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To cite this article: B Pigawati *et al* 2018 *IOP Conf. Ser.: Earth Environ. Sci.* **123** 012034

View the article online for updates and enhancements.

The Settlements Growth in Mijen District, Suburb of Semarang

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Abstract: Semarang is one of metropolitan cities in Indonesia. As common in metropolitan cities, Semarang has problems regarding the availability of urban space, especially for settlements. This is related to the increase of population in Semarang. The selection of settlements should consider the suitability of space usage. This study aimed to analyze the growth of Semarang settlements in 2006-2015, distribution patterns, characteristics, directions and factors affecting growth. The location of the research is Mijen District located in Suburb of Semarang. This research used a quantitative descriptive spatial approach by using remote sensing technique and Geographic Information System (GIS). The results showed that some of the growth sites of settlements in Mijen District, the suburb of Semarang are located in areas which not suitable for settlements. There are several types of settlement patterns in Mijen District. Accessibility is the major factor driving the growth of settlements. An integrated development policy is needed to maintain a sustainable balance of urban settlement development.

Keywords: Settlement Growth, Suburban Area, Semarang City

1. Introduction

City is the center of creativity. It is also human containers and an object which is perceived and enjoyed by millions of people of widely diverse class and character [1]. City is as a place of livelihood activity [2].It is also reflects the vitality and human opportunities to achieve what they are dreaming about as well as symbolizes of socio-economic progress. Furthermore, this phenomenon causes population growth in urban areas quite rapidly. Limitations of land for settlements as well as the high level of land use competition in the city center results in shifting land use to settlements to the peripheral area. As a result, in the peripheral area develops settlements scattered area, irregular houses, and disintegrated each other.In addition, urban suburbs have a type of development—the low income groups—they look for living opportunities near the city [3].

Initially, humans choose the area for settlements in areas that fit with their needs and ensure their lives. However, due to the increasing population growth and the economic limitation for people to choose places to live, it results unsuitable areas that becomes their residence, and also. Unstable land, too oblique, unhealthy areas, dirty areas are built into settlements [4]. The suburbs are composed of low population categories but due to the migration of the high cities gives rise to fairly complex dynamics in the area [5,6].Moreover, this is also supported by the existence of competition for development activities for settlements and non-settlements, these unplanned and unorganized activities

are done by the public, private and the government. This development forms are sometimes lacks of appropriate direction with irregular spatial structuring of the region, with the occurrence of ineffective use of space and complicate the subsequent planning pattern.

The changes of physical development and land use can cause various problems, one of them is environmental problem of settlement. Further, it has an effect on environmental quality of settlement [7]. Moreover, city's physical development can be identified based on the widespread area of the built area which is mostly used as a residential area [8].

Residence is generally called as settlement and it is specifically referred to as a house [9,10].Settlement is an area dominated by residential environments with its primary functions as residential areas equipped with infrastructure, environmental facilities and workplaces. Further, it provides limited services and employment opportunities to support livelihoods, so that the functioning of these settlements can be efficient and effective [11]. Hence, the high demand for residential and limited settlement land can lead to decreasethe quality of settlements. Quality of settlement is the ability of a settlement to interact with its supporting elements. The elements are residents, facilities and environmental infrastructure. In the context of residential environment, the quality of settlements is decreased or can not be seen from the development of settlement areas that are more oriented towards achieving the quantitytarget only [12].

The topographic condition of Semarang City varies from flat to hilly affects the pattern and distribution of residential areas. Initially, residents chose the location of the settlement by considering a safe place, not indisasters prone area and have good access to the city center or workplace. Accessibility means to demonstrate the ease of movement or scope from one place to another within an area and it has to do with distance [13]. Furthermore, accessibility has been accepted as part of the spatial aspect for various activities. Hence, a better accessibility means a greater land use change. The high land use change is also due to the ease of accessibility in the research area, thus encouraging land conversion from agriculture to non-agricultural.

