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Digital land registration and legal certainty: Evidence from Indonesia's e-government reforms

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Abstract

Land registration services are undergoing significant development with the introduction of e-government. However, no quantitative research has been conducted to measure legal certainty in the land registration process in Indonesia. This study aims to identify the relationship between the development of the land registration system and the level of legal certainty of land titles in Indonesia. This quantitative study, conducted across several high case cities, analyzed *inkracht* land case decisions from 2002 – 2020 using probit and simple linear regression models. The analysis revealed that newer land titles have higher court win rates and faster dispute resolution. Furthermore, it demonstrated a positive correlation between e-government implementation (supported by accurate spatial data) and improvements in the quantity, quality and legal certainty of land registration services. The government needs to strengthen regulations that support the digitalization of land registration services.

Keywords: Development, e-government, Indonesia, land registration, land title, legal certainty

Introduction

A land title, also known as a "*sertipikat tanah*" in Indonesian, is a legal document that proves ownership of a piece of land. It contains essential information such as physical data and juridical data (Government of Indonesia, 1997). Physical data are information about the location, boundaries, and area of land plots and units in registered apartment buildings, including information about the existence of buildings or parts of buildings on them. Meanwhile, juridical data are information about the legal status of land plots and units in registered apartment buildings, their rights holders and other parties' rights as well as other encumbrances that burden them. A land title issued by authorized officials provides the rights holder with legal certainty regarding their ownership (Saleh et al., 2022). Therefore, land titles has perfect verification value and it can serve as powerful evidence.

Confirming land ownership is essential for the land registration system to protect property rights (Naguji et al., 2024). Well-registered land will allow the government to plan spatial planning more efficiently and manage the region better. The processes involved in land use and regional

development will affect the achievement of sustainable development (Kalfas et al., 2023). Land tenure studies have always been linked to what later became the goals of sustainable development, especially those related to the eradication of poverty and hunger in the first period (Parsa et al., 2011), economic growth and reduction of disparity in the second period (Acemoglu et al., 2012; Zevenbergen, 2002) and climate change in the third period (Mengesha et al., 2022; Salmerón-Manzano & Manzano-Agugliaro, 2023).

The main purpose of land registration is to provide legal certainty and legal protection to land rights holders through the issuance of certificates as strong proof of rights (Apriani & Bur, 2020). Indonesia's land registration system adheres to a negative publication system with positive elements, meaning that issued certificates have strong evidentiary power but are not absolute, thus still allowing claims from other parties who feel entitled (Wardhani, 2018). The land registration process is carried out by the National Land Agency (BPN), which is now the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN), through various activities such as land parcel measurement and mapping, rights registration and certificate issuance (Oe, 2015).

The importance of land registration/land title in ensuring legal certainty has led Indonesia to launch various land registration acceleration programs. Initially, land registration services in Indonesia were carried out manually, with registration documents being stored in the archives of the land office. In 1997, the land office began to implement information and communication technology, with the development of a centralized land information system. In the early 2010s, the land office computerization application was developed into a more comprehensive computerized land activity system, which has been implemented in 430 offices throughout Indonesia as of 2015. The development of this land registration system, known as KKP (*Komputerisasi Kantor Pertanahan* or computerized land office), has gone through several stages, including the initial implementation stage, the addition of geo-referenced features and finally the development of a web-based application. Until 2020, KKP had developed a system that better meets the needs of the institutions (Mustofa, 2015). Land registration services are undergoing better development with e-government. However, quantitative research to measure legal certainty and legal protection for the land registration process in Indonesia has never been conducted before.

Along with the rapid digital transition in Indonesia, the level of land disputes is also increasing. Land problems that often arise are related to the existence of a double land title, meaning that two or more land titles have been issued, overlapping on a piece of land controlled/owned by a person or a different legal entity/agency (Wardhani, 2018). Based on statistical data, land disputes increase yearly and are becoming increasingly complex, both in number and quality (Ginting, 2021). If these cases are brought to court, the consequences are that the decision will declare the land deed annulled or invalid. The legal status of land deeds will then become uncertain and landowners will lose their rights without receiving any protection from the state (Suharyono, 2019).

