



# Analysis of land use dynamics in Jatinom District, Klaten Regency: 2015-2020

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## ABSTRACT

**Background:** Land use change is a significant phenomenon in the context of regional development. Jatinom District, as part of Klaten Regency, experienced a notable change in land use from 2015 to 2020. The aim is to identify patterns of land use change. **Methods:** This research method includes visual interpretation and digitization of GeoEye imagery, accuracy test, overlay, and field checking. The use of Remote Sensing and Geographic Information System (GIS) is key in spatial analysis of land use change in Jatinom District. **Results:** Land use change in Jatinom District predominantly occurs in the form of land conversion into settlements. Factors such as strategic location, land price, labor availability, and infrastructure support this change. In addition, there are also other changes in land use types, such as the growth of industrial and trade land. **Conclusion:** In the last five years, Jatinom District has experienced significant changes in land use, with the most notable growth occurring in residential land. Factors such as location, land price, and infrastructure are the main drivers of this change. This shows the importance of wise spatial planning in the face of dynamic regional development.

**KEYWORDS:** geoeeye; GIS; land use change; remote sensing.

## 1. Introduction

Land use reflects the direct impact of human activities on the earth's surface, and changes in its use occur over time. The main factor driving these changes is population growth, while land area remains limited. Land includes landscape elements such as climate, topography, hydrology and natural vegetation that influence its use (FAO, 1995).

Regional development and expansion by the government to improve infrastructure and community services also increases the need for land. Land is a very important natural resource because humans need land for various life and livelihood activities, including housing and business. According to Baja (2012), land is an area on the earth's surface with certain characteristics that include soil, atmosphere, hydrology, geology, humans, animals, plants, and is influenced by human activities such as economic, social, and cultural, both past and present, which ultimately affect the potential for future land use.

Increasing population and human activities have a significant impact on land use patterns in an area. As the population increases, changes in land use occur more rapidly. To accommodate intensive population growth and activities, proper land use planning is needed to fit the intended use of the area. Appropriate land use according to its designation will provide economic and ecological benefits, and help reduce environmental

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damage. According to Su Ritohardoyo (2002), land use involves all human interactions with natural and artificial resources in an area, whether sedentary or mobile, with the aim of meeting material and spiritual needs.

Intensive development in various sectors encourages land use change. In many areas, fields and paddy fields are often converted into residential, industrial, service or other land. This change is in line with the increase in population which increases the demand for land. Hadi Sabari Yunus and colleagues (1980) suggest that changes in land use always affect the structure of people's lives, either directly or indirectly, with impacts that can be positive or negative. The process of converting land from previously undeveloped to built-up land is referred to as built-up land expansion (Suharyadi, 2010).

Jatinom District has experienced major changes in land use, especially from agricultural land to non-agricultural land such as settlements, industries, services, and other public facilities. This change is driven by rapid population growth every year and the strategic location of Jatinom District as the center of economic development compared to the surrounding Districts. Between 2015 and 2019, there was an increase of 31 hectares of land use that shifted from agriculture. In 2015, Jatinom District had 1396.8 hectares of developed land and 2326.09 hectares of non-developed land. However, in 2019, built-up land increased to 1425.8 hectares, while non-built-up land decreased to 2295.09 hectares.

This land use change raises issues related to the availability of land that continues to grow over time and development that continues in Jatinom District. According to Martono & Dwi (2008), remote sensing is a technology that produces information about natural events through the analysis of data obtained from recording objects. This technology is used in research to monitor land use change because the temporal data it produces can identify changes from year to year. Geographic Information System (GIS) makes it easier to monitor land use development spatially, enabling identification of land distribution, calculation of area, and direction of regional development. Bernhardsen (2002) states that GIS is a computer system used for the manipulation of geographic data. This technology can be an evaluation tool and input in planning spatial utilization control in Klaten Regency.