However, in subsequent developments, the distribution of settlements tends to be unfocused. The housing developers compete to build housing in a location that is expected to give big profits. This condition seems to have a good impact for the city as it looks more advanced, but this phenomenon actually leads to the backwardness of urban conditionsFactors affecting the development of settlements are the physical factors of nature, social factors and economic factors [4].

Implementation of spatial arrangement is the effort of achieving the objectives of spatial planning through the implementation of spatial planning, space utilization, and control of space utilization [14]. The policy of urban settlement utilization of Semarang City has been explicitly stated in the spatial plan of Semarang City by setting location and its distribution based on the carrying capacity of the environment and should not be converted to other function. The suitability between the spatial use and the development of the field is the main key to see how far the spatial policy can accommodate development of each region.

Remote sensing refers to the activities of recording, observing, and perceiving (sensing) objects or events in faraway (remote) places. In remote sensing, the sensors are not in the direct contact with the objects or events being observed [15]. Public can utilize this technology to conduct various studies or plans related to the environment and natural resources. The settlement environment can be identified by the image generated by the remote sensing technology. This is a technological advances support in obtaining data that has a high degree of detail. Quickbird image is a high resolution satellite image generated by Remote Sensing Techniques that can be used to clasify regular and irregular settlements [16].

Research Sites were located in Mijen District. Mijen District is located in the suburb of Semarang City. It is a district with the widest area in Semarang City that is 57.55 km² consisting of 14 sub disctricts. Administratively, Mijen District is adjacent to Kendal Regency in the west. This research aims to examine the growth of settlement areas in Mijen district, suburb of Semarang.
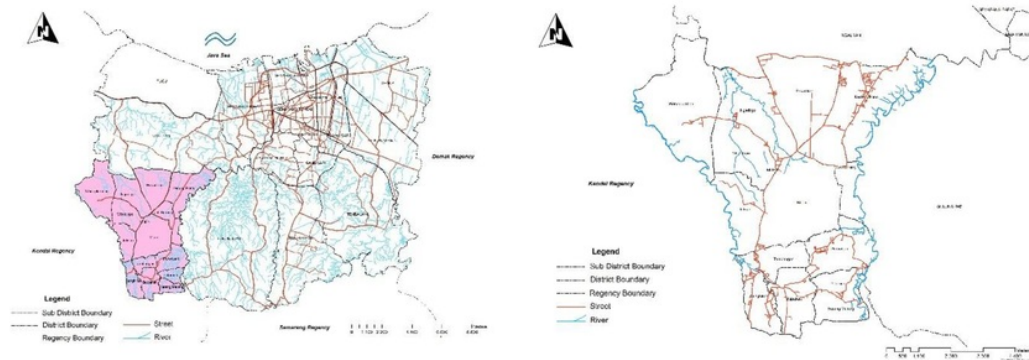

Figure 1. Administrative map of Mijen District and Semarang City

The land use in Mijen District consist of settlement of 1157 ha (20,10%), Industrial of 122 ha (2.12%), commercial of 37 ha (0.64%), non built area 4444 ha, and others 2 ha (0.03%).
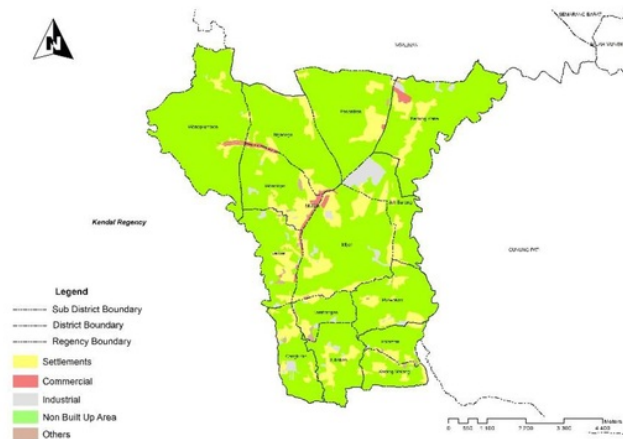

