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(1 Juli 2022)



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Chloe Crawford <preview.hrpub@gmail.com>
To: Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Fri, Jul 1, 2022 at 2:22 PM

Dear Irwan Wunarlan,

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Pengiriman Revisi Formatting

(20 Juli 2022)

[Revised Draft ID: 14828167]: Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

Irwan Wunarlan <irwan.wunarlan001@gmail.com>
To: Mark Robinson <preview.hrpub@gmail.com>

Wed, Jul 20, 2022 at 11:28 AM

Dear Editorial Team,

Attached is the revised version of the manuscript and the figures 1-4, figure 9, figure 14, Figure 15.
Thank you and I look forward to hearing from you.

Best regards,

Irwan Wunarlan

8 attachments

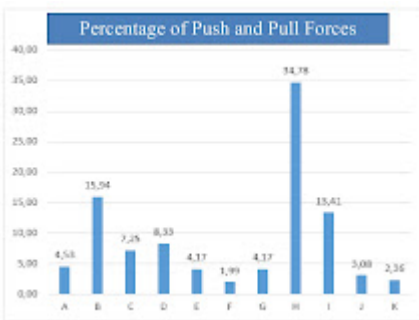


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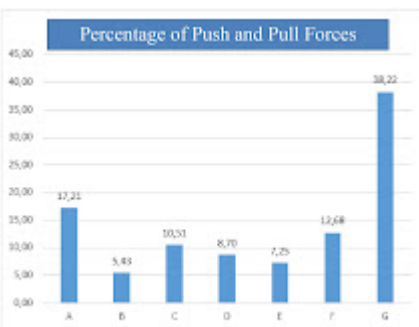


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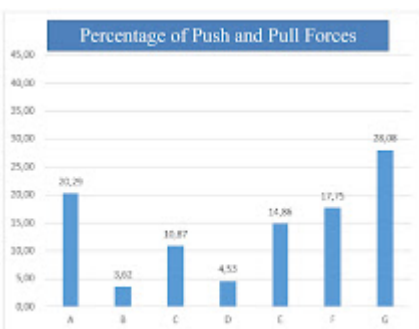


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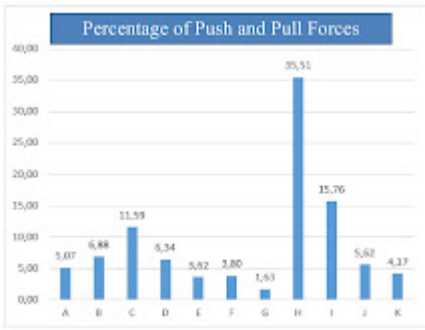


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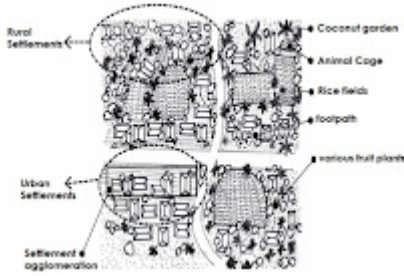


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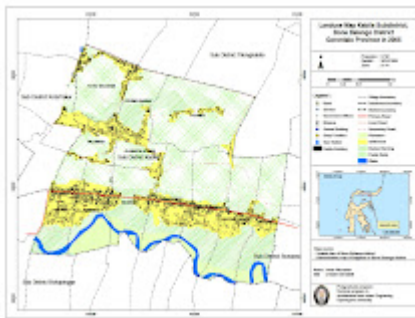


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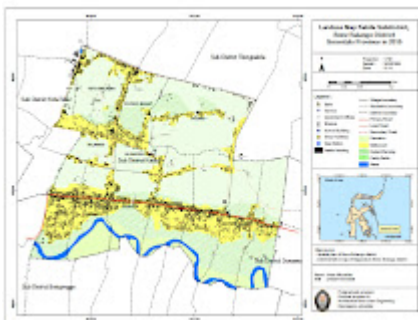


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Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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Abstract The two sub-districts can be viewed as a peri-urban area of Gorontalo city is a fascinating topic to comprehend the peri-urban area. The stages of this qualitative descriptive research consisted of preliminary survey and observation, distributing questionnaires, collecting data, processing data, data analysis, and data interpretation. Over the last ten years, urban land use has increased in both Telaga and Kabila sub-district by 5% (49.18 ha) and 3% (45.58 ha), respectively. Agropolis activities still dominated the two peri-urban areas. The pattern of land use in the Sub-District of Telaga was the pattern of octopus, while that of Kabila sub-district was a linear pattern (southern part) and frog jump (northern part). Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned.

Keywords City morphology, sub-district, land, peri-urban, physical development

City and Suwawa City have yet significantly contributed to the development of Telaga and Kabila sub-district. In relation to the physical development of the two sub-districts, the effect of Gorontalo city is very dominant in determining the direction of the physical development of the region because the location of the two sub-districts is in the suburb of Gorontalo city with their excellent accessibility.

The physical development of Telaga and Kabila sub-districts as a result of the physical development of Gorontalo City to the outer part of its administrative area is highly influenced by various factors previously discussed in the above paragraph. The factors help contribute to the form and morphology of the city. Morphology of a city is not only limited to analysis of the form of the city or the factors that influence the form of the city [2]. The phenomenon is an intriguing topic to study because the two sub-districts have different regional characteristics and different development of the physical morphology of the city influenced by Gorontalo City. The two sub-districts can be regarded as the peri-urban of Gorontalo city, so it is fascinating to be a study material in comprehending peri-urban area.

1. Introduction

The suburban areas outside the administrative area of Gorontalo City are the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency). The two areas are directly adjacent to Gorontalo City, which serves as the center of regional growth. The social-economic situation of the two cities is very dominant with urban nuance in that of Gorontalo city. Scientifically, determining the border determination of the peri-urban area is not an easy task. The outermost area of peri-urban is a place where people still want to commute to work/ do activities in a city [1].

The location of the sub-district of Kabila is on the east side of Gorontalo city. The sub-district is one of the entrances to Suwawa City in Bone Bolango Regency. On top of that, the area, which connects Suwawa City and Gorontalo City, has quite a high traffic flow. Telaga City, as a city of Telaga sub-district, is located in the western part of Gorontalo city and one of the access to the area of Limboto City. Limboto

1.1. City morphology

There are several morphological indicators of a city; those involve land use, plot, the layout of streets, and buildings [3]. The four indicators are described as follows [4]:

(1) Land use, as one of the indicators of city morphology, has a temporary nature because its functions are easy to change. Land use can be divided into two kinds of utilization, namely urban land and non-urban land. Urban land is oriented to secondary and tertiary sectors (trade and services), and non-urban land is oriented to the primary sector (agriculture).

(2) The plot is a plot of a certain size for housing. The arrangement of plots forms blocks. Plot and block are the initial elements of city formation. Urban plots are usually arranged and face the environmental street, while service street is located between one plot and another plot. In the development of a city, the ownership of plots can be transferred and traded. This may cause changes in the width.

Generally, a plot is rectangular, but the shape can be affected by the surrounding environment and the street pattern.

A street pattern consisting of streets serves as the forming of the block pattern of a city area. Streets may also form spaces between blocks in urban areas, and the street connected to other streets form a network and street pattern. Street network pattern in an urban area is formed through a very long process and usually a continuation of previous patterns. Street pattern in a city is usually a grid pattern, either regular or irregular. A grid pattern is created from crossing and intersecting two lines or more parallel lines forming geometric patterns with regular spacing and producing regional blocks. A grid-shaped street pattern can be found in old cities and planned cities. Grid street patterns generally have good transport circulation making it easier for city residents to interact from one area of the city to another.

The intended buildings include the buildings for settlements and the buildings utilized to accommodate human activities; this infrastructure plays a vital role in forming network structure, street patterns, and public areas. Buildings form mass plots (single and blocks patterns) and open spaces. Buildings located on a plot can be transformed in their function, shape, or width. The buildings in the peri-urban area have the utilization characteristics of both urban and rural.

1.2. Peri-urban area

Peri-urban is an important area in the city development cycle. This region experiences a very rapid transformation process from the rural stage to the urban stage to the urban stage both qualitatively (urban lifestyle) and quantitative (new residential zone) [5]. For this reason, this area can be defined as an area of dynamic change from land use, social, environmental aspects, and infrastructure [6].

The peri-urban area has an important role in the lives of future residents because the peri-urban area is an area between two regions, which clearly shows differences in environmental conditions. Peri urban areas encompass a combination of rural characteristics and urban characteristics simultaneously [7]. Furthermore, the area is a zone with a mixture of urban and rural activities [8]. This is the case with land use [9], so that peri urban areas are a transition zone [10], where urban and rural activities are juxtaposed [11].

1.3. Centrifugal force

The growth of cities turns out to cover a variety of factors that are more complex than just agglomeration economies. Optimal city size theory defines the spatial equilibrium of economic activity as a result of the attraction between centripetal and centrifugal forces [12]. Centrifugal forces are the power of dispersion [13]; in the centrifugal force, a population movement and functions that originate from the inside of a region goes to the outer side [14], thus resulting a movement of activity between centers cities and suburbs [15].

This situation has triggered rapid physical development and expansion of suburban areas [16].

1.4. Centripetal force

Centripetal force refers to a force causing population movements from the suburbs to the city. In addition, centripetal forces, driven by agglomeration augmentation, are all forces that attract economic activity to urban areas [17,18]. Centripetal strength is a force that tends to produce an integration style that brings together various social, economic, cultural, and political activities from the periphery to the downtown area, which has positive and negative implications [19].

There are two kinds of forces that have contributed to forming the centripetal force; push and propelling forces. Push force is spatially associated with the origin region of movement, and propelling force is associated spatially with the destination area of the movement because the centripetal movement is opposed to centrifugal movement and the two forces play different roles [20]. Centrifugal and centripetal forces have similar implications in developing an activity center [15].

2. Methodology

The method used in this research was qualitative-descriptive. ArcGis and Google Earth Pro were two main instruments used to analyze the physical appearance of space or morphology in the peri-urban area. Further, Microsoft Excel was used to perform tabulation and analysis of data derived from the questionnaires. The questionnaire, i.e., the research instrument, was used to identify the centrifugal and centripetal forces and the factors causing the occurrence of the two forces within the study area. The survey and observation were conducted to eliminate the sense of doubt over the uncertainty in certain objects of space physical appearance in the research location. All informants' names were written in pseudonyms and the informed consent was written.

3. Result and Discussion

3.1. An overview of study area

Geographically, Telaga sub-district is located at $0^{\circ}34'40''$ South Latitude and $123^{\circ}2'40''$ East Longitude, and Kabila sub-district lie at $0,30^{\circ}$ North Latitude, $1,00^{\circ}$ South Latitude and $121,00^{\circ}$ East Longitude, $123,30^{\circ}$ West Longitude. The area of Telaga and Kabila sub-districts is 58.44 km^2 and 193.45 km^2 , respectively. There are 22,884 and 23,634 of people in these two sub-districts. The borders of the two peri-urban areas are presented in Table 1.

Table 1. The borders of Telaga and Kabila Sub-districts

| Study Area | Borders | Bordering with |
|---------------------|---------|--------------------------------------|
| Telaga sub-district | North | Telaga Biru sub-district |
| | East | Sipatana sub-district-Gorontalo city |
| | South | Tilango and Telaga Jaya sub-district |
| | West | Telaga Biru sub-district |
| Kabila sub-district | North | Tilongkabila sub-district |
| | East | Central Suwawa sub-district |
| | South | Botupingge sub-district |
| | West | Gorontalo city |

Source: BPS, 2016

In general, the two peri-urban areas have lowland areas. Telaga sub-district is slightly hilly in the northern region and fed by Bulango and Nanati rivers. Kabila sub-district is flown by Bone River, making the two peri-urban areas quite fertile. People's livelihoods in the study area were mostly in the agricultural sector. Table 2 provides information on the distance between the peri-urban areas and Gorontalo city, airport, and regency capitals from each study area.

Table 2. The distance of peri-urban areas (study area) to several capitals in Gorontalo ProvincE

| No | Origin | Destination (km) | | |
|----|--------------------------|------------------|--------------|---------------------|
| | | Gorontalo City | Limboto City | Jalaludd in Airport |
| 1 | Telaga Jaya sub-district | 11 | 9 | 31 |
| | | Destination (km) | | |
| 2 | Kabila sub-district | 4,3 | 7 | 40 |
| | | Destination (km) | | |

Source: Primary Data, 2017

3.2. Centrifugal force analysis

There were 11 factors of push and propelling forces that affect the development of the morphology of peri-urban areas in Telaga and Kabila sub-districts. Those factors involved: (1) smaller population compared to urban population (A); (2) low-dense settlements (B); (3) low rate of air, sound and water pollutions (C); (4) friendly inhabitants (D); (5) low crime rate (E); (6) less restrictive rules (F); (7) no traffic jam and traffic congestion (G); (8) low land prices and large areas (H); (9) cool air and tranquil atmosphere (I); (10) beautiful natural scenery (J); and (11) the guarantee of

privacy (K).

Further, three push forces for the residents of Gorontalo City to live and move in the peri-urban area, i.e., high land prices at the city center, settlement density, and air, sound and water pollutions (Figure 1 and 2). On the other hand, the propelling forces for the residents of Gorontalo City to settle in the peri-urban areas are related to low land prices and vast land, low density of settlements, and cool air and calm atmosphere. The existing conditions in the peri-urban areas also attract developers in investing their capital to develop housing close to Gorontalo City.

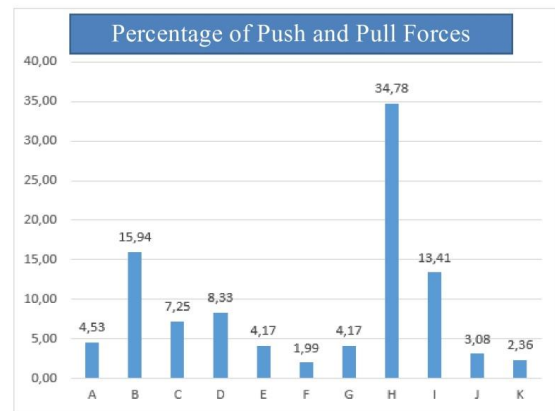


Figure 1. Centrifugal force: Percentage of push and pull forces (Telaga Sub-district)

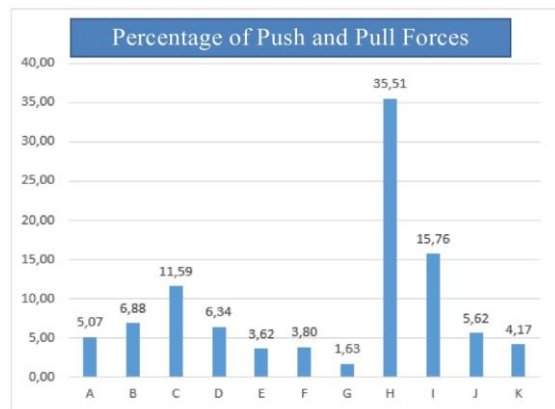


Figure 2. Centrifugal force: Percentage of push and pull forces (Kabila Sub-district)

3.3. Centripetal force analysis

The centripetal force analysis refers to the seven centripetal forces expressed [2]. The seven centripetal forces are: (1) the number of socio-economic facilities for life (A); (2) ensuring security (B); (3) high income (C); (4) high prestige (D); (5) high accessibility from the village (E); (6) the number of job opportunities (F); (7) close to the workplace (G).

The existence of centripetal movement for the residents in the peri-urban areas studied is supported by questionnaire data, where the productive age population (17 - 30 years) in

the sub-districts of Telaga (60.87%) and Kabila (53.62%) daily travel using shuttle service as students, university students, private employees, traders, army or police, and informal workers or government officials (Figure 3 and 4). From the types of work, the commuters between Telaga and Kabila sub-districts had different characteristics. There were three characteristics of commuters in Telaga sub-district, namely civil servants (14.49%), entrepreneurs/traders (13.04%), and students (11.59%). The commuters in Kabila sub-district were students (13.04%), civil servants (11.59%), and private employees (10.14%). The difference between the two commuter characteristics in the peri-urban areas was influenced by the distance and accessibility of the peri-urban areas towards higher education, economic facilities, and government office facilities.

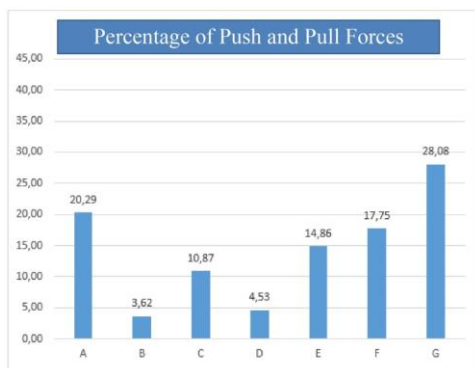


Figure 3. Centripetal force: Percentage of push and pull forces (Telaga sub-district)

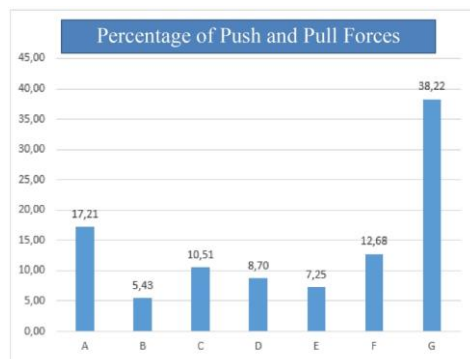


Figure 4. Centripetal force: Percentage of push and pull forces (Kabila sub-district)

3.4. Land use analysis

In 2005, the peri-urban area (Telaga sub-district) consisted of the plantation area of 463.12 ha, settlements of 242.41 ha, annual crop farming of 201.61 ha, water bodies of 8.75 ha, and sports stadium of 2.97 ha. The land use in the peri-urban area (Kabila sub-district) in the same year consisted of rice field area of 620.48 ha, settlement of 334.75 ha, annual crops of 270.25 ha, plantation of 83.86 ha, and the water body of 36.55 ha.

The land use in Telaga and Kabila sub-districts in 2015

had changed. In Telaga sub-district, the plantation and agricultural areas of seasonal plants were changed into the residential areas of 29.15 ha and 20.03 ha, respectively. In Kabila sub-district, some areas were converted into a residential area of 29.65 ha. In the two peri-urban areas, it appears that most of the agricultural areas were converted into the lands for settlement or urban areas. In Telaga sub-district, the function change of agricultural lands into housings was relatively more massive compared with that in Kabila sub-district.

The land use in 2005 and 2015 in the sub-districts of Telaga and Kabila signifies that the rural landscape dominated the ones of urban areas. In 2005, the land use in Telaga sub-district for urban areas was 27% (245.20 ha), and the remaining 73% (673.47 ha) was for non-urban lands (Figure 5). In 2015, the percentage of land use for urban areas was 32% (294.38 ha), signifying an increase by 5% (49.18 ha) and non-urban land by 68% (624.29 ha) (Figure 6). On one's hand, the percentage of land use in Kabila sub-district in 2005 was 25% (urban land, 334.75 ha) and 75% (non-urban land, 1011.14 ha) (Figure 7). In 2015, the composition of land use in Kabila sub-district experienced a change (urban land, 28%, or 380.34 ha) (Figure 8). The percentage of land use for urban areas was increased by 3% or 45.58 ha and by 72% for non-urban areas (965.56 Ha).

The high level of urban influence in the peri-urban area of Telaga sub-district correlates with the high accessibility in the peri-urban area. Telaga sub-district has the main road, which is the arterial road connecting Gorontalo City as the National Activity Center (in Indonesian known as *Pusat Kegiatan Nasional*) with the other cities in Gorontalo and North Sulawesi Provinces.

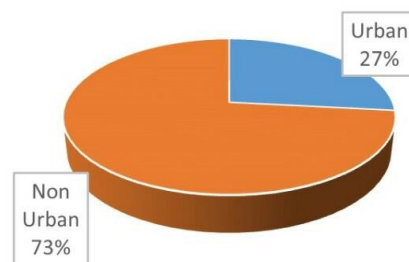


Figure 5. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2005

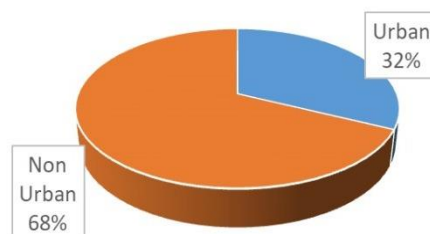


Figure 6. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2015

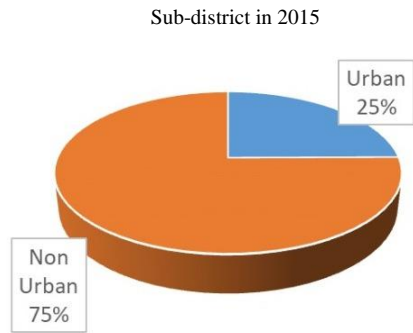


Figure 7. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

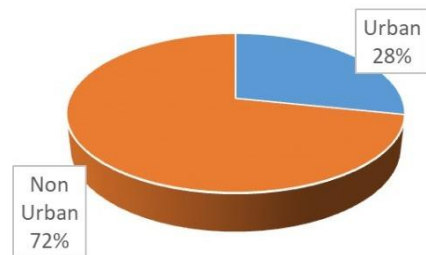


Figure 8. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

3.5. Settlement analysis

The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts. The first characteristic is the settlements along the arterial road (Jl. A.A. Wahab Limboto in Telaga sub-district and Sultan Botutihe Street in Kabila sub-district). Both roads have permanent building characteristics and modern architecture with a large yard with a paving block or concrete cover that can accommodate one or more houses to form a house group (in Gorontalo known as *ngala'a*) and a wall fence as a symbol of territory between *ngala'a*. The composition of the plant consists of ornamental flowers, such as garden croton, ashoka, Chinese evergreen, lily, and many more. Mango or jackfruit trees serve as protective plants and keep the microclimate, thus keeping the cool atmosphere of the yard [15], with a beautiful building arrangement. In *ngala'a*, there is a path to connect home, and it is useful to facilitate pedestrians in promoting communication with the neighbor in one *ngala'a*. Second, the settlements located far from arterial roads are semi-permanent and non-permanent buildings, simple building structures, traditional architectural features, and large yard. There is a garden on the left side with only coconut trees (monocultures) and vegetable plants on the right or backside of a house to meet daily needs. One can also find goat or chicken den at the back of the house for live stocks. There are also paths that interconnect low-density neighbors. Below is the structure of the settlements in the

peri-urban area of Telaga and Kabila sub-districts (Figure 9).

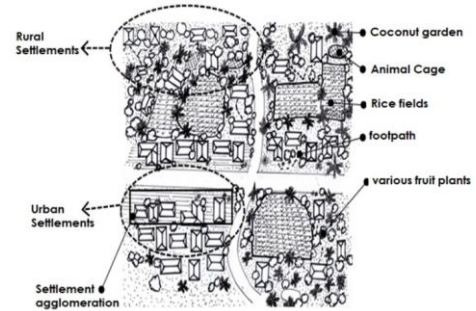


Figure 9. Settlement structure in peri-urban area of Gorontalo Province

3.6. Building use analysis

There are five types of building use in the peri-urban areas studied; residential houses, shop houses, stalls/ kiosks, informal businesses, and agriculture. The building in the peri-urban area of Telaga and Kabila sub-district has different characteristics. In Telaga sub-district, there were 37 respondents (54%) using their buildings for residential houses, 16 respondents (23%) for shop-houses, nine respondents (13%) for informal businesses (beauty salon/ barbershop and workshop), five respondents (7%) for kiosks, and two respondents (3%) for agricultural business (Fig.10). In Kabila sub-district, 34 respondents (49%) use their building for settlement purposes, 14 respondents (20%) for shop-houses, 12 respondents (18%) for kiosks, six respondents (9%) for informal business (beauty salon/ barbershop, and workshop), and three respondents (4%) for agricultural businesses (Fig.11).

The building for residential houses, shop-houses and informal businesses in Telaga sub-district outnumbers those in Kabila sub-district. On one's hand, the building for stalls/ kiosks and agricultural businesses in Telaga sub-district are fewer compared to those in Kabila sub-district. This is due to the fact that Telaga sub-district is, although considered a small town, more prominent than that of Kabila sub-district. On top of that, the physical development of the peri-urban area of Telaga sub-district is heavily influenced by the transportation activities in Telaga bus station. The station serves as the inter-city and inter-regency bus station in Gorontalo Province, thus resulting in diverse activities around the bus station and livelihoods of the population. Recently, the peri-urban area (Telaga sub-district) has become one of the nodal points in Gorontalo Regency and transformed into a newly developing area that attracts investors.

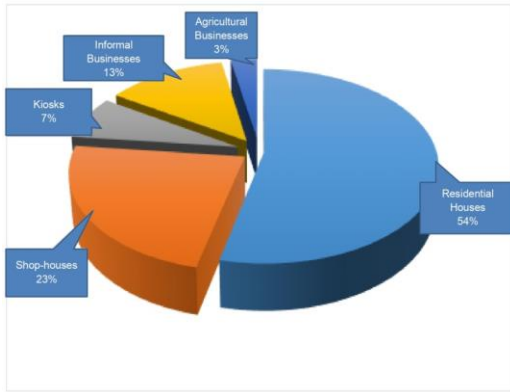


Figure 10. Building uses in peri-urban area (Telaga Sub-District)

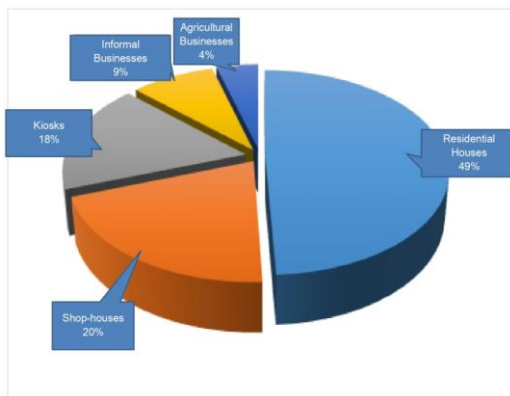


Figure 11. Building uses in peri-urban area (Kabila Sub-District)

In the peri-urban area (Kabila sub-district), the livelihood of the residents is relatively homogenous. The volume of average traffic in the area, particularly on the road of Sultan Botutihe that connects the sub-districts of Kabila and Buludawa (Suwawa sub-district), has decreased and the orientation of traffic movement had changed to the northern area of Bone Bolango regency. It is due to the change of the government center of Bone Bolango Regency, which initially from Suwawasub-district to Tilongkabila sub-district. Besides, the office facilities of the Provincial Government of Gorontalo was relocated to the northern area of Bone Bolango Regency, Tapa sub-district. This relocation contributes to the preference choosing the northern road for official administration purposes in Bone Bolango Regency and the Government of Gorontalo province.

3.7. Street pattern and circulation analysis

The roads in the sub-districts of Telaga and Kabila are relatively in good condition, and they also have good transportation circulation. Consequently, various modes of transportation especially *bentor* (motorized rickshaw), can provide their services to passengers in every part of the settlements. The transportation modes like *angkot* (local minibus for public transportation) and *bentor* can reach the villages in the two peri-urban areas. The existence of quality

transportation facilities and infrastructures strongly supports the mobilization and activities of the population to be commuters and reside in the peri-urban area. The farmer road program has changed the landscape of rural areas in both peri-urban areas; this is seen in the improvement of roads near farms. Initially, access to farms is mostly dirt roads. However, the dirt roads are rarely found recently. The existing condition is also similar to the condition of roads in rural areas. However, good road conditions in the sub-districts Telaga and Kabila have no traffic signs and road markings. Traffic signs and road markings can only be seen in arterial roads.

3.8. Analysis of peri-urban area morphology

Land use is among factors to consider in analyzing morphological types in peri urban areas. This factor also functions to explain the spatial distribution of residential mobility [18]. Characteristics of the peri-urban area of Telaga and Kabila sub-districts depict the quality of the rural areas and urban areas. Both sub-districts areas are growing due to contributions from the capital of Gorontalo city. Still, agricultural activities still dominate in the two peri-urban areas studied. The analysis shows that the pattern of roads in urban units is classified as linear and integrated with a grid road system. When viewed from the hierarchy level, land use for services and trade activities located around the main road (A.A. Wahab and Sultan Botutihe Streets) is the highest hierarchy. The pattern of land use from the peri-urban area in Telaga sub-district is octopus/star-shaped (a combination of concentric pattern and linear). Meanwhile, the land use pattern of peri urban area in Kabila sub-district is linear pattern (southern part) and leapfrog (northern part). The initial developmental patterns of these two peri-urban areas studied. The development is horizontal in its character, and the road planning implements vertical development. This situation is determined by the condition of the density of the buildings and the price of the land compared to other parts of the city. Government Regulation No. 12 of 2012 and Provincial Regulation No. 1 of 2014 on the protection of sustainable agricultural land on incentives ensure the sustainability of agricultural land.

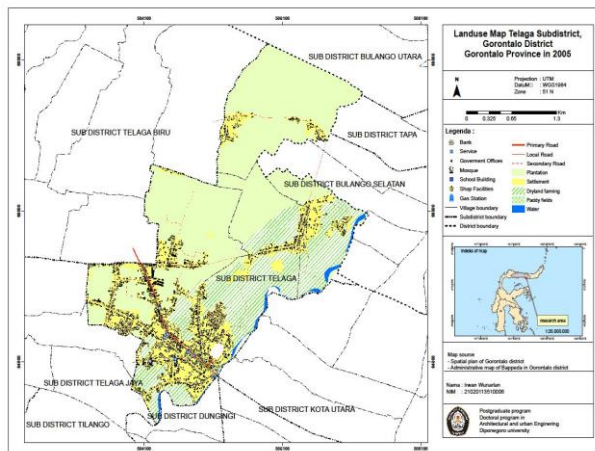


Figure 12. Map of land use and built use in Telaga Sub-District, 2005

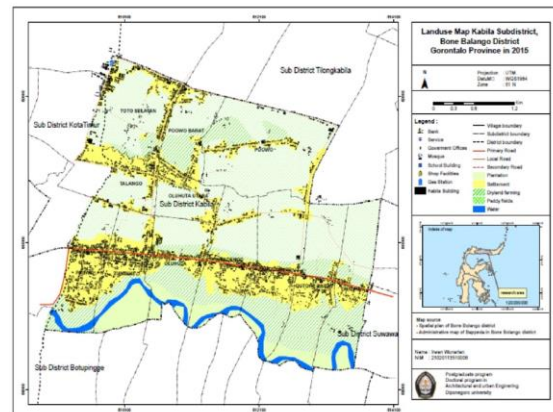


Figure 15 Map of land use and built use in Kabila Sub-District, 2015.

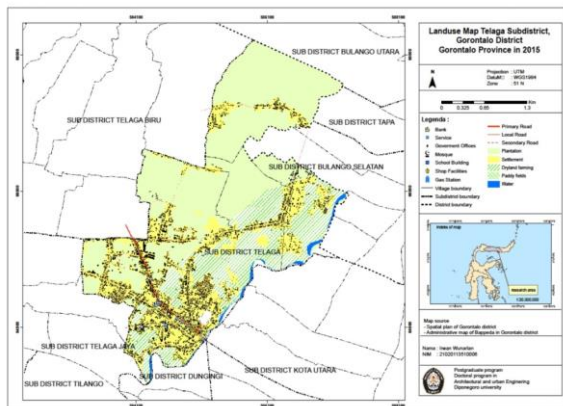


Figure 13. Map of land use and built use in Telaga Sub-District, 2015

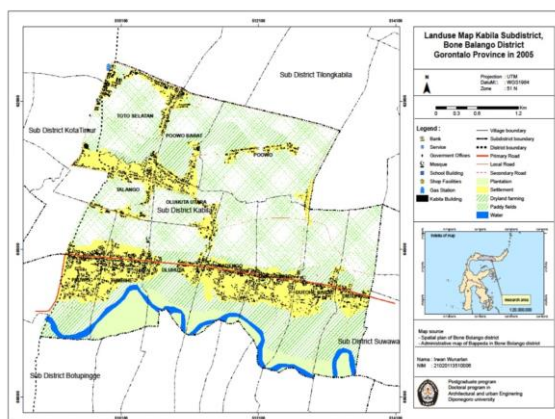


Figure 14. Map of land use and built use in Kabila Sub-District, 2005

4. Conclusion

Based on the research results and discussion, it can be concluded that the development of the peri-urban area in Telaga District is heavily influenced by the accessibility of the area. Further, the location is very strategic (it is located in the middle of two developed cities in Gorontalo Province, i.e., Gorontalo city and Limboto city). The existence of primary arterial roads that cross the district serves as the main access to main facilities, such as Jalaludin Airport. Kabila sub-district is the area receiving significant impact because of the proximity of the distance between Kabila sub-district with the city of Gorontalo.

