

# **Integrated Parcel Boundary Survey and Mapping: A Pilot Project to Improve Spatial Data And To Accelerate Complete Systematic Land Registration (PTSL)**

**Indra Roharatua HUTABARAT, Septein Paramia SWANTIKA, Virgo Eresta JAYA, Fitriyani HASIBUAN and Hesekiel SIJABAT, Indonesia**

**Keywords:** Integrated Parcel Boundary Survey and Mapping, Complete Systematic Land Registration (PTSL), Land Administration

## **SUMMARY**

Complete Systematic Land Registration (PTSL) is a National Program to accelerate land registration in Indonesia, with a target of 126 million land parcels to be completed by 2025. From the implementation results since 2017, these are issues found as follows: PTSL mapped sporadically instead of systematically, gaps and overlaps between previous land parcels and new surveys, and many existing certified land parcels that still exist need to be mapped (K4).

This project tries to demonstrate Integrated Parcel Boundary Survey and Mapping. In general, the steps in this pilot are divided into several stages. The first step is to get an aerial photo image of a village with accuracy that has been defined. Second, the boundaries survey method is focused on using aerial image photos, so people identify their boundaries on aerial image photo or using surveying if it is not visible. Third, collect information of land parcels owners and land use, land utilization. Last, verify the spatial data of people and announce land parcels map. This method also complies with the Fit-For Purpose Land Administration (FFPLA).

The goals of this project are expected to improve parcel boundaries spatial data, accelerate Complete Systematic Land Registration (PTSL), and complete the coverage base map of Indonesia using an aerial photo map. It is focused on mapping the village as one complete target, which means whole land parcels in a village, either registered or unregistered, should be surveyed and mapped. As a result, there are many significant differences in area, shape, and position between previous boundaries that have been certified and new survey boundary parcels, though they also have similarities. These new boundaries of parcels would be used for the existing spatial data. The following conclusion is that the speed of the Boundary Survey and Mapping using the identification boundaries on aerial image photos is better than surveying whole land parcels. Then it helps to map K4 by identifying the information of land parcel owners with the owner's name on existing certified land parcels which still need to be mapped. However, the result also found several overlapping land parcels. This information is used as information to map land disputes.

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## **1. INTRODUCTION**

A National Strategic Program is part of the Agrarian Reform to accelerate land registration in Indonesia with a target of 2025 for all land parcels being registered. From the enactment of the UUPA of 1960 until 2016, for 56 years, the number of registered land parcels has only been about 48 million, which is only 38% of the 126 million land parcels in Indonesia. From 2017 to 2022, registered land has increased by 85 million land parcels through various programs. The remaining unregistered, about 41 million land parcels, should be finished by 2025.

One of the Programs is the Complete Systematic Land Registration (Pendaftaran Tanah Sistematis Lengkap - PTSL). It is a National Program to accelerate land registration in Indonesia for all land parcels in every village using fixed boundary methods and terrestrial surveys (Aditya et al., 2020). The results of the implementation of the work still found the following issues:

- The results of the survey and mapping of PTSL still need to be more consistent than systematic.
- Land parcels which have been registered on the base map (KW123) do not match the actual conditions on the ground.
- Land parcels that have been registered but have not been mapped on the base map (KW456/K4).
- There is still a gap and overlap between previous land parcels and new surveys on the base map.
- Land parcels that are mapped on the base map do not match the actual conditions on the ground.

The problems mentioned above arise due to the need for base maps for every village, which is needed as a reference working map and the control of actual conditions of land parcels. According to the Regulation of the Head of the Geospatial Information Agency No. 18 of 2021 concerning Procedures for Organizing Geospatial Information, the base maps can be formed as aerial image maps or high-resolution satellite imagery. The development of photogrammetric mapping technology using UAV is proliferating. The latest UAV technology is equipped with GPS PPK (Post Processing Kinematic). GCP measurements are not required to obtain an orthophoto. From the results of trials carried out, the difference in coordinates measured by GPS RTK and coordinates from orthophoto UAV results is in

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the range of centimeters (cm). Thus photogrammetric mapping using UAV can be carried out quickly and with accurate results so that it can be used for making aerial photo maps and as a reference/base in implementing Integrated Parcel Boundary Surveys and Mapping activities.

