# Thematic geovisualization of the data profile of Kaligesing, Purworejo, Central Java

**Sudaryatno Sudaryatno, Shafiera Rosa El-Yasha, Zulfa Nur'aini Afifah**

**Angaben zur Veröffentlichung / Publication details:**

Sudaryatno, Sudaryatno, Shafiera Rosa El-Yasha, and Zulfa Nur'aini Afifah. 2019. "Thematic geovisualization of the data profile of Kaligesing, Purworejo, Central Java." *Forum Geografi* 33 (2): 153–61. https://doi.org/10.23917/forgeo.v33i2.8876.

ISSN: 0852-0682, EISSN: 2460-3945
Forum Geografi, Vol 33 (2) December 2019: 153-161
DOI: 10.23917/forgeo.v33i2.8876


FORUM GEOGRAFI
Indonesian Journal of Spatial and Regional Analysis

# Thematic Geovisualization of the Data Profile of Kaligesing, Purworejo, Central Java

**Sudaryatno***, **Shafiera Rosa El-Yasha, Zulfa Nur'aini 'Afifah**
Dept. of Geographic Information Science, Universitas Gadjah Mada, Bulaksumur, Yogyakarta 55281
*) Corresponding Author (e-mail: sudaryatno@ugm.ac.id)

Received: 22 September 2019/ Accepted: 23 Desember 2019/ Published: 27 Desember 2019

**Abstract.** The scientific field has a variety of purposes, one of which is the presentation of data and information which can be used by other parties to support their decision making. Moreover, the information is presented spatially. This research aims to map the data profile of Kaligesing district to establish the region's potential through thematic geovisualization of its data profile, such as slopes, land use, livelihoods and population. The primary data were obtained from visual interpretation of remote sensing images to extract land use information, and DEM processing to extract slope information. Secondary data were provided by the Kaligesing district government. In order to build tiered spatial modelling, each thematic map was classified and weighted according to its contribution to the potential of the region. Based on this modelling, each village was given a compilation of weights, which were used as a basis for regional potential analysis. From the results of the thematic mapping, Kaligesing has three villages that have the potential for development in the agricultural, trade and service sectors, supported by the potential of human resources, and the abundant non-residential land available.

**Keywords:** Thematic Map, Spatial Database, Regional Profile, Data Geo-visualization.

**Abstrak.** Bidang keilmuan memiliki beragam tujuan, salah satunya adalah penyajian data dan informasi sehingga dapat diterima dengan baik oleh berbagai pihak sebagai salah satu pendukung pengambilan keputusan. Terlebih bila informasi disajikan secara spasial. Penelitian ini bertujuan untuk memetakan profil data kecamatan Kaligesing untuk mengetahui potensi wilayah melalui geo-visualisasi tematik profil data Kaligesing seperti kemiringan lereng, penggunaan lahan, lapangan usaha, dan jumlah penduduk. Data primer didapatkan dari interpretasi visual citra penginderaan jauh untuk mengekstraksi informasi penggunaan lahan dan pengolahan DEM untuk mengekstraksi informasi kemiringan lereng. Data sekunder telah disediakan oleh pemerintah kecamatan Kaligesing. Setiap peta tematik diklasifikasikan dan diberi bobot sesuai kontribusi terhadap potensi wilayah untuk membangun pemodelan spasial berjenjang. Berdasarkan pemodelan spasial, setiap desa mempunyai kompilasi bobot yang digunakan sebagai dasar analisis potensi wilayah. Berdasarkan hasil pemetaan tematik, Kaligesing mempunyai tiga desa yang mempunyai potensi pengembangan di sektor agrikultur, perdagangan, dan jasa yang didukung oleh sumber daya manusia dan banyaknya lahan non-permukiman yang tersedia.

**Kata kunci:** Peta Tematik, Basis Data Spasial, Profil Daerah, Geo-visualisasi Data.

## 1. Introduction

The research and scientific fields in Indonesia vary. The scientific field has a variety of purposes, one of which is the presentation of data and information which can be employed by users or parties who need knowledge to support their decision making. These data are collected and compiled into databases, including a spatial database. There are two types of database in the mapping process (Buckley *et al.*, 2005): the digital landscape model (DLM) and digital cartography model (DCM). The DLM shows the data types that most consider as GIS databases, compiled from source information which is registered on the ground. GIS data that are modified for use in advance mapping processes are stored in a product database called a digital cartography model, or DCM.

