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Optimal Island City Capacity: Ternate City Case

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ABSTRACT

Cities that grow on an island have limitations in utilizing space for various activities. The limited space of island activity, population growth, and high urban activity have signaled the need to analyze the optimal capacity of island cities. With the Ternate City case study, this study aims to determine the capacity of island cities economically by analyzing the optimal size of island city residents. The optimal measurement of island cities uses the Alonso-Richardson approach, minimum management cost, net benefit, and long-term profit. The results of the analysis showed that the city of Ternate, with a population density of 1,264 people / km^2 per the year 2020, has exceeded the optimum capacity of the size of the city both from the minimum per capita city management fee (658 people/$km^{2)}$ and from the maximum approach of per capita benefits (877 people/$km^{2).}$ While from the long-term maximum per capita profit approach, the city's population is still below the optimum limit (2,054 inhabitants/$km^{2).}$ Thus, strict population control is essential, especially on Ternate island, through the spread of residents and activities directed to islands or sub-districts whose urbanization is still below the optimum point of the city population.

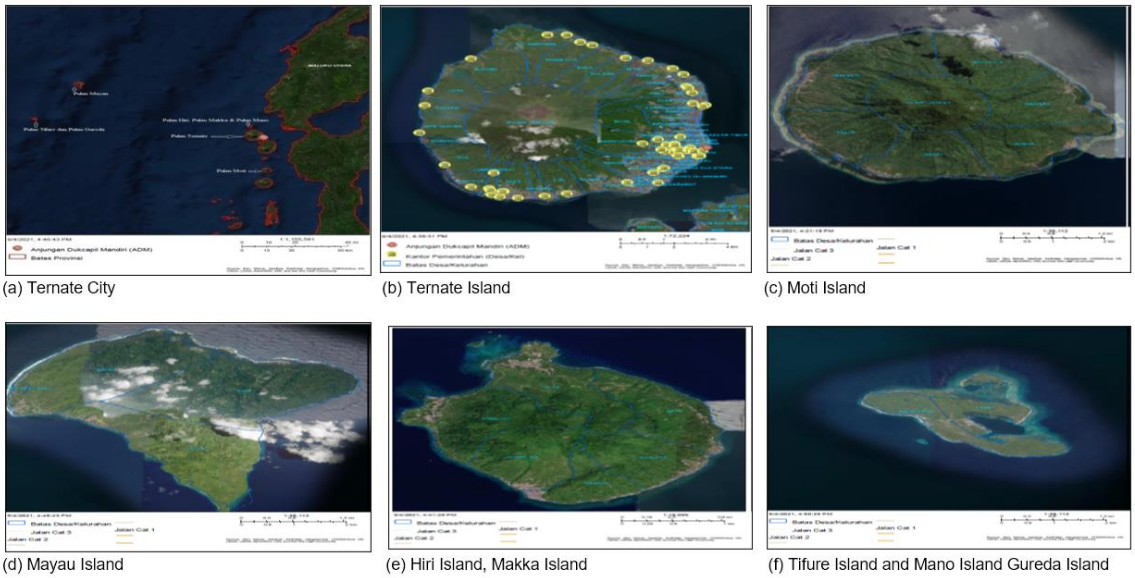
Keywords: Island City Capacity, Optimal City Size, Ternate

INTRODUCTION

The island city is located outside the main island and meets urban characteristics, namely population density and economic structure (Maulana & Benita, 2017). Although they referred to the "Island City" vocabulary, two fundamental uniqueness need to be understood: the city and the island. The city is the center of various activities with various facilities and has the characteristics of high population density, total economic spreading power, and is dominated by economic activity in the secondary and tertiary (non-agricultural) sectors. At the same time, the island is a tiny landmass surrounded by water and separated from the wider mainland. Its fundamental uniqueness is; first, cities with various characteristics in their development will create rapid population growth, social diversity, agglomeration and urbanization, and increased use of resources (Maulana & Benita, 2017); second, islands with physical appearances have long-term utilization limits.