Figure 2. Landuse map of Mijen District

2. Methods

Research on Development of Settlement in Mijen District of Semarang City used quantitative descriptive method. All data and information were analyzed quantitatively with spatial approach by using overlay analysis technique with utilizing remote sensing imagery and Geographic Information System. Stages of analysis performed are as follows:

a. Analysis of residential population characteristics based on socio-economic and population condition was aimed to describe the characteristics of residents by using education level indicator,

type of livelihood, population density and population growth rate. Population Growth Rate is the rate of population growth per year within a certain period used to know the change of population between two time periods.This numbers was expressed as a percentage of the base population.To calculate population growth rate, geometric method was used.

b. Analysis of environmental characteristics of settlements based on facilities and Infrastructure Facility by using indicators of trading facilities, educational facilities, health facilities, street infrastructure, drainage infrastructure. This analysis aims to describe the characteristics of settlements in Mijen District. Using the Indonesian National Standards (SNI) which contains the standard of meeting the needs of facilities and infrastructure of settlements, determined by scoring techniques.

c. Analysis Pattern of settlement distribution nearest neighborhood analysis [17]was determined by calculating magnitude of adjacent neighbor parameter (T) using formula:

$$T = \frac{Ju}{Jh} \qquad\qquad Jh = \frac{1}{2\sqrt{p}}$$

Explanation

T: Index spread of nearest neighbour
N: Number of settlements
∑J: Distance between settlements
Ju: ∑J/N
A: Area
p: ∑N/A (Density)
Jh: 1/2√p

T = 0–0.7Clustered pattern
T = 0.71 –1,4Random pattern
T = 1.41 –2.15 Uniform pattern

d. Analysis of the Development of Settlements based on indicators of changes in the settlement area Year 2006 and 2015 was done with overlay techniques. This analysis will result in extensive growth of settlements and their distribution in Mijen District.

e. Analysis of land suitability based on indicators of the existence of disaster prone areas and land use directives as stated in the Spatial Planning Document done by overlay techniques. This analysis aimed to find out whether the settlement developments are still in the suitable zone for settlements.

3. Results and Discussion

3.1 Population and Social Economy

Population is the object of a plan. To plan the settlement area it is necessary to know the condition of the people who are the residents of the settlement area. The total population in Mijen District in 2006 was 45248 inhabitants. Residents in large numbers are located in Wonolopo Sub disctrict (5493 inhabitants). The total population in Mijen District in 2015 was 61405 inhabitants. Residents in large numbers are located in Jatisari Sub disctrict.

The population density of Mijen District in 2006 was 786 inhabitants/km^2 and in 2015 it became 1307 inhabitants/km^2 with growth rate 3.45%. The area that has the greatest population density wasJatisari Sub disctrict.

Table 1. Population Density and Growth Rate of Mijen District 2006-2015

No	Sub Districts	Population Density (person/km^2)		Population Growth Rate 2006-2015	
		2006	2015	(r)	(%)
1	Cangkiran	911	1,307	0.041	4.09
2	Bubakan	902	1,061	0.018	1.81
3	Karangmalang	1,037	1,122	0.009	0.88
4	Polaman	976	1,115	0.015	1.48
5	Purwosari	776	963	0.024	2.43
6	Tambangan	955	1,151	0.021	2.09
7	Jatisari	2,078	4,476	0.089	8.9
8	Mijen	939	1,320	0.039	3.85
9	Jati Barang	1,019	1,268	0.025	2.46
10	Kedungpani	745	911	0.023	2.25
11	Pesantren	131	197	0.047	4.67
12	Ngadirgo	884	1,133	0.028	2.79
13	Wonolopo	1,360	1,857	0.035	3.53
14	Wonoplumbon	370	411	0.013	1.27
Mijen District		786	1,307	0.035	3.45