The data used to compile thematic information databases can be either primary or secondary. Primary data can be obtained from measurements through surveys and visual interpretations of remote sensing images, while secondary data can be obtained from statistical data of various scientific fields. The data possessed by each scientific field include thematic statistical data, one type of which is in the form of profile data for a district, which are included in secondary data. Other data come from primary data in the form of visual interpretation of remote sensing images. To ensure effective geographical knowledge, appropriate representation must be used (Zhou *et al.*, 2016). Data presentation can be realized by one of the information presentation techniques, supported by spatial information. This will be more effective if it is realized in the form of a map which is designed and represented to communicate with map users and delivers a particular message (Buckley *et al.*, 2005).

Any statistical data mapping requires data compilation according to their categories, together with systematic ordering, which is called classification (Kraak and Ormelling, 2007). Classification is not always the same for all mapped phenomena; it depends on the type of data and the level of generalization used (Tyner, 1992). Usually, no fewer than four categories are produced and no more than ten categories are mapped in the form of black and white maps, gray maps and color gradation maps.

The study of maps is known as cartography, which is the art, science and technology of making maps (ICA, 1973). Nowadays, cartography is not only defined as map-making, but also as the delivery of information in the form of maps (Kraak and Ormeling, 2007). It can involve a number of aspects, such as map design, map scale, map objectives, and the audience or users of the map (Bandrova *et al.*, 2014). Maps that can support all scientific fields are termed thematic maps. These are maps that can represent almost all geographical phenomena that exist on the surface of the earth and have the purpose of being able to provide information about different places and to map the characteristics of geographic phenomena in order to express them spatially (Tyner, 1992). In general, in thematic maps the background map is not as detailed as the topographic map (Tomai and Kavouras, 2005).

Excellent symbolization is needed to represent an attractive map, and also to help map users' understanding. All the information visualized by a map should be easy to read. A thematic map is represented by symbolization, which embodies the power of visual cartography (Hardy, 2004), and needs visual variables to represent each feature with certain characteristics. Rautenbach *et al.* (2015) explain there are at least 13 visual variables introduced earlier by Bertin (1983), DiBase *et al.* (1992) and MacEachren (1995), namely position, size, shape, value, color, orientation, texture, movement, duration, frequency, order, rate of change, and synchronization. The visual variables used in this research are color and value. Based on a table developed by Rautenbach *et al.* (2015), color is the visual variable which can adjust the color hue without affecting the value visualized in the map. On digital displays, adjustments in saturation and transparency are included in this visual variable. Value is the visual variable which represents the quantitative range and level in the value of a color. It is attained by changes in lightness or darkness (range of shades in grey or greyscale).

This study aims to map the data profile of Kaligesing district to establish the region's potential through thematic geovisualization. Analysis of this potential is made based on the spatial conditions of the thematic information. The thematic map information needed in this study are the administrative boundaries, land cover, population distribution, livelihoods and slopes of Kaligesing district. Analysis of the potential can be used in consideration of regional development policy by the local government.

## 2. Research Method

The study area of the research is Kaligesing, as shown in Figure 1. It is a district in Purworejo Regency, Central Java, consisting of 21 villages. To the north it is bordered by Samigaluh district, to the east by Girimulyo district, to the south by Bagelan, and to the west by Purworejo city.

### 2.1. Research Tools

A laptop to process the data, equipped with:

1. ArcGIS 10.3: used to visualize the data and create maps resulting from the research
2. Microsoft Excel: used to process the statistics data
3. Avenz : used to coordinate the plotting, tracking, and navigation of the field survey

### 2.2. Research Materials and Dataset

1. Topography map of Purworejo
2. Statistics data of livelihood and population of Kaligesing district
3. DEM of Purworejo regency (ALOS PALSAR)
4. ESRI imagery basemap

