Spatial Data Quality Evaluation Of Complete Map Of Village Land Parcels Information Based On Participatory Mapping Result

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Key words: Spatial Data Quality, Participatory Mapping, FFP-LA, Land Registration.

SUMMARY

In order to accelerate land registration in Indonesia, the Ministry of Land Affairs and Spatial Planning / National Land Agency (BPN) implement the complete systematic registration programme (PTSL), so there is a need to complete data on the object and subject of land in a village administration area. To overcome the problem, a complete map of village land parcel information becomes an important thing to be realized. Tangerang Selatan Land Office with Local Goverment, the community, the youth organization, the village government to implement participatory mapping through inventory and verification of all parcels of land, either unregistered or registered land by utilizing general boundary delineation methods on aerial photograph map scale 1:1000 with the FFP-LA approach. it was conducted an distance and area accuracy test based on technical guidance in Regulation of Land Affairs Minister (PMNA) Number 3 Year 1997, also spatial data quality test based on SNI-ISO 19113:2011 (near-distance, polygon, and circularity ratio). To do so, by comparing data of general boundary delineation methods and field survey data collected using terrestrial methods during government land registration program. The result of land parcels distance and area test for open area, the majority fullfill the standart and closed area did not. Factors affecting the accuracy in the opened areas, the boundaries are clearly visible, while the closed areas are blocked by buildings and vegetation. Based on the result of spatial data test, not all of data are in very good quality because it still contains areas that have significantly difference in geometry dan position, therefore if the data complete map of village land parcel information based on participatory mapping result will be applied for land registration, it should pass the quality control (QC) according to the existing standards in the Ministry of Land Affairs and Spatial Planning / National Land Agency (BPN).

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1. INTRODUCTION

The Ministry of Land Affairs and Spatial Planning / National Land Agency has taken a policy to accelerate land registration through the complete systematic registration progamme (PTSL). It is targeted in 2025, with the PTSL activities, all land parcel has been registered (Kementerian ATR/BPN, 2017). In order to accelerate the land registration through PTSL, it is necessary to have the data of subject and object of registered and unregistered land in one village completely and thoroughly so a complete land database is developed and known by the name of Complete Map Of Village Land Parcels Information (PIBT). In the implementation of complete village - PIBT through participatory mapping, a census and land & building taxes activities between Tangerang Selatan Land Office and Local Government. (Kementerian ATR/BPN, 2016). Participatory mapping activities include the collection of spatial data and land data throughout the land boundaries. Spatial data collection is by utilizing the general boundary delineation method on a 1: 1000 aerial photograph map with the Fit For Purpose Land Administration (FFP-LA) approach, supported by the active participation of communities, village chief, and the youth organization.

The general boundary delineation method happens to be the superior in terms of the effectiveness of cost, energy and time required compared to terrestrial measurements for opened areas and agriculture, but the encountered obstacles are if densely populated areas and boundary fields are blocked by vegetation and buildings. (Sudarsono, B, and Nugraha, 2008). The implementation of the identification, verification, and delineation of land parcels by utilizing the aerial photograph map, its accuracy is influenced by the scale factor and the resolution of the aerial photograph, the quality of the aerial photograph, the clarity of the plane boundary object in the aerial photograph and the ability of the Human Resources in conducting the identification. Besides, it is possible to make mistakes in implementing the land boundary interpretation. Therefore, it is necessary to evaluate the quality of spatial data of complete map of village land parcels information based on participatory mapping result, in order to support the accelerating land registration programme in Indonesia.

2. PARTICIPATORY MAPPING

To support government land administration programme, it can also be done by the participatory mapping as the research conducted by Zarqoni and Pasaribu (2013) that is the participatory mapping to realize the National Agrarian Reform. The participatory approach is useful in the process of adjudication, the measurement of land, the recording of land history and fixing the parcel of land (Keenja, et al., 2012). Grobogan District Land Office conduct a participatory

mapping exercise for the complete village development using the general boundary identification and delineation (Aisyah, et al., 2015). Participatory mapping for complete village development in supporting one map policy has been implemented in Giriketo Village, Turi District, Sleman Regency (Aditya, et al, 2015). In the implementation of participatory mapping, a working map of satellite images and aerial photographs are required. The spatial data collection of land parcels in Rwanda using the aerial photo map with the general boundary method can list all 10.4 million parcel of land within 5 years (Enemark, et al., 2014).

