

# Spatial Empirical Analysis on Urban Dwellers' Human Development Index in North Sulawesi, Indonesia



Joune J. E. Ganda and Lin Yola

**Abstract** The Human Development Index (HDI) is an essential indicator to measure the urban community's welfare. North Sulawesi is the only province with the HDI above the national index in Sulawesi in 2021 (73.3 over 72.3). The HDI level is calculated based on the aggregation of three dimensions; health seen from the life expectancy at birth indicator, knowledge which counted from the average duration of study and the expected duration of study indicators, and the decent standard of living represented by adjusted average per capita expenditure indicator. This study explored analytical method through the quantitative includes descriptive analysis, inferential analysis, the spatial regression method and GeoDa Software. The model to be used based on the spatial dependence test is the Ordinary Least Square (OLS) analysis. The results show that average of per capita expenditure of the urban dwellers caused a positive and significant impact on the Human Development Index in North Sulawesi Province.

**Keywords** Human Development Index · North Sulawesi Province · Urban spatial analysis

## 1 Introduction

Human development is a multidimensional development process of human being as a complex entity. The concept of human development examines humans from two different perspectives. First, the increase of physical capabilities or the formation of human functioning abilities through improving health, knowledge, and skills. Second, how to get advantage of the capabilities or abilities possessed to carry out productive activities [1].

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The Human Development Index (HDI) is an important indicator to measure the urban community's welfare in Indonesia. Even though the HDI develops, it is still relatively low compared to neighboring countries. In the Sulawesi region, North Sulawesi recorded as the only province in Sulawesi performed the HDI above the national value. The Central Statistics Agency of North Sulawesi Province reported its' HDI value in 2021 reached 73.3 over the national level of 72.29. The HDI value consist of three dimensions; health seen from the life expectancy at birth indicator, knowledge counted from the average duration of study and the expected duration of study indicators, and the decent standard of living represented by adjusted average per capita expenditure indicator [1, 2].

Hence, the achievement of North Sulawesi on the human development index is the significant concern to consider to study the influencing factors to achieve the better development of the province. This paper presents the analysis of impact of the average duration of study and average per capita expenditure variables on Human Development Index in North Sulawesi in 2021 through the spatial empirical analysis approach.

## 2 Literature Review

The Human Development Index (HDI) is a measure to calculate the achievement of human development based on several basic components of quality of life. HDI is formulated through a basic three-dimensional approach which includes a long and healthy life, education, and a decent life. Many factors relate to these three-dimensional approach covers a very broad concept [3].

The average duration of study as the indicator of education dimension, defined as the number of years spent in formal education by the population aged 15 years old and above. Under normal circumstances, average duration of study of a place relatively increases time by time. Meanwhile, the record considers for the population with average duration of study consists of the population within the age range of 25 years old and above, as it is assumed that the highest education level keeps within that age limit [4].

Meanwhile, the average per capita expenditure as an indicator of decent life dimension defined as an overview of the level of purchasing power owned by the urban community. Expenditure per capita is one of the important components considered in determining the status of development of a region [5].

## 3 Methods

This study explored the spatial empirical approach through the GeoDa Software analysis. Overall, the data derived from the secondary data of Central Statistics Agency of North Sulawesi Province. The data include the Human Development

Index, average duration of study, and adjusted per capita expenditure. The data analysis were performed according to the districts/cities in North Sulawesi Province, which consist of eleven regencies and four administrative city areas (see Fig. 1). The selection was considered due to the availability of data in the district/city level.

This study used empirical spatial quantitative descriptive analysis and inferential analysis in processing the data. The empirical study by using the computer analysis were discussed as a reliable approach to investigate the spatial study [7, 8]. Descriptive analysis was used to describe the distribution of research variables by district/city. Then, the results of the descriptive analysis were presented in a thematic map to describe the situation of the variables studied. The inferential analysis was also carried out to determine the effect of the independent variable on the dependent variable by using the spatial regression method.

Spatial regression develops a classical linear regression method with consideration of the impact of spatial or non-spatial variables on the others [9]. There are two causal effects that can be seen from the spatial regression, they include the spatial dependence effect and the spatial diversity effect. The spatial dependence effect describes the existence of autocorrelation between locations of the research object, which can be divided into two, namely spatial lag and spatial error, while the spatial diversity effect refers to the diversity of functional forms and parameters at each location [10]. The Lagrange Multiplier test was used to test the spatial dependence effect while the Brush-Pagan test was used to test the spatial diversity effect [11]. Ordinary Least Square (OLS) used as a regression technique to estimate the

