

CARTOMETRIC MAPPING METHODS OF VILLAGE BOUNDARY IN TEGINENENG SUB-DISTRICT, PASAWARAN REGENCY, LAMPUNG PROVINCE, INDONESIA

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ABSTRACT: Village boundaries are an important element in regional development. Clarity of village boundaries makes it easier for the government to regulate the movement of people, commodities, capital, information and administration; minimize boundary conflicts; orderly government administration; legal certainty and jurisdiction of regional government; targeted spatial plan; and the implementation of good & clean governance. Indonesia, with its vast territory and thousands of village administrations, has homework to quickly and accurately map village boundaries. This study aims to examine the effectiveness of the village boundary mapping method using cartometrics in Indonesia. This study was conducted in Tegineneng Sub-District, Pasawaran Regency, Lampung Province. The analytical method used is quantitative descriptive spatial analysis. Identify objects using high-resolution imagery combined with field tests. This study was carried out through the stages of data preparation, work map creation, work meeting, processing and presentation of final results. The data used in this study are indicative village boundary maps of a scale of 1: 25,000, high-resolution satellite imagery, aerial photographs, administrative area codes and data, minutes of history of village establishment, and village potential. The results obtained showed that the use of high-resolution images greatly helped the process of mapping village boundaries by means of cartometrics. The biggest obstacle of the application of this method is the non-technical aspect, namely an agreement between regional stakeholders. The results of this study are expected to improve the quality of village boundary maps through improved mapping methods and accelerate the process of mapping village boundaries throughout Indonesia.

1. INTRODUCTION

Village boundaries are an important element in regional development. Clarity of village boundaries makes it easy for the government to regulate the movement of people, commodities, capital, information and administration; minimize boundary conflicts; orderly government administration; legal certainty and local government jurisdiction; spatial planning; and implementation of good & clean governance (Budisusanto et al, 2014; Varol and Söylemez, 2017). Village boundary mapping activities in Indonesia have been carried out a long time ago, but until now they have not yet been completely resolved. Some challenges related to mapping village boundaries in Indonesia include: 1) Indonesia's territory is very broad; 2) Indonesia consists of many islands; 3) ethnic, religious, cultural and racial diversity; 4) conflict of interest. The development of knowledge about resolving border conflicts has developed very rapidly in recent years. The concept of e-negotiation in the settlement of territorial boundaries has been initiated since the late 90s (Goldsmith et al, 1999; Yan et al, 2000; Kersten, 2003). Settlement of

village boundary issues in Indonesia is regulated in Minister of Domestic Affairs Regulation No. 45 of 2016 concerning Guidelines for Determination and Confirmation of Village Boundaries. The method used is the cartometric method, namely by tracing / drawing village boundaries on the work map without having to go to the field.

Several village boundary mapping studies using the cartometric method have been conducted by previous researchers such as Khasanah and Alfian (2018), Purwanti and Budisusanto (2015), and Ma'ruf et al (2009). The results of this study prove that the settlement of village boundaries using cartometrics can be implemented and done well if the basic data uses large-scale imagery. One obstacle to cartometric mapping experienced by Ma'ruf et al (2009) is when the village boundaries that were emphasized were not in the form of natural boundaries or in the form of artificial boundaries, namely land parcels that cannot be drawn on a work map. This requires more effort to measure to the field using GPS Geodetic to obtain maximum results.

Pesawaran Regency is one of the regencies in Lampung Province that has a wealth of natural potential. Based on data from the Central Statistics Agency (2018), Pesawaran District has 9,191 ha of paddy fields, and dry fields with an area of 35,774 ha. Abundant natural resources are distributed in 11 districts and 144 villages. Until this research was conducted, not all village boundaries in Pesawaran District were agreed by various parties. All this time, the village boundaries in Pesawaran Regency use indicative data whose sources cannot be accounted for, so a study is needed to agree on village boundaries.

One area that has not yet been identified is the village boundary of Tegineneng District. Tegineneng District was chosen as a research location because it has a fairly dense settlement, and most of its area consists of rice fields and dry fields. Potential land such as rice fields and dry fields is often a source of problems in mapping village boundaries in Indonesia because agriculture is one of the main livelihoods of rural communities. Ownership of land that moves frequently, as well as the existence of a "bent rice field" system (rice fields that the government lends to the village head to manage), is an interesting object to study. The purpose of this study is to examine the effectiveness of village boundary mapping in Tegineneng District, Pesawaran District, by applying the cartometric method.

