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PARTICIPATORY MAPPING OF VILLAGE POTENTIAL WITH GEOTAGGING DATA (Case Study: Wedomartani village, Sleman, Yogyakarta)

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Abstract: Digital spatial data has the highest demand, especially for the needs of analysis in terms of mapping. Mapping is currently the focus of attention of many institutions because real objects in the field in a wide range can be visualized in a precision field with a specific scale. Many villages do not have digital spatial data; one of them is Wedomartani village. Therefore, an inventory of digital spatial data of important village objects needs to be done. This study aims to map the potential of village using satellite imagery data from Google Earth and Geotagging photographs and determine the zoning potential of the Land Use of Wedomartani village. The method used to map the potential of villages using satellite imagery data is the method of interpretation, then geotagging photo data obtained through surveys utilizing GPS tag technology from smartphones and the participatory role of village communities. The determination of village land-use zoning used the matching method of the potential map with validation of geotagging photo data. The results interpretation of satellite images shows that the potential in the village of Wedomartani in the form of important objects as the potential of the village is public facilities, tourism objects, theme parks, sports facilities, buildings, roads, rivers, and agriculture. The zoning results of the potential land use of the Wedomartani village consist of Trade and Service Zones in the form of micro, small and medium businesses spread along the main road as a sector of economic potential (212.73 Ha); The Recreation Zone is in the form of Maguwoharjo Football Stadium, Jogja Bay Pirates Adventure Park Family Park, Tambak Boyo Reservoir and Gebang Temple Cultural Heritage Site as a potential tourism sector (23.48 Ha); Agricultural and Plantation Zones in the form of irrigated rice, maize and chili as potential for sustainable agriculture (661.19 Ha).
Keywords: Geotagging; Participatory; Wedomartani village, Yogyakarta

A. Introduction

In the Era of the industrial revolution 4.0 as it is today, all space for life is inevitable and intertwined digitally both data and various streams or data transactions to encourage and support all activities that occur, most of the data generated has geographic elements in the form of location aspects (Fraser 2019). This data then became known as digital spatial data needed for analysis in the mapping process so that demand is now increasingly high by decision-makers. Mapping becomes the attention center of various institutions including politics because real objects in the field in a broad scope can be visualized in a precision field with a certain scale as accuracy for supporting the right decision making (Wagner & Stehman 2015; Richardson & Bissell 2019;).

With the rapid development of digital spatial-

based information technology, it can interconnect rural areas with urban centers and global markets; on the other hand, local governments increasingly focus on developing smart urban areas, this will certainly lead to gaps in development, so rural areas must utilize digital spatial technology to realize village community social security (Young 2019). Following the directives contained in the Nawacita program by the government, national development will be carried out based on villages and rural areas to improve the nation's resilience (Setiawan 2019). The village was given authority not as an object of development, but as a subject of development (RI Law No. 6, 2014). However, village development faces enormous challenges with economic conditions, limited Human Resources (HR) and management of Natural Resources (SDA). Village-based and peripheral national development requires adequate geospatial information, both the scope of availability and the level of detail available using high-resolution satellite imagery data and citizen participation in the mapping process.

Until now, there are still many rural areas in Indonesia that do not yet have digital spatial data: one of them is Wedomartani village, a village full of potential but does not have geospatial information data to support development. Much of the potential of this area is not exposed as a uniqueness or attraction that should be optimized for improving the quality of life in terms of economic, social, cultural and environmental sustainability. Therefore, an inventory of spatial digital data of important objects in the village needs to be done in an effort to involve digital technology to participate in the participation of the villagers in the form of Participatory Mapping (Richardson & Bissell 2019). Participatory mapping provides a way to compile various land use values for visual representation and inform future land planning by stimulating public participation which has the potential to produce a management approach that integrates the needs of rural communities and their local wisdom (Ernoul et al. 2018). The role of village communities who take part in village land use planning will produce village potential that can be developed to be more optimal by minimizing the occurrence of conflict in village communities (Young 2019).

This study aims to map the potential of villages in Wedomartani village, DI.Yogjakarta using high-resolution satellite imagery data and the integration of cellular telecommunications technology developments in the form of geotagging photos. Furthermore, it aims at determining the zoning potential of land use that may be optimized as a source of income and attractiveness for Wedomartani village.

