

# Urbanization and Land Use Changes in Peri-Urban Area using Spatial Analysis Methods (Case Study: Ciawi Urban Areas, Bogor Regency)

D L Cahya<sup>1</sup>, E Martini<sup>1</sup>, and K M Kasikoen<sup>1</sup>

<sup>1</sup>Esa Unggul University, Indonesia

Email: [darmawan@esaunggul.ac.id](mailto:darmawan@esaunggul.ac.id)

**Abstract.** Urbanization is shown by the increasing percentage of the population in urban areas. In Indonesia, the percentage of urban population increased dramatically from 17.42% (1971) to 42.15% (2010). This resulted in increased demand for housing. Limited land in the city area push residents looking for an alternative location of his residence to the peri-urban areas. It is accompanied by a process of land conversion from green area into built-up area. Continuous land conversion in peri-urban area is becoming increasingly widespread. Bogor Regency as part of the Jakarta Metropolitan Area is experiencing rapid development. This regency has been experienced land-use change very rapidly from agricultural areas into urban built up areas. Aim of this research is to analyze the effect of urbanization on land use changes in peri-urban areas using spatial analysis methods. This research used case study of Ciawi Urban Area that experiencing rapid development. Method of this research is using descriptive quantitative approach. Data used in this research is primary data (field survey) and secondary data (maps). To analyze land use change is using Geographic Information System (GIS) as spatial analysis methods. The effect of urbanization on land use changes in Ciawi Urban Area from year 2013 to 2015 is significant. The reduction of farm land is around -4.00% and wetland is around -2.51%. The increasing area for hotel/villa/resort is around 3.10%. Based on this research, local government (Bogor Regency) should be alert to the land use changes that does not comply with the land use plan and also consistently apply the spatial planning.

**Keywords:** Land Use Change, Peri-Urban Area, Spatial Analysis Methods, Urbanization

## 1. Introduction

Rustiadi [1] said that the sub-urbanization in the peri-urban happening more and more around the major cities in Indonesia. The expansion of the urban area to the suburb is often considered as a process that is contradictory, since it is always accompanied by a process of conversion of agricultural land which is very productive. Peri-urban as the area around the big cities is a dynamic zone, due to the conversion of agricultural land is continuously creating mixed land use, as stated by Rakodi in Adell [2].

The urban population in Indonesia has increased significantly since 1971 until 2010. In 1971 the urban population in Indonesia reached 20.7 million people, or 17.42% of the total population of Indonesia, but in 2010 reached 92 million people or 42, 15% [3], proved to have occurred on a large scale urbanization in Indonesia [4]. Considering the limited urban land for urban residents as place for living, then as an alternative to choose peri-urban as a place for living, because it is still possible to



carry commuters daily. As a result, the conversion of agricultural land that occurs in the area around the major cities in Indonesia are very apprehensive. On the other hand, the city grows large and uncontrollably.

In the peri-urban area, which is an alternative place for living of the urban population, the conversion of agricultural land changes into residential land. This condition will reduce agricultural product such as rice for the Indonesia country, in turn, it can be turned into a net importer of rice, which should be self-sufficient rice needs.

In the core cities, the limited supply of amenities of life such as housing, water, electricity and others, makes the working population in the city choose to live outside the city, and the best choice is peri-urban area [5], because while still enabling the commuter daily, dualism atmosphere of cities and villages is still very strong, so the peri-urban area is become a comfortable place to live. The impact will occur daily commuter movements that requires the availability of transport that is fast, easy, cheap and safe, which can accommodate the movement of population in large numbers.

Limitations of the Government to provide land for housing and its various amenities, then the choice of the population residing in peri-urban area needs to be supported by the availability of transport facilities. The dynamics of peri-urban area can also be caused by other things such as an alternative tourist location, comfortable apartment, vacation home, although in the core city population had homes. Conversely, for the working population in the peri-urban area can also perform commuting to the core city, as do various activities, such as trade, schools and others.

Bogor Regency as a part of Jakarta Metropolitan Area is experiencing rapid development [6]. Most of Bogor Regency is an agricultural region. Along with the development of Jakarta Metropolitan Area, most of the population looking for an alternative place to stay in this regency. As a result of land use changes occur very rapidly, from agricultural areas into urban areas.

