Digital Mapping of Dukuh Village's Potential, Banyudono Subdistrict, Boyolali Regency

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Abstract Law Number 6 of 2014 concerning Villages provides opportunities for villages to develop according to their potential. Development in Dukuh Village had not been supported by digital geospatial information data. Digital mapping of village potentials needs to be carried out for more optimal utilization of village potentials to support sustainable development. This activity aimed to educate village officials and community representatives (Head RT/RW and Bumdes) in making digital maps of the village's potential web-based so that it could be easily accessible and developed, which could also be a supporting data for the village development policies of the Dukuh Village. The activities of the community service program were held from April to September 2021. The methods used were field surveys, data processing, outreach, training, and mentoring. Questionnaires were given to students before and after the training. The data were analyzed using quantitative descriptive technique. The entire program successfully increased the knowledge and skills of the village officials in making digital maps of the potential in Dukuh Village. Posttest results of more than 70% of the 28 participants show that they managed to acquire digital map knowledge and skills. Village officials became able to make digital maps using WebGIS very well in the fields of agriculture, livestock, and plantations. The digital map they created could provide data and information for planning the development of the agricultural, livestock, and plantation sectors in Dukuh village.

1. INTRODUCTION

Dukuh Village in general, has natural and cultural potential to be developed in the agricultural, industrial, trade, and service sectors. This condition is due to the relatively flat morphology, fertile soil, and fairly close to the metropolitan center of Surakarta City. Law Number 6 of 2014 concerning Villages provides opportunities for villages to develop according to their potential. Mapping village potential is the first step to create and implement development plans. Village potential management can generate new and innovative ideas for managing village management activities.

Information systems can improve the performance of an area and can implement advanced technological developments increasingly. The purpose of building an information system is to make it easier for humans to access, process, and perform other data processing (Limbanadi et al., 2018). Accurate data will be an essential requirement in the policy-making process. One of the information systems products is a Geographic Information System (GIS). Geographic information systems (GIS) are powerful tools and methodologies to support design, planning, and decision-making processes in various fields (Sang et al., 2021). Geospatial data collected about natural phenomena is needed to create maps and is increasingly used in GIS (Randazzo et al., 2021). One of the applications of GIS is mapping the village's potential.

GIS and WebGIS development is expensive, but open-source software (OS) is available for this sector (Mohamed et al., 2021). One of the village's potential data collections that can be used is a Geospatial Information System (GIS)

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with "Quantum GIS" open-source software. GIS can assist in data visualization.

QGIS (Quantum GIS) and Decision Support System (DSS) help the decision-making process based on geospatial analysis in planning and programming which is implemented by the village government. The web-based GIS platform successfully improves data access and dissemination, spatial data exploration, and visualization capabilities and provides additional options for processing, analyzing, and modeling available data sets (Mariotto et al., 2021).

Village potential maps can be created in WebGIS. WebGIS combines geographic information systems with the internet or web technology (Patera et al., 2022). The ability of WebGIS can provide websites with subject-specific information (Nunes et al., 2022). Access to archived data and facilitating visual analysis is also offered in WebGIS (Hu et al., 2019). Another advantage of WebGIS is that it is easier to present spatial data that can be accessed online without using GIS software (Mertha et al., 2019). WebGIS will store interconnected databases on one web part (Ihsan et al., 2021). Mapping of village potential is also a priority program for using village funds in 2021 based on PERMENDESA PDTT No. 13 of 2020. The priority of the village potential mapping program is to encourage village officials to be able to master technology and GIS.

Village Potential Development in Dukuh Village has several problems, including (1) a Lack of knowledge among Village official about geospatial data as input for excellent and correct digital mapping of village potential and the value of spatial information, (2) There is no application of QGIS digital mapping technology on the computers of Dukuh village officials, (3) There is no information regarding the skills to obtain geospatial data in identifying the potential of Dukuh Village. The problem with the Dukuh Village official creates an opportunity to share information about the potential of digital maps on a wide scale through training and mentoring. Village official training related to mapping village potential and making digital maps of village potential is essential because it follows the priority program of PERMENDESA PDTT.

Based on the existing problems, the objectives of the community service were (1) Increasing the knowledge of village officials and representatives community (head RT/RW and Bumdes) regarding digital maps by explaining the importance of mapping digital potential to all stakeholders, (2) mapping village potential for field surveys and Focus Group Discussions (FGD) by PkM (Community Service Program) team, (3) Improving skills in inputing, processing, and outputing the digital maps in WebGIS with QGIS Software.

