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An Overview of GIS Used in Oil Palm Plantation

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Abstract: Oil palm plantations have expanded rapidly in recent decades, especially in major oil palm producing countries like Malaysia and Indonesia. The rapid development of the information technology and computers are affecting the way people perceive the overall plantation technology. Oil palm plantation mapping and monitoring needed more precise technological innovation. Previous studies have proven the capability of Geographical Information Systems (GIS) collecting information and interpreting data for mapping oil palm plantations. Therefore, this research study discusses and elaborates the accuracy in term of data processing for oil palm plantation mapping using GIS approach. This study will be conducted by systematic literature review. As result from research papers that been selected shown that this technology had high accuracy value which is 86.0% in producing mapping of oil palm plantations as well as assist in plantation management.

Keywords: Technologies, Mapping, Oil Palm, Data Processing, Geographic Information System

1. Introduction

The oil palm (*Elaeis guineensis*) is a palm species that is widely planted in Southeast asia, especially in Indonesia, Malaysia and Thailand. Among other crops, such as soybean, rapeseed and sunflower, it has the highest oil-yeilding ability. Palm oil has surpassed olive oil as the most widely consumed vegetable oil on the world [1] and continues to be the top choice as vegetable oil.

The rapid development of the information technology and computers are affecting the way people perceive the overall plantation technology. Some things that used to be done manually and take long time desired to be done faster and is done automatically and digitally [2]. For the effective development of agricultural production, it it necessary to introduce highly efficient technologies for collecting and

processing information. Precision agriculture now has the potential to measure large scale spatial and temporal variability using GIS techniques and technology which aids in efficient crop troubleshooting.

GIS or Geographic Information System is a decision-support system or more like database system with many of the characteristic of an information system about coordinates for locating spatial objects and allows for the execution of various procedures[3]. The fact that GIS data is geo-referenced distinguishes it from other information systems. GIS are now used in almost every area of engineering, natural science and social science, providing precise, reliable and repeatable methods for capturing, displaying and analyzing spatial data [4], [5]. GIS technology were widely applied in oil palm sector with enable industry to manage and mapping plantation especially for large-scale area. The aim of this research is to provide a systematic literature review on overview of technologies used in oil palm plantation mapping. However, the specific objective is to evaluate the accuracy of technology in term of data processing and its effectiveness for oil palm plantation mapping using GIS approach.

2. Benefits of GIS in Oil Palm Plantation

This technology are essential tools in giving well-organized oil palm and resource planning. This in because GIS fit in software, hardware and also data for capturing, analysing, managing and displayed all of information that got geographically referenced [6]. GIS also visualizes and interprets data into a number of ways that will present relationships, trends and patterns in more understandable forms such as maps, charts and reports. Indirectly, they provide reliable information to decision-makers and researchers for the collection of different data into meaningful information especially when combine with best instrument [7]. These had been proven by previous research that GIS can be used to create the different level of oil palm databases. According to [8], ground data of land evaluation for oil palm cultivation such as length and density of roads, terraces and drainage, and the number of planting points are tracked and collected precisely using GIS, global positioning system (GPS) and remote sensing (RS). Then, these GIS databases used in management, development and mapping plantation that more systematic.

3. Research Methodology

The aim of methodology is to ensure the objective and goals for this study can be achieved. In addition, methodology also can be used as guidance and planning for this study so that research's process will run smoothly. It will be discussed in detail overall method for this study.

3.1 Planning

This section contains five stages for completing this study. The process of this research was shown graphically in figure 1.
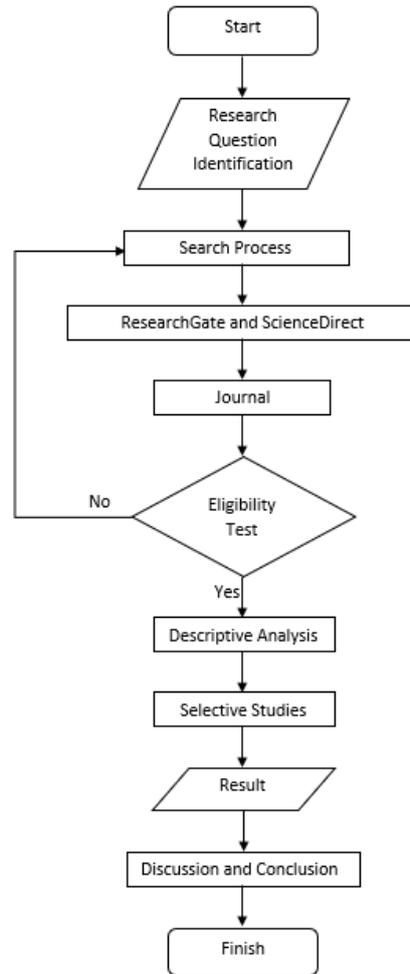
Figure 1: Flowchart research methodology

3.2 Conducting the Review

This section contains two phase which is identification of research question, search process and eligibility test. Research question that been identified which are:

RQ1: How accurate the data processing produced by GIS approach used to mapping oil palm plantation?

RQ2: Is a systematic literature review method able to clearly elaborate the GIS approach used?