This situation needs to watch out for in turn agricultural land will be reduced so as to reduce agricultural product and may eventually disrupt food security. This study aims to analyze the dynamics of land use changes in peri-urban areas of Bogor Regency using case study of Ciawi Urban Area that are experiencing land use change from agriculture area into build up area quite rapidly in the last few years [7,8].

## **2. Data and Methods**

To achieve the objectives, the stages of research that will be done is the preparation, data collection, and analysis. Preparation was done by compiling survey instruments, data requirements, and other preparation.

The data used in the analysis of the dynamics of land use changes were primary data and secondary data [9–14]. Sources of primary data consist of field observations, interviews with stakeholders, while secondary data in both softcopy and hardcopy documents and maps. Secondary data sources consisted of relevant institutions, libraries and electronic media.

Analysis of the dynamics of land use change was done by super-impose method using ArcGIS software [15]. The research was conducted in May through November 2016 with a case study of Ciawi Urban Area, Bogor Regency.

### 3. Results and Discussion

#### 3.1. Characteristics of Ciawi Urban Area

##### 3.1.1. Administrative

Ciawi Urban Area consists of 11 villages in two districts, namely the District of Ciawi (Village Banjarwangi, Banjarwaru, Bantarsari, Bendungan, Bitungsari, Ciawi, Pandansari, and Telukpinang), and the District of Megamendung (Village Gadog, Sukakarya, and Sukamahi). This area has boundaries as follows: (a) North: District of Sukaraja, (b) East: District of Cisarua, (c) South: District of Caringin, (d) West: City of Bogor, For more details about the area can be seen in Table 1, Figure 1 and Figure 2.

**Table 1.** Administrative of Ciawi Urban Area (GIS Analysis, 2016)

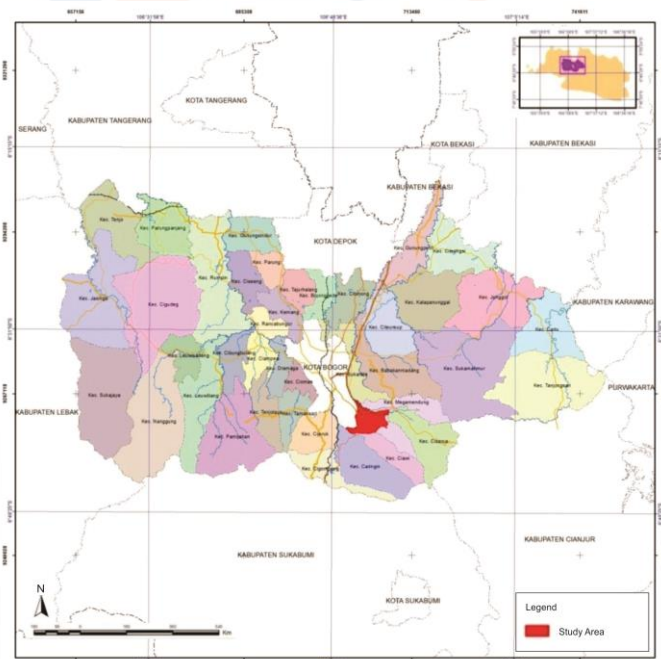
District	Village	Area (Ha)
Ciawi	Banjarwangi	108.08
	Banjarwaru	148.54
	Bantarsari	122.03
	Bendungan	155.87
	Bitungsari	156.05
	Ciawi	145.65
	Pandansari	225.40
	Telukpinang	124.46
<b>Total 1</b>		<b>1,186.07</b>
Megamendung	Gadog	191.97
	Sukakarya	3.35
	Sukamahi	257.89
<b>Total 2</b>		<b>453.22</b>
<b>Total</b>		<b>1,639.29</b>

