AGRICULTURE LAND MANAGEMENT:

ROLE OF REMOTE SENSING

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Toward sustainable agriculture

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.

Jumaat, 1 November 2019 - 7:37AM

BH ONLINE

Ladang sayur, buah akan kurangkan import negara dalam 2 tahun

Oleh Ahmad Suhael Adnan
ahmad.suhael@bh.com.my

KUALA LUMPUR: Pelaburan swasta dan syarikat berkaitan kerajaan (GLC) dalam penanaman sayur-sayuran secara besar-besaran, dijangka dapat mengurangkan dengan ketara import makanan negara dalam tempoh dua hingga tiga tahun.

Pakar ekonomi pertanian dan sumber, Prof Datuk Dr Mad Nasir Shamsudin, berkata pelaburan dalam sektor sayur-sayuran akan memberi pulangan paling pantas untuk mengurangkan bil import makanan yang mencecah RM60 bilion ketika ini.

Ketika ini, kadar sara diri bagi sayur-sayuran hanya 60 peratus, baki 40 peratus diimport. Dengan pelaburan serius serta penggunaan teknologi, kita mampu capai 100 peratus, bererti tidak perlu lagi mengimport sayuran daripada luar.

Beliau mengulas kenyataan Perdana Menteri, Tun Dr Mahathir semalam, yang menggalakkan syarikat swasta dan syarikat milik kerajaan seperti Khazanah Nasional Bhd membuat pelaburan dalam penanaman buah-buahan dan sayur-sayuran secara besar-besaran bagi mengurangkan bil import makanan yang mencecah RM60 bilion.

"Pelaburan dalam sektor ini akan berjaya jika mendapat sokongan kuat daripada kerajaan menerusi insentif tertentu dan penggunaan teknologi terkini.

"Ia juga perlukan aspek keusahawanan, iaitu tanaman diusahakan petani lulusan universiti dalam bidang berkaitan pertanian yang boleh menggunakan sistem teknologi pertanian seperti persekitaran terkawal, sensor, dron dan sebagainya," katanya.

The Malaysian Reserve

JOIN THE REAL CONVERSATION

Thursday, October 31st, 2019

PM: Malaysia could reap additional RM60b from modern agricultural production

Local farmers could also be taken out of poverty with the current modern procedures available for agricultural use

By SHAHEERA AZNAM SHAH / Pic By BERNAMA

THE agricultural industry is likely to reap a significant return of RM60 billion if Malaysia implements a new approach to increase agricultural production in order to reduce dependence on imported products.

Prime Minister (PM) Tun Dr [illegible] Mohamad said local farmers could also be taken out of poverty with the current modern procedures

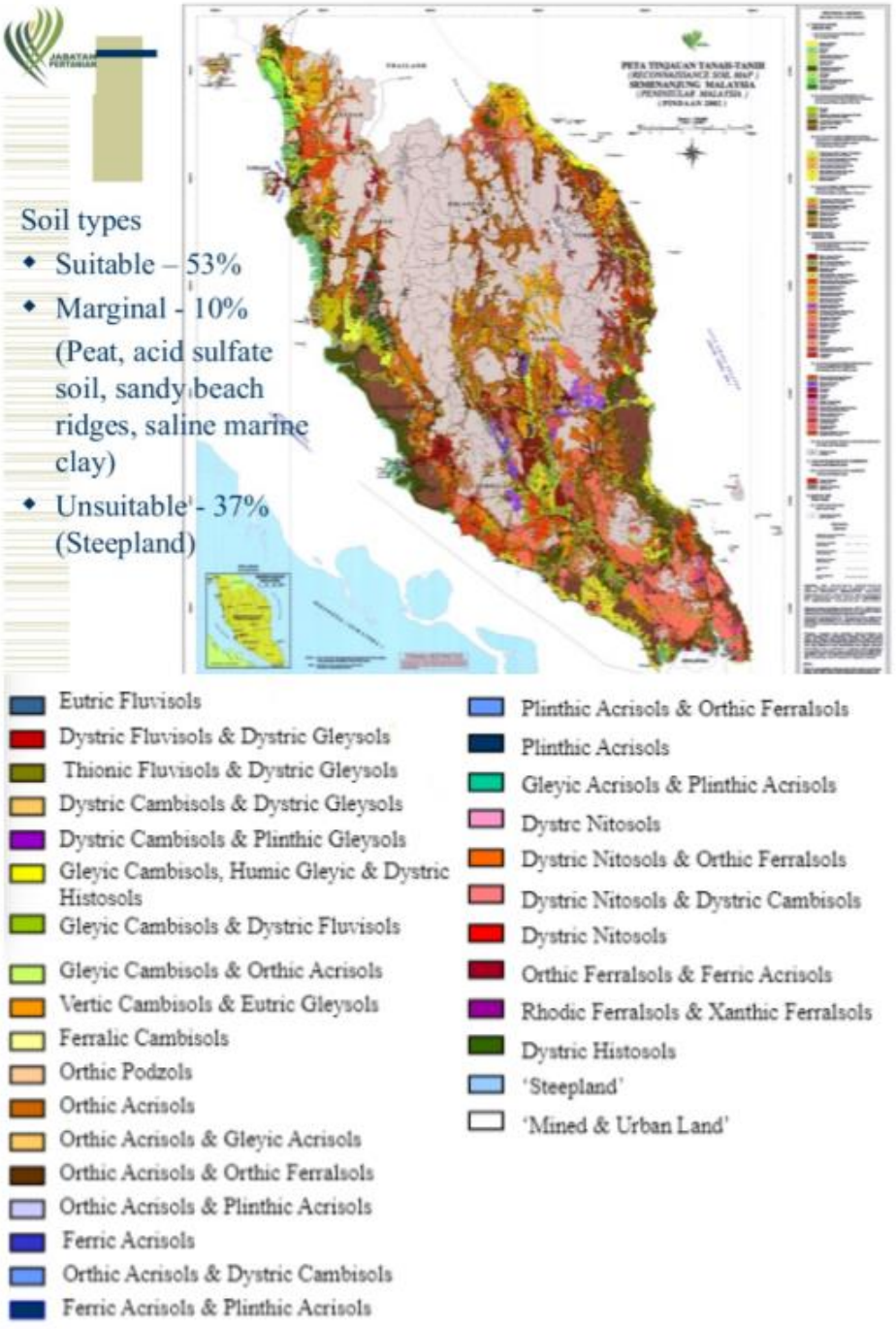
"At present, we are importi

produce a sizeable amoun

Dron PadiU Putra by Universiti Putra Malaysia. The drone technology is able to capture images of 140ha-950ha of the paddy field in an hour.

Malaysian Soil Taxonomy

Category	No. of Taxo	Differentiating characteristics
Order	11	Soil-forming process as indicated by the presence or absence of major diagnostic horizons
Sub-Order	28	Genetic homogeneity – according to presence or absence of properties associated with wetness; major parent materials; nature and origin of organic materials
Great Group	87	According to profile morphology with emphasis on upper sequum; degree of weathering; presence or absence of diagnostic layers, e.g. plinthite
Sub-Group	279	Central concept for great group
Soil Family	325	Properties important for plant growth - particle size classes; mineralogical classes; temperature; and color
Soil Series	527	Kind and arrangement of horizons, color, texture, structure, consistence, and major differences in chemical and mineralogical properties of the horizons.



IS FOOD SECURITY IMPORTANT TO MALAYSIA?

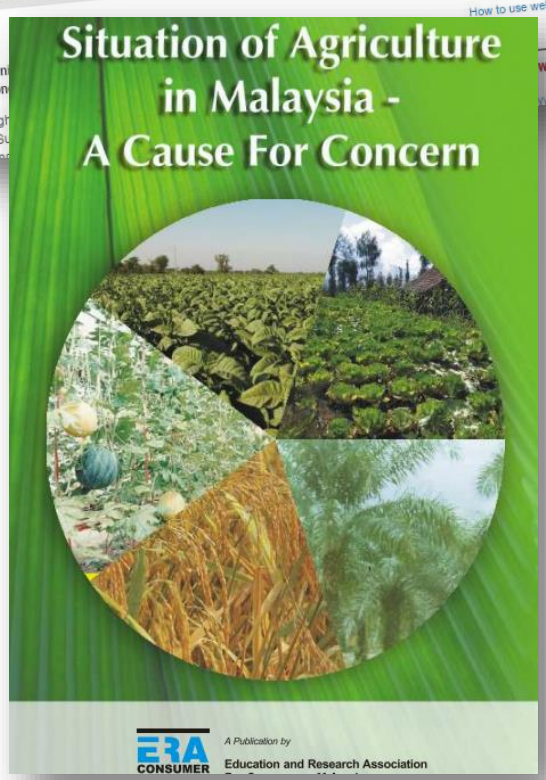
The importance of food security in Malaysia can be viewed from both the perspectives of supply and demand. When looking at supply, we have the agriculture sector, which can be further categorised into industrial crops and food.

