

Type of Urban Ecosystem Based on Land Use: A Study in Mapanget sub-district, Manado City

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Abstract. The developments that occur in Manado city, have an impact on changes in existing urban ecosystems and land use. Mapanget sub-district is an area adjacent to the suburbs, when viewed from the ecosystem typology of the land use with plantations, but due to developments in the city center, land changes and land use in the Mapanget district have changed the typology of existing urban ecosystems. The purpose of this study was to analyze land changes and land use in Mapanget sub-district in order to determine the typology of urban ecosystems. The method used is descriptive. To be able to analyze land changes and land use Arc Gis 10.3 software was used with supporting data, namely the 2002-2018 satellite imagery map, 2007-2016 land use map. Based on the results of the analysis, the changes in land use from 2002 was 86.95% reduced to 74.26%. Built land in 2002 was increased from 13.05% to 25.74%. The use of residential lands significantly increases from a land area of 394.09 ha to 733.05 ha. Research shows that the typology of urban ecosystems in Mapanget sub-district consists of absorption typology for around 1395.62 Ha (26.96%), composite ecosystems for approximately 40.54 Ha (0.78%), and production ecosystems around 3740.67 Ha (72.26%). Hence, the typology of production ecosystems is the most dominant changes in land use and more directed to the ecosystem typology of absorption, while land accretion is built at 25.74%.

1. Introduction

The development of Manado city space has an impact on the changes in Manado's urban ecosystem and existing land use. Such as protected areas that turn functions into cultivation areas, Changes in land use such as forests change into settlements, trade and services, industries etc. Mapanget sub-district is an area located near to the suburbs area, an area located near to the suburban area identical to the land that has not yet been built. But as time went on, development in the city of Manado resulted in changes in land use in this region, which was once identical with the use of agricultural land, turning into a densely populated area. Since the Mapanget sub-district was established as a new city in Manado based on Mayor Decree No.128 / Kep / B.01 / BAPELITBANG / 2017 regarding the delineation of the new city of Manado, saying that the development of the new city of Manado will be directed at Mapanget sub-district, with an area of around + 5,160 Ha consisting of 10 Sub-Districts to prevent uncontrolled settlements (urban-sprawl), prior to the issuance of a letter from the Mayor, Mapanget Sub-District



already listed in the Manado Spatial Plan for 2014-2034 that Mapanget sub-district was designated as KASIBA (area ready to build). The typology of urban ecosystems includes several classifications of cities according to their land use, namely the typology of natural ecosystems, production, absorption and composites. The typology of urban ecosystems that viewed from land use in 2002 is identical to green open land, agriculture, and plantations but because of developments resulting in land changes and land use occur. The typology of the urban ecosystem in Mapanget sub-district will be what it looks like in the future when viewed from land changes and land use. From the problems mentioned above, the author feels interested in analyzing the ecosystem typology existing of Mapanget sub-district, if it is examined from changes and existing land use. The objectives of the study were: To analyze land changes and land use in Mapanget sub-district and to determine the typology of urban ecosystems based on changes and land use in the Mapanget sub-district.

2. Discussions

Jayadinata (1999) concluded that land use consists of 2 (two) elements, which is: use which means structuring or regulating usage, human and land resources which means space, and requires the support of various other elements such as water, climate, soil, animals, vegetation, minerals, etc. Thus, in principle, land use is calculated by cultural geography or social geography and natural geography and relations between humans and nature. Riddel (1981) stated that there are four types of ecosystems that are distinguished by physical characteristics, functions and resources needed. The four types are Absorption ecosystem, Production ecosystem, Composite ecosystem and Natural ecosystem. Absorption Ecosystem (Urban and Industrial) is an urban and industrial community ecosystem, which is characterized by the consumption of resources that can and cannot be recycled. Environment depends on multiple resources like sunlight, raw materials, especially food, minerals and energy, and produces solid waste, liquid waste, and gas that is returned to nature around the city and factories. Production Ecosystem, included in this ecosystem are agricultural areas in the suburbs or areas within cities that are used for agriculture, including agribusiness. Composite Ecosystems (rural settlements) is a natural rural environment, consisting of houses, fields, forests, rivers, mountains etc. Natural Ecosystem is a natural environment that is dominated by forests, mountains, deserts, and areas in the northern or southern parts of the world which are only a small part inhabited by humans.

