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Study of Environmental Carrying Capacity on the Development of Formal Housing in Moncongloe District, Maros Regency

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Abstract

Moncongloe District is an area with a relatively high population growth rate and distribution of housing, especially formal housing. This condition has implications for the tendency of increasing problems related to the carrying capacity of the environment and the suitability of land functions in the area. Therefore, it is necessary to harmonize the development of formal housing with the carrying capacity of the environment so that the negative impact of the phenomenon of formal housing development in this area can be avoided. The purpose of this study is to analyze the environmental carrying capacity of the development of formal housing for the prediction of the next 20 years. The analytical method used is a combined method of qualitative and quantitative analysis with a focus on the study of population projections, land availability and needs, and the carrying capacity of residential land. The results showed that the population in Moncongloe District in 2021 was 23,738 people, while the projected population in 2041 was 46,779 people, which means an increase of 97.06%. The results of the analysis of land availability show that 50% of the area of Moncongloe District is recommended for the development of residential land, including formal housing. The value of the carrying capacity of residential land (DDPm) in Moncongloe District in 2021 is 20.7 while in 2041 it is 20 so it can be concluded that the environmental carrying capacity in Moncongloe District can still accommodate the development of settlements for the next 20 years.

Keywords: Environmental carrying capacity, land availability, land requirement

1. Introduction

Utilization of land is a human renewal of the environment to regulate their lives. Humans need land to live which is a rare natural resource because the amount is limited and does not increase, but the need for land continues to increase. According to Law Number 32 of 2009 concerning Environmental Processing (Undang-undang No. 32 tahun 2009 tentang Pengolahan Lingkungan Hidup), the carrying capacity of the environment is defined as the ability of the environment to support human life and living creatures. One of the factors that can be used as a measure of environmental carrying capacity is the availability of land which describes the area's capacity to support population growth. The importance of analyzing population development in relation to the ability of the area to accommodate it is based on the fact that human activities have a significant impact on environmental conditions. This is because human activities will take advantage of the natural resources around them. Therefore, human activities must be in accordance with the natural carrying capacity they occupy. Furthermore, this human activity can generally be seen from population growth and economic development [1].

The concept of carrying capacity has been written in Indonesia's spatial planning law which mostly deals with environmental issues. The carrying capacity of the environment is divided into two, namely carrying capacity and carrying capacity. Carrying capacity means the ability of the environment to support human life and other organisms, carrying capacity is the capacity of the environment to absorb objects, energy or other components that are discharged into the environment by themselves or through human intervention. The purpose of Indonesia's spatial planning is to make effective and efficient use of space, which in essence is towards sustainable environmental management, prevention of space wastage and prevention of space quality degradation. Spatial planning based on area characteristics

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or carrying capacity and supported by adequate technology [2].

Carrying capacity and containment capacity of the environment is an instrument that describes the process/method of scientific studies to determine/know the ability of an area to support the needs of human life and other living creatures. Therefore, the determination of the carrying capacity and carrying capacity of the environment is carried out through an indicative approach based on the unit of analysis, parameters, indicators and benchmarks in each of these units of analysis. Bearing in mind that the carrying capacity and containment capacity are dynamic and complex and highly dependent on the geographical characteristics of an area, the number of inhabitants and the existing conditions of natural resources in their respective regions.

The definition of environmental carrying capacity according to the regulation of the state minister of the environment regarding guidelines for determining environmental carrying capacity in regional spatial planning is the ability of the environment to support the lives of humans and other living creatures. The definition of environmental carrying capacity (carrying capacity) in an ecological context is the number of populations or communities that can be supported by the resources and services available in the ecosystem. Factors that affect the limitations of ecosystems to support livelihoods are the number of available resources, population numbers and consumption patterns. The concept of environmental carrying capacity in this ecological context is closely related to natural capital. However, in the context of sustainable development, a community does not only have natural capital, but also human capital, social capital and artificial environmental capital. Therefore, in the context of the continuity of a city, the carrying capacity of the urban environment is the number of populations or communities that can be supported by available resources and services because of the natural, human, social and artificial environmental capital it has.

