Current State Research & Development on Rice Mechanization in Achieving Climate Smart Agriculture

Presentation by

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OUTLINE

Introduction

R&D on Rice Mechanization towards Climate Smart Agriculture

1) Sustainably increasing agricultural productivity and incomes

2) Adapting and building resilience to climate change

3) Reducing and/or removing greenhouse gas (GHG) emissions

Conclusion & Way Forward

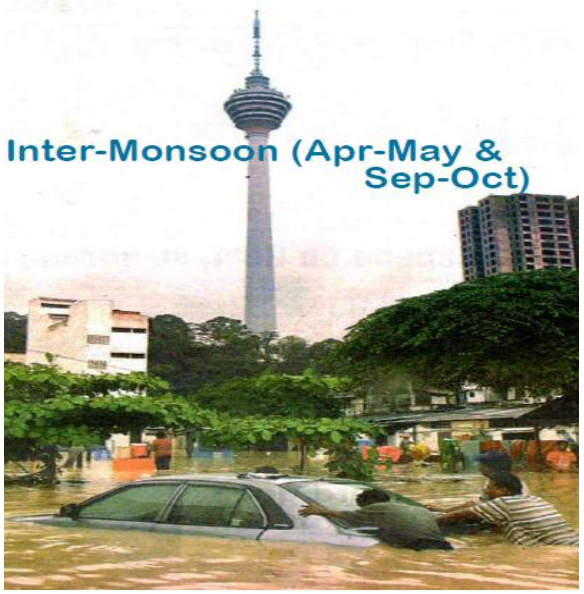
INTRODUCTION

CLIMATE CHANGE SCENARIO

Tropical climate with:

- ✓ **Uniform temperature** *(27 ℃ (80.6 ℉))*
- ✓ **High humidity** *(86%)*
- ✓ **Rainfall throughout the year** *(250 centimetres (98 in))*

Climate change → increasing sea levels and rainfall, increasing flooding risks and leading to large droughts.



Observed Climate Change

- The range of annual mean temperature: 26°C to 28°C.
- Rate of mean temperature increase: 0.6°C to 1.2°C per 50 years.
- Annual maximum rainfall intensity increase: 17 – 29 %
- Rate of sea level rise: 1.3 mm/year.

CLIMATE STATISTICS AT SELECTED METEOROLOGICAL STATIONS

2011 - 2014

- Temperature in the low lands of Malaysia recorded a difference of 4.2°C
- Temperature in the high lands recorded a difference of 2.7°C
- 2013 was considered the hottest year while 2012 was the coolest.
- Rainfall was high in 2011 (5,403 mm) while 2013 demonstrated the lowest (1,390 mm)

	Suhu Temperature		Hujan Rainfall	
	Tertinggi Highest	Terendah Lowest	Tertinggi Highest	Terendah Lowest
2011	33.3°C Subang	15.2°C Cameron Highlands	5,403.4 mm Sandakan	1,632.4 mm KLIA
2012	36.6°C Subang	13.0°C Cameron Highlands	3,936.2 mm Bintulu	1,833.8 mm Sitiawan
2013	37.5°C Chuping	13.6°C Cameron Highlands	4,125.2 mm Kuching	1,389.8 mm Melaka
2014	**33.7°C Temerloh**	**15.7°C Cameron Highlands**	**3,776.0 mm Kuantan**	**1,420.6 mm Temerloh**

SOURCE: COMPENDIUM OF ENVIRONMENT STATISTICS, 2015

Effect of Climate Change

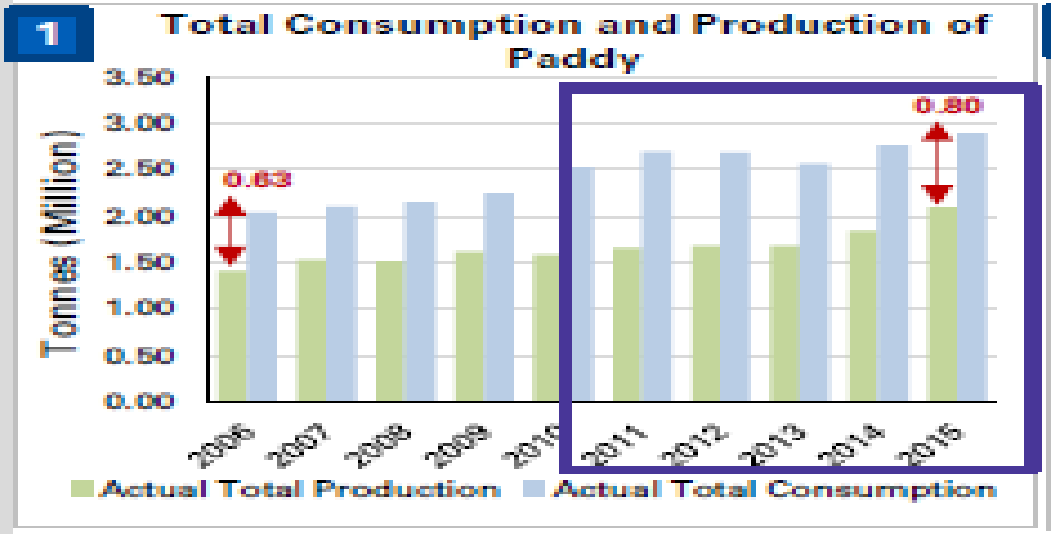
Environmental stress such as drought, high temperature and air pollution are major limiting factors to crop productivity in the tropics *(Ariffin et.al., 2003)*