Sujarto (1989) proposed that development and growth factors that work in a city can develop and grow the city in a certain direction, there are three main factors that determine the pattern of development and growth of the city, including first, human factors, which are related to aspects of urban population development both due to birth and due to migration to the city. Aspects of workforce development, development of social status and development of knowledge and technology capabilities. Second human activities, which are related concerning aspects of work activities, functional activities, urban economic activities and broader regional relations activities. Third, movement patterns, which are related as a result of developments caused by the two factors of population development accompanied by the development of functions of their activities will require a pattern of communication between the centres of these activities.

2.1. Materials and Methods

Descriptive methods are used using a spatial/spatial analysis approach. By compiling data on research variables, namely satellite image data, RTRW land use, existing land use which is then analysed using supporting software with spatial/spatial analysis approaches to obtain changes and land use area. This method also helps determine the typology of percutaneous ecosystems by sorting land use and classifying land use types according to variables based on urban ecosystem typology theory and then using ArcMap applications to draw descriptions and calculations for analysis.

One of a spatial analysis method used in this study is the process of overlaying between two or more maps. By using time series maps and existing condition maps. This analysis was used to determine land changes in Mapanget sub-district. By overlaying the map, we can find out the locations that have changed.

2.2. Research location

Mapanget sub-district is one of the sub-districts in Manado City. Mapanget sub-district administratively borders with: North side with North Minahasa Regency, East side with North Minahasa Regency, South side with Paal Dua District, North Minahasa Regency.

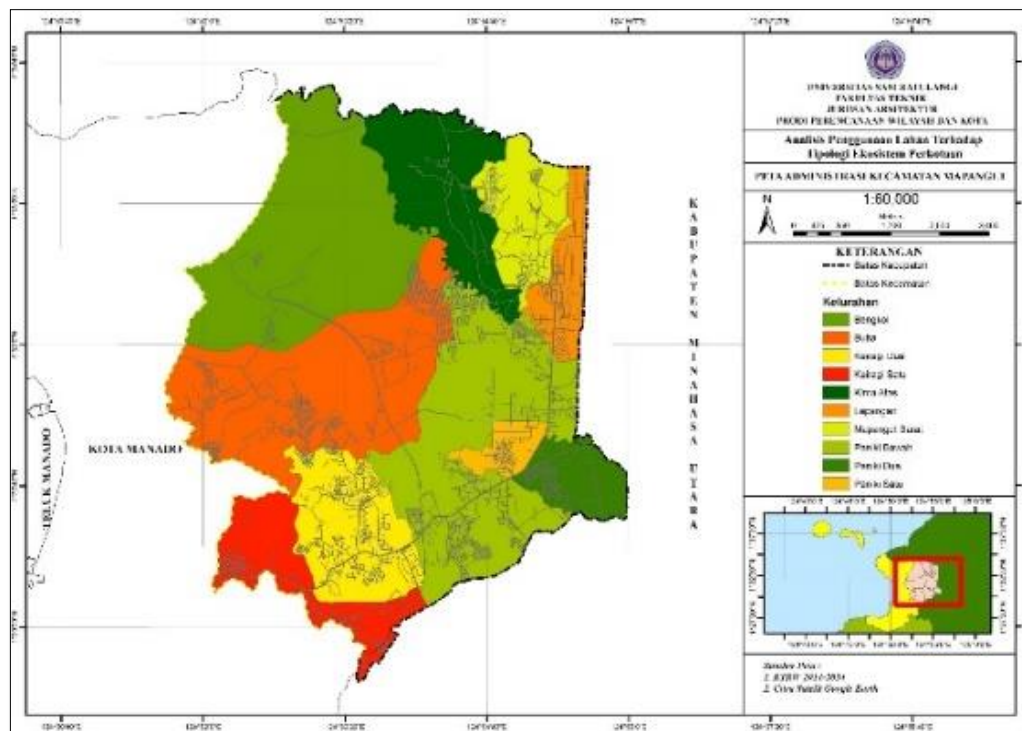


Figure 1. Administrative Map of Mapanget District

Source: Author 2018

As for some research variables as follows, namely changes in land use and urban ecosystem typology, to be more clearly seen in the following table. However, the typology of urban ecosystem variables is more emphasized to determine the typology based on Riddel's theory (Riddle, 1981).