The theory of Gustav Radbruch considered legal certainty to be one of law's essential components, along with justice and usefulness (Alexy, 2021). He asserted that the law should provide society with certainty, which depends on legal rules being unambiguous, consistent, and predictable in practice. Indonesia's land ownership system is governed by the 1960 Basic Agrarian Law (*Undang-Undang Pokok Agararia*/UUPA) (Am et al., 2013), generally classified as a modified Torrens system which is a part of the positive land registration system in which the right-holder obtains an official document (Zevenbergen, 2002). The ideal Torrens-type land registration often refers to Australia, where the state guarantees that the registered parcels reflect the actual legal position. Since it does not require searching through a chain of historical documents to secure

the land title, it can reduce the cost of transferring ownership and speed up the process of such transfers (Dekker, 2017). In this study, legal certainty refers to the assurance that registered land titles are accurate, secure and protected from later or overlapping claims, reflecting the state's guarantee of ownership as recognized under the Torrens principle.

Guaranteed quantity, quality and legal certainty of land registration are greatly influenced by a well-organized land registration system (Yubaidi et al., 2022). Positive publications in the land registration system which are assessed by groups of experts can help guarantee legal certainty. The system can provide more valid data with a more transparent land title issuance procedure (Hutagalung, 2005; Sumanto, 2020). Technological advances provide increasingly open and extensive possibilities for changes to the land registration publication system in Indonesia, which provides more legal certainty (Suhadi et al., 2022). Digitizing land maps will minimize conflicts and land disputes as well as several existing land title conflicts which are detrimental to the state and society due to wasted time and energy due to the weakness of the existing land registration system (Rahmi, 2019).

E-Government is constantly recognized as a key strategy to enhance government services and the effectiveness of government policies (Pardo et al., 2012). Research on the success of e-government implementation is important to conduct (Manoharan & Ingrams, 2018). The existence of land cases in court can be used to test the legal certainty of land rights. The greater the number of land certificate products that win a lawsuit in court, the greater the value of legal certainty. This study aims to quantitatively analyze the progress of land registration services from year to year and how the development of e-government in land registration services can reflect the increase in legal certainty of land rights.

Background of land registration in Indonesia

Indonesia's land registration background shows a journey from fragmented customary systems through a colonial dualistic system to a unified national framework aimed at social justice (Sihombing, 2018). However, a more comprehensive system only began to develop after independence, especially with the enactment of the Basic Agrarian Law (UUPA) Number 5 of 1960, which became the foundation of national land law. The UUPA mandated the need for land registration as a guarantee of legal certainty for land rights for all Indonesian people (Sibuea, 2011). To implement this mandate, the government later issued Government Regulation Number 10 of 1961 concerning Land Registration, which was then refined into Government Regulation Number 24 of 1997 and most recently updated with Government Regulation Number 18 of 2021 regarding Management Rights, Land Rights, Apartment Units, and Land Registration.

To provide better land services, the Ministry of ATR/BPN makes improvements in the process of issuing land titles every year. To facilitate analysis, the land title is divided into 3 periods.

The first period, namely the period of issuance of land titles from 1960 to 1997. The first period began when the registration of land was mandated to ensure legal certainty as referred to in the Basic Agrarian Law 1960, which was further regulated in Government Regulation No. 10 of 1961 regarding Land Registration. The first period mandates the implementation of village-by-village or equivalent area land registration.

