

Urban Sprawl In Palu City

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Abstract. The development of the city is identical with the physical aspect in the form of area construction horizontally and vertically. Population growth is a major factor in the expansion of the developed land. The relatively constant area of land results in land-building activities by city dwellers leading out of the city center. Understanding the urban sprawl is the core of this study. The main objective of this research is to study the urban sprawl by identifying the distribution and extent of physical changes of the buildings as well as the type of the distribution. This research uses spatial approach with survey. Data collection is done by examining remote sensing data (satellite imagery) and using map overlay technique in spatial data analysis. Quantitative descriptive analysis becomes a follow-up of sample data that has been collected.

Keywords : Urban Sprawl, Remote Sensing, Quantitative Descriptive

1. Introduction

City is an interesting area in terms of the complexity of the problems it has. The increasing urban population has consequences in the provision of space as a place for activities, both for shelter and as functional activities such as economic facilities and services. Changes in land use (conversion) become logical as the urban population increases. The city development speed is influenced by many aspects, such as the landscape, population characteristics, and policies. The point of view that can be the basis for assessing the city is the assessment of the city physically, socially, economically [1], its sustainability, and aesthetic value [2]. The problem that often arises in this kind of development is the depletion of productive land area, both in the area within the city itself and in other areas around it.

The demands of the space provision by the residents of urban areas according to [3] can be considered in two ways, namely (1) the spatial consequences physically, which in terms of the process, is divided into two kinds; spatial development process horizontally and vertically; (2) and spatial consequences of juridical-administrative, which creates conditions over bounded city, true bounded city, and underbounded city. The factors of need, progress of education level, to the propagation of ideas resulting from interaction with other areas are some things that strongly influence the changes and development of the city [2]. The implications of some of the above factors result in the identification of identified cities into two developmental processes, namely the outward extension and the internal reorganization.

The development of urban areas is closely related to the changes that subsequently occurred in the surrounding areas, especially in the suburbs and even in areas far from the main land area, i.e. rural areas. Residential mobility and functional mobility of the population are the factors which trigger the development of the urban areas. Concentration of activity is the basis of the development of a city [17]. The existence of the power of urban spatial changes (centrifugal, centripetal, and lateral), both as drivers and towers, is highly correlated with the intensity of physical changes occurring in urban areas. There are at least six (6) main factors of spatial variation of physical development of the city according to Lee, 1979 [3], namely (1) the existence of public facilities, (2) accessibility level, (3) existence of certain rules, (4) physical land characteristics, (5) characteristics of the land owner, and (6) the developer initiative.

The changes that occur on the basis of some of the determinants have a significant effect on the pattern of the physical appearance of a city. The effect is proven when the process of physical urban and physical exposure take place outside the main waking region (urban

sprawl). [3] mentions that the process of physical urban and physical exposure will give rise to three spatial expressions of urban development, :concentric spatial development, linear spatial development, and leapfrog development.

Uncontrolled urban development generates a variety of urban issues, such as urban sprawl, slum area, squatter settlement, to crime. The issues are broadly related to the physical formation that focuses on the physical spatial conflict entity (the problem of physical space unity) as a result of mutually stimulating social and spatial changes [6]. The availability of land and environmental capacity are the two things that need special attention in the development of an urban area or region. Further explanation is given by [6] that the design of the form of the city needs to be emphasized on its environmental, functional, and visual aspects. This is related to (1) Singularity; lack of clear boundaries, (2) Continuity; related to the function of the city, (3) Simplicity; clarity and coherence morphology and typology, (4) Dominance; Character (5). Clarity of joint; node connectivity, (6) Visual scope; Land or open space, (7) Directional differentiation; a variety of physical formations arrangements, (8) Motion awareness; emotional drive capability for its citizens.

Specifically in this research, the study of the city will focus on the physical development of the urban form of urban sprawl. The distribution and typology of urban sprawl can be assumed as the initial process of physical development of urban area. The factual condition is associated with the spatial condition of the local population which can then be used as a basis for consideration for sustainable urban development.