Table 1: Variable Typology Ecosystem Urban

Urban Ecosystem	Variable	Indicator	Data source
Absorption Ecosystem	Area that have Urban Character	Settlement	Observation
		Social Facilities	
		economic activity	
		Industry	
Production Ecosystem	Agriculture, Plantation, Fertilization	Types of Plantation	Observation/ Relevant agencies
	Agrobisnis	Agriculture Business	

Composite Ecosystem	Rural Settlements	1. residential building 2. spacious yard 3. the existence of gardens on the left and right of the building 4. the composition of plants in the garden is multi variate 5. the existence of a connecting road between neighbors. 6. Low building density. 7. distance between relatively remote buildings. 8. Diversity of Livelihoods 9. Fulfilled Needs from local natural resources 10. Less Dense Population 11. Rice Fields	Observation
Natural Ecosystem	forest, the mountains and desert		Observation

Source: Author 2018

3. Analyses and Results

3.1. Changes in Land Use in Mapanget District

Overlay analysis is an analysis of overlapping maps, the authors use satellite imagery maps namely maps of 2002, 2007, 2012 and 2018. Maps obtained from satellite images digitized into built-up land maps and not built land are then analyzed using Geographic Information Systems, namely map overlays. to analyze changes in land use the author uses several supporting maps : Mapanget sub-district land use maps in 2007, 2010 and 2016 then author digitizes that map using geographic information system analysis to obtain calculations and classification of land use so that changes in land use in Mapanget sub-district can be known.

3.2. Land Built in Mapanget District in 2002

For land use in 2002 based on the results of the land development digitization using arc gis 10.03 using the 2002 satellite imagery map, it was found that the built land was 680.36 ha (13.05% of the total area) and the unbuilt land was 4531.15 ha (86.95% of the total area).

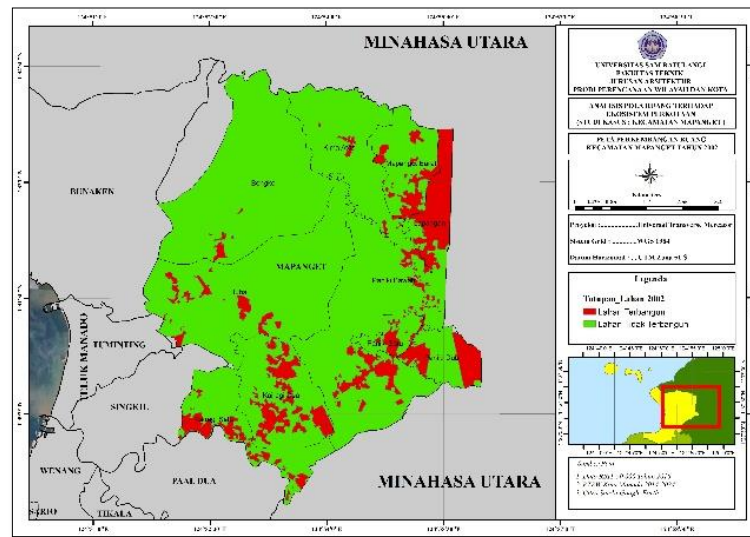


Figure 2. Map of Land Built in Mapanget sub-district in 2002. Source: Author 2018

3.3. Changes in 2007 Mapanget Sub-district land

In 2007 Lapangan sub-district has not have increased number in land change which is still with an area of 159.35 ha (21.17% of total area), while land expansion occurred in Kairagi Dua sub-district which in 2002 amounted to 124.82 ha to 138.61 ha and the smallest land change was in Bengkol village with the area of land built is 10.54 ha (1.40% of the total area).