2. METHOD

This activity was conducted in Dukuh Village (Figure 1), Banyudono District, Boyolali Regency from May to August 2021. Administratively Dukuh Village, Banyudono district, Boyolali Regency, has an area of ± 16 Ha (Hectares) with a height of +196.2 to ± 203.8 meters above sea level. Dukuh

Village is located at 7°33'11.51" S and 110°40'34.77" E. Dukuh village consists of 19 hamlets, has an area of 149.87 ha, which consist of 4,082 people. The community service program was carried out in Dukuh Village for three months, from May to August 2021. The implementation of the activities consisted of four stages: the-knowledge-sharing stage, the making digital map stage, the training stage, and the evaluation and mentoring stage.
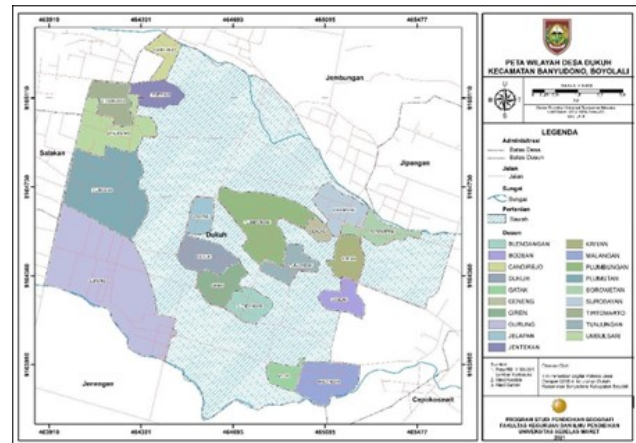

Figure 1 . Administration map of Dukuh Village

The tools and materials used in the digital mapping of Dukuh Village's potentials are as follows.

a. Drones
b. GPS
c. Compass
d. Theodolite
e. Measuring Tape
f. Questionnaire
g. Computer
h. QGIS
i. Printers and Scanners

2.1 The presentation of digital mapping

Before implementing the program, a pretest was conducted with a questionnaire on the understanding and skills in using the QGIS application. The pretest was used to measure participant's knowledge of the training and mentoring participants related to digital mapping before the activity was carried out. The knowledge sharing was carried out using the lecturing method to provide information on the utility and benefit of digitizing potential village maps along with the advantages of the QGIS application for possible mapping in terms of accuracy and data integration.

The knowledge sharing was intended for village officer and community representatives of Dukuh Village by explaining digital maps in detail. The digital mapping presentation activity was conducted on May 4, 2021, at the Dukuh Village Hall. In this stage, the PkM team coordinated with the head of Dukuh Village to gather information related to the needs and wants of the digital

map of the village's potentials. The agreement between the PkM team and the head village to create a WebGIS-based agricultural potential map was officially made.

2.2 Making a digital map of the village's potential

The village's website address is https:/bit.ly/PetaDigital PotensiDesaDukuh and is accessible as an online platform. The mechanism in the preparation of digital maps was divided into activities in the field and indoors. There were three main activities in the field activities in the digital mapping of the potential of Dukuh Village. First one is measurement of Ground Control Point (GCP). GCP activities aimed to obtain exact coordinates at locations that have been determined using GPS, theodolite, meter, and compass. These coordinate values served as a critical point in the aerial photo to get accurate results with a shift error of only a few centimeters to millimeters. This activity was held on May 8-25, 2021, in Dukuh Village, Banyudono Subdistrict, Boyolali Regency.

Next one, acquisition of aerial photo data. Aerial photo data acquisition activities included the creation of aerial photo flyways using drones adapted to mapping areas with flying altitudes of 120-150 meters above ground level. The image recording was done in about 15 minutes when the drone was flying above the 40-50 hectares of area coverage. This activity was carried out on May 26-June 6, 2021, in Dukuh Village, Banyudono Subdistrict, in 2021.

In completing the information for thematic maps, a direct survey of the field of facilities and infrastructure owned by the Village was conducted. These facilities and infrastructure consisted of electricity, irrigation, desalination, apples, important village buildings, and other thematic maps. On June 7-14, 2021, this activity was carried out in Dukuh Village, Banyudono Subdistrict, Boyolali Regency.

The training and assistance aimed to teach the village officials and representatives how to operate and utilize the village potential map to the fullest and update the data independently. The success in the training and mentoring was measured by pretest and posttest using a questionnaire. The training was held on 24-28 August 2021 at the Dukuh Village's hall.

The indoor activities served as avenues to discuss important matters relating to the digital mapping of the village's potentials with the village head and representatives.