Further, the morphological form in the two peri-urban areas studied is significantly influenced by Gorontalo city. The morphological indicators of peri-urban areas (WPU) in Telaga and Kabila sub-districts can be described as follows: (a) The utilization of the land within ten years for urban development purposes in Telaga and Kabila sub-districts was increased by 5% (49.18 ha) and 3% (45.58 ha), respectively. (b) The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts: first, the settlements in the arterial road form the house group (*ngala'a*) and the wall fence as a symbol of the territory between *ngala'a*. Secondly, the settlement located far from the arterial road with the characteristics of semi-permanent and non-permanent buildings, simple building structures, traditional architectural styles, and low building densities. (c) Characteristics of building use for tertiary sectors (trade and service) in Telaga sub-district are more common than Kabila sub-district. In addition, stalls and agricultural business buildings (primary sector) in Telaga sub-district are not that common compared to Kabila sub-district.

Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

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Hasil Review Tahap 1

(19 Agustus 2022)



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Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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Abstract The two sub-districts can be viewed as a peri-urban area of Gorontalo city is a fascinating topic to comprehend the peri-urban area. The stages of this qualitative descriptive research consisted of preliminary survey and observation, distributing questionnaires, collecting data, processing data, data analysis, and data interpretation. Over the last ten years, urban land use has increased in both Telaga and Kabila sub-district by 5% (49.18 ha) and 3% (45.58 ha), respectively. Agropolis activities still dominated the two peri-urban areas. The pattern of land use in the Sub-District of Telaga was the pattern of octopus, while that of Kabila sub-district was a linear pattern (southern part) and frog jump (northern part). Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned.

Keywords City morphology, sub-district, land, peri-urban, physical development

City and Suwawa City have yet significantly contributed to the development of Telaga and Kabila sub-district. In relation to the physical development of the two sub-districts, the effect of Gorontalo city is very dominant in determining the direction of the physical development of the region because the location of the two sub-districts is in the suburb of Gorontalo city with their excellent accessibility.

The physical development of Telaga and Kabila sub-districts as a result of the physical development of Gorontalo City to the outer part of its administrative area is highly influenced by various factors previously discussed in the above paragraph. The factors help contribute to the form and morphology of the city. Morphology of a city is not only limited to analysis of the form of the city or the factors that influence the form of the city [2]. The phenomenon is an intriguing topic to study because the two sub-districts have different regional characteristics and different development of the physical morphology of the city influenced by Gorontalo City. The two sub-districts can be regarded as the peri-urban of Gorontalo city, so it is fascinating to be a study material in comprehending peri-urban area.

1. Introduction

The suburban areas outside the administrative area of Gorontalo City are the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency). The two areas are directly adjacent to Gorontalo City, which serves as the center of regional growth. The social-economic situation of the two cities is very dominant with urban nuance in that of Gorontalo city. Scientifically, determining the border determination of the peri-urban area is not an easy task. The outermost area of peri-urban is a place where people still want to commute to work/ do activities in a city [1].

The location of the sub-district of Kabila is on the east side of Gorontalo city. The sub-district is one of the entrances to Suwawa City in Bone Bolango Regency. On top of that, the area, which connects Suwawa City and Gorontalo City, has quite a high traffic flow. Telaga City, as a city of Telaga sub-district, is located in the western part of Gorontalo city and one of the access to the area of Limboto City. Limboto

1.1. City morphology

There are several morphological indicators of a city; those involve land use, plot, the layout of streets, and buildings [3]. The four indicators are described as follows [4]:

(1) Land use, as one of the indicators of city morphology, has a temporary nature because its functions are easy to change. Land use can be divided into two kinds of utilization, namely urban land and non-urban land. Urban land is oriented to secondary and tertiary sectors (trade and services), and non-urban land is oriented to the primary sector (agriculture).

(2) The plot is a plot of a certain size for housing. The arrangement of plots forms blocks. Plot and block are the initial elements of city formation. Urban plots are usually arranged and face the environmental street, while service street is located between one plot and another plot. In the development of a city, the ownership of plots can be transferred and traded. This may cause changes in the width.

Generally, a plot is rectangular, but the shape can be affected by the surrounding environment and the street pattern.

A street pattern consisting of streets serves as the forming of the block pattern of a city area. Streets may also form spaces between blocks in urban areas, and the street connected to other streets form a network and street pattern. Street network pattern in an urban area is formed through a very long process and usually a continuation of previous patterns. Street pattern in a city is usually a grid pattern, either regular or irregular. A grid pattern is created from crossing and intersecting two lines or more parallel lines forming geometric patterns with regular spacing and producing regional blocks. A grid-shaped street pattern can be found in old cities and planned cities. Grid street patterns generally have good transport circulation making it easier for city residents to interact from one area of the city to another.

The intended buildings include the buildings for settlements and the buildings utilized to accommodate human activities; this infrastructure plays a vital role in forming network structure, street patterns, and public areas. Buildings form mass plots (single and blocks patterns) and open spaces. Buildings located on a plot can be transformed in their function, shape, or width. The buildings in the peri-urban area have the utilization characteristics of both urban and rural.

1.2. Peri-urban area

Peri-urban is an important area in the city development cycle. This region experiences a very rapid transformation process from the rural stage to the urban stage to the urban stage both qualitatively (urban lifestyle) and quantitative (new residential zone) [5]. For this reason, this area can be defined as an area of dynamic change from land use, social, environmental aspects, and infrastructure [6].

The peri-urban area has an important role in the lives of future residents because the peri-urban area is an area between two regions, which clearly shows differences in environmental conditions. Peri urban areas encompass a combination of rural characteristics and urban characteristics simultaneously [7]. Furthermore, the area is a zone with a mixture of urban and rural activities [8]. This is the case with land use [9], so that peri urban areas are a transition zone [10], where urban and rural activities are juxtaposed [11].

1.3. Centrifugal force

The growth of cities turns out to cover a variety of factors that are more complex than just agglomeration economies. Optimal city size theory defines the spatial equilibrium of economic activity as a result of the attraction between centripetal and centrifugal forces [12]. Centrifugal forces are the power of dispersion [13]; in the centrifugal force, a population movement and functions that originate from the inside of a region goes to the outer side [14], thus resulting a movement of activity between centers cities and suburbs [15].

This situation has triggered rapid physical development and expansion of suburban areas [16].

1.4. Centripetal force

Centripetal force refers to a force causing population movements from the suburbs to the city. In addition, centripetal forces, driven by agglomeration augmentation, are all forces that attract economic activity to urban areas [17,18]. Centripetal strength is a force that tends to produce an integration style that brings together various social, economic, cultural, and political activities from the periphery to the downtown area, which has positive and negative implications [19].

There are two kinds of forces that have contributed to forming the centripetal force; push and propelling forces. Push force is spatially associated with the origin region of movement, and propelling force is associated spatially with the destination area of the movement because the centripetal movement is opposed to centrifugal movement and the two forces play different roles [20]. Centrifugal and centripetal forces have similar implications in developing an activity center [15].

2. Methodology

The method used in this research was qualitative-descriptive. ArcGis and Google Earth Pro were two main instruments used to analyze the physical appearance of space or morphology in the peri-urban area. Further, Microsoft Excel was used to perform tabulation and analysis of data derived from the questionnaires. The questionnaire, i.e., the research instrument, was used to identify the centrifugal and centripetal forces and the factors causing the occurrence of the two forces within the study area. The survey and observation were conducted to eliminate the sense of doubt over the uncertainty in certain objects of space physical appearance in the research location. All informants' names were written in pseudonyms and the informed consent was written.

3. Result and Discussion

3.1. An overview of study area

Geographically, Telaga sub-district is located at $0^{\circ}34'40''$ South Latitude and $123^{\circ}2'40''$ East Longitude, and Kabila sub-district lie at $0,30^{\circ}$ North Latitude, $1,00^{\circ}$ South Latitude and $121,00^{\circ}$ East Longitude, $123,30^{\circ}$ West Longitude. The area of Telaga and Kabila sub-districts is 58.44 km^2 and 193.45 km^2 , respectively. There are 22,884 and 23,634 of people in these two sub-districts. The borders of the two peri-urban areas are presented in Table 1.

Table 1. The borders of Telaga and Kabila Sub-districts

| Study Area | Borders | Bordering with |
|---------------------|---------|--------------------------------------|
| Telaga sub-district | North | Telaga Biru sub-district |
| | East | Sipatana sub-district-Gorontalo city |
| | South | Tilango and Telaga Jaya sub-district |
| | West | Telaga Biru sub-district |
| Kabila sub-district | North | Tilongkabila sub-district |
| | East | Central Suwawa sub-district |
| | South | Botupingge sub-district |
| | West | Gorontalo city |

Source: BPS, 2016

In general, the two peri-urban areas have lowland areas. Telaga sub-district is slightly hilly in the northern region and fed by Bulango and Nanati rivers. Kabila sub-district is flown by Bone River, making the two peri-urban areas quite fertile. People's livelihoods in the study area were mostly in the agricultural sector. Table 2 provides information on the distance between the peri-urban areas and Gorontalo city, airport, and regency capitals from each study area.

Table 2. The distance of peri-urban areas (study area) to several capitals in Gorontalo ProvincE

| No | Origin | Destination (km) | | |
|----|--------------------------|------------------|--------------|---------------------|
| | | Gorontalo City | Limboto City | Jalaludd in Airport |
| 1 | Telaga Jaya sub-district | 11 | 9 | 31 |
| | | Destination (km) | | |
| 2 | Kabila sub-district | 4,3 | 7 | 40 |
| | | Destination (km) | | |

Source: Primary Data, 2017

3.2. Centrifugal force analysis

There were 11 factors of push and propelling forces that affect the development of the morphology of peri-urban areas in Telaga and Kabila sub-districts. Those factors involved: (1) smaller population compared to urban population (A); (2) low-dense settlements (B); (3) low rate of air, sound and water pollutions (C); (4) friendly inhabitants (D); (5) low crime rate (E); (6) less restrictive rules (F); (7) no traffic jam and traffic congestion (G); (8) low land prices and large areas (H); (9) cool air and tranquil atmosphere (I); (10) beautiful natural scenery (J); and (11) the guarantee of

privacy (K).

Further, three push forces for the residents of Gorontalo City to live and move in the peri-urban area, i.e., high land prices at the city center, settlement density, and air, sound and water pollutions (Figure 1 and 2). On the other hand, the propelling forces for the residents of Gorontalo City to settle in the peri-urban areas are related to low land prices and vast land, low density of settlements, and cool air and calm atmosphere. The existing conditions in the peri-urban areas also attract developers in investing their capital to develop housing close to Gorontalo City.

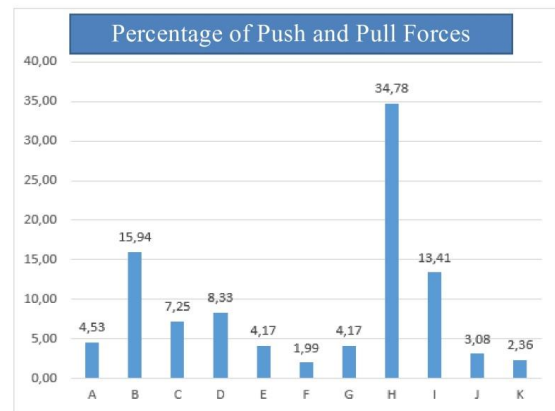


Figure 1. Centrifugal force: Percentage of push and pull forces (Telaga Sub-district)

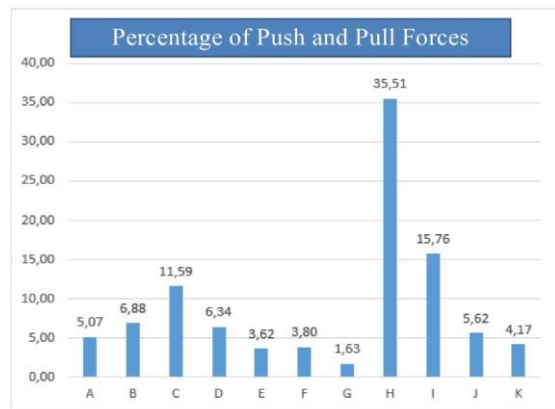


Figure 2. Centrifugal force: Percentage of push and pull forces (Kabila Sub-district)

3.3. Centripetal force analysis

The centripetal force analysis refers to the seven centripetal forces expressed [2]. The seven centripetal forces are: (1) the number of socio-economic facilities for life (A); (2) ensuring security (B); (3) high income (C); (4) high prestige (D); (5) high accessibility from the village (E); (6) the number of job opportunities (F); (7) close to the workplace (G).

The existence of centripetal movement for the residents in the peri-urban areas studied is supported by questionnaire data, where the productive age population (17 - 30 years) in

the sub-districts of Telaga (60.87%) and Kabila (53.62%) daily travel using shuttle service as students, university students, private employees, traders, army or police, and informal workers or government officials (Figure 3 and 4). From the types of work, the commuters between Telaga and Kabila sub-districts had different characteristics. There were three characteristics of commuters in Telaga sub-district, namely civil servants (14.49%), entrepreneurs/traders (13.04%), and students (11.59%). The commuters in Kabila sub-district were students (13.04%), civil servants (11.59%), and private employees (10.14%). The difference between the two commuter characteristics in the peri-urban areas was influenced by the distance and accessibility of the peri-urban areas towards higher education, economic facilities, and government office facilities.

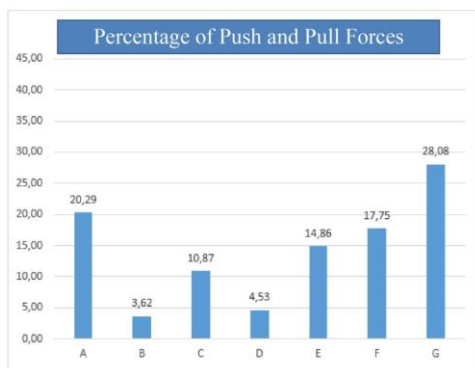


Figure 3. Centripetal force: Percentage of push and pull forces (Telaga sub-district)

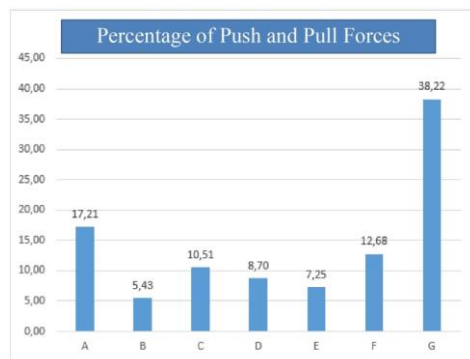


Figure 4. Centripetal force: Percentage of push and pull forces (Kabila sub-district)

3.4. Land use analysis

In 2005, the peri-urban area (Telaga sub-district) consisted of the plantation area of 463.12 ha, settlements of 242.41 ha, annual crop farming of 201.61 ha, water bodies of 8.75 ha, and sports stadium of 2.97 ha. The land use in the peri-urban area (Kabila sub-district) in the same year consisted of rice field area of 620.48 ha, settlement of 334.75 ha, annual crops of 270.25 ha, plantation of 83.86 ha, and the water body of 36.55 ha.

The land use in Telaga and Kabila sub-districts in 2015

had changed. In Telaga sub-district, the plantation and agricultural areas of seasonal plants were changed into the residential areas of 29.15 ha and 20.03 ha, respectively. In Kabila sub-district, some areas were converted into a residential area of 29.65 ha. In the two peri-urban areas, it appears that most of the agricultural areas were converted into the lands for settlement or urban areas. In Telaga sub-district, the function change of agricultural lands into housings was relatively more massive compared with that in Kabila sub-district.

The land use in 2005 and 2015 in the sub-districts of Telaga and Kabila signifies that the rural landscape dominated the ones of urban areas. In 2005, the land use in Telaga sub-district for urban areas was 27% (245.20 ha), and the remaining 73% (673.47 ha) was for non-urban lands (Figure 5). In 2015, the percentage of land use for urban areas was 32% (294.38 ha), signifying an increase by 5% (49.18 ha) and non-urban land by 68% (624.29 ha) (Figure 6). On one's hand, the percentage of land use in Kabila sub-district in 2005 was 25% (urban land, 334.75 ha) and 75% (non-urban land, 1011.14 ha) (Figure 7). In 2015, the composition of land use in Kabila sub-district experienced a change (urban land, 28%, or 380.34 ha) (Figure 8). The percentage of land use for urban areas was increased by 3% or 45.58 ha and by 72% for non-urban areas (965.56 Ha).

The high level of urban influence in the peri-urban area of Telaga sub-district correlates with the high accessibility in the peri-urban area. Telaga sub-district has the main road, which is the arterial road connecting Gorontalo City as the National Activity Center (in Indonesian known as *Pusat Kegiatan Nasional*) with the other cities in Gorontalo and North Sulawesi Provinces.

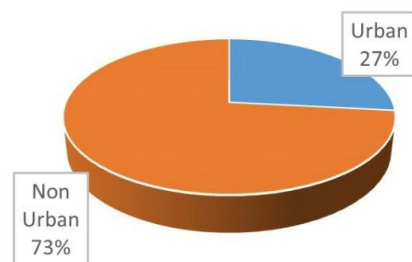


Figure 5. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2005

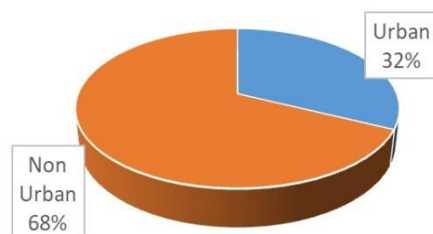


Figure 6. Urban and non-urban land uses in the peri-urban area of Telaga

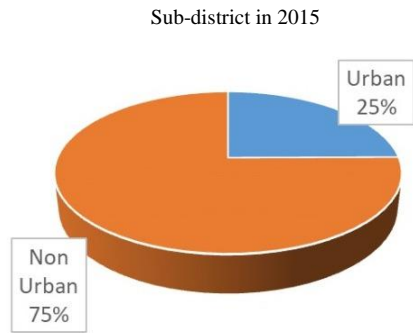


Figure 7. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

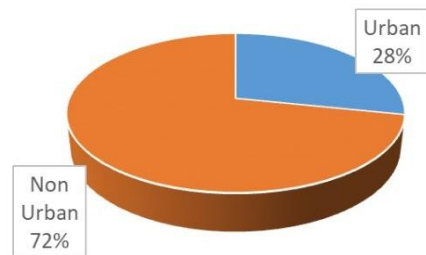


Figure 8. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

3.5. Settlement analysis

The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts. The first characteristic is the settlements along the arterial road (Jl. A.A. Wahab Limboto in Telaga sub-district and Sultan Botutihe Street in Kabila sub-district). Both roads have permanent building characteristics and modern architecture with a large yard with a paving block or concrete cover that can accommodate one or more houses to form a house group (in Gorontalo known as *ngala'a*) and a wall fence as a symbol of territory between *ngala'a*. The composition of the plant consists of ornamental flowers, such as garden croton, ashoka, Chinese evergreen, lily, and many more. Mango or jackfruit trees serve as protective plants and keep the microclimate, thus keeping the cool atmosphere of the yard [15], with a beautiful building arrangement. In *ngala'a*, there is a path to connect home, and it is useful to facilitate pedestrians in promoting communication with the neighbor in one *ngala'a*. Second, the settlements located far from arterial roads are semi-permanent and non-permanent buildings, simple building structures, traditional architectural features, and large yard. There is a garden on the left side with only coconut trees (monocultures) and vegetable plants on the right or backside of a house to meet daily needs. One can also find goat or chicken den at the back of the house for live stocks. There are also paths that interconnect low-density neighbors. Below is the structure of the settlements in the

peri-urban area of Telaga and Kabila sub-districts (Figure 9).

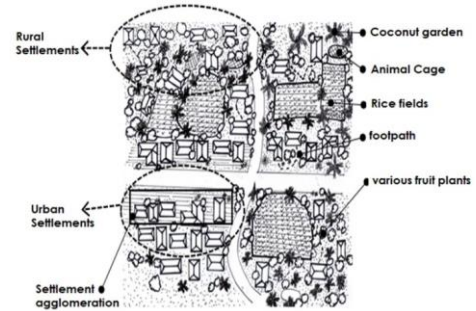


Figure 9. Settlement structure in peri-urban area of Gorontalo Province

3.6. Building use analysis

There are five types of building use in the peri-urban areas studied; residential houses, shop houses, stalls/ kiosks, informal businesses, and agriculture. The building in the peri-urban area of Telaga and Kabila sub-district has different characteristics. In Telaga sub-district, there were 37 respondents (54%) using their buildings for residential houses, 16 respondents (23%) for shop-houses, nine respondents (13%) for informal businesses (beauty salon/ barbershop and workshop), five respondents (7%) for kiosks, and two respondents (3%) for agricultural business (Fig.10). In Kabila sub-district, 34 respondents (49%) use their building for settlement purposes, 14 respondents (20%) for shop-houses, 12 respondents (18%) for kiosks, six respondents (9%) for informal business (beauty salon/ barbershop, and workshop), and three respondents (4%) for agricultural businesses (Fig.11).

The building for residential houses, shop-houses and informal businesses in Telaga sub-district outnumbers those in Kabila sub-district. On one's hand, the building for stalls/ kiosks and agricultural businesses in Telaga sub-district are fewer compared to those in Kabila sub-district. This is due to the fact that Telaga sub-district is, although considered a small town, more prominent than that of Kabila sub-district. On top of that, the physical development of the peri-urban area of Telaga sub-district is heavily influenced by the transportation activities in Telaga bus station. The station serves as the inter-city and inter-regency bus station in Gorontalo Province, thus resulting in diverse activities around the bus station and livelihoods of the population. Recently, the peri-urban area (Telaga sub-district) has become one of the nodal points in Gorontalo Regency and transformed into a newly developing area that attracts investors.

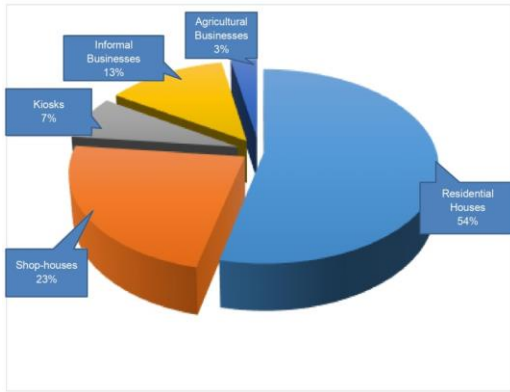


Figure 10. Building uses in peri-urban area (Telaga Sub-District)

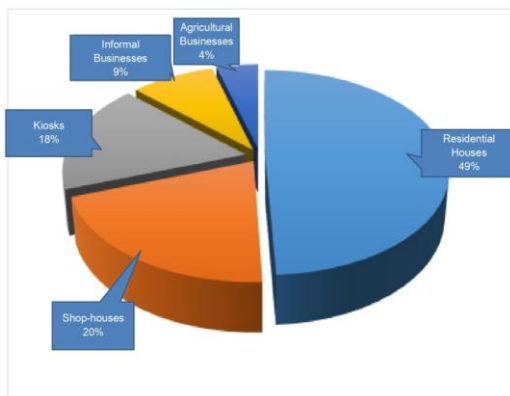


Figure 11. Building uses in peri-urban area (Kabila Sub-District)

In the peri-urban area (Kabila sub-district), the livelihood of the residents is relatively homogenous. The volume of average traffic in the area, particularly on the road of Sultan Botutihe that connects the sub-districts of Kabila and Buludawa (Suwawa sub-district), has decreased and the orientation of traffic movement had changed to the northern area of Bone Bolango regency. It is due to the change of the government center of Bone Bolango Regency, which initially from Suwawasub-district to Tilongkabila sub-district. Besides, the office facilities of the Provincial Government of Gorontalo was relocated to the northern area of Bone Bolango Regency, Tapa sub-district. This relocation contributes to the preference choosing the northern road for official administration purposes in Bone Bolango Regency and the Government of Gorontalo province.

3.7. Street pattern and circulation analysis

The roads in the sub-districts of Telaga and Kabila are relatively in good condition, and they also have good transportation circulation. Consequently, various modes of transportation especially *bentor* (motorized rickshaw), can provide their services to passengers in every part of the settlements. The transportation modes like *angkot* (local minibus for public transportation) and *bentor* can reach the villages in the two peri-urban areas. The existence of quality

transportation facilities and infrastructures strongly supports the mobilization and activities of the population to be commuters and reside in the peri-urban area. The farmer road program has changed the landscape of rural areas in both peri-urban areas; this is seen in the improvement of roads near farms. Initially, access to farms is mostly dirt roads. However, the dirt roads are rarely found recently. The existing condition is also similar to the condition of roads in rural areas. However, good road conditions in the sub-districts Telaga and Kabila have no traffic signs and road markings. Traffic signs and road markings can only be seen in arterial roads.

3.8. Analysis of peri-urban area morphology

Land use is among factors to consider in analyzing morphological types in peri urban areas. This factor also functions to explain the spatial distribution of residential mobility [18]. Characteristics of the peri-urban area of Telaga and Kabila sub-districts depict the quality of the rural areas and urban areas. Both sub-districts areas are growing due to contributions from the capital of Gorontalo city. Still, agricultural activities still dominate in the two peri-urban areas studied. The analysis shows that the pattern of roads in urban units is classified as linear and integrated with a grid road system. When viewed from the hierarchy level, land use for services and trade activities located around the main road (A.A. Wahab and Sultan Botutihe Streets) is the highest hierarchy. The pattern of land use from the peri-urban area in Telaga sub-district is octopus/star-shaped (a combination of concentric pattern and linear). Meanwhile, the land use pattern of peri urban area in Kabila sub-district is linear pattern (southern part) and leapfrog (northern part). The initial developmental patterns of these two peri-urban areas studied. The development is horizontal in its character, and the road planning implements vertical development. This situation is determined by the condition of the density of the buildings and the price of the land compared to other parts of the city. Government Regulation No. 12 of 2012 and Provincial Regulation No. 1 of 2014 on the protection of sustainable agricultural land on incentives ensure the sustainability of agricultural land.

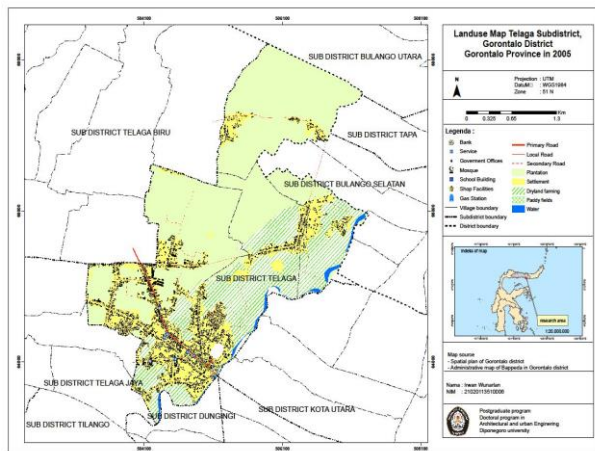


Figure 12. Map of land use and built use in Telaga Sub-District, 2005

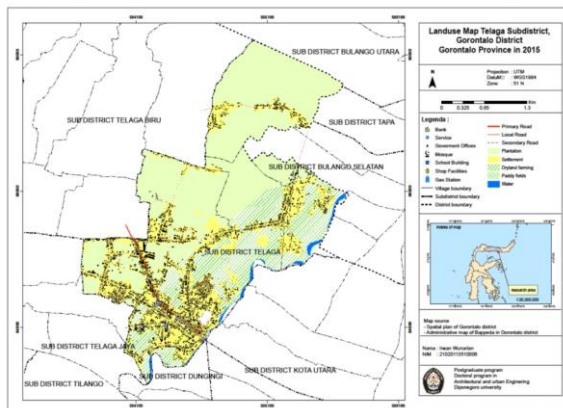


Figure 13. Map of land use and built use in Telaga Sub-District, 2015

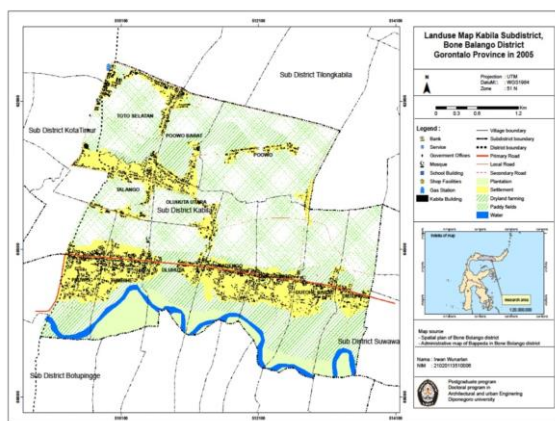


Figure 14. Map of land use and built use in Kabila Sub-District, 2005

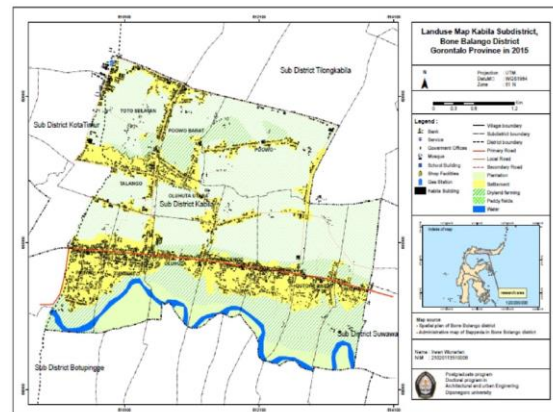


Figure 15 Map of land use and built use in Kabila Sub-District, 2015.

4. Conclusion

Based on the research results and discussion, it can be concluded that the development of the peri-urban area in Telaga District is heavily influenced by the accessibility of the area. Further, the location is very strategic (it is located in the middle of two developed cities in Gorontalo Province, i.e., Gorontalo city and Limboto city). The existence of primary arterial roads that cross the district serves as the main access to main facilities, such as Jalaludin Airport. Kabila sub-district is the area receiving significant impact because of the proximity of the distance between Kabila sub-district with the city of Gorontalo.

Further, the morphological form in the two peri-urban areas studied is significantly influenced by Gorontalo city. The morphological indicators of peri-urban areas (WPU) in Telaga and Kabila sub-districts can be described as follows: (a) The utilization of the land within ten years for urban development purposes in Telaga and Kabila sub-districts was increased by 5% (49.18 ha) and 3% (45.58 ha), respectively. (b) The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts: first, the settlements in the arterial road form the house group (*ngala'a*) and the wall fence as a symbol of the territory between *ngala'a*. Secondly, the settlement located far from the arterial road with the characteristics of semi-permanent and non-permanent buildings, simple building structures, traditional architectural styles, and low building densities. (c) Characteristics of building use for tertiary sectors (trade and service) in Telaga sub-district are more common than Kabila sub-district. In addition, stalls and agricultural business buildings (primary sector) in Telaga sub-district are not that common compared to Kabila sub-district.

Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Acknowledgements

The authors would like to express their gratitude to all participants and parties who are involved in this research.

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Pengiriman Revisi Tahap 1

(23 Februari 2023)



Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Revision after Peer Review (ID:14828167)-Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

Irwan Wunarlan <irwan.wunarlan001@gmail.com>
To: Anthony Robinson <revision.hrpub@gmail.com>

Thu, Feb 23, 2023 at 6:17 PM

Dear Editorial Team,

I would like to send you the revised manuscript and the response letter.
Thank you and I look forward to hearing from you.