The second period was from 1998 to 2009. The second period began after 1997, following the enactment of Government Regulation Number 24 of 1997 concerning Land Registration. The

enactment of this regulation occurred after Government Regulation Number 10 of 1961 concerning Land Registration was considered to no longer fully support the achievement of more tangible results in national development. The fundamental changes through PP Number 24/1997 are: 1) the implementation of land parcel numbering for registered land parcels; and 2) the use of basic registration maps and registration maps that have been tied to specific geodetic control points with coordinates obtained from measurements and calculations in a particular system serving as reference or tie points for measurement and boundary reconstruction purposes. In addition, the recognition of property rights to land becomes more acceptable to the community and provides legal certainty when compared to the previous regulation, so it is very helpful for the government in providing public services in the land aspect (Lambonan, 2018). LOC or Land Office Computerization project ended in 2009, but LOC became the beginning of the computerization of land activities in the Ministry of ATR/BPN. This period is also marked by the start-up centralized communication technology application, through Land Office Computerization. At the end of its contract term in 2009, LOC had been implemented at 325 offices scattered throughout the Indonesia Republic (Mustofa, 2015).

The third period is from 2010 to 2020. The next critical period was at the beginning of the 2010s, characterized by the development of a more comprehensive computerized land activity system called *Komputerisasi Kantor Pertanahan* (KKP/Computerized Land Office). This period began the evolution of LOC into a computerized land office (KKP). The implementation of KKP until 2015 has broadened to as many as 430 offices throughout Indonesia, where KKP was developed starting from the initial implementation (KKP-Desktop), to the patching of geo-reference/Geo-KKP features (Mustofa, 2020). This study limits the study to 2020 because the form of land services in 2021 has been transformed into an electronic land service, which requires further study.

Method and study area

This research uses a quantitative approach to measure the progress of land registration services and legal certainty over time. The analysis focuses on several regencies/municipalities with the highest number of cases that can represent national trends, namely municipality of Surabaya, Bandung, South Jakarta, Tangerang Regency and Sleman Regency. The data used are the *inkracht* decision of land dispute cases from 2002 to 2020.

Data are analyzed using probit model regression because the dependent variable used is binary (0 and 1) with the following equations:

$$Pr(Y_1 = 1|X) = \Phi(\beta_0 + \beta_1 X) \quad (1)$$

Where Φ is the function of the cumulative normal distribution of $(\beta_0 + \beta_1 X)$ and $Y_1$is the result of the trial expressed in the probability value. The probability value of the land title when it is under litigation is between 0 and 1, where the value of 0 means that the land title is lost in the trial and 1 indicates that the land title is declared win in the trial. This probability is correlated with the year of expiration of the land title (X). The initial hypothesis taken from this equation (1) is that the longer the year of land title issued, the less likely the land title is to win when tested in a court, thus the development of land registration is positively correlated with the legal certainty of its product, namely the land title. This initial hypothesis will be tested if the coefficient value of

the variable year of issuance of this land title (β_1) equation (1) is positive. β_0 is a constant in the equation (1).

Then, for the next dependent variable, namely the length of time for the settlement of the trial case, denoted by Y_2, when the land title is taken to court. The data are processed using linear regression analysis with the following equations:

$$Y_2 = \alpha_0 + \alpha_1 X + \varepsilon \quad (2)$$

Where, Y_2 is the duration of a case settlement, and the variable X or independent variable is the year of land title issued. The constant of the equation (2) is denoted by α_0. α_1 is the coefficient of the year land title issued, and ε is the error term. The initial hypothesis taken from the results of this equation (2) is that the time needed for the settlement of a trial case of the land title will be shorter when the issuance of the land title is in a more recent year, so it is expected that the value α_1 will be negative.

This study is limited to submitted land dispute cases, which may not be representative of all land disputes. In addition, the process of adopting land registration technology varies regionally, potentially influencing generalization. Additionally, this study only investigates a single independent variable, year of land certificate issued, towards the trial result and the duration of a case settlement. Meanwhile, there are an abundance of unobservable variables that might be significantly corelated to land case trial results and the duration of a land case settlement.