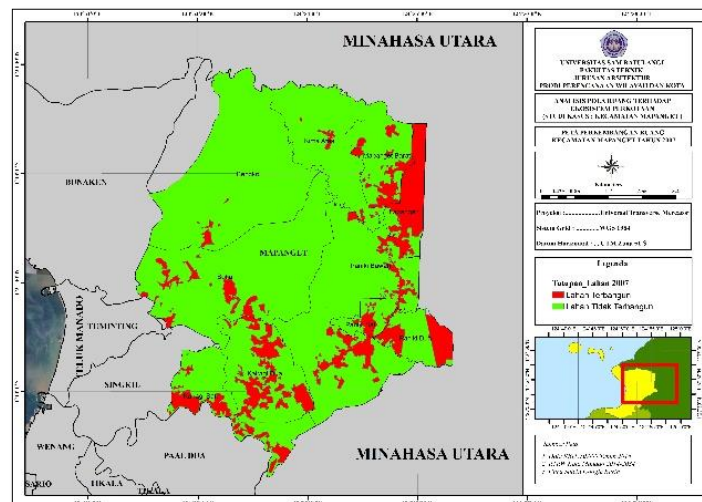
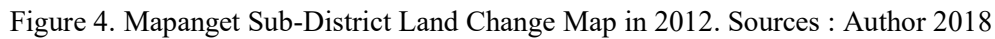


Figure 3. Mapanget Sub-District Land Change Map in 2007. Source: Author 2018

3.4. Changes in 2012 Mapanget Sub-district land

The results of digitizing land use using a satellite imagery map in 2012. Land use in 2012 made a significant change, namely from the built land in 2007 which amounted to 14.43%, increasing 5.69% to 20.12% making the area of land use built at 1049.61 ha which only had an area of 752.74 ha in 2007.

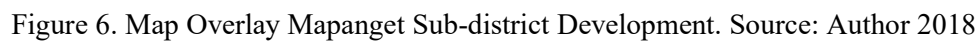


The use of built-up land is 1342.93 ha (25.74% of the total area), the increase in the area of built-up increases significantly, the increase in the area of land built is 5.62%. while for land that is not built it decreases. Land not built in 2018 amounted to 3874.15 ha (74.26% of the total area).

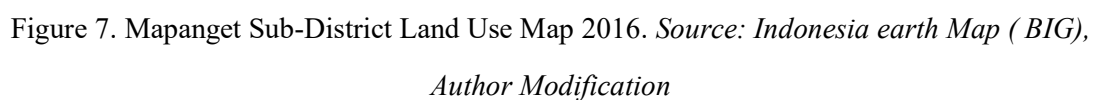
Changes in land in Mapanget sub-district, namely the area of land change from 2002 to 2018, the development center is in the Paniki Bawah sub-district, with an area of 704.45 ha (40.78% of the total area) while the smallest change is in the upper Kima area 23.9 ha (1.38% of the total area) results obtained based on the map overlay results.



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Identifying the land use of Mapanget sub-district the author uses the 2016 land use map, while analyzing land use changes the author uses the 2007, 2010 land use map, the 2014 RTRW land use map and the 2016 map.



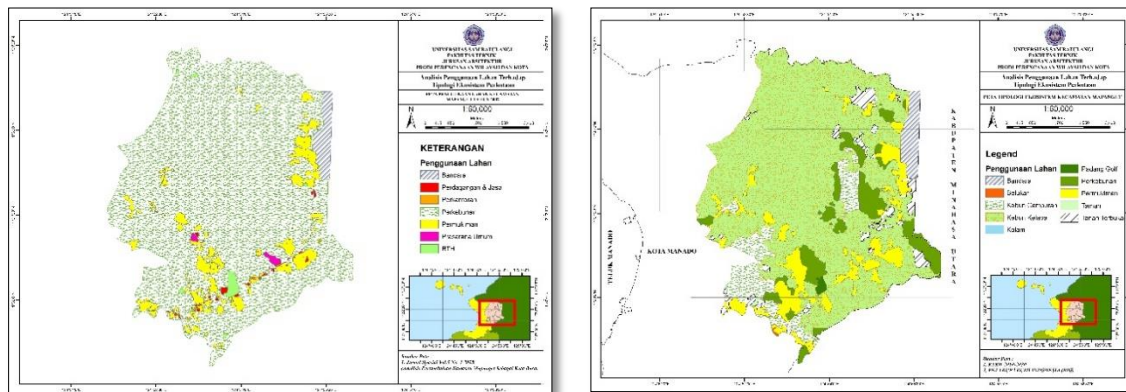


Figure 8a and 8b. Mapanget Sub-District Land Use Map 2007 and 2010

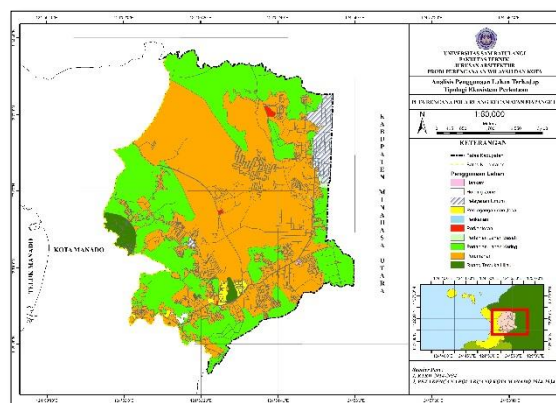


Figure 9. Mapanget Sub-District Land Use Map 2014. Source: RTRW 2014-2034, Author Modification