##### 3.1.2. Position of Ciawi Urban Area

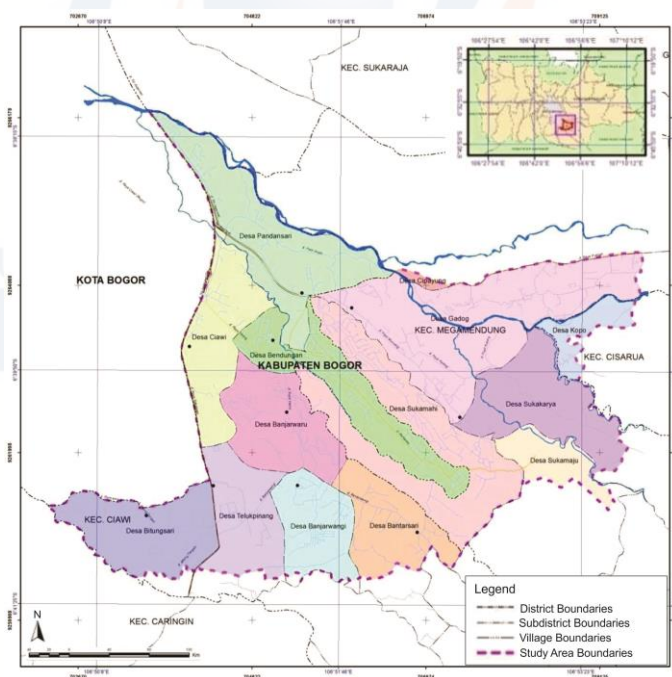
The accessibility of Ciawi Urban Area is high enough, it will attract the development of urban activity. The road from Bogor City - Ciawi - Puncak - Cianjur is the primary road that acts as a regional road. By looking at natural resources that abundant in Ciawi Urban Area, it is a potential as a main attraction for developing tourism activities, as well as the attraction of Puncak area makes Ciawi is crossings for tourists headed to the summit. The problem posed is congestion peaked on holidays such as Saturday and Sunday. With the implementation of the system through the Puncak does not have a significant impact to break the bottleneck.

Neighborhood of Ciawi Urban Area was considerable influence on the development of Urban Ciawi for their system of movement that occurs. Cibinong city which is the capital city of Bogor and Bogor influence on activities in the Ciawi Urban Area. Judging from its functions, Cibinong City is the center of government, trade centers and regional scale services and settlements, giving rise to the movement patterns in the surrounding area. While the Bogor City is the center of trade settlements and regional scale. The orientation of the marketing activities of agricultural production and plantation activities in addition to meeting the needs of local scale also meets the needs of the regional scale.





**Figure 1.** Orientation Map of Ciawi Urban Area



**Figure 2.** Map of Ciawi Urban Area

### 3.1.3. Population

Residents of Urban Ciawi progress was being decreased from the year 2009 had a population of 85 436 inhabitants, in 2010 amounted to 85 453 inhabitants, in 2011 amounted to 85 036 people, the year 2012 amounted to 86 615 inhabitants and in Year 2013 amounted to 87 804 inhabitants. Total population in Ciawi Urban Area in Year 2013 was the most numerous in the Village Dam and the number of people are in the village at least Banjarwangi.

Total migration of population Ciawi Urban Area in Year 2013 were more likely Ciawi Urban Area residents who moved out of Urban Ciawi compared to newcomers. Judging from the number of people coming was as many as 575 people, while the total population was 730 people moved.

#### *3.1.4. Housing and Settlement*

The development of some housing in the Ciawi Urban Area, such as Housing Vimala Hills, a residential development in the Ciawi Urban Area attracts investors to invest, mainly by class developer PT Agung Podomoro Land, Tbk through its subsidiary PT. Adhi Putra Prima. With the concept of the development of villas and resorts which provide 80% of the land as a green open space, Vimala Hills will have 690 residential units.

In Vimala Hills will also be built by Pullman, it is adapted the resort concept. This hotel will be the first five star hotel in Ciawi Urban Area, Bogor. Besides villas and hotels, Vimala Hills will also be equipped with commercial areas, flower gardens, fishing village, deer park, tea house and strawberry fields, children playground, and others. Vimala Hills will also have a traditional market selling vegetables and fruits are organic crop farmers around the site.

