WEBGIS-BASED MAPPING OF LAND AND AGRICULTURAL COMMODITIES IN EAST BORNEO

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Abstract

The potential for agricultural land in Indonesia is still vast, making the agricultural sector a primary source of income for the majority of Indonesians. The agricultural sector is widespread across various regions in Indonesia, one of which is East Borneo. As an agricultural area, the majority of the population in East Borneo chooses farming as their livelihood. However, comprehensive agricultural land mapping has not yet been conducted, which could provide essential information about the location of agricultural land, particularly in East Borneo. In this research, a web-based Agricultural Land Geographic Information System has been developed for East Borneo. The geographical information system built can display both spatial and non-spatial data, describing objects based on the Earth's condition. The object-oriented method was employed in creating this system. It is expected that the development of this Geographic Information System will provide valuable information to the public regarding the distribution of agricultural land locations and their respective areas, especially in the East Borneo. This system will be instrumental in promoting more efficient and sustainable agricultural management in the region.

Keywords: *Agricultural Land Mapping, Geographic Information System (GIS), East Borneo Agriculture, Web-Based GIS, Object-Oriented Methodology*

INTRODUCTION

The development of the agricultural land sector is essential to meet the needs of the local population (Widhiyastuti et al., 2023). Additionally, the diversity of food sources from the agricultural sector can also attract tourists from other regions. Currently, there is a pressing need for an analysis of the potential of agricultural land. Understanding and comprehending the distribution and characteristics of agricultural land can help predict agricultural crop commodities and recommend suitable land utilization. This, in turn, can lead to maximizing agricultural production to meet local food requirements (Sekhar et al., 2024).

However, the distribution of agricultural land in East Borneo has not yet been mapped, which can provide vital information on the location and extent of agricultural land. To address this, a system is required to support this endeavor. One of the

technologies that can facilitate this is the Geographic Information System (GIS) (Mahanta et al., 2024).

The rapid development of information technology has brought significant benefits to society. In the realm of technology and information, the term often used is "information system." In simple terms, an information system can be defined as a medium or system consisting of technology, organized steps, and human resources within an organized system working in combination to acquire information and use it for management and decision-making (Nwafor, 2022). One of these combinations, particularly in the geographic domain, aims to make the benefits of information technology accessible to the community.

Various techniques, methods, and approaches can be employed to develop and build technology for obtaining rapid, accurate, and precise geographic information. GIS is a computerized land mapping system that encompasses a set of procedures related to data storage, processing, and presentation, with applications in various fields such as agriculture, forestry, hydrology, and more (Yahya et al., 2023). It utilizes graphical or spatial data to visualize the Earth's surface, typically with reference to coordinates on maps, aerial imagery, and satellite images. Attribute data is derived from statistics, survey records, and other relevant information related to the geographic information system.

Agricultural land in East Borneo comprises paddy fields, dryland fields, gardens, and more. Paddy fields are categorized as wetland farming, highly dependent on water resources. Land, in a broader sense, refers to the surface of the Earth containing elements essential for human life. On the other hand, dryland fields rely on rainwater and represent areas separated from the vicinity of houses, often cultivated with seasonal and annual crops.

Mapping is the process of categorizing a set of areas related to geographic positions, encompassing regions and societal developments that affect socio-cultural aspects and are precise in the use of specialized scales (Teimouri et al., 2022). In the context of this research, mapping is the main process of segmenting data to form the geographic information, presenting the distribution of specific regional conditions in a rubric

manner, and transcribing the actual conditions into base maps while implementing the map's scale (Zhang et al., 2023).

In light of the aforementioned issues, it is essential to initiate research focused on the development of a web-based GIS for mapping agricultural land and crop commodities in East Borneo. This system aims to make it more accessible for the local community to understand the distribution, extent, and characteristics of agricultural land in the region.

In conclusion, East Borneo in Borneo Island, Indonesia, is an agrarian area with agriculture as the primary livelihood for its residents. The Perjaya Dam plays a significant role in the local irrigation system, and there is a growing need for comprehensive mapping of agricultural land. The application of GIS technology can facilitate this mapping process and provide valuable insights for local farmers and decision-makers (Mathenge et al., 2022). This technology is essential for efficient land use, agricultural planning, and maximizing food production to meet the region's needs.

METHODOLOGY

The research methodology employed in this study falls under the category of Applied Research. Applied research is conducted to acquire information that can be used to address existing problems (Dwivedi et al., 2024). The purpose of applied research is to apply, test, and evaluate the practical applicability of a theory in problem-solving.

A. Data Collection Method

This research was carried out at the Department of Agriculture in East Borneo on Borneo Island. To ensure alignment with the research objectives, the study was focused on the indicators related to agricultural land in East Borneo. This involved visiting several agricultural land sites to conduct interviews and observations.