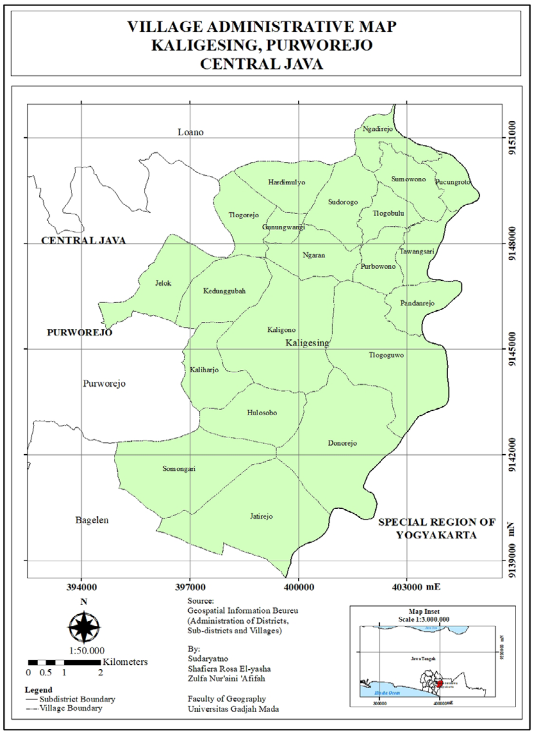


***Figure 1. Village Administration Map of Kaligesing, Purworejo, Central Java***

### 2.3. Research Step

1. Acquisition Data Stage. Primary and secondary data were used in the research. The primary data were acquired by visual interpretation of the remote sensing images and field validation. This was used to map the land cover, serving as thematic information. Land cover classification was based on the authors' interpretation (Table 1). The secondary data were acquired from government data by downloading demographic data and DEM. Government demographic data at the district level can be used to obtain more detailed data at the village level. The DEM processing results were used to make a slope map.
2. Field Stage. The field stage validates the land cover sample area in a tentative land cover map. In this stage, field validation is made by observing land cover changes in a tentative map and observing conditions around the slope areas.

3. Data Processing Stage. The data processing stage is conducted after the field stage so that the processed data was correct and feasible to visualized. This stage includes geovisualization processing of the thematic mapping from the statistical data, base maps and field data. Spatial database preparation is included in this stage. The database compiled in this stage includes all the thematic information that will be visualized in the form of maps.

a. Slope map. The slope map of Kaligesing district was made employing the DEM of ALOS PALSAR with the use of ArcGIS slope making tools. The raster data of the slopes then had to be reclassified based on the percentage of the slope contained in each pixel. These areas were then classified according to Table 1. The symbolization used for the visualization was in accordance with the level of slope classification interval data. These data were symbolized using gradual color visual variables; in this case, the color symbol scheme of traffic was used as the quantitative scale of each slope class.

b. Population distribution map. The population distribution map was based on secondary data obtained from the Kaligesing district government, with the mapping unit at village level. Each village with a known population was then sorted from the highest to the lowest population. The population map was visualized with the choropleth map method. Symbolization used visual variables of values and colors, with the main color used for the mapping population in general being red. The gradations of red from the RGB composition of dark red to pink represented the intensity or a large number of residents in a village.

c. Livelihood distribution map. The livelihood distribution map was also based on secondary data obtained from Kaligesing district government, with the mapping unit also at village level. The secondary data on livelihood were sorted based on the village and livelihoods of the population. Many secondary data on work types were obtained from the Kaligesing government, so the type of livelihood could be classified into several classes in each village (Table 1). The livelihood data for each village were then represented in a diagram showing the types and number of livelihoods of the residents living there.

d. Land cover map. The results of validating the tentative land cover map were used as the basis for correcting visual image interpretation errors. Consequently, corrections made could be in the form of changes in classifications, in area and so on. The changes or corrections to the tentative land cover map were then processed by completing spatial attributes based on the authors' interpretation (Table 1). Subsequently, the land use map was visualized on the basis of the land use classification provisions of the National Standardization Agency (Indonesia National Standard 7645: 2010), so that the classification conditions would also follow mapping scale requirements. In addition, the map visualization took into account the colors and symbols determined by the relevant agency.

e. Village potential map. The results of the thematic geovisualization of the Kaligesing district data profiles, namely slope map, livelihood map, land cover map and population distribution map, as explained above, were weighted according to their contribution to the classification of potential areas to be mapped (Table 1).

All of the maps were overlayed based on the tiered modelling method, with each attribute of the maps quantified based on the Table 1. As previously mentioned, since the livelihood variables and land cover are categorical variables, the weights are equal to each class. Nevertheless, the slope variables and population values are continuous variables, so weights are given to each class level. However, the potential area map must be presented based on the delineation or zoning of the results of the spatial analysis modeling-related variables. Since the population map is the only one that shows the information based on area value, generalization of the other maps was required. In the following stage, the authors classified each village depending on the domination of certain classes visually, not quantitatively. In other words, village areas were classified based on the visual judgement of the authors for all the map attributes, especially in the case of the slope map because of technical limitations. From this, based on the weighting results and overlapping, delineation was conducted to produce a spatial analysis model symbolized with a gradual color symbol scheme showing the ordinal data scale characteristics. Finally, the results of the spatial analysis model would be the basis for establishing areas of potential in Kaligesing.