Focus Group Discussion of Village Boundary Information. The Focus Group Discussion was conducted through participatory methods with village officials to obtain regional boundary information. The mechanism in the FGD was that a village official was accompanied by the PKM-UNS team to portray the boundary directly on the results of aerial photos that have been printed and then digitized on June 15, 2021, at Dukuh Village Hall, Banyudono Subdistrict, Boyolali Regency.

Focus Group Discussion on Buildings and Potentials. This Focus Group Discussion was carried out through participatory methods in which the village officials inputted data on buildings and the potentials of Dukuh Village. This FGD also facilitated corrections of basic maps that had been created. This activity was held on August 2, 2021, at Dukuh Village Hall, Banyudono Subdistrict, Boyolali Regency.

2.3 Traning

The training and assistance aimed to teach the village officials and representatives how to operate and utilize the village potential map to the fullest and update the data independently. The success in the training and mentoring was measured by pretest and posttest using a questionnaire. The training was held on 24-28 August 2021 at the Dukuh Village's hall.

2.4 Evaluation and mentoring

The fourth stage was evaluation and mentoring. In the evaluation session, we evaluated the level of the participants' knowledge about digital mapping and software application. The evaluation was done by asking training participants to complete a questionnaire. The questionnaire used a Likert scale that consisted of three levels. There were nine questions in the pretest and posttest, and there were three answer options that participants could choose for each question, namely Very Familiar, Familiar, and Not Familiar.

The mentoring session was provided during the implementation of operation training of the village's website. Continuous mentoring was carried out, so that the operation of the website could continue in the long term in order to improve the head officer village and representative community village potential information based on what the development planning decide. The mentoring was carried out by the PkM-UNS team. Table 1 is a list of pretest and posttest questions.

Table **1** . List of pretest and posttest questions

No	Question	Code	Topic
1	Do you know the village potential in Dukuh Village?	Q1	Village
2	Do you know the agriculture potential in Dukuh Village?	Q2	Potential
3	Are you aware of Digital Maps?	Q3	
4	Do you know the benefits of using digital maps?	Q4	Knowledge
5	Do you know the stages of making digital maps?	Q5	Village
6	Do you know how to operate digital maps?	Q6	
7	Are you aware of QGIS applications?	Q7	Digital
8	Can you download the QGIS application?	Q8	Mapping
9	Are you able to install QGIS applications?	Q9	Skills

Source: Research Analysis, 2021

3. RESULT AND DISCUSSION

3.1 Presentation of digital mapping

The presentations were carried out in person with health protocols. Twenty-eight participants participated in the presentation of the digital mapping of the potential of the Dukuh Village. The result of this event was good understanding of the importance of using QGIS technology to map village potentials that are valuable assets in building a sustainable spatial database. Based on the result of the questionnaire by the PkM team at the beginning, it was informed that the officials of Dukuh Village needed digital map to build a spatial database of village potentials. Especially a WebGIS-based agricultural potential map.

3.2 Making a digital map of agriculture potential of Dukuh Village based on WebGIS

The making of digital maps is carried out by field surveys to determine the boundaries of Dukuh Village with the technique of (a) terrestrial measurements to obtain information on the coordinates of the earth's surface using optical measuring instruments (theodolites); (b) measurements using GPS to obtain information on the coordinates of the earth's surface using satellites; (c) Remote Sensing, a technique or science that explains the process of recording an object through remote sensing techniques without touching the object, the result is an image/image of the earth's surface with low to high resolution. One of the implementations of remote sensing is using aircraft, UAV (Unmanned aerial vehicle), or drone-mounted camera. The socio-economic census was conducted to add attribute data to the digital map (d).

Figure 2 . a) Optical measurement technique using a theodolite; b) Measurement technique using GPS; c) Measurement technique using a drone; d) Census of socio-economic data

Field data collection activities are presented in Figure 2. The data obtained was then visualized as a map to get a Map of Village Boundaries, Buildings, vegetation, and service facilities in Dukuh Village based on WebGIS by QGIS. The results of the digital mapping of potential in Dukuh Village could be accessed through the link potensidesadukuh.000webhostapp.com. WebGIS-based village potential maps can disseminate spatial data that has been done so far using existing media such as print media (maps), CD-ROMs, and other storage media. The results

of interviews with village officials and stakeholders feel the benefits and can meet the needs in providing data for village development planning.

