The results of the Moran Index analysis show that the center-hinterland interaction has a random pattern, indicating that the regional income of a region is influenced by factors in that region and adjacent regions. The results of the geographically weighted regression analysis clearly demonstrate that the regional income of the hinterland region is influenced by economic factors in both the hinterland region and the center region. Likewise, regional income in the center region is influenced by economic factors in both the center and hinterland regions. The economic factors in question include GRDP, population, GRDP in the agricultural sector, center-hinterland interactions, and vice versa. According to the GWR value mapping, the economy of Kupang Regency is integrated (clustered) with Kupang City or in other words agglomerated with Kupang City due to its close proximity; meanwhile, other hinterland areas which include TTS, TTU, Belu and Malaka regencies have a relatively similar spatial pattern to the hinterland and are different from Kupang as the center. Therefore, to maintain a balanced regional income, it is recommended that center-hinterland agricultural products be allocated based on demand. Additionally, there is a need for more investigation into the connections among economic sectors across regions and the multiplier economic effects that occur as a result of interregional interactions.

1. INTRODUCTION

The existence and exploration of regional economic activities will find several locations as economic centers and several locations as hinterlands that have an impact on regional economic growth. According to Francois Perroux [1], the growth of a region is influenced by the economic activity of the region, and is driven by growth poles with different intensities. Generally, this is caused by differences in the concentration of economic sectors in each region which are the catalysts for the economic growth of a region and the regions that interact with the region.

The flow of production factors entering and leaving other regions causes regional income to depend inter-regionally. Interactions among regions, commonly referred to as spatial interactions, are triggered by this dependence. Spatial interaction is referred to as the movement of people, goods, or information from origin to destination areas through geographic space in the form of flows between locations [2]. Several cities nearby each other, whether or not they were previously separate and autonomous cities, might benefit in the form of synergies from interactive city growth due to highly developed regional information and transportation networks that constitute growth centers [3].

Areas that arise as growth hubs as a result of natural processes and, in certain cases, intentional planning. Regions that become centers of growth are expected to be able to distribute economic development to their hinterland regions. It is also hoped that growth centers that are determined in multiple regions will have more of a trickle-down effect on

hinterland regions, rather than a polarizing effect that could drain resources from hinterland regions, as found by Ezcurra and Del Villar [4] that there is a regional income gap as an effect of unbalanced spatial interaction. Spatial development policies that encourage more synergistic spatial interactions are necessary to achieve joint progress for all regions, as Tobler [5] has stated that two or more regions that are geographically near to one another, even though they are administratively separated, can generate mutual benefits in the form of synergy and interactive growth, despite their administrative separation.

Kupang City is the center of West Timor and NTT Province because it is the capital of East Nusa Tenggara Province and is also designated in Peraturan Perundang-undangan Nomor 179 Tahun 2014 [6] as the National Strategic Activity Center (PKSN). The industrial, tourism, and marine fisheries sectors are the primary activities of Kupang City. These sectors are bolstered by the presence of infrastructure and facilities that support central economic activities, thereby generating a growth influence in the hinterland region. The hinterland area of Kupang City specifically in West Timor includes Kupang Regency, TTS Regency (South Central Timor Regency), TTU Regency (North Central Timor Regency), Belu Regency, and Malaka Regency.

Interaction between the center of economic growth and the hinterland in West Timor will increase regional income (spread effect) if each region has potential and supporting regional facilities. As stated by Evcim and Yesilyurt [7], the economic progress of a region will directly or indirectly improve the lives of its residents and adjacent areas.

The economic structure of the districts in West Timor, NTT Province, is dominated by the agricultural sector, whose contribution ranges from 22% to 45%. However, the agricultural sector's development is slowly undergoing a shift because it is often viewed as a supporting element in the economy [8]. More massive development of the agricultural sector is needed to increase economic growth and reduce regional development gaps [9]. Therefore, it is necessary to recognize spatial interactions between regions in West Timor, NTT Province, through marketing agricultural products between the center and hinterland in order to increase the economic growth of agricultural commodity-producing regions and regions that interact alongside them.

Agricultural commodities that are traded almost every day from the hinterland to the center (Kupang City) are horticultural commodities, while vice versa, from the center to the hinterland are fisheries commodities. Horticultural and fishery commodities have unique qualities, notably that they are perishable. These particular traits cause the product to require special handling after harvest, as well as a faster and easier marketing reach. The growth center in West Timor (Kupang City) and the hinterland, namely the regencies in West Timor, have spatial interactions due to this condition, consequently bringing up options to extend the market and providing opportunities to profit and increase regional income. As stated by Amidi et al. [10], economic performance of neighboring regions and the geographical position of trading partners determine the economic growth of a region.

Taena et al. [11] stated that the factors that cause spatial interactions between hinterland districts in West Timor include economic distance, population, prices, and GDP. This study needs to be expanded to analyze the interaction patterns of the spatial hinterland (regencies) with the center (Kupang City) in West Timor, as well as the impact of this interaction on regional income in other regions. For this reason, researchers are keen on conducting research with the following aims: the pattern of spatial dependency among center and hinterland in West Timor, as well as the influence of center-hinterland interaction on regional income for the center and hinterland.