Many studies have used remote sensing technology to evaluate land use change in various regions. For example, Ilham Adinata (2020) utilized Quickbird imagery. Ari Dwi Mukti (2020) also used Quickbird imagery in his research, while Fatikha Ardeasari (2020) used GeoEye imagery for similar purposes. Identifying land use change requires spatial data obtained through satellite image analysis and information from relevant government agencies. Against this background, this study aims to investigate land use change in Jatinom District, Klaten Regency, in 2015 and 2020 using GeoEye imagery.

## 2. Methods

This study aims to identify the distribution of land use change in Jatinom District between 2015 and 2020. The visual interpretation method of GeoEye imagery was used to observe land use change and development. In addition, field checks were conducted to validate the 2020 land use map created with GIS technology. The research framework is shown in Figure 1 below.

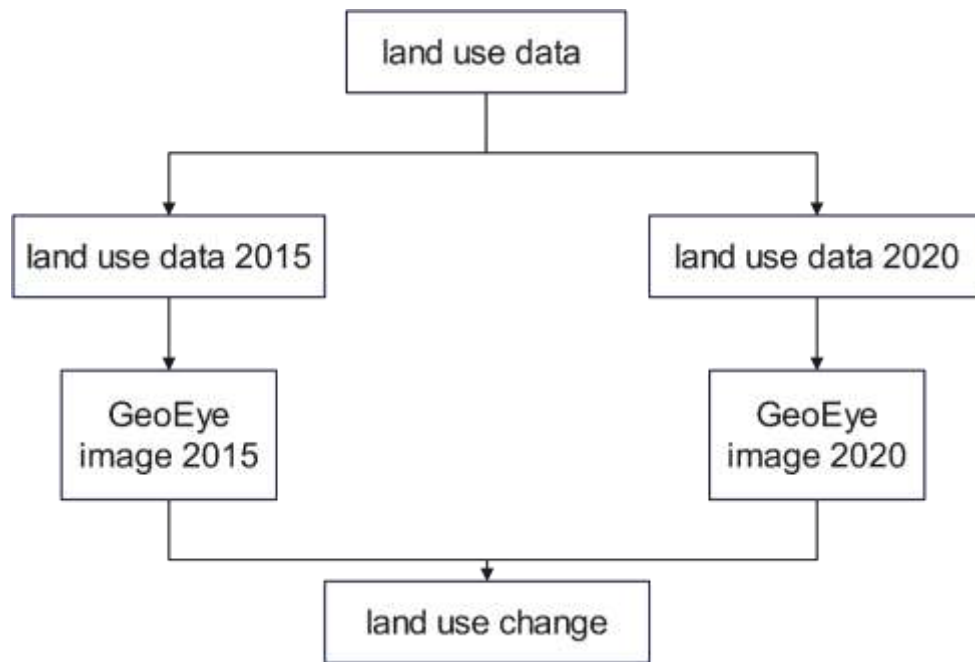


Fig. 1 Research framework

### 2.1 Data processing

Data processing in this study was carried out through several stages to achieve results in accordance with the research objectives, including:

#### a. Visual interpretation and digitization of geoeeye imagery

Visual interpretation of imagery is the process of studying imagery to identify objects and generate information. The process consists of three stages: detection, identification, and analysis. Detection aims to observe objects, identification classifies detected objects accordingly, and analysis gathers further information. Object identification is done by understanding remote sensing elements such as size, shape, shadow, color, texture, pattern, association, and tone. This research uses GeoEye images of Jatinom District in 2015 and 2020.

GeoEye imagery was chosen because it has a high resolution (0.46 meters), provides high detail and accuracy compared to other high-resolution satellite imagery, facilitates accurate interpretation and digitization of land use. Digitization converts raster data into vector data with certain classifications such as roads, houses, rice fields, plantations, rivers, and others. This process was carried out using ArcGIS 10.2 software to facilitate the analysis of objects in the image of Jatinom District in 2015 and 2020.

