

Geographic Information System In Forest Management

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Abstract

The overall aim of this paper is to explore the potential application of Geographic Information System (GIS) technology in forest management in JohorTengah area. The use of GIS has flooded almost every field in the engineering, natural and social sciences, offering accurate, efficient, reproducible methods for collecting, viewing and analyzing spatial data. According to research area, GIS is the best tools to make better decision, to improve productivity, to save time, money and man power in forest management activities, required are dynamic both locational and descriptive inventory data, rather geographic information. The evolution of GIS, technologies has enabled the collection and analysis of field data in ways that were not possible. Despite the diversity of applications, however, a number of broad conclusions can be reached about the role of GIS in forestry. GIS applications in forestry management are developed using Avenue programming in ArcView Ver 3.1 software as a interface and buffer analysis using extensions in ArcView Ver 3.1 software namely geoprocessing and 3D analysis. The interface built in the windows environment allows the forest management to operate this application easily. In addition, the production of this database is in line with the needs of the Johor Forestry Department in forest management in line with the sustainable forest management system.

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Key-word:

GIS, Forestry, Software,Technologies,Sustainable

1. Introduction

Geographical Information System (G.I.S) are “smart maps.” The important of Sustainable Forest Management (FIM) in ensuring continuous forest resources. Geographical Information System (G.I.S) play significant role as a planning technology in mapping and zoning forest even. These systems provide tools that can be used improve the quality of information available to forest managers.

The conventional method is not practical for the requirement of forest management. Better technique which is faster, accurate and efficient need to be use in order to handle forest management to overcome lack of forestry resources. This geographical information system (GIS)technique helps in the process to control, monitor and upgrade records for **Forest Information System** (FIM).

Objective of this system is :

- i. To create an application using Arc View GISsoftware
- ii. To design and develop database in forest management.

iii. Using GIS-application to zoning forest for protection in Johor Tengah area.

With regard to forest management, GIS is an amazing tool because it answers crucial questions that help foresters in forest management departments such as condition, location, modelling and trends make decisions. Other important fields of forest management that have improved by GIS include forest monitoring, protection, harvest, conservation and rehabilitation. It has also improved climate change and biodiversity. GIS enables foresters and other specialists to create databases which are crucial in the preparation of work plans, wildlife conservation and soil conservation. Forest sectors can improve their operations by using GIS in managing forests and other important sectors related to forestry.

To conduct of this study, area that has been selected is forest of Johor Tengah,, area which covering of Batu Pahat and Kluang district. The total area of this forest is 18,8774.17 hectares. It consist of two categories namely for protection and production. The study area is in Figure 1.

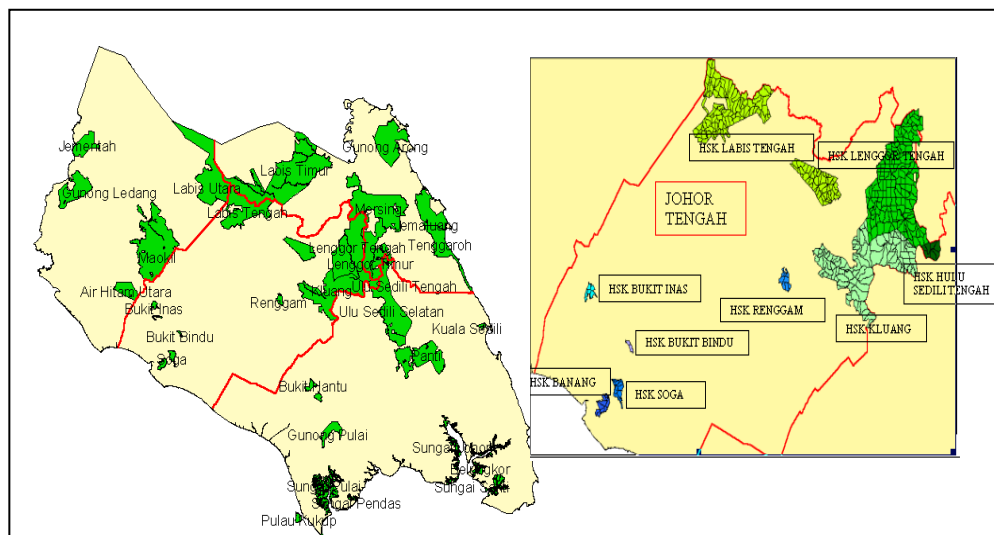


Figure 1 : Study Area

According to research by Sonti SH, 2015; Application of Geographic Information System (GIS) in Forest Management, The use of Geographical Information Systems (GIS) has flooded almost every field in the engineering, natural and social sciences, offering accurate, efficient, reproducible methods for collecting, viewing and analyzing spatial data. Forests are important renewable natural resources and have a significant role in preserving an environment suitable for human life. In addition to timber, forests provide such resources as grazing land for animals, wildlife habitat, water resources and recreation areas. Forestry involves the management of a broad range of natural resources within a forested area. Forest resource management in today's ever-changing world is becoming more complex and demanding to forest managers.