Based on that considerations, an Integrated Parcel Boundary Survey and Mapping Project has been carried out. In this activity the whole land parcels in the village of PTSL location, would be surveyed and mapping systematically, whether registered land parcels and unregistered land parcels, so the targeted village will be complete.

The goals of this project are expected to improve the quality of parcel boundaries spatial data, to accelerate Complete Systematic Land Registration (PTSL), and complete the coverage base map of Indonesia using an aerial photo map. It is focused on mapping the village as one complete target, which means whole land parcels in a village, either registered or unregistered, should be surveyed and mapped.

## **2. MECHANISM OF INTEGRATED OF BOUNDARIES SURVEY AND MAPPING**

This project tried to demonstrate Integrated Parcel Boundary Survey and Mapping. In general, the steps in this pilot are divided into several stages. The stages in this activity are:

### **2.1 Socialization**

Socialization or counseling is an activity to provide complete information about the activities to be carried out to the community in the location and invite the community to participate in the activity actively. Counseling is implemented by the officer of the National Land Agency involving communities who own or claim land parcels in the village area. The communities or people that were involved in this counseling included those whose land had not been certified and those that already had been certified.

### **2.2 UAV Mapping**

The second step is to get an aerial photo image of a village with accuracy that has been defined. Making an aerial photo map is done by shooting a non-metric camera mounted on an Unmanned Aerial Vehicle (UAV) equipped with GNSS PPK per village. The aerial images photos will be used to control the shape of boundary parcels. The logical consistency of the previous shape of land parcels will be matched with the area in the photos. It also identifies the boundary parcels and maps the new land parcels.

### **2.3 Checking Service Level Agreement (Accuracy and Ground Sample Distance)**

Quality control is essential to ensure that the outputs/products are delivered following the required specifications. Quality control is carried out by checking coordinates in the field and coordinates measured from aerial photographs.

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The Service Level Agreement is defined as:

- GSD Resolution less than 0.15 m
- Horizontal Accuracy/Accuracy less than 0.5m.

#### **2.4 Upload Basemap to Portal**

Aerial photo maps that have met the Service Level specified and have received approval from the Head of the Mapping Survey Section of the local Land Office are then uploaded by the task force team into Basemap Portal. This process means achieving the completeness of base map coverage in Indonesia.

#### **2.5 Collect old data on land parcels which have been registered**

In this step, the old land parcel data were downloaded from the database of land registration maps, both spatial and attribute data. The term of spatial data is land parcels that have been mapped/registered, while the attribute data show the area ( $m^2$ ), owner, and type of rights. These data will be compared with the new surveys. There are terms of registered land parcels used in the National Land Agency of Indonesia:

- KW123: Land parcels that have been registered and certified have been plotted on the base map
- KW456, usually called K4: and parcels that have been registered and certified but have not been plotted on the base map.

#### **2.6 Survey and Mapping with public participation.**

Collecting the physical data of the land parcels process was held on all land parcels in villages that have been pointed as Pilot Project locations. All land parcels that have been registered and unregistered are surveyed and mapped. So we can get the actual condition of the registered parcel and map a new parcel that is unregistered.

The primary method used in measurement and mapping activities in Integrated Physical Data Collection is the Photogrammetric Method involving community participation. If the boundaries of the land parcel are not visible on the Aerial Photo Map, other methods such as terrestrial, GNSS Survey, or a combination are necessary.

The community plays a significant role in this stage, as it will help to show and declare their land boundaries in the field. Surveyors and claimants also acquire information on land tenure and land utilization in each parcel. If the subject of the land parcel is unknown, the land parcel shall be marked with a note "subject not found" on the base map/mapping sketch. All The Claimants or people showing the boundary parcels put a signature on the base map/mapping sketch. The last step has an essential role in the declaration of boundaries.