Source: Analysis, 2017

Population in Mijen consisted of 38046 educatedpeople ≤ Junior high school, 11761 people are Senior High School graduated, and 4899 people are College graduated. The inhabitants of Mijen District are mostly educated ≤ Senior High School (81%). This condition can occur because there is educational facilities ≤ Junior high school that well spread in each sub disctrict, Mijen District. Residents in Mijen District whose college education 9% is located in Jatisari Sub disctrict. Residents in Jatisarisub disctrict who mostly work as civil servants and Indonesian Armed Forces have an average income of Rp 3,000,000. The average income of the population in Jatisati is the highest income compared to the other sub disctricts. Therefore, they are able to send their children to college. Jatisari sub disctrict is also located in a strategic place supported by good road infrastructure, so it facilitates people to reach the location of higher education facilities which are not available in Mijen District.

Mostly, people in Mijen District work as farm workerof 9947 people (43%), with monthly income aroundRp 1,500,000. This condition is related to the available of large agricultural land/non-built land in Mijen District, which is 77% of the total area of Mijen District. Population working as farmers is spread in WonoplumbonSub disctrict 1602 people (16%), Wonolopo 1563 people (16%), and Purwosari 1445 people (15%). Another occupation ofMijen population is as industrial workers of 6255 people (27%), with total monthly income is Rp 1,900,000.

This industrial worker lives in Mijen Sub disctrict (21%) and Ngadirgo Sub disctrict (16%). In these two areas there is a lot of land used as an industrial area. The average income of the population in Mijen District is Rp 2,000,000 per month. The condition of Mijen District which works as farmers and industrial workers indicates that Mijen District has the characteristic of mixing area of sub disctrict and city. Therefore, Mijen Districtbecome the initial transition from sub disctrict to the city.

3.2 Settlement Environment

The completeness of facilities and infrastructure in an area will be an attraction for residents to choose the location as an ideal residence. Facilities are elements in a residential environment that serve to support the implementation and development of social, cultural and economic life (Ministry of Law and Human Rights, 2011). The attractiveness of a region which has comprehensive facilities and infrastructure, as well as close to the workplace is another factor causing the growth of residential areas. To describe the completeness of residential area facilities in Mijen District, see the following criteria:

Category low   : contain ≤ 1 kind of facility score 1
Category moderate   : contain 2 kind of facility score 2
Category high   : contain ≥ 3kind of facility score 3

a. Educational facilities

Educational facilities in Mijen District consist of Kindergarten of 34, Primary school of 36, Junior high school of 9 and Senior High School of 8. Distribution of educational facilities includedas high category is in Cangkiran, Bubakan, Polaman, Purwosari, Jatisari, Kedungpani, Ngadirgo, Wonolopo, and Wonoplumbonsub disctrict. The distribution of educational facilities included as moderate category is located in Karangmalang, Mijen, Jatibarang and Pesantren Sub disctrict. There was no low category in Mijen Districts.

b. Trading Facilities

The trading facilities in Mijen District consist of Market of 1, Store/shop of 597, Cooperative (Economic Enterprise) of 9. Trading facilities including the high category are only located in Ngadirgo Sub disctrict. The other sub disctricts include in moderate category. There was no sub disctrict in Mijen District in low trading facilities.

c. Health Facilities

Health facilities in Mijen District consist of Polyclinic of 16, Community Health centers of 5, Clinic/Doctor of 16. Health facilities including high category are located in Pesantren and WonolopoSub disctrict. Health facilities including moderate category are located in Jatisari and Ngadirgo Sub disctricts. The distribution of low category health facilities are located in Cangkiran, Bubakan, Karangmalang, Polaman, Purwosari, Tambang, Mijen, Jatibarang, Kedungpani, and Wonoplumbon sub disctricts.

d. Settlement facilities in Mijen District

The determination of categorization of settlement facilities was done by summing the score of educational, trade and healthfacilities. The characteristics of settlements in Mijen District based on residential facilities are as follows:

1. Settlements with high facilities are located inJatisari, Pesantren, Ngadirgo, Wonolopo Sub disctrict
2. Settlements with medium facilities are located in Cangkiran, Bubakan, Karangmalang, Polaman, Purwosari, Tambang, Mijen, Jatibarang, Kedungpani, Wonoplumbon sub disctrict
3. Settlements with Low-facilities are not found in Mijen District.