Previous studies claimed managing a very complex ecosystem such as a tropical forest sustainably is very challenging. The challenge has increased in the recent years in timber producing countries like Malaysia due to increased demands and environmental pressures that need forest managers to make crucial and quick decisions. At present, forest management not only deals with harvesting but also conservation and rehabilitation. These normally involve large volumes of data and analysis, which have been mostly carried out manually in most tropical countries. As a result, the efficiencies and effectiveness of the decisions implemented are limited. To overcome this difficulty, this study proposes the development of a GIS-based tool for timber harvesting planning for a tropical forest in Malaysia. (M. Y. Safiah Yusmah et al ., 2009; The application of Geographic Information System (GIS) in forest harvesting in Malaysia.

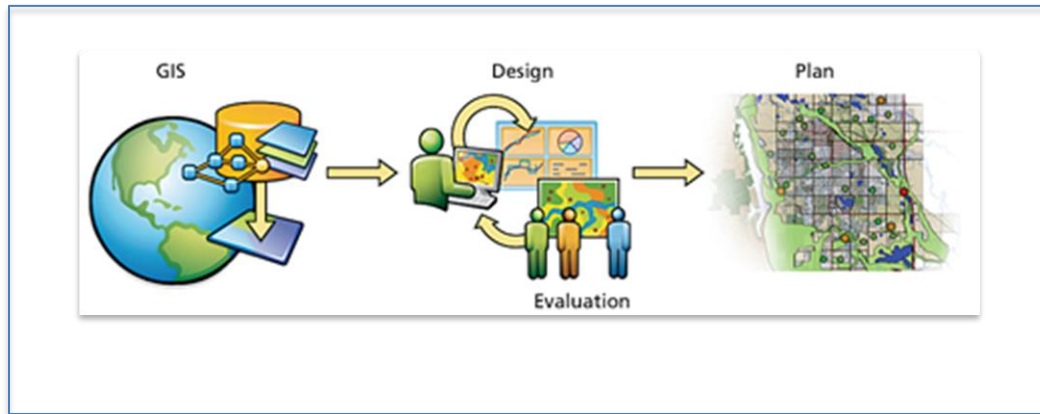


Figure 2 : Process of GIS design

Generally, Figure 2 show GIS is a computer system that manages maps and related databases. It is capable of measuring, mapping, storing, editing, manipulating, forming spatial models, making presentation and decision making. According to Bruce E. Davis(2001), GIS is a relationship of three elements, namely :

Geography : the real world, earth , spatial reality.

Information : Data and information which the purposes and use of data.

System : Computer technology and support equipment.

ArcView is a software used in this study. It is a fully featured GIS for visualizing, analyzing, and creating data with a geographic component. It consists of address, postcode, GPS location, city, local government area, etc. **ArcView** visualizes, explores, and analyses data, revealing patterns, relationships, and trend

2. Problem Statement

Forestry management is a very complex activity where it involves a lot of data and information that requires an efficient and detailed management. In addition, careful planning needs to ensure that the development of a forest area is not affected by human activities. Various problems faced by the Johor State Forestry Department in the management of forestry information such as data dropout, security and so on.

The problem faced in forest management is due to still adopting a traditional management system that is based on conventional data acquisition and storage system. The maintenance of this practice has resulted in JPNJ's objective of managing and developing forest resources on a sustainable basis for optimal continuous production in accordance with environmental needs has not been achieved.

For forestry management, it always needs the latest information to ensure that forestry management can be done in an orderly and planned manner. However, forestry development and planning is changing from time to time. This poses a problem to management as the development and planning of forestry information involves a large and complex amount of data. Attribute data that is not stored regularly and systematically in a database will cause data dropout. Therefore, in forest management, JPNJ needs an efficient and systematic data management system, up-to-date information and also requires a data storage system, integrated and effective data acquisition. This can ensure the effectiveness of the forest management system while ensuring the development of a forest area is not affected by human activities

3. Methodology

GIS applications can be grouped into various categories depending on the level of integration with other forest management and financial systems. These categories include :

- i. Data collection and maintenance.
- ii. Map production.
- iii. Data viewing and query.
- iv. Decision support systems

