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A GEOGRAPHIC INFORMATION SYSTEM FOR MAPPING POTENTIAL PROPERTY TAX

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Abstract

This study aims to develop a mapping model of land and building tax potential through the development of a web-based geographical information system (GIS). This GIS is one of the innovations that make it easy for users to search locations. Furthermore, it is designed to capture, store, manipulate, analyse, manage, and present all types of spatial or geographical data. The development method applied in the information system is the waterfall. The results showed that with the GIS application, managers are able to calculate, monitor, and control the potential land and building tax revenues per village, district, and city. Additionally, taxpayers use this application to obtain billing information and other services.

Keywords: Web-based geographical information system, land and building tax, source of income

INTRODUCTION

The government's duty is to provide adequate public services by supplying society with the correct information. This became very difficult when Covid-19 affected Indonesia, as the people were unable to obtain the information, they needed directly due to lockdown. One of the issues faced during this process is updating property and construction tax data.

Tax has become a source of development fund for various countries. A type of tax generated internally as a potential source of income is land and building. It is important to note that a nation's effort to be independent financially lies in its method of exploring local sources of income. Meanwhile, the tax in the spotlight is the land and building, which is generally considered good by economists. In fact, many countries have recommended the increase in the sources of development funds from this type of tax. According to Slack and Bird (2014), almost every country has implemented reforms to this tax collection, but the skills required are still far from expected.

The Indonesian government has also implemented various tax reforms. Initially, land and building tax was managed by the state, but in 2013, its administration was handed over to the local governments as part of the regional original revenue (PAD). This transfer of tax management does not run smoothly because there are still cases of many unpaid taxes in several regions of the country (Ahmad, Brosio, & Pöschl, 2015; Kosasi & Barus, 2017; Yusuf, 2018). This is consistent with Irham & Samsul Bachri (2011) who discovered that tax revenues did not meet the actual target or expectation. Therefore, various income sources need to be adequately studied.

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Land and building tax potential is a source to recover the costs required for city and country development (Chang & Caneday, 2011; Curtis & Decker, 2018; Ibrahim, 2012; Mintz & Chen, 2011; Pareta, 2017; Shakede & Komolafe, 2017; Zoneh, 2013). Many parties have used the GIS to obtain information in various fields including livestock, agriculture, tourism, and health (Curtis & Decker, 2018; Gkatzoflias, Mellios, & Samaras, 2013; Jia, Cheng, Xue, & Wang, 2017; Rastuti, Abdillah, & Agustini, 2015; Wibowo, Kanedi, & Jumadi, 2015). The GIS has also been used by many parties and countries to calculate the potentially recoverable taxes (Mintz & Chen, 2011; Neene & Kabemba, 2017).

In addition, the latest technology such as web-based GIS was developed and used because of the need for high-quality and increasingly complex information about the potential of regions (Rastuti et al., 2015; Wibowo et al., 2015). Complex problems in the organization are often solved through a structured approach and the results are easy to maintain, flexible, more user-friendly, have good documentation, are timely, in line with the development cost budget, as well as able to increase productivity and quality. The development and implementation of GIS for calculating land and building tax aims to increase the accuracy, as well as supervise and control the potential sources of funds from the land and building tax sector.

LITERATURE REVIEW

Tax has become a source of development fund for several countries. One type of tax that is generated internally, which has also become a potential source is land and building. This implies that to be independent in financing development, there is a need to explore regional sources of income such as the land and building tax. It has been observed that several countries around the world use land and building tax as a means of financing development. This revenue stream is considered the most profitable and promising even though it is administratively difficult, with a relatively slow process, unpopular, and tedious to be managed in inflationary conditions (Zachary, Kariuki, & Mwangi, 2017). According to Kelly (2003), the property tax is the least-used source of revenue for supporting the city government. Heavy reliance on methods of filling, recording, storing, and retrieving information, as well as the manual assessment, has been identified as the main reason for low compliance with the draft bill. In the manual method, there is no relationship between site properties and associated data, making all forms of spatial analysis impossible. This is the reason this method is considered ineffective and inefficient as it is time-consuming, expensive, complicated, and full of fraud.