Results and discussion

Probability of land case trial results

The legal certainty of land rights is based on the work of land titles as a sign of proof of land rights holders. The lower the lawsuit in the court, the more the existence of the land title provides certainty. Legal certainty is strengthened if land cases, especially in the field of State Administration (TUN), can be secured by the ministry of ATR/BPN. This study collects land case data in the State Administrative court with *Eintracht* rulings from 2002 to July 2020 and records the year of publication of the litigant land title as a variable that will be analyzed in this paper. The number of cases the sample in this research is 177 cases. Victory in the trial by the ATR/BPN can be interpreted as the process of issuing the land title under the applicable legal procedures. Thus, the greater the winning probability of the legal product of the land title in court, the more it can provide legal certainty. In this context, the data presented in Table 1 serves as an empirical indicator of legal certainty. A consistent decline in the number of disputes or a higher the ATR/BPN success rate suggests that procedural reforms such as improved mapping systems, digital record-keeping, and clearer registration standards have enhanced predictability and reduced ambiguity in land ownership recognition.

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Table 1. Results of land case trial at the sample location

Land title issuance period	Land cases		
	Sum	Win	Lose
Period 1 (1960-1997)	61	43	18
Period 2 LOC (1998-2009)	67	47	20
Period 3 KKP (2010-now)	49	39	10
Sum	**177**	**129**	**48**

Source: Data processing, 2021

The results of the land case trial at the sample location showed that land cases were mostly won by the ATR/BPN, with 129 cases out of a total of 177 cases or 72.9% (Table 1). Defeat in the land case court was experienced by the ATR/BPN of 48 cases or 27.1% of the existing cases. Furthermore, the analysis of land cases that BPN won annually will be analyzed with the following probit regression (Table 2).

Table 2 shows that in a court, the land title with more recent years, is more likely to obtain victory in the outcome of the trial, with a significance level of 0.1. The variable coefficient of the year land case issued in the marginal effect test on the mean indicates the number 0.005, it means that each addition of the number of one year in land title issued (e.g. land title issued in 1993 compared to the land title issued in 1994), then associated with an increase of 0.5% chance of a land title to be able to win in the trial whenever there is a land dispute on that land title.

Table 2. Probit regression of trial results with the year of land title issued

	Dependent variable: Trial result (Win= 1)
Year of land title issued	0.016*
Marginal effect on *the mean*	(0.009)
	0.005*
	(0.003)
Pseudo R^2 *(McFadden* R^2*)*	0.014
% Correct prediction	72.88%
Sample count	177

Source: Data processing, 2021

Description: Degree of significance *0.1 **0.05 ***0.01. The number in parentheses is the standard value of the error

Pseudo R^2 and correct predicted percentage are two parameters used to measure how fit a probit model is built. *Pseudo* R^2 shows how well the model predicts the result (the value is close to 1, the better the model is at predicting probability). The value of *Pseudo* R^2 in the results of this data is only 0.014 and this indicates that the variable year of publication of the relative land title is still unable to explain the prediction of the outcome of a case trial. This also means that in addition to the variable year of, there are still many other variables outside this study that correlate with the results of the trial case that can be analyzed to be able to better explain the dependent variable. Therefore, there is a gap in studies that are to be done in the future. The percentage of correct predictions indicates what percentage of predictions from observations that show correct results (see table 3) of all observations. From the results of the data, the % predicted value correctly shows

a figure of 72.88%. There is no reference to determine what is the value of this parameter, but several scientists argue that this value should be above 70%.