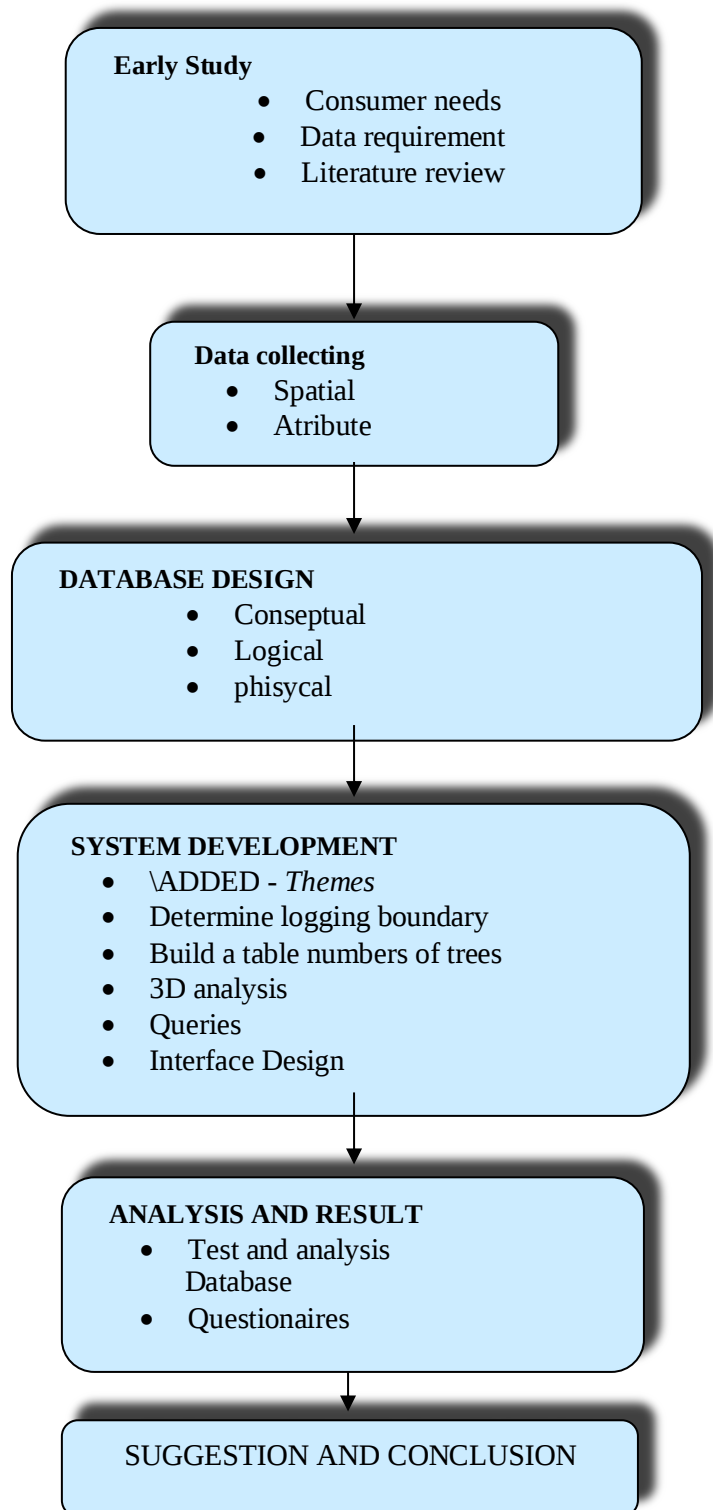


Chart 1 : System Development Flow Chart

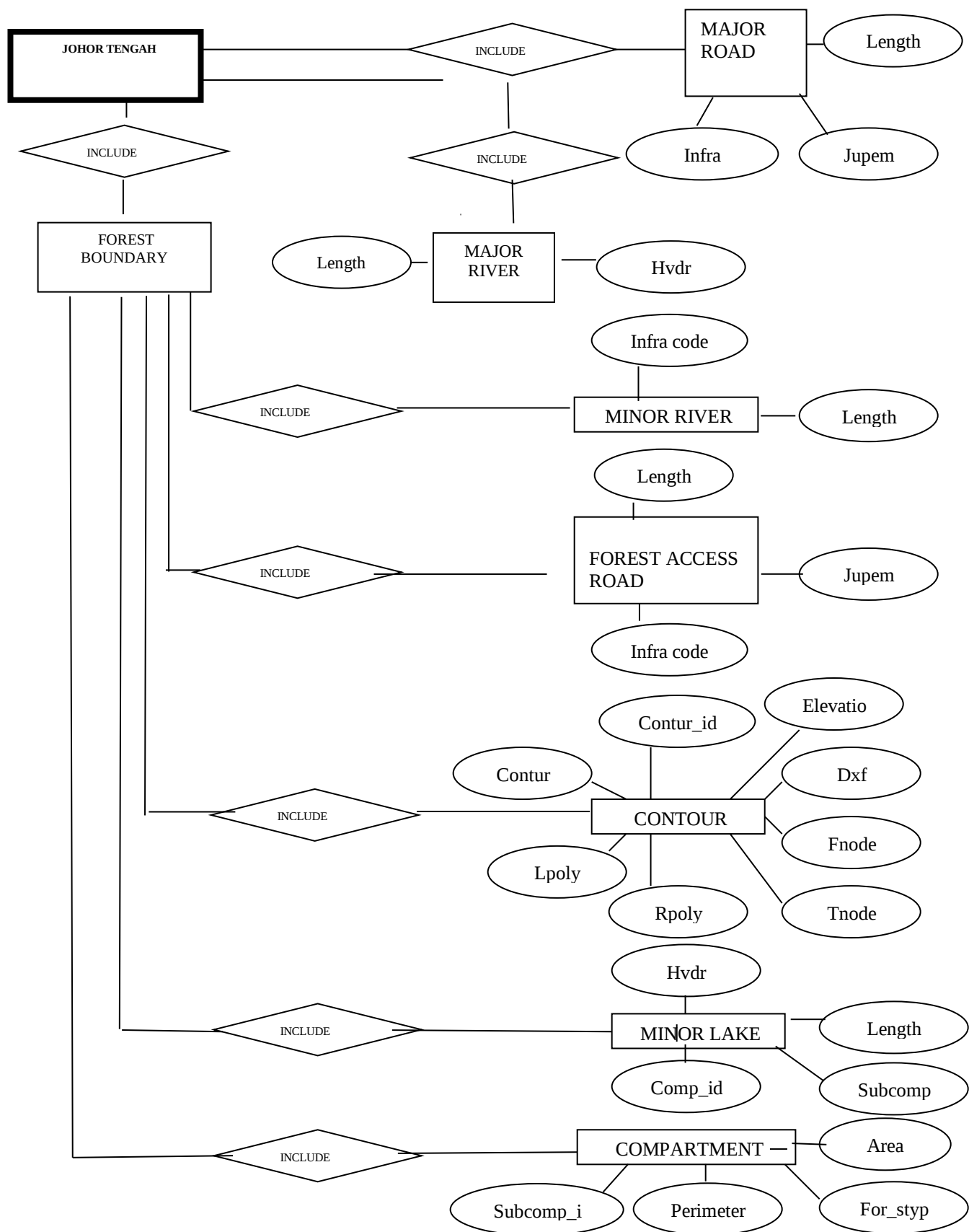


Chart 2 : The entity Relationship Model for spatial

4. Analysis

In this study Geographic Information System(GIS) can manage and manipulate data of forest management by using variety method. Pointed out that GIS is a good tool for forest management because it answers the following question that helps in forest management activities. Its also focus on to find a location. From the GIS system we can find the location of forest resources in the earth in many ways such as a place name, post or zip code, or geographic references such as latitude and longitude.

For other situation is about condition of forest. Forest can be classes into Non forested land of certain size distance from road or river. Others issue is about trends. What