Most city governments rely on collecting property tax revenue to fund their municipal infrastructure and operations. This lack of finance negatively affects growth and progress and also reduces the city's economic potential. By developing a GIS-based tax assessment and management system, city governments are able to perform the following 1) Compare the amount of tax collected for a specific area, such as buildings with the expected environmental revenue, 2) Plan tax renewal based on urban development and new constructions, and 3) Develop more systems based on areas to improve tax collection (Mintz & Chen, 2011).

It has been discovered that the problem frequently encountered by the government is non-compliance in paying taxes (Anggadini, Surtikanti, Bramasto, & Fahrana, 2022; Artawan,

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Widnyana, & Kusuma, 2020; Hantono, 2021; Hartikayanti & Siregar, 2019; Hartikayanti, Heni Nurani, Ilyas, Ridwan, & Siregar, Ifan Wicaksana, 2021; Ilmiyani & Djamaluddin, 2020; Nasution, Santi, Husaini, Fadli, & Pirzada, 2020; Rahim, 2021), which is due to lack of morals, understanding, and quality of government services. The Covid-19 pandemic that occurred in different parts of the world also influenced taxpayers' disobedience because several issues needed to be resolved directly (Amah, Rustiarini, & Hatmawan, 2021; Noviyanti - & Azam, 2021).

The property tax data usually includes a large object number, and some changes in information, specifically concerning building data. Therefore, property tax administration needs a dynamic system that is adaptable to the continuous changes in information technology and capable of handling ever-increasing data amounts (Balogun, 2019). It was discovered that the need for high-quality and increasingly complex information about the potential of a region encouraged the development and usage of the latest technology, such as web-based GIS (Rastuti et al., 2015; Wibowo et al., 2015). Consequently, complex problems in the organization have been solved and the results are easy to maintain, flexible, more satisfying to the user, well-documented, timely, consistent with the development cost budget, and increase productivity and quality. Some of the studies on the implementation of web-based GIS were conducted by Barbu et al. (2022) and Mennecke & Crossland (1996).

Mantey and Aduah, Mantey, & Tagoe, (2012) stated that by linking computerized data processing activities with an effective integrated property tax management component, a comprehensive system is formed. The GIS functions by identifying all control objects based on the existing map. According to Droj (2015), the creation and maintenance of large tax data as well as the changes in the land and building evaluations required a lot of money. This means that there is a need to properly design a good system to smoothly function and provide accurate information.

GIS is a special information system for managing data containing spatial information. In other words, it is a computer system capable of creating, storing, managing, and displaying information that reflects geographical and identity data. A GIS consists of software and data used for geographical analysis, mapping, database management, and geospatial statistics (Alexander T. Demetillo *1, 2018; Alzahrani, Sheikh Abdullah, Mohamed, & Mukred, 2021; Arshad, Sani, & Ibrahim, 2018; Artvinli, 2010; Balogun, 2019; Barkham, Bokhari, & Saiz, 2022; Berke, 2010; Cho & Gimpel, 2012; Ebifuro, Mienye, & Odubo, 2016; Ebifuro et al., 2016; Javed, Saqib, Razaq, & Saeed, 2018; Rika, Susilo, & Nurjani, 2016; Shaw & McGuire, 2017; Standiford, Bartolome, Frost, & McDougald, 1999; Wei, 2012; Wiweko, 2015; Xiao & Tao, 2021; Zaman & Khan, 2020; Zoneh, 2013).

Furthermore, a GIS-based tax information system is one of the efforts to facilitate tax assessment by providing location and thematic information about each property, including 2D footprint structure on each improved package in the field assessment. The system automatically calculates the tax owed for each property simply by adding the raw data (Pareta, 2017; Standiford et al., 1999). Additionally, this system has the potential to generate tax refund information and locate any property when required, to be monitored by a tax inspector. Most

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importantly, a GIS-based tax information system offers an opportunity to perform various spatial and attributes data analyses, thereby providing a basis for decision-making, future planning, and facilitating the evaluation of property tax (Mintz & Chen, 2011; Shakede & Komolafe, 2017). It was also found that the majority of respondents indicated they had never paid taxes, despite being aware of tax payments because they have been notified through their media, friends/colleagues, and the Internal Revenue Service Board as shown in the survey (Ciprian, 2015; Guo, Hao, & Ren, 2014; Shakede & Komolafe, 2017).