2. RESEARCH METHOD

2.1 Research site

The research was conducted on Timor Island, East Nusa Tenggara Province, which consists of 1 city, namely Kupang City as the center, and 5 districts as hinterland, namely Kupang Regency, TTS Regency, TTU Regency, Belu Regency, and Malaka Regency. The consideration is that these districts/cities are located on 1 island which facilitates interaction or connectivity between regions, as Sokol [12] states interaction between regions makes it easier to move production factors or products and information from one location to another. Map of research locations as shown in Figure 1.

Figure 1. Location of research

2.2 Types and sources of data

The research uses two types of data, namely secondary and primary data. Secondary data is obtained from the Institute of Agriculture, Trade, MSMEs, Cooperatives, BPS, and other agencies. Primary data was obtained by conducting interviews and observations to obtain data on demand and supply, as well as the frequency of interactions. The primary data population involves farmers, traders, and consumers of agricultural products in six districts/cities in West Timor, Indonesia. The sampling method utilizes a snowball to simplify the process of tracing the flow between business actors [13]. The number of samples was 100 respondents, with the distribution of trader samples of agricultural commodity traders as follows: Oesao Market in Kupang Regency (10 people), Soe Inpres Market in TTS Regency (10 people), Kefamenanu New Market in TTU Regency (10 people), Atambua New Market in Belu Regency (10 people), and Beiabuk Betun Market in Malaka Regency (10 people), as well as Naikoten Inpres Market (10 people) and Oeba Market in Kupang City (10 people). Furthermore, 15 farmers and consumers were involved in tracing and had interactions with those who interacted with agricultural commodity traders in each market.

2.3 Data analysis

The data were analyzed using the Moran Index to determine the spatial dependence pattern between center and hinterland because each region is not independent but rather influences each other [14], so that it can group the center-hinterland in West Timor according to the spatial dependence pattern. The spatial dependence pattern is determined by the potential/factors of each region which can then affect economic growth in the region and other regions. Thus, a geographically weighted regression (GWR) analysis was carried out to determine the factors that influence economic growth in the region and adjacent regions, especially among the center and hinterland in West Timor. Caraka and Yasin [15] stated that GWR analysis is a comprehensive method that can produce parameter estimates between regions. A brief data analysis flowchart is shown in Figure 2.

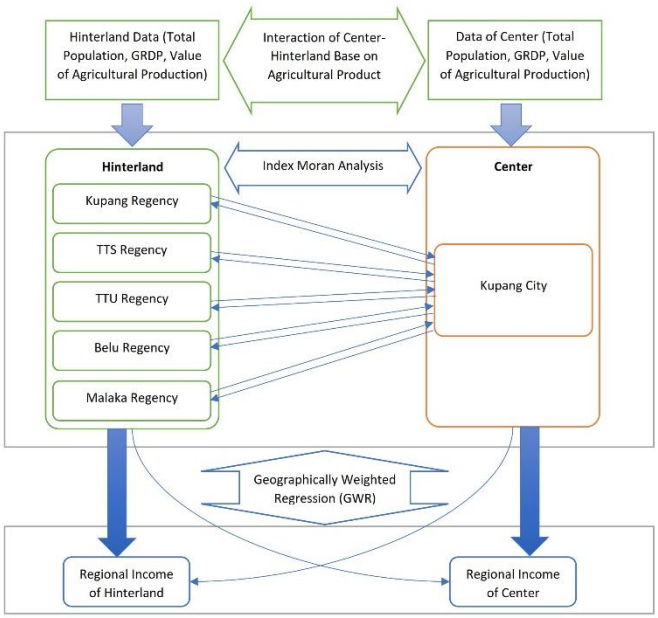

Figure 2. Data analysis flowchart

2.3.1 Index Moran analysis

Moran's Index analysis was used to evaluate the first aim. The Moran Index is based on spatial autocorrelation theory, which means estimates between observed values connected to the spatial location of the same variable. The Moran Index analysis technique can describe and visualize spatial distribution, as well as identify concentrations and outlier locations [16]. The presence of positive autocorrelation (I > 0) indicates that there are similar values from adjacent locations and they tend to be clustered. Negative autocorrelation (I < 0) indicates that adjacent locations have different values and tend to be dispersed. The following formula for analyzing spatial autocorrelation using the Moran Index:

$$I = \frac{n\sum_{i-1}^{n}\ \sum_{j=1}^{n}\ Wij(X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^{n}\ (X_i - \bar{X})^2} \quad (1)$$

where, I = Moran Index of Agricultural Income; n = Number of observation areas; x_i = Region observation value in the i-th; x_j = obersvation value in region j (neighboring region i); $\bar{x}$ = average value of all observed variables; W_{ij} = matrix element between regions i and j.