has changed since? It can helps tofind out what has changed within study forest or land used an area over a time. Patterns in forest management also should be concerned. Its about what spatial patterns exist? And the last one this system also can determine create a modeling in 3 dimensional view.

5. Result

5.1 Interface Design of System

The design should enable use to understand easily the applications in it. Figure 3 show interface design using Arcview. This design is to ensure that it is easy to learn and run the system.

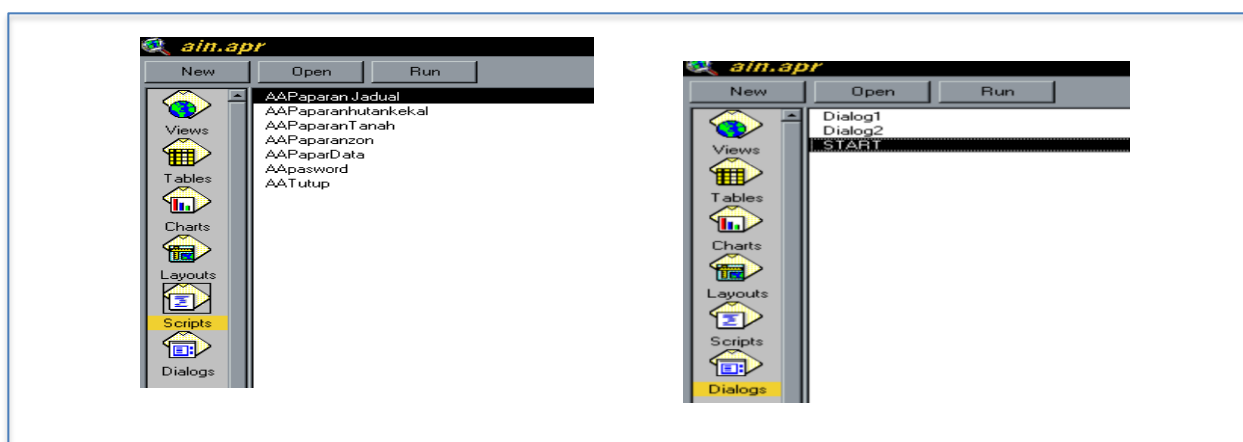


Figure 3 : Interface Design

In the interface , the password created to ensures that only certain user can excess the applications shows in the Figure 3. Furthermore all the data are private and confidential and need to protect from any kind of damage and information leakage.