2. MATERIALS AND METHODS

This study was conducted in the Tegineneng District area, which is part of the administration of Pesawaran Regency. The Tegineneng District area covers 16 village administrations. This study examines the process of asserting village boundaries in 16 existing village administration areas. Fieldwork from this study was carried out at the end of 2018 at the study site. Data preparation and analysis activities were carried out in early 2019 at the work studio of the Geospatial Information Agency (BIG), in Cibinong, Bogor.

Village boundary mapping activities carried out in several stages, namely 1) data preparation; 2) making work maps; 3) work meetings; 4) processing and presentation of the final results. In the preparation stage, an inventory of data is carried out for cartometric delineation activities. The data used in this study are 1) indicative village boundary maps sourced from the Indonesian Rupa Bumi Map scale of 1: 25,000; 2) orthorectified high resolution satellite imagery with accuracy <2.5 meters; 3) aerial photographs with accuracy <2.5 meters; 4) administrative area code and data; 5) other supporting data such as minutes of history of village establishment, village potential, and other data.

The next step is to create a geodatabase file that is used for storing data from the village boundary delineation. Feature dataset consists of element classes with type types, polyline and polygon. Point type element classes for public and toponym facilities (government offices, worship facilities, transportation, hydrographic, and administrative areas). Polyline type element class for boundary and hydrographic boundary line segments. Polygon type element class for administration area coverage. Raster dataset consisting of raster high-resolution satellite imagery and rectified aerial photographs.

Data that has been grouped by type, then presented in a cartographic map. The layout of the draft work map for each village is made on one map with the largest scale on the face of the map according to specifications for paper size A0. The draft work map is presented in digital and printed form. Draft work maps were printed for all villages and sub-districts where the activity was located.

Working meetings are carried out together with related institutions for the socialization of activities while at the same time conveying technical mapping of village boundaries. The drawing of village boundaries is done by interpreting the draft work map against the background of high-resolution upright imagery. The drawing of the boundary is accompanied by the drawing of the boundary above the draft work map with a marker. Border markers are used to reduce ambiguity, help in the representation of boundaries and improve legal clarity (Frank, 1996; Casati et al., 1998). This activity is carried out by village officials, community leaders and people who know the village pedigree, accompanied by a technical team for the determination and confirmation of village boundaries.

The drawing and drawing of the boundary lines in the draft work map are carried out both in the village boundary segments agreed by the two bordering parties and in the village boundary segments that do not meet the agreement of the two parties that border. Determination of cartometric points at the village boundaries agreed upon in the draft work map to mark certain locations. Cartometric points are used to extract coordinates at certain locations at agreed village boundaries. The naming of the cartometric points in the database combines the abbreviation of the cartometric point or TK (as a type of point), the area code and the serial number of the cartometric point with the picture presented in Figure 1, as follows:

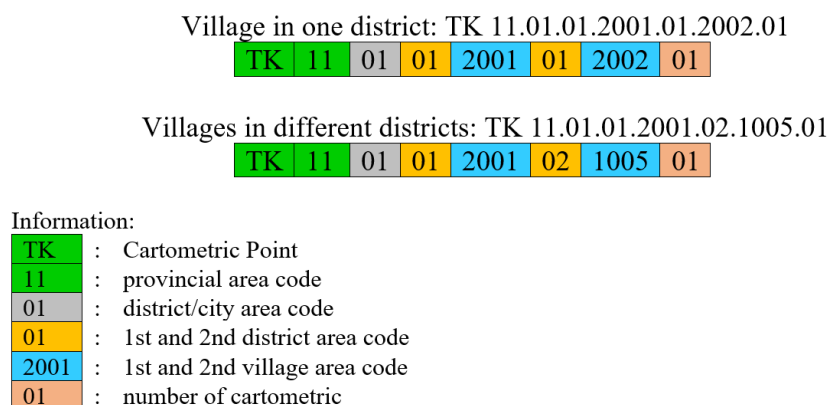


Figure 1. Cartometric point system
Source: Researcher, 2018

The regional code is based on the Minister of Home Affairs Regulation of the Republic of Indonesia, concerning the latest and applicable regional codes and data. Whereas the 1st or 2nd area numbering is based on the sequence of the district/village/kelurahan area code. Each

boundary segment (to digital data) is added by several components, namely the direction, boundary element, and toponym of the boundary element (if any). Evidence that the boundary is valid is the signing of a draft work map and minutes by the two adjacent village heads.