Moran Index analysis is extended by Local Indicator of Spatial Autocorrelation (LISA) analysis for assessing groupings of regions with significant similarities if not all observed areas have spatial effects. The higher the local value, the more the adjacent locations have almost the same value or form a clustered distribution [17]. The LISA formula is:

$$I_i = Z_i \sum_{i=1}^{n} W_{ij} Z_j \quad (2)$$

where, I_i: LISA coefficient; Z_i,Z_j: Standarized data; W_{ij}: The weight between region i dan j, j is the region located around i.

The test hypothesis for the LISA parameter is as follows:

H0: I=0 (no autocorrelation between regions)

H1: I≠0 (there is autocorrelation between regions)

2.3.2 Geographically weighted regression

The geographically weighted regression (GWR) model improves the linear regression model by taking into consideration of spatial data (location). The GWR model is employed when spatial heteroscedasticity occurs. The weighting of predictor variables in GWR uses latitude and longitude coordinates [18]. In general, the GWR formula is formulated as follows:

$$Yi=ßo\ (ui, vi)+\sum_k=1\ ß_k\ (ui, vi)Xi_k+\varepsilon i \quad (3)$$

where, Yi = Observation value of the i-th response variable; Xi_k = Observation value of Predictor k at the i-th observation; ßo = Intercept; $ß_k$ = Regression Coeffitient; ui = longitude spatial coordinate for the i-th observation; vi = Spatial latitude coordinate for i-th observation; εi = i-th error.

The estimated parameters at each location i using Weighted Least Square (WLS) are:

$$\hat{\beta} i(\text{ui,vi})=(\text{XTW(ui,vi)X}) - 1\text{XTW(ui,vi)y} \quad (4)$$

where, $\hat{\beta} i$ = coefficient for the i-th regency; X = data matrix of the independent variable; Y = vektor of response variable (n×1); $W(i)$ = weighting matrix for regency i.

The stages of GWR data analysis for this research are as follows:

a. Determine the weighting matrix using the graphic coordinate points of each district and city in West Timor. The Adaptive Gaussian Kernel weighting function is obtained using the equation:

$$w_{ij} = \exp\left(-\frac{1}{2}\left(d_{ij}/b_i\right)^2\right) \quad (5)$$

where, b_i is *bandwidth* dan d_{ij} is the *Euclidean* distance between the observation at the i-th location and the j-th location. The d_{ij} value is calculated using the following equation:

$$d_{ij} = \sqrt{(u_i - u_j)^2 + (v_i - v_j)^2} \quad (6)$$

where, (u_i, v_i): point coordinates (latitude, longitude) at the i-th location, (u_j, v_j): point coordinates (latitude, longitude) at the j-th location.

The optimum bandwidth value is generated by an iteration procedure that produces a minimum Cross Validation (CV) value. According to the initial analysis, the optimum bandwidth value is 189,219 km, which is located in Kupang

City, indicating that districts/cities located 189,219 km away still have quite a high influence from the center. After obtaining the distance matrix value (di) and bandwidth value, the Adaptive Gaussian Kernel weighting function is calculated.

b. Parameter testing for each X variable used GWR to determine its significance on GRDP growth in the center and hinterland in West Timor. Significance tests were carried out at significant levels of 1% (0.01), 5% (0.05), and 10% (0.1). The hypotheses used are as follows:

H_0: $\beta_{\tau k}$ (u_i, v_i) = 0 (parameter $\beta_{\tau k}$ at location (u_i, v_i) has no significant effect on the model)

H_1: $\beta_{\tau k}$ (u_i, v_i) ≠ 0 (parameter $\beta_{\tau k}$ at location (u_i, v_i) has a significant effect on the model)

for k = 1, 2, …, p and I = 1, 2, …, n

Hypothesis testing for the parameters $\beta_{\tau k}$ (u_i, v_i) can be formed using the t test statistics as follows:

$$t_k(u_i, v_i) = \frac{\hat{\beta}_{\tau k}(u_i, v_i)}{\hat{\sigma}\hat{\beta}_{\tau k}(u_i, v_i)} \quad (7)$$

c. Mapping of GWR results. Visualization of GWR results in maps, using significant variables from each regency and city in West Timor for easy understanding in policy making.

3. RESULTS AND DISCUSSION

3.1 Spatial center-hinterland dependency patterns in West Timor

Tobler [5] stated that all regions are related to each other, but regions that are close are more connected than regions that are far away. Tobler's law is one of the pillars of regional science studies, stating that spatial effects arise naturally between regions. Similarly, the pattern of income distribution in the agricultural sector in West Timor's regencies and cities is influenced by other adjacent regions.

The statistical method used to analyze spatial proximity is the Moran Index. The results of the global Moran Index analysis as shown in Figure 3 indicate that the pattern of income distribution of the central-hinterland agricultural sector in West Timor with a p-value of 0.2344, which means it is not significant for cluster or dispersion patterns, so the center-hinterland spatial pattern is classified as random. Fotheringham et al. [19] state that the grouping of significant spatial relationships is based on similar values in the observation area.