In its later development, the concept of environmental carrying capacity was applied as a calculation method to determine the number of living organisms that can be continuously supported by an ecosystem, without destroying the balance in the ecosystem. The decline in quality and damage to the ecosystem is then defined as an indication that the carrying capacity of the environment has been exceeded [3].

Land use by any development activity must be in line with the principles of sustainable development, namely balanced economic, socio-cultural, and environmental development as pillars that are interdependent and mutually reinforcing one another. Development that aims to improve the welfare of the community cannot be avoided from excessive use of natural resources or exploitation that threatens its sustainability, this will result in a decrease in the ability of the environment to support human survival in the future [4]. The carrying capacity of land is highly correlated with the availability of land, the economic value of the land, and the high demand housing. In relation to efforts to provide housing in relation to the carrying capacity of land, every effort to provide settlements must consider the stability of the foundation, drainage, availability of ground water, and aspects of disaster vulnerability [5].

The construction of housing and settlements as one of the mandates of the law is an aspect that is directly correlated with the availability of land and the carrying capacity of the environment. Housing is a group of houses that function as a residential or residential environment that is equipped with environmental infrastructure, namely the basic physical features of the environment, such as the provision of drinking water, waste disposal, availability of electricity, telephone, roads, which allow the residential environment to function properly [6].

Settlement is part of a residential environment consisting of more than one housing unit that has infrastructure, facilities, public utilities, and has supporting telephone activities, roads, which allow the residential environment to function as it should other functions in urban areas or rural areas [7]. Housing and settlements are multi-sectoral activities, the results of which directly touch one of the basic needs of the community. The problems faced cannot be separated from aspects that develop in the dynamics of people's lives and government policies in managing existing problems. In order for the implementation of housing and settlement development to run optimally, orderly and well organized, the process is carried out in stages through the stages of preparation, planning, implementation, management, maintenance and development [8].

There are five elements in settlement planning that must be considered, including: (1) the shell/environment, namely the place where humans live starting from the micro scale such as space, buildings to the macro scale such as villages, cities or regional agglomerations; (2) Network, or a network that includes infrastructure where humans communicate and interact; (3) Nature, or nature as a natural environment consisting of non-biotic and biotic elements and the habitats of creatures that occupy them. These natural elements are also in natural processing conditions such as landscaping, agriculture, forestry; (4) Man, or humans as individual beings with all their personalities and identities; and (5) Society, or society/human group from family, neighborhood to the world with all its complex relationships in social, economic, cultural and political life [9].

In the 1980s, low-cost housing and home improvement programs remained the two main policies in Indonesia in both rural and urban areas. However, Indonesia still faces serious housing problems related to high population growth rates, high rates of urbanization, resource scarcity, inefficient housing production, economic crisis, rampant corruption, lack of control over land prices, land speculation, misdirected subsidies and etc [10]. Ideally, when housing development has become a national work, the perspective on housing must become one unit. There are five perspectives on housing that must be considered, namely: (1) Houses as an economic commodity that directs their perspective on the fact that all housing is financed, produced and distributed by the private market;

(2) House as Home which directs perspective to the fact that the house is inhabited together by the people who live in it. There they create life and families. Therefore, these residential spaces must be protected and are expected to receive legal recognition. On a broad scale, laws and policies should benefit householders; (3) Housing as a human right that directs the perspective that equality, security and affordability of housing is very important for human development. Homes enable humans to be healthy, benefit from educational opportunities, be productive members of working groups and to care for families. Because the house is important as the basis of human development, all humans have the right to a house that is protected by law; (4) The house provides a social order that directs the perspective that wherever the location of the house is, the type of house, and who lives in it, the housing pattern creates a social order, in which we live and become part of a life. Therefore, housing laws and policies must respect and promote good community, including by respecting people who interact socially in residential areas; and (5) The house as a function of the land use system that directs the perspective of the fact that housing is one of the many land uses that are important for a healthy city. Housing also has positive and negative aspects. Therefore laws and policies must be planned with regard to financing, provision, design and management in relation to other land uses as a geographical area [11].