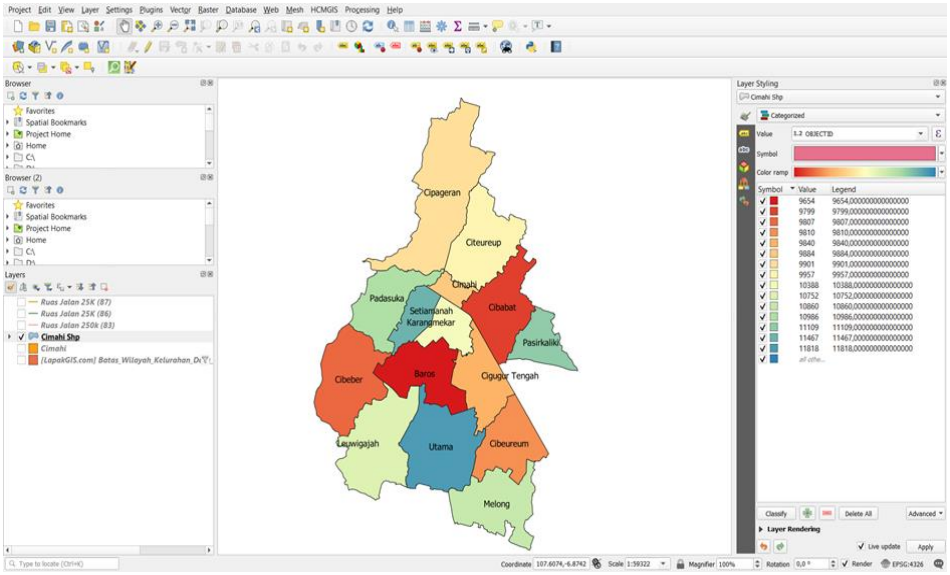
The application of GIS to the calculation of land and building tax helps to improve the efficiency and transparency of tax assessment and collection in several ways. First, GIS is useful for calculating and collecting property taxes. Second, it is used to directly map and monitor the tax payment statuses. This information or map is easily published through web-based GIS.

METHOD

Study Area

Cimahi City is located in West Java Province, Indonesia. Astronomically, it is situated between longitude 107°30' – 107°34' east and latitude 6°5' and 6°6' South. The area is 40.2 km^2 with a total population of 560,512 people. In terms of administration, Cimahi City consists of 3 districts and 15 sub-districts.

Figure 1: Cimahi City Study Area



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Database Development

Spatial and non-spatial data are required for the development of the database of land and building tax administration. Conceptually, spatial data are objects related to property taxes, including location, building number, and class, as well as the street on which it is located. A map is created with satellite images, geo-referenced data and screen digitization of building footprints, zones, and streets, which shows all existing buildings. The digitization process automatically assigns a unique map to each digital feature. This process generates the property location limit and its area in square meters that is required to calculate the tax for all properties in the study area. Site mapping is conducted using a web framework, including codeigniter, php 7.3, jQuery, leaflet js, moment.js with Bootstrap Ui framework. Moreover, non-spatial data includes informational attributes that describe spatial data such as the owner's name, land and building address, tax identification number, building type, tax year, tax rate, etc.

Tax Base

The current manual methods used by the Cimahi City Government to generate property information have not been able to provide all the necessary information about the affected property taxes, thereby resulting in potential loss of income and low tax returns. This low buoyancy is one of the biggest challenges in managing property taxes in this location.