There were 12 major El-Nino events recorded by the Malaysia Meteorology Department; the worst occurred in the year 1997/98 (delay in monsoon rain, prolonged drought, forest fire and pollution) *(MMD report, 2010)*

Losses in the agriculture sector in Peninsular Malaysia caused by El-Nino were at least MYR 3.4 billions. *(Ariffin et.al., 2002)*

Development of Paddy & Rice Industry Over Past Years

1



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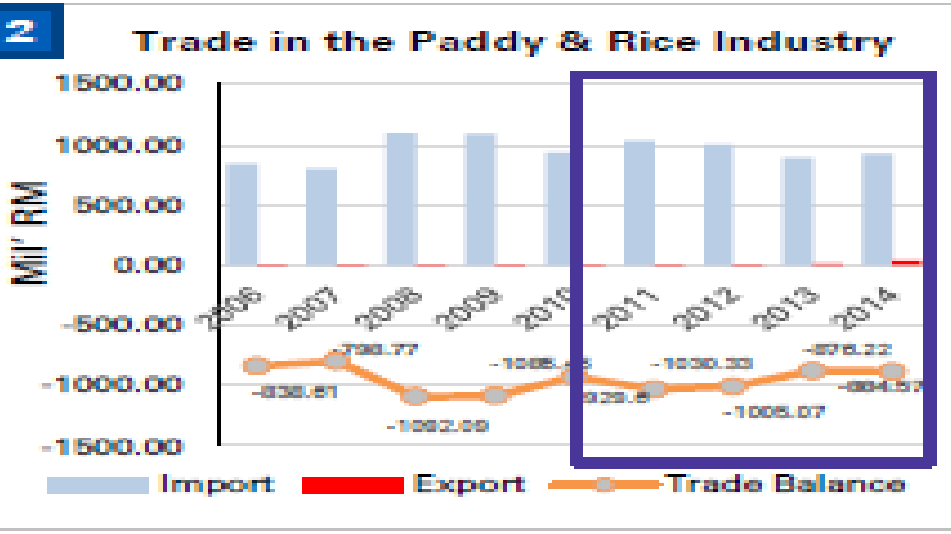

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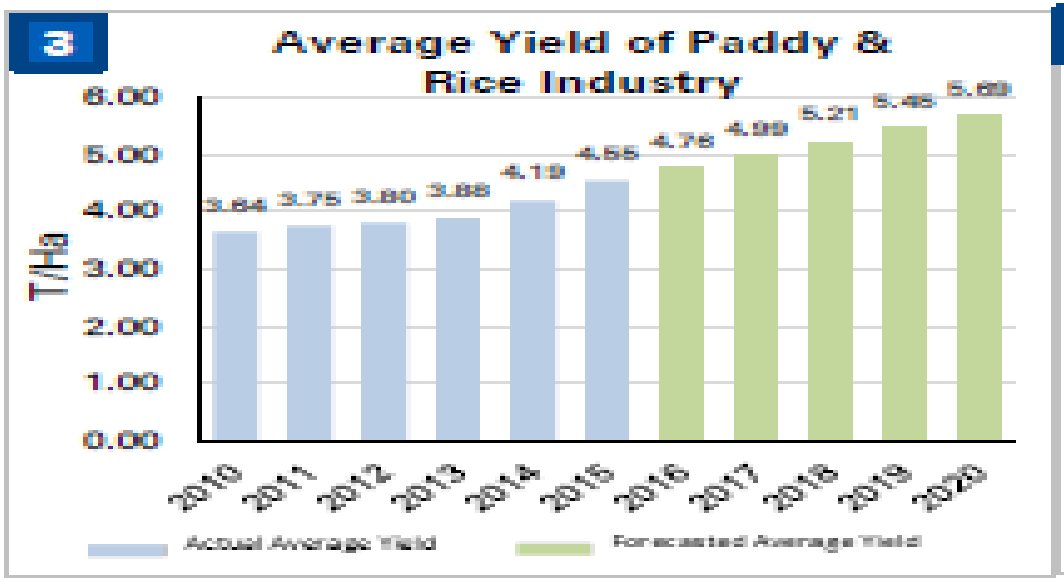