3.3 Settlement Infrastructure in Mijen District

There are three types of roadin Mijen District; collector roads, local roads, and environmental roads. Generally, the road infrastructure in Mijen District is in good condition. Inadequate road infrastructure is located in Jatibarang and Wonoplumbon sub disctrict. The condition of drainage in Mijen District is mostly good. Inadequate drainage infrastructure is located in Karangmalang, Purwosari sub disctrict and Wonoplumbon sub disctrict.

Source: Observation, 2017

Figure 3. Road Infrastructure and drainage

Based on the condition of road and drainage infrastructure in Mijen District, it can be concluded that the areas that have good and optimal working infrastructure condition are located in Cangkiran, Bubakan, Polaman, Tambang, Jatisari, Kedungpani and Ngadirgo. In other sub disctricts, the infrastructure is not functioning optimally.

3.4 Characteristics of Settlements in Mijen District

Settlement clustering is generally caused by social class and the ability of land access to build residential dwellings. People prefer settlements based on environmental characteristics such as location, education, crime rate, environmental quality, socio-demographic composition facilities, settlement characteristics and land prices.

There are 3 (three) types of Settlement Characteristics in Mijen District determined based on the completeness of facilities and infrastructure condition, see follows:

1. Settlement area which has very complete facilities with good infrastructure condition and optimal function can be found in Tambangan, Jatisari, Kedungpani, Pesantren, and Ngadirgo sub disctrict.
2. Settlement area that has adequate facilities with good infrastructure condition and optimal function is located in the Cangkiran, Bubakan, Polaman, and Wonolopo sub disctrict.
3. Settlement Area that has adequate facilities and good infrastructure condition but not function optimally are in Karangmalang, Purwosari, Mijen, Jatibarang and Wonoplumbon sub disctrict.

3.5 Settlement Patterns

There are several factors that influence the formation of settlement patterns, such as geographical and natural, man-made and site factors.Selection of settlement sites is influenced by accessibility, availability of space and land, availability of facilities and infrastructure of settlements, physical and environmental conditions [18].

The distribution patterns of settlements are distinguished into compact and not compact. Not compact distribution pattern of settlement that spreads randomly and systematicly provides opportunities for settlement development due to physiographic factors and the accessibility of settlers. On the other hand, compact distribution pattern of settlement that is uniform and clustered is supported by the availability of land for settlements. The factors that influence distribution pattern of settlement are geographical, socio economic, and population factors [19]. This study also utilized the same variables, but tried to apply to different areas ie in the suburban area.

Settlement is a source of information about humans and their activities. The settlement patterns give the impression of the physical dispersal of settlements along with the density of its inhabitants [20]. Social status is one of the factors that drive the clustering of settlements. High-income societies and those with high social status have a better chance of choosing a settlement environment according to their interests and tastes whereas low-income communities have limited access to their settlement environment [21].

One of the methods to measure settlement patterns is nearest neighborhood analysis model [17], by calculating the nearest neighborhood parameters (T).