B. Research Method

Wedomartani village is at coordinates 7°43'29 "S - 7°44'47"S and 110°25'30 "- 110°25'50"E. Geographically, the Northside bordered with Sukoharjo Village, Southside with Maguwoharjo and Condong Catur Villages, Westside with Minomartani and Sinduharjo Villages, Eastside with Widodomartani and Selomartani Villages. This village has an area of 1.244 Hectare. Population in this village consists of 15.921 males and 15.353 females. Thus, according to data from the Central Statistics Agency (2018), Wedomartani village is the most populous of the five villages in Ngemplak District with a density of 2.514 people/km2. Besides, based on age groups, the highest number of population are in the ages range from 25 to 29 years old. Where at these ages, people are more productive in having and utilizing smartphones.

Wedomartani village is a village with urban characteristics which population has a variety of jobs and mostly work in the service sectors. The strategic location as an alternative crossing path between the northern and southern parts of Yogyakarta causes the economy to grow fast. This growth has coincided with changes in the natural environment associated with an increase in land use from the agricultural sector to the service sectors. Developing and strategically located villages require a review of the village's potential to support future spatial use plans. The location of this study is presented in Figure 1.

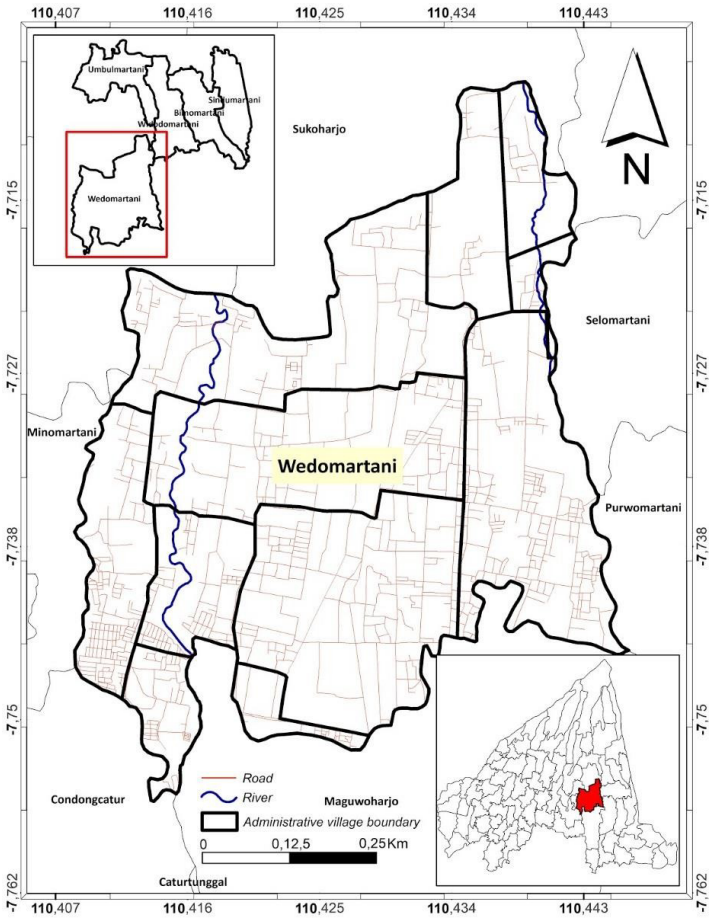

Figure 1. **Location of the study area**

Sampling and data collection

Geotagging photo data obtained through surveys utilizing tagged GPS technology from smartphones and the participatory role of village communities. The tagging process is done by placing the camera 0.9 meters higher than object land to be photographed. The height of the placement may be higher or lower according to the quality and resolution of the camera smartphone's (Table 1). The images that equipped with coordinate data are called geotagging data. A higher camera placement aims to make the photos look precise and able to reach the area around the recorded objects. This technology is considered very simple and efficient with all conditions can even be used to rapid mapping.

Table 1. **Appropriate shooting distance and error rate**

	Distance from the camera (m)				
	2.00	4.15	6.00	16.00	25.00
Transversal Scale (1 Pixel -mm)	1.7	2.2	2.8	14.6	42
Transversal Scale (0.25 Pixel -mm)	0.4	0.54	0.7	3.7	10.5
Error on transversal distance (mm)	0.6	0.8	1	5.2	15
Error on the target to target transversal distance (%)	0.028	0.037	0.046		
Longitudinal scale (1 Pixel-mm)	3.6	5.8	7.7	36	101
Longitudinal scale (0.25 Pixel-mm)	0.9	1.5	2.6	9	25
Error on the point to ne arest target distance (mm)		1.8	2.8	10	26
Error on the point to nearest target distance (%)		0.084	0.065	0.071	0.113

Source: Lemieux (2015)

The sample in this study was the location of taking geotagging photos conducted at 750 points that represented the entire Wedomartani village. Sampling was carried out systematically random (systematic random sampling) following the transportation routes and various types of land-use. In detail, the technique for collecting geotagging data is presented in Figure 2.