Table 2 . Potential for agriculture, livestock, and plantations in Dukuh Village

No	Commodities	Production Potential
1	Rice	74 Q/Ha
2	Corn	81 Q/Ha
3	Cassava	240 Q/Ha
4	Vegetables	
	a. Chili	28 Q/Ha
	b. Eggplant	35 Q/Ha
	c. Cucumber	25 Q/Ha
5	Fruit	
	a. Rambutan	35 Q/Ha
	b. Banana	16 Q/Ha
	c. Sapodilla Fruit	9 Q/Ha
	d. Papaya	70 Q/Ha
	e. Mango	10 Q/Ha
	f. Jackfruit	35 Q/Ha
6	Plantation Crops	
	a. Coconut	18.291 grains/3,1 ha
	b. Tobacoo	11.680 kg/8 Ha
	c. Kenanga	247 kg/3 Ha
	d. Kapok	1.250 kg/2,5 Ha
7	Livestock	
	a. Beef cattle	97 heads
	b. Kerau	38 heads
	c. Riding	4 heads
	d. Goat	363 heads
	e. Sheep	118 heads
	f. Rabbit	950 heads
8	Poultry	
	a. Broilers	9.900 heads
	b. Kerau	5.300 heads
	c. Riding	6.974 heads
	d. Goat	6.445 heads

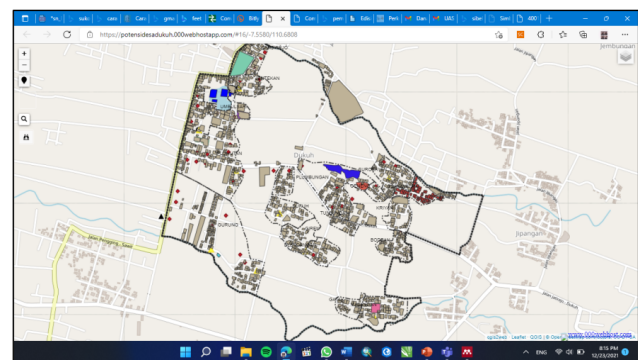Source: Data Processing Results, 2021

Figure 3 . WebGIS Potential of Dukuh Village

Based on Figure 3, the potential of Dukuh Village can be seen spatially in terms of the potential for agriculture, livestock, and plantations, along with their coordinates. The production results of each sector of Dukuh Village can be seen in Table 2.

The information in the WebGIS of the potential map of Dukuh Village can meet the community's needs to obtain information on agriculture, animal husbandry, and plantations for development planning and investment. The village's potential map created with WebGIS is expected to reduce mobility and speed in getting information about Dukuh Village.

3.3 Training

This training was attended by twenty-eight participants. The website has accessed the participants through 000webhostapp.com. Participants login with user id. Participants who have logged in could access the administrator. The next page after the participants was access to the features. These features were homepage, dashboards, FTP manager, and website. Homepage is the main menu of administrator access which displays the managed website. Dashboard has a function for website customization. FTP Manager is used to upload mapping results that have been done with QGIS (After the feature is done using the qgis2web plugin). The website can display WebGIS results that have been made.

WebGIS results can be viewed by anyone. There are several features that can be enjoyed by WebGIS users including (1) Zoom, (2) My Location, (3) Search, (4) Map Search, (5) Layers, and (6) Pop Up. Zoom function to zoom in and zoom out the map. The user can find out the location where he is with the "My Location" feature. Other location information outside the destination map can also be searched with the "Search" feature. Much of the information on the displayed map can be searched with "Map Search". User can show and hide map layers with "Layer" feature. Detailed information regarding a location that has added attribute data in QGIS can be accessed using the "Pop Up" feature by simply dragging the cursor to the specified place (until it changes color). Features for WebGIS users are presented in Figure 4.
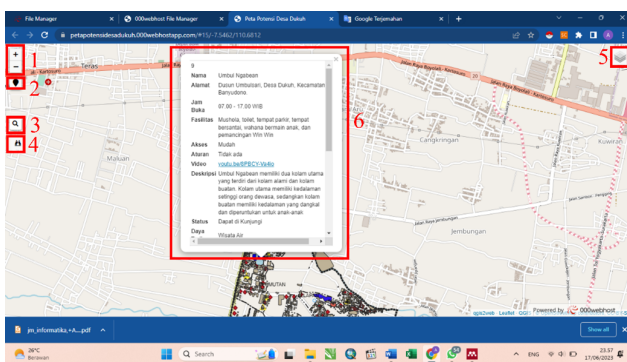

Figure 4 . Features for WebGIS users

Capacity building for digital mapping of village official and the Dukuh Village community is carried out using training and mentoring methods. Twenty-eight participants attended the training and mentoring activities, with information from 15 village officials (54%), ten from the Dukuh Village community and youth (28%), and three from Bumdes (11%). The training and mentoring participants comprised 23 men (82%) and five women (18%).