In general, industrial crops – such as palm oil – have developed into a competitive and efficient subsector that contributes significantly to national development and the export industry. However, the food subsector that consists of food crops, livestock and fisheries has not been able to perform as well.

Malaysia is self-sufficient in some of its food commodities such as poultry meat, eggs, pork and fisheries. However, the self sufficient is not comes to rice, fruits, vegetables, beef, mutton and dairy milk. Thus, with the exception of poultry, eggs, pork and fisheries, Malaysia depends on imports for most of its food items, as well as machinery, which is an indication of lack of comparative advantage in this sector.

The food trade deficit has grown steadily, from RM1.1bil in 1990 to RM12bil in 2011. Like any other developing country, Malaysia has enjoyed the benefits of cheaper food imports. This dependence, however, has come at a price. The country was not forced to learn how to improve productivity and efficiency, and during the food crisis in 2008, Malaysia fumbled in securing adequate food, particularly rice.

With rapid economic growth, the percapita income of the population has improved. This has caused, not only an increase in consumption of food, but also a change in consumption patterns, in terms of attributes and high-valued foods such as beef, dairy and vegetables.



FOOD SECURITY ISSUES IN MALAYSIA

Due to bitter experience Malaysian government has realized and identified agricultural sector as one of economic growth development. Agricultural R&D agencies for public sectors are expected to play an important role in achieving this sector .

In the Malaysian context, food security includes 3 key pillars, namely:

- Food availability in terms of consistency of food supply and adequacy,
- Accessibility of adequate and nutritious food
- Nutrient food that is capable of providing sufficient nutrition

Key challenge for food security in the country is to achieve self-sufficiency level in most of the food requirements as well as to reduce dependency on food importation. So, further research is urgently needed to set more effective policies and strategies for achieving the self- sufficiency in producing food commodities in the country.

National Food Security: Oil Palm.

The Federal Land Development Authority (FELDA), set up just over 50 years ago, was tasked with carrying out land development and resettling the landless in the country, and now has developed 853,313 ha of land and resettled 112,635 families

Based on an estimated 5-person per household, the total number of people in Malaysia dependent on the oil palm industry could well be around 2.26 million.

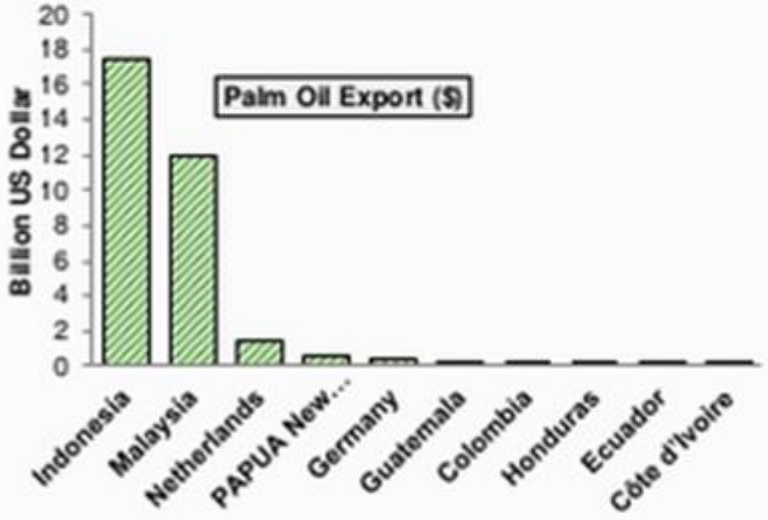
Palm oil industry plays an important role in enhancing food security and has long been an acceptable and affordable food source to the nation. Ensuring adequate supply of edible oils for the nation market at affordable prices is very important to low income peoples.

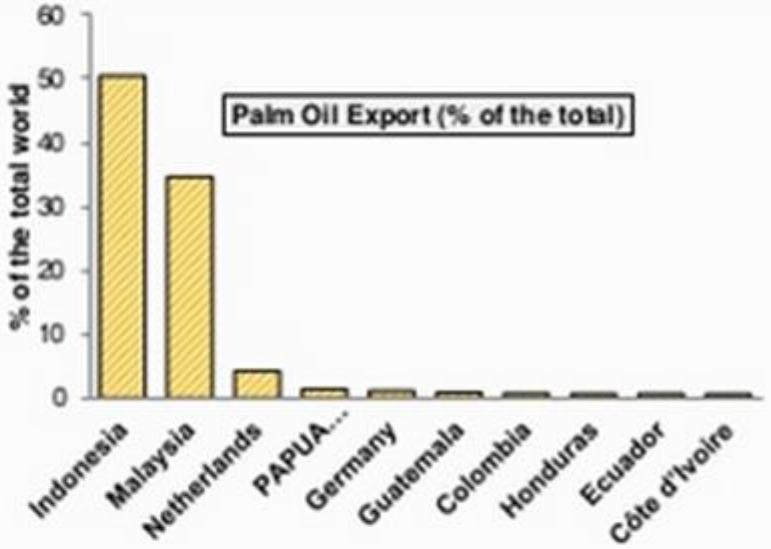
Table 1: Palm oil as a source of higher income and poverty eradication

Year	Felda Settler[1]	Independent Smallholder[2]	National Poverty Line (PGK)[3]
2006	RM 1,338 (US$ 429)	RM 476 (US$ 153)	RM 526 (US$ 169)
2007	RM 2,221 (US$ 712)	RM 1,209 (US$ 388)	RM 740 (US$ 237)
2008	RM 3,278 (US$ 1,051)	RM 1,094 (US$ 351)	RM 691 (US$ 221)
2009	RM 2,457 (US$ 788)	RM 944 (US$ 303)	RM 666 (US$ 213)
2010	RM 3,000 (US$ 962)	RM1,259 (US$ 404)	RM 720 (US$ 231)

Source:
1 Maklumat Asas Felda 2009 (published)
2 MPOB Data
3 Economic Planning Unit (EPU), Tenth Malaysia Plan and Mid-Term Review of the Ninth Malaysia Plan
Note: *PGK for Peninsular Malaysia

Oil Palm contribute to 12 billion USD of Malaysian economy





Potential for monitoring oil-palm plantations in such a great detail has been never possible

National Food Security: Rice

Malaysia has more than 100,000 farmers depending on rice production for their livelihoods and many more working in rice-related industry.

To ensure the stability of the food security, the government interprets the achievement in the form of self-sufficiency level (SSL) of rice production.

NAP-3 will help governments to mitigate risks to food security and protect farmers from the financial losses that they endure as a consequence of natural catastrophes and economic crisis

Table 2: Self-sufficient level of rice in Malaysia.

Master Plan/NAP	Period	Self sufficiency level (SSL) target	SSL achieved (%)
First Malaya plan	1956-1960	-	54.0
Second Malaya plan	19611965	-	60.0
First Malaysia plan	1966-1970	-	80.0
Second Malaysia plan	1971-1975	-	87.0
Third Malaysia plan	1976-1980	90	92.0
National agricultural plan I	1984-1991	65	75.9
Fourth Malaysia Plan	1981-1985	65	76.5
Fifth Malaysia plan	1986-1990	65	75.0
Sixth Malaysia plan	1991-1995	65	76.3
National agricultural plan II	1992-2010	65	65.0
Seventh Malaysia plan	1996-2000	65	71.0
National agricultural plan III	1998-2010	65	71.0
Eighth Malaysia plan	2001-2005	65	71.0
Ninth Malaysia plan	2006-2010	65	72.0
National food security policy	2008	80 by 2010	72.0
New economic model	2010	85 by 2020	-
National agro-food policy	2011-2020	70 by 2012	-

Malaysia's land area for rice remained fairly constant at no more than 0.7 million hectares since the1980s.

Even though the land area for rice has remained rather constant, Malaysia's rice productivity increases every year from 2.1 ton/ha in 1961 to 3.6 ton/ha in 2008.