**Table 1. Regional Potential Variable Modelling**

| Variable | Class | Category | | Weight |
|---|---|---|---|---|
| | | Range | Type | |
| Slope | | Slope (%) | | |
| | 1 | 0 – 8 | Flat | 100 |
| | 2 | 8 – 15 | Sloping | 80 |
| | 3 | 15 – 25 | Rather Steep | 60 |
| | 4 | 25 – 45 | Steep | 40 |
| | 5 | >45 | Very Steep | 20 |
| Total Population | | Population | | |
| | 1 | 270 – 808 | Very low | 20 |
| | 2 | 809 – 1,122 | Low | 40 |
| | 3 | 1,123 – 1,660 | Middle | 60 |
| | 4 | 1,661 – 2,583 | High | 80 |
| | 5 | 2,584 – 4,166 | Very high | 100 |
| Livelihood Sector | | Sectors | | |
| | 1 | Agricultural | | 10 |
| | 2 | Industry | | 10 |
| | 3 | Trading | | 10 |
| | 4 | Services | | 10 |
| | 5 | Other | | 10 |
| Land Cover | | Land Cover Types | | |
| | 1 | Agricultural Area | | 10 |
| | 2 | Non-agricultural Area | | 10 |
| | 3 | Open field and other | | 10 |
| | 4 | Settlement | | 10 |
| | 5 | Waters | | 10 |

4. Data Analysis Stage. From the explanation of the stages above, village potential maps were arranged based on an overlay of the four thematic maps. In the other words, modeling of the thematic maps into village potential maps was based on predetermined classification and weighting (Table 1). Accordingly, each village had its own value depending on the weights representing its potential from the population, topography, livelihood and land cover aspects. The model could subsequently act as guidance for the Kaligesing government to develop the region.

## 3. Results and Discussion

The Kaligesing slope map (Figure 2) shows that the physiographic conditions of Kaligesing District are very heterogeneous in each village. The dominant slope is that classified above 15%; slope classes are often found in the 15%-25%, 25%-45% and> 45% ranges. Slope domination was performed by visual judgement interpretation in each village. Kaligesing district has heterogeneous slopes, which mean it will also affect other conditions represented on the following map. Steep slopes dominate the district. This means much land cover in the form of forests is included in the non-agricultural area category.

The population map (Figure 3) shows that there are four villages in the west and south which are bigger than the other villages and have the highest populations, in the of range 2,584 – 4,166 (classification five). These villages were Kaligono Village, Tlogoguwo Village, Donorejo Village and Somongari Village. Other villages in the north and east have smaller population patterns and populations that are not so high. The condition of the population can also be seen from the slopes which tend to be sloping (see classification in Table 1) and used as a settlement, so that there are many people living in the village.

The land cover map of Kaligesing District (Figure 4) shows a more detailed distribution, especially that of residential and non-residential areas. Based on the map, non-agricultural areas dominate the entire Kaligesing District, especially in the east. This is due to the influence of the physiographic conditions described previously. Such conditions in areas with land cover in the form of settlements tend to be sloping, in comparison to non-agricultural areas. In addition, the land cover map also shows that the settlement areas are not always linear with the population in a village.