Process of searching for the related previous research contains source such as articles, journal and book. There are few platforms that used to search these sources which is ResearchGate and ScienceDirect. Papers published that be considered were from year 2015 to year 2021 and a total of 15 articles were included. All the articles will be manually selected in eligibility test section. In eligibility test section, full-articles assessment is carried out together with a group call as review partners and to ensure the quality of systematic review it been verified by supervisor. Systematic review processes are shown in figure 2.
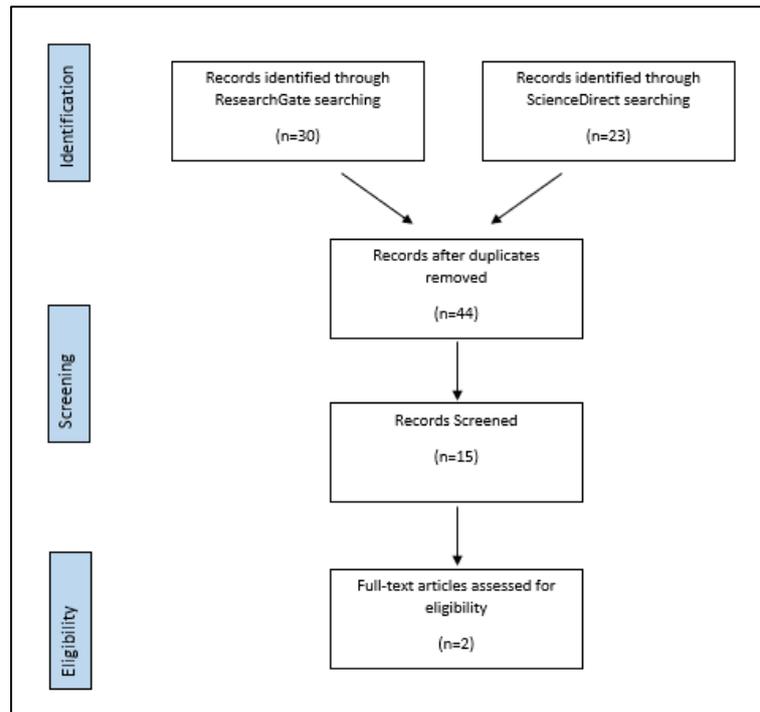
Figure 2: The systematic review processes

4. Results and Discussion

Data are collected form less than 4 or 4 articles. The data collected will be evaluated and analysis in terms of its accuracy. Figure 3 shows the accuracy for Geographical Information System technology obtained from various papers in percentage units.
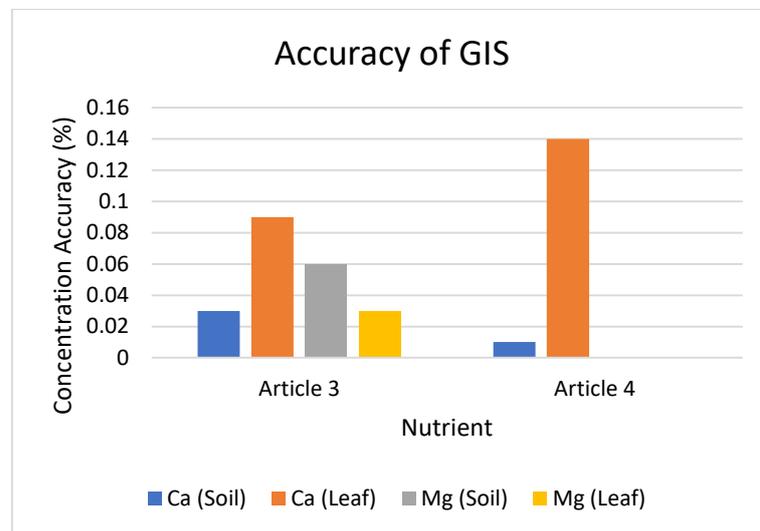

Figure 3: Accuracy of GIS obtained from various articles

From Article 3 [9] researched on the spatial variability of calcium (Ca) and magnesium (Mg) in soil and leaf collected in BSR infected oil palm plantation. This researched was done by applying the geographical information system (GIS) techniques in oil palm plantation that affected by basal stem rot (BSR) disease for observed the correlation between the disease and its incidence. As a result, this technique able to quantifying and observe the relation between the variability of Ca and Mg with BSR occurrence throughout large scale oil palm plantations. By using this model, the content of Ca and Mg obtained in the soil and leaves is low and this indicates a lack of these elements at the study site. The

Ca and Mg content in the soil is between 0.03 – 0.05% and 0.06 – 0.35% respectively while in the leaves it is 0.09 – 0.60%, and 0.03 – 1.87% respectively. Therefore, these findings point to the need for a site-specific approach in oil palm plantation field management in order to limit BSR disease incidence at the early stages of planting and save time and money.

This comparison can also be referred to Article 4 [10], a case study to map nutrient status in oil palm plantation by using GIS technique. By taking sample using standardized method for laboratory analysis, and transfer to GIS software, even in the large-scale area with obstacles, the results showed that the accuracy obtained for all points are below 0.14% with an average of 0.00% for Mg (soil), and Mg (leaf), 0.01% for Ca (soil) and 0.14% for Ca (leaf) respectively. This is due to relationship between Mg concentration in soil and leaf. The lower Mg concentration, the lower Ca concentration.

By comparing Article 3 and Article 4, the result of nutrient occurrence in Article 4 are worsened than Article 3. This is because the data processing method used Article 4 is analyze using the complex technique while for Article 3, analyze using the simple technique.

5. Conclusion

In conclusion, the objective of this research which is to evaluate the accuracy of technology in term of data processing and its effectiveness for oil palm plantation mapping using GIS approach were succesfully achived when the result shown this technology had high overall accuracy value of 86.0%. This shows that this technology can help in producing mapping of oil palm plantations as well as assist in plantation management. In the future, for better analysis results, research on the accuracy of this technology can be done by comparing more fields other than oil palm plantations.

Acknowledgement

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