Thus, Malaysia's total rice production would also increase each year. Since 1985, Malaysia sees an average increase in total rice production of about 28,000 tonnes per year.

Although Malaysia's rice production and productivity increase each year, Malaysia's rice yield per capita (per person) declines each year. From a high of 174.6 kg of rice per capita in 1974, rice yield per capita has since fallen steadily, falling to 86.0 kg of rice per capita in 2008.

How much rice must Malaysia produce to be 100% self-sufficient? (photo from icargoa.res.in)

Will Malaysia achieve 100% self-sufficiency in rice by 2015?

by CHRISTOPHER TEH BOON SUNG

Update (22 Jun 2011):
Online news portal, Free Malaysia Today, used the information from this blog entry in their article "Tambatuon dam is unnecessary" (published Jun 14, 2011). Journalist, Stephanie Sta Maria, also conducted an interview with me regarding my views on rice production in Malaysia.

due to the frequent water shortages (*i.e.*, droughts) in Australia. Japan also sees a large annual variation in its rice productivity but this variation is much less than that for Australia. China's rice productivity, however, is a rapid and steady increase throughout the years, from a low 2.1 ton/ha in 1961 to 6.6 ton/ha in 2008.

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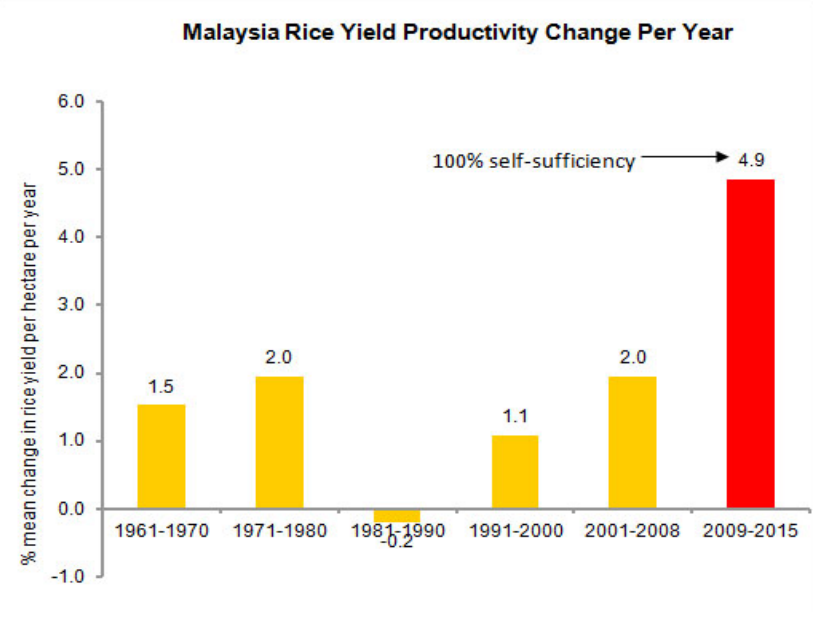


SOME OTHER KEY EFFECTIVE FACTORS TO SUPPORT PA FOR FOOD SECURITY:

(a) Political will:

(b) Human development index (HDI):

(c) Suitable crops for doing PA in Malaysia

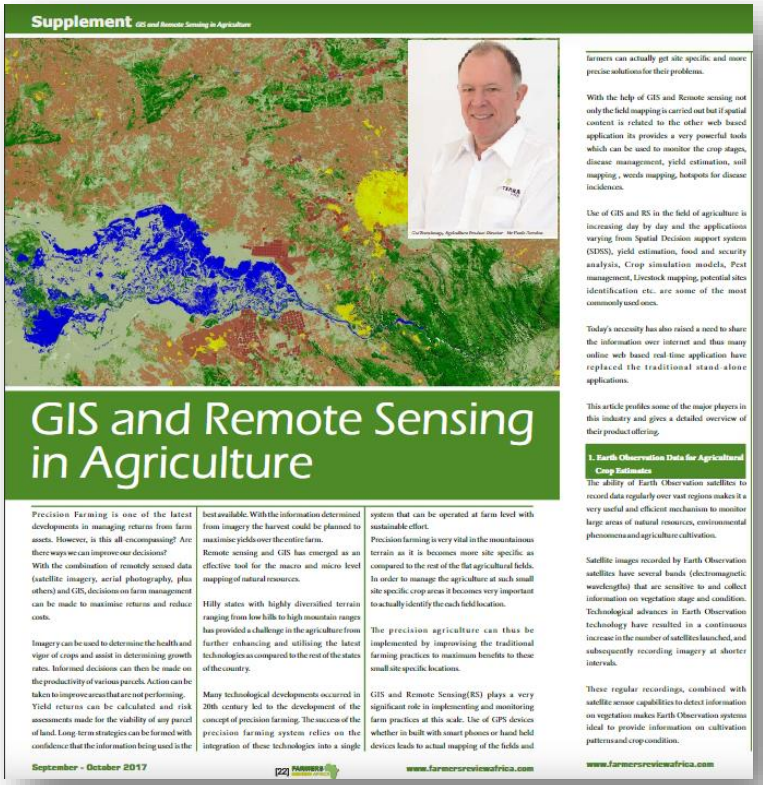
(d) Decision support systems (DSS):

Fig.4: HDI trend in Malaysia, East Asia and the Pacific and the World (*Source: http://www.undp.org/, 2014*)

How can remotely-sensed data be used in agriculture?

RS techniques play an important role in;

- ✓ assessing crop condition and yield forecasting
- ✓ acreage estimates of specific crops
- ✓ detection of crop pests and diseases
- ✓ disaster location and mapping
- ✓ wild life management in agricultural land
- ✓ water supply information and management
- ✓ weather forecasting
- ✓ rangeland management
- ✓ livestock surveys.



Supplement GIS and Remote Sensing in Agriculture

GIS and Remote Sensing in Agriculture

Precision Farming is one of the latest developments in managing returns from farm assets. However, is this all-encompassing? Are there ways we can improve our decisions? With the combination of remotely sensed data (satellite imagery, aerial photography, plus others) and GIS, decisions on farm management can be made to maximise returns and reduce costs.

Imagery can be used to determine the health and vigor of crops and assist in determining growth rates. Informed decisions can then be made on the productivity of various parcels. Action can be taken to improve areas that are not performing. Yield returns can be calculated and risk assessments made for the viability of any parcel of land. Long term strategies can be formed with confidence that the information being used is the best available. With the information determined from imagery the harvest could be planned to maximise yields over the entire farm.

Remote sensing and GIS has emerged as an effective tool for the macro and micro level mapping of natural resources.

Hilly states with highly diversified terrain ranging from low hills to high mountain ranges has provided a challenge in the agriculture from further enhancing and utilising the latest technologies as compared to the rest of the states of the country.

Many technological developments occurred in 20th century led to the development of the concept of precision farming. The success of the precision farming system relies on the integration of these technologies into a single system that can be operated at farm level with sustainable effort.

Precision farming is very vital in the mountainous terrain as it is becomes more site specific as compared to the rest of the flat agricultural fields. In order to manage the agriculture at such small site specific crop areas it becomes very important to actually identify the each field location.

The precision agriculture can thus be implemented by improvising the traditional farming practices to maximum benefits to these small site specific locations.

GIS and Remote Sensing(RS) plays a very significant role in implementing and monitoring farm practices at this scale. Use of GPS devices whether in built with smart phones or hand held devices leads to actual mapping of the fields and farmers can actually get site specific and more precise solutions for their problems.

With the help of GIS and Remote sensing not only the field mapping is carried out but if spatial content is related to the other web based application its provides a very powerful tools which can be used to monitor the crop stages, disease management, yield estimation, soil mapping , weeds mapping, hotspots for disease incidences.

Use of GIS and RS in the field of agriculture is increasing day by day and the applications varying from Spatial Decision support system (SDSS), yield estimation, food and security analysis, Crop simulation models, Pest management, Livestock mapping, potential sites identification etc. are some of the most commonly used ones.

Today's necessity has also raised a need to share the information over internet and thus many online web based real-time application have replaced the traditional stand-alone applications.

This article profiles some of the major players in this industry and gives a detailed overview of their product offering.

1. Earth Observation Data for Agricultural Crop Estimates

The ability of Earth Observation satellites to record data regularly over vast regions makes it a very useful and efficient mechanism to monitor large areas of natural resources, environmental phenomenon and agriculture cultivation.