The results of the Moran Index analysis show that the typology and income distribution pattern of the agricultural sector in West Timor, NTT Province, has spatial autocorrelation in each region with a random distribution pattern. This suggests that each region has considerable spatial influence in affecting the increase in agricultural sector revenue in its own region, as well as agricultural sector income in adjacent regions. Regions that have high agricultural sector income will influence neighboring regions, and vice versa, regions with low agricultural sector income have a smaller influence on the surrounding areas. The results of the research are in line with Nawaro et al. [20] which states that there is a spatial interaction between regencies/cities in Indonesia.

The results of the LISA (Local Indicators of Spatial Autocorrelation) test prove that local spatial linkages in West Timor are grouped spatially based on agricultural sector income consisting of 3 categories. First, High-High (HH), namely districts that have high levels of agricultural sector income and are surrounded by areas that also have high levels of agricultural sector income. The districts included in this category are TTS District, Belu District, and Malaka District. These three regions are classified as having high levels of agricultural sector income because they are supported by the capability and suitability of land for the development of the agricultural sector. Zhang et al. [21] stated that areas with the HH category show high spatial agglomeration, namely high in one region and also high in neighboring regions.

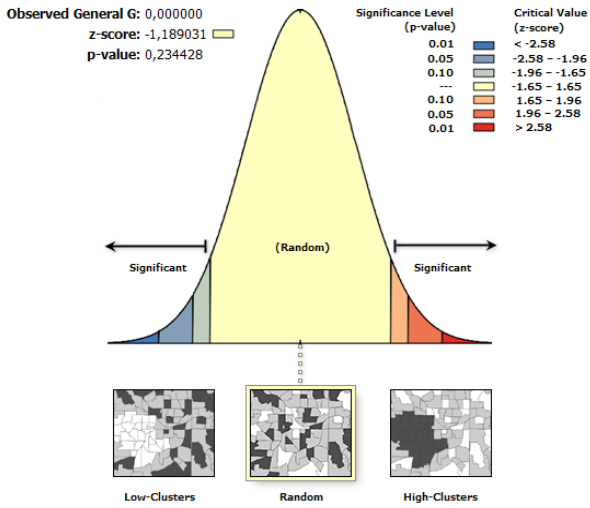

Figure 3. Spatial center-hinterland dependency patterns

Second, the High-Low (HL) category, namely districts that have high levels of income in the agricultural sector but are surrounded by districts that have low levels of income in the agricultural sector. The potential for agricultural land in Kupang and TTU Regencies is quite extensive, but production and productivity are relatively low as a cause. Cima et al. [22] stated that asymmetric conditions between adjacent regions occur due to different economic potentials and development concentrations. Therefore, Kupang and TTU Regencies need government support to develop agricultural potential so that they can increase production.

Third, Low-Low (LL), namely areas that have low levels of agricultural sector income as well as the surrounding areas. The districts/cities included in this category are Kupang City, where the cause is that Kupang City is the economic center of West Timor, NTT Province, so that the secondary and tertiary sectors are more developed. In line with the findings of Liao and Zhang [23] that significant differences in resource and technology ownership are the cause of the economic concentration of a region and adjacent regions becoming LL.

3.2 The impact of center-hinterland interaction on regional income in West Timor

Growth centers initially absorb a lot of resources from the surrounding area (backwash effect), but in the long term this decreases because resources are spread to the surrounding area (spread effect), resulting in a Spillover Effect [24]. The high level of interaction between the growth center and the hinterland has an impact on the progress of the two regions, which is followed by strengthening infrastructure and technology transfer to supporting areas. This is important for the interaction between the growth center and the hinterland, which influences the transfer of potential resources to the

growth center so that infrastructure and technological support to boost economic activity in the supporting areas.

Mankiw [25] stated that interaction between regions is aimed at meeting the needs for goods and services that a region cannot produce itself, so that region requires interaction with other regions that have excess production of goods and services. The interaction value is determined by the price and volume of the type of goods/services as well as the number of trips to and from other places. Interaction between regions depends on the demand in the region receiving the product, which is usually used for consumption or production purposes in the recipient region of the product. The analysis used to analyze the influence of these factors on the GRDP of the center and hinterland regions in West Timor, NTT Province of Indonesia is Geographically Weighted Regression (GWR). The results of the GWR analysis are described in the following section.

3.2.1 Goodness of test

Based on the analysis results in Table 1, it was found that the R-Square value ranged from 99.90% in TTS Regency to 99.99% in Kupang Regency and Kupang City, which means that the independent variable for each regency/city in West Timor influences the dependent variable almost to perfection. The results of the simultaneous test (F test) also show that each district and city in West Timor is significant at α = 0.01, which indicates a dependency among regions in West Timor. Soares et al. [26] stated that the flow of products to and from other regions shows the existence of dependence between one region and other regions.

