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SPATIAL DISTRIBUTION OF REGIONAL DEVELOPMENT LEVEL USING SPATIAL AUTOCORRELATION APPROACH (A CASE STUDY: CIANJUR REGENCY, WEST JAVA)

Khursatul Munibah[1], Widiatmaka[2], Hermanu Widjaja[3]
Faculty of Agriculture, Bogor Agricultural University (IPB) Miranti Street Dramaga, Bogor Indonesia

Email: khursamun@yahoo.co.id[1], widiatmaka@yahoo.com[2], hermanu_wijaya@yahoo.com[3]

Abstract

The increasing of population and economic activities will effect to regional development level that marked by high availability of public facilities and high population. The higher availability of public facilities so it can support human activities well. In this cases, public fasilities like education, healty, economic, social fasilities and accessibilities have function for supporting the economic activities. A region related to another region due to their spatial neighborhood. Likewise, the availability of public facilities on a region will effect to its neighboring regions.
A topographic were found in Cianjur Regency are flat, undulating, hilly until mountainous with range of elevation (0-3000) m above sea level and range of slope flat until very steep (>40 %). This physical condition would effected to availability of public facilities and number of population. Finally, the relationship between them would effected to spatial distribution of regional development level.
Research objectives were (1) to analyze the regional development level based on the availability of public facilities and (2) to identify the spatial distributian of regional development level based on spatial autocorrelation (Moran's Index).
Determining of regional development level based on availability of public facilities using schallogram approach. Variable of public fasilities were grouped into education, healty, economic, social fasilities and accessibilities. Identifying of the spatial autocorrelation on the availability of public facilities using Moran's Index approach. Neighborhood Concept in this research was the sub-regency bordering defined as a neighbor with weighted spatially equal 1, otherwise = 0.
This research concluded that majority of sub-regencies in Cianjur Regency clustered into hierarchy II and III and only 5 of 32 sub-regencies clustered into hierarchy I. It means that the regional development in Cianjur Regency was moderate level. Spatial distribution of regional development level in Cianjur Regency was rather clumped that supported by Moran's Index = 0, 30 and statistical test where Z(I) = 2,299 more bigger than $Z_{1-\alpha}$ =1,645). This research recommendated to apply the different concept of neighborhood, like an inverse distance weighting and an length of shared boundary between zones.

Key words*: Spatial Autocorrelation, Regional Development, Spatial Distribution, Cianjur Regency, Index's Moran*

INTRODUCTION

Background

The increasing of population and economic activities will effect to regional development level that marked by high availability of public facilities and high population. The higher availability of public facilities so it can support human activities well. In this cases, public fasilities like education, healty, economic, social fasilities and accessibilities have function for supporting the economic activities. Some regions can grow more rapidly than others that effect to levels of social welfare (Dawkins, 2003). Besides that, Regional accessibility have a statistically significant effect on the spatial dispersal the area of the activity space, the total distance traveled and housing prices (Cerda and El-Geneidy 2009).

A region related to another region due to their spatial neighborhood. Likewise, the availability of public facilities on a region will effect to its neighboring regions. Tobler (1970) claims that everything is related to everything else, but near things are more related than distant thing. Because objects are spatially related, each observation is longer independent. Spatial autocorrelation is a technical term for the fact that spatial data from near locations are more likely to be similar that data from distant locations (O'Sullivan and Unwin 2002). To determine the relationship between regional

linkages used Moran's Index method (Wuryandari *et al*. 2014).

A topographic were found in Cianjur Regency are lowland until upland. In the lowland can be found coastal area in southern, hilly area in center and northern. While in the upland can be found the Gede volcano in northern and structural mountainous in southtern. Elevation were found in Cianjur Regency are 0 m until around 300 m above sea level with slope range flat to very steep (>40%). This physical condition would effected to availability of public facilities and number of population. Sub-regency on the lowland like Cianjur sub-Regency (*Kecamatan*) has complete public fasilities for supporting human activities. This phenomenon will effect to regional development level.