3.4 Evaluation and Mentoring

Based on the pretest results, training participants of village officials and representative community showed that the knowledge related to village potential was 93% high. Knowledge related to digital maps of training participants is low, where more than 60% of participants do not know digital maps. All participants do not have the skills to operate a WebGIS-based QGIS application and do not know how to handle it. The pretest results are shown in Table 3.

Table 3 . Pretest results

No	Questions	Very Familiar		Familiar		Not Familiar	
		n	%	n	%	n	%
1	Q1	26	93	2	7	0	0
2	Q2	26	93	2	7	0	0
3	Q3	0	0	11	39	17	61
4	Q4	0	0	9	32	19	68
5	Q5	0	0	0	0	28	100
6	Q6	0	0	8	29	20	71
7	Q7	0	0	0	0	28	100
8	Q8	0	0	0	0	28	100
9	Q9	0	0	0	0	28	100

Source: Data Processing Results, 2021

Training is an intervention effort to increase the capacity of official village representative community in the digital mapping of village potential. Based on the posttest results, it can be seen that there is an increase in the knowledge of village officials, representative community related to digital maps. It is known that the participants know enough and are very knowledgeable about digital mapping. There are more than 50% who are very knowledgeable about digital maps. An increase also occurred in the level of understanding of participants related to software in processing digital maps, one of which is QGIS. In the posttest results, there were still participants who did not understand digital mapping and the applications used. The lack of understanding regarding digital maps is caused by age and lack of adaptability to technology. The strategy used is to use the peer learning method. The peer learning method is applied using participants who already understand teaching other participants, so it is hoped that there will be the same understanding and skills in digital mapping of village potential using Web-based QGIS. The posttest results can be seen in Table 4.

The evaluation was carried out before and after the training implementation. Evaluations were given to participants in the first and second training. Based on Table 3 and Table 4 there was an increase in the ability to operate the QGIS application, from no participant who were know or able to operate it to all administrator management being able to operate it. The participants could understand the QGIS application materials delivered by the speakers, and the training method encouraged participants to be more active and think creatively. The speakers were PkM team members who especially had competency in information spatial technology called geographic system information (SIG) with QGIS software. The PkM kept giving mentoring even though the training activities had been done.

Table **4** . Posttest results

No	Questions	Very Familiar			Familiar			Not Familiar		
		n	**%**	**g**	**n**	**%**	**g**	**n**	**%**	**g**
1	Q1	26	93	0	2	7	0	0	0	0
2	Q2	26	93	0	2	7	0	0	0	0
3	Q3	16	57	57	10	36	-3	2	7	-54
4	Q4	16	57	57	10	36	4	2	7	-61
5	Q5	14	50	50	9	32	32	5	18	-82
6	Q6	12	43	43	10	36	7	6	21	-50
7	Q7	7	25	25	15	54	54	6	21	-79
8	Q8	7	25	25	15	54	54	6	21	-79
9	Q9	7	25	25	15	54	54	6	21	-79

*g = improvement of results from pretest to posttest (%)
Source: Data Processing Results, 2021

4. CONCLUSION

The implementation of the knowledge sharing, making digital map, the training, and the evaluation and mentoring were successful. The participants were Dukuh Village officials and representatives from the community (head RT, RW and Bumdes). The training activities were organized to provide new knowledge and skills for the Dukuh Village officials. The village official and heads RT/RW/Bumdes became able to manage the village's website (https://bit.ly/PetaDigitalPotensiDesaDukuh), which had been dynamically designed and built by the PkM team.

Mentoring activities are still being carried out exclusively by the PkM team of Universitas Sebelas Maret. This monitoring is closely related to managing the village's website. Head of village Dukuh suggested that PkM activities have a continuation. It is recommended that in the next PkM activity there should be digital village information system to improve performance of the Village Government to be more efficient in managing village administration and governance.

ACKNOWLEDGMENT

CONFLICT OF INTERESTS

The PkM team declares there is no conflict of interest with any of its partners with regard to this article entitled Digital Mapping of the Potential of Dukuh Village, Banyudono Boyolali Regency. The PkM team also declares that all team members have read and approved the contents of this article. Finally, the PkM team has given authority to the editorial team of the Jurnal Pengabdian Kepada Masyarakat Universitas Gadjah Mada to process the publishing of this article through the corresponding author.

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