Table 1. Goodness of test results of the GWR model

Regency/City	p-Value Uji F	R^2
Kupang City	0.00120	0.9999945
Kupang Regency	0.00140	0.9999991
TTS Regency	0.00150	0.9989740
TTU Regency	0.00130	0.9998440
Belu Regency	0.00138	0.9997980
Malaka Regency	0.00123	0.9997980

Agricultural sector income in a region and adjacent regions is a factor that causes GRDP growth in a region. Besides that, other factors such as the total GRDP of adjacent regions, the population of one's own region and neighboring regions, and the frequency of interaction (center to hinterland or hinterland to center). The general cause, according to Li et al. [27] is changes in environmental factors along with changes in geographic location. The GWR model that shows changes in factors along with changes in Regency/City in West Timor is as follows:

$$\widehat{\boldsymbol{Y}}_{\boldsymbol{Kupang\ City}} = 18{,}896{,}445\beta_0 + 60{,}343{,}454\ \boldsymbol{WY} + 42.21814X_1 + 2.555027\boldsymbol{W}X_1 + 1.8003X_2 + 7{,}345{,}456\ \boldsymbol{W}X_2 + 68.14601X_3 + 834.4827\boldsymbol{W}X_3 \quad (8)$$

$$\widehat{\boldsymbol{Y}}_{\boldsymbol{Kupang\ Regency}} = 17{,}789{,}398\beta_0 + 58{,}168{,}861\ \boldsymbol{WY} + 40.11947X_1 + 3.687238\boldsymbol{W}X_1 + 1.610558X_2 + 9{,}862{,}539\boldsymbol{W}X_2 + 26.06694X_3 + 794.7612\boldsymbol{W}X_3 \quad (9)$$

$$\widehat{\boldsymbol{Y}}_{\boldsymbol{TTS\ Regency}} = 15{,}194{,}689\beta_0 + 53{,}305{,}809\ \boldsymbol{WY} + 35.2512X_1 + 6.504380\boldsymbol{W}X_1 + 1.171825X_2 + 1{,}601{,}909\boldsymbol{W}X_2 + 24.0136X_3 + 703.243\boldsymbol{W}X_3 \quad (10)$$

$$\widehat{\boldsymbol{Y}}_{\boldsymbol{TTU\ Regency}} = 15{,}194{,}689\beta_0 + 53{,}312{,}906\ \boldsymbol{WY} + 35.25098X_1 + 6.515895\boldsymbol{W}X_1 + 1.171805X_2 + 1{,}603{,}842\boldsymbol{W}X_2 + 24.0234X_3 + 703.2388\boldsymbol{W}X_3 \quad (11)$$

$$\widehat{\boldsymbol{Y}}_{\boldsymbol{Belu\ Regency}} = 15{,}194{,}689\ \beta_0 + 53{,}312{,}994\ \boldsymbol{WY} + 35.25162X_1 + 6.493585\boldsymbol{W}X_1 + 1.171863X_2 + 1{,}600{,}159\ \boldsymbol{W}X_2 + 23.9946X_3 + 703.2514\boldsymbol{W}X_3 \quad (12)$$

$$\widehat{\boldsymbol{Y}}_{\boldsymbol{Malaka\ Regency}} = 15{,}194{,}689\beta_0 + 53{,}312{,}994\ \boldsymbol{WY} + 35.25098X_1 + 6.516030\boldsymbol{W}X_1 + 1.171805X_2 + 1{,}603{,}864\boldsymbol{W}X_2 + 24.0234X_3 + 703.2388\boldsymbol{W}X_3 \quad (13)$$

3.2.2 Partial test

Partial test of the GWR Model to analyze the influence of each independent variable on the dependent variable. Sofue, and Kohsaka [28] stated that the partial test allows for considering factors that are a priority for improvement and development in the future. The results of the partial test analysis show that each variable in the GWR model for each district/city is significant at α = 0.01. Partially, the dependence of spatial center-hinterland in West Timor on economic growth analyzed using GWR is described as follows:

a. GRDP of neighboring regencies/cities

Production activities and interactions with adjacent regions influence a region's economic growth. The results of the GWR model analysis state that the GRDP of the center region (Kupang City) is influenced by the GRDP of the hinterland region, which is shown by a coefficient of 60,343,454 and is significant at α=5%. This means that every 1 billion increase in GDP in the hinterland will increase GDP in the center by IDR 60,343,454, because the hinterland region supplies agricultural products used in the center, the variations of which are caused by weather and product volume. The previous findings of Lin et al. [29] that weather factors and travel volume affect spatial heterogeneity.

Likewise, regional income in the hinterland is not only influenced by production activities (GRDP) in each region but is also influenced by its interaction with the center and is significant at α=0.01. The results of the GWR model analysis show that the largest coefficient value is for Kupang Regency, which is 58,168,861 because it is very close to Kupang City as the center, in fact, part of the Kupang Regency area is agglomerated with Kupang City. In line with Su et al. [30] who stated that regional market integration will encourage regional economies to grow. The influence of the center's GRDP on the GRDP of other districts (TTS, TTU, Belu, Malaka) is generally the same, around 53,300,000. Indicating that an increase in GRDP in the center by 1 billion rupiah will increase GRDP in each hinterland district by IDR 53,300,000.-. The diversity is shown in Figure 4.