Sustainable settlement development in Indonesia has a dualism in terms of formal and informal aspects. The resolution of this dualism is a new phenomenon in several urban areas in Indonesia [12]. Housing and settlement development policies and programs tend to adopt it as one-step regularization, meaning regularization of the housing supply system in one step [13]. Housing and settlement development policies and programs tend to adopt it as one-step regularization, meaning regularization of the housing supply system in one step [13]. The one-step regularization policy is driven by an obsession to provide housing 'only' through 'formal' development mechanisms through organized control of both technical requirements and formal development procedures. In the following, many excerpts from the policy obsession with one-step regularization, such as various 'informal' resettlement programmes, follow. However, one step The regularization policy in Indonesia ignores harmonization in the provision of housing and the settlement system in Indonesia is very dynamic and complex with a cross between 'formal' and 'informal' as a dualism in the housing mechanism [14].

To overcome housing and settlement problems, several ideas that can support housing and settlement policies in Indonesia are: (1) Development management by formulating a comprehensive and integrated housing policy by considering functional environmental aspects, potential funds and resources, economic improvement, governance space and land use; (2) an ethical approach to development by considering the principle of affordability, differentiation of subsidies, differentiation of programs so that it can cover various problems in all circles of society and the principle of equitable distribution of housing; (3) a technical approach, housing development in stages, continuously with appropriate and targeted technology; (4) Sociological approach with consideration of social aspects that have a culture that should be considered in making site planning [15]. From the aspect of development management, there is the term property management which is the process of managing financial, physical conditions in terms of administration in the process of operating a property. The term property management is usually used for office buildings, hotels and shopping centers, while for residential property the term estate management is used. The function of estate management is not only managing the physical environment but also managing the psychological environment such as a sense of security, comfort and order. Developers must always maintain the quality of the residential environment by establishing estate management because it can attract consumers and have a better image in the eyes of consumers [16].

Maros Regency is one of the administrative regions of South Sulawesi Province with an area of 1,619 km2 consisting of fourteen sub-districts. Maros Regency is an area directly adjacent to Makassar City, therefore this area plays an important role in the development of Makassar City because it is a crossing area which is also the gateway to the Mamminasata Region in the north which in itself provides a very large opportunity for the development of the Mamminasata Area. . Likewise, the largest air transportation facility in Eastern Indonesia, which is located in Maros Regency, makes it the entry and exit point for the South Sulawesi Province. This condition is strategically very beneficial for the Maros economy as a whole.

Moncongloe District is one of the 14 sub-districts in Maros Regency. The total area of all villages in Moncongloe District is 46.87 km2. Geographical conditions, in the west it borders with Makassar City, in the east it borders with Tanranlili District, in the north it borders Mandai District and in the south it borders Gowa Regency.

2. Methodology

This type of research is a descriptive type of research with quantitative and qualitative approaches. This study aims to provide an overview of the suitability of land use for formal housing in Moncongloe District, Maros Regency. The quantitative approach is an approach that in research efforts, processes, hypotheses, goes to the field, analyzes data and concludes data until the writing uses aspects of measurement, calculation, formula and certainty of numerical data. On the other hand, a qualitative approach is an approach that in research proposals, processes, hypotheses, goes to the field, analyzes data and concludes data until the writing uses aspects of tendencies, non-numeric calculations, situational descriptive, and in-depth interviews, content analysis, snowballing, and stories [17].

