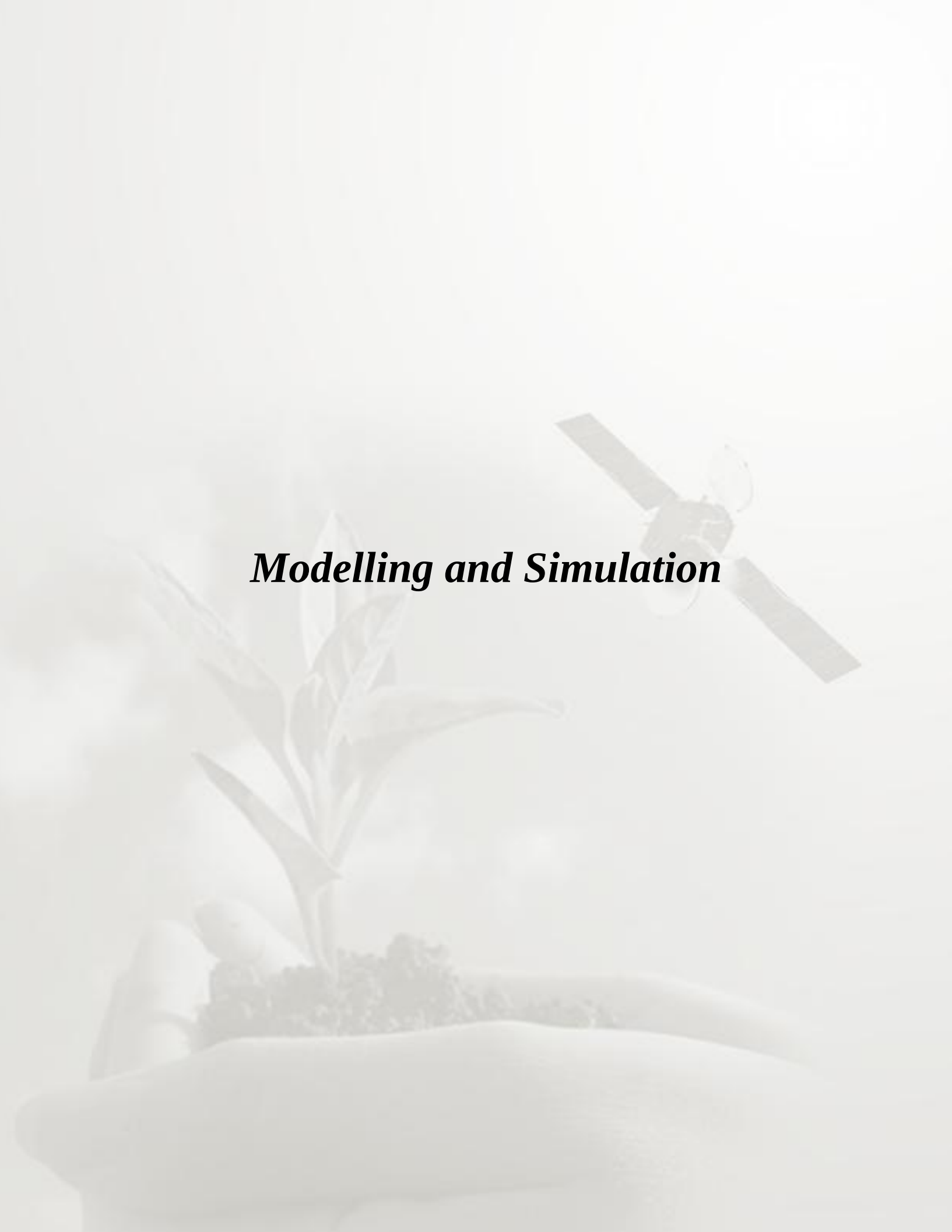

Modelling and Simulation

Extended Enterprise Resources Planning (ERP) for Palm Oil Industry

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***Abstract*— The objective of this paper is to report the implementation an Enterprise Resources Planning (ERP) a Geographic Information System (GIS) and GIS implementation at one palm oil plantation in Indonesia. The benefits of GIS for resource management are relatively well known when discussing the applications of this technology and this paper focuses on GIS applications in a specialized sector within resource management - palm oil plantations. This report involves the development of ERP and GIS for palm oil estates with the aim of improving plantation and production management.**

Keywords- Palm Oil, ERP, GIS

I. INTRODUCTION

The oil palm, Elaeis guineensis Jacq. is indigenous to West Africa where the main palm belt ran from Sierra Leone, Liberia, the Ivory Coast, Ghana and Cameroon to the equatorial regions of the Republics of Congo and Zaire. (Teoh, 2002). Its oil, extracted from its fruits, has been used as food and medicine through the ages, the earliest archeological evidence suggests the existence of an earthenware jar containing residues of palm oil in a 5,000-year-old Egyptian tomb. (www.rspo.org)

Nowadays, palm oil is used in a vast range of everyday products including crisps, cakes, biscuits, pastry, margarines, ice cream and soaps. Over 28 million tons of palm oil are produced worldwide annually and Indonesia and Malaysia occupy 80 percent of the world's CPO (crude palm oil) production.