Satellite images recorded by Earth Observation satellites have several bands (electromagnetic wavelengths) that are sensitive to and collect information on vegetation stage and condition. Technological advances in Earth Observation technology have resulted in a continuous increase in the number of satellites launched, and subsequently recording imagery at shorter intervals.

These regular recordings, combined with satellite sensor capabilities to detect information on vegetation makes Earth Observation systems ideal to provide information on cultivation patterns and crop condition.

September - October 2017

www.farmersreviewafrica.com

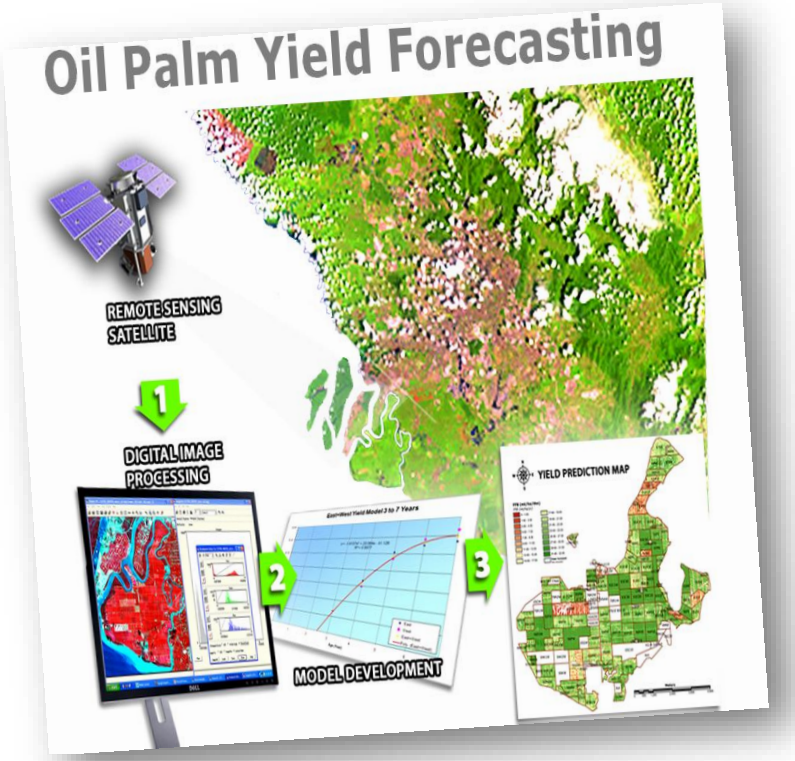
ROLE OF REMOTE SENSING. *How can remote sensing help?*

Malaysia is still insufficient in many major food items especially in the term of agriculture.

Malaysia must produce 30-40 percent more food, with limited land and water, using less energy, fertilizer and pesticide by 2030

Application of remote sensing and related technology in food security and productivity is focusing mainly for rice and oil palm production.

The main focus is to observe and map crop growth and crop losses, where remote sensing data can also be calibrated to make yield predictions. This can eventually help governments to make informed policy decisions to improve the equitable supply of rice and palm oil, thereby reducing poverty through improved and diversified systems.



ROLE OF REMOTE SENSING. *How can remote sensing help?*

Food security through RS technology is carried out under precision agriculture (PA) technique. PA is an improved farming system where technologies such as GIS, GPS and RS are used to improve agricultural land practices.

The biggest pilot projects for Precision Farming study was undertaken by Malaysian Remote Sensing Agency (MRSA) together with agriculture-related agencies and Universiti Putra Malaysia (UPM). The project named Malaysian National Paddy Precision Farming Project was started in 2001 and ended in 2007.

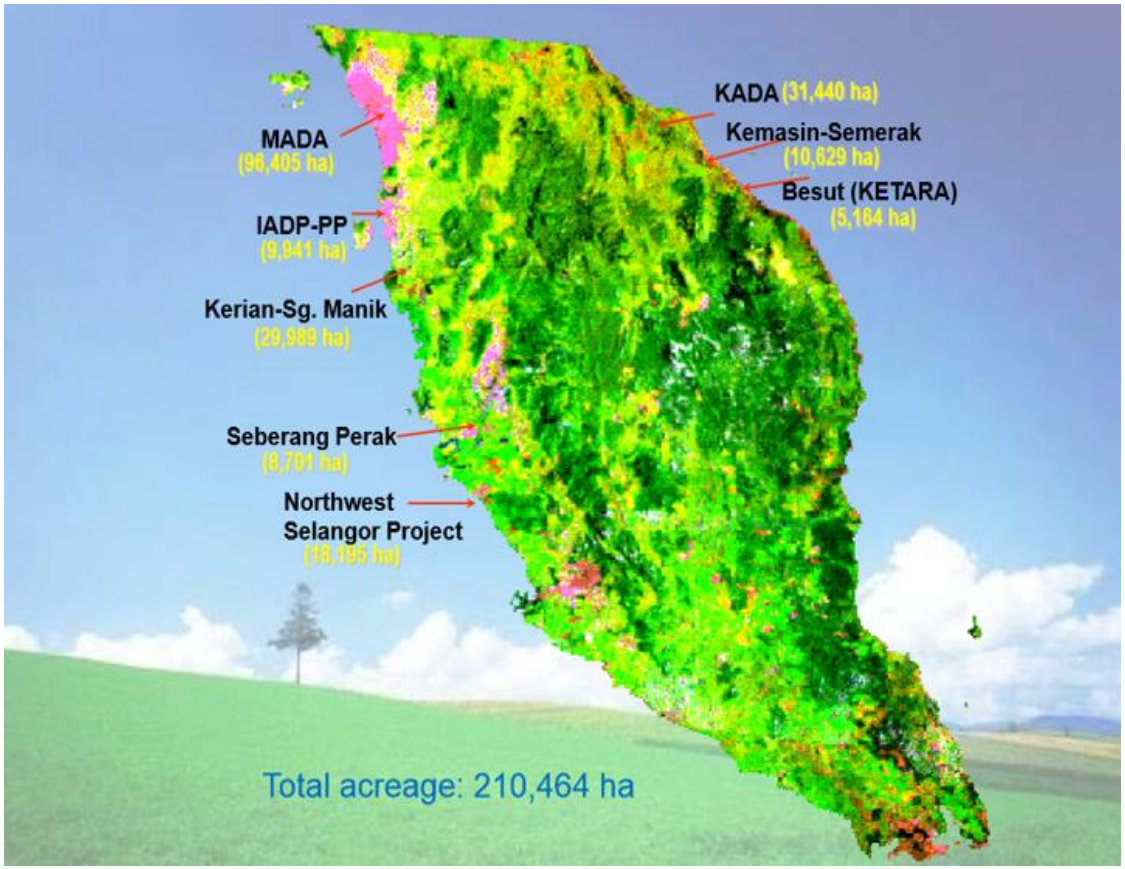
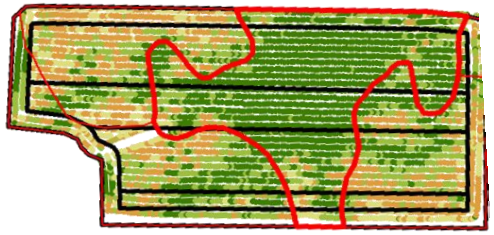


Fig. 3: Eight major granary areas in P. Malaysia

Six important criteria about the quality of geospatial information



Accuracy: *Accurate information describes properties or the state of relevant objects according to the reality. If the entity can be described with measurable variables the degree of accuracy can be described easily.*

Reliability: *The user of information should be convinced that any information available is correct in the widest sense. Even if a high accuracy is given for any variable it might be less reliable because of the measurement procedure used.*

Relevancy and process orientation: *Information of high quality should meet objectively given information needs. Although this criterion seems to be quite understandable, it is one of the more difficult ones. In particular in forest management decision making is often based on individual approaches of information use.*

Timeliness: *Information that is not available in time is useless and therefore of very low quality.*