Trade and services in the Ciawi Urban Area is still within their jurisdiction. Meeting the needs of people concentrated in Ciawi Urban Area Ciawi market. Ciawi Urban Area community needs can already be met by the availability of local market this. However, problems arising from market activities are centralized bottleneck at one point that is the intersection of Jalan Raya Ciawi and Sukabumi, Jalan Raya Bogor Ciawi and City. With the lack of land market made the proliferation of street vendors (PKL) along the streets around the market.

Ciawi Urban Area trading activities are not only limited in Ciawi Market Center, but also linear along the street. Since their natural tourism area Puncak revive growth in trade and services along the main road. With affordable location make the activities of trade in services is growing series. The dominance of trade and services along this road are the sellers of souvenirs and harvest local area.

The development of trade and services activities makes a special attraction for tourists, because tourists can easily get souvenirs typical of the region.

#### *3.1.5. Infrastructure*

Based on its status, Urban Ciawi consists of Environmental Road, County Road, National Roads and Highways. On the other hand, based on its function consists of a Local Road, primary arterial roads, collector roads primer. In general, the road network in Ciawi Urban Area form a grid pattern is radial. This is because the road network Ciawi Urban Area forming concentric radial field with the intersection as a center for further growth of unit concentrically connecting with the surrounding area.

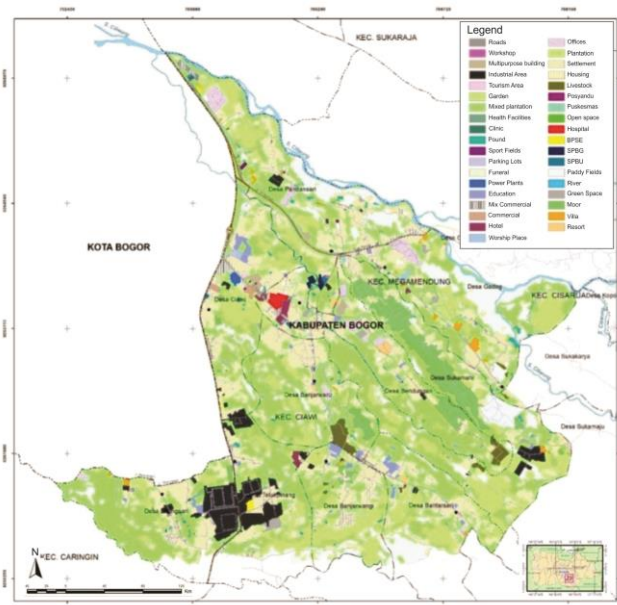
Condition of roads in Ciawi Urban Area good enough and have asphalt pavements. Road conditions consist of two (2) lanes for two (2) directions undivided (2/2 UD), but there are also some points consisting of two lanes in one direction. With the peak tourist appeal makes Ciawi Urban Area be crossing travelers heading to the summit so that the impact of congestion is high enough, by looking at such conditions it is applied peak one-way lanes. But the one-way system that was unable to break the bottleneck that ada. Hence, to look for a solution to be able to parse the existing congestion.

### *3.2. Dynamics of Land Use Changes*

#### *3.2.1. Land Use In Year 2013*

Land use in Ciawi Urban Area in Year 2013 (Figure 3) can be categorized into 21 types of land use. With the dominance of the largest land use is a garden area of 919.12 ha (56.07%) and the housing area of 335.90 ha (21.71%). From the data of land use in the Ciawi Urban Area in Year 2013,