With the growing demand and production (expected to nearly double by 2020 and may be more due to the bio energy demand), palm oil sales are set to rise in Europe and dramatically so in the growing economies of China and India. (Fitrian, 2006)

II. USAGES

Palm oil in its various forms has become the leading vegetable oil produced globally accounting for one quarter of global consumption and nearly 60% of international trade in vegetable oils. Over 85% of global palm oil is consumed as cooking oil and in processed foods. Over 70% of global palm oil is consumed in Asia as staple cooking oil.

Palm oil is used for a variety of purposes, as an ingredient in food products and engine lubricants. Palm oil is also used in soaps, detergents, cosmetics, oleo chemicals, and lately as a feedstock for the production of bio diesel. Commonly 50% of products in a supermarket contain palm oil as an ingredient.

New uses for palm oil have emerged in recent years. For example, unstable and at times soaring petroleum prices and increasing concern about the global warming have increased the demand for palm oil as a feedstock for bio diesel, a renewable and green substitute for diesel. Palm oil is a source of one of the raw materials in bio diesel, a diesel equivalent processed fuel derived from biological sources which can be used in unmodified diesel-engine vehicles. With soaring crude oil prices and few harmful emissions compared to petroleum based fuels, Asian palm oil producers see huge opportunities for the future as global demand for bio fuel surge.

The oil palm fruit produces two oils - palm oil from the fleshy mesocarp and palm kernel oil from the seed or kernel. Palm oil is used primarily in food products: cooking oil, shortening, margarine, milk fat replacer and cocoa butter substitute. Palm kernel oil is mostly used in the oleo chemical industry for making soap, detergent, toiletries and cosmetics.

Apart from the oil, every part of the palm can be utilized. Palm kernel residue is used in animal feed. The shell, after the cracking and the removal the kernels, is used as a fuel in many industrial burners and to produce activated charcoal. The fronds, trunks and empty fruit bunches have been used to make fiber boards and chipboards for furniture and even fiber mats to fight erosion and desertification.

III. INDONESIA PALM OIL PRODUCTION

World palm oil consumption has significantly increased over the years from 1964 to 2008, while consumption has increased at an average of 8.7% annually. In 2007 and 2008, the world consumption of palm oil reached almost 40 million tons and in 2050, it is forecasted to reach 93-256 million tons, depending on the edible oil substitute demand (Amzul Rifin, 2010) It is commercially cultivated on about 12 millions ha in the humid tropics. Major producers are Indonesia and Malaysia. Other smaller but significant producers include Nigeria, Colombia, Costa Rica, Ecuador,

Honduras, Cote d'Ivoire, Ghana, Cameroon, Papua New Guinea, and Thailand. Major importers are China, EU, India, and Pakistan.

Indonesia has scored a significant achievement on oil palm development by becoming the biggest palm-oil-producing country in the world, both in plantation area and in total national production of palm oil. Incredible growth was noticeable in the last three years with approximately close to a million hectare developed as new areas reaching about 6.2 millions hectares and 17.2 millions tons of crude palm oils (CPO) and its derivatives last year. It is hard to say that the country has not benefited much from this commodity with export earnings up to more than USD 12 billions in 2007. (Goenadi, 2008)

The Oil Palm mostly are planted in Sumatra, with recent expansions move into forested parts of Riau, Jambi, and South Sumatra, as well as into West Kalimantan and South Sulawesi. Most oil palms were developed by Indonesian interests, although by 2002, there were over 600,000 ha of private estates owned by foreign and largely Malaysian companies. (Colin, 2003)

A significant change in the oil palm industry has taken place during the past season, as Indonesia surpassed Malaysia in production of palm oil and is now the world leader. Indonesia is the biggest CPO producer in the world, accounting for 47 percent of world production. The country produced 19 million tons of CPO from 7.9 million hectares of plantations 2008, and produce 20 million tons 2009 and is expected to produce 22 million tons in 2010. Malaysia, currently the second-biggest CPO producer, may see its production drop from an expected 17.7 million tons 2009 to 17.5 million in year 2010.