2. Materials and Methods

This study used survey method with spatial approach as the basis for analysis. The basic materials of this study were ALOS in 2012 and Worldview in 2016. The availability of data is the reason for the use of the two images. The built up land variable becomes the important data taken from both images. Variation of land cover was built to be classified into 2 areas namely settlement and trade. Both of these areas are assumed to be the main products of the growth of the city's population from all its activities. Identifying the extent of changes in the two regions is the basis of the analysis in this study. The extensive change data were followed by analyzing urban typology based on the classification of compact, elongated, and leapfrog. Mechanical map overlay becomes a way to get the results used in this analysis.

3. Results and Discussion

Palu is the capital city of Central Sulawesi province, Indonesia, located on 0.35° to 1.20° N and 120° to 122.90° E (BPS, 2016). The area of Palu City covers some coastal areas of the Gulf of Palu, where the administration is divided into eight (8) districts with forty-six (46) wards. As the capital, the region has experienced significant urban development. It is characterized by the increasing rate of population growth as well as the increasing use of changes, especially the wake land. Variations in the growth of land built in this region are the evidence of high regional development. One of them is the type of land built for residential and commercial areas. The widespread change of the two areas of built land became the basis for analysis of urban development in Palu City. The general purpose of this research is to know how the process takes place.

3.1 Population Growth in Palu City

The concrete manifestation of activity was marked by widespread population of undeveloped land (built-up area). The intensity of the comprehensive settlement gain is correlated with the population growth. The growth of urban population, either from natural increase (births and deaths) and urbanization, supports sub-urbanization to the outskirts of the city [11].

The increase in population of Palu City during the last 26 years amounted to 16%. The percentage is shown by the change of population from 199,495 inhabitants (1990) to 368,086 inhabitants (2016) [12]. Besides the natural growth of the city, the interaction with other areas is identified to be another thing that accelerates the increase of population. The interaction with other regions here refers to how the city of Palu is affected by more advanced regions in the surrounding areas such as South Sulawesi (Makassar) and North Sulawesi (Manado). This influence then leads to the structural change of the population economy, therefore, various economic activities of the developing population have an impact on the regional changes both physically and socially (Iwan Alim Saputra, 2014). However, the characteristics of the coastal city area made the development of Palu City generally limited. The pattern of densification (compaction) occurred in this region is detected only in a few regions. East Palu Sub-district is the most populated area (69,261 inhabitants) in 2016 [12].

3.2 Development of Palu City Urban Area

Physical urban growth can be divided into five types: infill, isolated, linear branches, and clustered branches (Ellman, 1997; Antrop, 2000; Wilson, 2002 in Djaka Marwasta, 2014). The type of infill can be characterized by the emergence of land use (especially settlements) on a small scale in urban empty areas. It is mostly caused by the presence of unattended public facilities, such as roads, water pipes, and drainage systems [7]. The development of

infill type is frequently identified with the type of expansion, where the intensity of the smaller land use becomes the difference. The physical form of the city which is then formed from these two urban processes is the appearance of the periphery [7], [8], [9], [10].

Suburban or peri-urban in general is a transition between the region with the nature of urban areas with the nature of the countryside. Besides creating new characteristics, the mixing of urban and rural characteristics in one region can also cause new problems. The substitution of the two properties are feared to have negative effects, especially for rural areas. Changing patterns of land use from agricultural to non- agricultural allows conflicts of interest, both between local people and immigrants, among residents of the city with villagers, or between farmers and developers.

Other urban processes are often characterized by the conversion of non-urban land to urban areas that are located away from the core area of land. This growth starts from the fragmentation of land by the owners and developers. This type of growth mostly occurs in remote areas by considering the value of land. Furthermore, according to DjakaMarwasta (2014), the changes of non-urban to urban interiors are characterized by the interaction of peripheral areas with urban centers that form branched building patterns around new road networks. The physical urban reshaping process is generally classified into three (3): concentric, linear, and leap frogs [3], [14], [16],[17].