Various economists and regional planners have conducted studies of islands, cities, island cities, and the optimal economic size of cities. Theoretical concepts and empirical findings have been produced through several studies, such as Arif, Machdar, Azmeri, and Achmad (2019), Batty (2013), Burnett (2016), Cheng and Ma (2017), Frick and Rodríguez-Pose (2016), Grydehoj et al. (2015), Imelda, Yunisvita, Soebyakto, and Apriani (2020), Maulana and Benita (2017), Motak (2016), Sjafrizal, Suhairi, Winarno, abd Wau (2016), Tustt (2014), and UNEP (2014).

Many cities grow rapidly on an island or a large landmass, including the city of Ternate. Ternate City is an island city that belongs to the Maluku Islands group in Indonesia located in North Maluku Province with an area of 5,709.72 Km^{2,} consisting of a land area of 162.17 km^{2} and an ocean of 5,547.55 km^{2}. As an island city, it has five large inhabited islands and three small uninhabited islands, with the most significant island being Ternate Island, which is 101.68 km^{2} (Badan Pusat Statistik Kota Ternate, 2021).



(a) Ternate City (b) Ternate Island (c) Moti Island
(d) Mayau Island (e) Hiri Island, Makka Island (f) Tifure Island and Mano Island Gureda Island

Figure 1. Ternate City Map for 2021
Source: https://gis.dukcapil.kemendagri.go.id/peta/DigitalMap

Previous research on the typology of island cities in Indonesia has categorized Ternate city into a single urban zone located on a small island (Maulana & Benita, 2017). As shown in Figure 1, Ternate City is an island city that covers only one island and consists of five large islands and three small islands. However, it is undeniable that recent development up to the present time still makes Ternate Island the center of various activities in the city of Ternate. Furthermore, from the morphological aspect of space, Ternate City is a heritage city that, since the 18th century, has been designed into a city with a linear pattern of space on the beach and the grid at its center. This condition changes its characteristics when implementing reclamation, forming a new road network, and accommodating various business activities and public spaces, where the main development center of the city is on Ternate Island (Ibrahim, 2018).

The city of Ternate is administratively divided into eight sub-districts, where the center of government activities takes place on Ternate island, precisely in the Central Ternate Subdistrict. The population of Ternate City in 2020 is 205,001 people with a density of 1,264.11 people/km and an average growth of 2.4% per year, with the largest population distribution is in Pulau Ternate. The concentration of activities on Ternate island, which includes five sub-districts, causing high levels of population density, especially in three sub-districts, namely South Ternate 3,676 people/km^2, Central Ternate 3,564 people/km^2, and North Ternate 3,459 people/km^2 (Badan Pusat Statistik Kota Ternate, 2021).

Table 1. Geographic Region and Population of Ternate City in 2020

Island	District	Island Area (Km^2)	Subdistrict Area (Km2)	Population	Population Density (per Km^2)
Ternate Island	Ternate Island	101.68	17.39	8, 735	502
	North Ternate		14.16	48, 982	3. 459
	South Ternate		20.22	74, 329	3. 676
	Central Ternate		15.05	53, 643	3. 564
	West Ternate		34.85	8, 788	252
Pulau Hiri	Pulau Hiri	6.69	6.69	2, 922	437
Pulau Makka		0.013			
Mano Island		0.0004			
Moti Island	Motions	24.79	24.78	4, 811	194
Mayau Island	Batang Dua Island	24.17	29.03	2, 791	96
Tifure Island		4.60			
Pulau Gurandfrom		0.22			
TOTAL		162,17	162.17	205. 001	1, 264