Best regards,

Irwan Wunarlan
[Quoted text hidden]

2 attachments



Response Letter.docx
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To
Editor-in-Chief

Februari 23, 2023

Dear editor-in-chief,

Thank you for your reply regarding our manuscript ID: 14828167 entitled “**Morphology of Peri-Urban Area in Gorontalo Province, Indonesia**”

We are grateful for the reviewer’s comments, and the positive evaluation of our work. We have revised and modified the text and tables according to the referees' critiques. As a consequence we provide some changes and added many new and clarifying statements in all parts of the paper. These changes have improved the manuscript considerably and we hope that it can be published without delay.

Sincerely,
Corresponding Author on Behalf of All Authors,

Irwan Wunarlani

Detailed response: we have addressed and responded to the comments by the reviewers as follows.

REVIEWER 1

1. The abstract should clearly state the purpose of the research and explain why understanding the peri-urban area is important. Providing more information on the findings and their relevance would enhance the abstract.

Author responses: We have revised these sections accordingly. Please kindly see the red marks. (Abstract Section)

2. The methodology section should be further elaborated to provide more details and clarity.

Author responses: We have revised these sections accordingly. Please kindly see the red marks. (Methodology Section)

3. The author needs to discuss more based on the findings and indicate the results and contributions.

Author responses: We have revised these sections accordingly. Please kindly see the red marks. (Results and Discussion Section)

4. The author should question the paper's findings and put suggestions and the implications of the findings.

Author responses: We have revised these sections accordingly. Please kindly see the red marks. (Conclusion and Suggestion Section)

Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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Abstract As two areas directly adjacent to Gorontalo City, the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency) are the center of regional growth. The study aimed to examine the physical development of two sub-districts, Telaga and Kabila, since the sub-districts previously mentioned have different regional characteristics and different physical morphology development influenced by Gorontalo city. That the two sub-districts can be viewed as a peri-urban area of Gorontalo city is a fascinating topic to comprehend the peri-urban area. The stages of this qualitative descriptive research consisted of preliminary survey and observation, distributing questionnaires, collecting data, processing data, data analysis, and data interpretation. Over the last ten years, urban land use has increased in both Telaga and Kabila sub-district by 5% (49.18 ha) and 3% (45.58 ha), respectively. Agropolis activities still dominated the two peri-urban areas. The pattern of land use in the Sub-District of Telaga was a pattern of octopus, while that of Kabila sub-district was a linear pattern (southern part) and frog jump (northern part). Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Keywords City morphology, sub-district, land, peri-urban, physical development

1. Introduction

The suburban areas outside the administrative area of Gorontalo City are the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency). The two areas are directly adjacent to Gorontalo City, which serves as the center of regional growth. The social-economic situation of the two cities is very dominant with urban nuance in that of Gorontalo city. Scientifically, determining the border determination of the peri-urban area is not an easy task. The

outermost area of peri-urban is a place where people still want to commute to work/ do activities in a city [1].

The location of the sub-district of Kabila is on the east side of Gorontalo city. The sub-district is one of the entrances to Suwawa City in Bone Bolango Regency. On top of that, the area, which connects Suwawa City and Gorontalo City, has quite a high traffic flow. Telaga City, as a city of Telaga sub-district, is located in the western part of Gorontalo city and one of the access to the area of Limboto City. Limboto City and Suwawa City have yet significantly contributed to the development of Telaga and Kabila sub-district. In relation to the physical development of the two sub-districts, the effect of Gorontalo city is very dominant in determining the direction of the physical development of the region because the location of the two sub-districts is in the suburb of Gorontalo city with their excellent accessibility.

The physical development of Telaga and Kabila sub-districts as a result of the physical development of Gorontalo City to the outer part of its administrative area is highly influenced by various factors previously discussed in the above paragraph. The factors help contribute to the form and morphology of the city. Morphology of a city is not only limited to analysis of the form of the city or the factors that influence the form of the city [2]. The phenomenon is an intriguing topic to study because the two sub-districts have different regional characteristics and different development of the physical morphology of the city influenced by Gorontalo City. The two sub-districts can be regarded as the peri-urban of Gorontalo city, so it is fascinating to be a study material in comprehending peri-urban area.

1.1. City morphology

There are several morphological indicators of a city; those involve land use, plot, the layout of streets, and buildings [3]. The four indicators are described as follows [4]:

(1) Land use, as one of the indicators of city morphology, has a temporary nature because its functions are easy to change. Land use can be divided into two kinds of utilization, namely urban land and non-urban land. Urban land is oriented to secondary and tertiary sectors (trade and services),

and non-urban land is oriented to the primary sector (agriculture).

(2) The plot is a plot of a certain size for housing. The arrangement of plots forms blocks. Plot and block are the initial elements of city formation. Urban plots are usually arranged and face the environmental street, while service street is located between one plot and another plot. In the development of a city, the ownership of plots can be transferred and traded. This may cause changes in the width. Generally, a plot is rectangular, but the shape can be affected by the surrounding environment and the street pattern.

A street pattern consisting of streets serves as the forming of the block pattern of a city area. Streets may also form spaces between blocks in urban areas, and the street connected to other streets form a network and street pattern. Street network pattern in an urban area is formed through a very long process and usually a continuation of previous patterns. Street pattern in a city is usually a grid pattern, either regular or irregular. A grid pattern is created from crossing and intersecting two lines or more parallel lines forming geometric patterns with regular spacing and producing regional blocks. A grid-shaped street pattern can be found in old cities and planned cities. Grid street patterns generally have good transport circulation making it easier for city residents to interact from one area of the city to another.

The intended buildings include the buildings for settlements and the buildings utilized to accommodate human activities; this infrastructure plays a vital role in forming network structure, street patterns, and public areas. Buildings form mass plots (single and blocks patterns) and open spaces. Buildings located on a plot can be transformed in their function, shape, or width. The buildings in the peri-urban area have the utilization characteristics of both urban and rural.

1.2. Peri-urban area

Peri-urban is an important area in the city development cycle. This region experiences a very rapid transformation process from the rural stage to the urban stage to the urban stage both qualitatively (urban lifestyle) and quantitative (new residential zone) [5]. For this reason, this area can be defined as an area of dynamic change from land use, social, environmental aspects, and infrastructure [6].

The peri-urban area has an important role in the lives of future residents because the peri-urban area is an area between two regions, which clearly shows differences in environmental conditions. Peri urban areas encompass a combination of rural characteristics and urban characteristics simultaneously [7]. Furthermore, the area is a zone with a mixture of urban and rural activities [8]. This is the case with land use [9], so that peri urban areas are a transition zone [10], where urban and rural activities are juxtaposed [11].

1.3. Centrifugal force

The growth of cities turns out to cover a variety of factors that are more complex than just agglomeration economies. Optimal city size theory defines the spatial equilibrium of economic activity as a result of the attraction between centripetal and centrifugal forces [12]. Centrifugal forces are the power of dispersion [13]; in the centrifugal force, a population movement and functions that originate from the inside of a region goes to the outer side [14], thus resulting a movement of activity between centers cities and suburbs [15]. This situation has triggered rapid physical development and expansion of suburban areas [16].

1.4. Centripetal force

Centripetal force refers to a force causing population movements from the suburbs to the city. In addition, centripetal forces, driven by agglomeration augmentation, are all forces that attract economic activity to urban areas [17,18]. Centripetal strength is a force that tends to produce an integration style that brings together various social, economic, cultural, and political activities from the periphery to the downtown area, which has positive and negative implications [19].

There are two kinds of forces that have contributed to forming the centripetal force; push and propelling forces. Push force is spatially associated with the origin region of movement, and propelling force is associated spatially with the destination area of the movement because the centripetal movement is opposed to centrifugal movement and the two forces play different roles [20]. Centrifugal and centripetal forces have similar implications in developing an activity center [15].

2. Methodology

The method used in this research was qualitative-descriptive. ArcGis and Google Earth Pro were two main instruments used to analyze the physical appearance of space or morphology in the peri-urban area. Further, Microsoft Excel was used to perform tabulation and analysis of data derived from the questionnaires. The questionnaire, i.e., the research instrument, was used to identify the centrifugal and centripetal forces and the factors causing the occurrence of the two forces within the study area. The survey and observation were conducted to eliminate the sense of doubt over the uncertainty in certain objects of space physical appearance in the research location. All informants' names were written in pseudonyms and the informed consent was written.

2.1. The stage of determining analysis unit

The study used one or more units of analysis associated with urban morphology or morphological patterns of peri-urban areas. The morphological formation of the peri-urban area is strongly influenced by the social and

economic conditions and activities within the area. The analysis of the morphological pattern of the peri-urban area in this research was emphasized on building density, accessibility, and distance from downtown.

2.2. Preparation stage

The preparation stage of the research was started by studying and reviewing various literature as the references in conducting the research and the preparation of the research instruments (questionnaire). Following the previous process was an initial survey in several institutions to collect secondary data, such as the data on population numbers and density and people's livelihoods. The remote sensing imagery data were obtained from Google Earth Pro with the recording years of 2005 and 2015.

2.3. The stages of data processing and analysis

ArcGis software was used to process the image data derived from Google Earth Pro with the recording year of 2005 and 2015, and then the coordinate correction process was determined via georeferencing. This process was followed by digitization steps to get the derived data (shapefile). The digitization process generated new data as the physical appearance of the image data recording. The mapping of the patterns and distribution of settlements in Kabila sub-district was grouped into three parts: first, the pattern and distribution of settlements in southern Kabila sub-district bordering Gorontalo City; second, the pattern and distribution of settlements within the area along the main road of Gorontalo City - Suwawa City (Sultan Botutihe street); third, the pattern and distribution of settlements within the sub-district of Kabila to the north that borders Gorontalo city. The mapping of the patterns and distribution of settlements in Telaga sub-district was grouped into two parts: first, the pattern and distribution of settlements in the village areas of Telaga sub-district bordering with Gorontalo city; second, the pattern and distribution of settlements within the regions along the main road of Gorontalo City - Limboto City (A.A WahabLimboto Road). The mapping results were overlaid to find out the pattern and trend of the development of settlement areas in Telaga and Kabila sub-districts. Furthermore, the comparative development of settlements in both regions was conducted because the two areas of study had different peri-urban characteristics.

2.4. Data interpretation and drawing conclusion

The research data on the morphology of peri-urban areas (Telaga and Kabila sub-districts) was presented in the form of spatial or digital maps that provided information on the pattern and trends of future peri-urban development. The data of the tabulation result from the questionnaires were analyzed using hierarchical process analysis (AHP) so that the dominant factors that influence the development of

morphology in the peri-urban area can be identified.

2.5. Ethics statement

All of the participants' names in this research were written in pseudonyms and the informed consent was in written. This research has obtained approval ethics from the ethical committee of Gorontalo State University.

3. Result and Discussion

3.1. An overview of study area

Geographically, Telaga sub-district is located at 1210,159" – 1230, 32" West Latitude and 00,24" – 100,02" North Longitude, and Kabila sub-district lie at 0,30° North Latitude, 1,00° South Latitude and 121,00° East Longitude, 123,30° West Longitude. The area of Telaga and Kabila sub-districts is 58.44 km² and 193.45 km², respectively. There are 22,884 and 23,634 of people in these two sub-districts .The borders of the two peri-urban areas are presented in Table 1.

Table 1. The borders of Telaga and Kabila Sub-districts

| Study Area | Borders | Bordering with |
|---------------------|---------|--------------------------------------|
| Telaga sub-district | North | Telaga Biru sub-district |
| | East | Sipatana sub-district-Gorontalo city |
| | South | Tilango and Telaga Jaya sub-district |
| | West | Telaga Biru sub-district |
| | North | Tilongkabila sub-district |
| Kabila sub-district | East | Central Suwawa sub- district |
| | South | Botupingge sub-district |
| | West | Gorontalo city |

Source: BPS, 2016

In general, the two peri-urban areas have lowland areas. Telaga sub-district is slightly hilly in the northern region and fed by Bulango and Nanati rivers. Kabila sub-district is flown by Bone River, making the two peri-urban areas quite fertile. People's livelihoods in the study area were mostly in the agricultural sector. Table 2 provides information on the distance between the peri-urban areas and Gorontalo city, airport, and regency capitals from each study area.

Table 2. The distance of peri-urban areas (study area) to several capitals in Gorontalo Province

| No | Origin | Destination (km) |
|----|--------|------------------|
|----|--------|------------------|

| | | Gorontalo City | Limboto City | Jalaludd in Airport |
|---|--------------------------|------------------|--------------|---------------------|
| 1 | Telaga Jaya sub-district | 11 | 9 | 31 |
| | | Destination (km) | | |
| 2 | Kabila sub-district | Gorontalo City | Suwawa City | Jalaludd in Airport |
| | | 4,3 | 7 | 40 |

Source: Primary Data, 2017

3.2. Centrifugal force analysis

There were 11 factors of push and propelling forces that affect the development of the morphology of peri-urban areas in Telaga and Kabila sub-districts. Those factors involved: (1) smaller population compared to urban population (A); (2) low-dense settlements (B); (3) low rate of air, sound and water pollutions (C); (4) friendly inhabitants (D); (5) low crime rate (E); (6) less restrictive rules (F); (7) no traffic jam and traffic congestion (G); (8) low land prices and large areas (H); (9) cool air and tranquil atmosphere (I); (10) beautiful natural scenery (J); and (11) the guarantee of privacy (K).

Further, three push forces for the residents of Gorontalo City to live and move in the peri-urban area, i.e., high land prices at the city center, settlement density, and air, sound and water pollutions (Figure 1 and 2). On the other hand, the propelling forces for the residents of Gorontalo City to settle in the peri-urban areas are related to low land prices and vast land, low density of settlements, and cool air and calm atmosphere. The existing conditions in the peri-urban areas also attract developers in investing their capital to develop housing close to Gorontalo City.

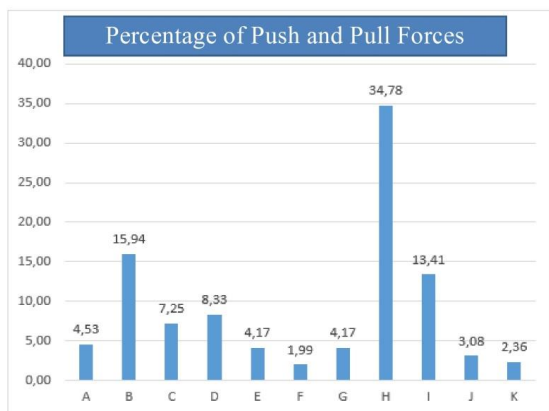


Figure 1. Centrifugal force: Percentage of push and pull forces (Telaga Sub-district)

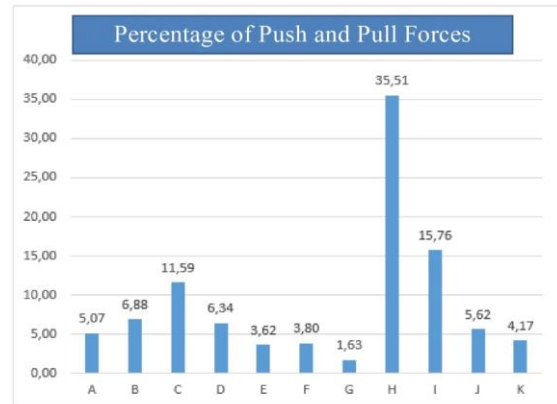


Figure 2. Centrifugal force: Percentage of push and pull forces (Kabila Sub-district)

3.3. Centripetal force analysis

The centripetal force analysis refers to the seven centripetal forces expressed [2]. The seven centripetal forces are: (1) the number of socio-economic facilities for life (A); (2) ensuring security (B); (3) high income (C); (4) high prestige (D); (5) high accessibility from the village (E); (6) the number of job opportunities (F); (7) close to the workplace (G).

The existence of centripetal movement for the residents in the peri-urban areas studied is supported by questionnaire data, where the productive age population (17 - 30 years) in the sub-districts of Telaga (60.87%) and Kabila (53.62%) daily travel using shuttle service as students, university students, private employees, traders, army or police, and informal workers or government officials (Figure 3 and 4). From the types of work, the commuters between Telaga and Kabila sub-districts had different characteristics. There were three characteristics of commuters in Telaga sub-district, namely civil servants (14.49%), entrepreneurs/traders (13.04%), and students (11.59%). The commuters in Kabila sub-district were students (13.04%), civil servants (11.59%), and private employees (10.14%). The difference between the two commuter characteristics in the peri-urban areas was influenced by the distance and accessibility of the peri-urban areas towards higher education, economic facilities, and government office facilities.

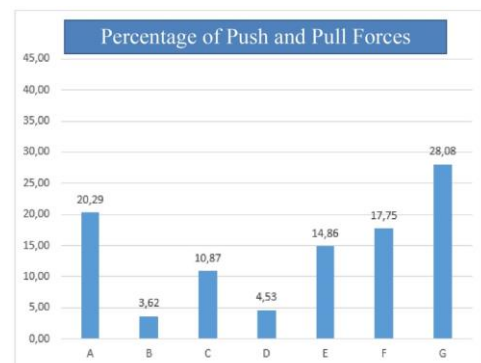


Figure 3. Centripetal force: Percentage of push and pull forces (Telaga sub-district)

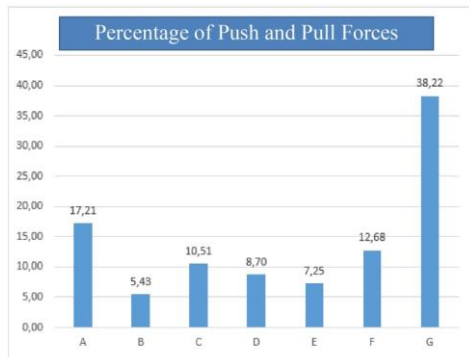


Figure 4. Centripetal force: Percentage of push and pull forces (Kabila sub-district)

3.4. Land use analysis

In 2005, the peri-urban area (Telaga sub-district) consisted of the plantation area of 463.12 ha, settlements of 242.41 ha, annual crop farming of 201.61 ha, water bodies of 8.75 ha, and sports stadium of 2.97 ha. The land use in the peri-urban area (Kabila sub-district) in the same year consisted of rice field area of 620.48 ha, settlement of 334.75 ha, annual crops of 270.25 ha, plantation of 83.86 ha, and the water body of 36.55 ha.

The land use in Telaga and Kabila sub-districts in 2015 had changed. In Telaga sub-district, the plantation and agricultural areas of seasonal plants were changed into the residential areas of 29.15 ha and 20.03 ha, respectively. In Kabila sub-district, some areas were converted into a residential area of 29.65 ha. In the two peri-urban areas, it appears that most of the agricultural areas were converted into the lands for settlement or urban areas. In Telaga sub-district, the function change of agricultural lands into housings was relatively more massive compared with that in Kabila sub-district.

The land use in 2005 and 2015 in the sub-districts of Telaga and Kabila signifies that the rural landscape dominated the ones of urban areas. In 2005, the land use in Telaga sub-district for urban areas was 27% (245.20 ha), and the remaining 73% (673.47 ha) was for non-urban lands (Figure 5). In 2015, the percentage of land use for urban areas was 32% (294.38 ha), signifying an increase by 5% (49.18 ha) and non-urban land by 68% (624.29 ha) (Figure 6). On one's hand, the percentage of land use in Kabila sub-district in 2005 was 25% (urban land, 334.75 ha) and 75% (non-urban land, 1011.14 ha) (Figure 7). In 2015, the composition of land use in Kabila sub-district experienced a change (urban land, 28%, or 380.34 ha) (Figure 8). The percentage of land use for urban areas was increased by 3% or 45.58 ha and by 72% for non-urban areas (965.56 Ha).

The high level of urban influence in the peri-urban area of Telaga sub-district correlates with the high accessibility in the peri-urban area. Telaga sub-district has the main road,

which is the arterial road connecting Gorontalo City as the National Activity Center (in Indonesian known as *Pusat Kegiatan Nasional*) with the other cities in Gorontalo and North Sulawesi Provinces.

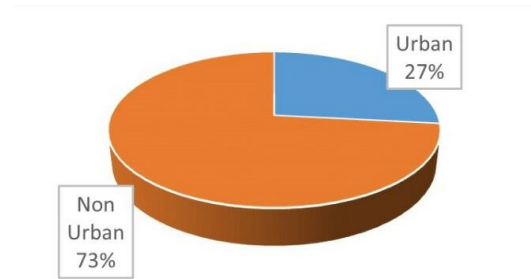


Figure 5. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2005

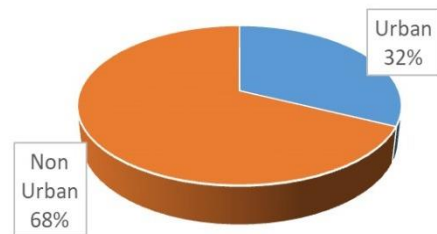


Figure 6. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2015

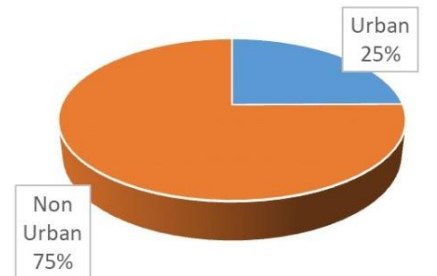


Figure 7. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2005

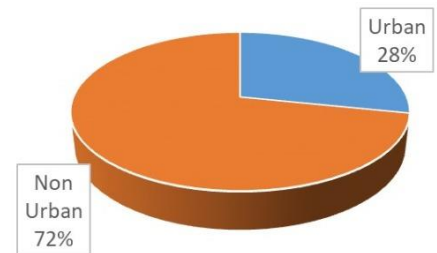


Figure 8. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

3.5. Settlement analysis

The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts. The first characteristic is the settlements along the arterial road (Jl. A.A. Wahab Limboto in Telaga sub-district and Sultan Botutihe Street in Kabila sub-district). Both roads have permanent building characteristics and modern architecture with a large yard with a paving block or concrete cover that can accommodate one or more houses to form a house group (in Gorontalo known as *ngala'a*) and a wall fence as a symbol of territory between *ngala'a*. The composition of the plant consists of ornamental flowers, such as garden croton, ashoka, Chinese evergreen, lily, and many more. Mango or jackfruit trees serve as protective plants and keep the microclimate, thus keeping the cool atmosphere of the yard [15], with a beautiful building arrangement. In *ngala'a*, there is a path to connect home, and it is useful to facilitate pedestrians in promoting communication with the neighbor in one *ngala'a*. Second, the settlements located far from arterial roads are semi-permanent and non-permanent buildings, simple building structures, traditional architectural features, and large yard. There is a garden on the left side with only coconut trees (monocultures) and vegetable plants on the right or backside of a house to meet daily needs. One can also find goat or chicken den at the back of the house for live stocks. There are also paths that interconnect low-density neighbors. Below is the structure of the settlements in the peri-urban area of Telaga and Kabila sub-districts (Figure 9).

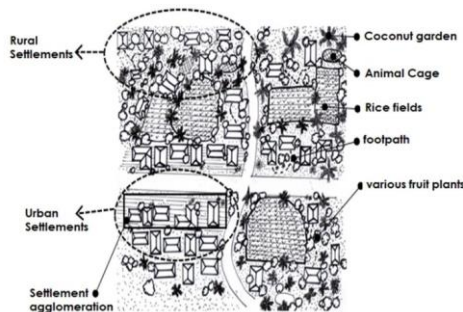


Figure 9. Settlement structure in peri-urban area of Gorontalo Province

3.6. Building use analysis

There are five types of building use in the peri-urban areas studied; residential houses, shop houses, stalls/ kiosks, informal businesses, and agriculture. The building in the peri-urban area of Telaga and Kabila sub-district has different characteristics. In Telaga sub-district, there were 37 respondents (54%) using their buildings for residential houses, 16 respondents (23%) for shop-houses, nine respondents (13%) for informal businesses (beauty salon/barbershop and workshop), five respondents (7%) for kiosks, and two respondents (3%) for agricultural business (Fig.10). In Kabila sub-district, 34 respondents (49%) use their building for settlement purposes, 14 respondents (20%) for shop-houses, 12 respondents (18%) for kiosks, six

respondents (9%) for informal business (beauty salon/barbershop, and workshop), and three respondents (4%) for agricultural businesses (Fig.11). **The presence of new buildings has had a major influence on the development of the city's morphology, making it rapidly abandon its original character as the city was originally built.**

The building for residential houses, shop-houses and informal businesses in Telaga sub-district outnumbers those in Kabila sub-district. On one's hand, the building for stalls/ kiosks and agricultural businesses in Telaga sub-district are fewer compared to those in Kabila sub-district. This is due to the fact that Telaga sub-district is, although considered a small town, more prominent than that of Kabila sub-district. On top of that, the physical development of the peri-urban area of Telaga sub-district is heavily influenced by the transportation activities in Telaga bus station. The station serves as the inter-city and inter-regency bus station in Gorontalo Province, thus resulting in diverse activities around the bus station and livelihoods of the population. Recently, the peri-urban area (Telaga sub-district) has become one of the nodal points in Gorontalo Regency and transformed into a newly developing area that attracts investors.

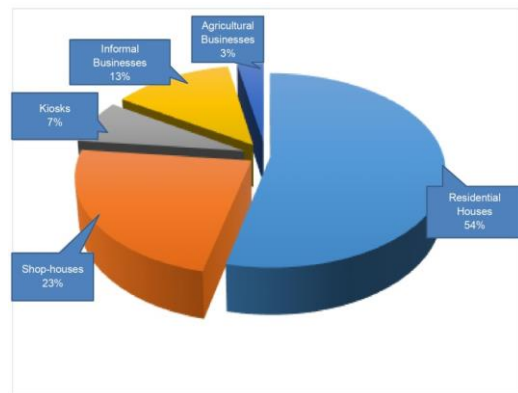


Figure 10. Building uses in peri-urban area (Telaga Sub-District)

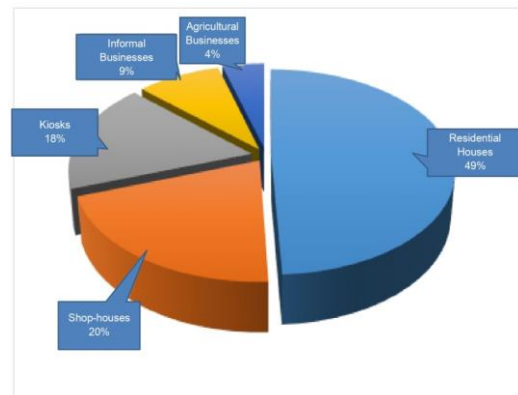


Figure 11. Building uses in peri-urban area (Kabila Sub-District)

In the peri-urban area (Kabila sub-district), the livelihood of the residents is relatively homogenous. The volume of

average traffic in the area, particularly on the road of Sultan Botutihe that connects the sub-districts of Kabila and Buludawa (Suwawa sub-district), has decreased and the orientation of traffic movement had changed to the northern area of Bone Bolango regency. It is due to the change of the government center of Bone Bolango Regency, which initially from Suwawasub-district to Tilongkabila sub-district. Besides, the office facilities of the Provincial Government of Gorontalo was relocated to the northern area of Bone Bolango Regency, Tapa sub-district. This relocation contributes to the preference choosing the northern road for official administration purposes in Bone Bolango Regency and the Government of Gorontalo province.

3.7. Street pattern and circulation analysis

The roads in the sub-districts of Telaga and Kabila are relatively in good condition, and they also have good transportation circulation. Consequently, various modes of transportation especially *bentor* (motorized rickshaw), can provide their services to passengers in every part of the settlements. The transportation modes like *angkot* (local minibus for public transportation) and *bentor* can reach the villages in the two peri-urban areas. The existence of quality transportation facilities and infrastructures strongly supports the mobilization and activities of the population to be commuters and reside in the peri-urban area. The farmer road program has changed the landscape of rural areas in both peri-urban areas; this is seen in the improvement of roads near farms. Initially, access to farms is mostly dirt roads. However, the dirt roads are rarely found recently. The existing condition is also similar to the condition of roads in rural areas. However, good road conditions in the sub-districts Telaga and Kabila have no traffic signs and road markings. Traffic signs and road markings can only be seen in arterial roads.

The livelihoods of people in Kabila sub-district tend to be homogeneous. The average daily traffic or traffic volume in this region, especially the Jalan Sultan Botutihe, i.e., a road connecting Kabila and Buludawa sub-districts (Suwawa sub-district) has decreased. Further, the orientation of traffic movement has shifted to the northern part of Bone Bolango County. This is allegedly due to the shift of the central government area of Bone Bolango Regency. The central government was initially located in Suwawa sub-district (the office was also relocated to Tilongkabila sub-district). In addition, the Gorontalo Provincial Government office facilities are gradually relocated to the northern part of Bone Bolango Regency, specifically in Tapa subdistrict. Another factor causing a decrease in the traffic volume at JalanBotutihe is the preference of the road users to pass the northern areas for government administration purposes. This situation also affects the physical development of space in Kabila sub-district.

3.8. Analysis of peri-urban area morphology

Land use is among factors to consider in analyzing morphological types in peri urban areas. This factor also functions to explain the spatial distribution of residential mobility [18]. Characteristics of the peri-urban area of Telaga and Kabila sub-districts depict the quality of the rural areas and urban areas. Both sub-districts areas are growing due to contributions from the capital of Gorontalo city. Still, agricultural activities still dominate in the two peri-urban areas studied. The analysis shows that the pattern of roads in urban units is classified as linear and integrated with a grid road system. When viewed from the hierarchy level, land use for services and trade activities located around the main road (A.A. Wahab and Sultan Botutihe Streets) is the highest hierarchy. The pattern of land use from the peri-urban area in Telaga sub-district is octopus/star-shaped (a combination of concentric pattern and linear). Meanwhile, the land use pattern of peri urban area in Kabila sub-district is linear pattern (southern part) and leapfrog (northern part). The initial developmental patterns of these two peri-urban areas studied. The development is horizontal in its character, and the road planning implements vertical development. This situation is determined by the condition of the density of the buildings and the price of the land compared to other parts of the city. Government Regulation No. 12 of 2012 and Provincial Regulation No. 1 of 2014 on the protection of sustainable agricultural land on incentives ensure the sustainability of agricultural land.

The policies previously mentioned are intended to limit the expansion of urban space and give protection against land sales [21]. Land sale also causes the loss of agricultural land [22], loss of rural areas, especially in the main urban areas [23], and environmental degradation [24] vulnerability in unplanned settlements areas in peri-urban areas [25]. Currently, transport routes from all directions are focused on this zone, meaning that Telaga sub-district has a high accessibility level, which contributes to the urban development in peri-urban areas.

In 2005, the settlement or the development area in Telaga sub-district reached 242.41 ha with building density level reaching 0.078 (Fig.12), and in Kabila sub-district, the area was 334.75 ha with the density level of 0.056 (Fig.13). There was a change of settlement land as development area in Telaga sub-district (291.59 ha) with the building density level of 0.12 (Fig.14), and in Kabila sub-district the development area was 380.34 ha with density level reaches 0.07 (Fig.15). In general, the development of the land was well established in both sub-districts, which directly adjacent to Gorontalo City. This indicates that the peri urban area is heavily influenced by the main city, that is the City of Gorontalo. Thus, it cannot be denied that the development of the two peri-urban areas has implications for changes in the appearance of the two sub-districts.