A. Distribution of Urban Areas

The urban area's exploitation of the research area can be observed on the following map of changes in trade and settlement areas. Based on the image data of trade area, in 2012 they still concenon several urban villages, such as UjunaVillage, New Village,Siranindi Village, and South Lolu Village. Other areas detected as the average trading area are scattered along the

downtown streets. Some means of trade, whether on a small or medium scale, are identified in such areas, such as the Inpres Market in Siranindi Village, shops in Ujuna Village, PasarTua in New Village, and MasombaMarket and Tatura Mall in South Lolu Sub-district (figure 1). Another mean that represents the spread of trade area is following the path of a road that connects the trade centers. The spatial expressions shown for trading areas in 2012 are generally seen as concentric patterns. This is confirmed by Rifai (2011) who states that the pattern of centering is the beginning of the development of the city of Palu. The development of the region began to change with the spread to other areas by following the path of the road. This concludes that the development of other areas in PaluCity is slightly behind its center. Although the area outside the main buildingis not much detected as trading area, many trade nodesare identified in thecityofPalu. Some of them are Petobo Market in South Palu, Mamboro Market in North Palu, and clusters of shops / stalls / kiosks in Panau Village, Tawaeli District. Special Economic Zone Development (KEK) gives a bigger encouragementto the northern area of Palu City, especially in Tawaeli District.

Based on the map of changes in trading area, the spreadof the general developmentof land follows the pattern of the road network (lengthwise). However, some sub-districts continue experiencing the process of compacting by filling or replacing the functions of adjacent lands. The roadaccessis important in the growth of distribution of the trade area. Changes in trade area indicate that the development of Palu City has increased. The concentric pattern that dominates in 2012 has changed to elongate. Administrative status changes (division) and the improvement of the access quality (roads and vehicle ownership) motivate people to perform economic activity in the "new"region. The intensity of the changes in land use for regional trade shows that there are three broad areas that have significant changes: the District of South

Palu, Palu Barat, and Tatanga (graph 1). Each of them has a comprehensive change of 33.44% (68.74 ha); 29.97% (61.59Ha); and 17.38% (35.73 Ha).

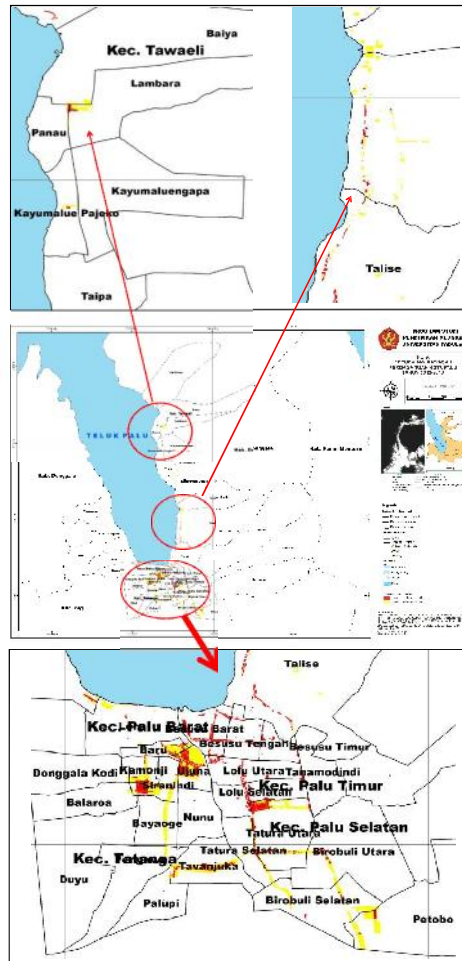


Figure 1. Extensive changes trade area

Another region that became the basis of the identification of spreading the urban area is residential. The land use for settlements in Palu City in 2012 has been spread evenly in almost all areas. Centralized (concentric) compaction is still the main pattern of the development of residential areas in the city of Palu. The downtown area such as, East Palu sub-district, Palu West, and South Palu has almost completely enclosed area settlements (figure 2). The change of administrative status (expansion) have accelerated the rate of