Table 1. Projection of the population of Moncongloe District in 2021-2041

No.	Village	R(Growth rate)	Projection Year				
			2021	2026	2031	2036	2041
1	Moncongloe Lappara	1.39	8,957	9,667	10,376	11,086	11,795
2	Moncongloe Bulu	2.92	4,971	5,936	6,902	7,867	8,833
3	Moncongloe	4.96	6,448	9,084	11,719	14,355	16,900
4	Bonto Bunga	3.76	2,010	2,558	3,106	3,654	4,202
5	Bonto Marannu	2.49	3,035	3,516	3,997	4,478	4,959
	Total	3.10	25,421	30,761	36,100	41,440	46,779

The data collection method is based on the needs of primary and secondary data. Primary data is data taken directly in the field, while secondary data is data taken from other parties as primary data takers, or data obtained through studies and analysis of literature studies or documents related to the carrying capacity of the environment. In the analysis of the environmental carrying capacity study in the formal housing of Moncongloe District, Maros Regency, primary data collection includes observation, documentation, and interviews using a questionnaire that aims to determine the physical condition of the area, the general condition of settlements in Moncongloe District, and documentation of formal/informal housing. Secondary data used include data on land use, soil type, slope, rainfall, disaster vulnerability, border areas, data related to housing investment, review of spatial plans, and population data.

The data analysis method used is a combination of qualitative and quantitative methods. Qualitative and quantitative descriptive analysis methods are used to analyze research questions regarding the physical characteristics of housing that display data in the form of an explanatory description of the data obtained from both the RTRW thematic data, image interpretation and observation results, while quantitative data for research questions concerns projected needs that analyze population projections. , the availability and need of land, and the carrying capacity of residential land. Spatial analysis methods (scoring, overlay, and buffer) were used to research and explore data from a spatial perspective with the help of ArcGIS software. Spatial analysis is carried out to determine the function of the area with predetermined parameters according to the criteria for suitability of residential land.

3. Results and Discussion

3.1. Projection and Population Growth

The calculation and population growth of Moncongloe District was calculated using the least square method because this method has the smallest standard deviation value. Population growth projection data in Moncongloe District can be seen in the Table 1.

3.2. Land Availability Analysis

Calculation of land availability aims to determine the total area of land that still has the potential to be built and can be used for residential functions. Land availability is assessed based on the results of the spread between existing land use, physical conditions such as slope and soil type, as well as the spatial pattern plan contained in the RTRW of Maros Regency.

Other aspects to be considered are protected areas in the form of protected forests that have been established and the proposed Sustainable Food Agricultural Land, in which areas that have been designated as part of these two aspects may not be developed into built-up areas. The results of the spread of several variables to measure land availability can be seen in Fig. 1.