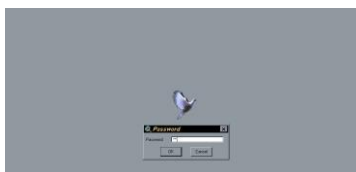


Figure 4 : Password window

In Figure 5 shows the system has being design with easy menu and layer that user need to find. However Table 1 shows the attribute of layer data created in this system.

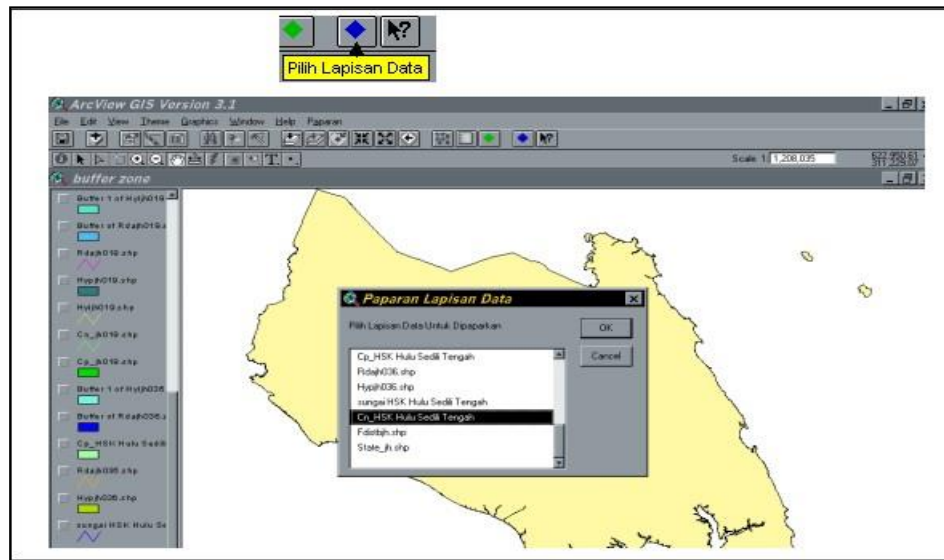


Figure 5 : View of Data spatial layer

Data	Data type	Source
Sempadan Daerah Hutan	Spatial	Dalam fail shape (RSO)
Sempadan Hutan	Spatial	Peta Skala 1:50 000
Kompartmen	Spatial	Peta Skala 1:50 000
Jalan Utama	Spatial	Dalam fail shape (RSO)
Kontur	Spatial	Dalam fail shape (RSO)
Jaringan Sungai (major river and cannals)	Spatial	Dalam fail shape (RSO)
Jalan dalam setiap Hutan Simpan/ jalan masuk ke setiap Hutan Simpan	Spatial	Dalam fail shape (RSO)
Takungan (minor lake)	Spatial	Dalam fail shape (RSO)
Tasik Besar	Spatial	Dalam fail shape (RSO)
Kawasan Ladang Hutan	Spatial	Dalam fail shape (RSO)
Kumpulan Pokok dan Bilangan	Atribut	Data bancian hutan sebelum penebangan (Pre-F) dan selepas penebanagn (Post-F)
Strata hutan	atribut	Manual Rancangan Pengurusan Perhutanan 1996-2005)

Table 1.: List of data layer in Forest Management

In this system there are many tools for the purpose of data analysis required. This allows various analyzes to be used to facilitate the work of forestry management to be more efficient. Figure 5 shows overlay of three data, compartment area, contour and river. This data can be shown by area or compartment selected.