growth of settlements in the area of research, such as in Mantikulore Subdistrict, Palu District of the North, and Tawaeli District. Based on the changes in the settlement area, the urban area of high intensity propagation occurs to the east of the city. Mantikulore Subdistrict becomes the fastest region in the construction of residential areas. Counting the area has experienced a settlement expansion of 140.78 Ha in the 2012-2016 period. This is related with the attractiveness of some public facilities that have a high service life, such as colleges, hospitals, ports and Special Economic Zones (KEK). Compaction is detected from houses spread around the facility with the distribution following the road network expansion from the extension based on each administrative region (district).

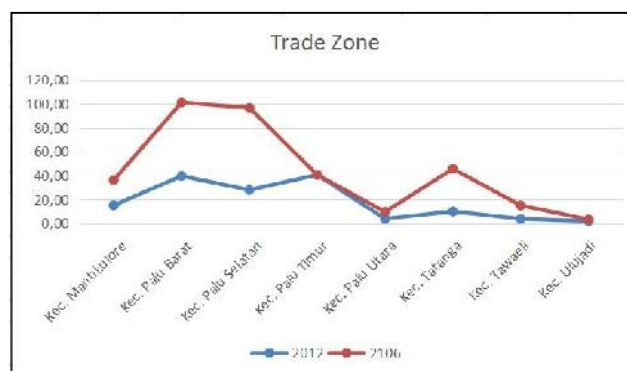


Figure 2. Trade Area Changes 2012-2016

Based on the results of this search, the land constructed for the two areas increased significantly. This is because the lag time from the data that there is relatively close. Mantikulore District has the largest wide spread change among other districts, with an area of 161.89 Ha or 32.79% (chart 2), while the district with the smallest change is West Palu District with 6 Ha or only 1.21%. Being examined from the two land-forming variables built in this

study, the two areas are interconnected. The additional land area for residential areas will be accompanied by an increase in the trade areas.

