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# Toward Malaysian sustainable agriculture in 21<sup>st</sup> century

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**Abstract.** Sustainable agriculture should be able to meet various social goals and objectives so that it can be maintained for an indefinite period without significant negative impacts on environment and natural resources. A wide variety of agricultural activities are running in Malaysia. Maintaining high quality of agricultural products with lower environmental impacts through a sustainable economic viability and life satisfaction of farmers and community are important factors helping to meet sustainable agriculture. Human resources are playing key role in directing the community toward sustainable development. The trend of improving the human development index in Malaysia is highest in the East Asia and the Pacific, high human development countries and the world, since 2000. Precision agriculture is providing strong tools to achieve sustainable agriculture. Different types of sensors, positioning and navigation systems, GIS, software and variable rate technology are well known components of precision agriculture. Drones and robots are promising tools that enabling farmers and managers to collect information or perform particular actions in remote areas or tough conditions. According to a survey, forestry and timber, rubber production and oil palm estates are three main agricultural divisions that precision agriculture may improve the productivity in respect to area of cropland/worker. Main factors affecting the adoption of precision agriculture in Malaysia are: a) Political and legal supports, b) Decision support systems and user interfaces c) Experienced research team works d) National educational policy e) Success in commercialization of precision agriculture system.

## 1. Introduction

According to the US government [1], "the term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that over the long term will:

- Satisfy human food and fiber needs.
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends.
- Make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls.
- Sustain the economic viability of farm operations.
- Enhance the quality of life for farmers and society as a whole."

The term of precision agriculture is mentioning on techniques and technologies to meet sustainable agriculture. Dr Pierre Robert (1941-2003) formed the precision agriculture centre at the University of Minnesota in 1995 [2] and recognised as the father of precision agriculture [3]. The term of "Site-

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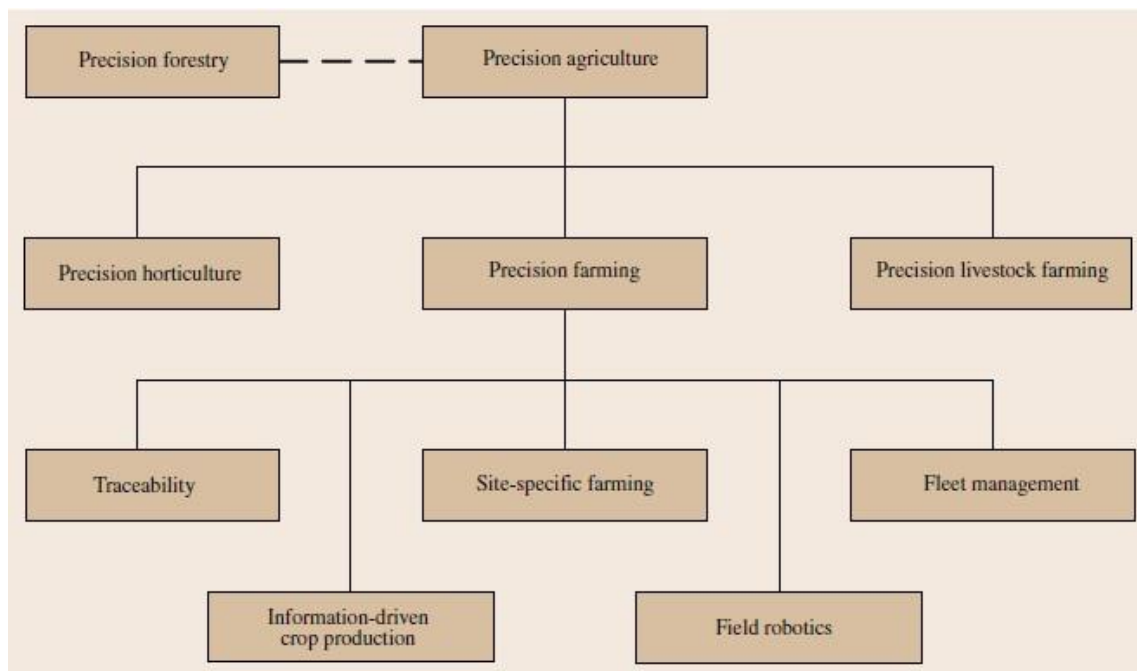


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Specific Management” which then changed to “Precision Farming” and “Precision Agriculture”, introduced at the early of 1990’s and definitions of precision agriculture evolving since then. precision agriculture is a management strategy using site-specific information to manage the farm, precisely. The mission of precision agriculture is to recognise soil and crop characteristics in small areas of the field to manage the production inputs within those areas. The philosophy behind precision agriculture is to apply production inputs (seed, fertiliser, chemicals, etc.) economic production [4]. According to Dobermann et.al [5], precision farming is a systems approach for managing soils and crops to reduce decision doubts through better understanding and managing variability. The term of precision agriculture is still devising as technology changes and our understanding of what is achievable grows [6].