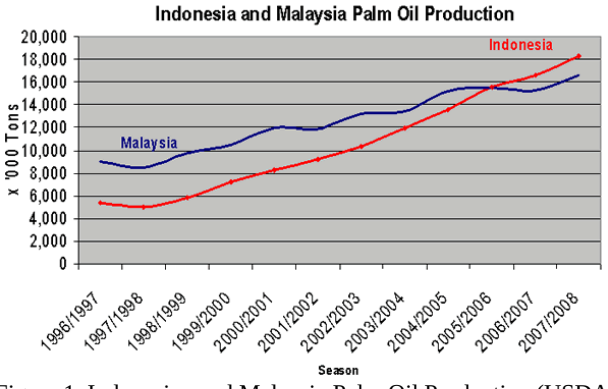

Figure 1. Indonesian and Malaysia Palm Oil Production (USDA Foreign Agricultural Service , 2007)

The Indonesian Palm Oil Industry has grown very fast and significantly recently. By 2007, planted area and production had increased to 23 and 24.5 times their level in 1980, and planted area growth rate on average 11% from 1980 to 2007, while the production growth on average is 13%. Seventy percent of palm oil production in Indonesia is exported. As a result, the export market contributed important role in the growth of the palm oil industry. By 2007, palm oil export had increased to 23.6 times its level in 1980. With an average growth of 28% in terms of quantity and 27% in terms of value annually. (James, 2007)

IV. PRODUCTION PROCESS

Oil palm planting is preceded by preparation of the land, which may be previously logged-over areas alienated for agricultural use, old oil palm stands, or areas once planted with rubber or cocoa. Standard practices guide the planning and implementation stages in establishing an oil palm plantation. The land preparation may include removing past vegetation and piling this into neat rows for natural decomposition, as open burning of the residual vegetation during replanting is disallowed by law. The planting points for the new palms are marked, planting holes are dug and the right dosage of basic fertilizer is put in, after which the oil palm seedlings are ready to be planted. The palms are placed in rows with a distance of 9 m between any two seedlings. The triangular planting pattern created is said to provide for maximum penetration of sunlight, to maximize yield. Planting density works out to 148 palms per hectare.(www.rspo.org)

A. Nursery

Seedlings are raised in the nursery for about 12 months prior to transplanting in the field. Ground cover is quickly established by planting cover crops to avoid soil erosion and the growth of weeds. After 30 months, the oil palm may already produce fruit bunches of sufficient size and number to initiate the harvesting process.

B. Harvesting and Collection

After about 24 to 30 months, the oil palm starts to yield fruit in compact bunches called fresh fruit bunches (FFB). Harvesting involves cutting ripe bunches manually using a chisel or sickle. Collection of harvested fruits is either done manually, sometimes with a wheelbarrow, or mechanically using a tractor-mounted grabber with trailer. Harvesting process involves removing the ripe bunches, and collecting and sending these to the mill for oil extraction. The harvesting rounds are organized throughout the year so that the same palm is visited every 2 weeks – during which the workers will harvest any ripe bunch using a chisel on a short pole, or a sickle on a longer pole for taller palms.

C. Extraction

To preserve the freshness and quality of palm oil, the FFB are preferably sent to the mill for extraction within 24 hours of harvesting. The FFB are steamed under high pressure to sterilize, loosen and soften the fruits before they

are stripped from their stalks and mechanically pressed to extract the oil. No solvents are used to express the oil.

D. Refining

The extracted oil from the mill is called Crude Palm Oil (CPO). The CPO is sent to a refinery where impurities, colors (by bleaching), and odors (by deodorizing) are removed. The refinery would also separate the solid (palm stearin) and liquid (palm olein) fractions oil to cater to a wide range of uses.

V. ERP FOR PLANTATION

Information and communications technologies (ICT) coupled with enterprise systems and electronic commerce (EC) have supported large-scale business transformations, and forced firms to change their structures and functionality as well as their business strategies. ICT have become major components of the competitive strategy of many businesses. This strategic emphasis has made it possible for managers to integrate information and communications technologies throughout the organization and link all business units together. (Hooshang, 2006)

Corporate-wide technology integration allows information users of the company to have access to the needed information in a timely fashion and make intelligent decisions and the most important development in the corporate use of IT has been the introduction of enterprise resource planning (ERP) systems.

