CAFEi2016-247

Environmental Management Information System (EMIS) for oil palm plantation

I.C. Hashim[1,a], A.R.M. Shariff[2], N.H. Ramli and N.H.N. Sidin

[1]Department of Geomatic & Surveying, Faculty of Architacture, Planning & Surveying, UiTM Perak, 32610 Seri Iskandar, Perak, Malaysia; [2]Department Electronic Technology, Faculty of Engineering Technology, Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia.

Abstract

Oil palm represents around 60 percent of the worldwide oil exchange. From 55,000 hectares in the 1960s, Malaysia today has more than 5.08 million hectares of plant territories spread over the provincial range with west Malaysia representing 55% of the aggregate, while Sabah and Sarawak consolidated record for 45%. It is anticipated that the requests for vegetable oils will increse to around 184.3 million tons in 2019/2020 and palm oil in the number one spot. The long-term economic sustainability of any crop production system is dependent on the implementation of its best management practice. However, to enhance these, we should have a good system design and management. System design and management must observe global trends in oil palm management. With well-executed management and the proper mechanism will grow the productivity, the effectiveness of work and financing in oil palm plantation. Hence, this paper presents a concept of management systems which suitable to use in oil palm plantation recognized as Environmental Management Information System (EMIS). The EMIS is designed to manage, store, analyze, manipulate and present all types of data in oil palm plantation.

Keywords: oil palm plantation, system management, Environmental Management Information System (EMIS)

INTRODUCTION

Recently, the productions of palm oil have increased drastically in Southeast Asia, especially in Malaysia and Indonesia (Sheil et al., 2009). The necessity of oil palm production is higher compared to other vegetable oil due to its advantages and applications (Sime Darby Plantation, 2014). Due to that factor, oil palm plantations are required to be managed properly in order to get higher yields (Heryansyah et al., 2014). Main elements in ensuring sustainability of oil palm plantations are water management, fertilizer and nutrient management, integrated pest and disease management, weed management, management of leaning and fallen palms, replanting practice and nursery management (Lim et al., 2012).

The development of oil palm cultivation has been improved by a combination of several new technologies for the management and agronomy (Basri et al., 2005). The cultivation of oil palm requires thorough understanding and knowledge of the management systems in order to increase the productions (Krstić & Petrović, 2012). Additionally, the social features and long term environments are also essential to be considered in oil palm plantations, especially for decreasing emissions of Greenhouse Gases (GHG) (Weng, 2005).

Therefore, this paper presents a concept of a cohesive management system for oil palm plantation known as Environmental Management Information System (EMIS). This system would be able to provide solutions for the oil palm plantation management including planning, monitoring and assessment through observations, reports, environmental measurement and project and human resource data. This system would also allow for a

[a] E-mail: izrahayu@gmail.com

wide range of application as it supports web mapping technologies and geographic information systems (GIS).

Oil Palm Plantation Environment

Proper maintenance of oil palm production demands for appropriate water management, fertilizer and nutrient management, integrated pest and disease management, weed management, management of leaning and fallen palms, replanting practice and nursery management. These elements, even though equally important in oil palm plantation, are also inter-dependant with one another. Placing over emphasis of one element or abandonment of another may lead to several consequences, which would ultimately cause poor yield. Further details on the elements of oil palm plantation can be seen from the following example, which depicts three of the aforementioned elements.

a) Water management

One of the main key to increase oil palm productivity is through effective water management. Study has shown that growth of healthy palms correlates significantly to high yield production. (Lim et al., 2012), and this can be achieved through good management and water availability. Figure 1 illustrates the water management in oil palm plantation whereby the nutrient of the oil palm fruit is affected by the water in the oil palm rooting zone (either too little or too much)(Melling et al., 2008).

Figure 1. The water management in oil palm plantation (University of Minnesota, 2015).

b) Fertilizer and nutrient management

Another element that needs to be managed properly is the fertilizer and nutrient of oil palm. Balanced and adequate fertilization will enhance productivity of oil palm. Moreover, the risk of leachimg will also minimized due to the high porosity thus reducing the cost of production (Goh et at., 2009).

c) Weed management

Weed management needs to be carried out without compromise and delay especially in harvesting paths and palm in order to have good accessibility and crop recovery especially for the loose fruit collection (Lim et al., 2012). Specifications for weed management such as selection of spray equipment and herbicides should not only consider the cost effectiveness and labour productivity but also the effect towards the environment and workers (Beheler & Michler, 2009). Figure 2 shows the worker sprays the weed.

Figure 2. Weed management (AA Resources, 2014).

Environmental Management Information System (EMIS)

Cultivation of oil palm can be considerably tough to manage, and one would require thorough understanding and knowledge of the relevant management systems in order to increase productions. Therefore, an adaptive management system known as Environmental Management Information System (EMIS); consisting of modules regarding the necessary management elements should be applied in order to manage the oil palm plantation in a proper manner.