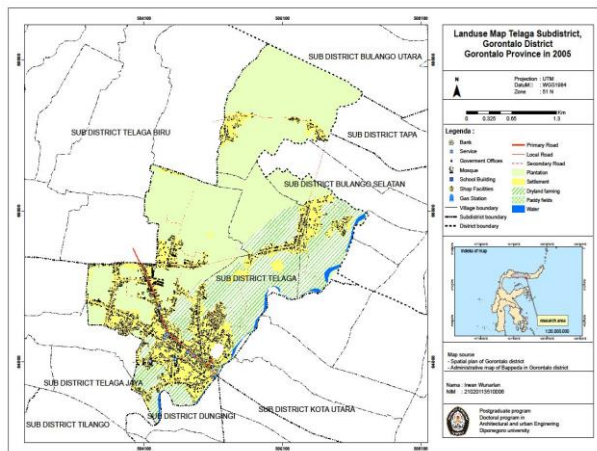


Figure 12. Map of land use and built use in Telaga Sub-District, 2005

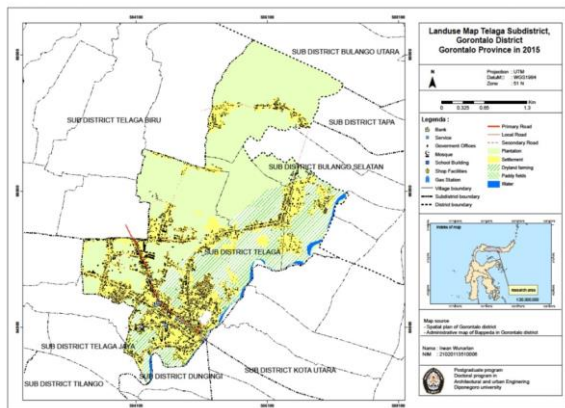


Figure 13. Map of land use and built use in Telaga Sub-District, 2015

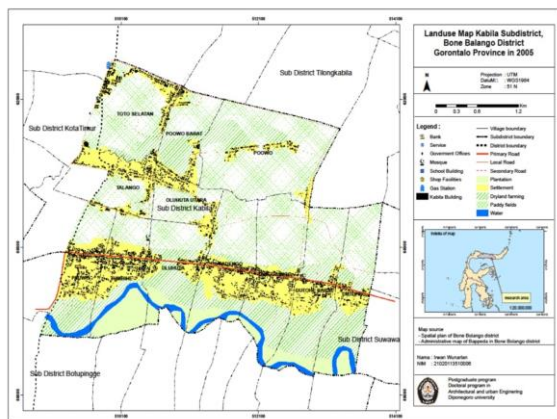


Figure 14. Map of land use and built use in Kabila Sub-District, 2005

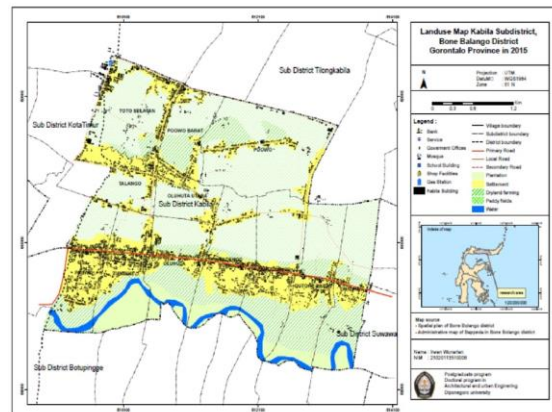


Figure 15 Map of land use and built use in Kabila Sub-District, 2015.

4. Conclusion

Based on the research results and discussion, it can be concluded that the development of the peri-urban area in Telaga District is heavily influenced by the accessibility of the area. Further, the location is very strategic (it is located in the middle of two developed cities in Gorontalo Province, i.e., Gorontalo city and Limboto city). The existence of primary arterial roads that cross the district serves as the main access to main facilities, such as Jalaludin Airport. Kabila sub-district is the area receiving significant impact because of the proximity of the distance between Kabila sub-district with the city of Gorontalo.

Further, the morphological form in the two peri-urban areas studied is significantly influenced by Gorontalo city. The morphological indicators of peri-urban areas (WPU) in Telaga and Kabila sub-districts can be described as follows: (a) The utilization of the land within ten years for urban development purposes in Telaga and Kabila sub-districts was increased by 5% (49.18 ha) and 3% (45.58 ha), respectively. (b) The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts: first, the settlements in the arterial road form the house group (*ngala'a*) and the wall fence as a symbol of the territory between *ngala'a*. Secondly, the settlement located far from the arterial road with the characteristics of semi-permanent and non-permanent buildings, simple building structures, traditional architectural styles, and low building densities. (c) Characteristics of building use for tertiary sectors (trade and service) in Telaga sub-district are more common than Kabila sub-district. In addition, stalls and agricultural business buildings (primary sector) in Telaga sub-district are not that common compared to Kabila sub-district. (d) Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Furthermore, Telaga and Kabila sub-districts are two

peri-urban areas that tend to be banded. Settlements and buildings are spread out in small groups and tend not to have regular urban spatial patterns. The spatial pattern of the city still has a connection with rural traditions and is traditional in nature.

5. Suggestion

It is necessary to carry out further research related to the role of transportation and changes in road patterns and circulation orientation in peri urban areas as it greatly influences the physical morphology of cities. Meanwhile, land use as built-up land should apply the concept of vertical and interstitial development, in which existing buildings must comply with detailed local spatial plans so that agricultural land can be maintained and remains sustainable.

The development of the city will have an impact on the surrounding area, especially the suburbs (peri urban). Peri urban areas can be identified based on the characteristics of peri urban areas, which will then look at the morphological components and identify the factors that influence the shape of the city. This is due to the availability of green open space in the form of rice fields and dry fields in peri urban areas.

The novelty of this study is to reveal the influence of community solidarity values on the development of urban morphological elements. Therefore, the results of this study can be used as a basis for the development of further research that refers to the development of urban morphology. The method in this study is an appropriate way to express the influence of physical aspects and socio-cultural aspects on urban development. At the practitioner level, there should be an understanding on the main aspects that must be considered in settlement planning to form an integrated spatial arrangement. As a result, there will be a creation of communal spaces that are integrated between the environment and social culture of urban society.

6. Recommendation

Based on the findings, this study provides several recommendations to be followed up by the government and subsequent researchers.

Firstly, the existing condition of Kabila Subdistrict must be maintained to maintain the microclimate and natural balance in the form of food and water supply by making measured and controlled land use so as not to change the face of the city. Thus, it is necessary to find a grand-design of a sustainable city.

Secondly, natural population growth and migration processes tend to accelerate urban development which can increase population density and the number of buildings in both peri-urban areas.

Thirdly, Telaga Subdistrict is changing more quickly when compared to Kabila Subdistrict or the urban appearance in the peri-urban areas of Telaga Subdistrict is

more visible than Kabila Subdistrict. This indicates that the influence of urbanization on morphology in the peri-urban area in Telaga District is higher when compared to the peri-urban area in Kabila District. Changes in Telaga Subdistrict can be followed up by conducting further research on the existence of Telaga Subdistrict between the two main urban centers, including Limboto City and Gorontalo City by looking at changes in people's socio-cultural behavior, economy, life style, transportation circulation and city characteristics.

Acknowledgements

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Hasil Review Tahap 2

(27 Februari 2023)



Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Revision after Peer Review (ID:14828167)-Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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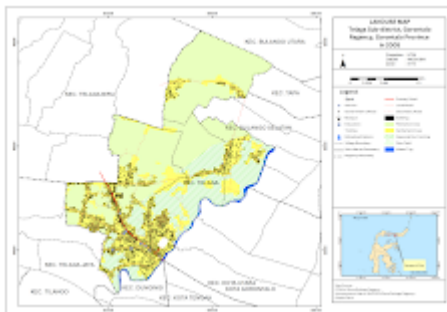
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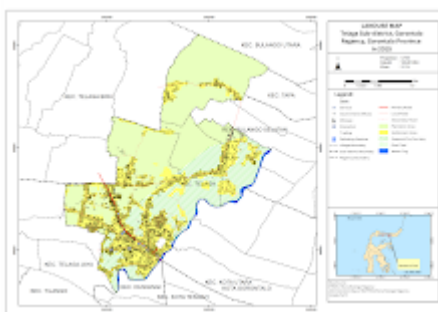
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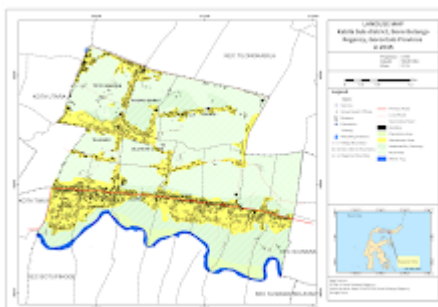
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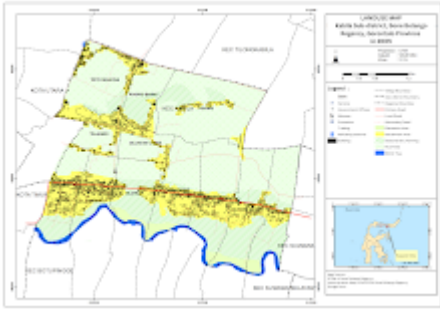
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Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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Abstract As two areas directly adjacent to Gorontalo City, the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency) are the center of regional growth. The study aimed to examine the physical development of two sub-districts, Telaga and Kabila, since the sub-districts previously mentioned have different regional characteristics and different physical morphology development influenced by Gorontalo city. That the two sub-districts can be viewed as a peri-urban area of Gorontalo city is a fascinating topic to comprehend the peri-urban area. The stages of this qualitative descriptive research consisted of preliminary survey and observation, distributing questionnaires, collecting data, processing data, data analysis, and data interpretation. Over the last ten years, urban land use has increased in both Telaga and Kabila sub-district by 5% (49.18 ha) and 3% (45.58 ha), respectively. Agropolis activities still dominated the two peri-urban areas. The pattern of land use in the Sub-District of Telaga was the pattern of octopus, while that of Kabila sub-district was a linear pattern (southern part) and frog jump (northern part). Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Keywords City morphology, sub-district, land, peri-urban, physical development

1. Introduction

The suburban areas outside the administrative area of Gorontalo City are the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency). The two areas are directly adjacent to Gorontalo City, which serves as the center of regional growth. The social-economic situation of the two cities is very dominant with urban nature in that of Gorontalo city. Scientifically, determining the border determination of the peri-urban area is not an easy task. The

outermost area of peri-urban is a place where people still want to commute to work/do activities in a city [1].

The location of the sub-district of Kabila is on the east side of Gorontalo city. The sub-district is one of the entrances to Suwawa City in Bone Bolango Regency. On top of that, the area, which connects Suwawa City and Gorontalo City, has quite a high traffic flow. Telaga City, as a city of Telaga sub-district, is located in the western part of Gorontalo city and one of the accesses to the area of Limboto City. Limboto City and Suwawa City have yet significantly contributed to the development of Telaga and Kabila sub-district. In relation to the physical development of the two sub-districts, the effect of Gorontalo city is very dominant in determining the direction of the physical development of the region because the location of the two sub-districts is in the suburb of Gorontalo city with their excellent accessibility.

The physical development of Telaga and Kabila sub-districts as a result of the physical development of Gorontalo City to the outer part of its administrative area is highly influenced by various factors previously discussed in the above paragraph. The factors help contribute to the form and morphology of the city. Morphology of a city is not only limited to analysis of the form of the city or the factors that influence the form of the city [2]. The phenomenon is an intriguing topic to study because the two sub-districts have different regional characteristics and different development of the physical morphology of the city influenced by Gorontalo City. The two sub-districts can be regarded as the peri-urban of Gorontalo city, so it is fascinating to be a study material in comprehending peri-urban area.

1.1. City morphology

There are several morphological indicators of a city; those involve land use, plot, the layout of streets, and buildings [3].

The four indicators are described as follows [4]:

(1) Land use, as one of the indicators of city morphology, has a temporary nature because its functions are easy to change. Land use can be divided into two kinds of utilization, namely urban land and non-urban land. Urban land is oriented to secondary and tertiary sectors (trade and services),

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28

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and non-urban land is oriented to the primary sector (agriculture).

(2) The plot is a plot of a certain size for housing. The arrangement of plots forms blocks. Plot and block are the initial elements of city formation. Urban plots are usually arranged and face the environmental street, while service street is located between one plot and another plot. In the development of a city, the ownership of plots can be transferred and traded. This may cause changes in the width. Generally, a plot is rectangular, but the shape can be affected by the surrounding environment and the street pattern.

A street pattern consisting of streets serves as the forming of the block pattern of a city area. Streets may also form spaces between blocks in urban areas, and the street connected to other streets form a network and street pattern. Street network pattern in an urban area is formed through a very long process and usually a continuation of previous patterns. Street pattern in a city is usually a grid pattern, either regular or irregular. A grid pattern is created from crossing and intersecting two lines or more parallel lines forming geometric patterns with regular spacing and producing regional blocks. A grid-shaped street pattern can be found in old cities and planned cities. Grid street patterns generally have good transport circulation making it easier for city residents to interact from one area of the city to another.

The intended buildings include the buildings for settlements and the buildings utilized to accommodate human activities; this infrastructure plays a vital role in forming network structure, street patterns, and public areas. Buildings form mass plots (single and blocks patterns) and open spaces. Buildings located on a plot can be transformed in their function, shape, or width. The buildings in the peri-urban area have the utilization characteristics of both urban and rural.

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1.2. Peri-urban area

Peri-urban is an important area in the city development cycle. This region experiences a very rapid transformation process from the rural stage to the urban stage to the urban stage both qualitatively (urban lifestyle) and quantitative (new residential zone) [5]. For this reason, this area can be defined as an area of dynamic change from land use, social, environmental aspects, and infrastructure [6].

The peri-urban area has an important role in the lives of future residents because the peri-urban area is an area between two regions, which clearly shows differences in environment conditions. Peri urban areas encompass a combination of rural characteristics and urban characteristics simultaneously [7]. Furthermore, the area is a zone with a mixture of urban and rural activities [8]. This is the case with land use [9], so that peri urban areas are a transition zone [10], where urban and rural activities are juxtaposed [11].

1.3. Centrifugal force

The growth of cities turns out to cover a variety of factors that are more complex than just agglomeration economies. Optimal city size theory defines the spatial equilibrium of economic activity as a result of the attraction between centripetal and centrifugal forces [12]. Centrifugal forces are the power of dispersion [13]; in the centrifugal force, a population movement and functions that originate from the inside of a region goes to the outer side [14], thus resulting a movement of activity between centers cities and suburbs [15]. This situation has triggered rapid physical development and expansion of suburban areas [16].

1.4. Centripetal force

Centripetal force refers to a force causing population movements from the suburbs to the city. In addition, centripetal forces, driven by agglomeration augmentation, are all forces that attract economic activity to urban areas [17,18]. Centripetal strength is a force that tends to produce an integration style that brings together various social, economic, cultural, and political activities from the periphery to the downtown area, which has positive and negative implications [19].

There are two kinds of forces that have contributed to forming the centripetal force; push and propelling forces. Push force is spatially associated with the origin region of movement, and propelling force is associated spatially with the destination area of the movement because the centripetal movement is opposed to centrifugal movement and the two forces play different roles [20]. Centrifugal and centripetal forces have similar implications in developing an activity center [15].

2. Methodology

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The method used in this research was qualitative-descriptive. ArcGis and Google Earth Pro were two main instruments used to analyze the physical appearance of space or morphology in the peri-urban area. Further, Microsoft Excel was used to perform tabulation and analysis of data derived from the questionnaires. The questionnaire, i.e., the research instrument, was used to identify the centrifugal and centripetal forces and the factors causing the occurrence of the two forces within the study area. The survey and observation were conducted to eliminate the sense of doubt over the uncertainty in certain objects of space physical appearance in the research location. All informants' names were written in pseudonyms and the informed consent was written.

2.1. The stage of determining analysis unit

The study used one or more units of analysis associated with urban morphology or morphological patterns of peri-urban areas. The morphological formation of the peri-urban area is strongly influenced by the social and

economic conditions and activities within the area. The analysis of the morphological pattern of the peri-urban area in this research was emphasized on building density, accessibility, and distance from downtown.

2.2. Preparation stage

The preparation stage of the research was started by studying and reviewing various literature as the references in conducting the research and the preparation of the research instruments (questionnaire). Following the previous process was an initial survey in several institutions to collect secondary data, such as the data on population numbers and density and people's livelihoods. The remote sensing imagery data were obtained from Google Earth Pro with the recording years of 2005 and 2015.

2.3. The stages of data processing and analysis

ArcGIS software was used to process the image data derived from Google Earth Pro with the recording year of 2005 and 2015, and then the coordinate correction process was determined via georeferencing. This process was followed by digitization steps to get the derived data (shapefile). The digitization process generated new data as the physical appearance of the image data recording. The mapping of the patterns and distribution of settlements in Kabila sub-district was grouped into three parts: first, the pattern and distribution of settlements in southern Kabila sub-district bordering Gorontalo City; second, the pattern and distribution of settlements within the area along the main road of Gorontalo City - Suwawa City (Sultan Botutihe street); third, the pattern and distribution of settlements within the sub-district of Kabila to the north that borders Gorontalo city. The mapping of the patterns and distribution of settlements in Telaga sub-district was grouped into two parts: first, the pattern and distribution of settlements in the village areas of Telaga sub-district bordering with Gorontalo city; second, the pattern and distribution of settlements within the regions along the main road of Gorontalo City - Limboto City (A.A WahabLimboto Road). The mapping results were overlaid to find out the pattern and trend of the development of settlement areas in Telaga and Kabila sub-districts. Furthermore, the comparative development of settlements in both regions was conducted because the two areas of study had different peri-urban characteristics.

2.4. Data interpretation and drawing conclusion

The research data on the morphology of peri-urban areas (Telaga and Kabila sub-districts) was presented in the form of spatial or digital maps that provided information on the pattern and trends of future peri-urban development. The data of the tabulation result from the questionnaires were analyzed using hierarchical process analysis (AHP) so that the dominant factors that influence the development of

morphology in the peri-urban area can be identified.

2.5. Ethics statement

All of the participants' names in this research were written in pseudonyms and the informed consent was in written. This research has obtained approval ethics from the ethical committee of Gorontalo State University.

3. Result and Discussion

3.1. An overview of study area

Geographically, Telaga sub-district is located at 1210,159" – 1230,32" West Latitude and 00,24" – 100,02" North Longitude, and Kabila sub-district lie at 0,30° North Latitude, 1,00° South Latitude and 121,00° East Longitude, 123,30° West Longitude. The area of Telaga and Kabila sub-districts is 58.44 km² and 193.45 km², respectively. There are 22,884 and 23,634 of people in these two sub-districts. The borders of the two peri-urban areas are presented in Table 1.

Table 1. The borders of Telaga and Kabila Sub-districts

| Study Area | Borders | Bordering with |
|---------------------|---------|--------------------------------------|
| Telaga sub-district | North | Telaga Biru sub-district |
| | East | Sipatana sub-district-Gorontalo city |
| | South | Tilango and Telaga Jaya sub-district |
| | West | Telaga Biru sub-district |
| Kabila sub-district | North | Tilongkabila sub-district |
| | East | Central Suwawa sub-district |
| | South | Botupingge sub-district |
| | West | Gorontalo city |

Source: BPS, 2016

In general, the two peri-urban areas have lowland areas. Telaga sub-district is slightly hilly in the northern region and fed by Bulango and Nanati rivers. Kabila sub-district is flown by Bone River, making the two peri-urban areas quite fertile. People's livelihoods in the study area were mostly in the agricultural sector. Table 2 provides information on the distance between the peri-urban areas and Gorontalo city, airport, and regency capitals from each study area.

Table 2. The distance of peri-urban areas (study area) to several capitals in Gorontalo Province

| No | Origin | Destination (km) |
|----|--------|------------------|
|----|--------|------------------|

| | | Gorontalo City | Limboto City | Jalaludd in Airport |
|---|--------------------------|------------------|--------------|---------------------|
| 1 | Telaga Jaya sub-district | 11 | 9 | 31 |
| | | Destination (km) | | |
| 2 | Kabila sub-district | Gorontalo City | Suwawa City | Jalaludd in Airport |
| | | 4,3 | 7 | 40 |

Source: Primary Data, 2017

3.2. Centrifugal force analysis

There were 11 factors of push and propelling forces that affect the development of the morphology of peri-urban areas in Telaga and Kabila sub-districts. Those factors involved: (1) smaller population compared to urban population (A); (2) low-dense settlements (B); (3) low rate of air, sound and water pollutions (C); (4) friendly inhabitants (D); (5) low crime rate (E); (6) less restrictive rules (F); (7) no traffic jam and traffic congestion (G); (8) low land prices and large areas (H); (9) cool air and tranquil atmosphere (I); (10) beautiful natural scenery (J); and (11) the guarantee of privacy (K).

Further, three push forces for the residents of Gorontalo City to live and move in the peri-urban area, i.e., high land prices at the city center, settlement density, and air, sound and water pollutions (Figure 1 and 2). On the other hand, the pulling forces for the residents of Gorontalo City to settle in the peri-urban areas are related to low land prices and vast land, low density of settlements, and cool air and calm atmosphere. The existing conditions in the peri-urban areas also attract developers in investing their capital to develop housing close to Gorontalo City.

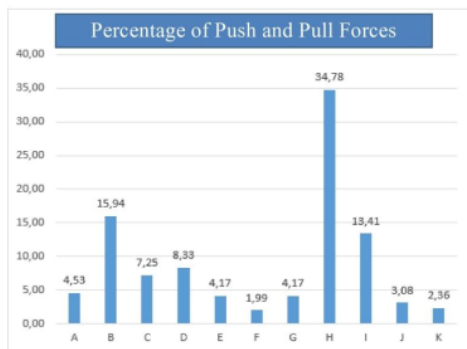


Figure 1. Centrifugal force: Percentage of push and pull forces (Telaga Sub-district)

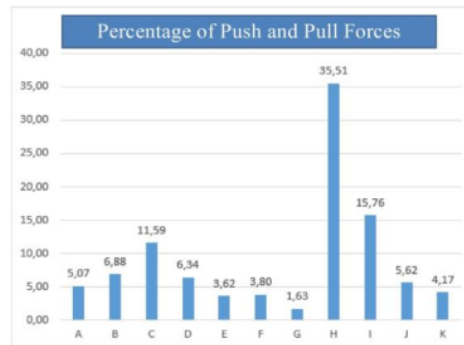


Figure 2. Centrifugal force: Percentage of push and pull forces (Kabila Sub-district)

3.3. Centripetal force analysis

The centripetal force analysis refers to the seven centripetal forces expressed [2]. The seven centripetal forces are: (1) the number of socio-economic facilities for life (A); (2) ensuring security (B); (3) high income (C); (4) high prestige (D); (5) high accessibility from the village (E); (6) the number of job opportunities (F); (7) close to the workplace (G).

The existence of centripetal movement for the residents in the peri-urban areas studied is supported by questionnaire data, where the productive age population (17 - 30 years) in the sub-districts of Telaga (60.87%) and Kabila (53.62%) daily travel using shuttle service as students, university students, private employees, traders, army or police, and informal workers or government officials (Figure 3 and 4). From the types of work, the commuters between Telaga and Kabila sub-districts had different characteristics. There were three characteristics of commuters in Telaga sub-district, namely civil servants (14.49%), entrepreneurs/traders (13.04%), and students (11.59%). The commuters in Kabila sub-district were students (13.04%), civil servants (11.59%), and private employees (10.14%). The difference between the two commuter characteristics in the peri-urban areas was influenced by the distance and accessibility of the peri-urban areas towards higher education, economic facilities, and government office facilities.

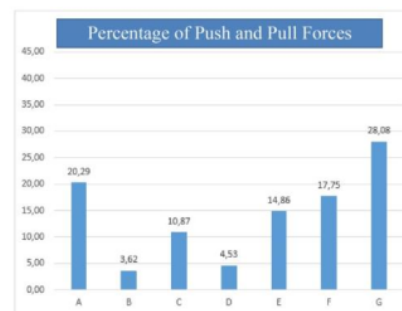


Figure 3. Centripetal force: Percentage of push and pull forces (Telaga sub-district)

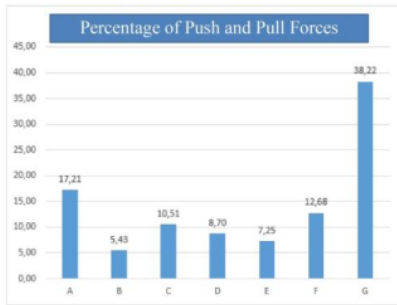


Figure 4. Centripetal force: Percentage of push and pull forces (Kabila sub-district)

3.4. Land use analysis

In 2005, the peri-urban area (Telaga sub-district) consisted of the plantation area of 463.12 ha, settlements of 242.41 ha, annual crop farming of 201.633, water bodies of 8.75 ha, and sports stadium of 2.97 ha. The land use in the peri-urban area (Kabila sub-district) in the same year consisted of rice field area of 620.48 ha, settlement of 334.75 ha, annual crops of 270.25 ha, plantation of 83.86 ha, and the water body of 36.55 ha.

The land use in Telaga and Kabila sub-districts in 2015 had changed. In Telaga sub-district, the plantation and agricultural areas of seasonal plants were changed into the residential areas of 29.15 ha and 20.03 ha, respectively. In Kabila sub-district, some 12s were converted into a residential area of 29.65 ha. In the two peri-urban areas, it appears that most of the agricultural areas were converted into the lands for settlement or urban areas. In Telaga sub-district, the function change of agricultural lands into housings was relatively more massive compared with that in Kabila sub-district.

The land use in 2005 and 2015 in the sub-districts of Telaga and Kabila signifies that the rural landscape dominated the ones of urban areas. In 2005, the land use in Telaga sub-district for urban areas was 27% (245.20 ha), and the remaining 73% (673.47 ha) was for non-urban lands (Figure 5). In 2015, the percentage of land use for urban areas was 32% (294.38 ha), signifying an increase by 5% (49.18 ha) and non-urban land by 68% (624.29 ha) (Figure 6). On one's hand, the percentage of land use in Kabila sub-district in 2005 was 25% (urban land, 334.75 ha) and 75% (non-urban land, 1011.14 ha) (Figure 7). In 2015, the composition of land use in Kabila sub-district experienced a change (urban land, 28%, or 380.34 ha) (Figure 8). The percentage of land use for urban areas was increased by 3% or 45.58 ha and by 21% for non-urban areas (965.56 Ha).

The high level of urban influence in the peri-urban area 5 Telaga sub-district correlates with the high accessibility in the peri-urban area. Telaga sub-district has the main road,

which is the arterial road connecting Gorontalo City as the National Activity Center (in Indonesian known as *Pusat Kegiatan Nasional*) with the other cities in Gorontalo and North Sulawesi Provinces.

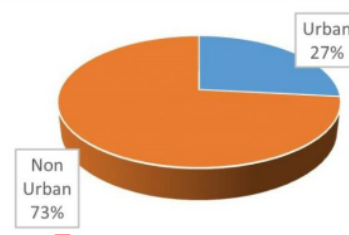


Figure 5. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2005

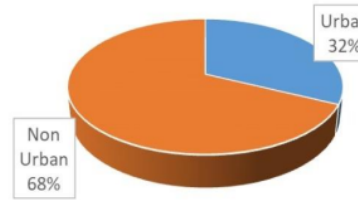


Figure 6. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2015

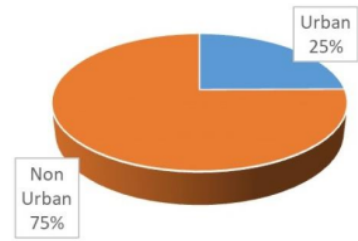


Figure 7. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2005

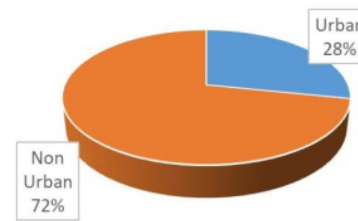


Figure 8. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

3.5. Settlement analysis

3

The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts. The first characteristic is the settlements along the arterial road (Jl. A.A. Wahab Limboto in Telaga sub-district and Sultan Botutihe Street in Kabila sub-district). Both roads have permanent building characteristics and modern architecture with a large yard with a paving block or concrete cover that can accommodate one or more houses to form a house group (in Gorontalo known as *ngala'a*) and a wall fence as a symbol of territory between *ngala'a*. The composition of the plant consists of ornamental flowers, such as garden croton, ashoka, Chinese evergreen, lily, and many more. Mango or jackfruit trees serve as protective plants and keep the microclimate, thus keeping the cool atmosphere of the yard [15], with a beautiful building arrangement. In *ngala'a*, there is a path to connect home, and it is useful to facilitate pedestrians in promoting communication with the neighbor in one *ngala'a*. Second, the settlements located far from arterial roads are semi-permanent and non-permanent buildings, simple building structures, traditional architectural features, and large yard. There is a garden on the left side with only coconut trees (monocultures) and vegetable plants on the right or backside of a house to meet daily needs. One can also find goat or chicken den at the back of the house for live stocks. There are also paths that reconnect low-density neighbors. Below is the structure of the settlements in the peri-urban area of Telaga and Kabila sub-districts (Figure 9).

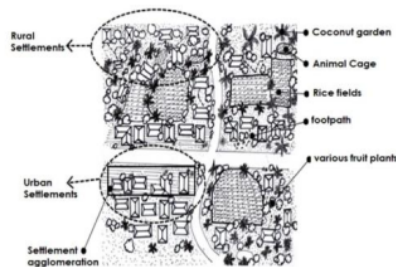


Figure 9. Settlement structure in peri-urban area of Gorontalo Province

3.6. Building use analysis

There are five types of building use in the peri-urban areas studied; residential houses, shop houses, stalls/ kiosks, informal businesses, and agriculture. The building in the peri-urban area of Telaga and Kabila sub-district has different characteristics. In Telaga sub-district, there were 37 respondents (54%) using their buildings for residential houses, 16 respondents (23%) for shop-houses, nine respondents (13%) for informal businesses (beauty salon/ barbershop and workshop), five respondents (7%) for kiosks, and two respondents (3%) for agricultural business (Fig.10). In Kabila sub-district, 34 respondents (49%) use their building for settlement purposes, 14 respondents (20%) for shop-houses, 12 respondents (18%) for kiosks, six

respondents (9%) for informal business (beauty salon/ barbershop, and workshop), and three respondents (4%) for agricultural businesses (Fig.11). The presence of new buildings has had a major influence on the development of the city's morphology, making it rapidly abandon its original character as the city was originally built.

The building for residential houses, shop-houses and informal businesses in Telaga sub-district outnumbers those in Kabila sub-district. On one's hand, the building for stalls/ kiosks and agricultural businesses in Telaga sub-district are fewer compared to those in Kabila sub-district. This is due to the fact that Telaga sub-district is, although considered a small town, more prominent than that of Kabila sub-district. On top of that, the physical development of the peri-urban area of Telaga sub-district is heavily influenced by the transportation activities in Telaga bus station. The station serves as the inter-city and inter-regency bus station in Gorontalo Province, thus resulting in diverse activities around the bus station and livelihoods of the population. Recently, the peri-urban area (Telaga sub-district) has become one of the nodal points in Gorontalo Regency and transformed into a newly developing area that attracts investors.

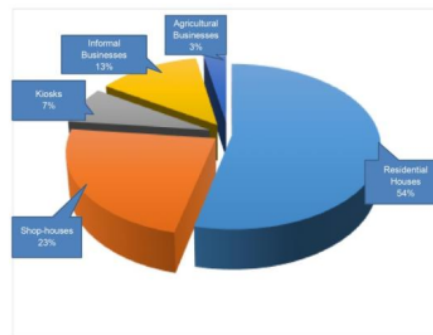


Figure 10. Building uses in peri-urban area (Telaga Sub-District)

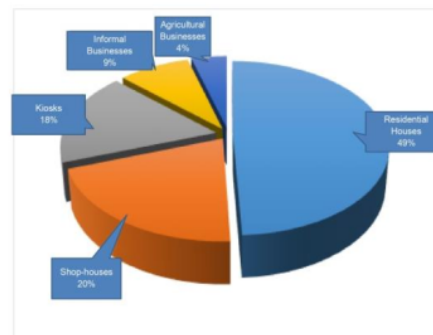


Figure 11. Building uses in peri-urban area (Kabila Sub-District)

In the peri-urban area (Kabila sub-district), the livelihood of the residents is relatively homogenous. The volume of

average traffic in the area, particularly on the road of Sultan Botutihe that connects the sub-districts of Kabila and Buludawa (Suwawa sub-district), has decreased and the orientation of traffic movement had changed to the northern area of Bone Bolango regency. It is due to the change of the government center of Bone Bolango Regency, which initially from Suwawasub-district to Tilongkabila sub-district. Besides, the office facilities of the Provincial Government of Gorontalo was relocated to the northern area of Bone Bolango Regency, Tapa sub-district. This relocation contributes to the preference choosing the northern road for official administration purposes in Bone Bolango Regency and the Government of Gorontalo province.