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## 2.7 Spatial Analysis

From the results of the physical data collection, it is then carried out:

- Overlay whole surveyed parcels with the spatial data of land parcels that have been mapped (KW1-KW3);
- Analysis of spatial and textual data of land parcels KW1-KW6 on registered land parcels, both already / flying parcels (unmapped registered land), so that Cadastral Surveyors verify the correctness of the location, owner, and boundaries in the field. This activity consists of verifying registered parcels against the suitability of spatial data (area, shape, position/location), land parcel attribute data (owner's name, Rights Number, Number of Letters of Measurement, written area, Number of Parcel (NIB) );
- Correcting spatial data of registered land parcels (KW1-KW3) according to the results of physical data collection;
- Plotting the registered land parcels KW4-KW6 according to the results of physical data collection and information;
- Mapping of unregistered land parcels.
- Suppose the K4 land parcel is not found in the field (cannot be mapped) after the community participation photogrammetric survey and mapping, field measurements, and interviews with the community. In that case, the land parcel should be included in the residual K4 list (KW4-KW6).

## 2.8 Verification

Activities to verify the suitability of land parcel data are carried out by the Head of the Survey and Mapping Section / Functional Position or a designated official. This activity includes:

### 2.8.1 Verification of Registered Land Parcels:

- a. Checking the suitability of spatial data (Area, Shape, Position/Location) against aerial photo maps and Letters of Measure.
- b. Land Parcel Attribute data (Owner's Name, Title No, SU No, Written Area, Number of Parcel) against the certificate.

### 2.8.2 Verification of Unregistered Land Parcels:

- a. Checking the suitability of spatial data (Area, Shape, Position/Location) against aerial photo map.
- b. Land Parcel Attribute Data (Owner's Name) against field note and ID number.

## 2.9 Printing and Issue of Land Survey Parcel Map (LSMP) include:

- The LSMP contains land parcels in one area/block and an aerial photo map in A0 paper format.
- The LSMP loaded are all land parcels due to physical data collection (KW1-KW6 and land parcels that have not been registered) and also contain geographical elements such as rivers, roads, and buildings.

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The land parcel layers on the land parcel map are distinguished as follows:

- Land parcels KW1-KW6.
- Land plots that have not been registered with the designation of boundaries by the owner.
- Land plots that have not been registered with the subject are not found
- Geographical elements of land parcels.

### **2.10 Agreement and Improvement on LSMP**

LSMP is clarified by claimants and the result from LSMP clarification which Improvements are pre-approved by the Head of Survey and Mapping Section of the Local Land Office and become an integral part of the announced Land Parcel Map and the improvements. The improvement is updated on the spatial database map.

### **2.11 Clarification and Confirmation to Claimants**

The LSMP is published for clarification to the public. If there are any objections, a re-measurement and remapping is carried out for corrections:

- LSMP is announced by the participants for clarification by the owner of the land parcel for a period of 3 days.
- LSMP is announced at the Land Office, Village Office, and third party's base camp and announced on the Land Office's official social media (Facebook, Instagram, and others).
- Clarification of LSMP aims to ensure the correctness and suitability of the data and physical documents that have been collected.
- The clarified LSMP is signed by the owner or claimants on stamp duty as a declaration of designation, approval, and determination of land parcel boundaries.
- If, during clarification, there are corrections to the name, NIK, area, or additional data, such as the name of the owner of the land parcel, then the LSMP Clarification must be corrected. Improvements are made by collecting physical data again.
- The corrected land parcel is signed by the owner/claimants with a stamp as a declaration of designation, approval, and determination of land parcel boundaries.

### **2.12 Validation and Legalization parcels maps**

Land parcels that have been clarified are then validated at the KKP.

- KW1-KW3 land parcels are updated and validated against spatial and textual data based on the results of physical data collection.
- Validation of K4 plotting land parcels.
- Land parcels KW 1-6 that have changed both spatial and textual are noted: "Changes were carried out in the pilot project of Integrated Physical Data Collection in 2022".
- Validate land parcels that have not been registered, but the boundaries of the land parcels have been declared on the land parcel map.
- Plotting land parcels that still need to declare the boundaries with the measured parcel layer.