Source: Badan Pusat Statistik Kota Ternate, 2021

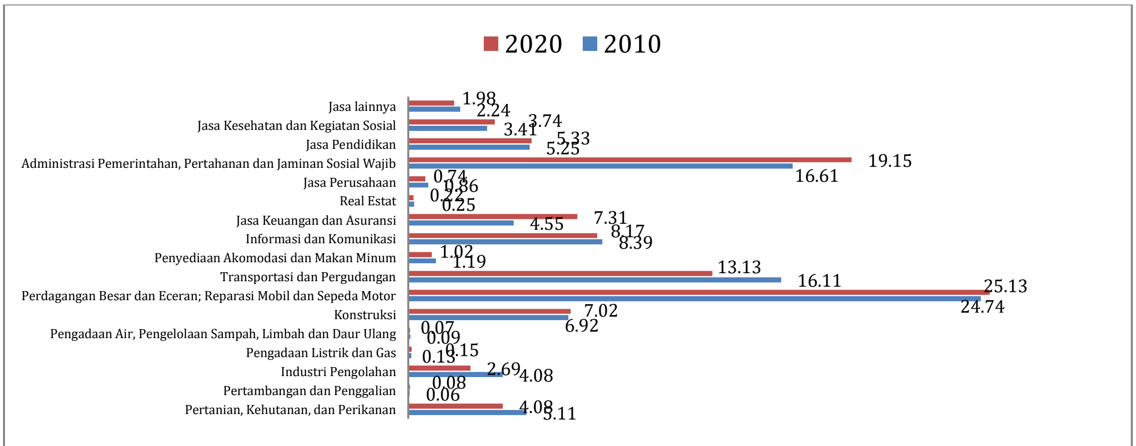


Figure 2. Economic Structure of Ternate City in 2010 and 2020
Source: Data Processed (Badan Pusat Statistik Kota Ternate, 2021)

As an island city, Ternate city's economy is dominated by the trade and services sectors From 2010 to 2020, as presented in Figure 2, extensive trade and retail sectors, car and motorcycle repairs are the sectors that dominate its economy. Likewise, the transportation and warehousing sector and several other service sectors that become a Ternate city as an island city to develop will provide a symbiotic relationship to the size or capacity of the city.

The uniqueness of the island city with physical, environmental, social, economic, and other characteristics has consequences for the island as a city. However, rapid urban population growth, advanced urban living patterns, and increased demand for resources and services have increasingly put enormous pressure on the island's physical, land, and resource availability that, in the long run, will threaten the sustainability of development. This condition is a study conducted by the United Nations Environment Program (UNEP, 2014). It revealed several problems that arise in small island developing countries, namely, environmental issues including cross-sector problems, rehabilitation of biodiversity and ecosystems, sustainability of natural resource use, the threat of chemicals and waste, and climate change. Secondly, socio-economic issues include economic diversification of the island, strengthening social cohesion, health challenges, preservation of cultural heritage and indigenous identity, future of food security, freshwater management, disaster preparedness, and declining resources for development financing (UNEP, 2014.

Regional development is an integral part of national development. It is carried out based on the principles of regional autonomy and resource management providing opportunities for heightening regional performance (Kotib, 2020). Historically, the city of Ternate, from time to time with various developments achieved and the approach of the utilization of space activities, has created the current city of Ternate, which is an island city with a buildup of activity at one point, namely Ternate Island. Consequently, the city center space has exceeded the maximum limit so that it is at risk of the diversion of forests and green space for the benefit of settlement and sectoral development. Besides, the land structure and water resources capacity decreases and becomes a precarious problem for cities and islands. There is also a development gap between islands in Ternate. Also, differences in people's income levels between islands widen the gaps.

For the characteristics and development of the island city, especially the city of Ternate, it becomes essential to measure the capacity of the island city. One approach in measuring urban capacity was developed by Allonso-Richardson (Sjafrizal et al., 2016), analyzing the relationship between population numbers and city management costs per capita and the per capita benefits of growing economic activity. Residents become essential keys in developing a city, including island cities. The growth of the population through birth and migration due to the attractiveness factor of the city will have significant consequences for the activity, capacity, and sustainability of Ternate City, affecting the economy of the city management cost, the net benefits, and maximum benefits of economic activity. Therefore, the study is intended to understand the capacity of island cities economically by analyzing the optimal size of island city residents, where the research case study is Ternate city.

LITERATURE REVIEW

We are equally aware that there are many islands in different parts of the world on which small cities grow to large cities and have given birth to new characteristics, where the analytical point of view of one or more islands becomes increasingly complex and creates coherence that should not be separated between the island's point of view and the city's point of view. Moreover, the island's geographical way has limited land and natural resources. Therefore, the growth of cities and community economic activities on an island will increase the number of local and outside residents. This condition certainly impacts the increase in-land use sporadically and the occurrence of degradation.