Research objectives were (1) to analyze the regional development level based on the availability of public facilities and (2) to identify the spatial distributian of regional development level based on spatial autocorrelation.

MATERIAL AND METHOD

Study Area

The study area (Fig. 1) is Cianjur Regency, West Java, Indonesia and has coordinate of 6° 21'- 7° 25' S and 106° 42'-107° 25' E. The total areas cover 361.435 ha, comprising 32 sub-Regency (*Kecamatan*). Capital Regency is located in Cianjur sub-Regency.

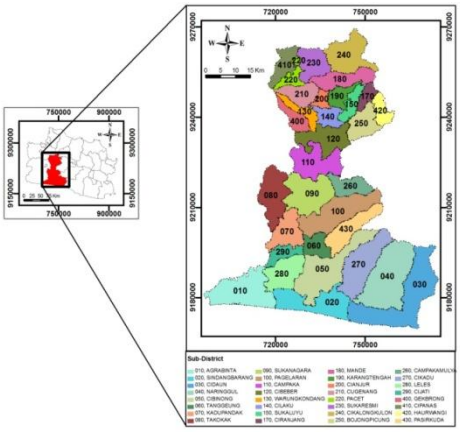

Figure 1. Location of Study Area

Data and Data Processing

Data that used in this research were administration map with scale 1:50.000 and several tabular data from *BPS* of Cianjur Regency (2014) and atribute of spatial data (Table 1).

Determining of regional development level based on availability of public facilities using schallogram approach (Table 2). Identifying of the spatial autocorrelation on regional development level using Moran's Index approach.

Table 1. Variables for Determining of Regional Development Level

Goup	Veriable of Public Fasilities	Number of Variable
Education Fasilities	Number of play group (unit) Nunber of elementary school (unit) Number of junior high school(unit) Number of high school (unit)	4
Healty Fasilities	Number of health centers (unit) Number of doctor (jiwa) Number of nurse (jiwa)	3
Economic Fasilities	Number of big industry (> 99 employes) Number of moderate industry (20-99 employes) Number of small industry (<20 employes) Number of *koperasi* (unit) Number of hotel (unit)	5
Social Fasilities	Numer of population (jiwa) Number of mosques (unit) Number of church (unit)	3
Acsessibility	Area of sub-regency (ha) Leght of pronvicial road (m) Leght of regencial road (m) Leght of rural road (m)	4
Total		19

Table 2. Step of Schallogram Approach (Rustiadi *et al*. 2009)

1.	Calculate the capacity of public facilities in every sub-regency	:	$K_{ij} = {}^{f_{ij}}/_{p_i}$	K f p	Capacity of public fasilities Number of public fasilities Number of population
2.	Calculate the weight capacity of public facilities in every sub-regency	:	$r_j = {}^{n_j}/_{N}$ $b_{ij} = {}^{K_{ij}}/_{r_j}$	n N r b	Number of public fasilities >0 Number of sub-regency Rasio Weighted
3.	Calculate the availability of public facilities in every sub-regency	:	$IF_i = {}^{(b_{ij} - min_j)}/_{std_j}$	min std IF j i	Minimum Standart deviation Availability of public fasilities Type of public facilities Sub-regency (32 sub-regency)
4.	Determine the level of region development in every sub-regency	:	Hierarchy I : $IF_i \geq (mean + std)$ Hierarchy II : $IF_i \geq mean - < (mean + std)$ Hierarchy III : $IF_i < mean$		

Spatial autocorrelation on the availability of public facilities was calculated by Index Moran formula (O'Sullivan and Unwin 2002).

$$I = \frac{n}{\sum_{i=1}^{n}(y_i - \bar{y})^2} \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}}$$

Where:

y_i : Number of public facilities availability in center sub-regency

y_j : Number of public facilities availability in adjacency sub-regency

$\bar{y}$: Average of public facilities availability of all sub-regency in Cianjur Regency

I : Moran's Index

w_{ij} : Spatial weighted between center and adjacency sub-regency

n : Number of sub-regency in Cianjur Regency (32 sub-regency)