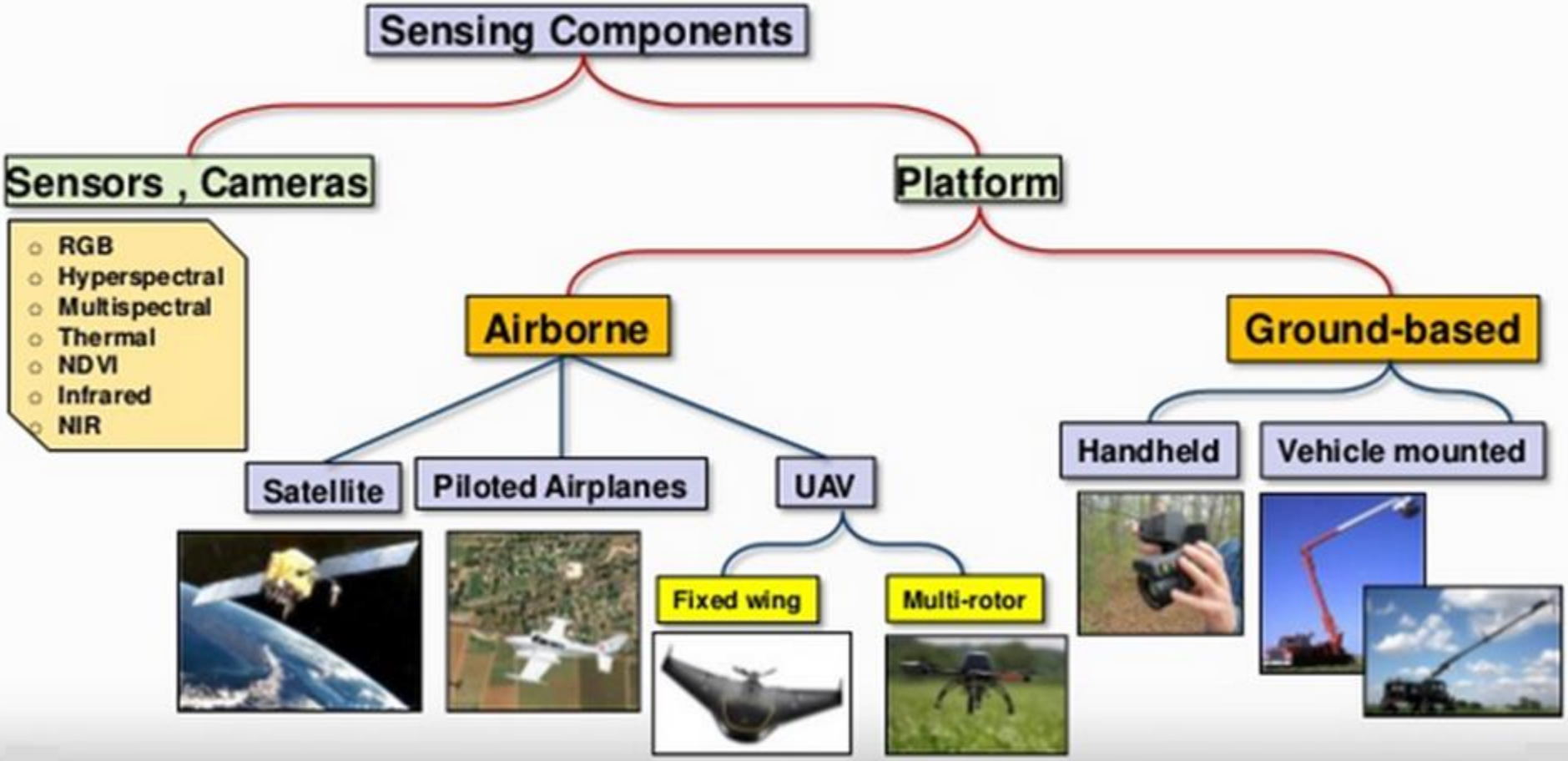
Completeness: *Incomplete information which misses several and crucial parts may be misleading. Normally decisions are based on complex sets of information which add up to a comprehensive picture of the situation to be considered.*

Presentation: *This criterion deals with the fact that information needs to be presented in a suitable manner. As information needs to be interpreted in order to prepare decisions appropriate presentation is an important quality issue. Although the criteria mentioned above are not listed according to a hierarchy, they will be of different importance in different enterprises.*

Sensing for Precision Ag

Precision Agriculture is about optimizing returns on inputs while preserving resources

PA is a farming Management concept based on Sensing, Measuring and Assessment



CASE STUDIES

Estimating cabbage production in Cameron Highlands, Malaysia (2008).

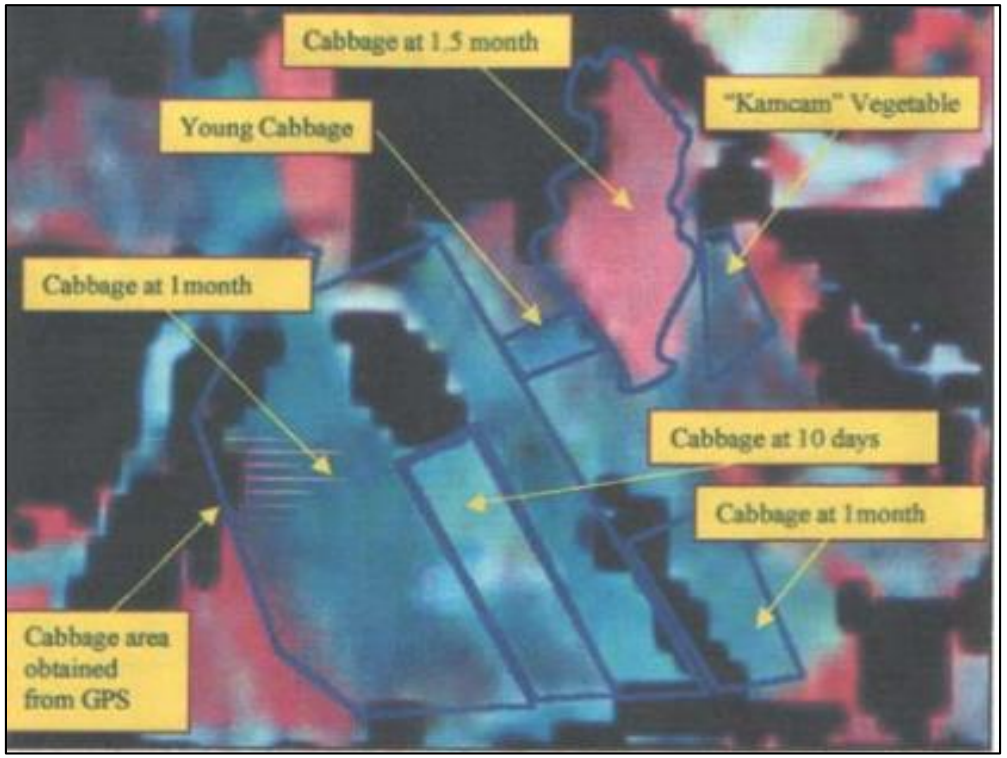
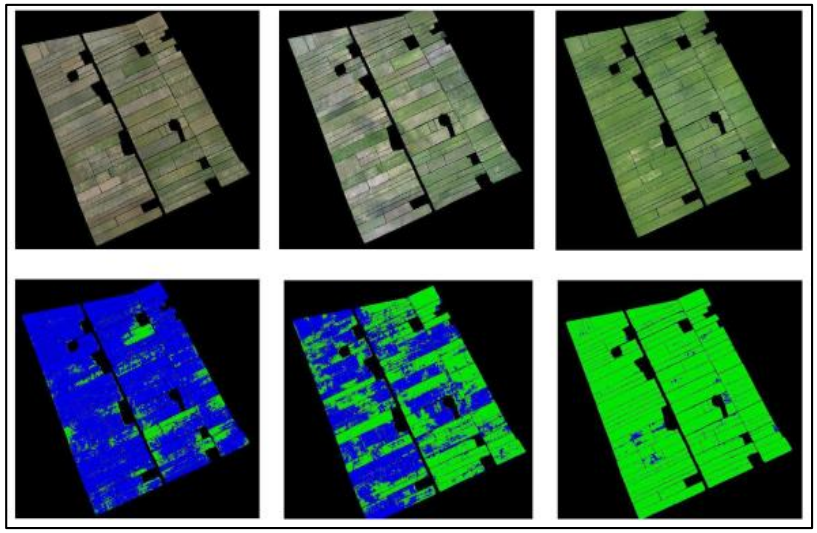


Fig. 4: IKONOS imagery of cabbages using band 4-3-2 (RGB) overlaid with ground data

IKONOS 4 m spatial resolution's capability of an individual cabbage counting which lead to about 25,000 cabbage/ha production estimate