An island is a tiny landmass surrounded by water and separated from the mainland (Motak, 2016), with a size typology from the largest to small and most minor islands located in oceans, rivers, or lakes either unpopulated to densely populated. At the same time, a city is an area with main non-agricultural activities with the arrangement of regional functions as a place of urban settlements, the concentration and distribution of government services, social services, and economic activities (UU RI No 26, 2007), with a total population of more than 10,000 residents, population density of more than 5000 people/km^2, and less than 25% of the total population working in the primary sector (Badan Pusat Statistik Republik Indonesia, 2010; UU RI No 26, 2007.

In the perspective of island city typology, cities has three distinct main groups. They are: 1) Cities located on smaller islands then spread to more significant landmasses, expanding and spreading with the surroundings, leaving behind island characteristics; 2) Historic cities are limited by time and are dying without tourist attractions, most of which were walled cities in the past; and 3). Simple cities are very limited to thriving, literally and metaphorically. Activities that grow are subsistence (Tutt, 2014). Grydehoj et al. (2015) divided islands or small islands with dense urban areas over four categories: 1). Cities are adjacent to one or more small islands; 2). Cities located on one or more dense urban small islands; 3). Small islands within cities located on the mainland; 4). Cities within small islands or islands cannot be said to be urban areas, but it meets the requirements of urban functions. Further, about the island city in Indonesia, Maulana & Benita (2017) concluded that three types of island cities are typical in Indonesia and lead to different characteristics and traits in managing island cities, namely: single zones in a group of small islands; part of a small island, shared with other areas; and a single urban zone, located on a tiny island.

An island city with various typologies, characteristics, and limitations requires a different management approach. One crucial instrument that should be of serious concern in the planning and development of island cities is the optimal size of the capacity of the island city. The study of Batty (2013) about the theory of the size of the city is mainly related to Bettencourt's thinking, explaining that the greater the benefits of income created, the greater the cost of social interaction that is beneficial. Hence, according to Bettencourt (Batty, 2013), income, resources, and infrastructure require trade-offs because it is superlinearly related to the size of the population.

The size of the city is the optimal quality of the population in a city. Burnett (2016) revealed that the distribution of household residents changes commensurate with the size of the city. Households tend to be high-income households in overpopulated cities. One of the recommended policies of this study is to reduce the overpopulation that leads to increased efficiency; then, the city expansion policy becomes one solution. The efficient size of the city also has to do with the urban network factor, which according to Cheng & Ma (2017), the city network greatly influences location selection decisions and migration for residents. In another study, Frick & Rodríguez-Pose (2016), examining the relationship between average city size and economic growth, found no universal positive relationship between average city size and economic growth. The results varied between high-income countries and developing countries. Through their study, Imelda et al. (2020) contended that the population and population growth significantly affect the city's optimal size.

As adopted in this island city study, one approach in measuring the optimal density of cities is analyzing its optimal size from an economic point of view developed by Allonso-Richardson (Sjafrizal et al., 2016). In this case, optimal city measurement is focused on three economic approaches: minimum average cost, maximum net gain, and maximum long-term profit. The minimum cost approach measures optimal urban aread based on the criteria for the minimum average cost of city operations managers, which is relevant to the local government's sgoal of minimizing budget usage. The net benefit approach measures the optimal urban area in terms of the difference between the total benefits provided to residents and the total operating costs incurred by the city government, especially when the goal is to maximize social welfare. At the same time, the maximum profit approach measures the optimal size of the city based on the criteria for equitable distribution of marginal costs and marginal benefits, which are undoubtedly suitable for the development of business cities to achieve maximum profit. Therefore, the optimal city size measured based on the long-term maximum profit approach will be larger than the city measured based on maximum net benefit. Furthermore, the optimal city size measured based on maximum net benefit will have a larger size than the city measured based on the minimum cost approach.