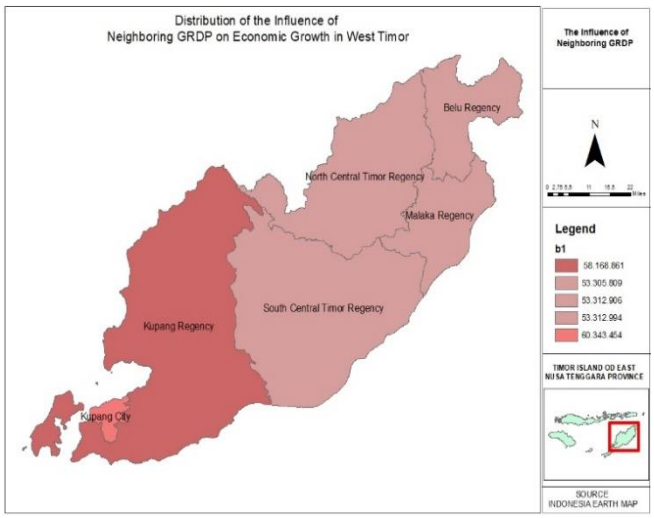

Figure 4. Distribution of the influence of neighboring GRDP on regional income in West Timor

b. Total population

The population is the potential workforce available in an area. Every production activity that uses labor from residents in a region increases regional income in that region, which is significant at α=0.01. The results of the analysis stated that the largest regression coefficient values were in Kupang City (42,218.14) and Kupang Regency (40,119.47); while other districts (TTS, TTU, Belu, and Malaka) have relatively small coefficient values, namely 35,251. This means that every person population rise in Kupang City as the center will raise GRDP by IDR 42,218.14, which is higher than Kupang Regency's IDR 40,119.47 and other districts' IDR 35,251.-; which shows that residents in Kupang City and Kupang Regency are more productive than residents in other districts in West Timor. Kasikoen et al. [31] stated population growth in an area will spur the growth of other economic sectors. The diversity is shown in Figure 5.

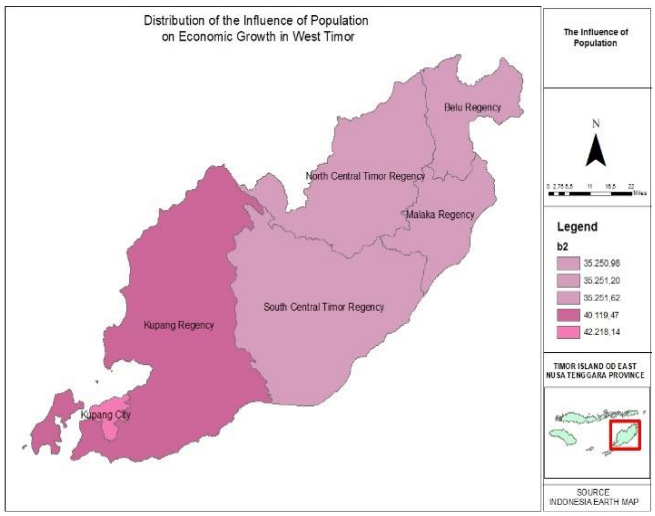

Figure 5. Distribution of the influence of population on regional income in West Timor

c. Population of neighboring regions

Taena et al. [11] stated that the population of a region influences interactions with other regions in West Timor. The subsequent impact is an increase in regional income in other regions that interact with it (significant at α=0.01), although the value is relatively small. The results of the GWR model analysis show that the smallest regression coefficient values are in Kupang City (2,555.03) and Kupang Regency (3,687.24), while the influence of the center (Kupang City) on other districts is greater, namely 6,500. This means that the increase in population in the districts in West Timor has a small impact on regional income in Kupang City as the center, amounting to IDR 2,555. On the other hand, the increase in population in Kupang City increases the regional income of the hinterland region in West Timor by IDR 3,687 in Kupang Regency and other districts (TTS, TTU, Belu, and Malaka) by IDR 6,500 because it requires agricultural products from the hinterland; so that the GDP of the hinterland regions has increased. Inter-regional interactions represent population movements, as well as economic sectors based on each region's peculiarity. The diversity is shown in Figure 6.

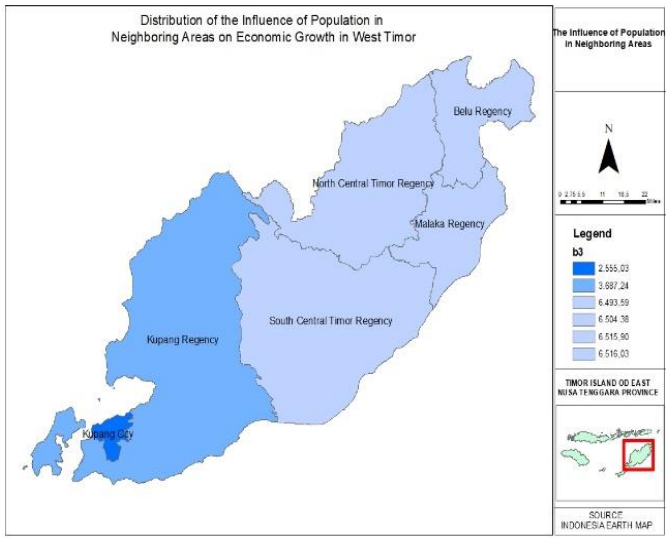

Figure 6. Distribution of the influence of population in neighboring areas on regional income in West Timor