Changes in land use from 2007 to 2016 with data analysis using ArcMap 10.3 with the results of digitizing as follows, residential land use is developed significantly from 2007 with the area of use of settlements amounting to 394.09 ha and increased in 2016 to 733.05 ha.



Figure 10. Development in Mapanget Land Use in 2007-2016

Source: Author, 2018

The author also uses the Manado City RTRW space pattern map for 2014-2034 to see developments or comparisons with existing conditions with the plans that have been set. To see the changes in the plan for the Mapanget District space pattern, the author returned to digitize the map using ArcMap.

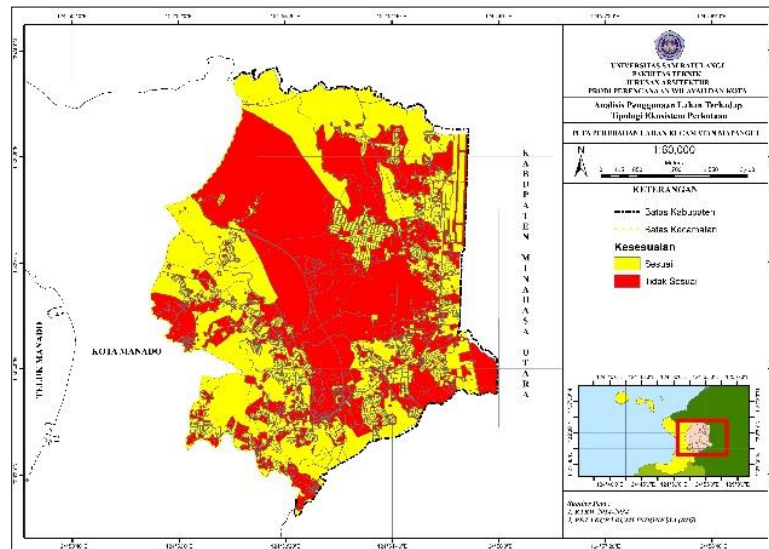


Figure 11. Overlay analysis of Mapanget Sub-District Land Use Map 2014. Source: Author. 2018

From the results of the analysis using the overlay analysis method for land use maps of RTRW Figure 4.29 and the map of Indonesian land use, namely Figure 4.26, the map of land use in Mapanget sub-district in 2016, the results of land use change were 2648.57 ha of total area. The most dominant changes are residential land use and dryland agriculture. For suitable land use, 2306.79 ha and for inappropriate land use are 2648.57 ha. The information can be seen in table 4.25 and figure 4.30 below.

3.8. Typology of Urban Ecosystems in Mapanget District

The analysis to determine the typology of urban ecosystems in Mapanget sub-district is using the indicators in the variable. The 2016 land use map also supports the analysis because the land use classification is the same as the indicator that will be observed later. The results of the analysis of the ecosystem typology of absorption were 1395.62 ha, composite ecosystems were 40.54 ha and production ecosystems were 3740.67 ha. The following is a table of merging of each existing urban ecosystem typology in Mapanget sub-district.

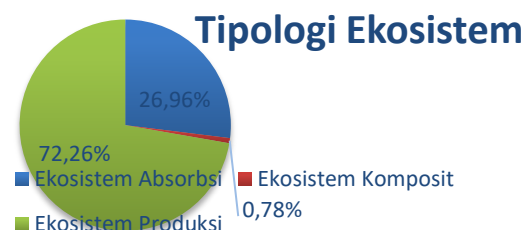





Figure 12. Percentage Of Ecosystem Typology in Mapanget District. Source : Author 2018