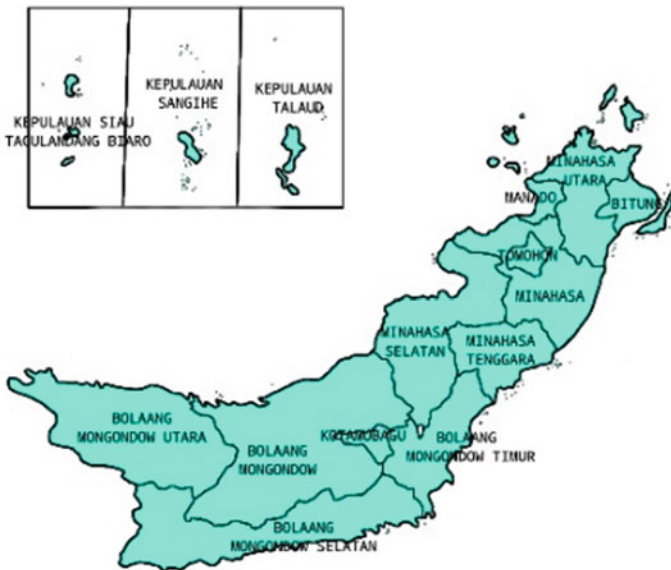


Fig. 1 Map of North Sulawesi Province [6]

coefficients of linear regression equations which describe the relationship between dependent and independent quantitative variables [12].

### 4 Results

The Human Development Index of each district/city in North Sulawesi Province were classified by using a quantile map which divides the area into four categories. The darker color gradation indicates the higher value of HDI in the region, while the light color represents the lower ones. Figure 2 shows the areas with the highest HDI values were indicated in the Northern part of the island of Sulawesi, covering the areas of Manado City, Tomohon City, Bitung City, and Minahasa Regency. Meanwhile, the lower HDI values were indicated in the Southern part of the island as well as the island regencies. These archipelagic districts do not have direct borders with the continental/mainland districts.

Figure 3 illustrates the average duration of study of the urban dwellers in North Sulawesi Province. In general, urban dwellers in administrative cities tend to experience higher average duration of study compared to the ones living in districts area. On the other hand, North Minahasa Regency has a higher average duration of study

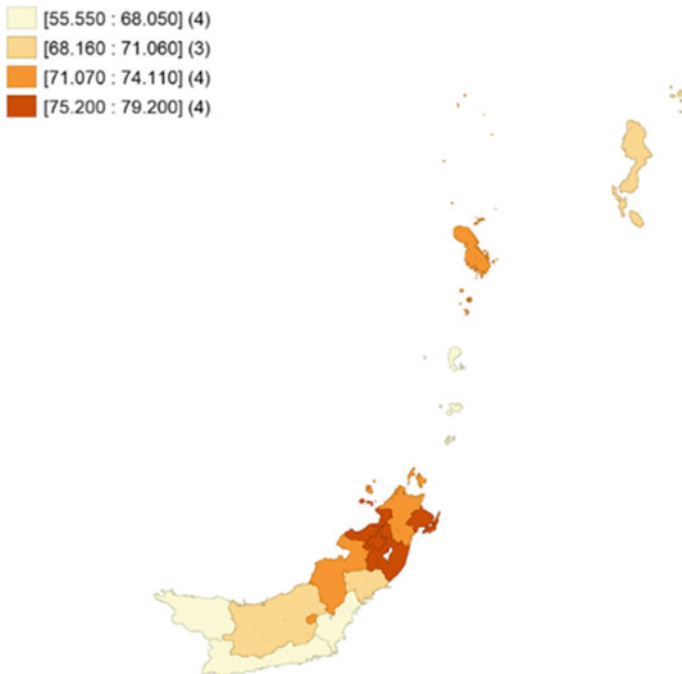
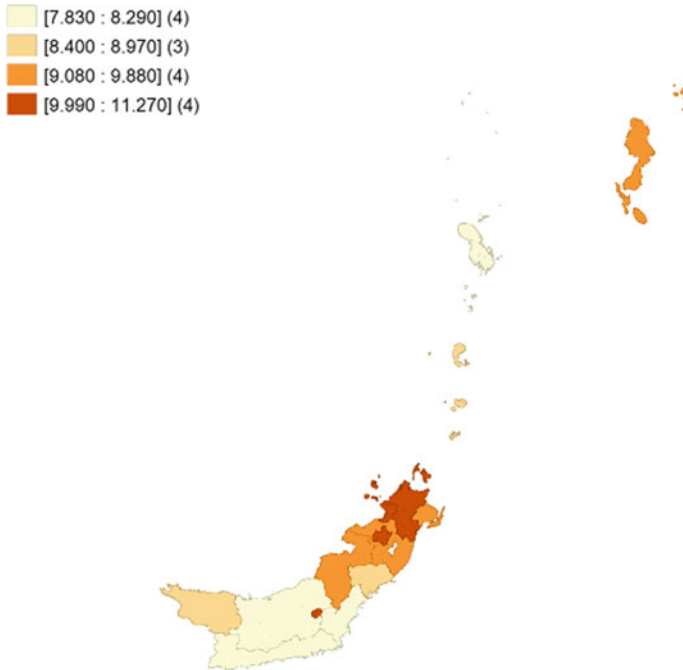