The global population increasing drastically and scientists called for new researches to fix the side effects of increasing human population. Sustaining the environment is another objective of the precision agriculture, added to its mission. Knight and Malcolm [7] defined the precision agriculture, using technology for checking and controlling the production by enabling better data collection to improve long-term and whole-farm productivity, parallel to lessening environmental impacts .

Another exciting new term that is a subdivision of precision agriculture is precision livestock farming (PLF). PLF applies principles of control engineering for optimised real-time surveying and management of animals' variables, for control purposes [8]. Precision farming is a very small subset of precision agriculture [9] and Figure 1 is giving a concise classification of precision technologies are using in precision agriculture [10].



**Figure 1.** Classification of precision technologies in precision agriculture.

Precision agriculture is a pathway to sustainable agriculture and Malaysia faces with some challenges toward sustainable agriculture.

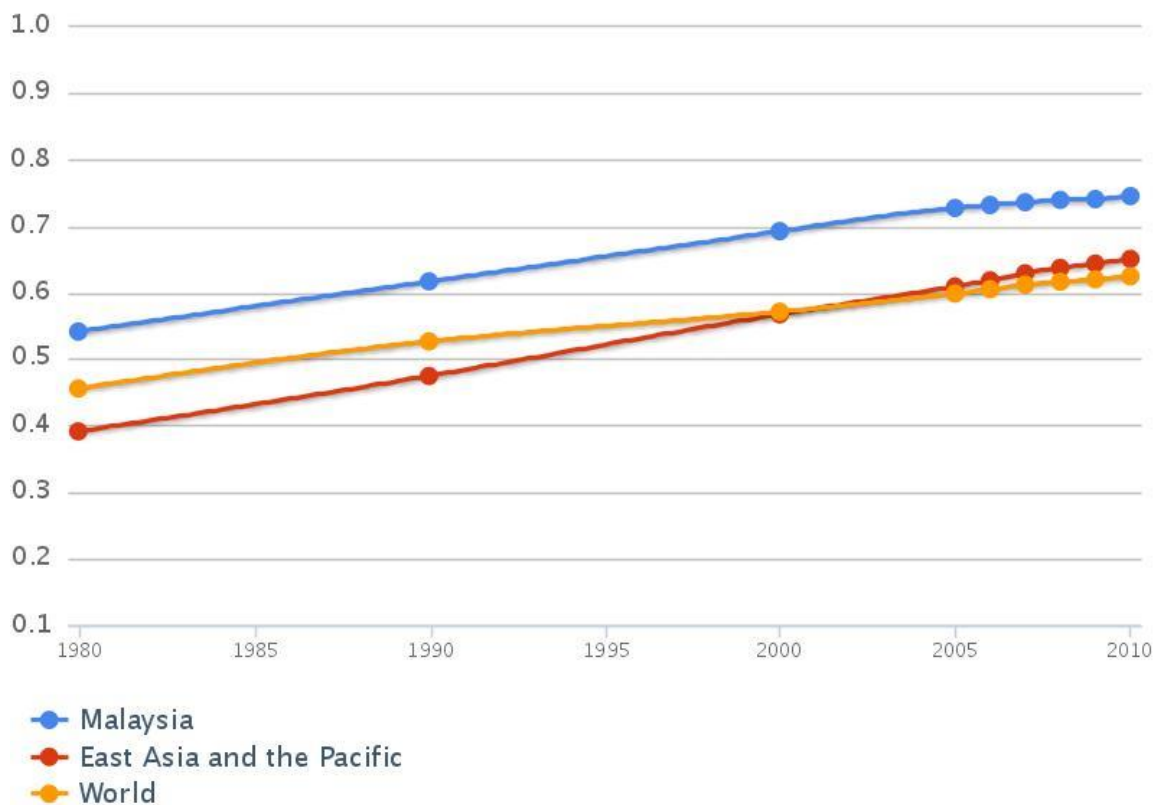
## 2. Key effective factors on adoption of precision agriculture in Malaysia

### 2.1. Political support

Malaysian agricultural sector received strong government support during last three decades. The government of Malaysia, set up strategic directions to use information and communication technologies in third National Agricultural Policy (NAP3) [11]. According to NAP3, training activities focused on new methods and technologies like PA and providing basic infrastructures (i.e. GIS and remote sensing) in national scale.

### 2.2. Human development index

New sophisticated technologies need educated people to use them. The Human Development Index (HDI) is a summary measure of three dimensions of human development - living a long and healthy life (Health), being educated (Education) and having a decent standard of living (Income) [12]. Since 1980 through 2010 Malaysia's HDI rose by 1.1% yearly from 0.541 to 0.744 today, which classify Malaysia as the 57th member out of 169 of the high human development countries with comparable data [13](Figure 2). Higher HDI, higher adoption rate and success of using new technologies, like those involving in precision agriculture systems. More educated, healthy and wealthy people are mostly choosing better jobs rather than risky, dangerous and tough agricultural jobs.