With the utilization of digital aerial photography in the implementation of the activities related to the land, simplify the land parcel identification in an open and regular area and developing a working map from the aerial photograph map helps the officer in the measurement, while the constraints in the identification of photo map include the areas covered by the vegetation and solid building and the area that undergoing rapid and drastic change of detail (Sudarsono and Nugraha, 2008). According to Alam (2001) errors and thoroughness in recognizing the boundaries of the plane of aerial photography can be influenced by the scale and resolution of the aerial photographs, the quality of the aerial photographs, and the clarity of the objects on the aerial photographs and the capabilities of the human resources on identifying the boundaries of the land parcels.

The quality test of a land parcels can be a distance, area and spatial quality. The accuracy test of distance and area is set in the technical guidance of Regulation of Land Affairs Minister (PMNA) Number 3 Year 1997 where its tolerance is for a distance of 10 cm (residential area) and area $\Delta L_i \leq \frac{1}{2}\sqrt{L}$. The accuracy test of distance and area delineation on aerial photographs is area compared to terrestrial measurements done by Alam (2001). The test results between the delineation of aerial photographs and terrestrial measurements in open and regular areas meet tolerance, whereas in the closed and settled districts partially do not meet. Testing the difference of general delineation boundary to the fixed boundary of RTK GNSS measurement in Rwanda resulted in the difference of the average land parcel area for 250 m2. The contributing factor is the misinterpretation of the boundary in the general boundary delineations activities (Tharcille, et al., 2015). The spatial data quality test has been done by Aditya, et al. (2012) by conducting geometry test and OpenStreetMap data position in Indonesia, that the result of data spatial accuracy is sufficient. Pratama (2017) conducted a test of registration map data quality at the Sleman Regency Land Office. The result is that not all the quality of registration map spatial data is in good condition, only 38.75% of data that has the very good quality.

3. FISCAL CADASTRE AND LEGAL CADASTRE CENSUS IN TANGERANG SELATAN

In 2016, Tangerang Selatan Land Office in collaboration with Tangerang Selatan Local Government launched a project called Sensus PBB dan Pertanahan (Fiscal Cadastre and Legal Cadastre Census). The project is parcel based participatory mapping which the outcome will be used by local government for land taxation and land permit issuance purposes and by land office for supporting land registration programme and improving land administration. Information collected in this project included land tenure, land value, land tax, land use, and spatial planning suitability. Together with Tangerang Selatan Local Government and Land Office employees as

well as community element including village youth organisation as census officers. (Dzihrina et al, 2017).

To implement the project particularly for identification and delineation purpose, the Android mobile app “Smile Cadastre” is employed. “Smile Cadastre” alone has several useful features such as a base map derived from aerial photo with a scale factor of 1:1000 and ground sampling distance (GSD) of 8 cm as well as land record feature that is a form to record the required information. Another important feature is an integration of ”Smile Cadastre” into KKP (Komputerisasi Kantor Pertanahan -land office data base application to store parcel information both its spatial and legal information) so that the distribution of existing registered parcels and their information can be loaded on the apps.

Figure.1. Parcel based participatory mapping using “Smile Cadastre”

4. IMPLEMENTATION OF FFP-LA SPATIAL FRAMEWORK

Sensus PBB dan Pertanahan (Fiscal Cadastre and Legal Cadastre Census) are implemented with the FFP-LA spatial framework approach. The FFP-LA spatial framework is built in an affordable and accessible way, using either aerial photographs or large-scale satellite imagery to identify and limit land parcels through participatory mapping (Enemark, et al., 2014). Below is an analysis of implementation FFP-LA spatial framework (Table 1).