Table 3. Accuracy of prediction results

	Actual result won ($Y_1 = 1$)	**Actual result loses ($Y_1 = 0$)**
Sample predicted to win ($\hat{Y}_1 = 1$)	129	48
Sample predicted to lose ($\hat{Y}_1 = 0$)	0	0

Source: Data processing, 2021

Table 3 reflects that the probit model is constructed using only one independent variable (year of land title issued) to predict all observations (case/sample) with the result of winning in the trial. A total of 129 cases showed actual results that matched the prediction results (72.88%), but there were still 48 cases whose prediction results did not match the actual results (27.12%), so the correct prediction percentage was equal to the percentage of actual results won. It indicates that the developed prediction model is very simple, since using only one independent variable. Considering the purpose of the research conducted, which is to see whether the legal certainty of the land title products issued by the Ministry of ATR/BPN from year to year is increasing along with the progress and development in the land registration service system, then this study analyzes using only one independent variable, namely the year of land title issued.

When viewed year by year, the probability of a land title winning in land cases is increasing as the year of land title issued gets more recent (figure 1). Thus, the more recent land title is issued, the more it can provide victory for the ATR/BPN in the land case trial. This shows that the process of registering land with the output of land titles increasingly results in a high probability of winning the trial of cases and indicates that the issuance of land titles increasingly provides legal certainty.

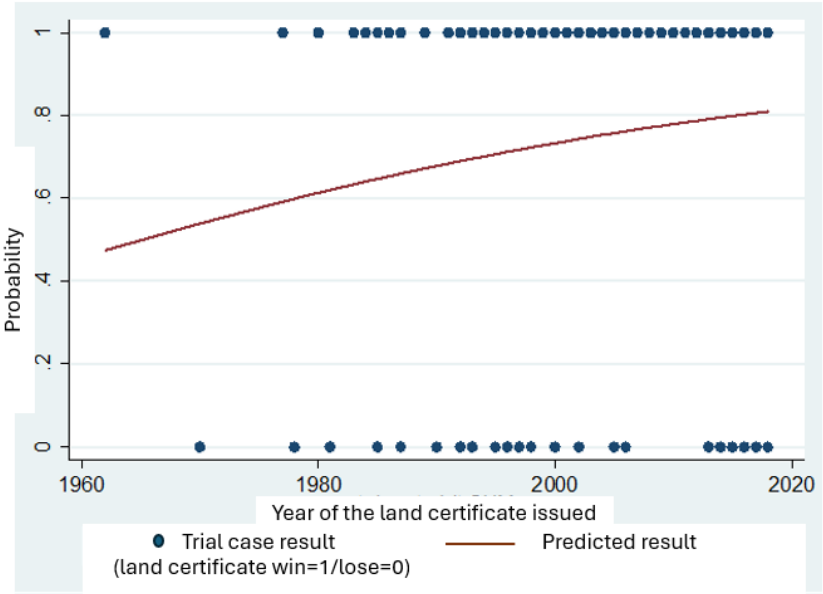

Figure 1. Non-linear curve of the year of land title issued vs probability of trial result

Time of settlement of case-based on the year of issuance of land title

In addition to analyzing the probability of a land title being able to win in a trial case, this paper also analyzes the duration of time needed in solving a land case. The assumption used in this discussion is that when a land title enters the land case trial process, the sooner the completion of the case reflects the clearer land registration process and is following the provisions of applicable regulations. Conversely, if the time needed to solve a case takes a relatively long time, it is indicated that in the registration process it is still unclear or not following the provisions. Thus, the shorter the time it takes to solve a land case reflects that the land title has guaranteed more legal certainty.

Refer to Table 1, the total case from the period of issuance of the land title relatively has an even distribution, but before the period of use of KKP tends to be higher than the previous two periods. This writing has got to show the amount of property rights litigated from each period because the total property rights data published at the sample location was not obtained.

Table 4. Regression of case settlement with year of the land title issued

	Dependent variable: Duration of case settlement (year)
Year of land title issued	- 0.031**
	(0.013)
R^2	0.031
Sample count	177

Source: Data processing, 2021

Description: Degree of significance *0.1 **0.05 ***0.01. The number in parentheses is the standard value of the error.