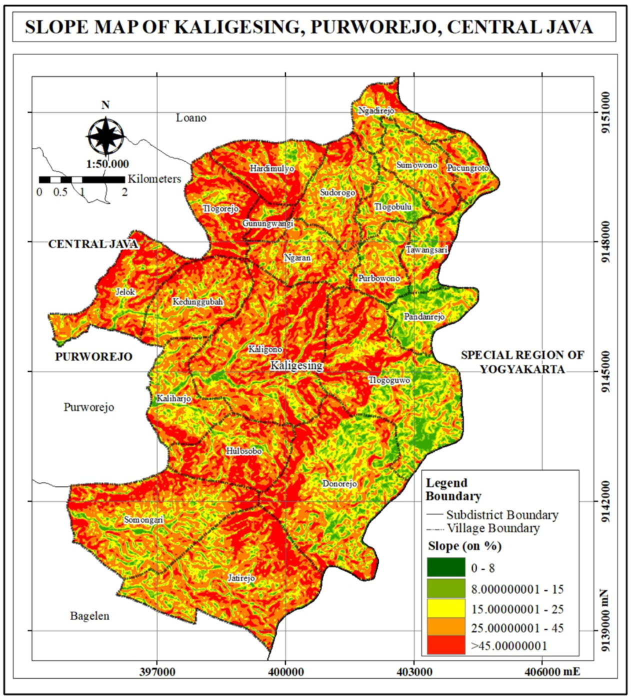


*Figure 2. Slope Map of Kaligesing*

The livelihood map (Figure 5) was created by classifying the various types of livelihood into five classes. Based on the map, it can be seen that the population of Kaligesing district has many livelihoods in the agricultural sector. In the west, which borders on other districts in Purworejo Regency, another fairly well developed livelihood is the service sector, while in the east, which borders the Special Region of Yogyakarta Province, the number of people working in the trade sector equal those in the service sector.

 ISSN: 0852-0682, EISSN: 2460-3945

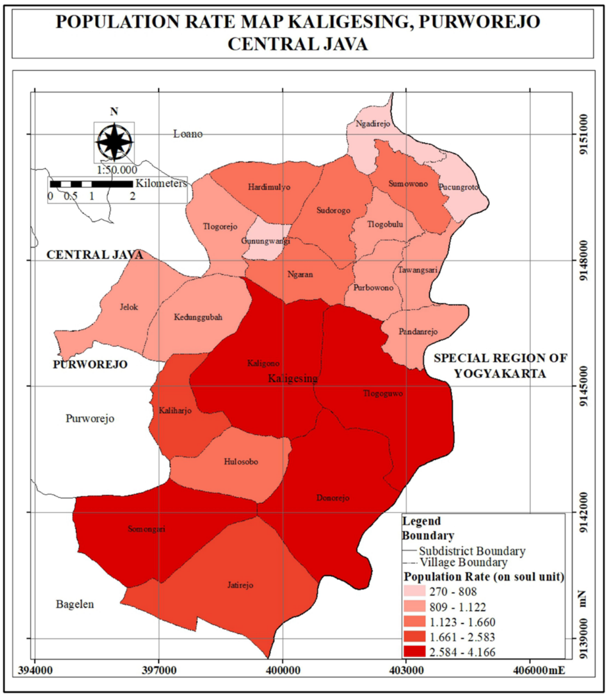


*Figure 3. Population Map of Kaligesing*

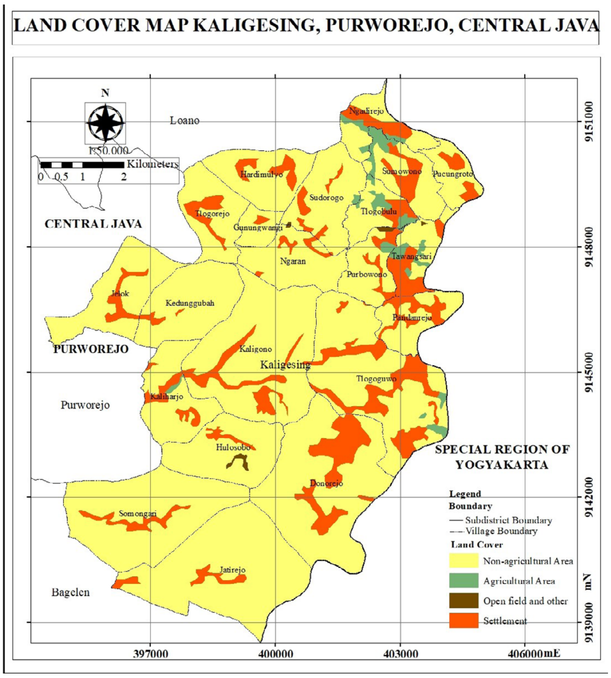


*Figure 4. Land Cover Map of Kaligesing*

The relation between the land cover map and livelihood map (Figure 6) was made with the aim of being the main reference for a region's potential. The relationship between the two aspects shows that in Kaligesing District, which is dominated by non-agricultural areas, the highest percentage of a population's livelihood is in the agricultural sector. This is due to the limitations of the classification used. Land cover, which is intended as non-agricultural areas, includes forests or plantations. These dominate Kaligesing district due to the physiographic conditions described earlier. The scale used as a reference for interpretation is not able to cover all the land cover classes. Livelihood classification limitations are also limited by the population livelihood class in agricultural sector. The class must include farmers, planters and farm workers at the same time. The reality encountered at the time of interpretation was that the agricultural area could only be included in the rice field classification.