Draft work maps and minutes of the results of tracking and determining the position of the boundaries of villages or villages are scanned (scanned) and stored in georeferenced digital format. The process of copying boundary data to digital data is done after the work map is scanned. Boundary data with polyline geometry, cartometric points using point geometry, and area coverage are obtained from polygon boundary lines. The next stage is to do seamless data to unify all village data in Tegineng District.

3. RESULTS AND DISCUSSION

In accordance with the stated method, the results of this study are submitted based on four stages carried out. Because the first and second stages of all activities are carried out in a work studio, the presentation of results and discussion will take precedence in the third step, which is the work meeting and the fourth step, the processing and presentation of the final results.

3.1 Data preparation and work map making

The first and second stages of this activity are all carried out in offices or work studios at BIG. This stage does not face significant problems. This condition is supported by the readiness of the equipment (hardware and software which is very adequate for mapping activities) and the availability of basic data and high-resolution satellite imagery that meets basic quality requirements. Factors that can be a barrier to this activity are the completeness of data and other supporting information such as: minutes of the history of the founding of the village, and the potential of the village. This factor is strongly influenced by the support of data supply and supporting information from the mapped regions.

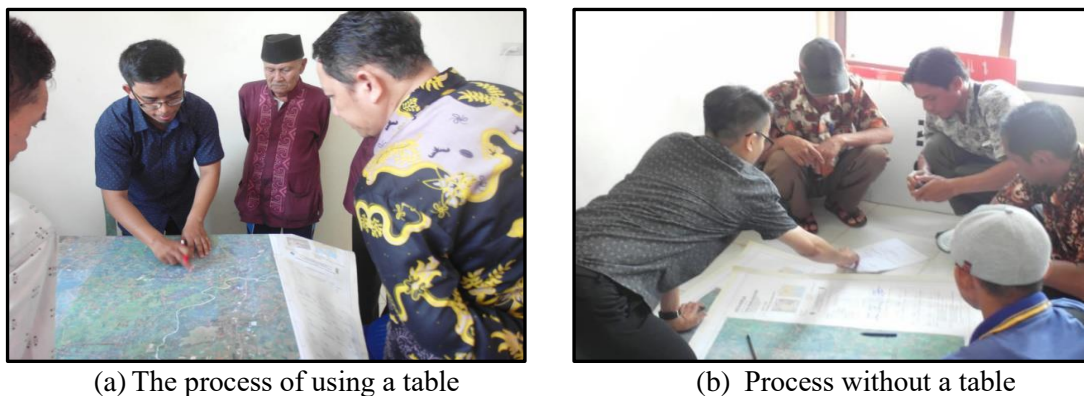


Figure 2. Implementation of cartometric delimitation at meeting hall
Source: Researcher, 2018

3.2 Implementation of work meetings

This stage was carried out at the location of cartometric mapping with several considerations, namely: the number of participants, ease of access, and convenience. The number of personnel involved in carrying out this stage is determined based on the consideration of time and the number of village administrations that have verified their limits. This activity is carried out by involving village officials, community leaders and people who know the village genealogy

accompanied by a technical team for the determination and confirmation of village boundaries from BIG. Description of the implementation of work meeting activities can be seen in Figure 2. This activity takes between 1-2 days depending on the number of technical team members establishing and asserting village boundaries, the complete presence of stakeholders and the smooth process of establishing stakeholder agreements.