The effectively PA management technique by MARDI



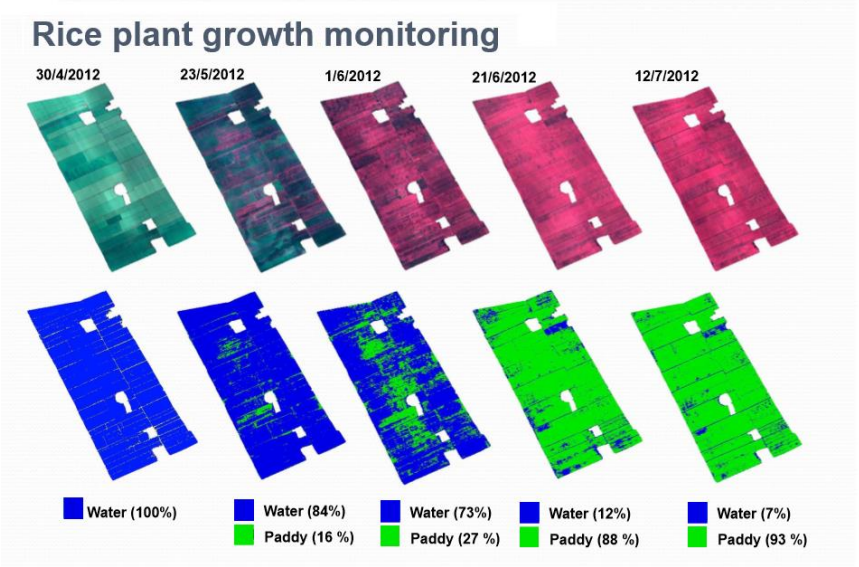
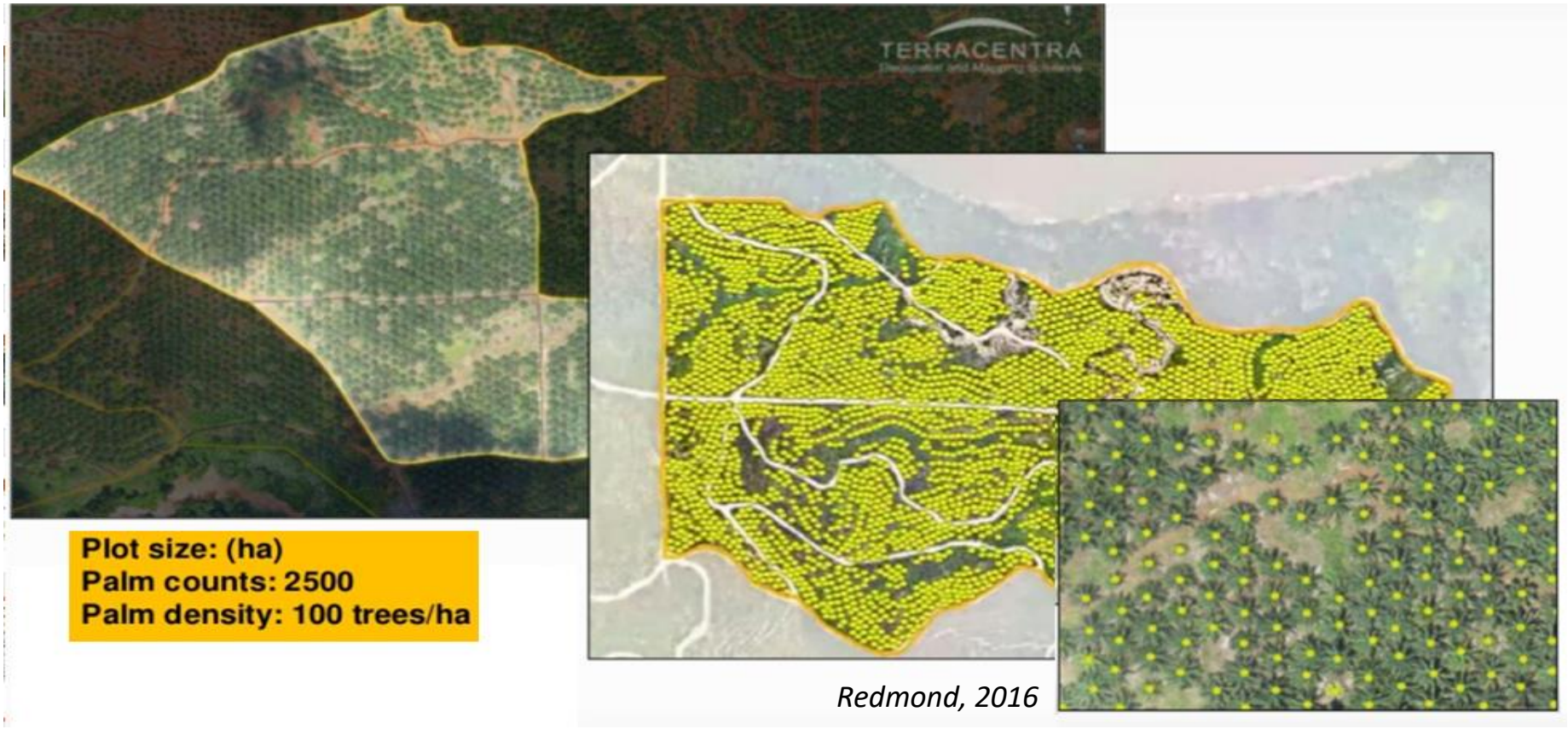


Fig.7: Rice crop growth monitoring using unmanned aerial vehicle (UAV) system and image processing techniques

fertilizer saving for each plot is about
10 to 15 per cent.

Inventory Management

Estimated/Precise Palm tree counts in a selected area of interest



Plot size: (ha)
Palm counts: 2500
Palm density: 100 trees/ha

Redmond, 2016

Oil Palm: Replanting procedures using LiDAR and airphoto imageries (2015).

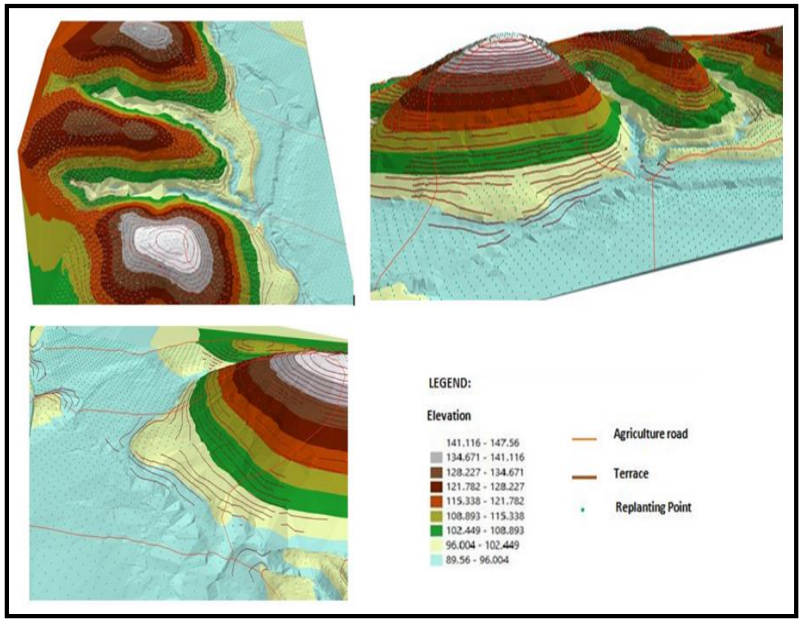
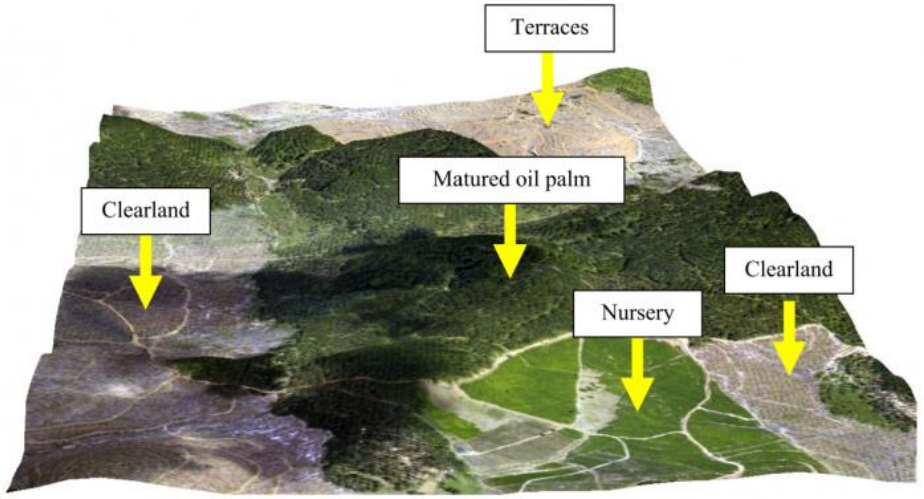


Fig. 5: DEM-LiDAR images showing the terrace lines and planting points.