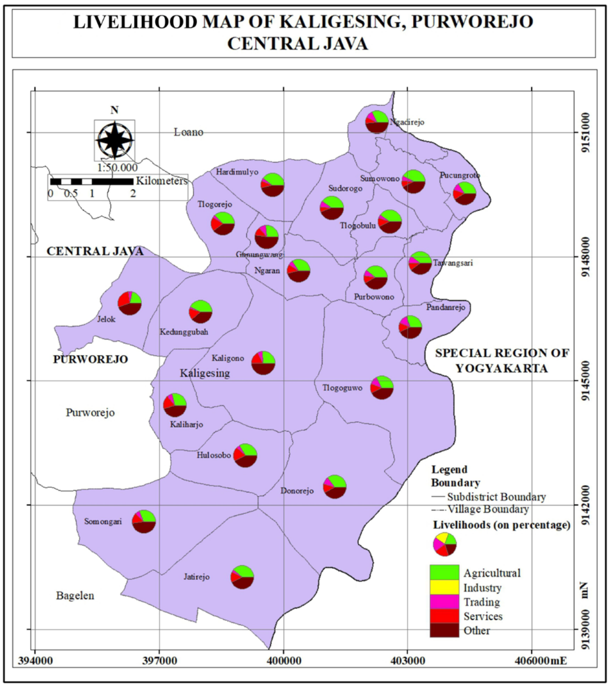


*Figure 5. Livelihood Map of Kaligesing*

The village potential map (Figure 7) are arranged based on an overlay of the four thematic maps. Modeling of the thematic maps into village potential maps was based on predetermined classification and weighting (Table 1). The highest weight was 200 and the lowest 60. Donorejo village is the only one included in the high potential village classification, followed by Pandanrejo and Tlogoguwo, which were included in medium potential classification.

These villagess are directly adjacent to the Special Region of Yogyakarta Province in the east. Other potential villages (classification three) show a linear pattern from north to south in Kaligesing District. In addition, other surrounding villages are included in the fairly low potential village classification, namely Jelok, Tlogorejo, Gunungwarigi and Pucungroto. These villages are bordered by other sub-districts in Purworejo, while Pucungroto village is included due to natural boundaries directly adjacent to areas with high slopes in Special Region of Yogyakarta Province.

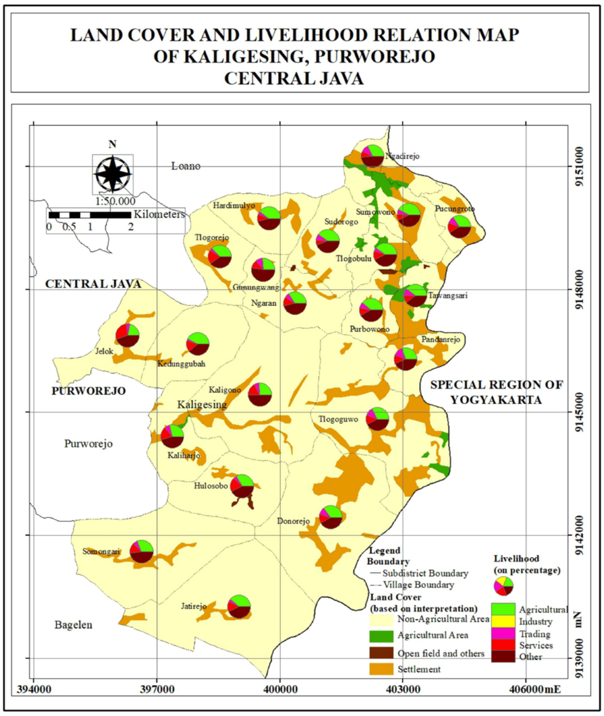


***Figure 6. Land Cover and Livelihood Relation Map***

Donorejo, Pandanrejo and Tlogoguwo have potential to develop in the agricultural, trade and service sectors because their slope tends to be sloping, meaning various types of development can be undertaken without significant natural constraints. Moreover, Donorejo and Tlogoguwo have a fairly high population, so human resources can be fulfilled, and much non-residential land is still available. However, this development still requires consideration of the natural environment because there are areas with high slopes.