Table. 1. Implementation of FFP-LA spatial framework

FFP-LA Spatial Framework	Fiscal Cadastre and Legal Cadastre Census	Land Administration System in Indonesia
General boundary rather than the fixed boundary	▪ The utilization of general boundary delineation method is using android application "smile cadastre". ▪ The implementation is with the active participation of the community.	▪ In Indonesia measurement of fixed boundary ▪ When it is identified on the map, the photograph should be measured in the field
The use of aerial photography/satellite imagery rather than field surveys	▪ Has 8 cm GSD and 1: 1000 scale the aerial photograph used, used as the base of registration map ▪ Delineation methods for the purposes of land registration need to be regulated from legal and institutional aspect	▪ The utilization of aerial photography as the base of registration map. ▪ The utilization of aerial photography has been set on PMNA No. 3 Year 1997
The accuracy is in accordance to the purpose rather then to the applied technical standard	▪ In the implementation, it is not too concern about the accuracy, since its main purpose is for the completeness of land information	▪ Field survey techniques with high accuracy that meet the technical rules of measurement and mapping. ▪ Rules of the accuracy of registration basemap, distance and area.
The opportunities for updates, upgrades, and the continuous improvement	▪ The participatory mapping exercise results were carried out by the quality control for land registration. ▪ Data quality improvement into Geo-KKP.	▪ Sporadic or systematic land registration is done in one process. ▪ Land registration includes first time registration and change of rights.

5. SPATIAL DATA QUALITY EVALUATION

5.1. Distance Accuracy Test

The distance accuracy test of the general boundary delineation in the opened and closed area and analyzed its tolerance of difference of distance is calculated based on technical guidance in Regulation of Land Affairs Minister (PMNA) Number 3 Year 1997. A summary of the distance accuracy test in the opened and closed area can be seen in Table 2.

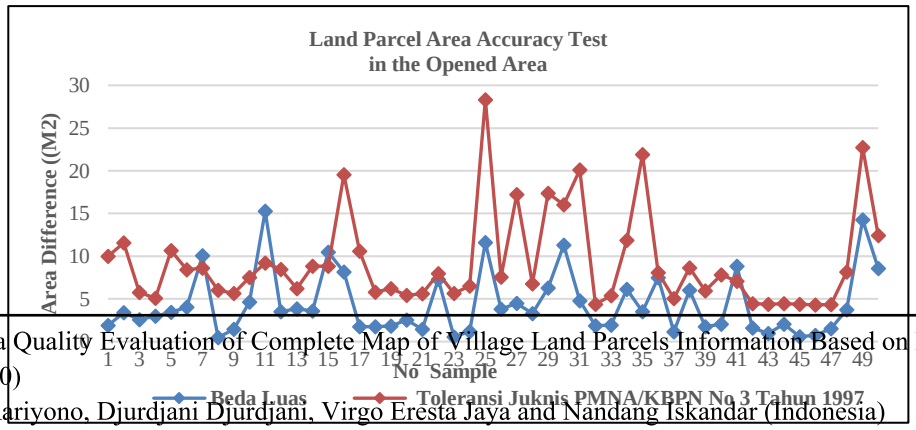
Table. 2. Distance accuracy test

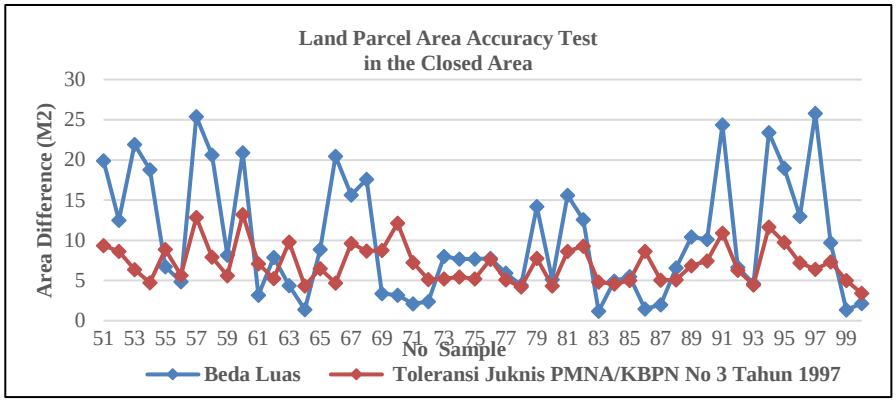
Note	Opened Area	Closed Area
Number of Samples	200	200
Average distance (m)	0,095	0,495
The largest distance difference (m)	0,534	4,105
The Smallest distance difference (m)	0,041	0,070
Fullfill tolerance	155	28
Does not fullfill tolerance	45	172

The land parcels distance accuracy test in the opened area has an average of 0.950 m, it fullfill the tolerance, while in the closed area the average of 0.495 m, it does not fullfill the tolerance based on the Technical Guidance of in Regulation of Land Affairs Minister (PMNA) Number 3 Year 1997 (tolerance of 0.100 m). Factors affecting the accuracy of the distance; in the open area, there are many of them fullfill the tolerance because it is easy to identify, while in the closed area, the land parcel boundaries are covered by the building and vegetation resulting in the error interpretation.