Fig. 2 The distribution of Human Development Index in North Sulawesi Province



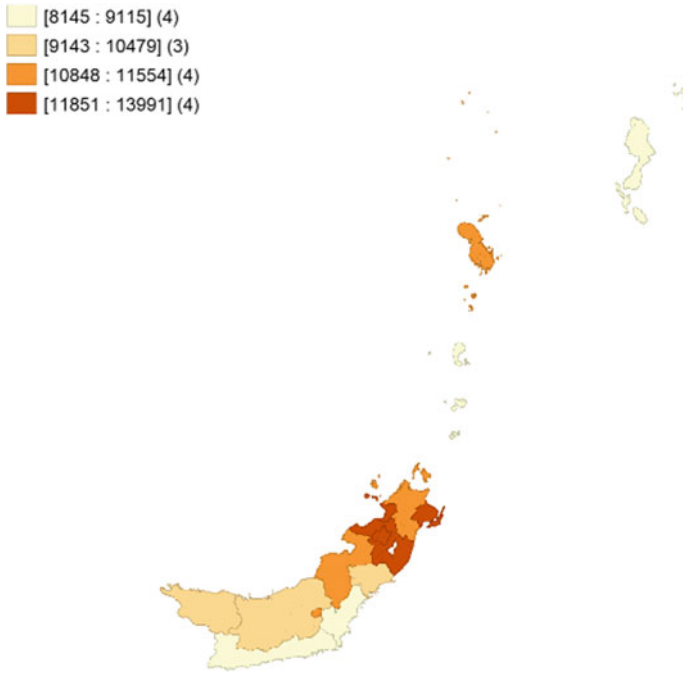
**Fig. 3** The distribution of average duration of study in North Sulawesi Province

over other regions, although as discussed earlier, those people living in districts area has lower average duration of study compared to the administrative areas. The regions with high average duration of study include Manado City, Tomohon City, Kotamobagu City, and North Minahasa Regency. Meanwhile, the regions with low average duration of study which tend to be in the south area, cover Bolaang Mongondow Regency, South Bolaang Mongondow Regency, and Sangihe Islands Regency.

Figure 4 explains the regions with a high level of average per capita expenditure consist of Manado City, Bitung City, Tomohon City, and Minahasa Regency. Meanwhile, the low level of average per capita expenditure recorded in South Bolaang Mongondow Regency, East Bolaang Mongondow Regency, Siau Tagulandang Biaro Islands Regency, and Talaud Islands Regency.

Table 1 presents the results of the spatial dependence test. It shows both Lagrange Multiplier (Lag and Error) have no significant result. A significant value is determined when the p-value is close to 0.01, while the most commonly used significant value is close to 0.05. Therefore, the model to be used based on the output is the Ordinary Least Square (OLS) analysis.

Although the OLS regression model is the most appropriate regression model to use, the following table also shows the results of the spatial lag regression and the spatial error regression for comparison (see Table 2). The average per capita



**Fig. 4** The distribution of average per capita expenditure in North Sulawesi Province

**Table 1** Spatial dependence results output

Spatial dependence test	p-value
Moran's I (error)	0,71,921
Lagrange multiplier (lag)	0,19,274
Lagrange multiplier (error)	0,43,129
Lagrange multiplier (SARMA)	0,33,915

expenditure has positive and significant impact on the Human Development Index with the significant value is close to 0.01 ( $\alpha = 1\%$ ). The average duration of study has positive but not a significant impact on the Human Development Index with the  $\alpha=10\%$ .

## 5 Conclusions

This study explores the spatial empirical analysis through the GeoDa Software using the OLS model to investigate the Urban Dwellers' Human Development Index in North Sulawesi, Indonesia. The average per capita expenditure of the urban dwellers

**Table 2** OLS regression results output

Variable	OLS	Spatial lag	Spatial error
W_IPM	–	–0,0,359,352	–
CONSTANT	28,0123	27,5575	27,2868
EDU	3,07,796	2,91,567	3,16,054
GDP	0,00,135,368	0,00,172,412	0,00,133,339
LAMBDA	–	–	–0,35,962

*HDI*: Human Development Index; *EDU*: Average Duration of Study; *GDP*: Average per Capita Expenditure

has a positive and significant impact on the Human Development Index in North Sulawesi Province. Therefore, the policies that should be implemented for the purpose of developing the quality of human life in these areas must be related to increase the average per capita expenditure of the urban dwellers, which requires further and specific study.

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