Table 2. Urban Ecosystem typology in Mapanget Sub District

Absorption Ecosystem Area that have Urban Character (Settlement, Social Facilities, economic activity, Industry)	
Production Ecosystem Agriculture, Plantation, Fertilization & Agrobisnis (Types of Plantation, Agriculture Business)	
Composite Ecosystem Rural Settlements	

Source :Survey Result, Author 2018

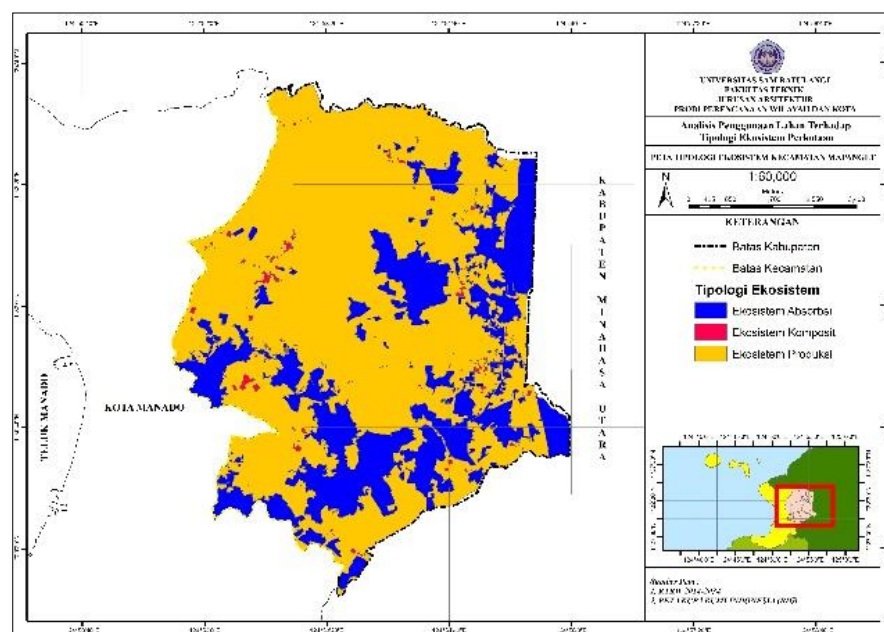


Figure 13. Mapanget Sub-District Typology Map Using GIS Analysis

Source : Author 2018

From changes in land use in mapanget sub-district from 2002 to 2018 the typology formed in the sub-district, namely 3 typologies, the two typologies between them began to change into typologies that influenced the factors like population increase, and economic activities in Mapanget sub-district.

4. Conclusion

Based upon analysis, changes in land use from 2002 amounting to 86.95% reduced to 74.26%. Built land in 2002 was increased from 13.05% to 25.74%. The development of built land leads the sub-district area to still have open lands, like in Bengkol, Buha and Kima Atas, while for Paniki sub-districts is the most developed sub-districts from 9 other sub-districts. Land use development is significantly increased by land area amounting from 394.09 ha to 733.05 ha. The use of open land, like plantations, green open

spaces, and agriculture has diminished and changed into built-in land which includes planned residential-land use, settlements, offices, trade and airport services and public infrastructure.

Typology of urban ecosystems in Mapanget sub-district consists of three types of urban ecosystem namely absorption typology of 1395.62 Ha (26.96%), composite ecosystems of 40.54 Ha (0.78%), and production ecosystems of 3740.67 Ha (72.26%). The typology of production ecosystems is the most dominant, however changes in land use are more directed to the ecosystem typology of absorption, where land accretion is built at 25.74%. Land development growth is due to developmental factors from the city center which made the population in Mapanget sub-district increase from 2002 for 23,789 people to 58,806 in 2016, the number and area of each housing in 2006 as many as 24 housing increases so that in 2016 These 40 housing factors influence the increase of Absorbent ecosystem typology so that the production ecosystem decreases due to developments and changes in land use.

Some recommendations to the city government of Manado when making decisions, for instance the stakeholders must consider all aspects of change from the developments that took place in the Mapanget sub-district, namely from the aspect of population and activities. Viewed from the aspect of activities related to land use, like plantation land is decreasing which can result in the loss of community livelihoods that depend on plantations. Second, regulation is needed so that the function of the Mapanget sub-district that identical to green open space and agriculture which is almost characteristic of peri-urban areas will not completely disappear so Manado will not become a city that is only filled with buildings but still has open spaces to support Manado as a sustainable city.

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