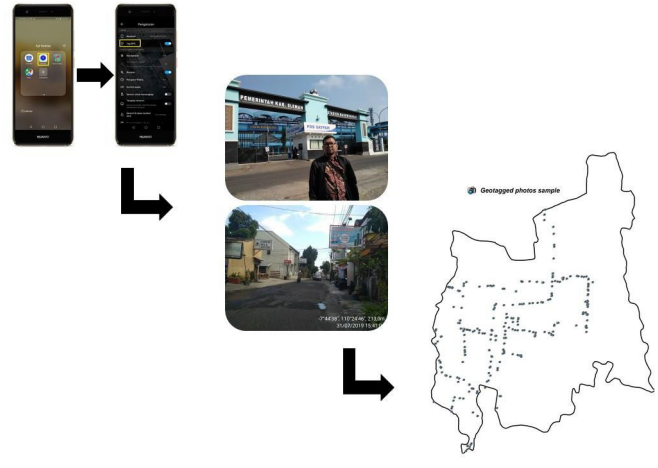

Figure 2. Outline of how data collection works with the geotagging feature

Analysis Method

The method used to map the village potential is the simple geotagging photo method. This method certainly supported by satellite imagery data interpretation from Google Earth. Satellite imagery used because with the high spatial resolution, it provides information about the location and level of land use/land cover class (Reddy & Singh 2018). From the geotagging photo data, matching and validation with satellite imagery are then performed to be able to identify the poten-

tial of the village. This process also applies the selection and elimination of photos to obtain the best results. Once identified, the zoning of village land use can be determined (see Fig. 2). Results of zoning are eventually realized in the form of zoning maps that can spatially support Wedomartani village.

According to Brown, Sanders & Reed (2018), zoning mapping is the result of initial development or revision of development plan and regional, commonly called a general or comprehensive land-use plan. Similar research has also been carried out by Orsi & Geneletti (2013), uses geotagged photographs to identify popular locations; Lemieux (2015), uses geotagged photos as an instrument of research and help formulate a path for future research; Brown, Sanders & Reed (2018), uses participatory mapping methods that engage the general public to explicitly inform zoning decisions. In addition, Hu et al. (2015) also use geotagging photos for extracting and understanding urban AOI. Then, Jia et al. (2018) use combining remote sensing imagery and mobile phone positioning data for urban land-use mapping in China. In addition to the matching method, to look at the village potential spatially, the buffering method was used. The buffer provides zone information with a certain radius, where regions are included in the radius limit represents the characteristics of existing potentials. for more details from the research framework, it can be seen in Figure 3 below.

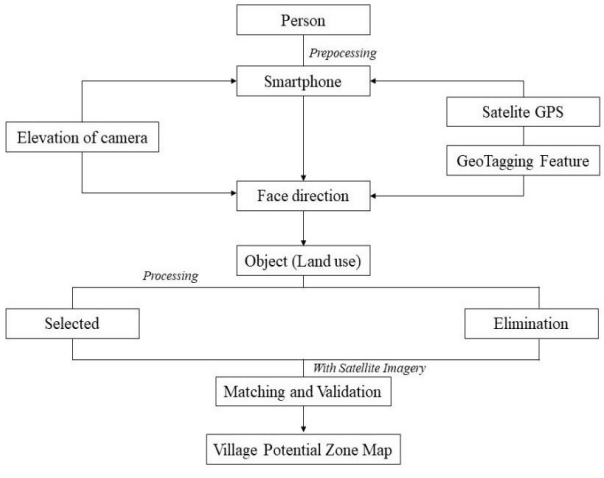

Figure 3. Research framework

C. Participatory mapping

Participatory mapping is a type of community participation in an area that includes the activity of making and or using spatial information for various purposes. Participatory mapping has many variations in design and implementation and is explained in terms of participatory geographic information systems and volunteered geographic information (Brown, Sanders & Reed 2018). The participatory mapping must be integrated. According to (Tani et al. 2016), in their study, participatory mapping has significant potential to facilitate various applications of regional planning support systems. However, between the simple technology-based mapping and community knowledge must be balanced. Brown, Sanders & Reed (2018), state that participatory mapping is used to evaluate relationships between participants mapped and existing or transferred land-use attributes. By involving the community as participants, in addition to the data obtained that are truly accurate, they also understand how things are going forward, with the aim that the potential of the village can be further magnified.