Table 2. Settlement Patterns of Mijen Sub District 2015

No	Sub Districts	$\sum N$	$\sum J$	Ju	A	p	$2\sqrt{p}$	Jh	T	Patterns
1	Cangkiran	5	2.53	0.506	2.76	1.81	2.69	0.371	1.36	Random
2	Bubakan	2	1.34	0.670	2.09	0.96	1.96	0.511	1.31	Random
3	Karangmalang	6	2.35	0.392	2.03	2.96	3.44	0.291	1.35	Random
4	Polaman	3	2.04	0.680	1.61	1.86	2.73	0.366	1.86	Uniform
5	Purwosari	5	2.96	0.592	4.67	1.07	2.07	0.483	1.23	Random
6	Tambangan	2	1.34	0.670	3.58	0.56	1.49	0.669	1.00	Random
7	Jatisari	6	3.09	0.515	2.21	2.71	3.30	0.303	1.70	Uniform
8	Mijen	7	5.84	0.834	4.74	1.48	2.43	0.411	2.03	Uniform
9	Jati Barang	6	4.18	0.697	2.27	2.64	3.25	0.308	2.27	Uniform
10	Kedungpani	2	0.98	0.490	5.83	0.34	1.17	0.854	0.57	Clustered
11	Pesantren	3	4.06	1.353	6.80	0.44	1.33	0.753	1.80	Uniform
12	Ngadirgo	4	5.36	1.340	4.91	0.81	1.81	0.554	2.42	Uniform
13	Wonolopo	3	2.91	0.970	4.04	0.74	1.72	0.580	1.67	Uniform
14	Wonoplumbon	3	2.98	0.993	10.01	0.30	1.09	0.913	1.09	Random

Source: Analysis, 2017

Based on nearest neighborhood analysis, settlement pattern in Mijen District can be classified into 3 (three) pattern types as follows:

- Settlements with random patterns are located in Cangkiran, Bubakan, Karangmalang, Purwosari, Tambangan and Wonoplumbonsub disctrict.
- Settlements with uniform patterns are found in Polaman, Jatisari, Mijen, Jatibarang, Pesantren, Ngadirgo and Wonolopo sub disctricts.
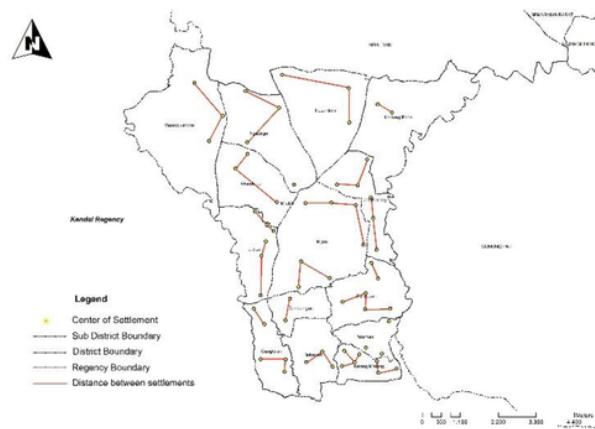- Clustered settlements are found only in Kedungpanisub disctrict.

Figure 4. Settlement Pattern of Mijen District 2015

3.6 Settlement Growth in Mijen District

Settlement area in Mijen District was 909 ha in 2006, while in 2015 it was 1157 ha. During the Period 2006 to 2015 there was a broad increase about 248 ha (27%). The increasing of settlement area was mostly found in Pesantren village (56%) and Mijen village (48%)
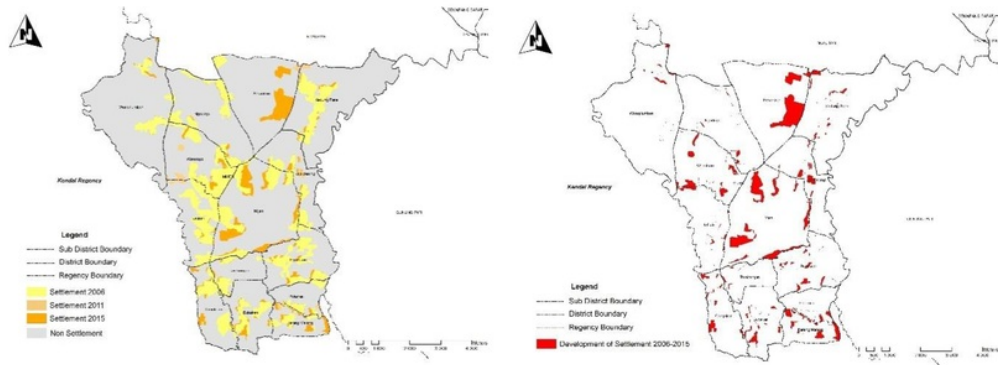