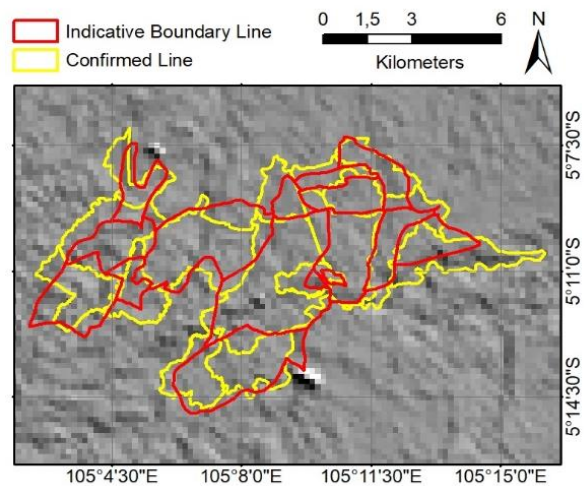
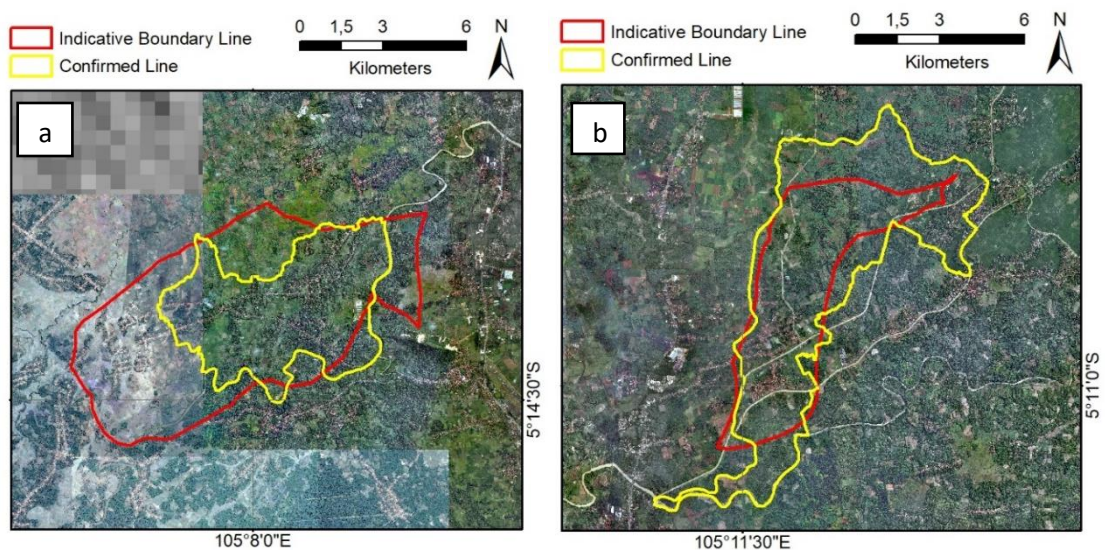


Figure 3. Differences in indicative and definitive of Tegineneng District boundaries
Source: Analysis, 2019

3.3 The processing and presentation of the final results

The results of the processing and the presentation of results can be seen in Figure 3. Based on Figure 3 can be seen the results of processing and presentation of results for all districts that are the study area. Visual differences are very visible in the details of village boundaries that have been successfully established and reaffirmed. The difference in affirmation boundaries certainly has implications for changes in the area of the map that was successfully mapped. Data on changes in the calculation of village area can be seen in Table 1.



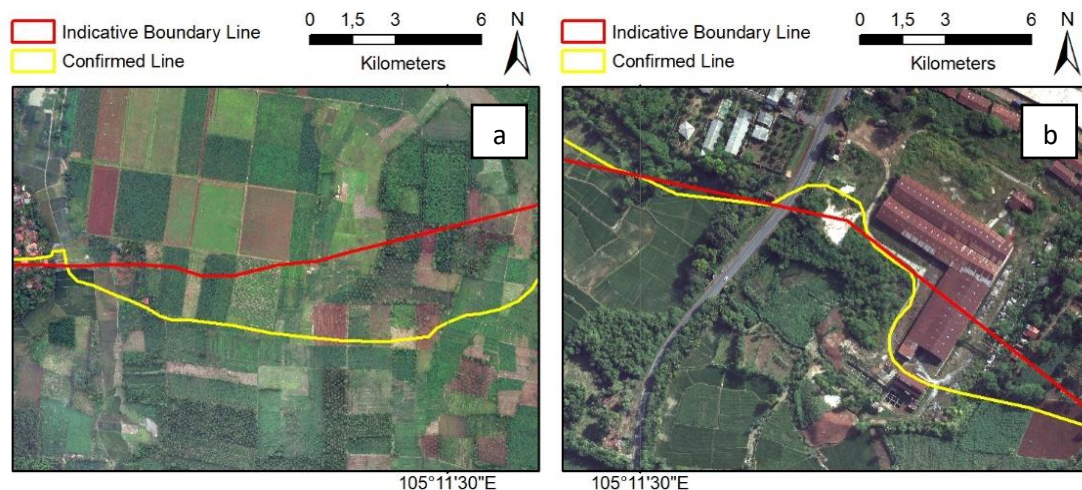
(a) Changes the village boundary of Kresno Widodo

(b) Changes the village boundary of Rejo Agung

Figure 4. Differences in indicative and definitive boundaries of villages
Source: Analysis, 2019

Detailed differences between the indicative boundaries with the definitive boundaries of the results of the work meeting can be seen in Figure 4. In Figure 4 the boundary mapping results are displayed in two different villages namely Kresno Widodo and Rejo Agung villages. Based on Figure 4 it can be observed descriptively that the addition of boundary details to the indicative boundary has a similar tendency at the two observation village locations (Figure 4 (a) and 4 (b)).