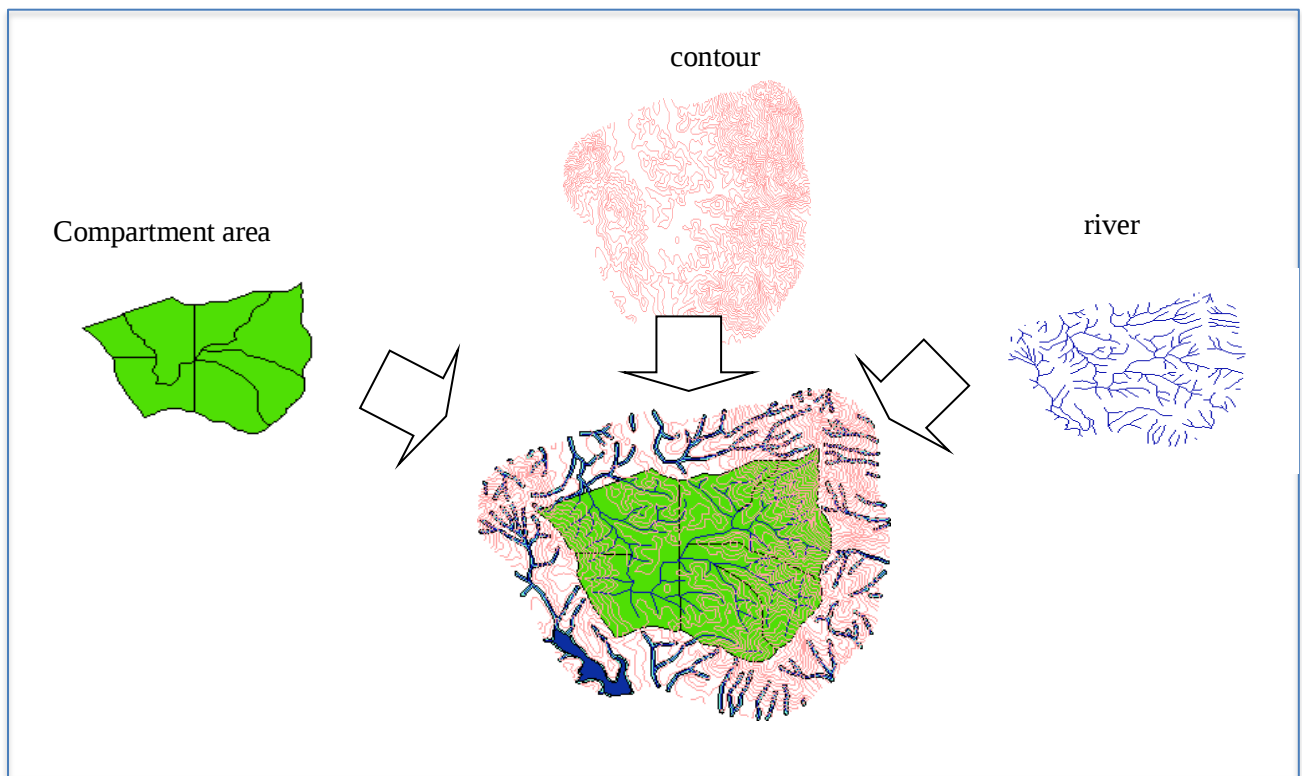


Figure 6 : Shows data result of using overlay tools

5.2 Analysis Data Using ArcView Tools

i. Adding theme

The user can choose which layers in a theme that need to be used to accurately register with other themes.

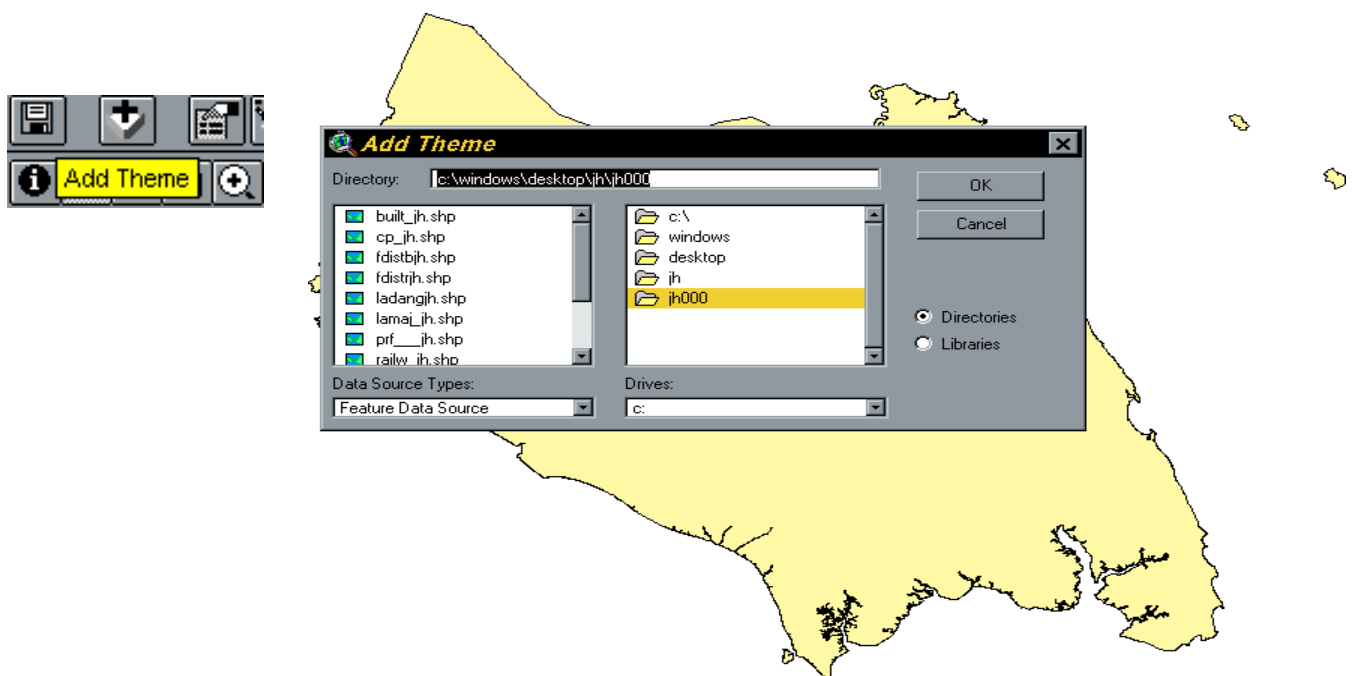


Figure 7 : Create new theme

ii. Buffer Zone Display

Through this menu in the GIS software it enables us to create zoning line for each compartment fast and accurate. It will show us any logging activities.