The basic map used is a high-resolution satellite image that is carried out onscreen digitization process to obtain spatial data in the form of vectors. Then, additional data such as attributes and road networks are obtained from the village government. The combination of high-resolution satellite imagery and existing village maps can maximize the extraction process of various information known to sources, and facilitate the transfer of information from map shapes in mind or estimates to digital or printed maps. The results of the participatory mapping were then integrated with the results of the field survey of land use geotagging conducted by researchers and residents, as a complement to the information on the results of land use mapping and at the same time became the material for validating the results of land use mapping (Figure 4). The results of the mapping that has been done can be monitored for the correctness of its position to be validated and corrected if errors are found.

Figure 4. a) Process and introduction of field geotagging survey results, b) Participatory mapping

Geotagged Data for Mapping

Smartphone not only serves for social media and communication activities, but also able to store and produce accurate data for various purposes. One of its features is a default camera with a high resolution even in some well-known products already equipped with geolocation and tagging features that are indicated by coordinates. Geotagging or geo-referencing is the process of adding geographical identification metadata to various media such as images and videos in websites, blogs, or photo-sharing web-services (Luo et al. 2011). The metadata usually consists of GPS latitude and longitude coordinates, and sometimes, altitude, camera heading direction and place names (Zheng, Zha & Chua 2011). Geotagging promises us a new approach for sorting and organising our photos (Chippendale, Zanin & Andreatta 2009). In general, the means of geotagging can be classified into two types: integrated hardware (automatic), and purely software solutions (manual) (Zheng, Zha & Chua 2011). According to (Pucci 2015), the opportunities offered by the use of mobile phone data compared to traditional data sources are: 1) A more regular distribution of data in time and space; 2) A ûner network of detection; the precision of information (the accuracy of locational data, the frequency of data availability); 3) The time required for calculating the position; 4) The availability of service coverage, especially in urban areas; 4) The characteristics of aggregated and anonymous data do not infringe on the privacy of mobile phone users; and 5) The implementation of integrated solutions that enhance the information obtained from mobile data, combining information not only from the identiûcation code of the telephone preûxes for outgoing and incoming calls (ID of incoming and outgoing calls), but also on user proûles (social identiûcation).

Meanwhile, smartphone data according to (Ahas et al. 2010) have some advantages:

- Mobile phones are widespread and popular in developing countries;
- People like to carry mobile phone with them, and they recharge the battery carefully;
- Data is originally digital, free from respondents' memory bias or manual digitalisation errors.

As geographers, they noted the importance of collecting spatial and visual information simultaneously to study a variety of research topics including: coastal erosion, the distribution of national chains vs independent retailers, vegetation successions and even crime signatures (Lemieux 2015). This proves that visual technology such as the result photos give a positive effect on solving various spatial problems such as photo tagging.

Nevertheless, various benefits of photo geotagging have not been widely used, especially in terms of mapping. Many studies employing geotagged photographs use publicly available images found on photo sharing sites such as Flickr and Panaramio (Lemieux 2015). However, not everyone takes photos for regional potential mapping purpose,

although mapping has recently become an important activity. Many people assume that the activity of making maps is difficult, and this is a challenge of going forward to make it simple so that the community can produce data from simple mapping. Although cellphone use depends on age, gender, profession, time, and activities (Aguiléra et al. 2008), but it is different from what happened in Wedomartani village, the high interest of the community towards the use of smartphones encourages the right direction of utilization. Geotagging photo-based mapping is one of the right directions. The technique of simple geotagging photos is expected by the village community in order to be able to operate it. The following are the results of geotagging input on maps that have geographic coordinate values (Figure 5).

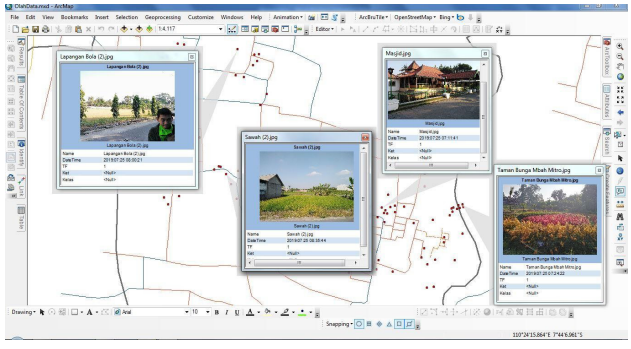

Figure 5. Data tagging input results

D. Mapping of Land use Potential Zones

The results of the interpretation of satellite images show that the potential in Wedomartani village in the form of important objects are public facilities, tourism objects, playgrounds, sports facilities, buildings, roads, rivers and agricultural land. The zoning results of the potential land use of the Wedomartani village consist of Trade and Service Zones in the form of micro, small and medium businesses spread along the main road as a sector of economic potential (212.73 Ha); The Recreation Zone is in the form of Maguwoharjo Football Stadium, Jogja Bay Pirates adventure Park Family Park, Tambak Boyo Reservoir and Gebang Temple Cultural Heritage Site as a potential tourism sector (23.48 Ha); Agricultural and Plantation Zones in the form of irrigated rice, maize and chili as potential for sustainable agriculture (661.19 Ha). For more details, it can be seen on the map of Wedomartani village land use potential (figure 6) and potential zone of land use data (table 2) below.