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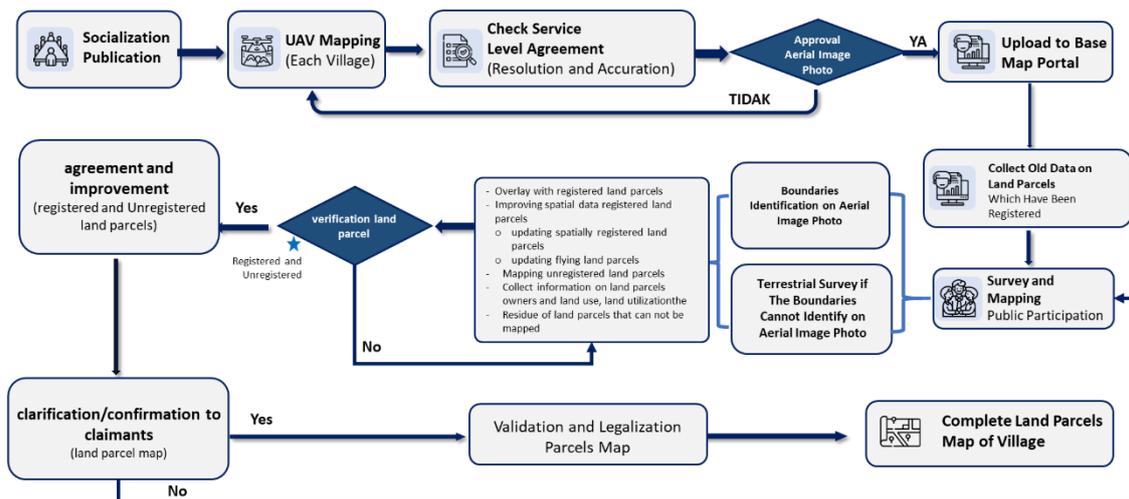


Figure 1 Mechanism of Integrated Parcel Boundary Survey and Mapping

### 3. PILOT PROJECT IMPLEMENTATION, RESULTS, AND FINDINGS

Integrated Parcel Boundary Survey and Mapping have been implemented in West Java Province as a Pilot Project. It is divided into two types, rural and urban areas, to address the issues. In this pilot project, the goal is to demonstrate how fast it is possible to create spatial data boundaries for unregistered parcels and how it can also be used to improve registered parcels. The table below shows the location of the pilot project in West Java Province with five different cities/regencies.

Tabel 1 Location of Pilot Project

No	Province	City	Village	Type
1	West Java	Karawang	Jatilaksana	Rural
2	West Java	Sumedang	Cibeureum Wetan	Rural
3	West Java	Bandung	Haurpugur	Rural
4	West Java	Ciamis	Banteng	Urban
5	West Java	Bandung	Andir	Urban

The result of land parcels that were surveyed and clarified by claimants in table 2

Based on the report, the pilot project is finished in about 50 days for both rural and urban area. This duration is entirely satisfactory for many activities, from aerial photography to physical data collection and spatial analysis. Compared to the ground surveying method usually carried out at BPN, it takes approximately six months to map 10,000 unregistered land parcels. In this pilot, about 13,299 parcels have been mapped. Also, this method