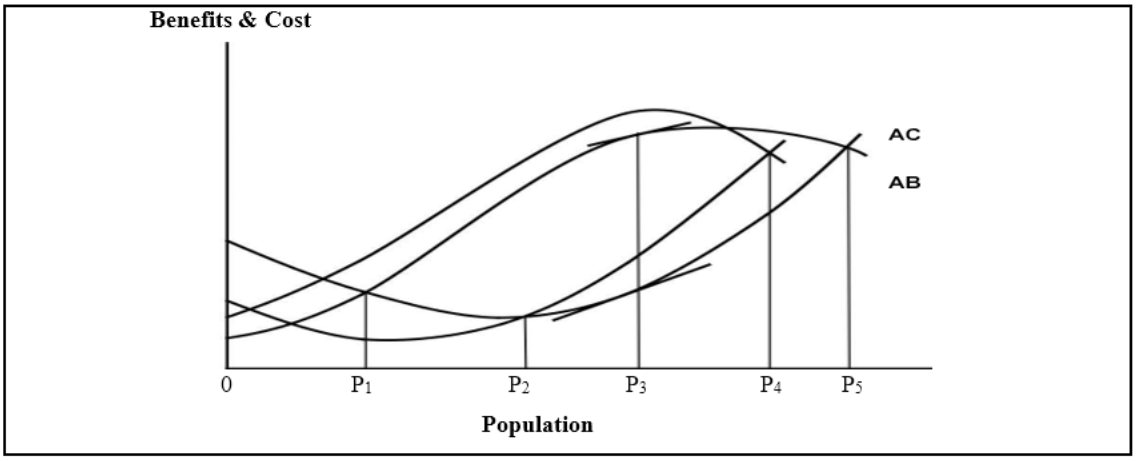


Figure 3. Optimal City Size in the Alonso-Richardson Model
Source: Sjafrizal et al. (2016)

As shown in Figure 3., there are four optional curves as the basis of the analysis representing Average Cost (AC) and Marginal Cost (MC) for city operations, as well as Average Benefit (AB) and Marginal Benefit (MB), thus generating economic activity in the city. Based on the shape of the four curves, there are several points on the horizontal line that have a significant economic value for optimal city size. First, the Pa point shows the optimal size of the city at a minimum average cost. Second, the Pb points indicate the optimal size of the city at maximum average net benefit conditions where the difference between AB and air conditioning is most significant. Third, Pc points refer to the optimal size of the city at the maximum long-term profit conditions where AC = AB. These three crucial points provide different methods for calculating the number of residents at optimal city sizes with different results.

RESEARCH METHOD

This study refers to research conducted by Sjafrizal et al. with the West Sumatra case study (Sjafrizal et al., 2016). The study drew on the Allonso-Richardson model, which economically analyzed the optimal city size based on the city's population density. It becomes interesting if the city's optimal size can also be applied in measuring the optimal capacity of island cities for planning and sustainability. As with the character of Ternate City as an island city, optimal city measurements, like previous studies, will be one of the optimal standard references of island cities. Optimal city measurement from an economic point of view includes three approaches (Imelda et al., 2020; Sjafrizal et al., 2016):

1. Minimum Cost Per Capita Approach

The minimum cost per capita approach is the minimum cost minimization of city management per capita (cost minimization), which in this study used data on the value of expenditure realization in APBD per capita in Ternate city. The formulation of the minimum cost equation per capita is:

$$AC_{it} = \alpha_0 + \alpha_1 (PD)_{it} + \alpha_2 (PD)_{it}^2 + e_{it} \quad (1)$$

Where the PD_{it} is the resident of the city *i* in year *t*, the constant, and the regression coefficient, while it is an error ($\alpha_0\ \alpha_1 \alpha_2 e_{it}$ *error*). By withdrawing derivatives from the equation (1) to the PD and equalizing it to zero, it can be obtained the optimal city size with a minimum cost approach as follows:

$$P_{mc} = -{}^{\alpha_1}/_{2_{\alpha 2}} \quad (2)$$

The minimum point of the second derivative of the equation is expected to be positive.

2. Maximum Per Capita Benefit Approach
The maximum per capita benefit approach is the maximum net benefit derived from the city's economic activities, which in this study used GDP value data per capita based on prevailing prices. The formulation of the average net benefit equation per capita is as follows:

$$AB_{it} = \beta_0 + \beta_1 (PD)_{it} + \beta_2 (PD)_{it}^2 + e_{it} \quad (3)$$

Net benefit (AB = Average Benefit) of an activity is defined as the value of production (income) minus the total cost (expense). By withdrawing the first derivative of the equation (3) against the PD and then equating it with the first derivative of the equation (1), it can be obtained the maximum optimal condition of net benefit as follows:

$$\beta_1 + 2\beta_2 (PD)_{it} = \alpha_1 + 2\alpha_2 (PD)_{it} \quad (4)$$

$$PD_{mb} = {}^{(\beta_1 - \alpha_1)}\Big/_{(2\alpha_2 + 2\beta_2)} \quad (5)$$

The maximum point of the second derivative of the equation (5) is expected to be negative.