The large taxes conducted in accordance with the Indonesian Tax Regulations specifically in Cimahi City is calculated with the following formula

Land Tax:	Land area x the rate of sale value of tax object according to class	=	xxx
Building tax:	Building area x pull class building	=	xx (+)
NJOP as base imposition tax			xxx
NJOP Not taxable (according to with policy government)			xx (-)
NJOP for calculated tax			Xxx
PBB payable: % x NJOP for calculated tax			Xx
Deducting factor (according to with policy government)			xx (-)
Land and building Tax that must be paid			Xx

RESULTS AND DISCUSSION

The Cimahi City Government already have 2 applications for calculating and creating land and building tax invoice as well as the one for managing maps of dashboard-based tax objects. The two applications exist separately but are not related to each other. Also, they are accessed locally on the operator's existing computer.

This condition leads to a tedious business process in managing and mapping tax data. The technical limitations faced are the difficulty in accessing local applications and inefficient operators. Therefore, this application is not publicly accessible to the executive department of the Cimahi City government and is not available to the public.

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To deal with these obstacles, applications are developed for easy accessibility by different parties. The software developed is called Cimahi City Geographical Tax Information System (SIGOCI). This system is web-based and the programming language used is PHP with MariaDB DBMS. Furthermore, it helps to manage tax data of Cimahi City residents through GIS technology.

The primary user of this system is the Cimahi City Regional Revenue Agency, while other related users include the government and citizens. This system is intended to assist in disseminating tax information and service requests of every citizen for easy accessibility. The development of applications based on GIS makes it easy for the Government to project land and building tax revenue in the form of digital maps.

The system used a soft supplementary device for conducting the administrative processes of tax management in the area of land and building. Currently, the Cimahi City Government already has an ongoing program/system but is unable to map the potential in the form of a GIS. It was observed that this newly built system runs alongside the one already existing and the data transformation process between them occurs through intermediary system migration. For example, in the old system, the data extraction process is performed, while the migration is conducted in the new.

Furthermore, citizens use the built system to access tax information based on spatial information possession. Technically, residents are permitted to search for the location of their houses through the search menu. The information tax objects, invoices, and history of the searched objects are displayed later in this study. This shows that the system was capable to increase public awareness of obtaining tax information and its payment.

The tax regulatory reform conducted by the government is unlikely to work well when it is not accompanied with the development of a good information system that identifies, assesses, and documents the land and building tax efficiently. This improves gift services, which eventually increase the taxpayer compliance. Unlike the existing manual system, the new technology corrects the errors in determining control objects. The following is an example of the mapping results with the new system.