#### b. Accuracy test

The accuracy test aims to measure the accuracy of the land use map digitation by comparing field data with the digitation results. This research uses the Kappa method, where classification results are considered valid if they reach a minimum of 85% or a coefficient of 0.85.

### c. Overlay

Overlay is the process of overlaying digital maps of Jatinom District in 2015 and 2020, comparing objects at the same location to produce a new map showing land use change.

### d. Field checking

Field checking is done to ensure the type of land use seen in the image matches the actual conditions in the field.

## 2.2 Data analysis

The analysis of land use change was conducted with a qualitative approach using GIS applications and the overlay method on the land use map of Jatinom District in 2015 and 2020. The data is also presented in tabular form to facilitate understanding. The results of the analysis were then examined descriptively to identify areas that experienced changes. This information allows further analysis of the distribution pattern of land use change in the studied area.

## 3. Results and Discussion

Land use in Jatinom District is dominated by fields and settlements. Land changes that occurred between 2015 and 2020 showed physical development in the area. These changes were analyzed through land use in 2015 and 2020 using Geographic Information System (GIS) with the overlay method. The results of this overlay reveal the level of land use change in Jatinom District during the 2015-2020 period, which is presented in table 1. Data on the extent of land use change in Jatinom District in 2015 and 2020 are presented in table 2.

Table 1. Land use change rate of Jatinom District 2015 – 2020

Land status	Area (Ha)	Percentage (%)
Fixed	3689,89	99,166
Changed	31	0,834
Total	3720,89	100

Table 2. Comparison of land use area of Jatinom District 2015 - 2020

No	Land use type area	2015		Area 2020		Change	
		Ha	%	Ha	%	Ha	%
1	Field/Mow	1657,8	44,55	1646,82	44,25	-10,98	-0,00295
2	Settlements	1392,41	37,42	1416,78	38,08	24,37	0,00654
3	Hardened field	16,32	0,44	9,85	0,26	-6,47	-0,00174
4	Industrial, office & trade buildings	1,67	0,05	7,77	0,22	6,1	0,00164
5	Paddy fields	651,62	17,51	638,42	17,16	-13,2	-0,00355
6	Tourism	0,79	0,02	0,79	0,02	0	0
7	Livestock	0,28	0,01	0,46	0,01	0,18	0,0000483
	Total area	3720,89	100	3720,89	100		

Over the past five years, land use in Jatinom District has experienced various changes, either increasing, decreasing, or remaining the same. The land use that increased the most

was for settlements, with an increase of 24.37 hectares. This was caused by many developers building new settlements, which in turn created jobs for local people as laborers or builders. The second highest increase in land use was for industrial buildings, offices and trade, with an increase of 6.10 hectares.

The land use that remains unchanged is the tourism sector, with no change in area (0 hectares). Meanwhile, the land use that decreased the most was rice fields, which shrank by 13.20 hectares because many rice fields were converted into settlements, industries, offices, and trade. The second highest decrease in land use occurred in fields or moorland, which decreased by 10.98 hectares, followed by paved fields which decreased by 6.47 hectares. The extent of land use change in Jatinom District can be detailed per village and can be presented in table 3 as follows.

Table 3. Distribution of land use change in Jatinom District 2015 - 2020

No	Village	Land use change	
		Ha	%
1	Beteng	0,83	2,68
2	Randulanang	0,84	2,71
3	Mranggen	1,49	4,81
4	Jemawan	3,22	10,39
5	Gedaren	1,71	5,52
6	Cawan	1,59	5,13
7	Tibayan	0,95	3,06
8	Bengking	0,64	2,06
9	Temuireng	0,72	2,32
10	Bandungan	1,02	3,29
11	Kayumas	1,48	4,77
12	Socokangsi	1,55	5,00
13	Glagah	1,10	3,55
14	Krajan	2,61	8,42
15	Jatinom	2,02	6,52
16	Bonyokan	2,24	7,23
17	Pandeyan	3,76	12,13
18	Puluhan	3,23	10,42
Total change		31	100

The data table above shows the distribution of the level of land use change in Jatinom District amounted to 31 Ha. The village that experienced the most changes was in Pandeyan Village by 3.76 Ha with a percentage of 12.13% and the least experienced changes was in Bengking Village by 0.64 Ha with a percentage of 2.06%.