These systems allow a company to share common data and practices across the enterprise and produce and access information in a real-time environment. These systems are designed to solve the fragmentation of information in large business organizations, and integrate all information flows within a company.

An ERP system is a set of business applications or modules, which links various Business units of an organization such as financial, accounting, manufacturing, and human resources into a tightly integrated single system with a common platform for flow of information across the entire business. With the use of the Internet as a business medium, organizations can use the expanded version of ERP, to connect their internal business systems with the systems of customers and suppliers.

The purpose of ERP is to enhance an organization's competitiveness by improving its ability to generate accurate and timely information for managerial decision making. ERP systems generally come with standard applications centralizing their information of separate departments into a common data base. The use of a common database and standardization of business applications provide companies with a similar appearance and use of software programs. These programs become more universal throughout the company. Standardizing the appearance and applications of various programs that are used in individual departments can create greater ease of use and improve efficiency.

To improve the efficiency of utilization of the company needed an information system in accordance with the characteristics of the plantation industry. Every plantation company works very hard to increase the efficiency of the resource utilization to strive in this competitive business climate. Adequate and reliable information systems plays a vital role in the organizations to assist the management in making the right time i.e. not only the strategic decision taken by the Board of Directors, but also the operative decisions taken by Estate Managers and Mills Managers.

Managing Information System in Palm Oil industry has challenges such as:

- Estate and Mill Operation Management, which covers seedling, nursery, cultivation, harvesting and crop delivery from the estate to factory for further processing.
- Financial Management which include consolidating financial activities from all entities, especially managing the flow on inter and intra company transactions.
- Logistics and Inventory Management, both for procurement and sales of estate's crop or factory finished goods.
- Human Resources Management to manage employee's activities which are required to support estate factory operations.
- Geographic Information System (GIS) to assist decision makers in analyzing operational and financial activities through digital mapping technology.
- Information system management to enable modern management concepts in plantations, such as information system decentralization, by centralized authorities.

The normal ERP design is not suitable for specific Palm Oil Industry, and the extended ERP implementation specific in Palm Oil Industry will assist the Management to control the operation as well as to increase the efficiency. The extended ERP for plantation synergize the plantation operational management, financial management, logistic management, human resources management, and geographic information system (GIS) within one Integrated Information System.

VI. EXTENDED ERP WITH GIS

In recent years businesses have been striving to optimize their processes and improve efficiency by using ERP systems for workflow management and GIS for location based information management (Mostafa ,2008)

A geographic information system (GIS), is a system that captures, stores, analyzes, manages, and presents data that are linked to location. GIS systems are used in plantations management, land surveying, emergency management, navigation, and many others. In petroleum industry mapping and geography are instrumental elements in most decision making processes in oil production and exploration operations for site selection, routing, resource allocation, planning and asset management.

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. (www.gis.com) GIS technology can be integrated into any enterprise information system framework, like ERP or other software for business applications.

In palm oil industry mapping and geography are instrumental elements in most decision making processes in production and operations for site selection, routing, resource allocation. Geographic concepts and techniques are used to create a common operation framework for different disciplines. GIS gives businesses the geographic advantage to become more productive, more aware, and more responsive to daily business needs in plantation management such as Mapping, Spatial Management, Data Management, Fertilization Program, Optimum Crop Life Cycle, Production Prediction and Forecasting

Mapping Estate boundaries typically are not well defined and mapped. Traditional mapping used the optical distance method. This is now considered to be unsuitable because of the inaccuracies in this form of measurement and is being replaced by GPS systems.

GIS provide an important tool for the management of plantations. Prior to the introduction of GPS (Global Positioning Systems) and GIS data obtained in the field was difficult to obtain and in many cases inaccurate. Typical examples include plantation boundaries varying from government permits, and applied production areas different from actual. This has been a result of the problems in measurement and mapping of difficult terrain and remote, inaccessible locations. Furthermore, plantation management has to consider the changing nature of an estate that extends from initial land clearing, the production stage and finally the re-planting or conversion phase. GIS differs from traditional methods to provide alternative tools which can monitor and analyze data. Typically, palm oil plantations include production areas requiring supporting infrastructure such as buildings, roads and services. To better control the associated resources and assets, GIS is considered to be an essential tool for effective management.

Data Management is important due to the dynamic nature of a plantation site, from initial land clearing, growing stage through to replanting, it is important for the information database to be current. Changes to the spatial information have to be easily modified in the GIS.