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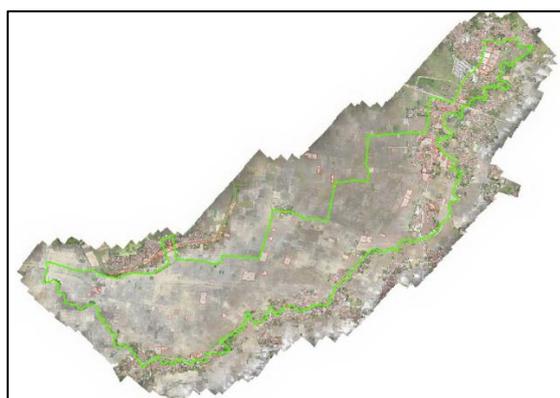
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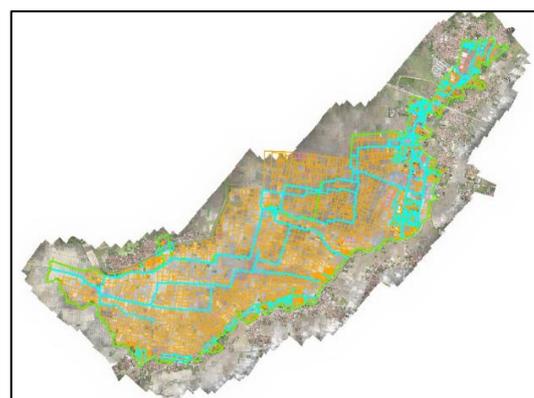
includes spatial improvement for registered land parcels to produce 653 KW123 and 236 KW456 flying parcels that have been landed. Meanwhile, 178 parcels could not be landed due to a lack of information from participants.

*Tabel 2 Results of Number of Parcels in Pilot Project Area*

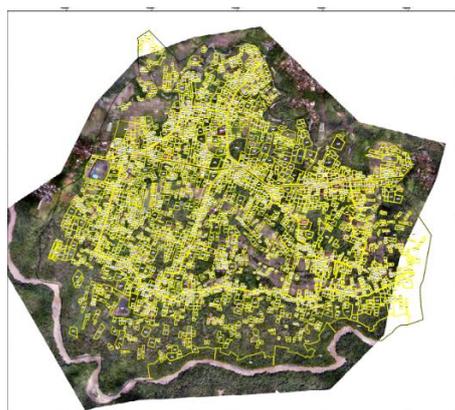
Nama Desa	No	Kw 123		KW456/K4 landed		Unregistered Parcels		KW456/K4 cannot landed		Roads, Rivers.	
		Number of Parcels	Area (m2)	Number of Parcels	Area (m2)	Number of Parcels	Area (m2)	Number of Parcels	Area (m2)	Number of Parcels	Area (m2)
Jatilaksana	1	546	17,541,637	25	88,476	2099	1,904,722	20	16,513	6	171,596
Cibeureum Wetan	2	511	295,199	65	67,601	2605	2,505,557	98	160,002	11	245,431
Haurpugur	3	116	168,241	35	83,106	3609	3,453,388	60	187,871	28	118,952
Banteng	4	2796	1,640,800	20	73,500	3155	1,451,100	7	16935		
Andir	5	537	429,159	111	54,360	9690	3,053,521	-	-	84	468,422
<b>Total</b>		<b>653</b>	<b>17,543,876</b>	<b>236</b>	<b>367,043</b>	<b>13,299</b>	<b>9,862.732</b>	<b>178</b>	<b>381.321</b>	<b>129</b>	<b>1.004.401</b>



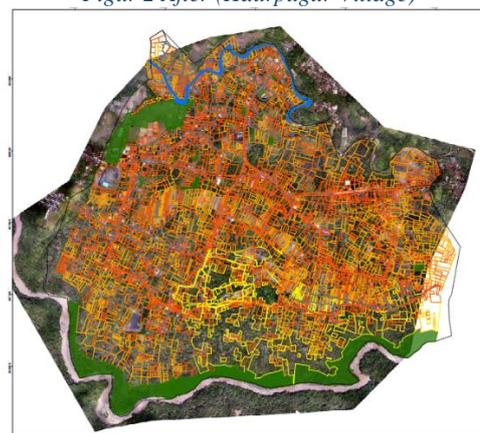
*Figur 1 Before ( Haurpugur Village)*



*Figur 2 After (Haurpugur Village)*



*Figur 3 Before (Benteng Village)*



*Figur 4 After (Benteng Village)*

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The figure shows an example of the results of Aerial Image Photos in one of The Pilot Project Haurpugur Projects. It can be seen that whole parcels on location are mapped. The accuracy of Aerial Image Photos for five villages is 10 to 20 cm, so the quality of each boundary point on the map is about that range.