3. Maximum Profit Per Capita Approach
The maximum profit approach is the maximum profit obtained from the city's economic activities in the long run. The formulation of this approach is measured by equating average cost with average benefit (AC= AB).

$$\alpha_0 + \alpha_1 (PD)_{it} + \alpha_2 (PD)_{it}^2 = \beta_0 + \beta_1 (PD)_{it} + \beta_2 (PD)_{it}^2 \quad (6)$$

$$PD_{mp} = \frac{(\beta_1 - \alpha_1) \pm \sqrt{(\alpha_1 - \beta_1)^2 - 4(\alpha_0 - \beta_0)(\alpha_2 - \beta_2)}}{2(\alpha_0 - \beta_0)} \quad (7)$$

The solving value of equation (7) is expected to be positive.

With equations 1 to 7, the optimal size of an island city is estimated using a linear regression model by looking at the relationship between population density and the minimum per capita city management cost and the maximum per capita benefit. The cost of managing cities is represented by the actual value of regional spending per capita, while the maximum benefit per capita is represented by the gross regional domestic product per capita value.

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RESULTS

Regression Model Estimation Results

Following the optimal size analysis approach of cities, according to Allonso - Richardson, who used the equation 1 to 7 previously, the regression model results estimates the relationship of varying levels of population density, cost of city management, and maximum benefits per capita (see Table 2).

Table 2. Results of Regression Model Equation of Minimum Management Costs and Average Net Benefits Per Capita in Ternate City 2002 to 2020.

Variables and Statistical Indicators	Per Capita Management Cost Equation (*Average Cost* / AC)		Benefit Equation Per Capita (*Average Benefit* / AB)	
Constant (Constant) / t-statistics (itself.)	3.752.921,48	2,017 (sig. 0.061)	158.506.150,22	4,177 (sig. 0.001)
Population Density (PD) / t-statistics (itself.)	-8.728,72	-2,638 (sig. 0.018)	-341.762,23	-5,066 (sig. 0.000)
Squared Population Density$^{(PD2)}$/ t-statistics (itself.)	6,63	4,588 (sig. 0.000)	183,27	6,217 (sig. 0.000)
Coefficient of Determination$^{(R2)}$	0,963		0,916	
Adjusted Coefficient of Determination (Adj. R$^{2)}$	0,959		0,905	
F-Statistics (itself.)	209,614 (sig. 0.000^b)		86,791 (sig. 0.000^b)	
Durbin Watson (DW)	0,857		1,070	
Number of observations (n)	19		19	

Source: Data Analysis Results, 2021

The statistical values show that simultaneously or partially, the population density variable and the population density square variable significantly affect the cost of per capita management indicated by a significantly smaller level than the real level of $\alpha = 0.05$. Likewise, the value of the coefficient of determination and adjusted (R^2 and Adj. R^2), which has an R2 value of 0.963 and Adj. R^2 of 0.959 signifies that 96.3% or 95.9% variations in changes in per capita management costs can be affected by the level of population density. Similar to the full equality of per capita benefits, both simultaneously and partially, the variable population density and square of population density also significantly influence the maximum variable of per capita benefits in Ternate. This conclusion is indicated by both simultaneous and partial significance level values of both variables smaller than the real level of $\alpha = 0.05$, with variations in variable changes being affected at the R^2 values of 0.916 or 91.6% and Adj. R^2 of 0.905 or 90.5%.

The regression estimates with the level of conformity of statistical values of both equations – namely minimum per capita management costs and maximum per capita benefits – show strong relationships between variables. The results conclude the regression model estimates presented in Table 2 can further be used to measure the optimal capacity of island cities with the case of Ternate City.