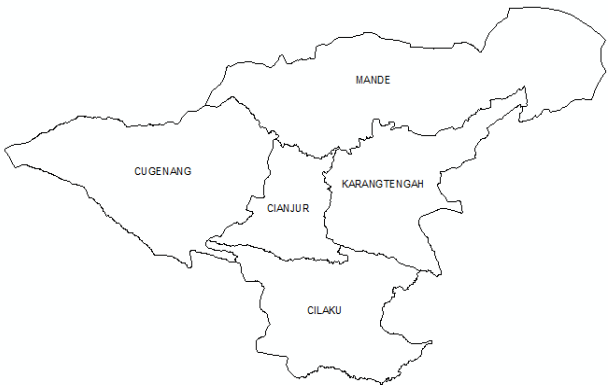

Figure 2. Ilustration of Neighborhood Concept

Figure 2. Ilustrates about the concept of neighborhoods, where the districts bordering defined as a neighbor. For example, if Cianjur District as the center (i) and then Mande, Cilaku, Karangtengah, Cuegenang sub-Regencies were as neighbors (j). In this case, value of w_{ij} = 1, otherwise = 0.

The Moran's Index supported by tests of significance with a significance level of 5%, indicating that there was a similarity value of the availability of public facilities between the region with its neighboring regions. Formula of significance test (Wuryandari *et al*. 2014):

i. Hypothesis
   H_0: there is no spatial autocorrelation
   H_1: there is spatial autocorrelation
ii. Significance level (α) = 5%
iii. Statistical test

$$Z(I) = \frac{I - E(I)}{\sqrt{var}(I)}$$

$$E(I) = \frac{1}{n-1}$$

$$Var(I) = \frac{n^2 S_1 - n S^2 + 3S_o^2}{(n^2-1) S_o} - [E(I)]^2$$

$$S_0 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}$$

$$S_1 = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} (w_{ij} + w_{ji})^2$$

$$S_2 = \sum_{i=1}^{n} \left[\sum_{j=1}^{n} w_{ij} + \sum_{j=1}^{n} w_{ji}\right]^2$$

If value of Z (I) > $Z_{1-\alpha}$ then H_0 rejected and H_1 accepted. It mean that there is spatial autocorrelatian and vice versa. Distribution pattern of the development region level indicated by the value of Z (I), $Z_{1-\alpha}$ and value of Moran's Index. Types of distribution pattern like spread and clumped.

RESULTS AND DISCUSSION

Regional Development Level Based on Public Facilities Availability

Table 3 shows that 32 sub-regencies in Cianjur Regency Categorized to three clusters based on the availability of public facilities, namely hierarchy I, II and III. The hierarchy levels shows that the smaller hierarchy, the public facilities more available to support the human activities.

There are 5 sub-regencies belong to hierarchy I, namely Cianjur, Sukanagara, Agrabinta, Cibinong and Cijanti. This means that 5 sub-regencies have the public facilities that are capable to support well their human activities. The Cianjur sub-regency is capital of The Cianjur Regency and also the center of economic activities so that it has become more developed regions than others. While Sukanagara, Agrabinta, Cibinong and Cijanti with a low population so that public facilities still have the ability to support their activities, although the low economic activities.

There are 12 and 15 sub-regencies belong to hierarchy II and III, respectively. The northern of Cianjur Regency dominated by the hierarchy III because high population and low public facilities due to hilly and mountainous topographic. The same topographic were found in the southern of Cianjur Regency however dominated by hierarchy II. This was due to low population and low public fasilities.