3.7. Street pattern and circulation analysis

The roads in the sub-districts of Telaga and Kabila are relatively in good condition, and they also have good transportation circulation. Consequently, various modes of transportation especially *bentor* (motorized rickshaw), can provide their services to passengers in every part of the settlements. The transportation modes like *angkot* (local minibus for public transportation) and *bentor* can reach the villages in the two peri-urban areas. The existence of quality transportation facilities and infrastructures strongly supports the mobilization and activities of the population to be commuters and reside in the peri-urban area. The farmer road program has changed the landscape of rural areas in both peri-urban areas; this is seen in the improvement of roads near farms. Initially, access to farms is mostly dirt roads. However, the dirt roads are rarely found recently. The existing condition is also similar to the condition of roads in rural areas. However, good road conditions in the sub-districts Telaga and Kabila have no traffic signs and road markings. Traffic signs and road markings can only be seen in arterial roads.

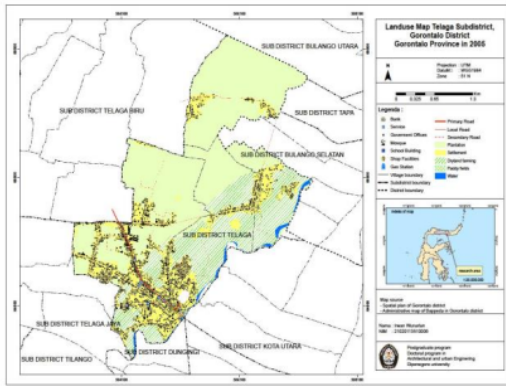
The livelihoods of people in Kabila sub-district tend to be homogeneous. The average daily traffic or traffic volume in this region, especially the Jalan Sultan Botutihe, i.e., a road connecting Kabila and Buludawa sub-districts (Suwawa sub-district) has decreased. Further, the orientation of traffic movement has shifted to the northern part of Bone Bolango County. This is allegedly due to the shift of the central government area of Bone Bolango Regency. The central government was initially located in Suwawa sub-district (the office was also relocated to Tilongkabila sub-district). In addition, the Gorontalo Provincial Government office facilities are gradually relocated to the northern part of Bone Bolango Regency, specifically in Tapa subdistrict. Another factor causing a decrease in the traffic volume at Jalan Botutihe is the preference of the road users to pass the northern areas for government administration purposes. This situation also affects the physical development of space in Kabila sub-district.

3.8. Analysis of peri-urban area morphology

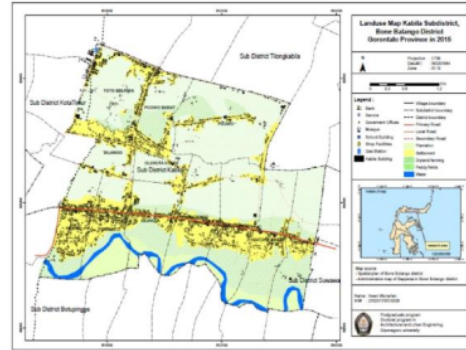
Land use is among the factors to consider in analyzing morphological types in peri urban areas. This factor also functions to explain the spatial distribution of residential mobility [18]. Characteristics of the peri-urban area of Telaga and Kabila sub-districts depict the quality of the rural areas and urban areas. Both sub-districts areas are growing due to contributions from the capital Gorontalo city. Still, agricultural activities still dominate in the two peri-urban areas studied. The analysis shows that the pattern of roads in urban units is classified as linear and integrated with a grid road system. When viewed from the hierarchy level, land use for services and trade activities located around the main road (A.A. Wahab and Sultan Botutihe Streets) is the highest hierarchy. The pattern of land use from the peri-urban area in Telaga sub-district is octopus/star-shaped (a combination of concentric pattern and linear). Meanwhile, the land use pattern of peri urban area in Kabila sub-district is linear pattern (southern part) and leapfrog (northern part). The initial developmental patterns of these two peri-urban areas studied. The development is horizontal in its character, and the road planning implements vertical development. This situation is determined by the condition of the density of the buildings, the price of the land compared to other parts of the city. Government Regulation No. 12 of 2012 and Provincial Regulation No. 1 of 2014 on the protection of sustainable agricultural land on incentives ensure the sustainability of agricultural land.

The policies previously mentioned are intended to limit the expansion of urban space and protection against land sales [21]. Land sale also causes the loss of agricultural land [22], loss of rural areas, especially in the main urban areas [23], and environmental degradation [24] vulnerability in unplanned settlements areas in peri-urban areas [25]. Currently, transport routes from all directions are focused on this zone, meaning that Telaga sub-district has a high accessibility level, which contributes to the urban development in peri-urban areas.

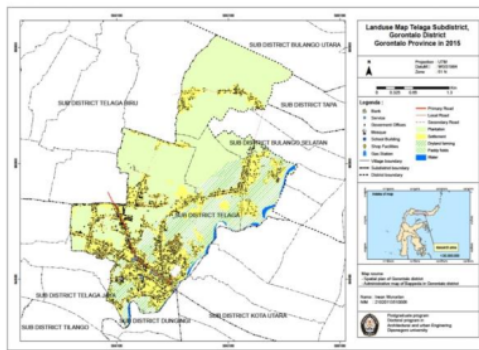
In 2005, the settlement or the development area in Telaga sub-district reached 242.41 ha with building density level reaching 0.078 (Fig.12), and in Kabila sub-district, the area was 334.75 ha with the density level of 0.056 (Fig.13). There was a change of settlement land as development area in Telaga sub-district (291.59 ha) with the building density level of 0.12 (Fig.14), and in Kabila sub-district the development area was 380.34 ha with density level reaches 0.07 (Fig.15). In general, the development of the land was well established in both sub-districts, which directly adjacent to Gorontalo City. This indicates that the peri urban area is heavily influenced by the main city that is the City of Gorontalo. Thus, it cannot be denied that the development of the two peri-urban areas has implications for changes in the appearance of the two sub-districts.



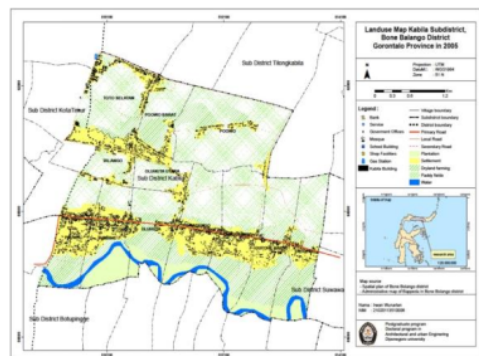
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Figure 12. Map of land use and built use in Telaga Sub-District, 2005



8
Figure 15 Map of land use and built use in Kabila Sub-District, 2015. 18



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Figure 13. Map of land use and built use in Telaga Sub-District, 2015



8
Figure 14. Map of land use and built use in Kabila Sub-District, 2005

4. Conclusion

Based on the research results and discussion, it can be concluded that the development of the peri-urban area in Telaga District is heavily influenced by the accessibility of the area. Further, the location is very strategic (it is located in the middle of two developed cities in Gorontalo Province, i.e., Gorontalo city and Limboto city). The existence of primary arterial roads that cross the district serves as the main access to main facilities, such as Jalaludin Airport. Kabila sub-district is the area receiving significant impact because of the proximity of the distance between Kabila sub-district with the city of Gorontalo.

Further, the morphological form in the two peri-urban areas studied is significantly influenced by Gorontalo city. The morphological indicators of peri-urban areas (WPU) in Telaga and Kabila sub-districts can be described as follows: (a) The utilization of the land within ten years for urban development purposes in Telaga and Kabila sub-districts was increased by 5% (49.18 ha) and 3% (45.58 ha), respectively. (b) The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts: first, the settlements in the arterial road form the house group (*ngala'a*) and the wall fence as a symbol of the territory between *ngala'a*. Secondly, the settlement located far from the arterial road with the characteristics of semi-permanent and non-permanent buildings, simple building structures, traditional architectural styles, and low building densities. (c) Characteristics of building use for tertiary sectors (trade and service) in Telaga sub-district are more common than Kabila sub-district. In addition, stalls and agricultural business buildings (primary sector) in Telaga sub-district are not that common compared to Kabila sub-district. (d) Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Furthermore, Telaga and Kabila sub-districts are two

peri-urban areas that tend to be banded. Settlements and buildings are spread out in small groups and tend not to have regular urban spatial patterns. The spatial pattern of the city still has a connection with rural traditions and is traditional in nature.

5. Suggestion

It is necessary to carry out further research related to the role of transportation changes in road patterns and circulation orientation in peri urban areas as it greatly influences the physical morphology of cities. Meanwhile, land use as built-up land should apply the concept of vertical and interstitial development, in which existing buildings must comply with detailed local spatial plans so that agricultural land can be maintained and remains sustainable.

The development of the city will have an impact on surrounding area, especially the suburbs (peri urban). Peri urban areas can be identified based on the characteristics of peri urban areas, which will then look at the morphological components and identify factors that influence the shape of the city. This is due to the availability of green open space in the form of rice fields and dry fields in peri urban areas.

The novelty of this study is to reveal the influence of community solidarity on the development of urban morphological elements. Therefore, the results of this study can be used as a basis for the development of further research that refers to the development of urban morphology. The method in this study is an appropriate way to express the influence of physical aspects and socio-cultural aspects on urban development. At the practitioner level, there should be an understanding on the main aspects that must be considered in settlement planning to form an integrated spatial arrangement. As a result, there will be a creation of communal spaces that are integrated between the environment and social culture of urban society.

6. Recommendation

Based on the findings, this study provides several recommendations to be followed up by the government and subsequent researchers.

Firstly, the existing condition of Kabila Subdistrict must be maintained to maintain the microclimate and natural balance in the form of food and water supply by making measured and controlled land use so as not to change the face of the city. Thus, it is necessary to find a grand-design of a sustainable city.

Secondly, natural population growth and migration processes tend to accelerate urban development which can increase population density and the number of buildings in both peri-urban areas.

Thirdly, Telaga Subdistrict is changing more quickly when compared to Kabila Subdistrict or the urban appearance in the peri-urban areas of Telaga Subdistrict is

more visible than Kabila Subdistrict. This indicates that the influence of urbanization on morphology in the peri urban area in Telaga District is higher when compared to the peri-urban area in Kabila District. Changes in Telaga Subdistrict can be followed up by conducting further research on the existence of Telaga Subdistrict between the two main urban centers, including Limboto City and Gorontalo City by looking at changes in people's socio-cultural behavior, economy, life style, transportation circulation and city characteristics.

Acknowledgements

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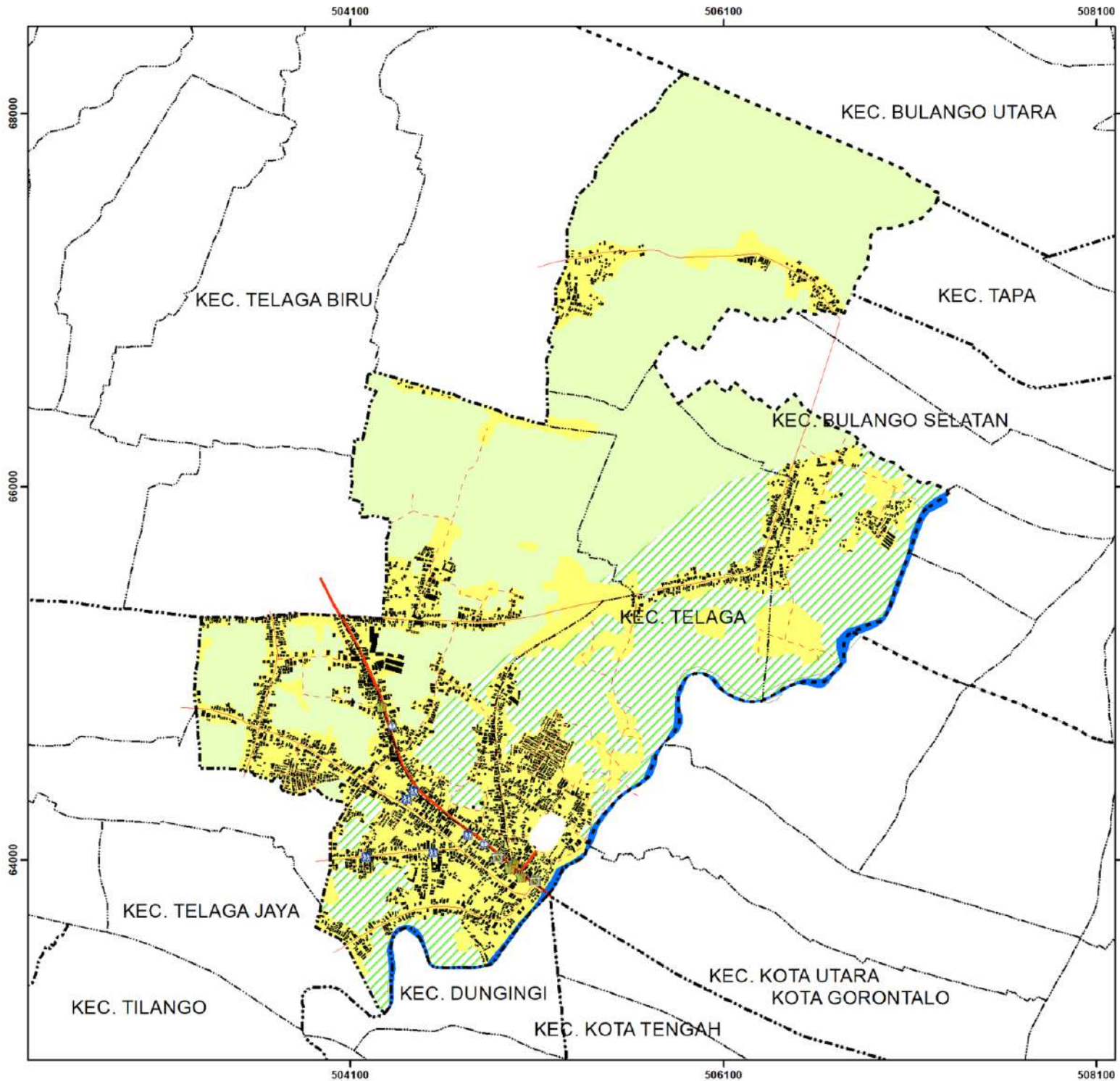
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LANDUSE MAP

Telaga Sub-district, Gorontalo Regency, Gorontalo Province in 2005

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Projection : UTM
Datum : WGS1984
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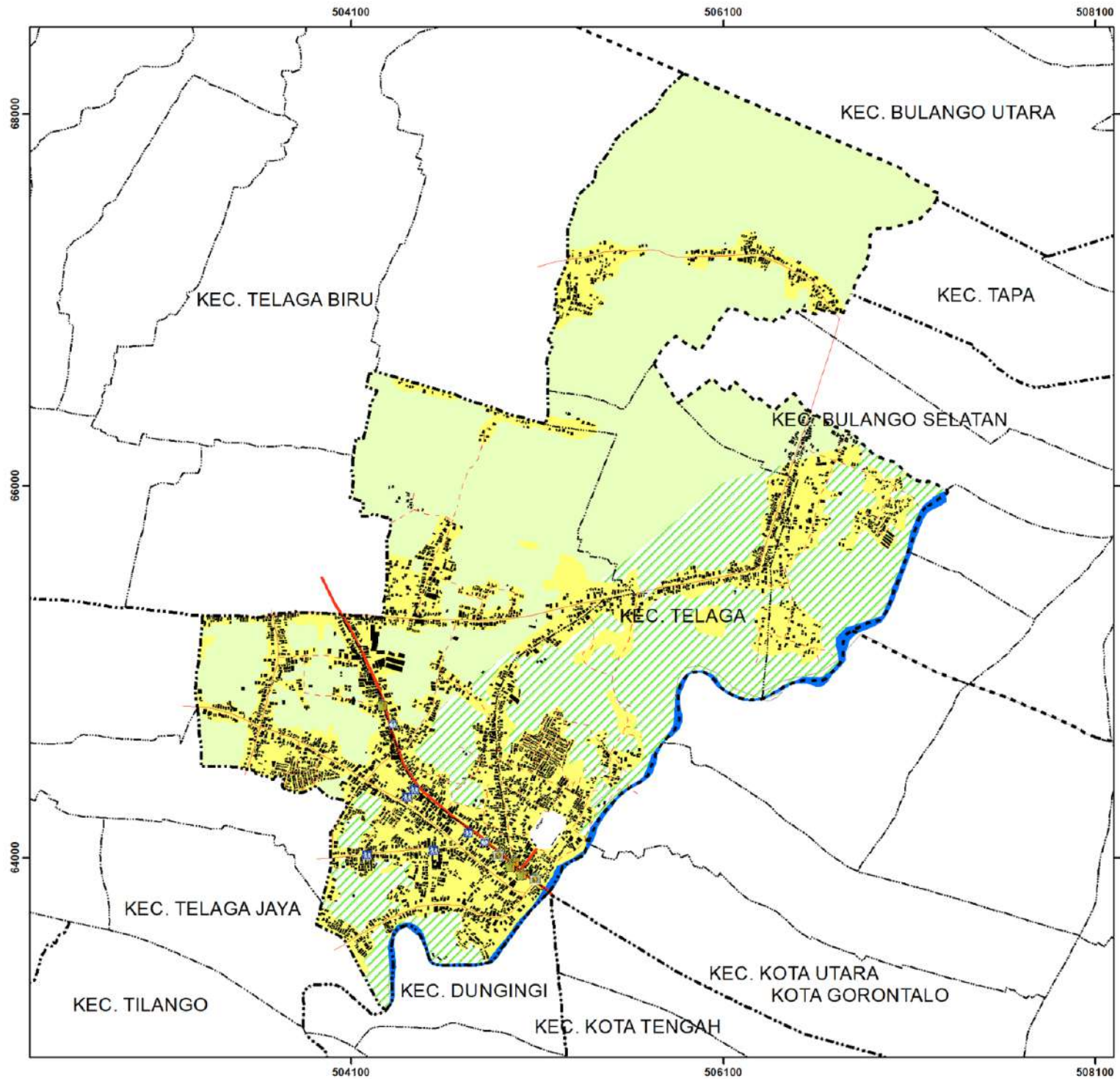
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Map Index

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Map Source:
RTRW of Bone Bolango Regency
Administration Map of BAPPEDA Bone Bolango Regency
Google Earth



LANDUSE MAP

Telaga Sub-district, Gorontalo Regency, Gorontalo Province in 2015

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Projection : UTM
Datum : WGS1984
Zone : 51 N

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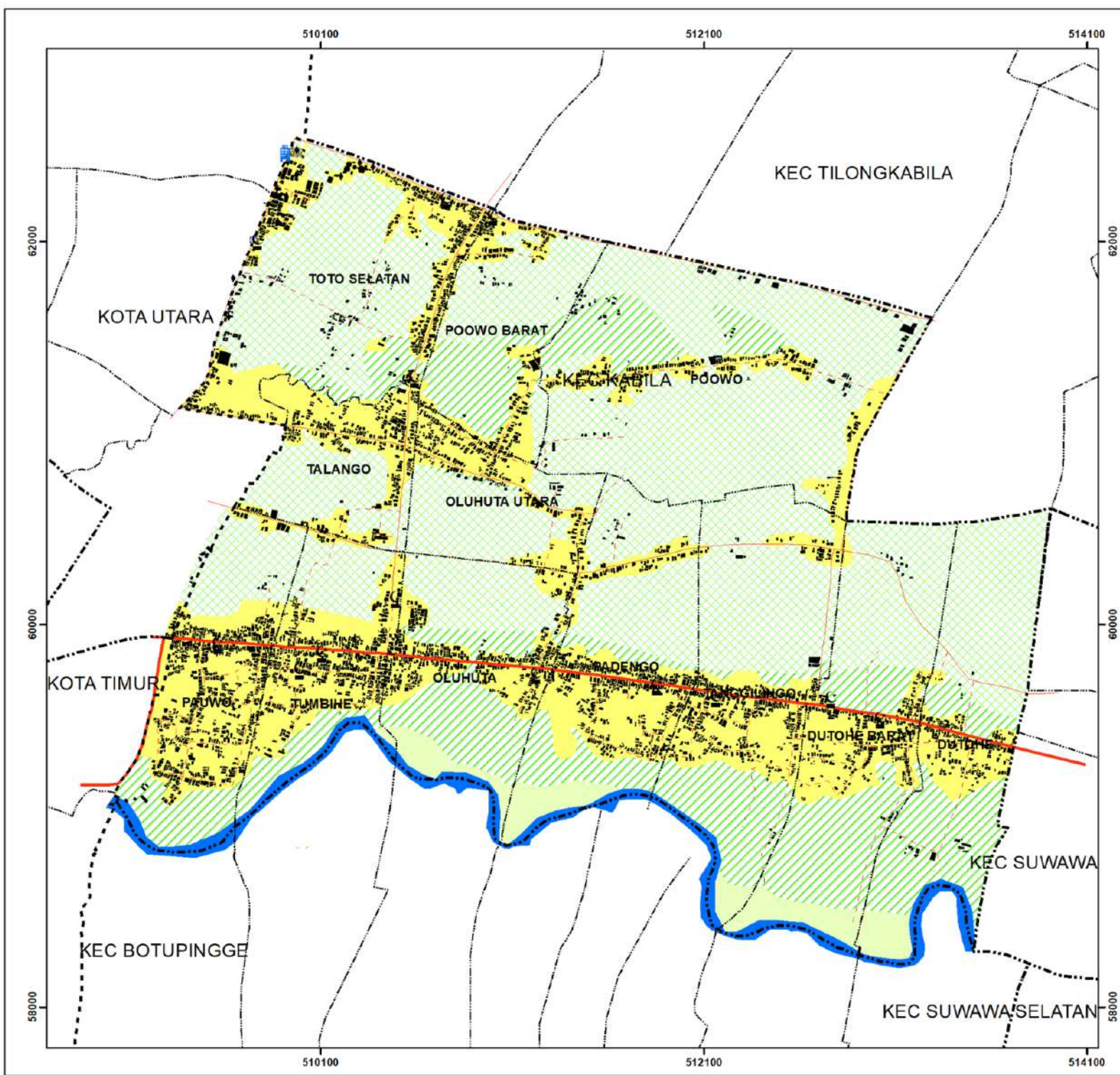
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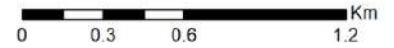
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RTRW of Bone Bolango Regency
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LANDUSE MAP

Kabila Sub-district, Bone Bolango Regency, Gorontalo Province in 2015

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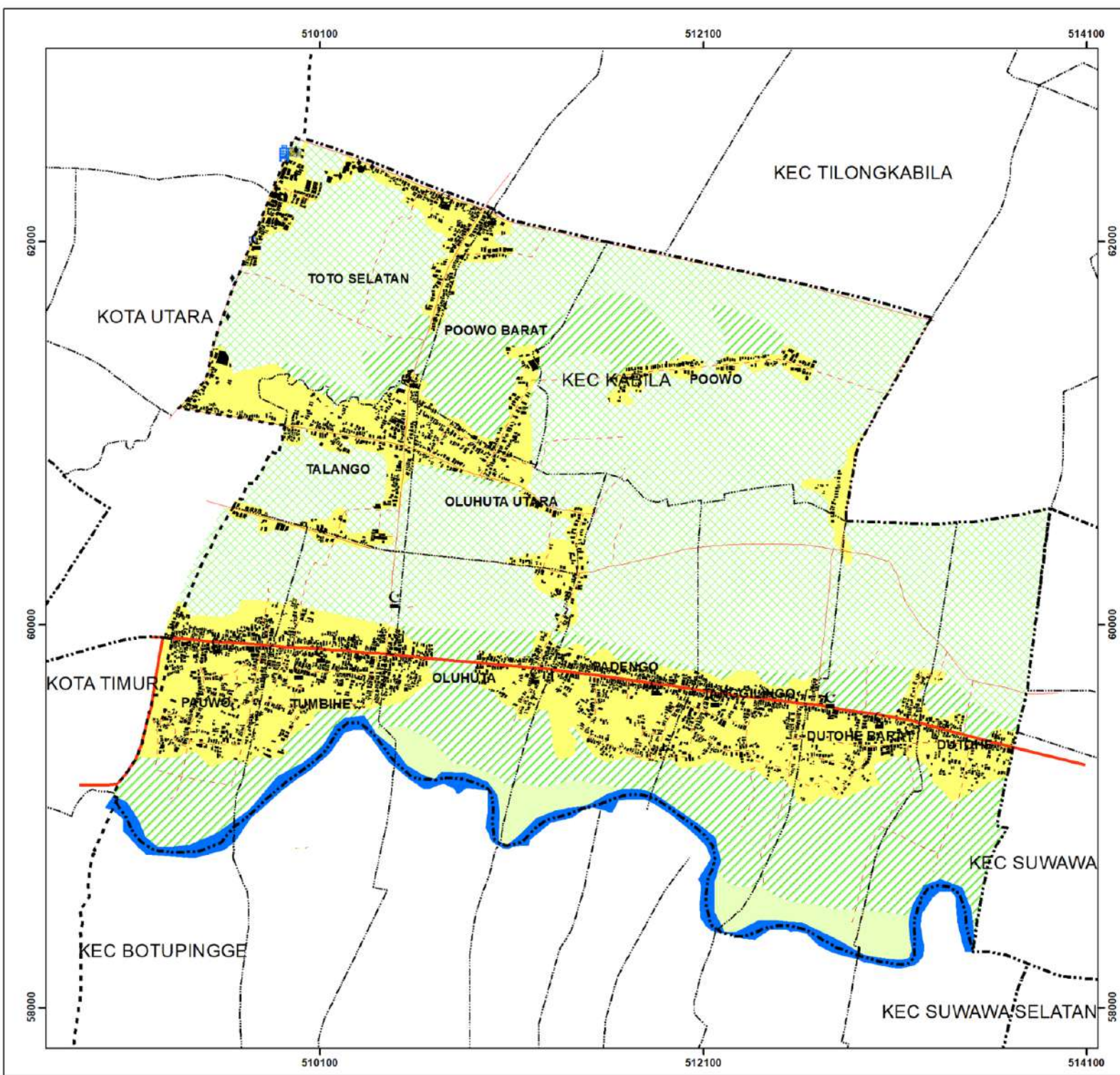


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| Bank | Primary Road |
| Service | Local Road |
| Government Offices | Secondary Road |
| Mosque | Building |
| Education | Plantation Area |
| Trading | Settlement Area |
| Refueling Stations | Seasonal Dry Farming |
| Village Boundary | Rice Field |
| Sub-district Boundary | Water Tug |
| Regency Boundary | |



Map Source:
 RTRW of Bone Bolango Regency
 Administration Map of BAPPEDA Bone Bolango Regency
 Google Earth



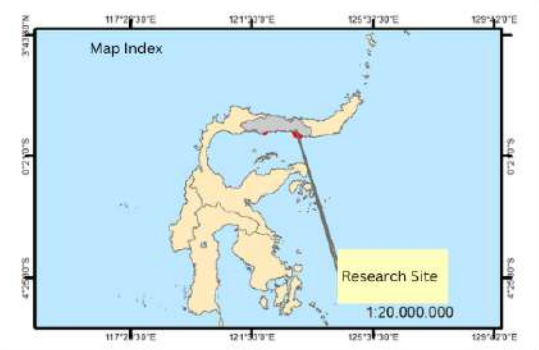
LANDUSE MAP

Kabila Sub-district, Bone Bolango Regency, Gorontalo Province in 2005

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 Datum : WGS1984
 Zone : 51 N



- Legend :**
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|--------------------|-----------------------|
| Village Boundary | Sub-district Boundary |
| Bank | Regency Boundary |
| Service | Primary Road |
| Government Offices | Local Road |
| Mosque | Secondary Road |
| Education | Plantation Area |
| Trading | Settlement Area |
| Refueling Stations | Seasonal Dry Farming |
| Building | Rice Field |
| | Water Tug |



Map Source:
 RTRW of Bone Bolango Regency
 Administration Map of BAPPEDA Bone Bolango Regency
 Google Earth

Article Acceptance

(25 Maret 2023)



Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Acceptance Letter & Advice of Payment (ID:14828167)-Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

Anthony Robinson <revision.hrpub@gmail.com>
To: Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Sat, Mar 25, 2023 at 3:29 PM

Dear Irwan Wunarlan,

Your paper has been accepted for publication. Herewith attached is the Acceptance Letter.

Please download the publication agreement (http://www.hrpub.org/download/HRPUB_Publication_Agreement2023.pdf) and fill in the authors' names, manuscript title, manuscript ID and signature, then send a scanned version to us.

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Acceptance Letter

Dear Irwan Wunarlan,

Congratulations! As a result of the reviews and revisions, we are pleased to inform you that your following paper has been accepted for publication.

Paper Title: Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

Paper ID: 14828167

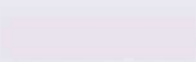
Contributor (s): Irwan Wunarlan, Sugiono Soetomo, Iwan Rudiarto

It is scheduled for publication on Civil Engineering and Architecture, Vol 11, No 4.

The publication fee \$ 480 should be paid within 2 weeks.

Should you have any questions, please feel free to let us know by quoting your **Paper ID** in any future inquiries.

Best wishes,



John Thompson

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Article Proofreading

(10 Mei 2023)



Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Proof Reading before Publication (ID:14828167)-Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

Anthony Robinson <revision.hrpub@gmail.com>
To: Irwan Wunarlan <irwan.wunarlan001@gmail.com>

Wed, May 10, 2023 at 8:25 PM

Dear Irwan Wunarlan,

Your manuscript has been accepted for publication. Authors are given a chance of checking the attached manuscript before publication. If we don't receive any confirmation or feedback of the manuscript before 05/13/2023, it will be regarded as the final version.


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Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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Abstract As two areas directly adjacent to Gorontalo City, the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency) are the center of regional growth. The study aimed to examine the physical development of two sub-districts, Telaga and Kabila, since the sub-districts previously mentioned have different regional characteristics and different physical morphology development influenced by Gorontalo city. That the two sub-districts can be viewed as a peri-urban area of Gorontalo city is a fascinating topic to comprehend the peri-urban area. The stages of this qualitative descriptive research consisted of a preliminary survey and observation, distributing questionnaires, collecting data, processing data, data analysis, and data interpretation. Over the last ten years, urban land use has increased in both Telaga and Kabila sub-district by 5% (49.18 ha) and 3% (45.58 ha), respectively. Agropolis activities still dominated the two peri-urban areas. The pattern of land use in the Sub-District of Telaga was the pattern of octopus, while that of Kabila sub-district was a linear pattern (southern part) and frog jump (northern part). Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Keywords City Morphology, Sub-District, Land, Peri-Urban, Physical Development

1. Introduction

The suburban areas outside the administrative area of Gorontalo City are the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency). The two areas are directly adjacent to Gorontalo City, which serves as the center of regional growth. The social-economic situation of the two cities is very dominant with urban nuance in that of Gorontalo city. Scientifically, determining the border determination of the peri-urban area is not an easy task. The outermost area of peri-urban is a place where people still want to commute to work/ do activities in a city [1].