d. GRDP in agricultural sector

An increase in the GRDP of the agricultural sector in a region has an impact on increasing the GRDP of the region. The results of the GWR model analysis show that the largest values are in Kupang City (1,800,299) and Kupang Regency (1,610,558), which means that an increase in GDP in the agricultural sector of IDR 1,000,000 in the center will increase the total GRDP in the center amounting to IDR 1,800,299. As well as increasing the GRDP in the agricultural sector by IDR 1,000,000 in Kupang Regency will increase the total GRDP by IDR 1,610,558. This condition is due to the economic multiplier effect, which is greater in Kupang City and Kupang Regency compared to other districts. Another cause is the efficiency of interaction where low interaction costs will generate higher income; as also found by Kim et al. [32].

The effect of increasing the production value of the agricultural sector in TTS, TTU, Belu, and Malaka Regencies by IDR 1,000,000 each will increase the total GRDP which is classified as smaller, namely IDR 1,171,800 due to the low economic multiplier effect, so comprehensive and sustainable agricultural development is needed. Putra et al. [33] explained that dynamic and sustainable agricultural development in a region is able to move the economy to a larger level. The diversity of centers and hinterlands is shown in Figure 7.

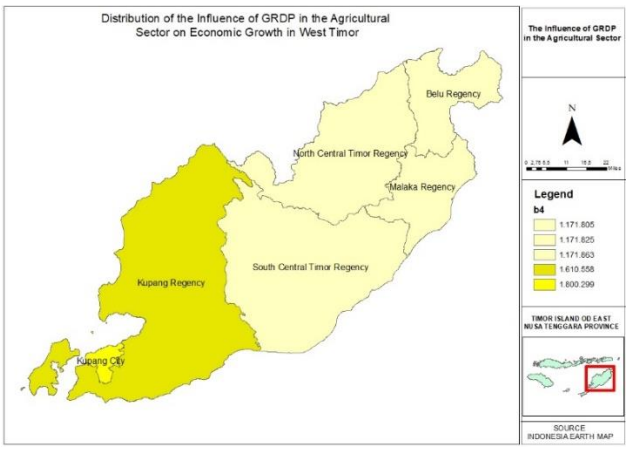

Figure 7. Distribution of the influence of GRDP in the agricultural sector on regional income in West Timor

e. GRDP in agricultural sector of neigboring regions

The results of the GWR model analysis state that an increase in GRDP in the agricultural sector in the hinterland area by IDR 1,000,000 will increase regional income in the center area (Kupang City) by IDR 73,455 and is significant at the 1% level. This occurs because there is a rise in demand for agricultural products which is fulfilled from the hinterland region, which has an impact on raising the GRDP of the central region. Likewise, on the other hand, an increase in GRDP in the agricultural sector in the center area of IDR 1,000,000 will encourage an increase in product marketing to the hinterland region, thereby encouraging an increase in GRDP in the hinterland (TTS, TTU, Belu, and Malaka Regencies) of IDR 160,000 each; while the impact on Kupang Regency is smaller, namely IDR 98,625.-. This happens because the fisheries potential in Kupang Regency is almost the same as Kupang City as the center. Previous research from da Silva et al. [34] stated that agricultural added value changes according to region. The diversity is shown in Figure 8.

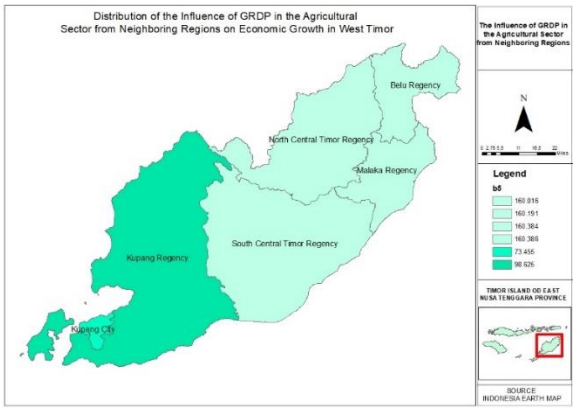

Figure 8. Distribution of the influence of GRDP in the agricultural sector from neighboring regions on regional income in West Timor

f. Interaction center to hinterland and Interaction hinterland to center

The results of the GWR model analysis state that center to hinterland interactions have an impact on hinterland GRDP with an average of IDR 240,000 for each regency, except Kupang Regency which is relatively small, namely IDR 26,067. This implies that agricultural products (particularly fisheries) from Kupang City also stimulate the hinterland economy both directly and through a multiplier effect. The impact of center to hinterland interactions also has an impact on the center (Kupang City), which is IDR 68,146 and is significant at α=0.01. This happened because of the flow of funds entering Kupang City as a result of marketing agricultural products to the hinterland area. According to Aspiansyah and Damayanti [35], regional interaction has a wide positive impact on regional income because if the interaction between two regions is substantial, economic growth also increases, especially due to the close distance and high population. The diversity is shown in Figure 9.