Figure 5. Settlement Growth in Mijen District 2006-2015

Table 3. Settlement Growth in Mijen District 2006-2015

No	Sub District	Settllement(ha)		Δ SettllementYear 2006-2015	
		2006	2015	ha	%
1	Cangkiran	60	63	3	5
2	Bubakan	33	47	14	42
3	Karangmalang	37	56	19	51
4	Polaman	34	44	10	29
5	Purwosari	114	133	19	17
6	Tambangan	73	96	23	32
7	Jatisari	81	96	15	19
8	Mijen	83	123	40	48
9	Jatibarang	43	51	8	19
10	Kedungpani	81	107	26	32
11	Pesantren	27	42	15	56
12	Ngadirgo	73	87	14	19
13	Wonolopo	117	135	18	15
14	Wonoplumbon	53	77	24	45
	Mijen District	909	1157	248	27

Source: Analysis, 2017

Regular settlements are settlements which plans are well laid out, ranging from home units as well as physical environmental conditions [22]. Regular settlements in Mijen District in 2006 were 59 ha and 2015 to 110 ha in total. During the period of 2006 until an increase occurred, the regular settlements area was 86%. Distribution Regions of regular settlements in 2006 were mostly found inJatisari, Kedungpani and Mijen Sub disctrict. Distribution Regions of regular settlements in 2015

were located in the same location as in 2006. This condition occurred because these 3 sub disctricts had a good road/access infrastructure, so that it had the potential for expansion of residential areas.

The irregular settlement area of Mijen District was 850 ha in 2006, while in 2015 it was 1047 ha. During the period 2006 to 2015 there was an increase of irregular settlement area around 23%. The distribution of irregular settlements in 2006 was predominantly located in Wonolopo and Purwosari village. Distribution of the irregular settlement area in 2015 was found in the same location with 2006. This condition occurred because these two villages are not available for vacant land suitable for settlement, so there is no expansion for residential area.
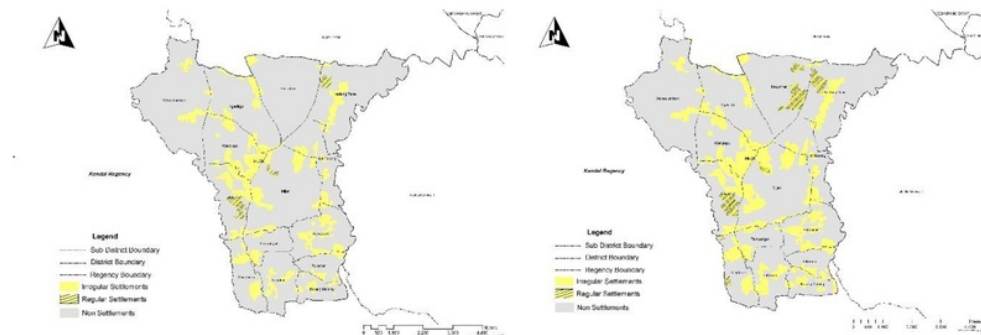
Figure 6. Settlement Area of Mijen District Year 2006 and 2015

3.7 Suitabilityof Settlement Development with Spatial Planning Document
Spatial Planning Document is a government guide document to determine spatial arrangement. Rapid and unfocused settlement growth causes unsuitable of settlement location construction.