Table 3. Index of Public Facilities Availability and Regional Development Level

Code	Sub-Regency	Public Facilities Availability	Regional Development Level (hierarchy)	Code	Sub-Regency	Public Facilities Availability	Regional Development Level (hierarchy)
250	Bojongpicung	16.50	III	110	**Campaka**	17.02	III
200	Cianjur	30.34	I	260	Campakamulya	25.33	II
120	Cibeber	20.51	III	070	Kadupandak	16.72	III
240	Cikalongkulon	22.69	II	100	Pagelaran	23.62	II
140	Cilaku	21.09	III	430	Pasirkuda	17.83	III
410	Cipanas	20.37	III	080	Takokak	24.69	II
170	Ciranjang	24.71	II	060	Tanggeung	23.36	II
210	Cugenang	14.55	III	090	Sukanagara	34.30	I
400	Gekbrong	17.12	III	010	**Agrabinta**	28.25	I
420	Haurwangi	18.97	III	050	Cibinong	29.70	I
190	Karangtengah	24.27	II	030	Cidaun	23.23	II
180	Mande	23.12	II	290	Cijati	32.07	I
150	Sukaluyu	18.02	III	170	Cikadu	25.04	II
220	Pacet	17.92	III	040	Naringgul	21.62	III
230	Sukaresmi	10.47	III	280	Leles	24.60	II
130	Warungkondang	16.99	III	020	Sindangbarang	25.42	II
	Minimum	10.47			Mean	22.20	
	Maximum	34.30			Std. Deviation	5.30	

Spatial Distribution of Regional Development Level

Number of Neighbors and Value of Weighted Spatially

In a spatial analysis to determine the presence of spatial autocorrelation, the main component required was a location map. This map was used to determine the relationship between one sub-regency with others. Based on the Cianjur Regency Map knowing that Cianjur Regency has 32 sub-regency so that size of weighted spatially was 32x32. Value of weighted spatially (w_{ij}) equal 1 if zone i and j are adjacent, otherwise equal 0. Therefore, number of

neighbors would be same with value of weighted spatially ($w_{ij}=w_{ji}$).

Based on Figure 3 showed that Mande sub-regency has the maximum neighbor (7) while Cibeber, Cilaku, Sukaluyu have 6 neighbors and others have 2 until 5 neighbors. The number of neighbors will increase the value of autocorrelation (Moran's Index).

Value of Spatial Autocorrelation

Spatial autocorrelation is a technical term for the fact that spatial data from near locations are more likely to be similar that data from distant locations (O'Sullivan and Unwin 2002). Tobler (1970) claims that everything is related to everything else, but near things are more related than distant thing. Because objects are spatially related, each observation is longer independent. Moran's Index is one of analysis techniques for knowing the spatial autocorrelation between observed locations.