The location of the sub-district of Kabila is on the east side of Gorontalo city. The sub-district is one of the entrances to Suwawa City in Bone Bolango Regency. On top of that, the area, which connects Suwawa City and Gorontalo City, has quite a high traffic flow. Telaga City, as a city of Telaga sub-district, is located in the western part of Gorontalo city and one of the access to the area of Limboto City. Limboto City and Suwawa City have yet significantly contributed to the development of Telaga and Kabila sub-district. In relation to the physical development of the two sub-districts, the effect of Gorontalo city is very dominant in determining the direction of the physical development of the region because the location of the two sub-districts is in the suburb of Gorontalo city with their excellent accessibility.

The physical development of Telaga and Kabila sub-districts as a result of the physical development of Gorontalo City to the outer part of its administrative area is highly influenced by various factors previously discussed in the above paragraph. ~~The~~ ~~These~~ factors help contribute to the form and morphology of the city. ~~Morphology~~ ~~The morphology~~ of a city is not only limited to analysis of the form of the city or the factors that influence the form of the city [2]. The phenomenon is an intriguing topic to study because the two sub-districts have different regional characteristics and different development of the physical morphology of the city influenced by Gorontalo City. The two sub-districts can be regarded as the peri-urban of Gorontalo city, so it is fascinating to be a study material in comprehending peri-urban area.

1.1. City Morphology

There are several morphological indicators of a city; those involve land use, plot, the layout of streets, and buildings [3]. The four indicators are described as follows [4]:

- (1) Land use, as one of the indicators of city morphology, has a temporary nature because its functions are easy to change. Land use can be divided into two kinds of utilization, namely urban land and non-urban land. Urban land is oriented to secondary and tertiary sectors (trade and services), and non-urban land is oriented to the primary sector (agriculture).
- (2) The plot is a plot of a certain size for housing. The arrangement of plots forms blocks. Plot and block are the initial elements of city formation. Urban plots are usually arranged and face the environmental street, while service street is located between one plot and another plot. In the development of a city, the ownership of plots can be transferred and traded. This may cause changes in the width. Generally, a plot is rectangular, but the shape can be affected by the surrounding environment and the street pattern.

A street pattern consisting of streets serves as the forming of the block pattern of a city area. Streets may also form spaces between blocks in urban areas, and the street connected to other streets ~~form~~ ~~forms~~ a network and street pattern. Street network pattern in an urban area is formed through a very long process and ~~are~~ usually a continuation of previous patterns. ~~Street~~ ~~The street~~ pattern in a city is usually a grid pattern, either regular or irregular. A grid pattern is created ~~from~~ ~~by~~ crossing and intersecting two lines or more parallel lines forming geometric patterns with regular spacing and producing regional blocks. A grid-shaped street pattern can be found in old cities and planned cities. Grid street patterns generally have good transport circulation making it easier for city residents to interact from one area of the city to another.

The intended buildings include the buildings for settlements and the buildings utilized to accommodate human activities; this infrastructure plays a vital role in

forming network ~~structure~~ ~~structures~~, street patterns, and public areas. Buildings form mass plots (single and ~~blocks~~ ~~block~~ patterns) and open spaces. Buildings located on a plot can be transformed in their function, shape, or width. The buildings in the peri-urban area have the utilization characteristics of both urban and rural.

1.2. Peri-Urban Area

Peri-urban is an important area in the city development cycle. This region experiences a very rapid transformation process from the rural stage to the urban stage to the urban stage both qualitatively (urban lifestyle) and quantitative (new residential zone) [5]. For this reason, this area can be defined as an area of dynamic change from land use, social, environmental aspects, and infrastructure [6].

The peri-urban area has an important role in the lives of future residents because the peri-urban area is an area between two regions, which clearly shows differences in environmental conditions. Peri urban areas encompass a combination of rural characteristics and urban characteristics simultaneously [7]. Furthermore, the area is a zone with a mixture of urban and rural activities [8]. This is the case with land use [9]; so that peri urban areas are a transition zone [10], where urban and rural activities are juxtaposed [11].

1.3. Centrifugal Force

The growth of cities turns out to cover a variety of factors that are more complex than just agglomeration economies. Optimal city size theory defines the spatial equilibrium of economic activity as a result of the attraction between centripetal and centrifugal forces [12]. Centrifugal forces are the power of dispersion [13]; in the centrifugal force, a population movement and functions that originate from the inside of a region ~~goes~~ ~~go~~ to the outer side [14], thus resulting ~~in~~ a movement of activity between centers cities and suburbs [15]. This situation has triggered rapid physical development and expansion of suburban areas [16].

1.4. Centripetal Force

Centripetal force refers to a force causing population movements from the suburbs to the city. In addition, centripetal forces, driven by agglomeration augmentation, are all forces that attract economic activity to urban areas [17,18]. Centripetal strength is a force that tends to produce an integration style that brings together various social, economic, cultural, and political activities from the periphery to the downtown area, which has positive and negative implications [19].

There are two kinds of forces that have contributed to forming the centripetal force; push and propelling forces. Push force is spatially associated with the origin region of movement, and propelling force is associated spatially with

the destination area of the movement because the centripetal movement is opposed to centrifugal movement and the two forces play different roles [20]. Centrifugal and centripetal forces have similar implications in developing an activity center [15].

2. Methodology

The method used in this research was qualitative-descriptive. ArcGis and Google Earth Pro were two main instruments used to analyze the physical appearance of space or morphology in the peri-urban area. Further, Microsoft Excel was used to perform tabulation and analysis of data derived from the questionnaires. The questionnaire, i.e., the research instrument, was used to identify the centrifugal and centripetal forces and the factors causing the occurrence of the two forces within the study area. The survey and observation were conducted to eliminate the sense of doubt over the uncertainty in certain objects of ~~space~~ space's physical appearance in the research location. All informants' names were written in pseudonyms and the informed consent was written.

2.1. The Stage of Determining Analysis Unit

The study used one or more units of analysis associated with urban morphology or morphological patterns of peri-urban areas. The morphological formation of the peri-urban area is strongly influenced by the social and economic conditions and activities within the area. The analysis of the morphological pattern of the peri-urban area in this research ~~was~~ emphasized on building density, accessibility, and distance from downtown.

2.2. Preparation Stage

The preparation stage of the research ~~was~~ started by studying and reviewing various literature as the references in conducting the research and the preparation of the research instruments (questionnaire). Following the previous process was an initial survey in several institutions to collect secondary data, such as the data on population numbers and density and people's livelihoods. The remote sensing imagery data were obtained from Google Earth Pro with the recording years of 2005 and 2015.

2.3. The Stages of Data Processing and Analysis

ArcGis software was used to process the image data derived from Google Earth Pro with the recording year of 2005 and 2015, and then the coordinate correction process was determined via georeferencing. This process was followed by digitization steps to get the derived data (shapefile). The digitization process generated new data as

the physical appearance of the image data recording. The mapping of the patterns and distribution of settlements in Kabila sub-district was grouped into three parts: first, the pattern and distribution of settlements in southern Kabila sub-district bordering Gorontalo City; second, the pattern and distribution of settlements within the area along the main road of Gorontalo City - Suwawa City (Sultan Botutihe street); third, the pattern and distribution of settlements within the sub-district of Kabila to the north that borders Gorontalo city. The mapping of the patterns and distribution of settlements in Telaga sub-district was grouped into two parts: first, the pattern and distribution of settlements in the village areas of Telaga sub-district bordering ~~with~~ Gorontalo city; second, the pattern and distribution of settlements within the regions along the main road of Gorontalo City - Limboto City (A.A WahabLimboto Road). The mapping results were overlaid to find out the pattern and trend of the development of settlement areas in Telaga and Kabila sub-districts. Furthermore, the comparative development of settlements in both regions was conducted because the two areas of study had different peri-urban characteristics.

2.4. Data Interpretation and Drawing Conclusion

The research data on the morphology of peri-urban areas (Telaga and Kabila sub-districts) was presented in the form of spatial or digital maps that provided information on the pattern and trends of future peri-urban development. The data of the tabulation result from the questionnaires were analyzed using hierarchical process analysis (AHP) so that the dominant factors that influence the development of morphology in the peri-urban area can be identified.

2.5. Ethics Statement

All of the participants' names in this research were written in pseudonyms and the informed consent was ~~in~~ written. This research has obtained approval ethics from the ethical committee of Gorontalo State University.

3. Result and Discussion

3.1. An Overview of Study Area

Geographically, Telaga sub-district is located at 1210,159" – 1230, 32" West Latitude and 00,24" – 100,02" North Longitude, and Kabila sub-district lie at 0,30° North Latitude, 1,00° South Latitude and 121,00° East Longitude, 123,30° West Longitude. The area of Telaga and Kabila sub-districts is 58.44 km² and 193.45 km², respectively. There are 22,884 and 23,634 of people in these two sub-districts. The borders of the two peri-urban areas are presented in Table 1.

Table 1. The borders of Telaga and Kabila Sub-districts

| Study Area | Borders | Bordering with |
|---------------------|---------|--------------------------------------|
| Telaga sub-district | North | Telaga Biru sub-district |
| | East | Sipatana sub-district-Gorontalo city |
| | South | Tilango and Telaga Jaya sub-district |
| | West | Telaga Biru sub-district |
| Kabila sub-district | North | Tilongkabila sub-district |
| | East | Central Suwawa sub-district |
| | South | Botupingge sub-district |
| | West | Gorontalo city |

Source: BPS, 2016

In general, the two peri-urban areas have lowland areas. Telaga sub-district is slightly hilly in the northern region and fed by Bulango and Nanati rivers. Kabila sub-district is flown by Bone River, making the two peri-urban areas quite fertile. People's livelihoods in the study area were mostly in the agricultural sector. Table 2 provides information on the distance between the peri-urban areas and Gorontalo city, airport, and regency capitals from each study area.

Table 2. The distance of peri-urban areas (study area) to several capitals in Gorontalo Province

| No. | Origin | Destination (km) | | |
|-----|--------------------------|------------------|--------------|--------------------|
| | | Gorontalo City | Limboto City | Jalaluddin Airport |
| 1 | Telaga Jaya sub-district | 11 | 9 | 31 |
| | | Destination (km) | | |
| 2 | Kabila sub-district | Gorontalo City | Suwawa City | Jalaluddin Airport |
| | | 4,3 | 7 | 40 |

Source: Primary Data, 2017

3.2. Centrifugal Force Analysis

There were 11 factors of push and propelling forces that affect the development of the morphology of peri-urban areas in Telaga and Kabila sub-districts. Those factors involved: (1) smaller population compared to the urban population (A); (2) low-dense settlements (B); (3) low rate

of air, sound and water pollutions (C); (4) friendly inhabitants (D); (5) low crime rate (E); (6) less restrictive rules (F); (7) no traffic jam and traffic congestion (G); (8) low land prices and large areas (H); (9) cool air and tranquil atmosphere (I); (10) beautiful natural scenery (J); and (11) the guarantee of privacy (K).

Further, three push forces for the residents of Gorontalo City to live and move in the peri-urban area, i.e., high land prices at the city center, settlement density, and air, sound and water pollutions (Figure-Figures 1 and 2). On the other hand, the propelling forces for the residents of Gorontalo City to settle in the peri-urban areas are related to low land prices and vast land, low density of settlements, and cool air and calm atmosphere. The existing conditions in the peri-urban areas also attract developers in investing their capital to develop housing close to Gorontalo City.

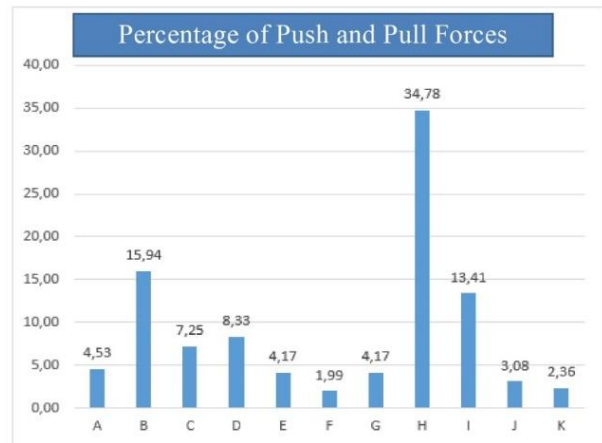


Figure 1. Centrifugal force: Percentage of push and pull forces (Telaga Sub-district)

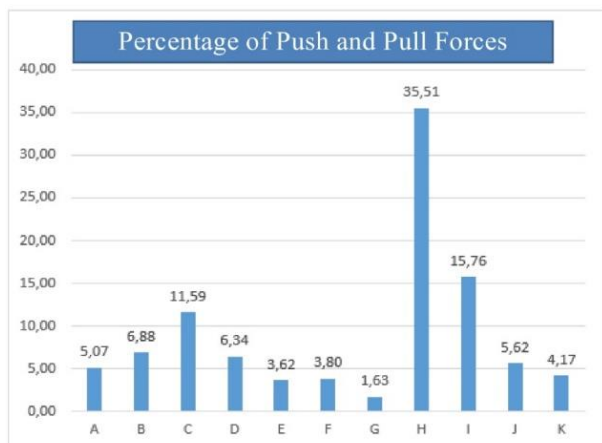


Figure 2. Centrifugal force: Percentage of push and pull forces (Kabila Sub-district)

3.3. Centripetal Force Analysis

The centripetal force analysis refers to the seven centripetal forces expressed [2]. The seven centripetal

forces are: (1) the number of socio-economic facilities for life (A); (2) ensuring security (B); (3) high income (C); (4) high prestige (D); (5) high accessibility from the village (E); (6) the number of job opportunities (F); (7) close to the workplace (G).

The existence of centripetal movement for the residents in the peri-urban areas studied is supported by questionnaire data, where the productive age population (17 - 30 years) in the sub-districts of Telaga (60.87%) and Kabila (53.62%) daily travel using shuttle service as students, university students, private employees, traders, army or police, and informal workers or government officials (Figure 3 and 4). From the types of work, the commuters between Telaga and Kabila sub-districts had different characteristics. There were three characteristics of commuters in Telaga sub-district, namely civil servants (14.49%), entrepreneurs/traders (13.04%), and students (11.59%). The commuters in Kabila sub-district were students (13.04%), civil servants (11.59%), and private employees (10.14%). The difference between the two commuter characteristics in the peri-urban areas was influenced by the distance and accessibility of the peri-urban areas towards higher education, economic facilities, and government office facilities.

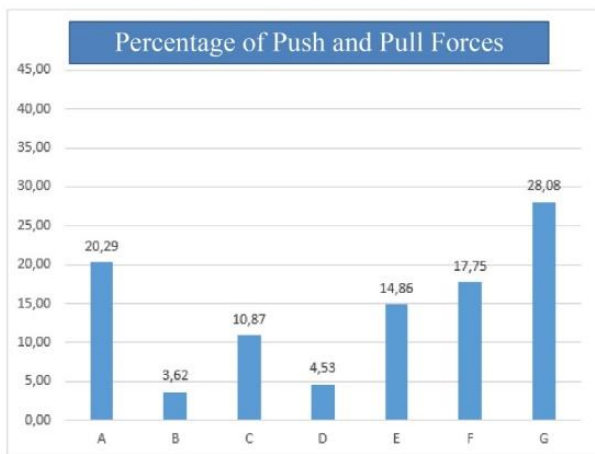


Figure 3. Centripetal force: Percentage of push and pull forces (Telaga sub-district)

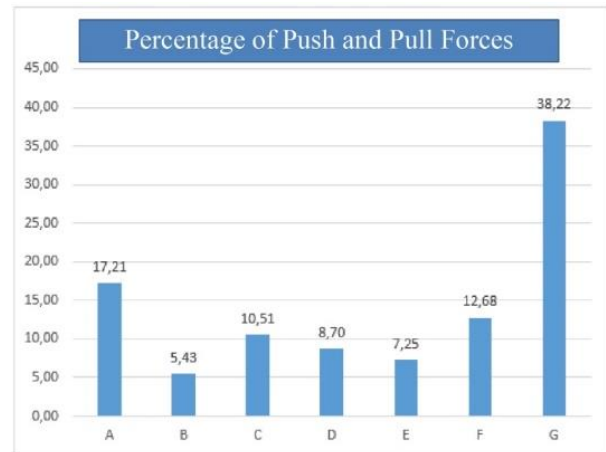


Figure 4. Centripetal force: Percentage of push and pull forces (Kabila sub-district)

3.4. Land Use Analysis

In 2005, the peri-urban area (Telaga sub-district) consisted of ~~the a~~ plantation area of 463.12 ha, settlements of 242.41 ha, annual crop farming of 201.61 ha, water bodies of 8.75 ha, and sports stadium of 2.97 ha. The land use in the peri-urban area (Kabila sub-district) in the same year consisted of ~~a~~ rice field area of 620.48 ha, settlement of 334.75 ha, annual crops of 270.25 ha, plantation of 83.86 ha, and ~~the a~~ water body of 36.55 ha.

The land use in Telaga and Kabila sub-districts in 2015 had changed. In Telaga sub-district, the plantation and agricultural areas of seasonal plants were changed into ~~the~~ residential areas of 29.15 ha and 20.03 ha, respectively. In Kabila sub-district, some areas were converted into a residential area of 29.65 ha. In the two peri-urban areas, it appears that most of the agricultural areas were converted into ~~the~~ lands for settlement or urban areas. In Telaga sub-district, the function change of agricultural lands into housings was relatively more massive compared with that in Kabila sub-district.

The land use in 2005 and 2015 in the sub-districts of Telaga and Kabila signifies that the rural landscape dominated the ones of urban areas. In 2005, the land use in Telaga sub-district for urban areas was 27% (245.20 ha), and the remaining 73% (673.47 ha) was for non-urban lands (Figure 5). In 2015, the percentage of land use for urban areas was 32% (294.38 ha), signifying an increase ~~by in~~ 5% (49.18 ha) and ~~for~~ non-urban land by 68% (624.29 ha) (Figure 6). On ~~one's one~~ hand, the percentage of land use in Kabila sub-district in 2005 was 25% (urban land, 334.75 ha) and 75% (non-urban land, 1011.14 ha) (Figure 7). In 2015, the composition of land use in Kabila sub-district experienced a change (urban land, 28%, or 380.34 ha) (Figure 8). The percentage of land use for urban areas was increased by 3% or 45.58 ha and by 72% for non-urban areas (965.56 Ha).

The high level of urban influence in the peri-urban area of Telaga sub-district correlates with the high accessibility

in the peri-urban area. Telaga sub-district has the main road, which is the arterial road connecting Gorontalo City as the National Activity Center (in Indonesian known as *Pusat Kegiatan Nasional*) with the other cities in Gorontalo and North Sulawesi Provinces.

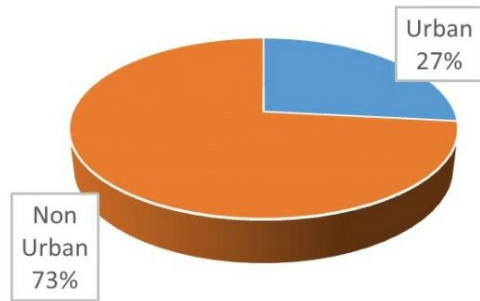


Figure 5. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2005

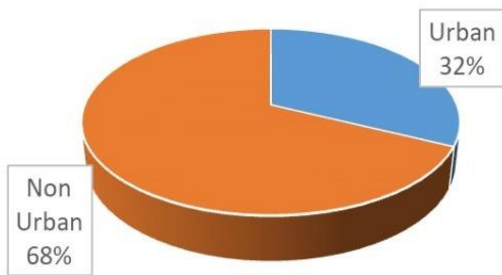


Figure 6. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2015

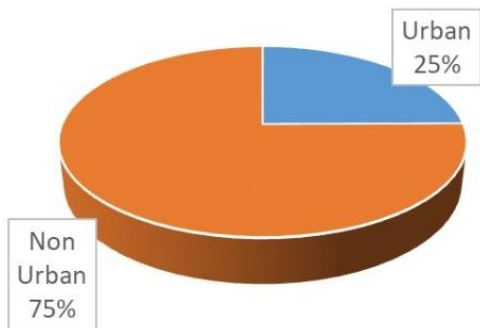


Figure 7. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2005

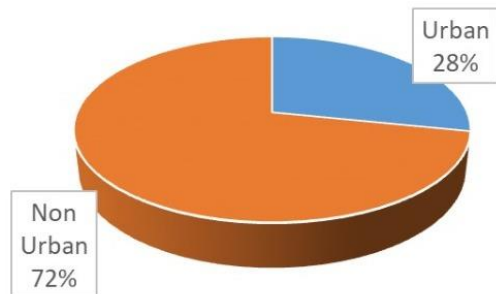


Figure 8. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

3.5. Settlement Analysis

The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts. The first characteristic is the settlements along the arterial road (Jl. A.A. Wahab Limboto in Telaga sub-district and Sultan Botutihe Street in Kabila sub-district). Both roads have permanent building characteristics and modern architecture with a large yard with a paving block or concrete cover that can accommodate one or more houses to form a house group (in Gorontalo known as *ngala'a*) and a wall fence as a symbol of territory between *ngala'a*. The composition of the plant consists of ornamental flowers, such as garden croton, ashoka, Chinese evergreen, lily, and many more. Mango or jackfruit trees serve as protective plants and keep the microclimate, thus keeping the cool atmosphere of the yard [15], with a beautiful building arrangement. In *ngala'a*, there is a path to connect to home, and it is useful to facilitate pedestrians in promoting communication with the neighbor in one *ngala'a*. Second, the settlements located far from arterial roads are semi-permanent and non-permanent buildings, simple building structures, traditional architectural features, and large *yardyards*. There is a garden on the left side with only coconut trees (monocultures) and vegetable plants on the right or backside of the house to meet daily needs. One can also find a goat or chicken den at the back of the house for live stocks. There are also paths that interconnect low-density neighbors. Below is the structure of the settlements in the peri-urban area of Telaga and Kabila sub-districts (Figure 9).

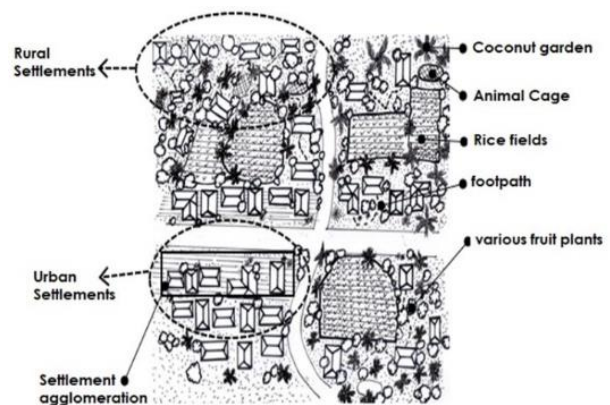


Figure 9. Settlement structure in peri-urban area of Gorontalo Province

3.6. Building Use Analysis

There are five types of building use in the peri-urban areas studied; residential houses, shop houses, stalls/kiosks, informal businesses, and agriculture. The building in the peri-urban area of Telaga and Kabila sub-district has

different characteristics. In Telaga sub-district, there were 37 respondents (54%) ~~using~~used their buildings for residential houses, 16 respondents (23%) for shop-houses, nine respondents (13%) for informal businesses (beauty salon/ barbershop and workshop), five respondents (7%) for kiosks, and two respondents (3%) for agricultural business (Figure 10). In Kabila sub-district, 34 respondents (49%) use their building for settlement purposes, 14 respondents (20%) for shop-houses, 12 respondents (18%) for kiosks, six respondents (9%) for informal business (beauty salon/ barbershop, and workshop), and three respondents (4%) for agricultural businesses (Figure 11). The presence of new buildings has had a major influence on the development of the city's morphology, making it rapidly abandon its original character as the city was originally built.

The building for residential houses, shop-houses and informal businesses in Telaga sub-district outnumbers those in Kabila sub-district. On ~~one's~~one hand, the building for stalls/ kiosks and agricultural businesses in Telaga sub-district are fewer compared to those in Kabila sub-district. This is due to the fact that Telaga sub-district is, although considered a small town, more prominent than that of Kabila sub-district. On top of that, the physical development of the peri-urban area of Telaga sub-district is heavily influenced by the transportation activities in Telaga bus station. The station serves as the inter-city and inter-regency bus station in Gorontalo Province, thus resulting in diverse activities around the bus station and ~~the~~ livelihoods of the population. Recently, the peri-urban area (Telaga sub-district) has become one of the nodal points in Gorontalo Regency and transformed into a newly developing area that attracts investors.

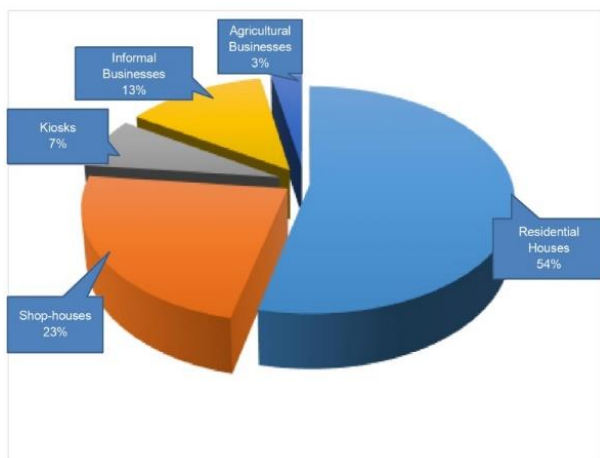


Figure 10. Building uses in peri-urban area (Telaga Sub-District)

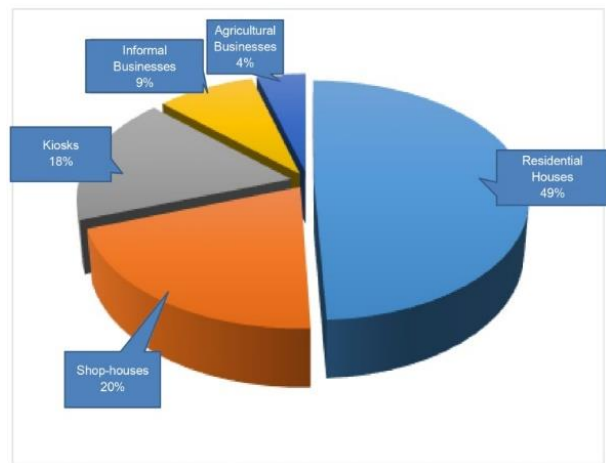


Figure 11. Building uses in peri-urban area (Kabila Sub-District)

In the peri-urban area (Kabila sub-district), the livelihood of the residents is relatively homogenous. The volume of average traffic in the area, particularly on the road of Sultan Botutihe that connects the sub-districts of Kabila and Buludawa (Suwawa sub-district), has decreased and the orientation of traffic movement had changed to the northern area of Bone Bolango regency. It is due to the change of the government center of Bone Bolango Regency, which initially from Suwawasub-district to Tilongkabila sub-district. Besides, the office facilities of the Provincial Government of Gorontalo ~~was~~were relocated to the northern area of Bone Bolango Regency, Tapa sub-district. This relocation contributes to the preference for choosing the northern road for official administration purposes in Bone Bolango Regency and the Government of Gorontalo province.

3.7. Street Pattern and Circulation Analysis

The roads in the sub-districts of Telaga and Kabila are relatively in good condition, and they also have good transportation circulation. Consequently, various modes of transportation especially *bentor* (motorized rickshaw), can provide their services to passengers in every part of the settlements. The transportation modes like *angkot* (local minibus for public transportation) and *bentor* can reach the villages in the two peri-urban areas. The existence of quality transportation facilities and infrastructures strongly supports the mobilization and activities of the population to be commuters and reside in the peri-urban area. The farmer road program has changed the landscape of rural areas in both peri-urban areas; this is seen in the improvement of roads near farms. Initially, access to farms is mostly dirt roads. However, ~~the~~ dirt roads are rarely found recently. The existing condition is also similar to the condition of roads in rural areas. However, good road conditions in the sub-districts Telaga and Kabila have no traffic signs and road markings. Traffic signs and road markings can only be seen in-on arterial roads.

The livelihoods of people in Kabila sub-district tend to

be homogeneous. The average daily traffic or traffic volume in this region, especially the Jalan Sultan Botutihe, i.e., a road connecting Kabila and Buludawa sub-districts (Suwawa sub-district) has decreased. Further, the orientation of traffic movement has shifted to the northern part of Bone Bolango County. This is allegedly due to the shift of the central government area of Bone Bolango Regency. The central government was initially located in Suwawa sub-district (the office was also relocated to Tilongkabila sub-district). In addition, the Gorontalo Provincial Government office facilities are gradually relocated to the northern part of Bone Bolango Regency, specifically in Tapa subdistrict. Another factor causing a decrease in the traffic volume at Jalan Botutihe is the preference of the road users to pass the northern areas for government administration purposes. This situation also affects the physical development of space in Kabila sub-district.

3.8. Analysis of Peri-Urban Area Morphology

Land use is among factors to consider in analyzing morphological types in peri urban areas. This factor also functions to explain the spatial distribution of residential mobility [18]. Characteristics of the peri-urban area of Telaga and Kabila sub-districts depict the quality of the rural areas and urban areas. Both sub-districts areas are growing due to contributions from the capital of Gorontalo city. Still, agricultural activities still dominate in the two peri-urban areas studied. The analysis shows that the pattern of roads in urban units is classified as linear and integrated with a grid road system. When viewed from the hierarchy level, land use for services and trade activities located around the main road (A.A. Wahab and Sultan Botutihe Streets) is the highest hierarchy. The pattern of land use from the peri-urban area in Telaga sub-district is octopus/star-shaped (a combination of concentric pattern and linear). Meanwhile, the land use pattern of peri urban

area in Kabila sub-district is a linear pattern (southern part) and leapfrog (northern part). The initial developmental patterns of these two peri-urban areas were studied. The development is horizontal in its character, and the road planning implements vertical development. This situation is determined by the condition of the density of the buildings and the price of the land compared to other parts of the city. Government Regulation No. 12 of 2012 and Provincial Regulation No. 1 of 2014 on the protection of sustainable agricultural land on incentives ensure the sustainability of agricultural land.

The policies previously mentioned are intended to limit the expansion of urban space and give protection against land sales [21]. Land-The land sale also causes the loss of agricultural land [22], loss of rural areas, especially in the main urban areas [23], and environmental degradation [24] vulnerability in unplanned settlements areas in peri-urban areas [25]. Currently, transport routes from all directions are focused on this zone, meaning that Telaga sub-district has a high accessibility level, which contributes to the urban development in peri-urban areas.

In 2005, the settlement or the development area in Telaga sub-district reached 242.41 ha with a building density level reaching 0.078 (Figure 12), and in Kabila sub-district, the area was 334.75 ha with the a density level of 0.056 (Figure 13). There was a change of settlement land as development area in Telaga sub-district (291.59 ha) with the building density level of 0.12 (Figure 14), and in Kabila sub-district the development area was 380.34 ha with density level reaches 0.07 (Figure 15). In general, the development of the land was well established in both sub-districts, which directly adjacent to Gorontalo City. This indicates that the peri urban area is heavily influenced by the main city, that is the City of Gorontalo. Thus, it cannot be denied that the development of the two peri-urban areas has implications for changes in the appearance of the two sub-districts.