Spatial Management is covered by Extended ERP with GIS system. Mapping of an estate is fundamental to the GIS system. Following mapping of the estate, data can be analyzed to quantify and qualify plantation resources. This data can easily be classified into year of planting, age, type of crop, administrative zones and size with the ERP and GIS software.

Production Prediction & Forecasting Income will be provided by Extended ERP with GIS system. GIS can efficiently summarize actual production yield data to look at monthly and yearly trends. Such information can assist management in planning labor and equipment requirements, work plans and schedules as well as monthly expenditure budgeting. Actual production can be monitored and graphed; production can be predicted based on crop age and additional agronomic information. By predicting production, management can forecast income based on CPO price trends. This valuable information can assist management in future organizational planning and potential enterprise expansion. (David, 2007)

The implementation of this technology is only slowly emerging in the palm oil industry. The information requirements of plantation management, and Extended ERP GIS integration to include the following: mapping, infrastructure, production planning, and control analysis for several plantations at various stages of development. Due to the dynamic nature of plantation development, information needs change during the life cycle of the crop (David, 2007). By creating a GIS, plantation and production can be more efficiently and effectively managed to increase profitability.

VII. TREES APPLICATIONS

Most of plantations industries require distributed system to overcome the problem of poor network or telecommunication infrastructure. The expectations of a complete integrated system among distributed database to company's legacy system such as ERP, is extremely high, and treeS Applications answer those requirement since treeS

Applications is Java web based ERP which designed for Plantation Industry.

treeS Application was develop by IFS Indonesia. IFS is a public company in Sweden (OMX STO: IFS) founded in 1983 that develops, supplies, and implements IFS Applications™, a fully-integrated, component-based extended ERP suite built on SOA technology. The company has more than 2,000 customers in 54 countries and focuses on eight main industries: aerospace & defense, utilities & telecom, manufacturing, process industries, automotive, retail & wholesale distribution, and construction contracting , service management and plantation management. IFS has 2,600 employees.

The treeS application is to simplify the procedure of entering the data (transactions) into the system by applying standardization of Chart of Account . This application were focused on capturing the Activity Based Costing (ABC) and transactions to improve company efficiency and productivity. ABC is a costing model that identifies activities in an organization and assigns the cost of each activity resource to all products and services according to the actual consumption by each: it assigns more indirect costs (overhead) into direct costs. It helps plantation companies improve production cost management, increase productivity and enhance operational efficiency through automation of end-to-end estate operational processes including payroll and check-roll management, inventory and storage management, vehicle management, nursery management, planting program, harvesting program, budgeting and financial management (Pahan, 2008)

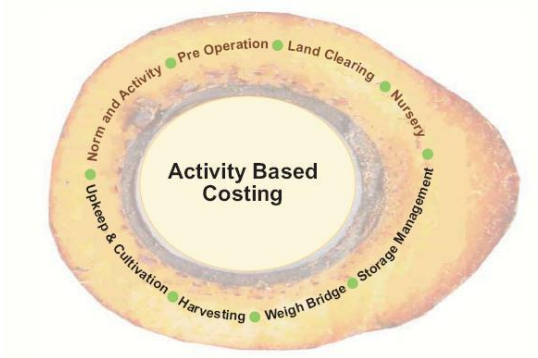

Figure 2. Activity Based Costing for Palm Oil Applications (IFS treeS presentation, 2010)

treeS Application is developed using open technologies, as IFS Indonesia have concrete action in supporting IGOS (Indonesia Go Open Source) program which declared by Indonesian Government, in a way to strengthen the national information technology system and to benefit the global information technology development.

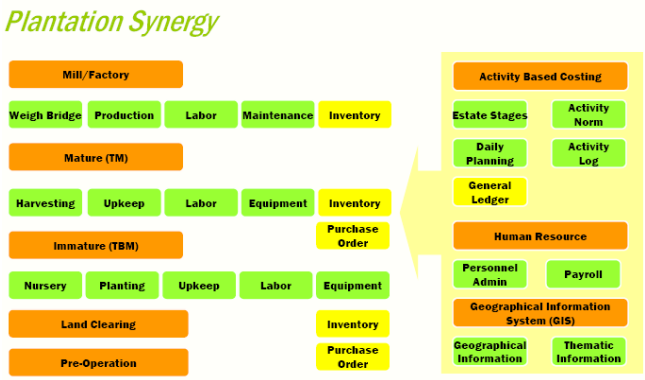

Figure 3. trees Applications
(IFS treesS presentation, 2007)

treeS provide specific plantation module such as Estate Management, GIS, Factory Statement and Storage Quality Management.