Figure 2: Map of Earth and buildings Pasirkaliki District

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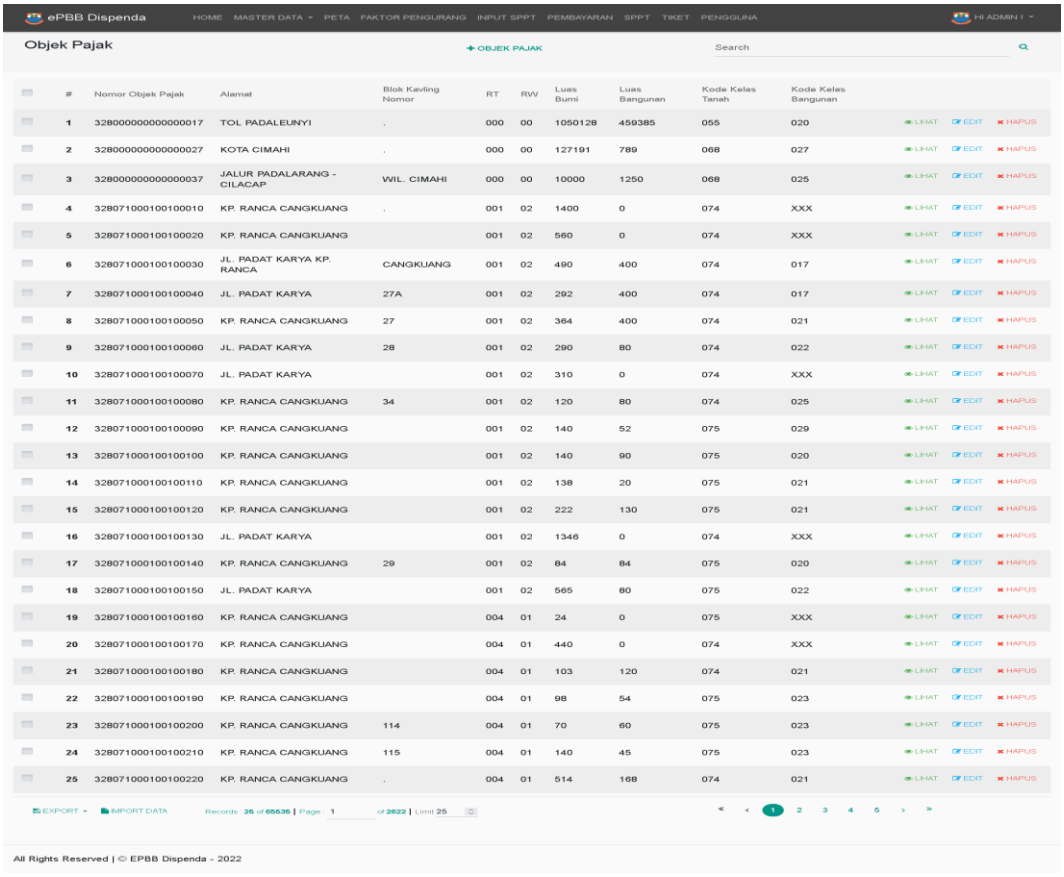
The database contains the required tax number, owner's name, property type, address, class of land and building, land and building size, as well as the tax rate. Additionally, it also comprises of tax policy rules that comply with the regulation areas. This information often shows the total tax potential for the study area based on the existing database. The model provides uniformity and consistency in calculating the tax rate for all taxpayers in each group simultaneously. Furthermore, the model's ability to perform bulk assessment proves that this approach speeds up the evaluation process and reduces costs. Several questions from the public about taxes are useful for determining the amount paid for property, registration of new taxpayers, and data correction. It is important to note that every property has an identification code that facilitates reconciliation between the amount already paid and those not paid, both for the previous period and the present. With this database, it is possible to obtain the total and excluded properties, as well as the expected income for the year. Figure 3 shows the screenshot of the database created to determine property tax. The database makes it possible to capture, edit, store, retrieve, update, query, manipulate, analyse, display, and generate proprietary data easily and accurately.