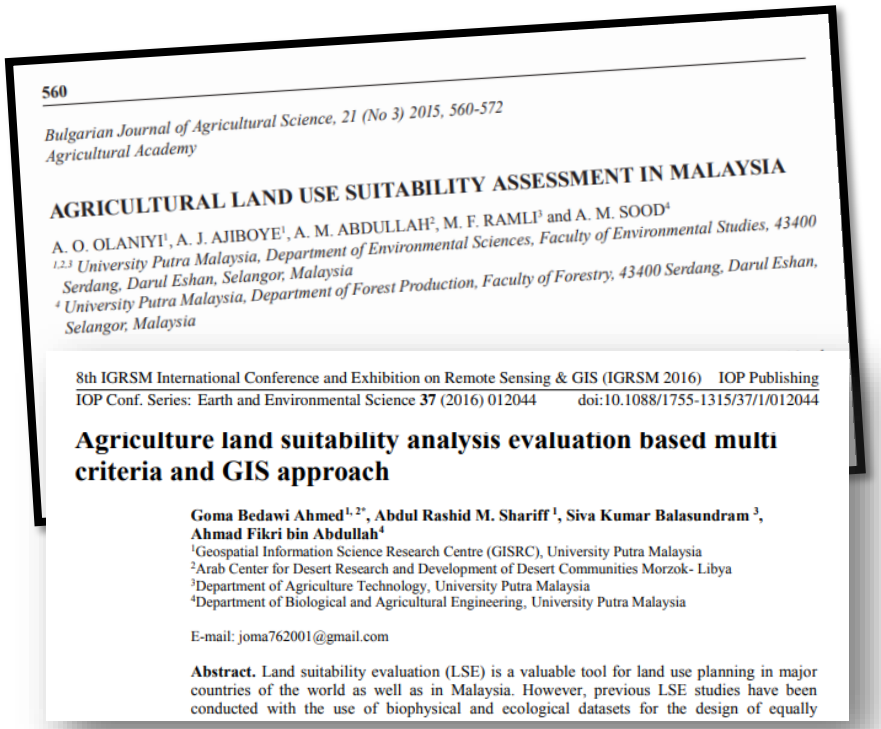
A 3 D model obtained from fusion analysis of LiDAR, DEM and aerial photo over oil palm plantation

Fig. 6: Designing planting points on terraces using AutoCAD

KEY PROJECTS

- **Oil palm yield forecasting**
  - Accurately forecast oil palm yield for the best next financial year
  - Accuracy of > 96% at estate level

- **Site yield potential**
  - Establish an achievable and realistic long term yield target based on site specific criteria.



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Agricultural Academy

AGRICULTURAL LAND USE SUITABILITY ASSESSMENT IN MALAYSIA

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Agriculture land suitability analysis evaluation based multi criteria and GIS approach

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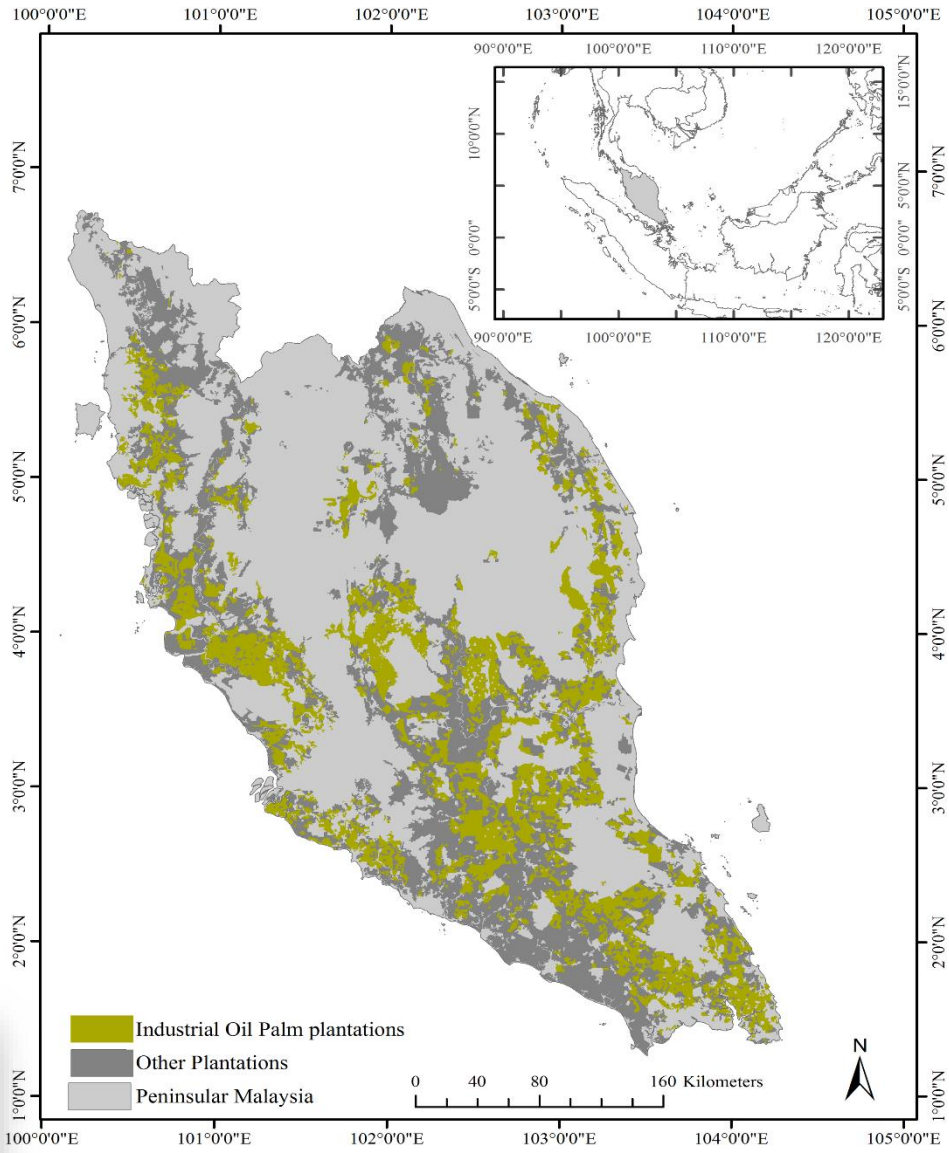
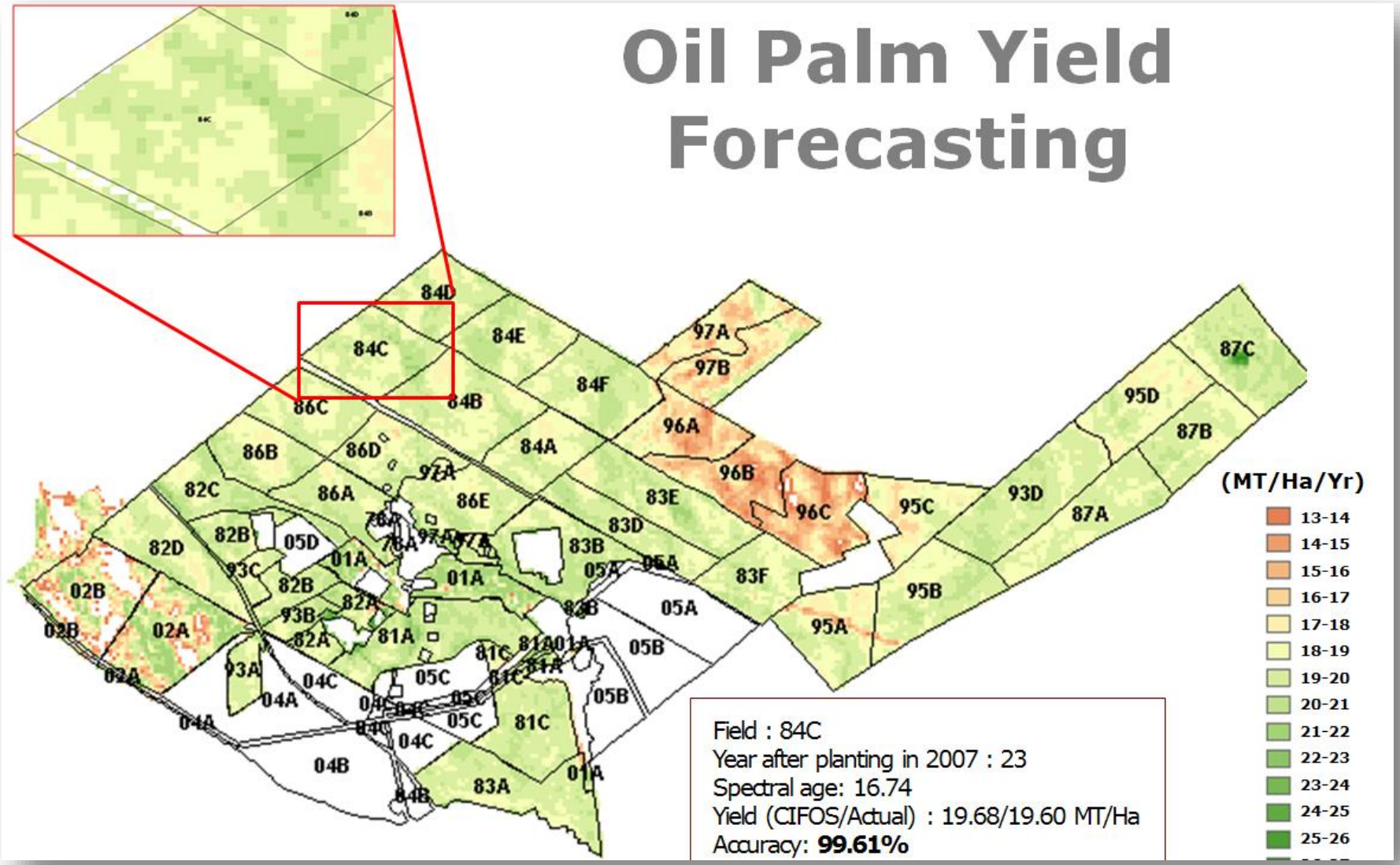
Abstract. Land suitability evaluation (LSE) is a valuable tool for land use planning in major countries of the world as well as in Malaysia. However, previous LSE studies have been conducted with the use of biophysical and ecological datasets for the design of equally