The data utilized in this research comprised both spatial and non-spatial data. Spatial data included:

1. Coordinates of East Borneo.
2. Raster Image Maps sourced from Google Maps.

Non-spatial data consisted of information regarding agricultural land, obtained through data collection methods involving observations and interviews with the East Borneo Agriculture Department (Christanto & Irwansyah, 2023).

B. System Development Phases

The stages employed in system development utilized the Object-Oriented method with the Unified Approach (UA) (Wazlawick, 2024). UA is a methodology for object-oriented system development that combines techniques and methodologies that were previously established while utilizing UML (Unified Modeling Language) to support the modeling process (Fitrani & Puspitaningrum, 2023). The steps involved in the UA methodology are as follows:

The Object-Oriented Analysis (OOA) phase using the Unified Approach (UA) is illustrated in the following Figure 1.

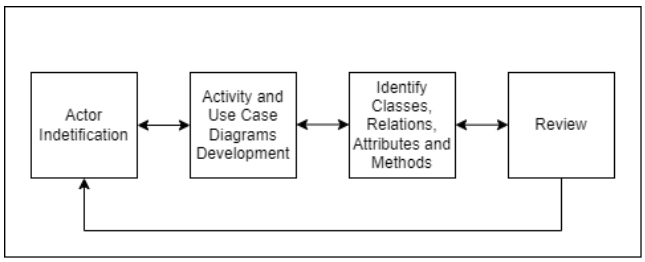

Figure 1. Image of Object-Oriented analysis (OOA) Phase

In summary, this research adopts an applied research approach to gather information for addressing practical problems. Data collection was conducted at the East Borneo Agriculture Department, focusing on agricultural land indicators in East Borneo. System development followed the Object-Oriented methodology, with the Unified Approach (UA) utilized for the analysis phase

RESULT AND DISCUSSION

A. System Modeling

The system modeling is made using UML (Unified Modeling Language) which consists of Use Case Diagrams, and GUI (Graphic User Interface Display) (Cavique et al., 2022).

B. Use Case Diagram

After conducting an analysis of various data and information identified within the system, a model of the actors involved in the performance processes currently in place at the Agriculture Department of East Borneo in Borneo Island has been established. The actors engaged in activities that can support the operation of a designed system are outlined in the following actor and use case identification table 1 and table 2.

Table 1. Actor Definition

Actor	Actor Type	Actor Activity	Benefit
User (Society)	PBA (Primary Business Actor)	Access map and information land data	Acquire information and layout land
Admin	PSA (Primary System Actor)	Input land Information data and access to the data report	Give service to user

Table 2. Use Case Definition

Use Case Name	Use Case Definition	Actor
Login	This Use case describe event when the process to go inside the system	Service Staff
Manage User	Event Where the process to manage user's data	Service Staff
Manage Regency	Event Where the process to manage regency's data	Service Staff
Manage Sub District	Event Where the process to manage sub district's data	Service Staff
View Land	Event Where the process to look at the land	Society

Use Case Diagrams describe the activities that will be processed by the system such as the login process, manage user data, manage land data, manage regency data, manage sub district data, access land information, view land map and logging out as shown in the following figure 2 use case diagram. In figure 2 of the use case, it can be seen that service staff can manage the user data menu, land data, regency data, sub district data with service staff can add, edit and delete data. Society can Access the land information data and view land map

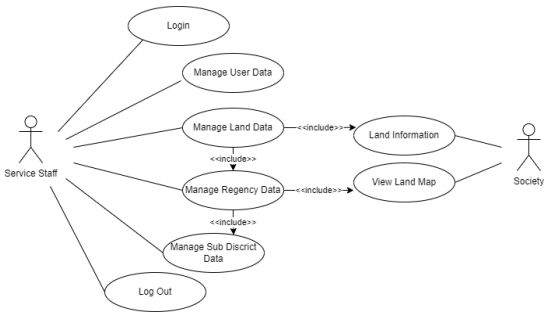

Figure 2. Use Case Diagram

C. GUI (Graphic User Interface Display)

Based following is a GUI from the analysis and design of a geographic information system mapping the location of agriculture and plantations as follows.

Login page design in following Figure 3, users will be asked to fill in a username and password to log in to the website.