Land use change from Fields/Fields to Settlements reached 9.45 hectares, with Mranggen Village as the village that experienced the largest change of 0.91 hectares. Land use change from Hardened Fields to Settlements reached 6.47 hectares, with Pandeyan Village as the village that experienced the largest change of 1.23 hectares. Land use change from Rice Fields to Fields/Fields reached 0.35 hectares, with Jemawan Village as the village with the most changes at 0.23 hectares. Land use change from Rice Fields to Livestock reached 0.18 hectares, with Krajan Village as the village that experienced the most changes. Land use change from Rice Fields to Settlement reached 8.45 hectares, with Krajan Village as the village with the most changes at 1.49 hectares. Changes in land use from Rice Fields to Industrial, Trade & Office Buildings reached 4.22 hectares, with Puluhan Village as the village with the most changes at 1.66 hectares. Land use change from Fields/Tegalan to Industrial, Trade & Office Buildings reached 1.88 hectares, with Jemawan Village as the village with the most changes at 0.67 hectares. This can be seen in Figure 2, which shows the distribution of land use change in Jatinom District between 2015 and 2020.

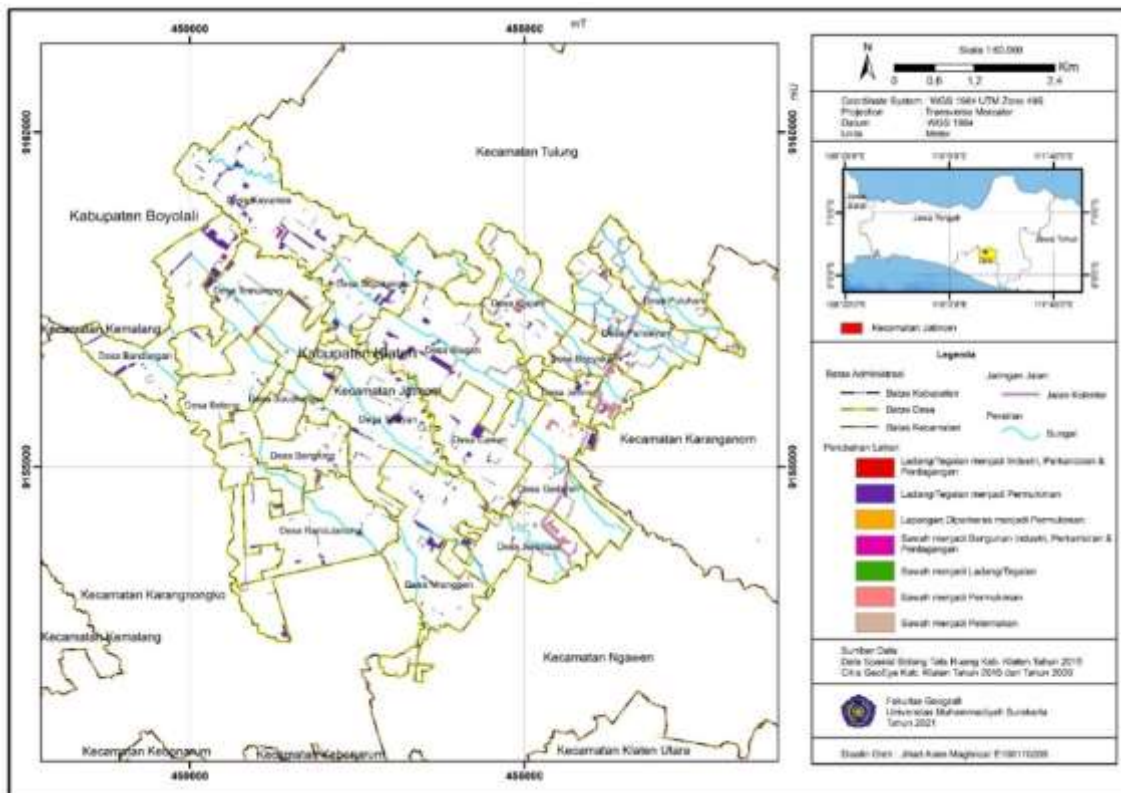


Fig 2. Distribution map of land use change Jatino District 2015 - 2020

Changes in land use patterns in Jatino District over the last five years, from 2015 to 2020, can be analyzed through overlay techniques in spatial analysis. These changes are a response to regional development that increases the need for housing and economic facilities. Residential development also expands public infrastructure to meet the needs of local communities. In an area consisting of 17 villages and 1 kelurahan with unique characteristics, land use types include agriculture, settlement, trade and industry, as well as other sectors.

Based on data analysis, in 2015, the majority of Jatino Sub-district was dominated by fields or moorland, which covered an area of 1657.80 hectares, with most of it located in Beteng Village, Kayumas Village, and Randulanang. In addition, settlements also play an important role in land use patterns, with an area reaching 1392.41 hectares and spread across each village. Rice fields also have considerable significance, especially in Pandeyan Village, Puluhan Village, and Jemawan Village. The region also has a small amount of land used for industrial buildings, offices, trade, tourism, and livestock.

In 2020, the most common type of land use was still dominated by fields or moorland, which covered an area of 1646.82 hectares. In addition, land use for settlements also remains dominant, with an area of 1416.78 hectares. Rice fields also still play an important role in land use patterns, covering an area of 638.42 hectares. In addition, there is a small amount of land used for paved fields, industrial buildings, offices, trade, tourism and livestock.