According to the land registration process in location samples, the boundary border certainty and location of land plots play an important role that must be considered in ensuring certainty and legal protection. The results of this study are also supported by other studies that conclude that the measurement process is the initial key to the legal certainty possessed by the land rights land title (Setyowati et al., 2022; Yamin & Zaidar, 2018). In the years 1960 to 1996 sophisticated tools have not been implemented, especially in the measurement process (Lambonan, 2018), therefore there will be a land title of which the exact location is difficult to determine. The land plots that are registered will be prone to be registered on some or even whole plots of land under different certifications. The overlapping plots of land of this land title are often problematic land cases in the court. In the second period, published from 1997 to 2009, land cases are still relatively the same as in the previous period. The coordinate that serves as a control point in the measurement of land plots is seen as a significant role in reducing land area overlap. In the next period, the computerized system in the process of land registration administration through the land office computerization application (KKP) increasingly made the land registration process more accurate. The decreasing number of land cases indicates that BPN continues to make improvements in the implementation of land registration.

From the regression results in Tabel 4, the coefficient of the variable year of land title issuance indicates several negative values, this shows that the newer or more recent the year of the land title that enters court process, it is associated with the shorter the completion of the case process by 0.031 years significantly. But the shorter the time of settlement of this case can also be

associated with other factors other than the year of issue of the land title, for example, the performance of the judiciary which is getting better from year to year both in terms of system, quality and quantity of human resources, and other aspects, may also be associated with the shorter time needed to solve a land case. These other factors cannot be analyzed in this paper, because the variable year of issuance of the land title is the focus of this study. This can be seen from the value of R2 which only has several 0.031, which means that the year of issue of the land title is only one of the variables that explain the shorter the time of solving cases from year to year, and there are many other factors outside this study that can explain the variable results.

Table 5. Average case resolution time per period of land registration

Period	N = 177	
	The average duration of settlement (years)	Standard error
1. (1960-1997)	2.48	0.35
2. (LOC 1998-2009)	1.97	0.18
3. (KKP 2010-now)	1.70	0.11

Source: Data processing, 2021

Table 5 shows that on average the time required to solve a land case from the year of land title issuance periodically getting shorter. The land title issued in period 1 when entering the trial case then the average time needed to complete it is 2.48 years, in period 2 which is 1.97 years, and in period 3 is 1.70 years. An illustration of the relationship between the year the land title was issued and the length of time the case was settled can be seen in Figure 2.

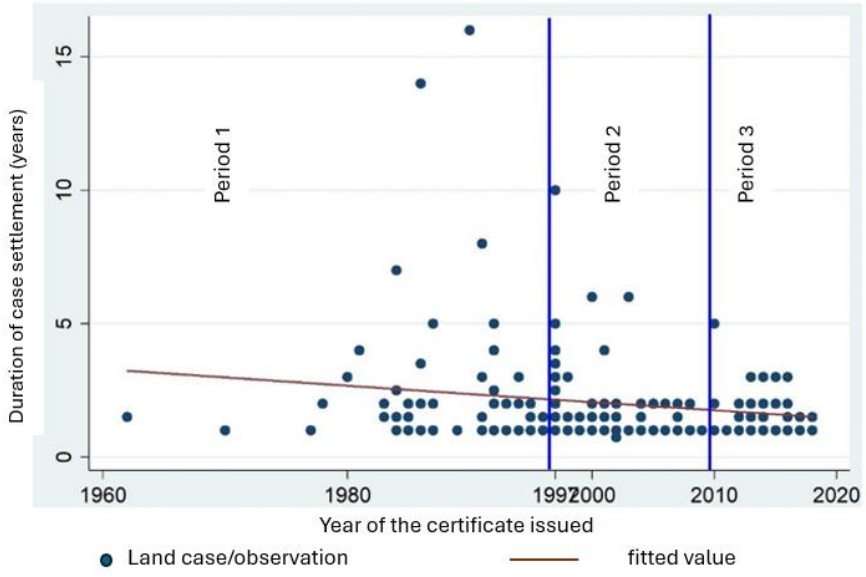

Figure 2. Correlation of land case settlement with the period of land title issued

The trial process for land cases, which takes a shorter time to complete, shows the clarity of the rules needed to resolve them. In other words, showing the availability of physical and juridical data in an adequate land titles issuance process, so that it does not take long to complete.