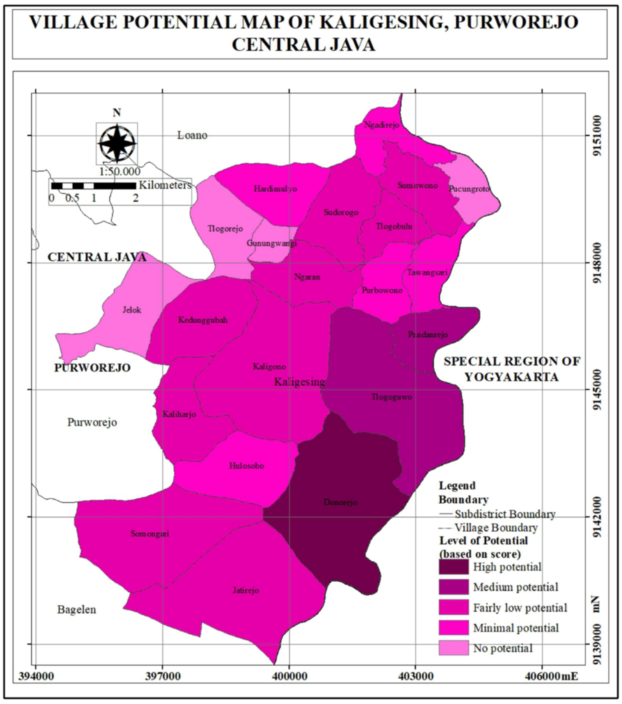


***Figure 7. Villages Potential Map of Kaligesing***

## 4. Conclusion

Donorejo village, Pandanrejo village and Tlogoguwo village have the potential to develop in the agricultural, trade and service sectors. Moreover, Donorejo and Tlogoguwo villages have a fairly high population, so there is availability of human resources, and considerable non-residential land is available.

## Acknowledgements

We are especially grateful to the Kaligesing district government, which has helped provide secondary data for this research. The research was supported by the Lecturer Independent Research Grant program, Faculty of Geography, Universitas Gadjah Mada.

## References

Bandrova, T., Konecny, M., & Zlatanova, S. (Eds.). (2014). Thematic cartography for the society. Springer International Publishing.

Bertin, J. (1983). *Semiology of Graphics: Diagrams, Networks, Maps* (1st ed). ESRI Press. California, USA.

Buckley, A., Frye, C., & Buttenfield, B. (2005, July). An information model for maps: towards cartographic production from GIS databases. In 22nd ICA Conference Proceedings, A Coruña, Spain.

DiBiase, D., MacEachren, A. M., Krygier, J. B., & Reeves, C. (1992). Animation and the role of map design in scientific visualization. Cartography and geographic information systems, 19(4), 201-214.

Hardy, P. (2004). *ESRI Cartography: Capabilities and Trends*. Available at http://www.esri.com/library/whitepapers/pdfs/esri-cartography.pdf

ICA. (1973). *Multilingual Dictionary of Technical Terms in Cartography written by Professor Emil Meynen*. [Online] http://icaci.org/files/documents/books/25YearsOfICA.pdf

Kraak, Menno-Jan., Ormeling, Ferjan. (2007). *Kartografi dan Visualisasi Data Geospasial*. Sleman: Gadjah Mada University Press.

MacEachren, AM. (1995). How Maps Work: Representation, Visualization and Design. *Guilford Publications*. New York, USA.

National Standardization Agency. (2010). *Indonesia National Standard 7645: 2010 Land Cover's Classification*.

Rautenbach, V., Coetzee, S., Schiewe, J., & Çöltekin, A. (2015). An assessment of visual variables for the cartographic design of 3D informal settlement models.

Tomai, E., & Kavouras, M. (2005, July). MAPPINGS BETWEEN MAPS–ASSOCATION OF DIFFERENT THEMATIC CONTENTS USING SITUATION THEORY. In Proc. XXII International Cartographic Conference (ICC 2005). A Coruña, Spain (pp. 11-16).

Tyner, J. A. (1992). Introduction to thematic cartography. Prentice Hall.

Zhou, M., Wang, R., Tian, J., Ye, N., & Mai, S. (2016). A map-based service supporting different types of geographic knowledge for the public. PloS one, 11(4), e0152881.