Table 4. Settlement Suitability of Mijen Sub District 2006-2015

No	Sub District	Total Growth	Suitable	Unsuitable
		ha	ha	ha
1	Cangkiran	9.34	2.38	11.72
2	Bubakan	3.40	8.19	11.59
3	Karangmalang	0.85	18.40	19.25
4	Polaman	4.24	1.73	5.98
5	Purwosari	6.79	4.08	10.88
6	Tambangan	1.70	0.98	2.67
7	Jatisari	6.79	0.19	6.98
8	Mijen	14.43	53.85	68.28
9	Jatibarang	10.19	1.13	11.32
10	Kedungpani	9.34	0.90	10.24
11	Pesantren	47.54	11.73	59.27
12	Ngadirgo	1.70	2.82	4.52
13	Wonolopo	14.43	5.17	19.60
14	Wonoplumbon	0.85	4.86	5.71
Mijen District		131.59	116.41	248.00

Source: Analysis, 2017

Width of settlement's development area in Mijen District according to Spatial Planning Document is 131,59 ha (53.6%), it is mostly located in Pesantren sub disctict 36.13%, while in Wonolopo and Mijen sub discticts were respecely 10.97%. The extents of settlements' development which were not in accordance with the Spatial Planning Document was 116.41 (46.94%).

Most of them were located in Mijen Sub district (53.85%) and 18.40% in Karangmalang sub disctrict. The location of residential areas in accordance with the Spatial Planning Document has accommodated the hazard-prone constraints of flood and land movement. The development of settlements located in locations that are inconsistent with the Spatial Planning Document need to receive serious attention. Since this location is located in the area designated as a catchment area. If this location is ignored, it will cause a flood disaster.
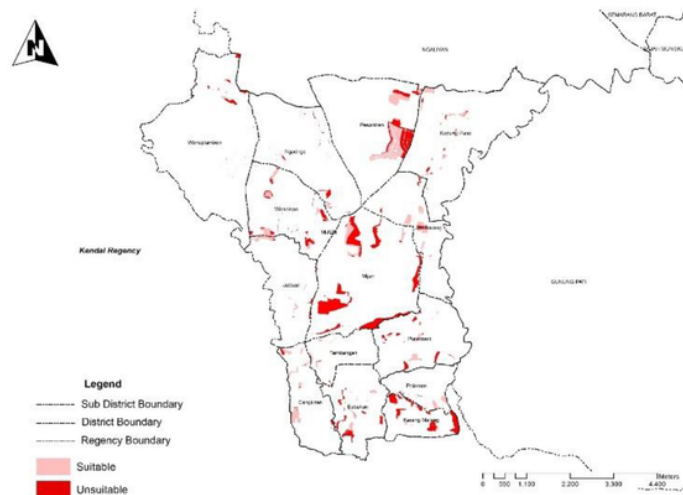
Figure 7. Suitability of Settlement Growth in Mijen District Year 2006-2015

4. Conclusion

In this study used applying population, socio-economic, geographical, and settlement infrastructure factors as variables affecting the development of settlements. Remote sensing and GIS were used to determine the development of settlements in Mijen sub district in 2006 - 2015. The results show that there were 3 settlement patterns, the most dominant is the uniform pattern in 7 sub districts. The types of environmental characteristics of settlements generally indicate the conditions of location. It has adequate facilities with good infrastructure conditions and optimal function.

Settlement area in Mijen District was 909 ha in 2006, while in 2015 it was 1157 ha. During the Period 2006 to 2015 there was a broad increase about 248 ha (27%). The increasing of settlement area was mostly found in Pesantren village (56%) and Mijen village (48%). Width of settlement's development area in Mijen District according to Spatial Planning Document is 131.59 ha (53.6%), it is mostly found in Pesantren sub disctict (36.13%), while in Wonolopo and Mijen sub discticts were respecelly 10.97%. The extents of settlements' development which is not in accordance with the Spatial Planning Document are 116.41 (46.94%). Most of them are located in Mijen 53.85% and 18.40% in Karangmalang sub disctrict. The location of residential areas in accordance with the Spatial Planning Document has accommodated the hazard-prone constraints of flood and land movement. The non-conforming location should be returned to its original function and controlled for its use in accordance with the relevant rules. It is certainly done to keep urban development sustainable.

5. Acknowledgements

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