**Figure 2.** HDI trend in Malaysia, East Asia and the Pacific and the World.

2.3. *Suitable crops for doing PA in Malaysia*

In Malaysia, the deficiency of labour in the market, going to be a big problem in agriculture sector, as the HDI increases year to year. In developing and developed countries, labour deficiency with moderate salaries is a challenge and the area of agricultural land that each person should manage will increase, consequently. As a general scientific rule and practical experiences, the soil and environmental variability, increases in bigger areas. The agricultural areas that manage by each person are a good and simple spatial index, to assess the profitability of precision agriculture. The larger the area, the greater the spatial potential for precision agriculture [6].

While, Canada, Australia and the US, with 154.2, 142.5 and 77.1 hectare of cropland worker<sup>-1</sup>, have the highest spatial index respectively [6], according to the given data [14], rubber trees, forestry and oil palm plantations have higher potentials for adoption of precision agriculture in Malaysia (Figure 3). The results of this research would help to use precision agriculture in to the oil palm plantation management. Oil palm precision agriculture, would improve the productivity, profitability and job satisfaction plus reducing the risk of facing this industry with the crisis of labour deficiency at the early future.

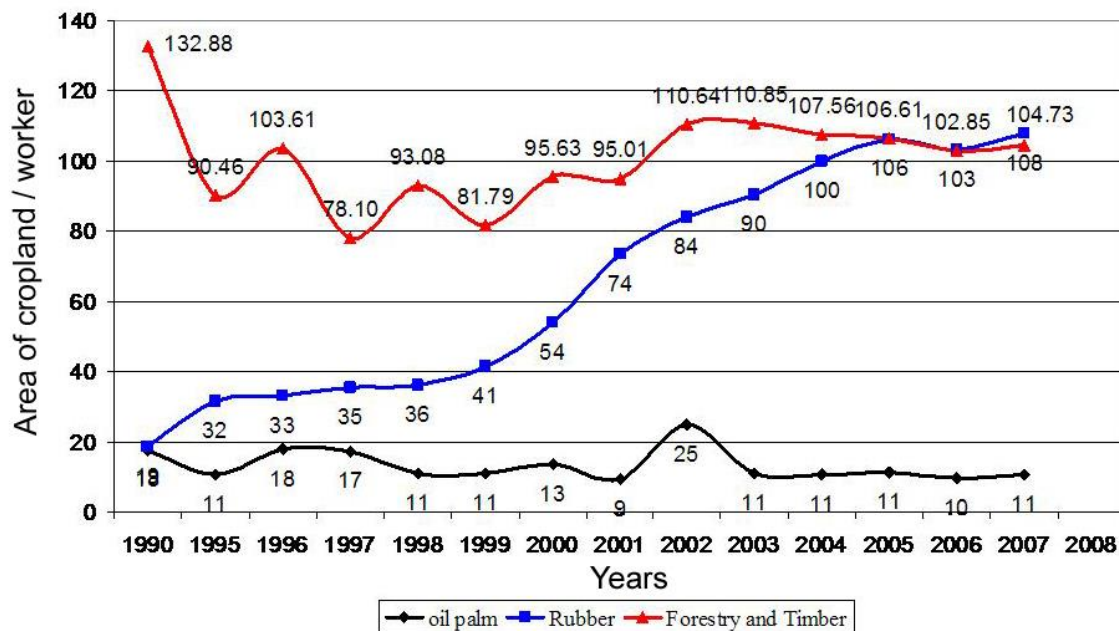


Figure 3. Areas assigned to each worker/year for particular crops in Malaysia (ha).

Precision farming techniques and technologies introduces many facilities, enable farm managers to collect, store, restore and analyze field data faster, more accurate and reliable than conventional methods.

2.4. *Decision support systems*

There are not many formal Decision Support Systems (DSS) for agricultural practices to fulfil precision agriculture concepts, internationally and thus for Malaysian specialty crops.

The lack of suitable DSSs is one of the main barriers for adoption of commercial precision agriculture [6] and developing DSS for oil palm, rubber plantation management and forestry and timber management is one of the main research areas in Malaysia.

### 3. Conclusion

Components of a precision agriculture system are positioning and navigation system, geographic information system, yield monitoring and mapping, soil sampling, sensing and digital mapping, management zones, variable rate technologies and sensing technologies. All these components different types of information and communication technologies (ICT) to collect, process, save, interpret and visualize data and information as decision making tools. Variable rate technologies are main tools to manage applying fertilizers and pesticides in right place and right amount.

Adoption of precision agriculture needs political support and human development programs to prepare the nation for utilizing essential sophisticated technologies in precision agriculture.

Currently, precision agriculture can not pay for all crops. Only those crops that use lower human resources per unit area are suitable. For Malaysia, forestry and timber, rubber trees and oil palm trees are main speciality crops suitable for a commercial precision agriculture.

Decision support systems are critical tools for managers to complete the circle of precision agriculture. Researches on developing decision support systems or localizing available decision support tools, playing basic role on adoption of precision agriculture in Malaysia.

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