5.2. Area Accuracy Test

The land parcels area accuracy test is done by comparing the area of delineation results of general boundary and terrestrial methods. The area of terrestrial measurement results as the field reference area when testing the accuracy of land parcel areas. Tolerance for the area differences is calculated based on Regulation of Land Affairs Minister (PMNA) Number 3 Year 1997. The accuracy test results of the opened and closed area can be seen in Figure 2**.**





(b)

Figure. 2. The area accuracy test results in the area of (a) opened and (b) closed

Area test results in the opened area indicate that 46 (92%) land parcels fullfill the tolerance and 4 (8%) land parcels do not. On the average, the area different of land parcel is 4,366 m^2. Meanwhile, the test results of the land parcel area in the open area indicated that 14 land parcel or 28% of the samples taken meet the tolerance of area difference and 36 land parcel or 72% did not meet. On the average, the difference of land parcel area is 10.222 m^2. An influential factor in the land parcel identification is the visibility of land parcel boundaries on the aerial photograph map. For the open areas land parcel, the boundaries are clearly visible so as to facilitate identification and delineation, while the closed areas are blocked by buildings and vegetation so the delineated boundary is the interpretation boundaries. To overcome these obstacles, it can be done by method 'pemotongan kemuka" (Figure 3a) and GNSS and terrestrial combination method (Figure 3b).

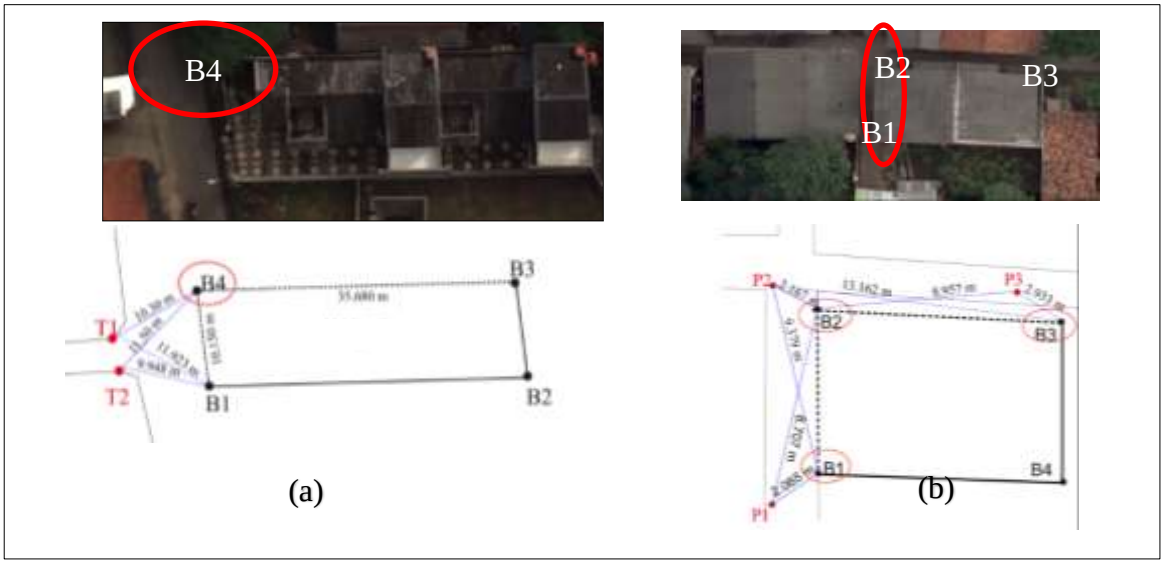


Figure. 3. (a) Determination of land parcel boundary B4 with methode of "pemotongan kemuka" (b) Determination of land parcel boundary B1, B2, and B3 with combination method of GNSS and Terrestris

Another factor that influences the area difference is the existence of differences in information related to the boundary of the field by the owner, is very influential on the area land parcel accuracy. The data of the general boundary delineation - the results of participatory mapping activities is different from the results of field measurements after the fulfillment of the principle of *Contradictoire Delimitatie.*

5.3. Spatial Data Quality Test

Spatial data quality accuracy test using three methods according to SNI-ISO 19113: 2011, namely Polygon Area, Polygon Near Distance, and Polygon Circularity Ratio. In this test, a test object is a land parcel of the general boundaries delineation, while the reference object is a land parcel of terrestrial measurement. Spatial data quaity test - the result of delineation of the general boundary. The accuracy test using 100 land parcel samples covering 50 land parcels in opened areas and 50 land parcels in closed areas. The land parcel as the result of the general boundary delineation is called the test object, whereas the land parcel as the result of the terrestrial measurement is called as the reference object. The result of Polygon Near Distance method test, Polygon Area test and Polygon Circularity Ratio test (figure 4,5 and 6).