EMIS consists of formalized steps to capture environmental data, and fixed procedures to regain it (Mugerezi, 2000). An EMIS includes the collection of information about the various environmental issues, continues by supporting strategy formulation and action planning, including maps and last but not least covers the gathering of information necessary for oil palm plantation process. By using EMIS, information is stored in archives, databases and maps. An EMIS can be worked by using a traditional manual system of storing and displaying information such as archive and manual representation of maps (Buhren and Decker, 2008). Nowadays, a computerized EMIS usually uses a Geographic Information System (GIS) as a creature to manage and treat the spatial and non-spatial data (Decker, 2001). Moreover, the system supports the visualization of spatial data structures by utilizing GIS and web mapping technologies (Buhrenand Decker, 2008). An EMIS can be constructed incrementally at various levels of refinement. A highly refined EMIS, however, uses GIS as an innovative spatial management tool. In line with this concept, an EMIS module for oil palm plantation is developed as follows:

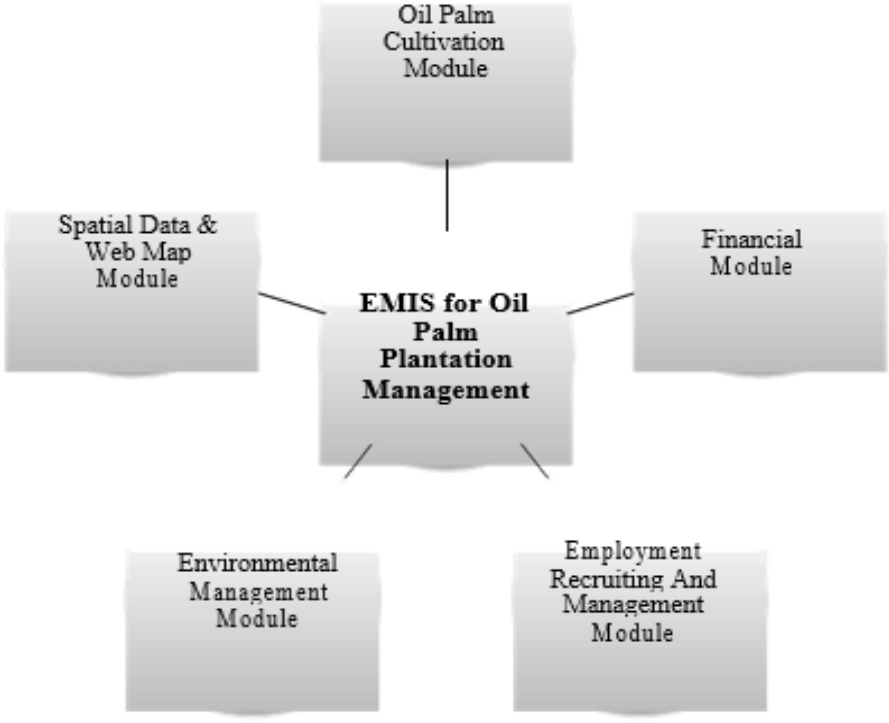

Figure 3. The proposed EMIS modules in oil palm management.

The proposed EMIS comprises of palm oil cultivation, financial, employment recruiting and management, environmental management and spatial data & web map modules as shown in Figure 3. The proposed EMIS is of a highly refined model based on the concepts and methods of oil palm management, whereby it would be able to facilitate project task and monitoring phases of the execution progress, through the embedded information in the relational database of the system in order to preserve and prevent further oil palm degradation.

The oil palm cultivation module is significant to enhance the cultivation of oil palm by providing a practical guidance based on information and field experience (Lim, 2006) including specific considerations for water management, fertilizer and nutrient management, integrated pest and disease management, weed management, management of leaning and fallen palms, replanting practice and nursery management (Lim 2005). The EMIS financial module addresses the details of the oil palm yield profits, expenditure on plantation development and other associated costs. The employment recruiting and management module functions to store human resource data such as employee information, salary and position. The environmental management module consists of conservation, maintenance and rehabilitation, minimization of Green House Gas (GHG) emissions of oil palm plantation (Couwenberg, 2011). The spatial data management and web map module enables display and analyze of information relevant to the oil palm plantation. The latter would also enable in identifying plantation areas and related information such as topography data, administrative boundary (block) and soil type. It also functions to recover, analyze and display plantation and subordinate data, based on time and location (Kehe et al., 2013). With all the aforementioned modules working properly in place, the proposed EMIS, once fully established would be able to provide an efficient way of managing oil palm plantation.

The first step in designing the system is to determine the types of information that is relevant to be stored in the database, and to specify the information that EMIS is functioning to do (Kouziokas, 2016). This stage is of primary significance, so as to determine the modules of the software and its social system. Following the establishment of the first EMIS stage, a certain quantity of information will be gathered and good outputs can be developed to improve oil palm plantation management. Notwithstanding the above, it must be registered that the EMIS can never be considered as final: it has to be continuously updated and kept. A fully dedicated system must incorporate appropriate equipment, personnel and funding to run the framework, and additionally providing clear policy rules for determination of the EMIS and the use of the outcomes it produces. Setting up a fully functional EMIS may take up to several years. However, the system can be constructed incrementally from a low-cost set-up to a sophisticated and complex system without compromising the value of the amount produced (Decker, 2001).