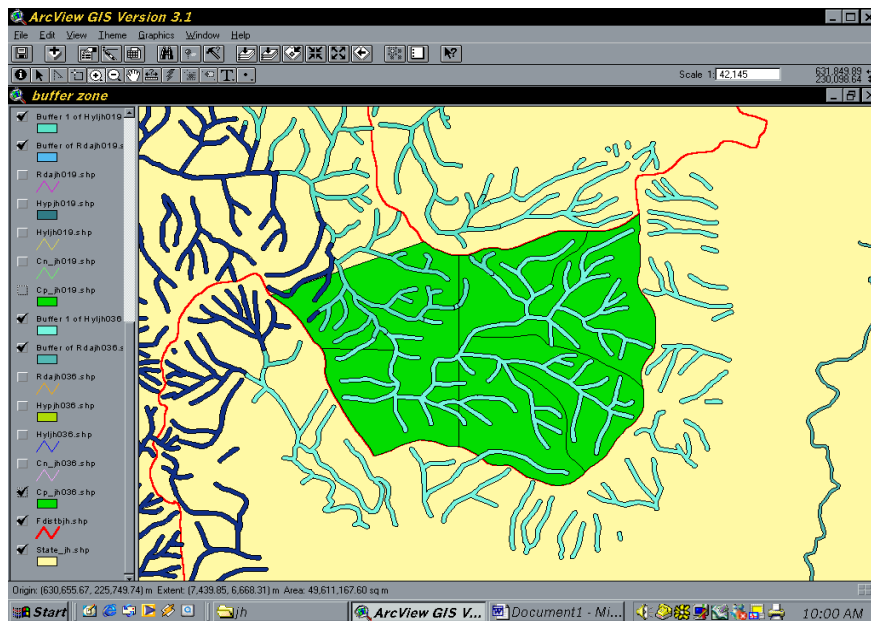
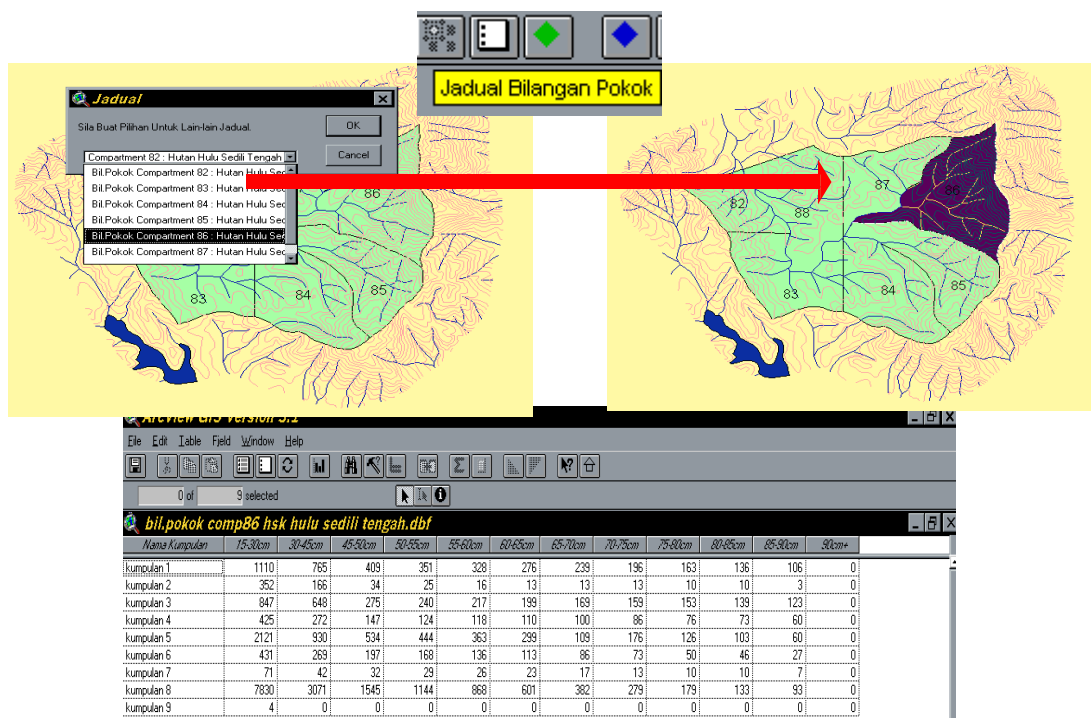