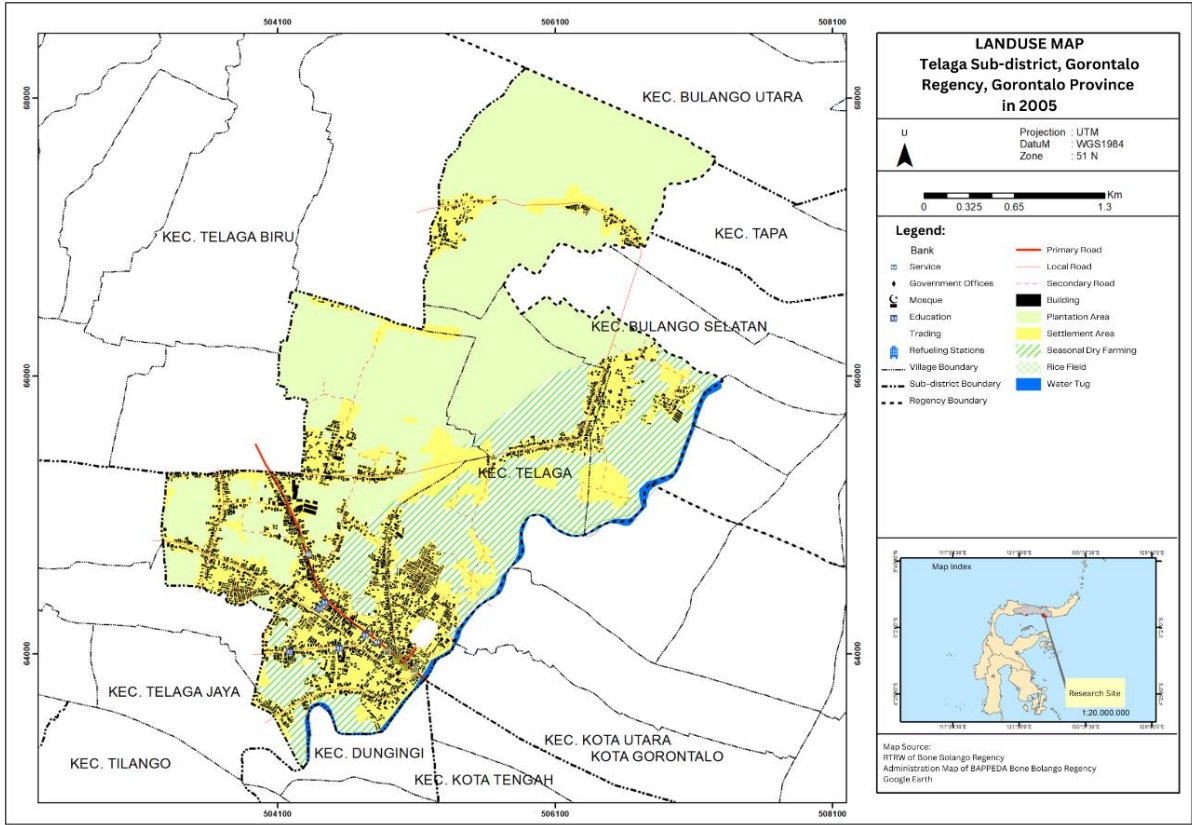


Figure 12. Map of land use and built use in Telaga Sub-District, 2005

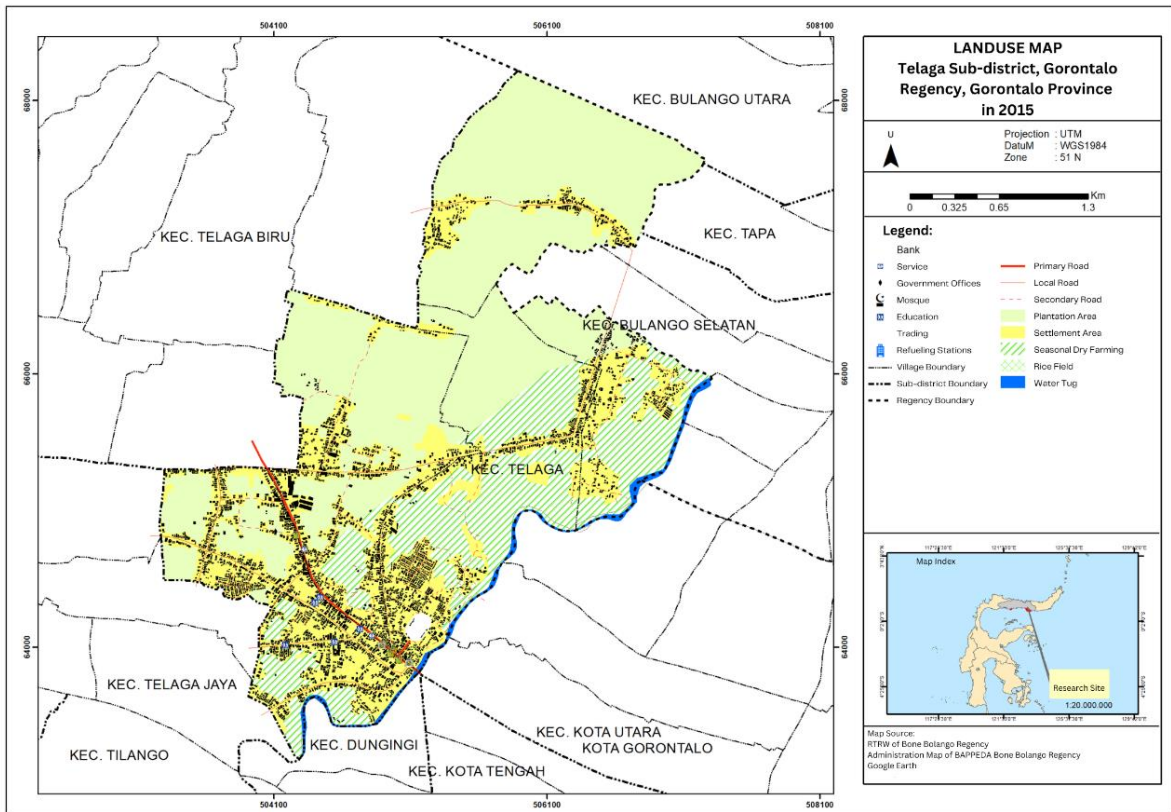


Figure 13. Map of land use and built use-using in Telaga Sub-District, 2015

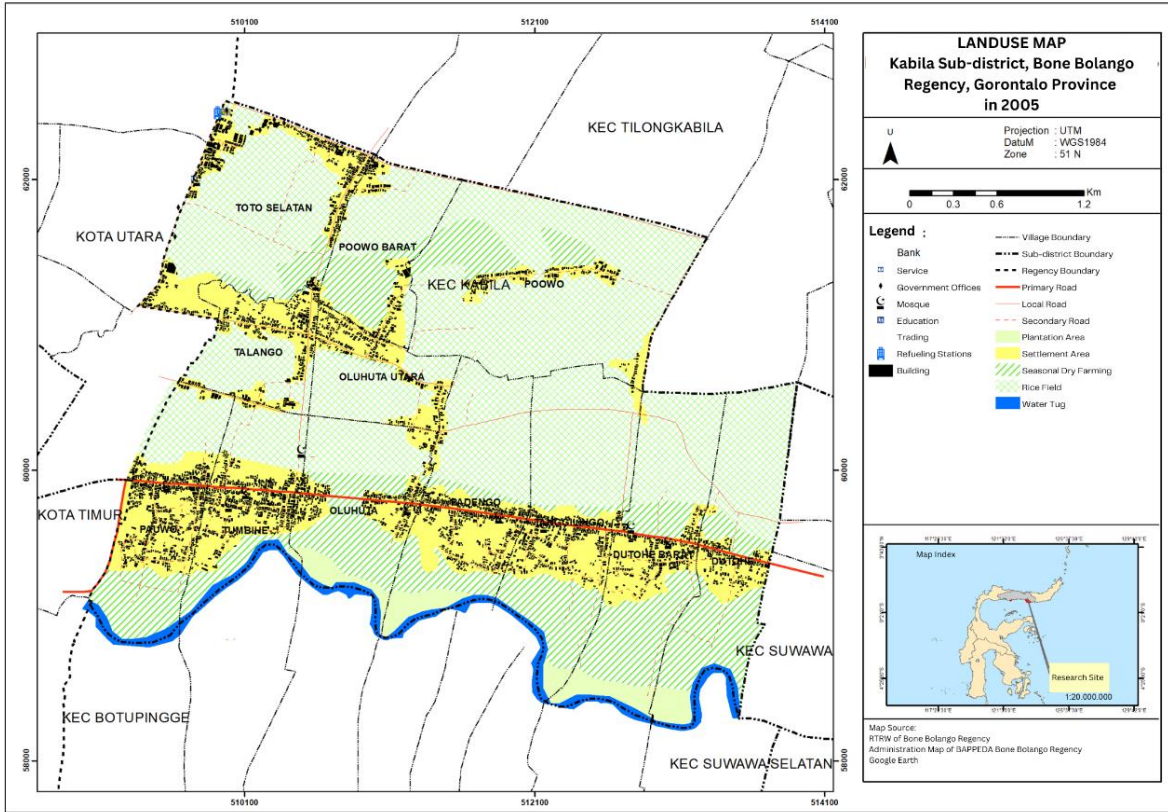


Figure 14. Map of land use and built use-using in Kabila Sub-District, 2005

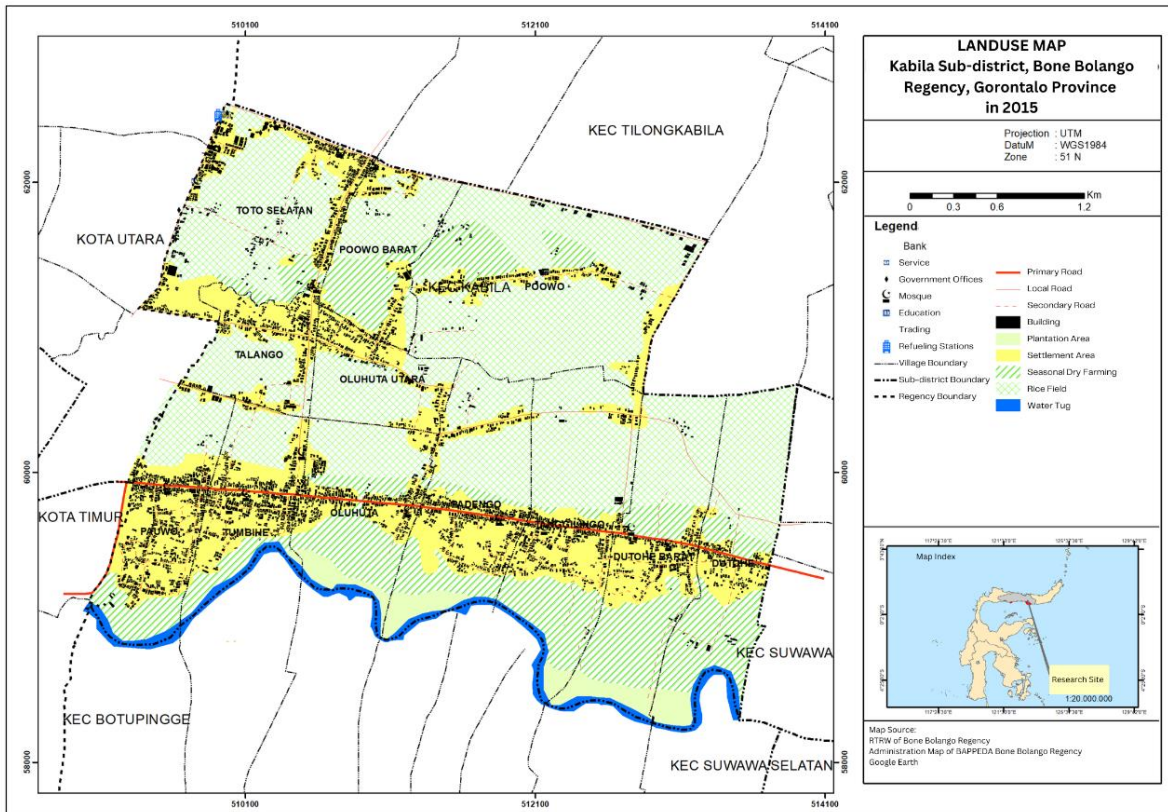


Figure 15. Map of land use and built use in Kabila Sub-District, 2015.

4. Conclusion

Based on the research results and discussion, it can be concluded that the development of the peri-urban area in Telaga District is heavily influenced by the accessibility of the area. Further, the location is very strategic (it is located in the middle of two developed cities in Gorontalo Province, i.e., Gorontalo city and Limboto city). The existence of primary arterial roads that cross the district serves as the main access to main facilities, such as Jalaludin Airport. Kabila sub-district is the area receiving significant impact because of the proximity of the distance between Kabila sub-district with the city of Gorontalo.

Further, the morphological form in the two peri-urban areas studied is significantly influenced by Gorontalo city. The morphological indicators of peri-urban areas (WPU) in Telaga and Kabila sub-districts can be described as follows: (a) The utilization of the land within ten years for urban development purposes in Telaga and Kabila sub-districts was increased by 5% (49.18 ha) and 3% (45.58 ha), respectively. (b) The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts: first, the settlements in the arterial road form the house group (*ngala'a*) and the wall fence as a symbol of the territory between *ngala'a*. Secondly, the settlement *is* located far from the arterial road with the characteristics of semi-permanent and non-permanent buildings, simple building structures, traditional architectural styles, and low building densities. (c) Characteristics of building use for tertiary sectors (trade and service) in Telaga sub-district are more common than Kabila sub-district. In addition, stalls and agricultural business buildings (primary sector) in Telaga sub-district are not that common compared to Kabila sub-district. (d) Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Furthermore, Telaga and Kabila sub-districts are two peri-urban areas that tend to be banded. Settlements and buildings are spread out in small groups and tend not to have regular urban spatial patterns. The spatial pattern of the city still has a connection with rural traditions and is traditional in nature.

5. Suggestion

It is necessary to carry out further research related to the role of transportation and changes in road patterns and circulation orientation in peri urban areas as it greatly influences the physical morphology of cities. Meanwhile, land use as built-up land should apply the concept of vertical and interstitial development, in which existing

buildings must comply with detailed local spatial plans so that agricultural land can be maintained and remains sustainable.

The development of the city will have an impact on the surrounding area, especially the suburbs (peri urban). Peri urban areas can be identified based on the characteristics of peri urban areas, which will then look at the morphological components and identify the factors that influence the shape of the city. This is due to the availability of green open space in the form of rice fields and dry fields in peri urban areas.

The novelty of this study is to reveal the influence of community solidarity values on the development of urban morphological elements. Therefore, the results of this study can be used as a basis for the development of further research that refers to the development of urban morphology. The method in this study is an appropriate way to express the influence of physical aspects and socio-cultural aspects on urban development. At the practitioner level, there should be an understanding ~~on~~ of the main aspects that must be considered in settlement planning to form an integrated spatial arrangement. As a result, there will be a creation of communal spaces that are integrated between the environment and social culture of urban society.

6. Recommendation

Based on the findings, this study provides several recommendations to be followed up by the government and subsequent researchers.

Firstly, ~~the~~ the existing condition of Kabila Subdistrict must be maintained to maintain the microclimate and natural balance in the form of food and water supply by making measured and controlled land use so as not to change the face of the city. Thus, it is necessary to find a grand-design ~~of~~ for a sustainable city.

Secondly, natural population growth and migration processes tend to accelerate urban development which can increase population density and the number of buildings in both peri-urban areas.

Thirdly, Telaga Subdistrict is changing more quickly when compared to Kabila Subdistrict or the urban appearance in the peri-urban areas of Telaga Subdistrict is more visible than Kabila Subdistrict. This indicates that the influence of urbanization on morphology in the peri-urban area in Telaga District is higher when compared to the peri-urban area in Kabila District. Changes in Telaga Subdistrict can be followed up by conducting further research on the existence of Telaga Subdistrict between the two main urban centers, including Limboto City and Gorontalo City by looking at changes in people's socio-cultural behavior, economy, life style, transportation circulation and city characteristics.

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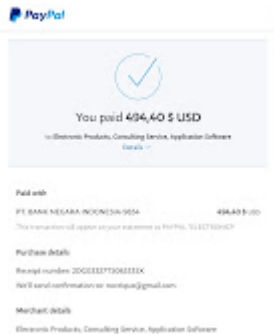
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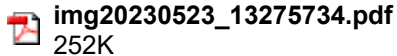
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Morphology of Peri-Urban Area in Gorontalo Province, Indonesia

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Abstract As two areas directly adjacent to Gorontalo City, the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency) are the center of regional growth. The study aimed to examine the physical development of two sub-districts, Telaga and Kabila, since the sub-districts previously mentioned have different regional characteristics and different physical morphology developments influenced by Gorontalo city. That the two sub-districts can be viewed as a peri-urban area of Gorontalo city is a fascinating topic to comprehend the peri-urban area. The stages of this qualitative descriptive research consisted of preliminary survey and observation, distributing questionnaires, collecting data, processing data, data analysis, and data interpretation. Over the last ten years, urban land use has increased in both Telaga and Kabila sub-district by 5% (49.18 ha) and 3% (45.58 ha), respectively. Agropolis activities still dominated the two peri-urban areas. The pattern of land use in the Sub-District of Telaga was the pattern of octopus, while that of Kabila sub-district was a linear pattern (southern part) and frog jump (northern part). Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Keywords City Morphology, Sub-District, Land, Peri-Urban, Physical Development

1. Introduction

The suburban areas outside the administrative area of Gorontalo City are the sub-districts of Telaga (Gorontalo Regency) and Kabila (Bone Bolango Regency). The two areas are directly adjacent to Gorontalo City, which serves as the center of regional growth. The social-economic situation of the two cities is very dominant with urban nuance in that of Gorontalo city. Scientifically, determining the border determination of the peri-urban area is not an easy task. The outermost area of peri-urban is a place where people still want to commute to work/ do activities in a city [1].

The location of the sub-district of Kabila is on the east side of Gorontalo city. The sub-district is one of the entrances to Suwawa City in Bone Bolango Regency. On top of that, the area, which connects Suwawa City and Gorontalo City, has quite a high traffic flow. Telaga City, as a city of Telaga sub-district, is located in the western part of Gorontalo city and one of the access to the area of Limboto City. Limboto City and Suwawa City have yet significantly contributed to the development of Telaga and Kabila sub-district. In relation to the physical development of the two sub-districts, the effect of Gorontalo city is very dominant in determining the direction of the physical development of the region because the location of the two sub-districts is in the suburb of Gorontalo city with their excellent accessibility.

The physical development of Telaga and Kabila sub-districts as a result of the physical development of

Gorontalo City to the outer part of its administrative area is highly influenced by various factors previously discussed in the above paragraph. The factors help contribute to the form and morphology of the city. The morphology of a city is not only limited to analysis of the form of the city or the factors that influence the form of the city [2]. The phenomenon is an intriguing topic to study because the two sub-districts have different regional characteristics and different development of the physical morphology of the city influenced by Gorontalo City. The two sub-districts can be regarded as the peri-urban of Gorontalo city, so it is fascinating to be a study material in comprehending peri-urban area.

1.1. City Morphology

There are several morphological indicators of a city; those involve land use, plot, the layout of streets, and buildings [3]. The four indicators are described as follows [4]:

- (1) Land use, as one of the indicators of city morphology, has a temporary nature because its functions are easy to change. Land use can be divided into two kinds of utilization, namely urban land and non-urban land. Urban land is oriented to secondary and tertiary sectors (trade and services), and non-urban land is oriented to the primary sector (agriculture).
- (2) The plot is a plot of a certain size for housing. The arrangement of plots forms blocks. Plot and block are the initial elements of city formation. Urban plots are usually arranged and face the environmental street, while service street is located between one plot and another plot. In the development of a city, the ownership of plots can be transferred and traded. This may cause changes in the width. Generally, a plot is rectangular, but the shape can be affected by the surrounding environment and the street pattern.

A street pattern consisting of streets serves as the forming of the block pattern of a city area. Streets may also form spaces between blocks in urban areas, and the street connected to other streets forms a network and street pattern. Street network pattern in an urban area is formed through a very long process and is usually a continuation of previous patterns. Street pattern in a city is usually a grid pattern, either regular or irregular. A grid pattern is created from crossing and intersecting two lines or more parallel lines forming geometric patterns with regular spacing and producing regional blocks. A grid-shaped street pattern can be found in old cities and planned cities. Grid street patterns generally have good transport circulation making it easier for city residents to interact from one area of the city to another.

The intended buildings include the buildings for settlements and the buildings utilized to accommodate human activities; this infrastructure plays a vital role in forming network structures, street patterns, and public areas. Buildings form mass plots (single and block patterns)

and open spaces. Buildings located on a plot can be transformed in their function, shape, or width. The buildings in the peri-urban area have the utilization characteristics of both urban and rural.

1.2. Peri-Urban Area

Peri-urban is an important area in the city development cycle. This region experiences a very rapid transformation process from the rural stage to the urban stage to the urban stage both qualitatively (urban lifestyle) and quantitative (new residential zone) [5]. For this reason, this area can be defined as an area of dynamic change from land use, social, environmental aspects, and infrastructure [6].

The peri-urban area has an important role in the lives of future residents because the peri-urban area is an area between two regions, which clearly shows differences in environmental conditions. Peri urban areas encompass a combination of rural characteristics and urban characteristics simultaneously [7]. Furthermore, the area is a zone with a mixture of urban and rural activities [8]. This is the case with land use [9], so that peri urban areas are a transition zone [10], where urban and rural activities are juxtaposed [11].

1.3. Centrifugal Force

The growth of cities turns out to cover a variety of factors that are more complex than just agglomeration economies. Optimal city size theory defines the spatial equilibrium of economic activity as a result of the attraction between centripetal and centrifugal forces [12]. Centrifugal forces are the power of dispersion [13]; in the centrifugal force, a population movement and functions that originate from the inside of a region go to the outer side [14], thus resulting in a movement of activity between centers cities and suburbs [15]. This situation has triggered rapid physical development and expansion of suburban areas [16].

1.4. Centripetal Force

Centripetal force refers to a force causing population movements from the suburbs to the city. In addition, centripetal forces, driven by agglomeration augmentation, are all forces that attract economic activity to urban areas [17,18]. Centripetal strength is a force that tends to produce an integration style that brings together various social, economic, cultural, and political activities from the periphery to the downtown area, which has positive and negative implications [19].

There are two kinds of forces that have contributed to forming the centripetal force; push and propelling forces. Push force is spatially associated with the origin region of movement, and propelling force is associated spatially with the destination area of the movement because the centripetal movement is opposed to centrifugal movement

and the two forces play different roles [20]. Centrifugal and centripetal forces have similar implications in developing an activity center [15].

2. Methodology

The method used in this research was qualitative-descriptive. ArcGis and Google Earth Pro were two main instruments used to analyze the physical appearance of space or morphology in the peri-urban area. Further, Microsoft Excel was used to perform tabulation and analysis of data derived from the questionnaires. The questionnaire, i.e., the research instrument, was used to identify the centrifugal and centripetal forces and the factors causing the occurrence of the two forces within the study area. The survey and observation were conducted to eliminate the sense of doubt over the uncertainty in certain objects of space physical appearance in the research location. All informants' names were written in pseudonyms and the informed consent was written.

2.1. The Stage of Determining Analysis Unit

The study used one or more units of analysis associated with urban morphology or morphological patterns of peri-urban areas. The morphological formation of the peri-urban area is strongly influenced by the social and economic conditions and activities within the area. The analysis of the morphological pattern of the peri-urban area in this research emphasized building density, accessibility, and distance from downtown.

2.2. Preparation Stage

The preparation stage of the research was started by studying and reviewing various literature as the references in conducting the research and the preparation of the research instruments (questionnaire). Following the previous process was an initial survey in several institutions to collect secondary data, such as the data on population numbers and density and people's livelihoods. The remote sensing imagery data were obtained from Google Earth Pro with the recording years of 2005 and 2015.

2.3. The Stages of Data Processing and Analysis

ArcGis software was used to process the image data derived from Google Earth Pro with the recording year of 2005 and 2015, and then the coordinate correction process was determined via georeferencing. This process was followed by digitization steps to get the derived data (shapefile). The digitization process generated new data as the physical appearance of the image data recording. The

mapping of the patterns and distribution of settlements in Kabila sub-district was grouped into three parts: first, the pattern and distribution of settlements in southern Kabila sub-district bordering Gorontalo City; second, the pattern and distribution of settlements within the area along the main road of Gorontalo City - Suwawa City (Sultan Botutihe street); third, the pattern and distribution of settlements within the sub-district of Kabila to the north that borders Gorontalo city. The mapping of the patterns and distribution of settlements in Telaga sub-district was grouped into two parts: first, the pattern and distribution of settlements in the village areas of Telaga sub-district bordering with Gorontalo city; second, the pattern and distribution of settlements within the regions along the main road of Gorontalo City - Limboto City (A.A WahabLimboto Road). The mapping results were overlaid to find out the pattern and trend of the development of settlement areas in Telaga and Kabila sub-districts. Furthermore, the comparative development of settlements in both regions was conducted because the two areas of study had different peri-urban characteristics.

2.4. Data Interpretation and Drawing Conclusion

The research data on the morphology of peri-urban areas (Telaga and Kabila sub-districts) was presented in the form of spatial or digital maps that provided information on the pattern and trends of future peri-urban development. The data of the tabulation result from the questionnaires were analyzed using hierarchical process analysis (AHP) so that the dominant factors that influence the development of morphology in the peri-urban area can be identified.

2.5. Ethics Statement

All of the participants' names in this research were written in pseudonyms and the informed consent was in written. This research has obtained approval ethics from the ethical committee of Gorontalo State University.

3. Result and Discussion

3.1. An Overview of Study Area

Geographically, Telaga sub-district is located at 1210,159" – 1230, 32" West Latitude and 00,24" – 100,02" North Longitude, and Kabila sub-district lie at 0,30 °North Latitude, 1,00 °South Latitude and 121,00 °East Longitude, 123,30 °West Longitude. The area of Telaga and Kabila sub-districts is 58.44 km² and 193.45 km², respectively. There are 22,884 and 23,634 of people in these two sub-districts. The borders of the two peri-urban areas are presented in Table 1.

Table 1. The borders of Telaga and Kabila Sub-districts

| Study Area | Borders | Bordering with |
|---------------------|---------|--------------------------------------|
| Telaga sub-district | North | Telaga Biru sub-district |
| | East | Sipatana sub-district-Gorontalo city |
| | South | Tilango and Telaga Jaya sub-district |
| | West | Telaga Biru sub-district |
| Kabila sub-district | North | Tilongkabila sub-district |
| | East | Central Suwawa sub-district |
| | South | Botupingge sub-district |
| | West | Gorontalo city |

Source: BPS, 2016

In general, the two peri-urban areas have lowland areas. Telaga sub-district is slightly hilly in the northern region and fed by Bulango and Nanati rivers. Kabila sub-district is flown by Bone River, making the two peri-urban areas quite fertile. People's livelihoods in the study area were mostly in the agricultural sector. Table 2 provides information on the distance between the peri-urban areas and Gorontalo city, airport, and regency capitals from each study area.

Table 2. The distance of peri-urban areas (study area) to several capitals in Gorontalo Province

| No. | Origin | Destination (km) | | |
|-----|--------------------------|------------------|--------------|--------------------|
| | | Gorontalo City | Limboto City | Jalaluddin Airport |
| 1 | Telaga Jaya sub-district | 11 | 9 | 31 |
| 2 | Kabila sub-district | Destination (km) | | |
| | | Gorontalo City | Suwawa City | Jalaluddin Airport |
| | | 4,3 | 7 | 40 |

Source: Primary Data, 2017

3.2. Centrifugal Force Analysis

There were 11 factors of push and propelling forces that affect the development of the morphology of peri-urban areas in Telaga and Kabila sub-districts. Those factors involved: (1) smaller population compared to urban population (A); (2) low-dense settlements (B); (3) low rate of air, sound and water pollutions (C); (4) friendly inhabitants (D); (5) low crime rate (E); (6) less restrictive rules (F); (7) no traffic jam and traffic congestion (G); (8)

low land prices and large areas (H); (9) cool air and tranquil atmosphere (I); (10) beautiful natural scenery (J); and (11) the guarantee of privacy (K).

Further, three push forces for the residents of Gorontalo City to live and move in the peri-urban area, i.e., high land prices at the city center, settlement density, and air, sound and water pollution (Figures 1 and 2). On the other hand, the propelling forces for the residents of Gorontalo City to settle in the peri-urban areas are related to low land prices and vast land, low density of settlements, and cool air and calm atmosphere. The existing conditions in the peri-urban areas also attract developers in investing their capital to develop housing close to Gorontalo City.

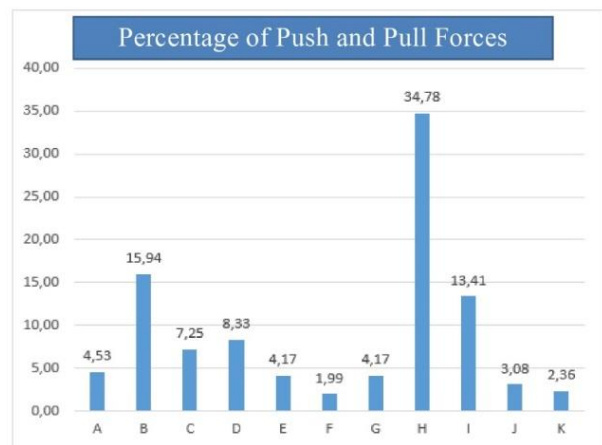


Figure 1. Centrifugal force: Percentage of push and pull forces (Telaga Sub-district)

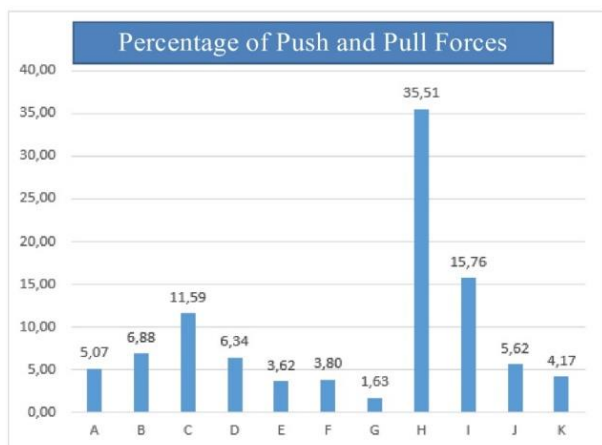


Figure 2. Centrifugal force: Percentage of push and pull forces (Kabila Sub-district)

3.3. Centripetal Force Analysis

The centripetal force analysis refers to the seven centripetal forces expressed [2]. The seven centripetal forces are (1) the number of socio-economic facilities for life (A); (2) ensuring security (B); (3) high income (C); (4) high prestige (D); (5) high accessibility from the village (E);

(6) the number of job opportunities (F); (7) close to the workplace (G).

The existence of centripetal movement for the residents in the peri-urban areas studied is supported by questionnaire data, where the productive age population (17 - 30 years) in the sub-districts of Telaga (60.87%) and Kabila (53.62%) daily travel using shuttle service as students, university students, private employees, traders, army or police, and informal workers or government officials (Figure 3 and 4). From the types of work, the commuters between Telaga and Kabila sub-districts had different characteristics. There were three characteristics of commuters in Telaga sub-district, namely civil servants (14.49%), entrepreneurs/traders (13.04%), and students (11.59%). The commuters in Kabila sub-district were students (13.04%), civil servants (11.59%), and private employees (10.14%). The difference between the two commuter characteristics in the peri-urban areas was influenced by the distance and accessibility of the peri-urban areas towards higher education, economic facilities, and government office facilities.