Figure 3: Taxpayer Database



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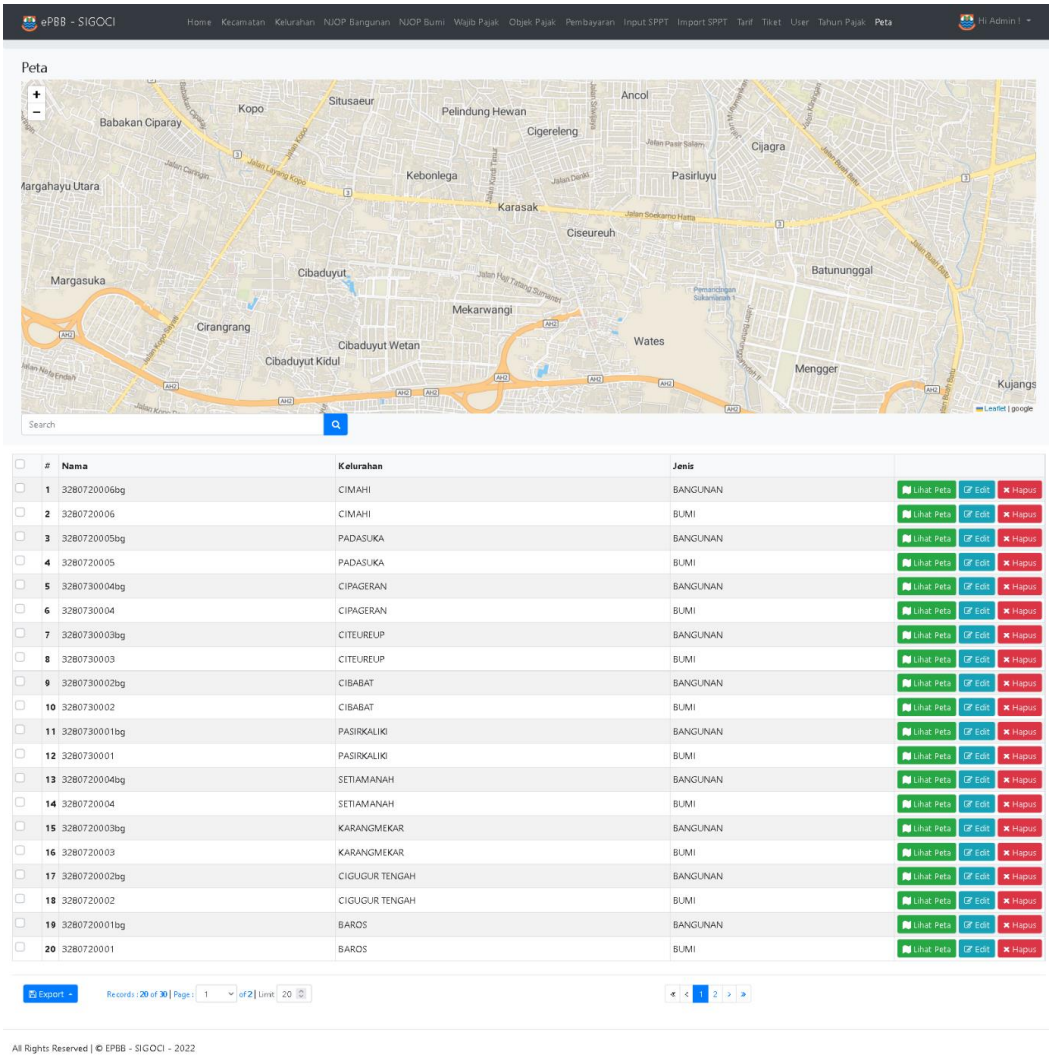
The mandatory database tax connection and mapping are shown as follows.

Figure 4: Combined Mandatory mapping and tax database



#	Nama	Kelurahan	Jenis	
1	3280720006bg	CIMAHI	BANGUNAN	Lihat Peta Edit Hapus
2	3280720006	CIMAHI	BUMI	Lihat Peta Edit Hapus
3	3280720005bg	PADASUKA	BANGUNAN	Lihat Peta Edit Hapus
4	3280720005	PADASUKA	BUMI	Lihat Peta Edit Hapus
5	3280730004bg	CIPAGERAN	BANGUNAN	Lihat Peta Edit Hapus
6	3280730004	CIPAGERAN	BUMI	Lihat Peta Edit Hapus
7	3280730003bg	CITEUREUP	BANGUNAN	Lihat Peta Edit Hapus
8	3280730003	CITEUREUP	BUMI	Lihat Peta Edit Hapus
9	3280730002bg	CIBABAT	BANGUNAN	Lihat Peta Edit Hapus
10	3280730002	CIBABAT	BUMI	Lihat Peta Edit Hapus
11	3280730001bg	PASIRKALIKI	BANGUNAN	Lihat Peta Edit Hapus
12	3280730001	PASIRKALIKI	BUMI	Lihat Peta Edit Hapus
13	3280720004bg	SETIAMANAH	BANGUNAN	Lihat Peta Edit Hapus
14	3280720004	SETIAMANAH	BUMI	Lihat Peta Edit Hapus
15	3280720003bg	KARANGMEKAR	BANGUNAN	Lihat Peta Edit Hapus
16	3280720003	KARANGMEKAR	BUMI	Lihat Peta Edit Hapus
17	3280720002bg	CIGUGUR TENGAH	BANGUNAN	Lihat Peta Edit Hapus
18	3280720002	CIGUGUR TENGAH	BUMI	Lihat Peta Edit Hapus
19	3280720001bg	BAROS	BANGUNAN	Lihat Peta Edit Hapus
20	3280720001	BAROS	BUMI	Lihat Peta Edit Hapus

The GIS developed is easily accessible to enable the public know about tax assessments and other related information on land and building, such as registration of new data, changes in data, and obstacles faced in society. Similarly, the Cimahi City Government is able to access the system to input new data, correct taxpayer data, correct tax rates, calculate bills for the current year, and evaluate the payment fulfilment. Figure 5 shows the interface of the system.