If the results of the assertion of village boundaries, especially Rejo Agung Village are observed more closely then it can be observed differences in the depth of boundary information and details of objects that can be restricted. A comparison of the results of this boundary affirmation can be seen in Figure 5. Based on the visualization of Figure 5, a detailed difference can be seen between the indicative boundaries that already exist with the definitive boundaries obtained. In Figure 5 (a) it can be seen that the village boundaries which previously did not follow a certain pattern and cut the paddy field area (red line) then the boundary line can be duplicated following the paddy boundary. The same thing can be seen in Figure 5 (b), the indicative boundary line before cutting the building, the results of the determination can be adjusted to the building boundary.



(a) Changing village boundaries from cutting the middle of the rice fields to switch to follow the rice field bunds
 (b) Changes in village boundaries from cutting off buildings going through the edges of the building

Figure 5. Detailed changes to the boundaries of Rejo Agung Village

Source: Analysis, 2019

The results of the calculation of the area of village administration are shown in Table 1. Based on Table 1, it can be observed that the total area of village administration that is mapped has changed in area compared to the indicative area. Most of the village administrative areas (9 villages) experienced an increase in area compared to the indicative area. A small portion (6 villages) experienced a reduction in area when compared to the initial indicative area. Only 1 new village was mapped in this activity. In total, the area of Tegineng Subdistrict experienced a change of 12.26% or 1557.24 ha wider than the indicative area. The tendency of differences in the area between indicative and confirmation, with varying percentage figures shows the dynamics of indicative data quality. This condition can be stated as initial identification that boundary mapping activities using the cartometric method can provide better results.

In the implementation of the inter-village boundary verification process it can be said that it was found that there were disagreements between villages faced by 5 villages. This figure is quite low when compared to the total number of villages. A list of villages that disagree about boundaries between regions is presented in Table 2. Visualization of the spatial location of disagreeable

boundaries is presented in Figure 6. The tendency of the low level of disagreement between these villages can be indicated as the successful application of the cartometric method used. The existence of a working meeting process that brings together stakeholders between administrative regions, can reduce the risk of border disagreement.

Table 1. Changes in village boundaries

No.	Village Name	Indicative (ha)	Confirmation (ha)	Area Difference (ha)	Change (%)
1.	Batang Hari Ogan	619.75	1,039.60	419.85	67.75
2.	Bumi Agung	1,028.34	1,274.49	246.15	23.94
3.	Gedung Gumanti	2,448.62	2,218.94	-229.68	-9.38
4.	Gerning	705.62	1,292.16	586.54	83.12
5.	Gunung Sugih Baru	548.69	530.37	-18.32	-3.34
6.	Kejadian	117.24	356.59	239.35	204.15
7.	Kota Agung	575.48	495.74	-79.74	-13.86
8.	Kresno Widodo	1,751.51	867.44	-884.07	-50.47
9.	Margo Mulyo	266.18	518.09	251.91	94.64
10.	Margo Rejo	1,114.96	780.21	-334.75	-30.02
11.	Negara Ratu Wates	277.79	365.43	87.64	31.55
12.	Panca Bakti	462.46	512.27	49.81	10.77
13.	Rejo Agung	568.61	1,001.79	433.18	76.18
14.	Sinar Jati	280.04	640.02	359.98	128.55
15.	Sriwedari	-	707.07	707.07	-
16.	Trimulyo	1,937.74	1,660.06	-277.68	-14.33
	Total	12,703.03	14,260.27	1,557.24	12.26

Source: Analysis, 2019

Table 2. List of villages disagreeing

No.	1st village	2nd village	Status
1.	Kejadian	Bumi Agung	disagreeing
2.	Kota Agung	Gunung Sugih Baru	disagreeing
3.	Negara Ratu Wates	Bumi Agung	disagreeing