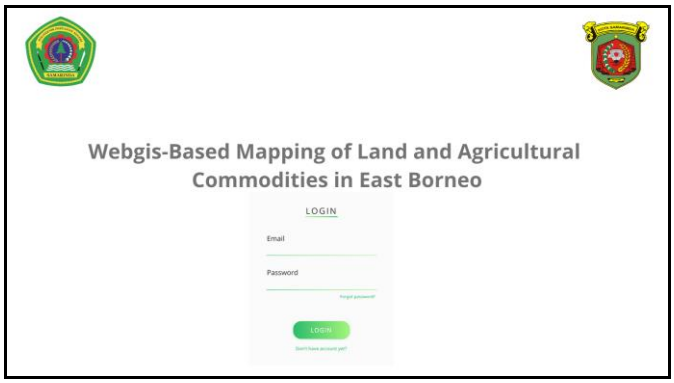

Figure 3. Login Display

This is the initial display of the system. actors can enter a username and password to enter the system. Next is the district List page in Figure 4. Users can choose to delete, add or edit districts. This show list of the regency, users can add, edit, delete district.

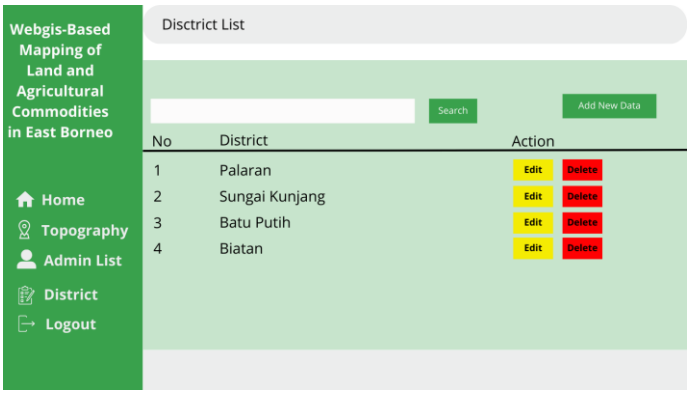

Figure 4. District Display

On the Land List page, the user will see a list of land registered in the system, the user could add, edit or delete land data. as shown in following Figure 5.

Figure 5. List Land Display

This page shows a list of land registered with address and description. user also can edit, delete and add new land. Land Data Detailed List page, users can add, delete or edit land data as shown in the following Figure 6.

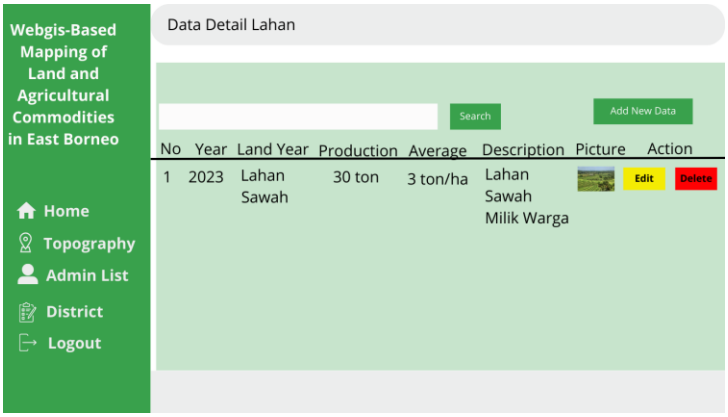

Figure 6. Land Detail Display

This page shows the detail of land registered with production, average production, description and picture. Next is Figure 7 is an interactive page that will provide information to users about land suitable for planting and previous planting results. This show all the location of registered land in the form of interactive maps.

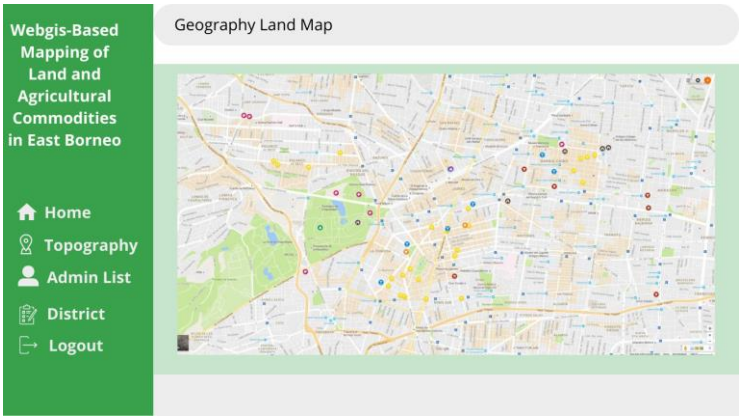

Figure 7. Map Plantation Areas

CONCLUSION

The research conducted on the development of the Geographic Information System for Agricultural Land Mapping in East Borneo on Borneo Island indicates that the system is valuable for users and the community. It facilitates understanding of various types of agricultural land, their locations, and the extent of agricultural areas in each village within East Borneo.

The information provided by the system serves as an additional resource for users to gain a deeper insight into the agriculture of the region. Moreover, the data displayed is expected to offer valuable insights to the East Borneo local government, enabling them to enhance productivity in the agricultural sector and promote the overall advancement of the agricultural industry in East Borneo.

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