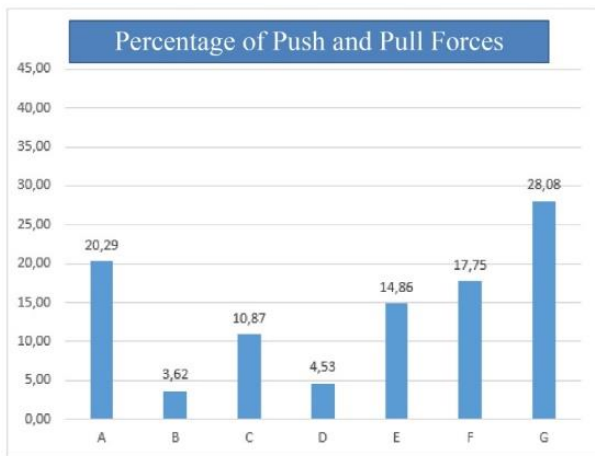


Figure 3. Centripetal force: Percentage of push and pull forces (Telaga sub-district)

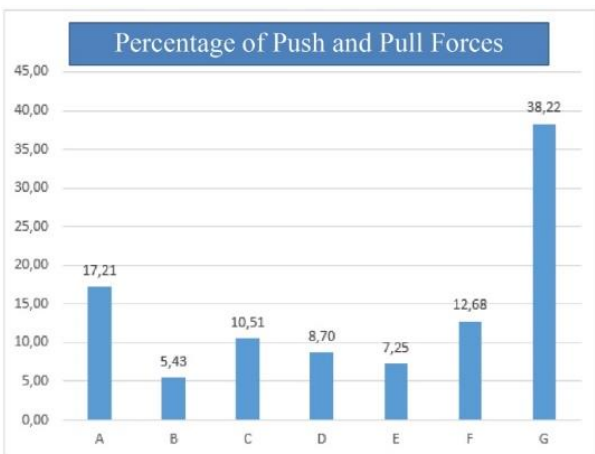


Figure 4. Centripetal force: Percentage of push and pull forces (Kabila sub-district)

3.4. Land Use Analysis

In 2005, the peri-urban area (Telaga sub-district) consisted of a plantation area of 463.12 ha, settlements of 242.41 ha, annual crop farming of 201.61 ha, water bodies of 8.75 ha, and sports stadium of 2.97 ha. The land use in the peri-urban area (Kabila sub-district) in the same year consisted of a rice field area of 620.48 ha, settlement of 334.75 ha, annual crops of 270.25 ha, plantation of 83.86 ha, and a water body of 36.55 ha.

The land use in Telaga and Kabila sub-districts in 2015 had changed. In Telaga sub-district, the plantation and agricultural areas of seasonal plants were changed into residential areas of 29.15 ha and 20.03 ha, respectively. In Kabila sub-district, some areas were converted into a residential area of 29.65 ha. In the two peri-urban areas, it appears that most of the agricultural areas were converted into lands for settlement or urban areas. In Telaga sub-district, the function change of agricultural lands into housing was relatively more massive compared with that in Kabila sub-district.

The land use in 2005 and 2015 in the sub-districts of Telaga and Kabila signifies that the rural landscape dominated the ones of urban areas. In 2005, the land use in Telaga sub-district for urban areas was 27% (245.20 ha), and the remaining 73% (673.47 ha) was for non-urban lands (Figure 5). In 2015, the percentage of land use for urban areas was 32% (294.38 ha), signifying an increase by 5% (49.18 ha) and non-urban land by 68% (624.29 ha) (Figure 6). On one hand, the percentage of land use in Kabila sub-district in 2005 was 25% (urban land, 334.75 ha) and 75% (non-urban land, 1011.14 ha) (Figure 7). In 2015, the composition of land use in Kabila sub-district experienced a change (urban land, 28%, or 380.34 ha) (Figure 8). The percentage of land use for urban areas was increased by 3% or 45.58 ha and by 72% for non-urban areas (965.56 Ha).

The high level of urban influence in the peri-urban area of Telaga sub-district correlates with the high accessibility in the peri-urban area. Telaga sub-district has the main road, which is the arterial road connecting Gorontalo City as the National Activity Center (in Indonesian known as *Pusat Kegiatan Nasional*) with the other cities in Gorontalo and North Sulawesi Provinces.

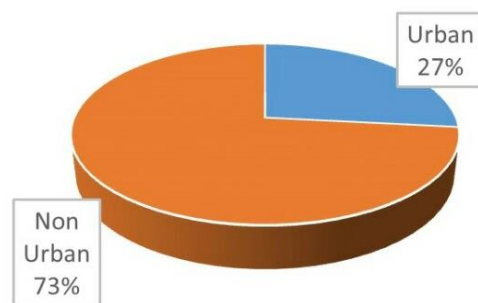


Figure 5. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2005

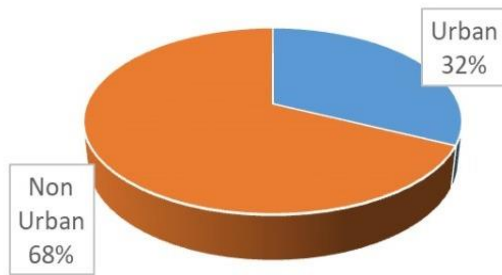


Figure 6. Urban and non-urban land uses in the peri-urban area of Telaga Sub-district in 2015

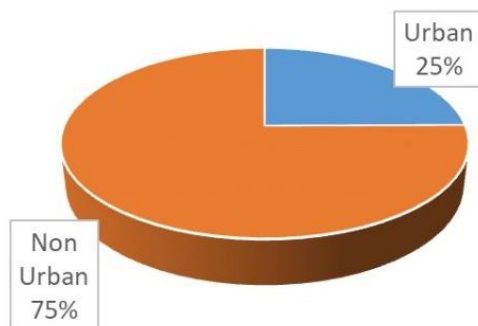


Figure 7. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2005

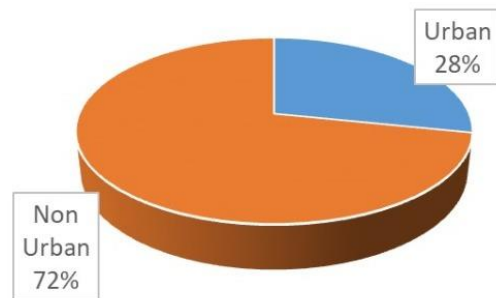


Figure 8. Urban and non-urban land uses in the peri-urban area of Kabila Sub-district in 2015

3.5. Settlement Analysis

The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts. The first characteristic is the settlements along the arterial road (Jl. A.A. Wahab Limboto in Telaga sub-district and Sultan Botutihe Street in Kabila sub-district). Both roads have permanent building characteristics and modern architecture with a large yard with a paving block or concrete cover that can accommodate one or more houses to form a house group (in Gorontalo known as *ngala'a*) and a wall fence as a symbol of territory between *ngala'a*. The composition of the plant consists of ornamental flowers, such as garden croton, ashoka, Chinese evergreen, lily, and many more. Mango or jackfruit trees serve as protective plants and keep

the microclimate, thus keeping the cool atmosphere of the yard [15], with a beautiful building arrangement. In *ngala'a*, there is a path to connect home, and it is useful to facilitate pedestrians in promoting communication with the neighbor in one *ngala'a*. Second, the settlements located far from arterial roads are semi-permanent and non-permanent buildings, simple building structures, traditional architectural features, and large yards. There is a garden on the left side with only coconut trees (monocultures) and vegetable plants on the right or backside of the house to meet daily needs. One can also find a goat or chicken den at the back of the house for live stocks. There are also paths that interconnect low-density neighbors. Below is the structure of the settlements in the peri-urban area of Telaga and Kabila sub-districts (Figure 9).

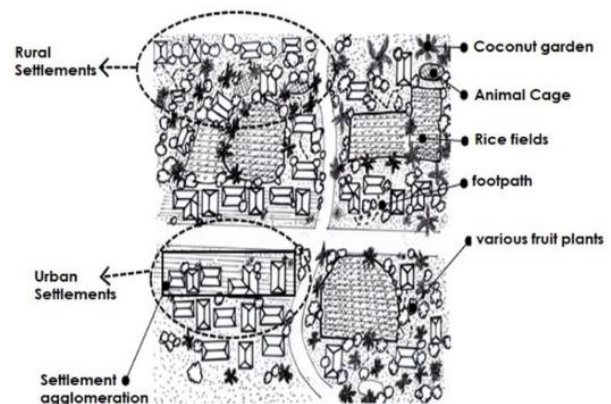


Figure 9. Settlement structure in peri-urban area of Gorontalo Province

3.6. Building Use Analysis

There are five types of building use in the peri-urban areas studied; residential houses, shop houses, stalls/kiosks, informal businesses, and agriculture. The building in the peri-urban area of Telaga and Kabila sub-district has different characteristics. In Telaga sub-district, there were 37 respondents (54%) using their buildings for residential houses, 16 respondents (23%) for shop-houses, nine respondents (13%) for informal businesses (beauty salon/barbershop and workshop), five respondents (7%) for kiosks, and two respondents (3%) for agricultural business (Figure 10). In Kabila sub-district, 34 respondents (49%) use their building for settlement purposes, 14 respondents (20%) for shop-houses, 12 respondents (18%) for kiosks, six respondents (9%) for informal business (beauty salon/barbershop, and workshop), and three respondents (4%) for agricultural businesses (Figure 11). The presence of new buildings has had a major influence on the development of the city's morphology, making it rapidly abandon its original character as the city was originally built.

The building for residential houses, shop-houses and informal businesses in Telaga sub-district outnumbers those in Kabila sub-district. On one hand, the building for stalls/kiosks and agricultural businesses in Telaga

sub-district are fewer compared to those in Kabila sub-district. This is due to the fact that Telaga sub-district is, although considered a small town, more prominent than that of Kabila sub-district. On top of that, the physical development of the peri-urban area of Telaga sub-district is heavily influenced by the transportation activities in Telaga bus station. The station serves as the inter-city and inter-regency bus station in Gorontalo Province, thus resulting in diverse activities around the bus station and the livelihoods of the population. Recently, the peri-urban area (Telaga sub-district) has become one of the nodal points in Gorontalo Regency and transformed into a newly developing area that attracts investors.

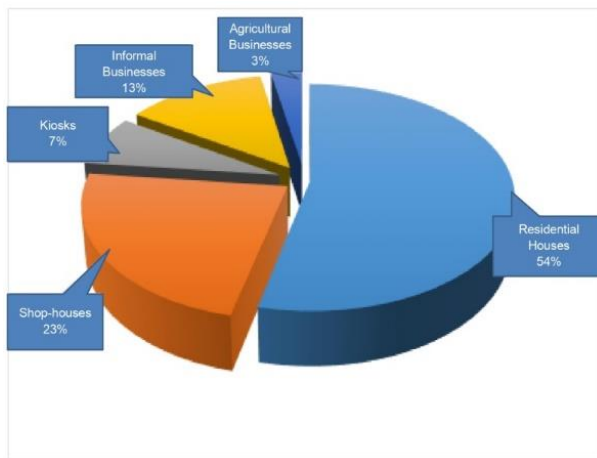


Figure 10. Building uses in peri-urban area (Telaga Sub-District)

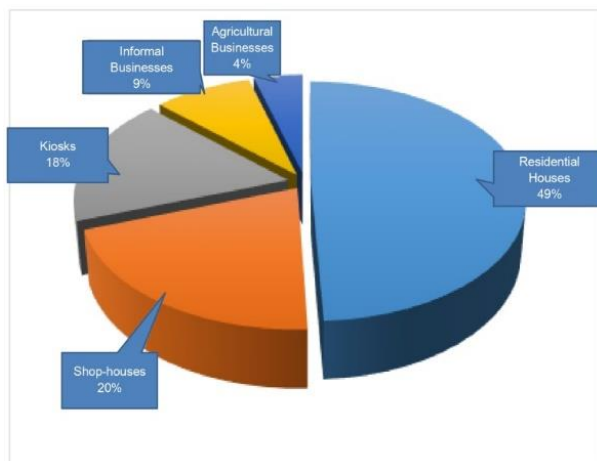


Figure 11. Building uses in peri-urban area (Kabila Sub-District)

In the peri-urban area (Kabila sub-district), the livelihood of the residents is relatively homogenous. The volume of average traffic in the area, particularly on the road of Sultan Botutihe that connects the sub-districts of Kabila and Buludawa (Suwawa sub-district), has decreased and the orientation of traffic movement had changed to the northern area of Bone Bolango regency. It is due to the change of the government center of Bone Bolango

Regency, which initially from Suwawasub-district to Tilongkabila sub-district. Besides, the office facilities of the Provincial Government of Gorontalo were relocated to the northern area of Bone Bolango Regency, Tapa sub-district. This relocation contributes to the preference for choosing the northern road for official administration purposes in Bone Bolango Regency and the Government of Gorontalo province.

3.7. Street Pattern and Circulation Analysis

The roads in the sub-districts of Telaga and Kabila are relatively in good condition, and they also have good transportation circulation. Consequently, various modes of transportation especially *bentor* (motorized rickshaw), can provide their services to passengers in every part of the settlements. The transportation modes like *angkot* (local minibus for public transportation) and *bentor* can reach the villages in the two peri-urban areas. The existence of quality transportation facilities and infrastructures strongly supports the mobilization and activities of the population to be commuters and reside in the peri-urban area. The farmer road program has changed the landscape of rural areas in both peri-urban areas; this is seen in the improvement of roads near farms. Initially, access to farms is mostly dirt roads. However, dirt roads are rarely found recently. The existing condition is also similar to the condition of roads in rural areas. However, good road conditions in the sub-districts Telaga and Kabila have no traffic signs and road markings. Traffic signs and road markings can only be seen on arterial roads.

The livelihoods of people in Kabila sub-district tend to be homogeneous. The average daily traffic or traffic volume in this region, especially the Jalan Sultan Botutihe, i.e., a road connecting Kabila and Buludawa sub-districts (Suwawa sub-district) has decreased. Further, the orientation of traffic movement has shifted to the northern part of Bone Bolango County. This is allegedly due to the shift of the central government area of Bone Bolango Regency. The central government was initially located in Suwawa sub-district (the office was also relocated to Tilongkabila sub-district). In addition, the Gorontalo Provincial Government office facilities are gradually relocated to the northern part of Bone Bolango Regency, specifically in Tapa subdistrict. Another factor causing a decrease in the traffic volume at Jalan Botutihe is the preference of the road users to pass the northern areas for government administration purposes. This situation also affects the physical development of space in Kabila sub-district.

3.8. Analysis of Peri-Urban Area Morphology

Land use is among factors to consider in analyzing morphological types in peri urban areas. This factor also functions to explain the spatial distribution of residential mobility [18]. Characteristics of the peri-urban area of

Telaga and Kabila sub-districts depict the quality of the rural areas and urban areas. Both sub-districts areas are growing due to contributions from the capital of Gorontalo city. Still, agricultural activities still dominate in the two peri-urban areas studied. The analysis shows that the pattern of roads in urban units is classified as linear and integrated with a grid road system. When viewed from the hierarchy level, land use for services and trade activities located around the main road (A.A. Wahab and Sultan Botutihe Streets) is the highest hierarchy. The pattern of land use from the peri-urban area in Telaga sub-district is octopus/star-shaped (a combination of concentric pattern and linear). Meanwhile, the land use pattern of peri urban area in Kabila sub-district is linear pattern (southern part) and leapfrog (northern part). The initial developmental patterns of these two peri-urban areas were studied. The development is horizontal in its character, and the road planning implements vertical development. This situation is determined by the condition of the density of the buildings and the price of the land compared to other parts of the city. Government Regulation No. 12 of 2012 and Provincial Regulation No. 1 of 2014 on the protection of sustainable agricultural land on incentives ensure the sustainability of agricultural land.

The policies previously mentioned are intended to limit

the expansion of urban space and give protection against land sales [21]. Land sale also causes the loss of agricultural land [22], loss of rural areas, especially in the main urban areas [23], and environmental degradation [24] vulnerability in unplanned settlements areas in peri-urban areas [25]. Currently, transport routes from all directions are focused on this zone, meaning that Telaga sub-district has a high accessibility level, which contributes to the urban development in peri-urban areas.

In 2005, the settlement or the development area in Telaga sub-district reached 242.41 ha with a building density level reaching 0.078 (Figure 12), and in Kabila sub-district, the area was 334.75 ha with a density level of 0.056 (Figure 13). There was a change of settlement land as development area in Telaga sub-district (291.59 ha) with the building density level of 0.12 (Figure 14), and in Kabila sub-district the development area was 380.34 ha with density level reaches 0.07 (Figure 15). In general, the development of the land was well established in both sub-districts, which directly adjacent to Gorontalo City. This indicates that the peri urban area is heavily influenced by the main city, that is the City of Gorontalo. Thus, it cannot be denied that the development of the two peri-urban areas has implications for changes in the appearance of the two sub-districts.

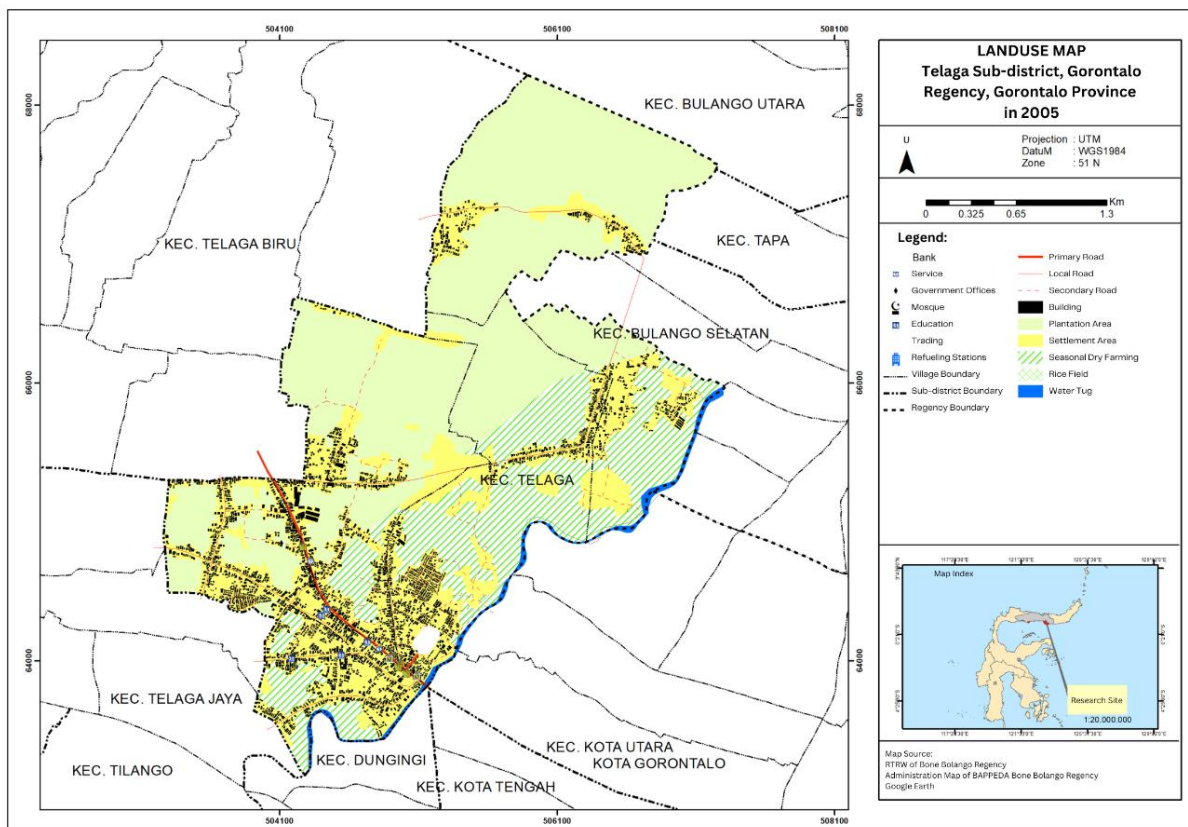


Figure 12. Map of land use and built use in Telaga Sub-District, 2005

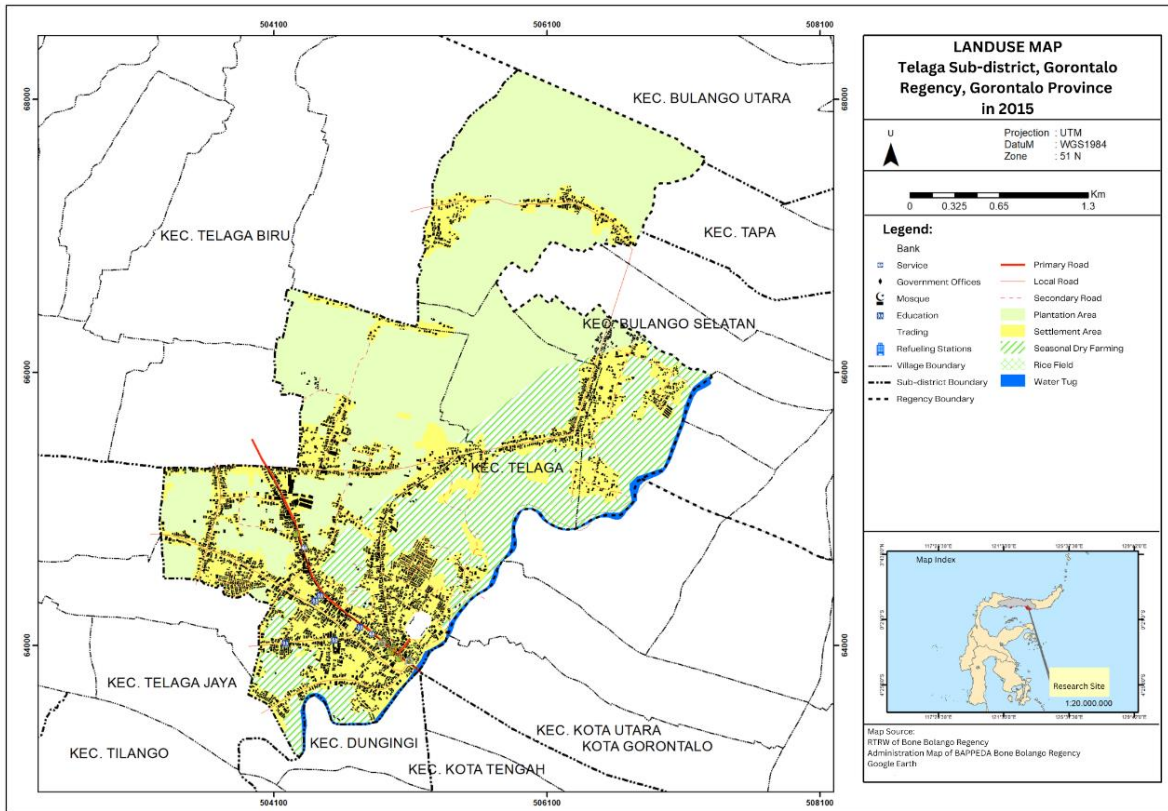


Figure 13. Map of land use and built use in Telaga Sub-District, 2015

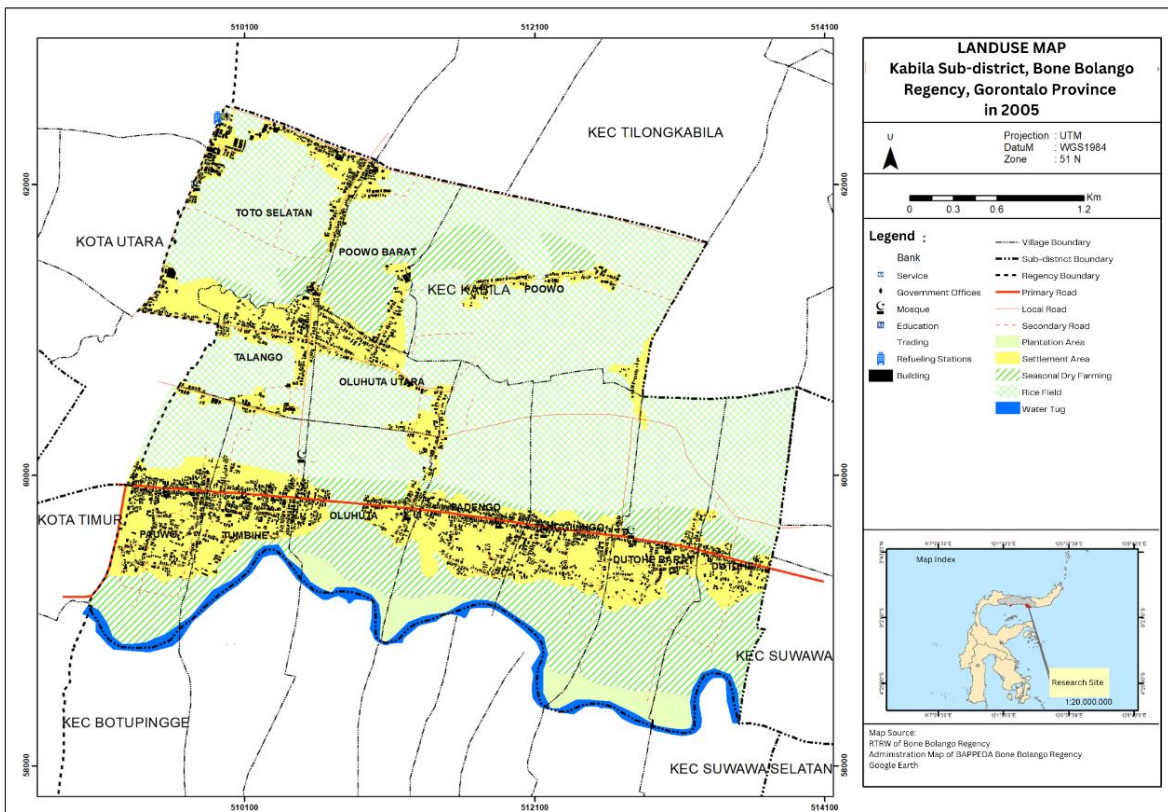


Figure 14. Map of land use and built use in Kabila Sub-District, 2005

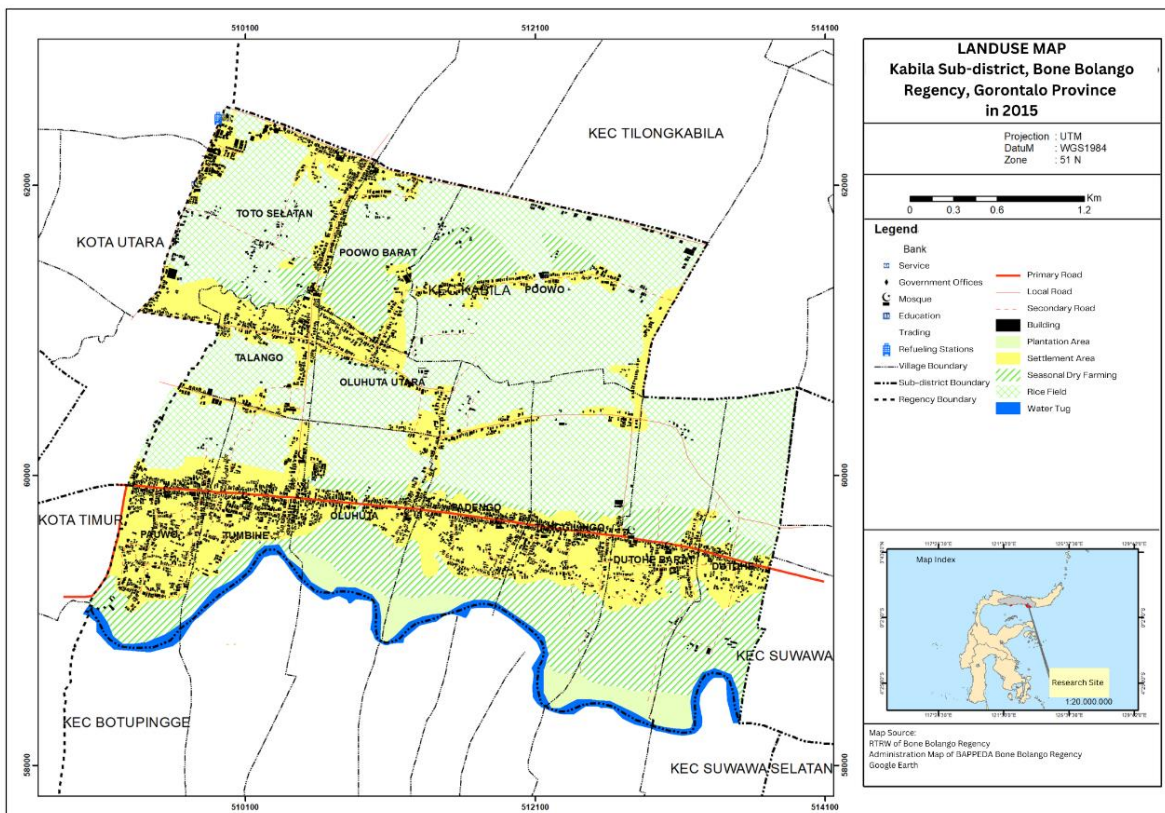


Figure 15. Map of land use and built use in Kabila Sub-District, 2015.

4. Conclusions

Based on the research results and discussion, it can be concluded that the development of the peri-urban area in Telaga District is heavily influenced by the accessibility of the area. Further, the location is very strategic (it is located in the middle of two developed cities in Gorontalo Province, i.e., Gorontalo city and Limboto city). The existence of primary arterial roads that cross the district serves as the main access to main facilities, such as Jalaludin Airport. Kabila sub-district is the area receiving significant impact because of the proximity of the distance between Kabila sub-district with the city of Gorontalo.

Further, the morphological form in the two peri-urban areas studied is significantly influenced by Gorontalo city. The morphological indicators of peri-urban areas (WPU) in Telaga and Kabila sub-districts can be described as follows: (a) The utilization of the land within ten years for urban development purposes in Telaga and Kabila sub-districts was increased by 5% (49.18 ha) and 3% (45.58 ha), respectively. (b) The characteristics of settlements in the peri-urban area of Telaga and Kabila sub-districts can be classified into two parts: first, the settlements in the arterial road form the house group (*ngala'a*) and the wall fence as a symbol of the territory between *ngala'a*. Secondly, the settlement is located far from the arterial road with the characteristics of semi-permanent and non-permanent

buildings, simple building structures, traditional architectural styles, and low building densities. (c) Characteristics of building use for tertiary sectors (trade and service) in Telaga sub-district are more common than Kabila sub-district. In addition, stalls and agricultural business buildings (primary sector) in Telaga sub-district are not that common compared to Kabila sub-district. (d) Generally, the street pattern in the peri-urban area has a linear path pattern. The development of this peri-urban area seemed unplanned. The situation is understandable since these two areas were initially agrarian villages and hinterland areas of Gorontalo city.

Furthermore, Telaga and Kabila sub-districts are two peri-urban areas that tend to be banded. Settlements and buildings are spread out in small groups and tend not to have regular urban spatial patterns. The spatial pattern of the city still has a connection with rural traditions and is traditional in nature.

5. Suggestion

It is necessary to carry out further research related to the role of transportation and changes in road patterns and circulation orientation in peri urban areas as it greatly influences the physical morphology of cities. Meanwhile, land use as built-up land should apply the concept of

vertical and interstitial development, in which existing buildings must comply with detailed local spatial plans so that agricultural land can be maintained and remains sustainable.

The development of the city will have an impact on the surrounding area, especially the suburbs (peri urban). Peri urban areas can be identified based on the characteristics of peri urban areas, which will then look at the morphological components and identify the factors that influence the shape of the city. This is due to the availability of green open space in the form of rice fields and dry fields in peri urban areas.

The novelty of this study is to reveal the influence of community solidarity values on the development of urban morphological elements. Therefore, the results of this study can be used as a basis for the development of further research that refers to the development of urban morphology. The method in this study is an appropriate way to express the influence of physical aspects and socio-cultural aspects on urban development. At the practitioner level, there should be an understanding on the main aspects that must be considered in settlement planning to form an integrated spatial arrangement. As a result, there will be a creation of communal spaces that are integrated between the environment and social culture of urban society.

6. Recommendation

Based on the findings, this study provides several recommendations to be followed up by the government and subsequent researchers.

Firstly, the existing condition of Kabila Subdistrict must be maintained to maintain the microclimate and natural balance in the form of food and water supply by making measured and controlled land use so as not to change the face of the city. Thus, it is necessary to find a grand-design of a sustainable city.

Secondly, natural population growth and migration processes tend to accelerate urban development which can increase population density and the number of buildings in both peri-urban areas.

Thirdly, Telaga Subdistrict is changing more quickly when compared to Kabila Subdistrict or the urban appearance in the peri-urban areas of Telaga Subdistrict is more visible than Kabila Subdistrict. This indicates that the influence of urbanization on morphology in the peri-urban area in Telaga District is higher when compared to the peri-urban area in Kabila District. Changes in Telaga Subdistrict can be followed up by conducting further research on the existence of Telaga Subdistrict between the two main urban centers, including Limboto City and Gorontalo City by looking at changes in people's socio-cultural behavior, economy, life style, transportation circulation and city characteristics.

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