A. Estate Management

Estate Management provides a complete set of financial, logistic, GIS, and plantation specific attribute. The parameterized design of system gives freedom for the user to set up the estate according to company policy. Whether an estate is defined as stand alone entity or belongs to domain of the legal company.

B. Geographic Information System (GIS)

The integrated GIS system broadens the perspective of Estate Manager to oversee the condition of the perspective of Afdeling (Division), Block, and even the tree. The GIS thematic and stage are designed to cater the requirement for required of estate managers and are customized in accordance to company specific requirement.

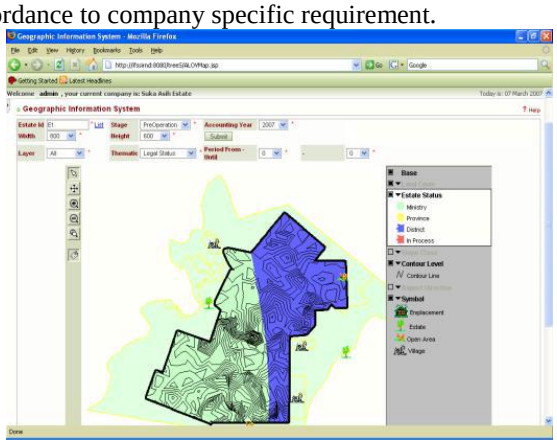

Figure 4. GIS in treeS Applications
(IFS treeS presentation, 2007)

C. Factory Statement

Factory statement helps estate manager to analyze the quality of the crop harvested from respective estate. All kind of crop's derivative, which is user defined parameter, could be forwarded by factory (mill) to estate that sends their crop. The ad-hoc query and reporting facilities return the desired information for all relevant data stored in system.

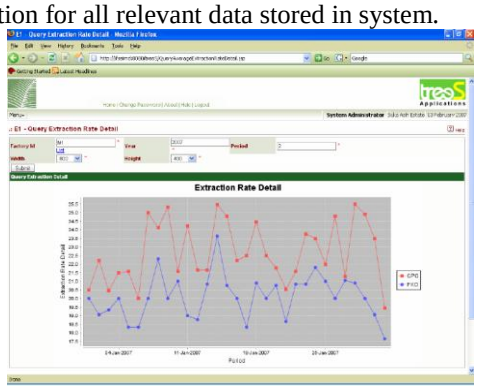

Figure 5. Factory statement in treeS Applications (IFS treeS presentation, 2007)

D. Storage Quality Management

Storage quality management daily records the quality of product based on the parameter that are defined by users. Each product has its own definition of quality parameter and quality classification. System automatically calculate the quality classifications based on product parameter value's/

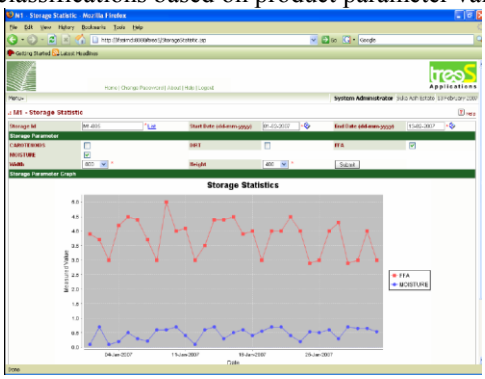

Figure 6. Storage Quality in trees Applications (IFS treeS presentation, 2007)

VIII. CONCLUSION

In recent years the level of interest in integrating GIS with ERP, such as IFS has grown significantly. This was observed since most business data have a geographic or spatial component that can be geo-referenced on a GIS map to visualize, understand and interpret data in ways not possible through a spreadsheet or table. By visualizing relationships, connections and patterns in business data, GIS helps in can making informed decisions and increase efficiency. The advantage technology of ERP in helping to consolidate all business activities, such as adjusting to market changes, sensing and responding to customer requirements and extending processes beyond the organization, could be further enhanced with the integration of GIS applications into business workflows. This makes GIS and ERP systems integral part of a powerful IT strategy.

When ERP and GIS technologies were applied, information was accurate, reliable and repeatable. These technologies were welcomed by plantation management, as GIS technology established a dependable basis on which to make decisions. GIS enables the effective management, analysis and display of information in a clear and structured manner. Use of this technology and its application advantages are not widely known by the plantation industry. Further education and industry exposure is necessary to bring greater awareness of GIS to the palm oil plantation industry .

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