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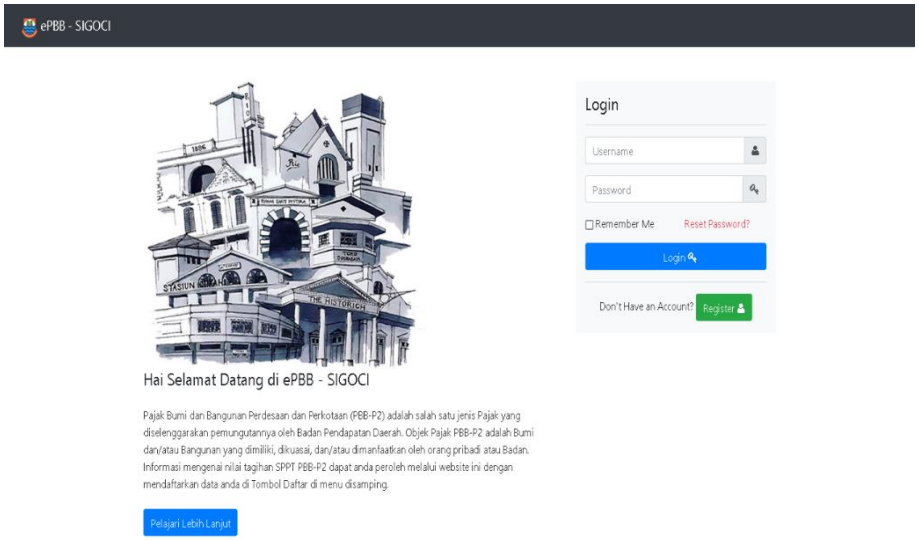
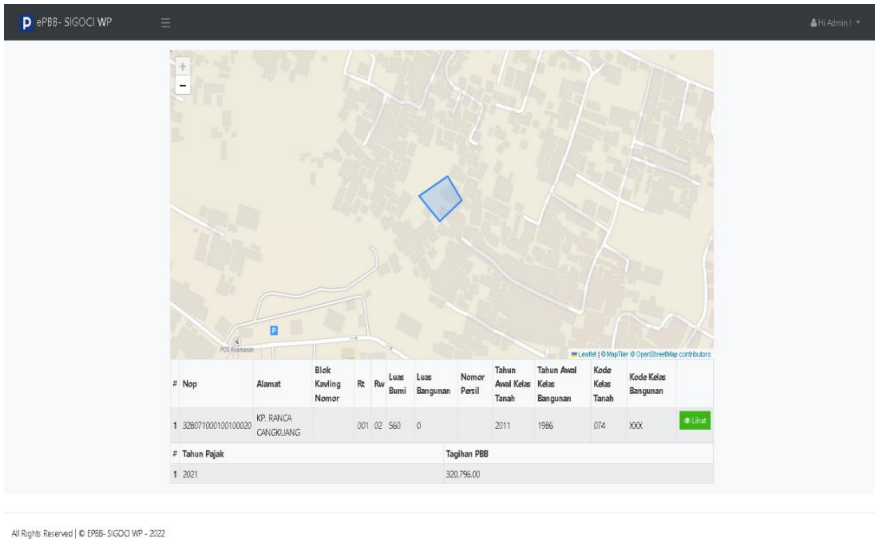
Figure 5: Login



The tax assessments information is shown in Figure 6 and it contains name, invoice, and a map showing the taxpayer's location.

Figure 6: Appearance Bills and Position of Taxpayer's Land and Building



For the benefit of the city in tax planning and control, government officials are able to access the system in order to see the potential and achievements of paying tax bills.

In Figure 7, potential land and building control map information is retrieved by ward, sub-district, and city. This information enables the government officials in villages and cities to monitor the progress in paying land and building tax. Furthermore, the information is useful for planning, monitoring, and controlling.