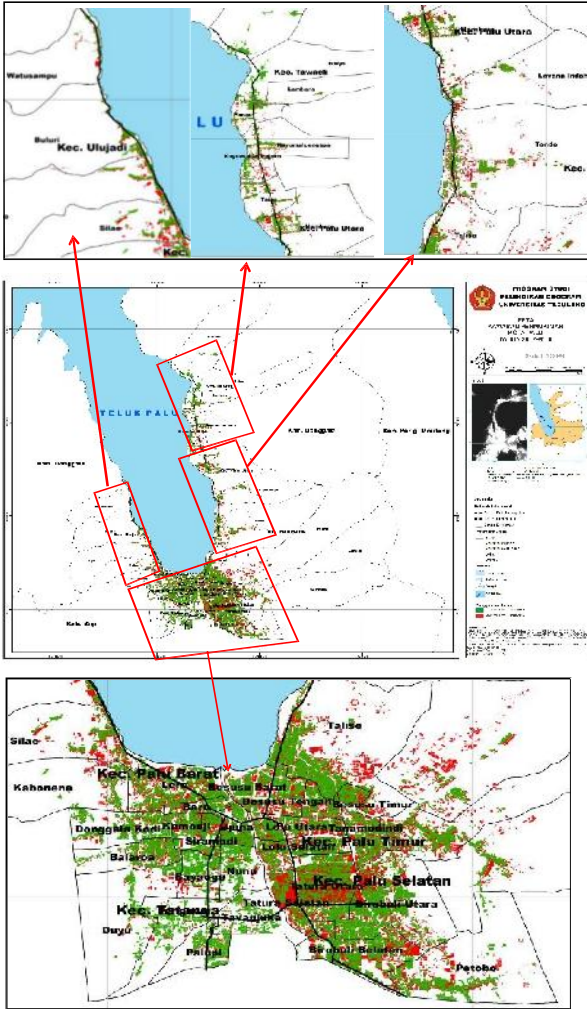


Figure 3. Changes in Settlement Area for 2012-2016

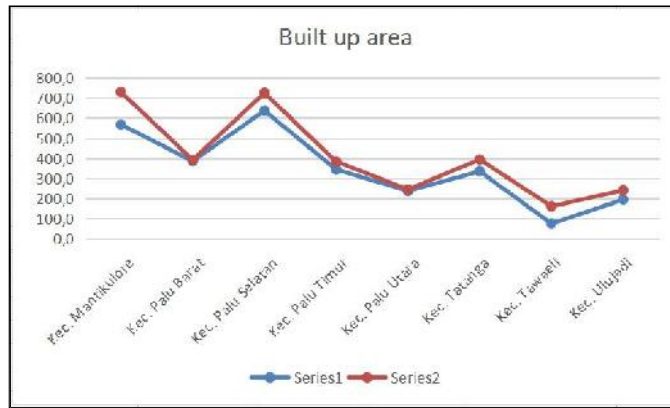


Figure 4. Changes in the built up area

B. Typology of urban area distribution

Based on the results of the analysis of land changes, it can be concluded that the type of the development of the city of Palu is included in the over bounded city. Although the development of urban areas in general can still be controlled, some regions began to show the process of change that is not controlled. This is detected from the results of the built-up land from several region, indicating that the frog jump type is the most commonal most all districts (table 1).The type of frog jumps that occurinal most all of the seareasindicates that the process of development of urban areas has high intensity.This type is able to provide a strong impetus for land conversion,especially land use

Table1. Typology of urban sprawl of Palu City

No	District	Typeofsprinkling				
		I	E	L	C	LF
1	Mantikulo		√			√
2	PaluBarat	√		√		
3	PaluSelata		√			√
4	PaluTimur	√				
5	PaluUtara			√		√
6	Tatanga					√
7	Tawaeli			√	√	√
8	Ulujadi			√		√

Description: I (infill); E (expansion); L (linear); C (clustered); LF (leapfrog)

Another type of development that also has high intensity in Palu City is linear. This type can be regarded as a consequence of the city of Palu which is located in coastal area. North Palu and Uluja disub-districts have the most extensive development of this type. This indication is proven from the development of residential areas of both regions (figure3). This condition occurs because the location of these two areas are on the edge of the beach (Palu Gulf). In addition, they are also traversed by the main connecting line of Palu with other regions. In line with these two things, it can be concluded that the city of Palu has a fairly high development area.

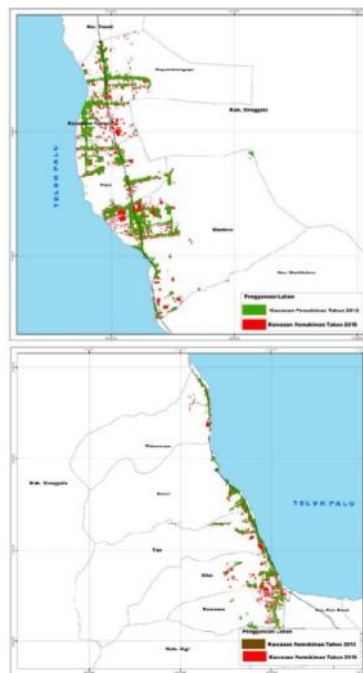


Figure 5. Development of the North Palu District and Ulujadi

4. Conclusion

The conclusion of the research is that the research area (Palu City) is included in the type of over bounded city. However, the development of the physical nature of the city that creeps with the typology of frog jumps needs special attention. This is related to the provision of public facilities and their compliance with the spatial plan. The spread of uncontrolled built-up areas will lead to the problems later on.

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