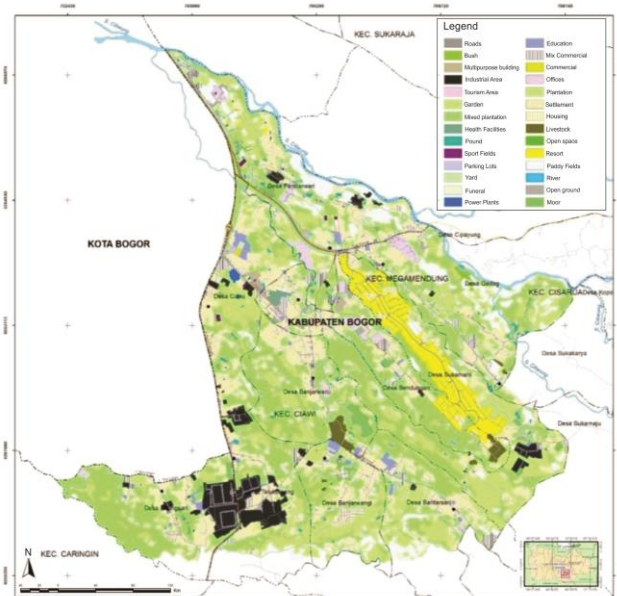
it can be said that the land contained in the Ciawi Urban Area still dominated by build-up area of 1,069.19 ha (65.22%). While non build-up area of 570.10 ha (34.78%).



**Figure 3.** Map of Land Use in Ciawi Urban Area Year 2013

### 3.2.2. Land Use in Year 2015

Land use in Ciawi Urban Area in Year 2016 (Figure 4) could be categorized into 21 types of land use. With the dominance of the largest land use is a garden area of 919.12 ha (56.07%) and the residential area of 335.90 ha (21.71%). From the data of land use in the Ciawi Urban Area 2015 can be said that the land contained in the Ciawi Urban Area still dominated by build-up area of 966.19 ha (58.94%). While non build-up area of 673.09 ha (41.06%).

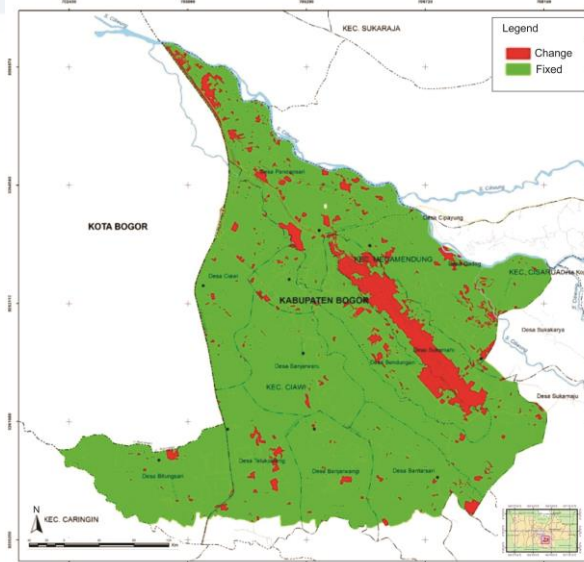


**Figure 4.** Map of Land Use in Ciawi Urban Area Year 2015



### 3.2.3. Dynamics of Change of Use of Land

Based on the data of land use Ciawi Urban Area in Year 2013 and 2015, it can be seen that within 2 (two) years there has been a significance change in land use is quite significant, namely the reduced land area of 65.62 Ha garden (-4%) and wetland at 41, 23 Ha (-2.51%) and an increase in land area hotel/villa/resort is quite large, amounting to 50.90 ha (3.1%). For more details about changes in land use in the Ciawi Urban Area Year 2013 to the Year 2016 can be seen in Table 2 and Figure 5.