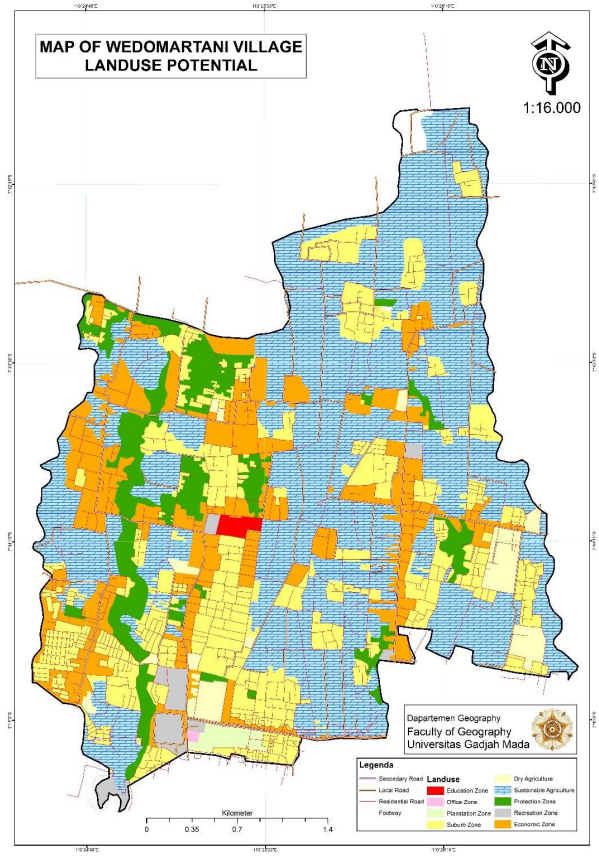

Figure 6. Land use potential map of Wedomartani village

Table 2. Potential zone of land use

Zona Potensi	Luas (Ha)
Office Zone	0.764
Educational Zone	4.578
Plantation Zone	9.602
Dry Agriculture	37.404
Recreation Zone	23.488
Protection Zone	104.297
Economic Zone	212.736
Suburb Zone	293.178
Sustainable Agriculture	623.792

Source: Research analytic, 2019

In this study, we explain how participatory mapping and the progress of smartphone technology possessed by almost every individual can inform potential zoning decisions on the future of land use planning process. A participatory

mapping process that is well designed with the help of digital technology can expand and increase the public participation of villagers and non-locals to assess the potential that exists in each area of the current and prospective land use zone in the future. In this discussion, we reflect the strengths and limitations of participatory mapping to inform land use planning and zoning decisions in the context of rural planning.

E. Conclusion

In this study, we describe a process whereby participatory mapping can be used to assist and inform a potential village and more accurately determine potential land planning and zoning regulation. Future research is expected to provide input and benefit from checking the methods used in this article and how local government authorities have adopted the results of this study to assess potential land use and decision making. Mapping with smartphone technology has not been widely used, because the mapping process is usually done with technology. Besides, most of them only carry out an inventory of data for physical evidence when making a report without realizing that the photographed data is important data that can be further analyzed related to changes in the spatial phenomena of an area. The advantages of the Cellular Mapping System make it possible to determine the coordinates of the different points of the georeferenced platform (Tao & Li 2007).

Concerning the village potential mapping method in a participatory way, the important future research question is the potential impact of using the Foto Geotagging Smartphone application in solving zoning problems and analyzing future land use planning. Land use in Wedomartani village tends to be an attraction for residents who live near the city with land use that leads to discrepancies and unwanted by residents and will lead to land-use conflicts. Another important research question is understanding variability in participatory assessments of village potential based on who is doing geotagging. Will Wedomartani villagers be able to achieve the same interpretation as local stakeholders as planners related to the consistency of preferences mapped with those that are potential zoning regulations? The zoning regulations are potentially subjective. More participatory mapping case studies are needed to determine potential zoning that minimize conflicts.

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Regulations

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