Optimal Size of Island City Economically
The optimal size of an island city in an economic approach and the model of equations and regression results have been done before estimating the optimal size in the ideal population density level for a city, especially an island city. Using the results of the previous equation model estimates, the optimal size of island cities with ternate city case studies is presented in Table 3 below.

Table 3. Optimal Size of Island Cities By Number and Population Density in Ternate City Using Economic Approach

Economic Approach Optimal City Size	**Optimal Conditions Requirements**	**Optimal City Size**	
		Population Density (people/km²)	**Population (people)**
Minimum Per Capita City Management Fee (*Cost Minimization*)	Minimum AC	PD_{mc} = 658	PD_{mc} = 106.708
Maximum Per Capita Benefits (*Maximum Net Benefit*)	Angle AB = AC Angle	PD_{mb} = 877	PD_{mb} = 142.223
Maximum Long-Term Per Capita Gain (*Long Run Maximum Profit*)	AC = FE	PD_{mp} = 2.054	PD_{mp} = 333.097

Source: Data Analysis Results, 2021

The results of the analysis presented in Table 3 have empirically proven the Allonso-Richardson hypothesis (Sjafrizal et al., 2016), namely that the optimal size of cities in the long-term maximum profit approach *(Long Run Maximum Profit)* is more significant than the *maximum net* benefit approach. Likewise, the maximum *net* benefit approach has a more optimal city size value than the minimum per capita city management fee approach (*Cost Minimization).* Mathematically, the formulation of the hypothesis of proving the optimal size of the island city case study ternate is PDmp > PDmb > PDmc, which is 2,054 > 877 > 658.

DISCUSSION

Referring to the results of the analysis, if the development of Ternate City is oriented to minimization of city management costs per capita indicated by the realization capacity of regional spending per capita, the optimal size of the city is at the optimal population density level (PDmc) of 658 people/km^2. At this population density level, the management of the city will efficiently take place as it will leads to city management with the lowest per capita cost. Assuming that the area of Ternate City is 162.17 Ha, the optimal population of 658 people/km^2 is 106,708 people.

Furthermore, if the optimal size of the city is seen from the maximum approach of benefits per capita, the maximum net benefit per capita is oriented to the number of net benefits obtained by the community for various economic activities in Ternate. In this approach, the optimal size of Ternate City as an island city is at a population density level (PDmb) of 877 people/km^2 and a population of 142,223 people. This tendency means that, at the population density level, the average net benefit and average cost are at an optimal distance. Therefore, the amount of average net benefits obtained by the community will be more significant than the average cost of city management. In other words, the amount of gross regional domestic product (GDP) per capita and the realization of regional spending per capita is at optimal levels so that the community can benefit optimally from the economic structure formed, including various public service facilities.

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If the importance of the city's economic growth in the long term is considered in Ternate city as an island city, the maximum profit approach becomes an option. In the long-term maximum per capita profit approach, the optimal size of the island city is at the optimal population density (PDmp) of 2,054 people/km^2 and 333,097 people. In this approach, in the long run, the private sector or production sector will achieve optimum production with marginal cost (MC) will be the same as the marginal product (MP). Therefore, the amount of population density in the maximum profit approach (PDmp) is much more significant than the other two approaches regarding the number of production inputs from the labor structure formed in the economy to maintain the sustainability of economic production in the long term.

The Evaluation of the Level of Population Density Optimization

Based on the results of the estimated optimal size of Ternate City as an island city, an assessment of the optimization of the level of population density applicable in the city of Ternate today and beyond is needed. The results of assessing the optimal size of the island city are presented in Table 4 below. Furthermore, the assessment of the optimal position of the size of Ternate city with the last data in 2020 is also classified administratively according to the subdistrict area to measure the distribution of residents and their current and long-term activities.

As the data and analysis presented in Table 3, the population density level of Ternate City in 2020 has reached 1,264 people/km^2. Therefore, if the minimum per capita city management cost approach and the maximum per capita benefit approach are used as the basis for optimal size of cities with population densities of 658 people/km^2 and 877 people/km^2, then the city of Ternate has experienced over urbanization or excess urbanization over the high level of population density.