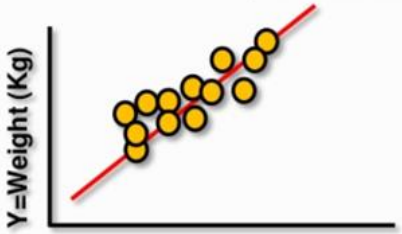
Peninsular Malaysia with industrial oil palm plantations and other plantations (*World Resources Institute, 2019*)


Oil Palm Yield Forecasting
(MT/Ha/Yr)
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
Field : 84C
Year after planting in 2007 : 23
Spectral age: 16.74
Yield (CIFOS/Actual) : 19.68/19.60 MT/Ha
Accuracy: 99.61%

Oil Palm Yield Monitoring with UAV

Geo-referenced

FFB detection/quantification



Yield

Yield Estimation Model development

Correlation between palm height (x_1), crown size (x_2), age (x_3), vegetation index (x_4), …, and yield

$$Yield = func(x_1, x_2, x_3, x_4 \ldots)$$

- ✓ A model that is based on a comprehensive information of each palm location, size, and health, will provide managers with an estimation of yield, and make decisions for sustainable practices methods for production increase without necessary needs for expanding the plantation into natural forests

How should research in PA to be attractive and relevant

1. **Building Partnership**
   Strong partnership should be built between researcher and stakeholder. This ensures:
   a. successful completion of the project
   b. effective technology transfer
   c. no duplication
   d. support of specialist of different discipline
   e. interest from donor and funding agencies

2 Market technology and yourself effectively

There is a need to market the capabilities of the technology. Should highlight following to clients and potential donors:

a. long track record

b. credibility to deliver the goods and services

c. successes that have been achieved to date

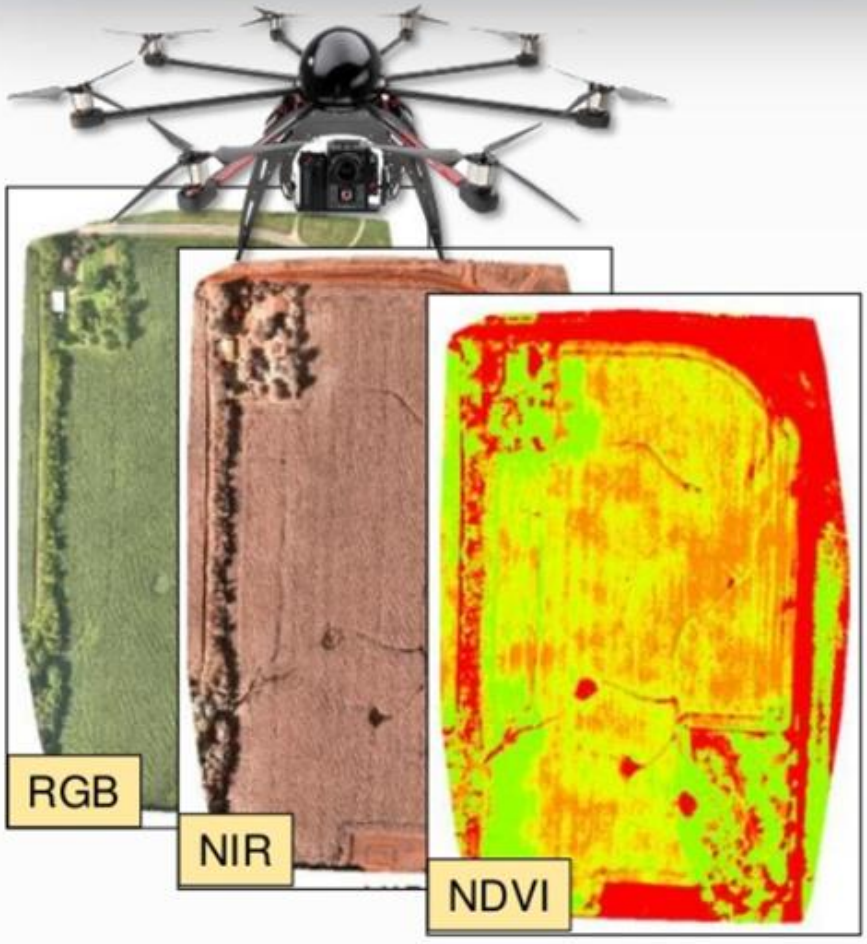
d. availability of appropriate facilities

e. new directions being taken

f. good networking with clients and donors

g. minimal bureaucracy

Commercialization



Nutrient contents, N, P, K, Mg, B

Integrated Mobile Apps

Palm heights, density,
Crown Diameter, Volume,
FFB quantification, etc

Predicted Yield
Disease detection
Management decisions

What next?

Drone survey?

April 2017- Muda Agricultural Development Authority (MADA) used drone technology to reduce up to 20 percent compared to the usual poison spray. Moreover the use of pesticides can also be cut by up to 30 percent. The use of drones is part of the efforts to introduce accurate and precise farming as practiced in developed countries to ensure that farmers are able to have more lucrative results.

The government is given a full support in the drone development and application to help monitor Palm Oil/paddy field plantations in Malaysia and support them to upgrade Agriculture Technology and use of autonomous farm vehicles.

Tap into new world of 'BIG DATA' & IOT

CONCLUSION

- Malaysian population increase, more food, energy and goods are required.
- The agricultural land resources and land are limited and while it is necessary to produce more food by using modern technology.
- Remote sensing technology has the potential of revolutionizing the detection and characterization of agricultural productivity based on biophysical attributes of crops and/or soils.
- Remote Sensing can play a role by providing a comprehensive knowledge base in the use of multiple sensor platforms -based maps and statistics that can be used to develop strategies for agricultural land management for food security.
- Last but not least, remote sensing and related technology need do more to enhance the capability of Agricultural land management and production for food security for the nation.