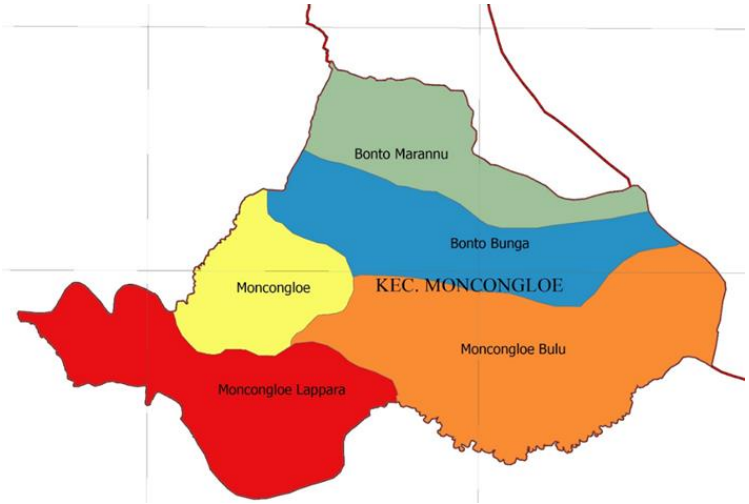

Figure 1. Maros district administration map

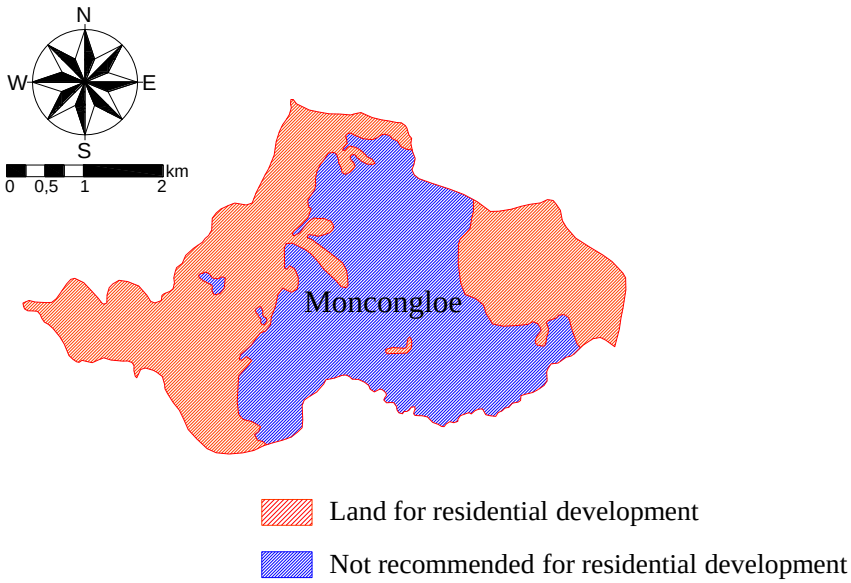

Figure 2. Land map for settlement development

Table 2. Availability of land for residential areas

No	Description	Area (Ha)
1	Recomended	2,417.99
2	Not recomended	2,417.17
	Total	4,835.17

Based on Fig. 2, there are two land classifications that can indicate land availability. Land for development is an area that is recommended and directed for development settlement. What is not recommended is an area that has been built and has other aspects, such as having been designated as sustainable food agricultural land or physically not meeting the criteria for settlement development. The area available for development is in the middle of the Moncongloe District, where this is in line with the Maros Regency spatial pattern plan that directs residential areas in the area. In the region the eastern and western parts, there are Sustainable Food Lands and the land use is mostly in the form of rice fields. The area of each classification on the map is described in Table 2.

Based on the data presented in Table 2, it can be explained that the recommended and non-recommended land areas have almost the same area. This shows that around 50% of the area can still be developed as a residential area.

3.3. Land Requirements Analysis

The need for land for housing development in Moncongloe District based on data from the Maros Regency Housing and Settlement Service is presented in Table 3. The data presented in this table shows that population growth from 2021 shows a significant increase until the projected year 2041 which has direct implications for land needs in Moncongloe District of 854,209 m^2.

3.4. Analysis of the Environmental Carrying Capacity of Formal Housing

The carrying capacity of residential land is obtained through data on the vastness of the area, the vastness of protected areas, and the vastness of disaster prone areas where the area is obtained from satellite imagery using the digitized method of land use which is then overlaid. The area of Moncongloe District is 48,408,400 m^2, the protected area is 24,171,700 m^2, and the disaster-prone area is 7,363,700 m^2.