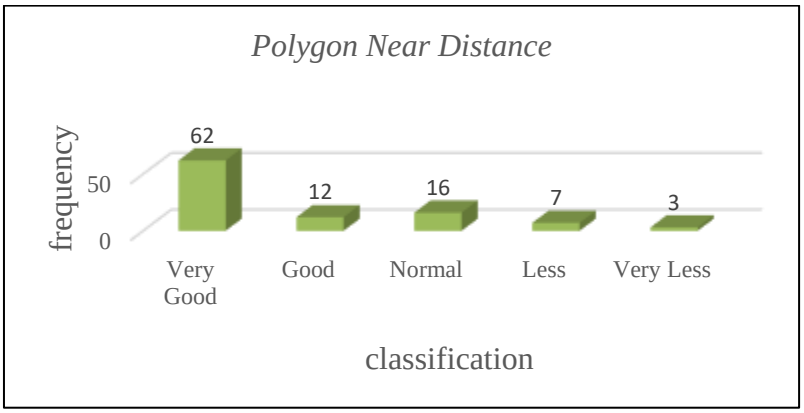


Figure 4. Result of polygon near distance test

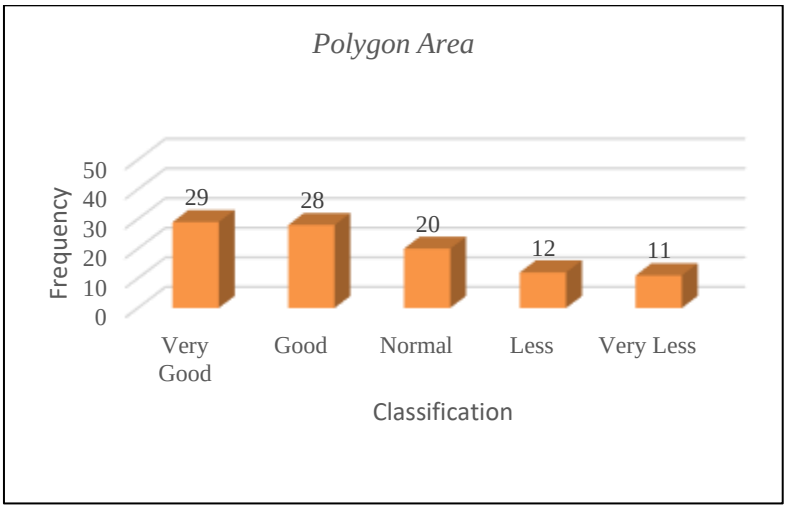


Figure 5. Result of polygon area test

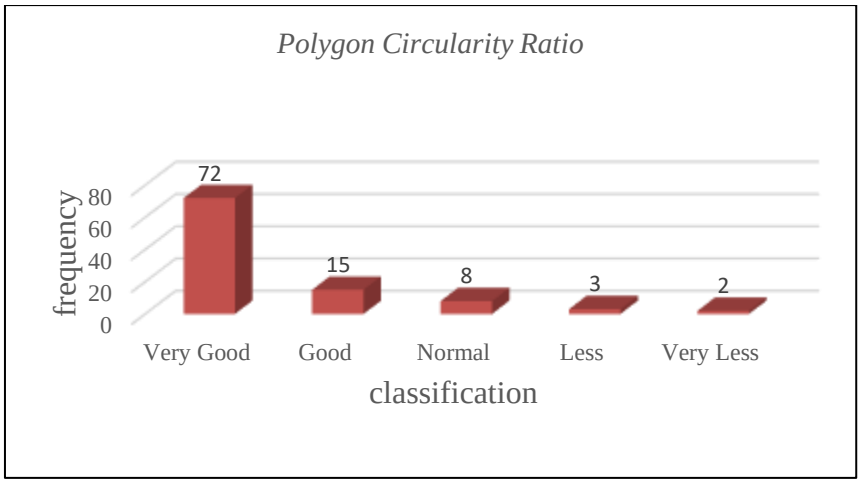


Figure 6. Result of polygon circularity ratio test

To display the quality of spatial data then weighing the results of the method used as a whole - which is then called the final weighting. The final weighting is used to form a new classification, to make it easy to understand (Table 3). The results of the final classification of spatial data quality can be seen in Table 4.