Source: Analysis, 2019

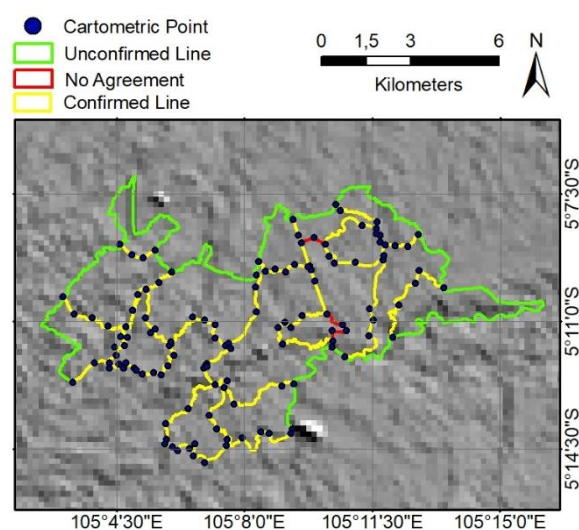


Figure 6. Status of village boundaries as a result of affirmation

Source: Analysis, 2019

Based on the results of data management about the coding of the cartometric point IDs, the results show that this method is quite systematic and facilitates the process of recognizing and managing

information again. Illustration of depiction and numbering of cartometric point ID is illustrated in Figure 7. Tabular information of each cartometric point ID that is in Figure 7, is presented in more detail in Table 3. Visualization of Figure 7 and presentation of Table 3, can give a little visualization of the ease and systematic management of segment data and points from existing village boundaries. With a systematic method of course efforts to repair or resolve disputes in the future can be more easily done. This condition is due to all existing data and information being recorded digitally and following a standardized recording system. This condition will facilitate the process of storing and tracing back.

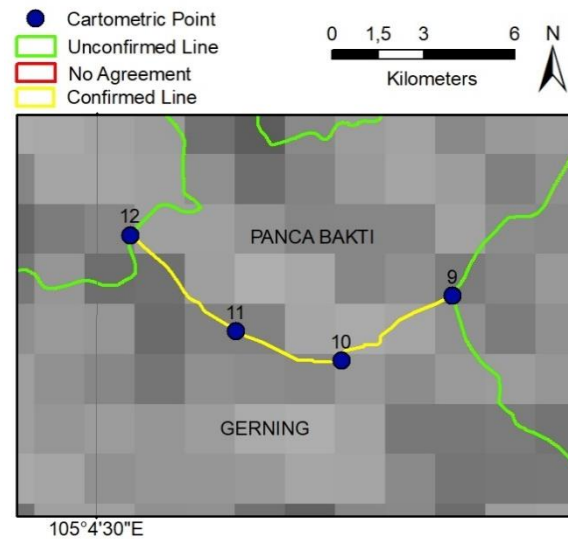


Figure 7. Example of a cartometric point ID
Source: Analysis, 2019

Table 3. Example of codification of the cartometric point ID

TK.	Cartometric point number	Segment name	Direction	Information	Status	X	Y
9.	18.09.03.2011-03.2010-18.02-000	PANCA BAKTI-GERNING-KAB LAMPUNG TENGAH	-	Knot Point	Agreed	510273	9430660
10.	18.09.03.2011-03.2010.002	PANCA BAKTI-GERNING	to the northeast	Through irrigation channels	Agreed	509662	9430304
11.	18.09.03.2011-03.2010.001	PANCA BAKTI-GERNING	to the southeast	Through oil palm plantations	Agreed	509081	9430465
12.	18.09.03.2011-03.2010-18.02-000	PANCA BAKTI-GERNING-KAB LAMPUNG TENGAH	-	Knot Point	Agreed	508497	9430995

Source: Analysis, 2019

The idea of using natural features as administrative boundaries has emerged in recent decades (Bennett et al, 2010). This idea is what underlies the development of boundary mapping methods using the cartometric method. The main requirement for mapping boundaries is that existing boundaries must be real and easy to recognize (Richardson, 2001). Through the application of the cartometric method, village boundary affirmation activities are proven to meet these requirements. Through the four stages carried out, quite good and adequate results were obtained for the confirmation of village boundaries.

4. CONCLUSION

Based on the results of this study, several conclusions can be drawn regarding the application of the cartometric mapping method in affirming village boundaries. The general conclusion that can be stated is that this method can be applied well for mapping village boundaries. The main advantage of this method is that there are work meeting stages that bring together stakeholders from each village who has the authority to set limits at the same time. This stage cuts a considerable amount of time in the boundary mapping process. The weakness of this method is in the initial stages, related to the completeness of data and village information that is highly dependent on its availability.

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