Table 3. Projected land requirements in Moncongloe District in 2021-2041

No.	Years	Total population	Amount KK	Home Supplies (Unit)			House Area Needs (m2)			Total Area Requirement (m^2)
				Big (10%)	Currently (30%)	Small (60%)	Big	Cuurrently	Small	
1	2021	25,421	6,219	622	1,866	3,731	186,570	279,855	358,214	824,639
2	2026	30,761	6,236	624	1,871	3,742	187,080	280,620	359,194	826,894
3	2031	36,100	6,247	625	1,874	3,748	187,410	281,115	359,827	828,352
4	2036	41,440	6,258	626	1,877	3,755	187,740	281,610	360,461	829,811
5	2041	46,779	6,442	644	1,933	3,865	193,260	289,890	371,059	854,209

The area of residential land can be calculated using the formula [18]:

$$LPm = LW - (LKL + LKRB) \quad (1)$$

where:
LPm = Residential Land
LW = An area (m^2)
LKL = Protected Area (m^2)
LKRB = Area of Disaster Prone Area (m^2)

After value *LPm* is found, the carrying capacity of settlements can be calculated using the formula [18]:

$$DDPm = \frac{LPM / JP}{\alpha} \quad (2)$$

where:
DDPm = Residential Carrying Capacity
LPm = Area of Settlement (m^2)
JP = Total population (jiwa)
α = Coefficient of Land Area Requirement (m^2/kapita)

The limits of the feasibility of carrying capacity of land for settlements are formulated as follows [18]:
a. *DDPm* > 1 : Able to accommodate balance residents to live;
b. *DDPm* = 1 : There is a balance between the population and those who live wit the existing area;
c. *DDPm* <1 : Unable to accommodate residents to live in the area.

Furthermore, the carrying capacity of residential land in Moncongloe District for 2021 based on the calculation results can be seen in Table 4.

Based on the calculation results of the formula for carrying capacity of residential land in 2021, accumulatively obtained the final result of *DDPm* in Moncongloe District is 20.7. Bonto Bunga Village has the highest *DDPm* of 262.4, and the lowest *DDPm* of 58.9 is in Moncongloe Lappara Village. Thus, it can be concluded that based on the calculation results, in 2021 the Moncongloe District can accommodate residents to live.

Table 4. Carrying capacity of residential land in Moncongloe District in 2021

No	Village	*DDPm*	Description
1	Moncongloe Lappara	58.9	Able to accommodate residents to live
2	Moncongloe Bulu	106.1	Able to accommodate residents to live
3	Moncongloe	81.8	Able to accommodate residents to live
4	Bonto Bunga	262.4	Able to accommodate residents to live
5	Bonto Marannu	173.7	Able to accommodate residents to live
Moncong district		20.7	Able to accommodate residents to live

Table 5. Carrying capacity of residential land in Moncongloe District in 2041

No	Village	DDPm	Description
1	Moncongloe Lappara	79.5	Able to accommodate residents to live
2	Moncongloe Bulu	106.1	Able to accommodate residents to live
3	Moncongloe	55.2	Able to accommodate residents to live
4	Bonto Bunga	223.1	Able to accommodate residents to live
5	Bonto Marannu	189.0	Able to accommodate residents to live
Moncong district		20	Able to accommodate residents to live

Furthermore, the carrying capacity of residential land in Moncongloe District for 2041 based on the calculation results can be seen in Table 5.

Based on the calculation of the carrying capacity formula for residential land in 2041, accumulatively obtained the final *DDPm* of Moncongloe District is 20. Bonto Bunga Village has the highest *DDPm* of 223.1, and the lowest *DDPm* of 55.2 is in Moncongloe Village. Thus, it can be concluded that based on the calculation results, in 2041 the Moncongloe District can accommodate residents to live.

4. Conclusion

Moncongloe District is an area with a relatively high population growth rate and distribution of housing, especially formal housing. Therefore, a study is needed that can be a guideline for controlling formal housing growth based on an analysis of the environmental carrying capacity which includes population analysis, land needs analysis, and housing needs analysis. From the results of a study of environmental carrying capacity indicators using the calculation formulation of environmental carrying capacity, it was found that the limit for the feasibility of environmental carrying capacity in 2021 and the projected year 2041 is above number 1, both calculations based on urban areas, as well as cumulative calculations in the Moncongloe District area. Thus, it can be concluded that the Moncongloe District area can accommodate community living activities until the projected year 2041.

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