Table. 3. Scoring classification spatial data quality

Methode / Kategori	*Polygon Near Distance*	*Polygon Area*	*Polygon Circulatiry Ratio*
Very Good	5	5	5
Good	4	4	4
Normal	3	3	3
Less	2	2	2
Very Less	1	1	1

Table. 4. Result spatial data quality test

Class	**Classification**	**Frequency**
$13 < x \leq 15$	Very Good	40
$11 < x \leq 13$	Good	30
$9 < x \leq 11$	Normal	15
$7 < x \leq 9$	Less	11
$5 < x \leq 7$	Very Less	4
Total Data		100

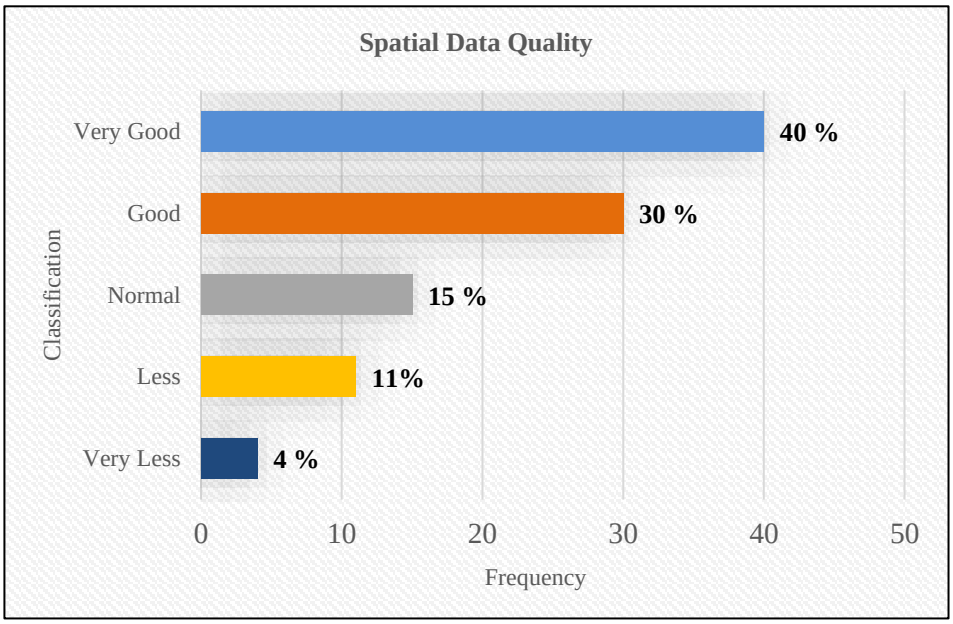


Figure 7. Result of spatial data quality test

From Table 4 and Figure 7. They pointed out the comparison of the map test object spatial data accuracy quality - the result of the general boundary delineation method is 40% in the very good category, while 60% of the test object is out of the excellent category. Factors that causing many parcels of land have poor spatial qualities are at the delineation of the land parcel boundary in a closed area, there are some land parcel boundaries blocked by vegetation, buildings, and other obstructing objects, so the delineation land parcel boundary is the approximate boundary. Besides, there is a difference in boundary information shown by the owner of the adjacent of a land parcel. With those various error factors causing the position, area, and shape to be different to the position, area, and shape from the field measurement on land registration activities. This is very influential on the spatial data quality of the land parcels.

6. CONCLUSION

The data complete map of village land parcels information based on participatory mapping through FFP-LA approach can be used as preliminary information for land registration. Meanwhile, In order to proceed into registration stage, quality control of identified and delineated parcels by conducting direct field measurements must be taken by National Land Agency's surveyors or cadastral licensed surveyors. It must be according to the existing standards in the Ministry of Land Affairs and Spatial Planning / National Land Agency (BPN). Integration fiscal cadastre and legal cadastre census through participatory mapping with PTSL can save budget, time and human resources. By doing so, it can support land registration acceleration in Indonesia.

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