Development developments between 2015 and 2020 have caused variations in the extent of each land use type in Jatino Sub-district, including expansion, shrinkage, and stability. During the five-year period, there was an increase in the area of land used as settlements, land for industrial buildings, offices, and trade, as well as livestock land. These changes are in line with population growth in the area, reflecting a growth of 8.1% in four years. However, there are also land use types that experienced a shrinkage in area

between 2015 and 2020, such as paddy fields, fields or moorland, and paved fields. There was no significant change in the area of land use for tourism over the five-year period.

From the data analysis, the most striking change in the type of land use in Jatinom Sub-district between 2015 and 2020 is the transformation of 9.45 hectares of land from fields or moor to residential areas. This change is mainly seen in Mranggen Village, with a change of 0.91 hectares, while the least change is the transformation of 0.18 hectares of land from paddy fields to livestock, which occurs in Krajan Village.

In general, the tendency of the population is to choose a place to live that is close to the center of activity. Based on the distribution map of land use change from 2015 to 2020, changes are mainly concentrated along the Klaten - Boyolali collector road. This is due to the community's perception of the strategic advantage and accessibility of the location, which facilitates various activities such as trade, economy and social interaction. Due to good access and strategic location, Jatinom Sub-district has the potential to become an area that combines residential, industrial, trade, and service functions.

#### **4. Conclusions**

During the time span between 2015 and 2020, there was a dominance of land use change in Jatinom District to residential land, with an area reaching 24.37 hectares. This change involves the transformation of previous land uses, including paddy fields, fields or moorlands, and hardened fields. Notably, this change occurred in several areas, such as Pandeyan Village, Puluhan Village, Jemawan Village, Krajan Village, Bonyokan Village, and Jatinom District. This increase in residential land area was triggered by a number of factors, such as strategic location, affordable land prices, abundant labor availability, proximity to provincial and national roads, good accessibility, complete infrastructure, and a reputation as a home industry center.

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Not applicable.

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The authors declare no conflict of interest.

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