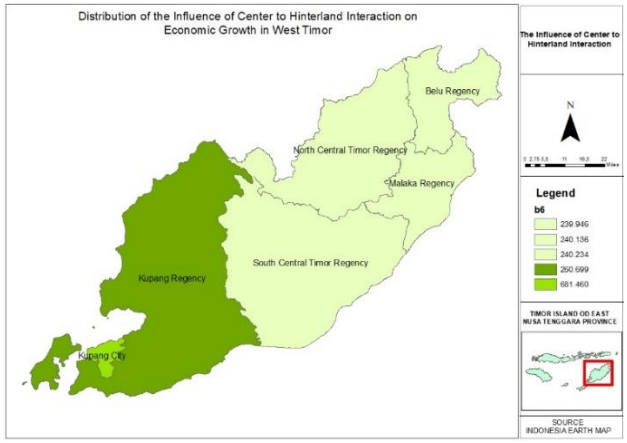

Figure 9. Distribution of the influence of center to hinterland interaction on regional income in West Timor

g. Interaction hinterland to center

The results of the GWR analysis stated that the interaction hinterland to center had the greatest impact on regional income in the central region (Kota Kupang) and Kupang Regency as the neighboring region, with values of IDR 834,483 and IDR 794,761 respectively. The hinterland to center interactions also have an impact on other regencies (TTS, TTU, Belu, and Malaka) with relatively smaller value, namely IDR 703,200. The finding indicates the need for the development of more comprehensive and mutually beneficial interactions. In line with the findings of Yuan et al. [36] regarding the exploration of interaction patterns, which allows for the development of more comprehensive interactions. Previous studies from Oktareni et al. [37] found that growth in regency and urban areas is interconnected, thus influencing the success of development in each region, including increasing regional income. The diversity is shown in Figure 10.

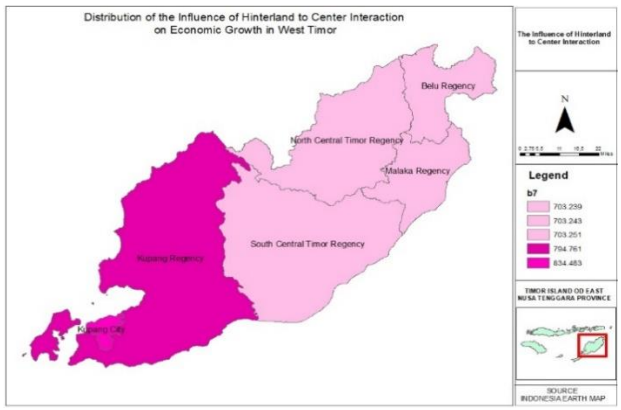

Figure 10. Distribution of the influence of hinterland to center interaction on regional income in West Timor

Therefore, regionally specific development policies are needed so that they can increase economic growth, equitably and sustainably. Miranti et al. [38] stated that spatial-based development policies are important for realizing equitable development; meanwhile [39], Xiao et al. [40] stated that sustainable regional interaction and mobility are needed with increasingly complex patterns that require the ability to develop. In line with Amir et al. [41] who stated that economic policies must support balanced economic growth and environmental sustainability. Further studies that focus on the relationship between economic sectors and regions, the multiplier effect and its impact on equitable growth, social justice and the environment are serious concern.

4. CONCLUSION

In accordance with the Moran Index analysis, it was found that the interaction between the center and the hinterland in West Timor, NTT Province, Indonesia, follows a random pattern, implying that it does not show a cluster or dispersion pattern. Therefore, it was further investigated using GWR value mapping and found that the economy of Kupang Regency is agglomerated (clustered) with Kupang City as the center because of its neighboring region; meanwhile, different spatial patterns are shown by other hinterland areas, including TTS Regency, TTU Regency, Belu Regency, and Malaka Regency, which seem to form other clusters. The results of the geographically weighted regression analysis also found that the regional income of the hinterland and center areas influence each other internally and externally. Economic factors that significantly influence it include the GRDP of neighboring areas, population, population of neighboring areas, GRDP of the agricultural sector, GRDP of the agricultural sector of neighboring areas, interaction between the center and the hinterland, and interaction between the hinterland and the center. Therefore, it is necessary to comply with the zoning of commodities and the appropriateness of the allocation of agricultural products with demand in the center-hinterland region so that it can increase the economic growth of the interacting regions in a balanced manner. Further studies are needed on the interrelationships of economic sectors among regions and the multiplier effects that have an impact on equitable growth, social equity, and the environment.

ACKNOWLEDGMENT

The author wishes to express sincere gratitude to LPPM Timor University for the generous funding of this research.

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