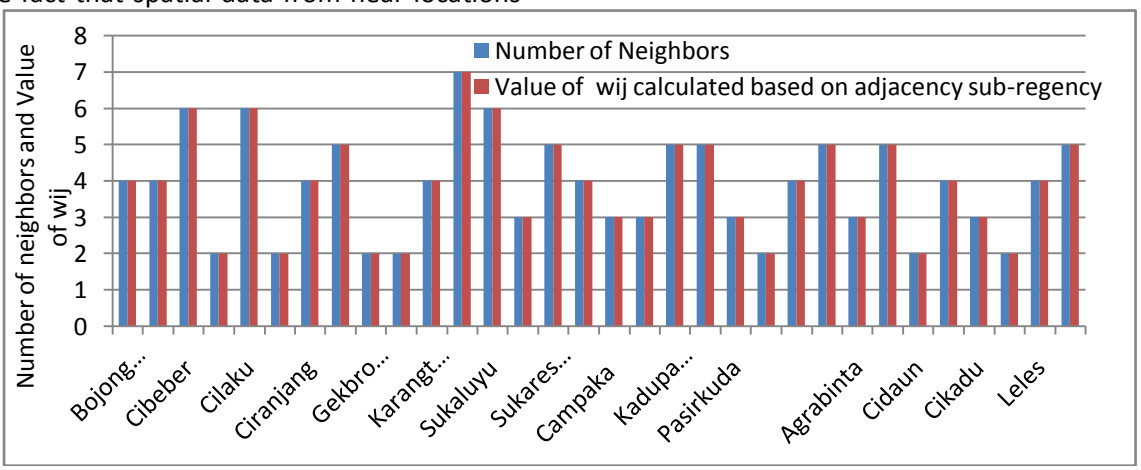

Figure 3. Number of Neighbors and Value of Weighted Spatially

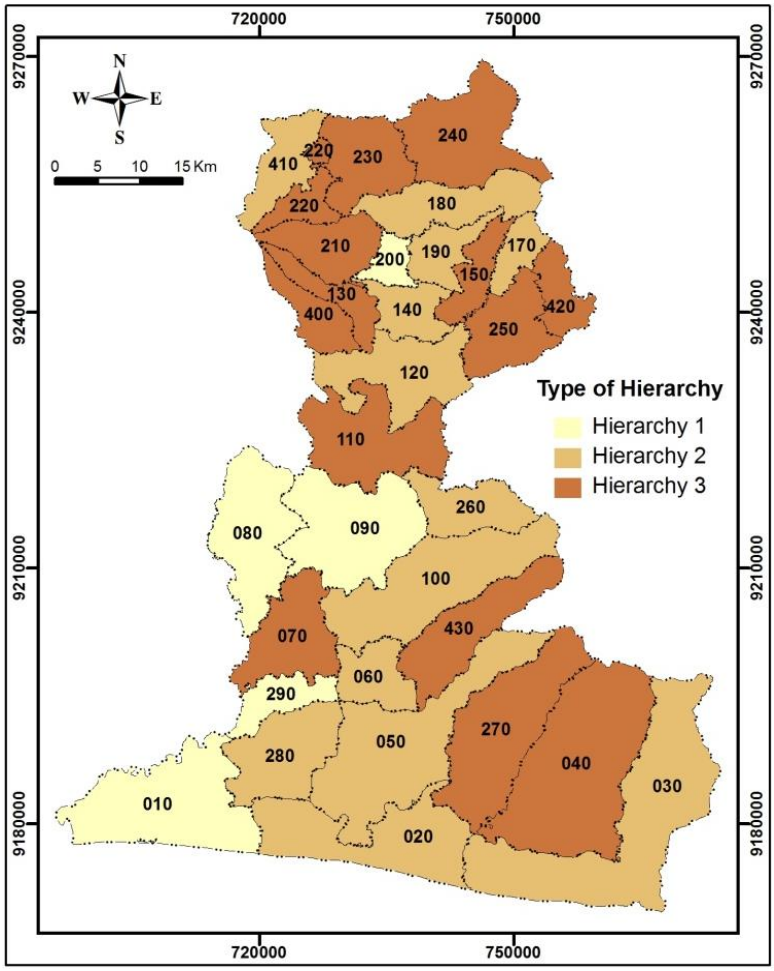

Figure 4. Spatial Distribution of Sub-Regency Development Level

Based on calculation of Index Moran formula obtained that I (Index Moran) is 0,3. It indicates a fairly positive autocorrelation between levels of regional development in neighboring sub-regencies. This result supported by statistical test, where Z(I) = 2,299 more bigger than $Z_{1-\alpha}$ (1,645). It means H_0 rejected and H_1 accepted that showed present of spatial autocorrelation. In other words, the spatial distribution of the regional development level was rather clumped (Figure 4).

The other research that support the result above area Moran's Index on Bush votes in USA = 0.41 which indicated a fairly strong positive correlation (O'Sullivan and Unwin 2002). Moran's Index on unemployment in Semarang Regency, Central Java was 0.0614 which indicated a positive spatial autocorrelation but very small correlation (Wuryandari *et al*. 2014).

CONCLUSION AND RECOMMENDATION

This research concluded that majority of sub-regencies in Cianjur Regency clustered into hierarchy II and III and only 5 of 32 sub-regencies clustered into hierarchy I. It means that the regional development level in Cianjur Regency was moderate. Spatial distribution of regional development level in Cianjur Regency was rather clumped that supported by Moran's Index = 0, 30 and statistical test where Z(I) = 2,299 more bigger than $Z_{1-\alpha}$ =1,645).

This research recommendated to apply the different concept of neighborhood, like an inverse distance weighting and an length of shared boundary between zones.

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