CONCLUSIONS

The following conclusions can be drawn from the study:

- Management of oil palm plantation is a relatively complex process, with each element is of equal importance and simultaneously inter-dependant with one another.
- The knowledge and understanding of these elements is therefore crucial to produce higher yield and maintain it at an optimum level.
- Consequently, there is a need to develop an Environmental Management Information System (EMIS) comprising of the identified basic modules which are palm oil cultivation, financial management, employment recruiting and management, environmental management and spatial data management & web map modules.
- From these modules, the information from the embedded relational database can be better managed and utilized to preserve and prevent further oil palm degradation.
- EMIS also has great flexibility and a wide array of future expansion, as it allows for incremental upgrade depending on the current necessity of oil palm plantation.

Literature cited

Basri Wahid, M., Abdullah, S.N.A., and Henson, I. E. (2004). Oil Palm-Achievements and Potential. International Crop Science Congress. *4*, 288–297.

Beheler, B.D., and Michler, C.H. (2009). Herbicide Practices in Hardwood Plantings, 68–73.

Buhren, K., and Decker, B. (2008). Sustainable Cities Programme (SCP) Building an Environmental Management Information System (EMIS), 235.

Couwenberg, J. (2011). Greenhouse Gas Emissions from Managed Peat Soils: Is The IPCC Guidance Realistic? Mires and Peat. *8(2),* 1–10

Decker, B. (2001). Sustainable Cities Programme (SCP) of the United Nations Centre for Human Settlements (Habita) and the United Nations Environment Program (UNEP). In ICSISD Nairobi, Kenya, 1–12.

Establishment: Weeding Operations in Immature Oil Palms. Digital Image. AA Resources. Applied Agricultural Resources Sdn. Bhd. Retrieved May 3, 2016 from http://www.aarsb.com.my/establishment-weeding-operations-in-immature-oil-palms

Goh, K.J., Ng, P.H.C., and Lee, C.T. (2009). Fertilizer Management and Productivity of Oil Palm in Malaysia. AAR Newsletter, 2–24.

Heryansyah, A., Idayu, I., and Supriyanto, E. (2014). Oil Palm Plantations Management Effects on Productivity Fresh Fruit Bunch (FFB). APCBEE Procedia. *8*, 282–286.

Kehe, W., Jiabo, C., Wei, C., and Chi, Z. (2013). Design and Implementation of Open Source Webgis Client Framework Based On Flex. In: 2013 Fifth International Conference on Computational and Information Sciences (ICCIS). IEEE, 1405–1408.

Kouziokas, G.N. (2016). Technology-based management of Environmental Organizations using an Environmental Management Information System (EMIS): Design and development. Environ. Technol. Inno. *5*, 106–116.

Krstić, B., and Petrović, B. (2012). The Role of Knowledge Management in Developing Capabilities for Increasing Enterprise. Facta Universitatis, Series: Economics and Organization, *8(1991)*, 275–286.

Lim, K.H. (2005). Soil, Water and Fertilizer Management for Oil Palm Cultivation On Peat Soils. In: Proc. PIPOC 2005 International Palm Oil Congress, Biotechnology and Sustainability Conf. 26-28 Sept. 2005. Malaysian Palm Oil Board, Kuala Lumpur: 433-455.

Lim, K.H. (2006) Challenges and Key Agro-Management Practices for Sustainable Cultivation of Oil Palm On Deep Peat. Proc. International Planters Conference, Organised by ISP, 26-28 June 2006, KL, 183-207.

Lim, K., Lim, S., Parish, F., and Suharto, R. (2012). RSPO Manual On Best Management Practices (BMPs) For Mananagement and Rehabilitation of Natural Vegetation Associated with Oil Palm Cultivation Peat.

Melling, L., Chua, K.H., and Lim, K.H. (2008). Managing Peat Soils Under Oil Palm.

MPOB. (2014). Economics & Industry Development Division -Malaysian Palm Oil Board.

Mugerezi, E. (2000). An Environmental Management Information System (EMIS) for Iringa Municipality, Tanzania Implementation Challenges. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. XXXIV, 78–86.

Sheil, D., Casson, a, Meijaard, E., Van Noordwijk, M., Gaskell, J., Sunderland-Groves, J., Kanninen, M. (2009). The impacts and opportunities of oil palm in Southeast Asia. Africa.

Sime Darby Plantation. (2014). Palm oil Facts & Figures. April 2014 (Vol. 2012). Retrieved from ttp://www.simedarby.com/upload/Palm_Oil_Facts_and_Figures.pdf

Tropical Peatland Carbon Losses from Oil Palm Plantations May Be Underestimated. Digital Image. University of Minnesota Driven to Discover. Regents of the University of Minnesota. Retrieved May 3, 2016 from http://discover.umn.edu/news/environment/tropical-peatland-carbon-losses-oil-palm-plantations-may-be-underestimated

Weng, C.K. (2005). Best-Developed Practices and Sustainable Development of the Oil Palm Industry. J. Oil Palm Res. *17*, 124–135.

World Bank. (2010). World development report 2010. Development and climate change. Washington DC.