*Figure 1 Overlapping Registered Parcels*

There are several issues that we have with this pilot project. First is the overlapping Registered Parcels. When whole parcels are mapped, spatial analysis shows overlapping data on registered land parcels. Interestingly, the data KW123 which has been mapped, and KW456, which has not been mapped, were found. As the figure displays, the red parcel is a KW456 or flying parcel. It can be landed by information from the participants and comparing data. The indication that can be concluded is that the parcels had been sold to other people, but the registration office did not change or delete the old data. This helps the office to fix the registration book.

The next problem is that the KW456 flying parcels cannot be landed, which mean the registered parcels could not be mapped because the subject or owner written on the certificate could not be found. Another problem is that many of the land parcels for registered land parcels KW123 and KW456 differ between the actual and the former, especially in the parcel numbers. For example, the registered land parcel is written as 200 m<sup>2</sup> on the certificate, but the new measurement is 180 m<sup>2</sup>. This could be a problem for the people who own the land. Nevertheless, the claimants have agreed with the existing parcels and signed the LSMP. Also, in this pilot project, many land parcels could not be identified through aerial photography due to the land cover of trees or forests. So, data was collected

by field surveys, which took time. Finally, many claimants had yet to sign the agreement when the LSMP was announced to clarify their land parcels. The reason for this is that the claimant does not live in the village or community and needs to know who owns the land, so the surrounding land parcels are not considered to be approved and finalized.

#### **4. CONCLUSION AND RECOMMENDATIONS**

LSMP clarification plays the primary role in the improvement of land parcels because the agreement between claimants can solve the problem of land boundaries dispute, and the ATR/BPN can improve their data. The ATR/BPN recommends the solution if claimants did not sign the agreement on LSMP, which is that when the owners or claimant is found in the future, the parcel is proposed to the claimant. If she or he agrees, then that parcel is fixed, but if it is not, the surveying should be carried out, and modify the shape of the parcel should be changed.

The spatial analysis is also crucial in the pilot project step, but it really needs a lot of time and information. At this stage, all data from the survey and mapping results from participants, claimants, or owners who showed the boundaries of parcels in the village are compared with the map of registered land parcels, whether plots have been mapped (KW123) or not yet mapped (KW456). For the KW123 land parcel, there will be changes in shape and area, while for KW456, information on ownership and the exact location of the land will be required, and they need to check the documents for each parcel to compare the old data with the actual data. When this information is not known, it will be difficult to plot the parcel. Another reason is that all plots of land have been mapped for the whole area in the village, so there is no location to plot the KW456 parcels. This condition cannot be denied. Therefore the KW456 certificate should be abolished to eliminate data redundancy.

The Land Cover of the location should be considered before capturing the aerial photo image. This could save the budget if the aerial is a forest with trees, so the method of ground surveying can be implemented on that spot. In addition, the aerial photo can be focused on rural areas such as paddy fields or open area boundaries. Land Cover of the location should be considered before capturing the aerial photo image. This could save budget if the aerial is a forest with trees, so the method of ground surveying can be implemented on that spot. In addition, the aerial photo can be focused for rural area such as paddy field or open area boundaries.

This pilot project is beneficial in assisting the creation of a guidebook for land registration activities in 2023. In addition, problems in this pilot project can be anticipated immediately, and reasonable solutions can be found. However, many things still need to be improved in the Parcel Boundary Survey and Mapping, one of them being the quality aspect of surveying and mapping. Identifying Aerial Photo images with 10 – 20 cm accuracy is enough for the land parcels. Community participation also plays an essential role in this activity, especially in providing information on land parcel boundaries on aerial photo images and the field. Apart from that, a boundary agreement between the parties to the land

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parcels is also strictly required. Having a land parcel agreement means that the parties accept the actual condition of the land parcels so that all changes in shape and area can be recorded and improve the quality of information on land parcels.

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