Figure 8 : Data using Buffer Zoning tools

iii. Table of Number Tree Display

From here user can make an equerry how many tree can cut in one compartment because the cutting limit prescribed for the group of dipterocarp species would not be less than 50cm, Understanding and analyzing the rings of trees and their positions in the forest database helps foresters understand the age of trees.



iv. 3D Display

From 3d analysis user can know area where the slope over 40, where this area are protect

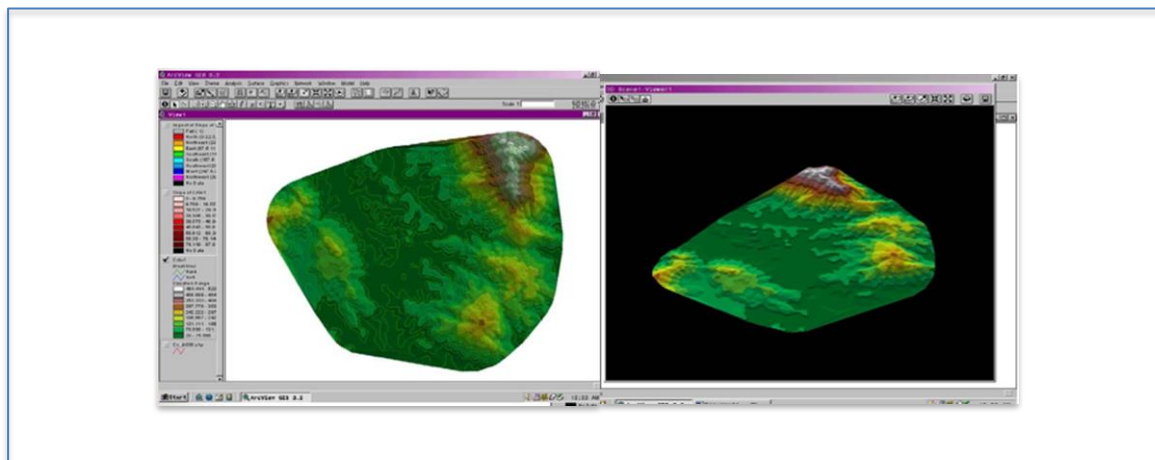


Figure 10: 3D display Using TIN analyze

v. Query Analysis

Using inquiry menu can do data search and inquiry. Normal inquiry and search application require use to key in the keyword. Basically, to obtain certain information through inquiry, layer involve must be activated first.

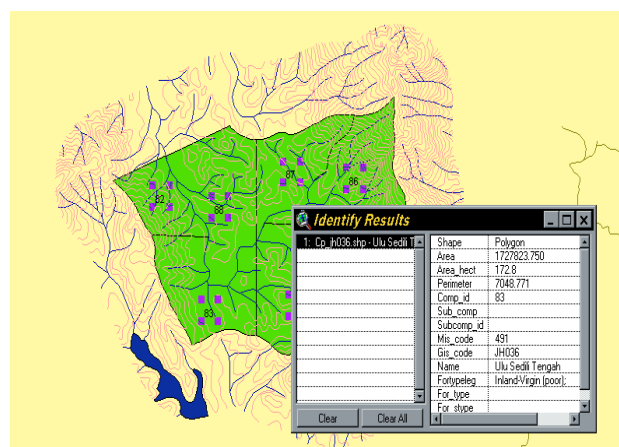


Figure 11: Result of Query Analyse

6. Conclusion

Overall, this study aims to develop a forestry management system based on GIS technology to assist the Johor State Forestry Department (JPNJ) in the management of permanent reserves in Central Johor. However, this application can only be accessed by certain people. From the development of applications made for forestry management it is to facilitate the storage of spatial data as well as attribute data for forestry management. Forestry management that has been using conventional methods can be simplified. By using GIS, forestry management will be more robust, where references to geography will be easily seen and analyzed.

In general, these GIS applications can be divided into four main functions, namely data handling, analysis implementation, spatial data display and attributes as well as information printing. The data handling function is more focused on providing dialog boxes for keywords and Pull down menus in the user interface to update forest data in the form of spatial data and attribute data. In the event of any change in the data, the data file must be changed via ArcView instead of through an interface that only provides forest-related data updates. Any spatial data and attribute data found in this forest management database can be updated from time to time.

Meanwhile, the analysis of GIS applications in forest management focuses on buffer zone analysis, analysis of the number of trees that can be cut down, spatial data overlap analysis and queries through the system function implementation flow model that has been described. The implementation of this analysis can be implemented easily through the interface developed. The last function categorized in this GIS application is the ease to print any data and information into hard copy form (hard copy) easily.

7. Suggestion

This study is a basic study on the role of GIS in forestry management. This study can be continued to a higher level by adding more robust analyzes such as forest areas remaining after logging, and so on. Since the objectives of this study are limited, the addition of objectives can be expanded as taking into account other information required for the increase of analysis such as logging schedule of an area, land use information and so on. Exposure to the software used is also necessary where exposure for Avenue programming language users so that users can use the application environment more user friendly and comfortable.

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