This helps court institutions to fulfil the principle of quickly obtaining legal certainty, in order to provide public satisfaction with court services (Widowati, 2021). The shorter the time needed to solve the case, the more the land titles provide legal certainty for the rights holder. Legal certainty of land rights will be realized without doubts and concerns about land ownership (Sumanto, 2020).

The implementation of e-government in land registration services in Indonesia has undergone significant development over the years. Initially, in 1997, the Ministry of ATR/BPN began to implement information and communication technology with the development of a centralized land information system. In the early 2010s, the land office computerization application was further developed into a more comprehensive computerized land activity system, known as KKP, which has been implemented in 430 offices throughout Indonesia as of 2015. The development of the KKP system has gone through several stages, including the initial implementation stage, the addition of geo-referenced features and finally the development of a web-based application.

E-government in land registration services using Geographic Information System (GIS) technology in practice. Geographic Information Systems (GIS) play a transformative role in the modernization (Babalola & Uyi, 2019) of land administration by facilitating the transition from manual to digital systems (Igbe Akeh, 2016), improving the efficiency of spatial data and attribute management, accelerating the mapping and registration of land parcels, reducing processing time and increasing the number of registered fields (Iloba Uwadinma et al., 2023; Wahyuddin et al., 2025), as well as supporting the digitization of land records for better ownership security (Navratil, 2020). This technology provides a comprehensive framework for decision-making through a web-based system that allows real-time (Chiemelu & Eze, 2014) access to land information for the public and stakeholders (Tjiaon, 2013), while reducing the risk of corruption and inefficiencies in land transactions.

The ideal concept in a digitally integrated land registration is to set up a national land base data center that stores data and prepares land legal instruments that regulate digitally integrated land registration to provide legal certainty over land rights (Aspan et al., 2021). The implementation of e-government in land registration services is expected to improve the quality and accessibility of services, as well as increase legal certainty over land ownership. Based on the results of data processing conducted, it appears that the implementation of e-government in land registration services has had a positive impact on the quantity and quality of services provided. The integration of GIS and e-government systems does not only improve efficiency but also strengthens procedural transparency and ownership protection. This contributes directly to greater legal certainty in Indonesia’s land administration.

Conclusion

The implementation of e-government in land registration services in Indonesia has undergone significant development, with the goal of improving the quality and accessibility of services, as well as increasing legal certainty over land ownership. The development of the land registration system has gone through several stages, including the initial implementation stage, the addition of geo-referenced features and finally the development of a web-based application. Based on the quantitative research conducted, the implementation of e-government in land registration services has had a positive impact on the quantity and quality of services provided. The increase in the period of issuance of certificates has a positive effect on the winning cases and the speed of

handling cases. This indicates that the land registration system built in Indonesia is getting better and better in providing legal certainty of land rights.

The government needs to strengthen regulations that support the digitalization of land registration services by setting strict data security and privacy protection standards. The development of e-government systems must be inclusive, ensuring accommodation for areas that still experience limited access to technology, thereby avoiding service gaps. From a social perspective, increasing digital literacy among the community and intensifying socialization of new systems are key factors that enable the transition to digital services to run effectively and provide tangible benefits for all levels of society. Technologically, continued investment in information technology infrastructure and human resource training must be a top priority, including the improvement of data security systems to prevent the risk of leaks and fraud. Indonesia needs land registration technology that further improves security, efficiency and transparency in the land registration process as blockchain technology has begun to be implemented in several countries (Hasan et al., 2022; Shuaib et al., 2020; Yaseen et al., 2025).

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