**Figure 5.** Map of Land Use Change in Ciawi Urban Area Year 2013-2015

**Table 2.** Land Use Change in Ciawi Urban Area Year 2013-2015

No	Land Use Types	Area (m <sup>2</sup> )	Area (m <sup>2</sup> )	Land Use Change (m <sup>2</sup> )	Percentage (%)
1	Roads	489,506.05	702,393.25	212,887.20	1.30
2	Hotel/Villa/Resort	131,198.76	640,159.17	508,960.41	3.10
3	Industrial Area	518,171.47	569,018.83	50,847.36	0.31
4	Tourism Area	4,834.56	6,545.01	1,710.45	0.01
<b>5</b>	<b>Plantation</b>	<b>9,191,169.47</b>	<b>8,534,963.54</b>	<b>(656,205.93)</b>	<b>(4.00)</b>
6	Health Facilities	31,319.02	31,625.37	306.35	0.00
7	Water Body	64,140.21	76,455.53	12,315.32	0.08
8	Commercial	268,545.60	311,578.11	43,032.51	0.26
9	Sport Fields	9,499.54	10,216.67	717.13	0.00
10	Parking Lots	6,714.15	17,996.88	11,282.73	0.07
11	Funeral	10,539.84	24,751.59	14,211.75	0.09
12	Power Plants	13,027.48	13,027.48	0.00	0.00
13	Education Facilities	139,259.08	152,338.22	13,079.14	0.08
14	Warehouse	18,705.05	18,705.05	0.00	0.00
15	Worship Place	37,284.11	43,258.50	5,974.39	0.04
16	Office	221,717.22	249,469.93	27,752.71	0.17
17	Settlement	3,559,048.74	3,717,519.74	158,471.00	0.97
18	Housing	158,907.91	169,890.01	10,982.10	0.07
<b>19</b>	<b>Livestock</b>	<b>109,460.45</b>	<b>105,392.09</b>	<b>(4,068.36)</b>	<b>(0.02)</b>
<b>20</b>	<b>Paddy Fields</b>	<b>1,349,901.35</b>	<b>937,645.09</b>	<b>(412,256.26)</b>	<b>(2.51)</b>
21	River	59,910.89	59,910.89	0.00	0.00
Total		<b>16,392,860.95</b>	<b>16,392,860.95</b>		

Sources: GIS Analysis, 2015

#### 4. Conclusion

It can be concluded that the dynamics of land use changes in Ciawi Urban Area of the Year 2013 to the Year 2015 is significant, namely the reduction of farm land area of 65.62 hectares (-4.00%) and wetlands of 41.23 ha (-2.51%) and increase in land area hotel/villa/resort is quite large, amounting to 50.90 ha (3.10%). Land use changes from green area into build-up area in Ciawi Urban Area mostly occur along the main road leading to Puncak.

#### 5. Acknowledgments

Thanks to Kemenristekdikti which has provided funding this research for two consecutive years with a competitive grants scheme in Year 2015 and 2016.

#### 6. References

- [1] Rustiadi E, Saefulhakim S and Panuju D R 2009 *Perencanaan dan pengembangan wilayah* (Yayasan Pustaka Obor Indonesia)
- [2] Adell G 1999 Theories and models of the peri-urban interface: a changing conceptual landscape
- [3] BPS 2010 *Data Kependudukan Indonesia* (Jakarta)
- [4] Ginsburg N S, Koppel B, McGee T G and Others 1991 *The extended metropolis: Settlement transition in Asia* (University of Hawaii Press)
- [5] Tacoli C and Others 2006 *The Earthscan reader in rural-urban linkages*. (Earthscan)
- [6] BPS 2015 *Kabupaten Bogor Dalam Angka 2013-2015*
- [7] BPS 2014 *Kecamatan Ciawi Dalam Angka 2013-2014*
- [8] BPS 2014 *Kecamatan Megamendung dalam Angka 2013-2014*
- [9] Cahya D L 2014 Model Sistem Dinamik Perubahan Guna Lahan Pertanian Perkotaan di Kabupaten Bogor *Forum Ilmiah* vol 11
- [10] Doyle J K and Ford D N 1998 Mental models concepts for system dynamics research *Syst. Dyn. Rev.* **14** 3–29
- [11] Forrester J W 1994 System dynamics, systems thinking, and soft OR *Syst. Dyn. Rev.* **10** 245–256
- [12] Forrester J W 1993 System dynamics and the lessons of 35 years *A systems-based approach to policymaking* (Springer) pp 199–240
- [13] Kasikoen K M 2011 Tipologi Perkotaan di Kabupaten Cilacap *Planesa* **2**
- [14] Kasikoen K M 2010 Pemanfaatan Model Sistem Dinamis Dalam Memperkirakan Jumlah Penduduk Di Masa Datang Studi Kasus: Kabupaten Cilacap *Planesa* **1**
- [15] Tian L 2015 Land use dynamics driven by rural industrialization and land finance in the peri-urban areas of China: “The examples of Jiangyin and Shunde” *Land use policy* **45** 117–127