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Figure 7: Area Map per Village

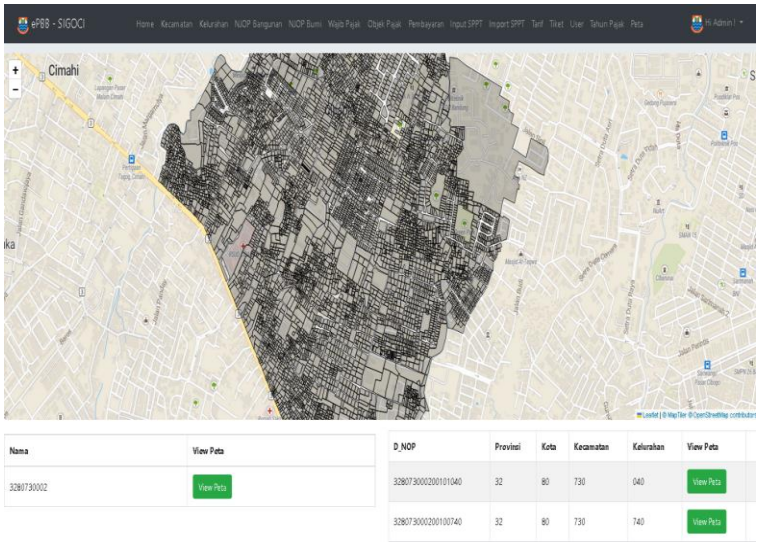
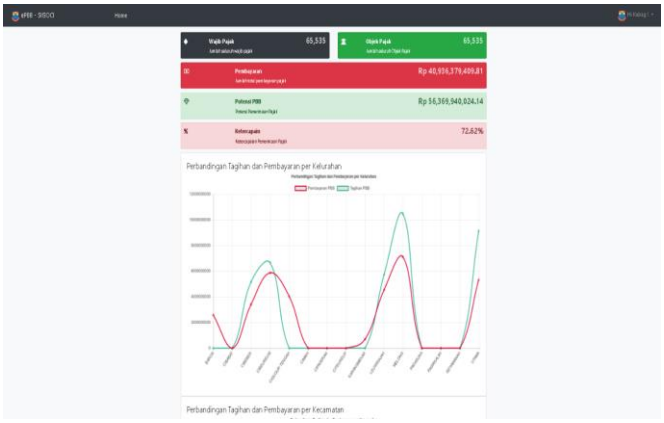


Figure 8 shows the information on the taxpayer's number, tax object's number, invoices, payments, and the percentage of tax payment achievement.

Figure 8: Potential and Achievement Tax Receipt



CONCLUSION

Overall, the result shows that a web-based GIS has the ability to quickly determine the location of land and building as well as their potential in an area. It also improves management efficiency, reduces service delays, and reduces operating costs, thereby making it to be more effective. The proposed recommendations for the implementation of this system require the cooperation of different government agencies and institutional capacity building.

The success of the land and building tax administration depends on the willingness of the ruling government. Given the importance, advantages, and urgency of a GIS-based system for land and building, it is recommended that government have the jurisdiction to complete the

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development of this system as a matter of priority. The concrete conclusions drawn from this study are as follows: 1) The main objective of this study is to develop a web-based GIS regarding land and building tax for the city government in Cimahi West Java Province through new technologies such as remote sensing and GIS; 2) The data in this application is from the previous land and building tax register; 3) Developing an integrated database with GIS automatically assists tax managers in enforcing existing rules or policies to reduce tax fraud; 4) This technology is ideal for analysing, visualizing, and mapping the market value of properties; 5) Also, the land and building tax system integrated with GIS makes it easy to identify the taxpayer's location and debtors. Hence, the potential areas for land and building tax are easily identified and mapped accordingly; 6) GIS is termed powerful tax arrears tracking tool needed to increase government income tax collection; 7) This study also aims to improve the assessment of efficiency in the taxation process through web-based geospatial technology, which allows multiple parties such as the government and the public to access their information using tax calculation methods in order to ensure data transparency; 8) Geospatial technology provides decision-makers with information to plan and control local income streams with limited resources and staff; and 9) With this web-based GIS, the interaction between government and citizens becomes better without having to meet immediately.

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