Table 4. Economically Optimal City Size Assessment Matrix by Population Density Level in Ternate City

Region	**Minimum Per Capita City Management Fee Approach (*Cost Minimization*)**	**Maximum Per Capita Benefit Approach (*Maximum Net Benefit*)**	**Long-Term Maximum Per Capita Profit Approach (*Long Run Maximum Profit*)**	**Population Density 2020 (people/km^2)**
Ternate Island*	**U's**	**U's**	**U's**	502
Motions*	**U's**	**U's**	**U's**	194
Batang Dua Island*	**U's**	**U's**	**U's**	96
Pulau Hiri*	**U's**	**U's**	**U's**	437
West Ternate*	**U's**	**U's**	**U's**	252
South Ternate*	O-u	O-u	O-u	3,676
Middle Ternate*	O-u	O-u	O-u	3,564
North Ternate*	O-u	O-u	O-u	3,459
Ternate City	O-u	O-u	**U's**	1,264
Optimal City Size (people/km^2)	658	877	2.054	

Source: Data Analysis Results, 2021.
Note: * = District Name; U-u = Under Urbanization; O-u = Over Urbanization

Based on these figures, the data shows that the city of Ternate has experienced over urbanization since 2001 and 2003, with a population density of 698 people/km^2 and 918 people/km^2. Furthermore, if the long-term maximum per capita profit approach is used as an optimal measure, Ternate city is still in the position of under urbanization or low urbanization with a population density level in 2020 of 1,264 people/km^2 smaller than the optimal size of the city at a density of 2,054 people/km^2.

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This result means it is still possible to increase the number of residents per square kilometer if the optimal Ternate city population density is based on a long-term maximum per capita profit approach. However, looking at the distribution data and the level of population density according to the subdistrict area in Ternate City presented in Table 3, the increase in population per square kilometer needs to get serious attention so as not to cause bias in various aspects in the long term.

Considering the population density data compared to the estimate results above, the increase in population per kilometer square in Ternate city should be directed to subdistrict areas that are still low in density. Out of eight subdistrict areas in Ternate city, five subdistrict areas are categorized under urbanization areas that still allow for an increase in population. The subdistrict in question is Ternate Island Subdistrict, Moti Subdistrict, Batang Dua Island Subdistrict, Hiri Island Subdistrict, and West Ternate Subdistrict. Conversely, the three subdistrict areas with over urbanization are the south Ternate Subdistrict, Central Ternate Subdistrict, and North Ternate Subdistrict.

CONCLUSION

Through the case study of Ternate City with an area of 162.17 km^{2,} the optimal size of the island city can be assessed from three economic approaches. The approach of minimum per capita city management costs identified the optimal size of island cities at a population density level of 658 people/km^2. The maximum per capita benefit approach identified the optimal size of the island city at a population density of 877 people/ km^2. The long-term maximum per capita profit approach identified the optimal size of the island city at a population density of 2,054 people/km^2.

Compared to the population density of Ternate City per 2020 of 1,264 people/km^2, if the orientation of Ternate city development to minimize the cost of city management per capita or maximize per capita benefits for urban communities, strict urbanization control policies are significant to do. The city of Ternate characterizes this condition as an island city with excess urbanization over the high level of population density exceeding the optimum limit of the city's population. Meanwhile, if the development orientation of Ternate City is to achieve maximum profit per capita in the long term and grow into a business city, the city of Ternate is still in a position of low urbanization. It is still possible to increase the city population to the optimum limit.

Given the focus of development that has been more focused on Ternate Island, especially in South Ternate District, Central Ternate Subdistrict, and North Ternate Subdistrict, strict urbanization control policies are significant in these areas. Conversely, some island areas and other subdistricts still allow additional population and development activities. Therefore, the policy of spreading and deflecting development activities must be immediately directed to islands or subdistricts with urbanization level below the optimum point of the city population.

The development activities in the islands or subdistricts that have not been optimal can be done by deflecting the concentration of specific economic sectors, especially those that have not become bases. This sector could include the agricultural sector, forestry and fisheries, and other sectors. This tendency is expected to break down urbanization in the city center, namely Ternate Island, reducing the gap in physical development and between islands or between subdistricts, and improving the quality of the environment and ecosystems in the city center damaged by dense activity.

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