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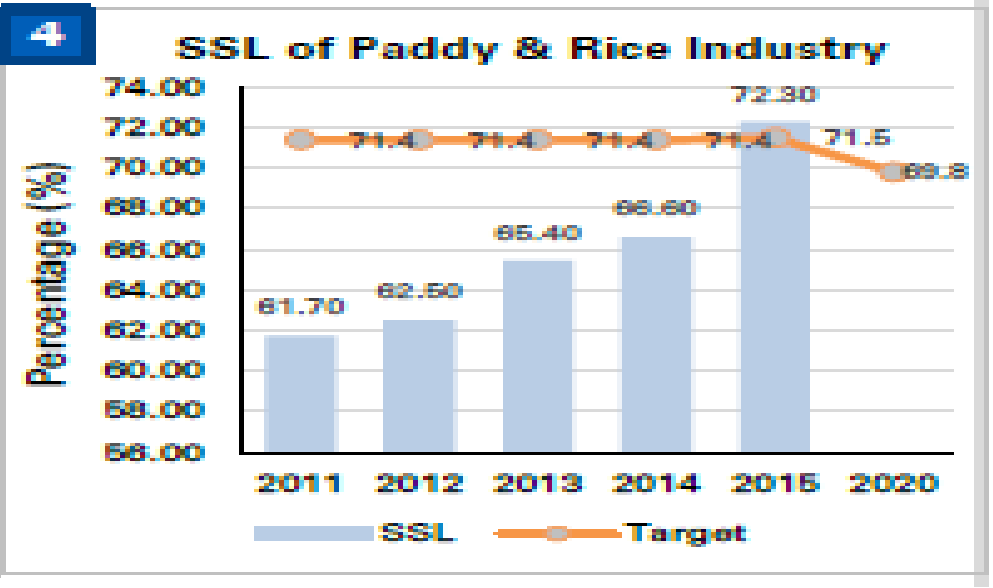


R&D on Rice Mechanization towards CSA

Aims to tackle three main goals:

Sustainably increasing agricultural productivity and incomes

Adapting and building resilience to climate change

Reducing and/or removing greenhouse gas (GHG) emissions

SOURCE: FAO, 2010

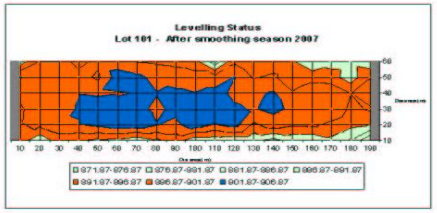
1) SUSTAINABLY INCREASING AGRICULTURAL PRODUCTIVITY AND INCOMES

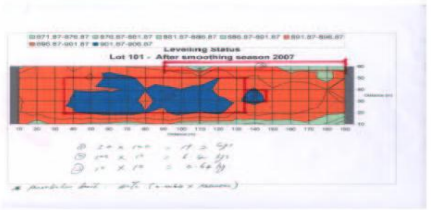
Rice Precision Farming

GOOD CROP ESTABLISHMENT

EFFECTIVE LAND LEVELLING & SEEDING

Manual Survey

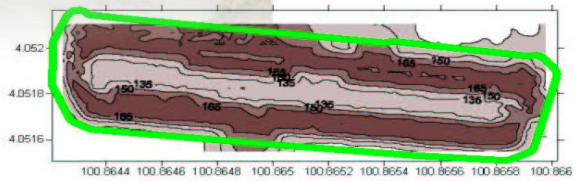


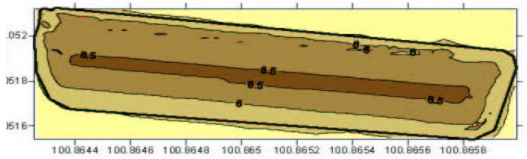


Contour Map

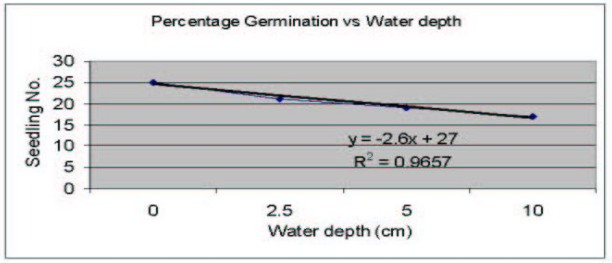
Treatment Map

Trimble® FieldLevel™ II





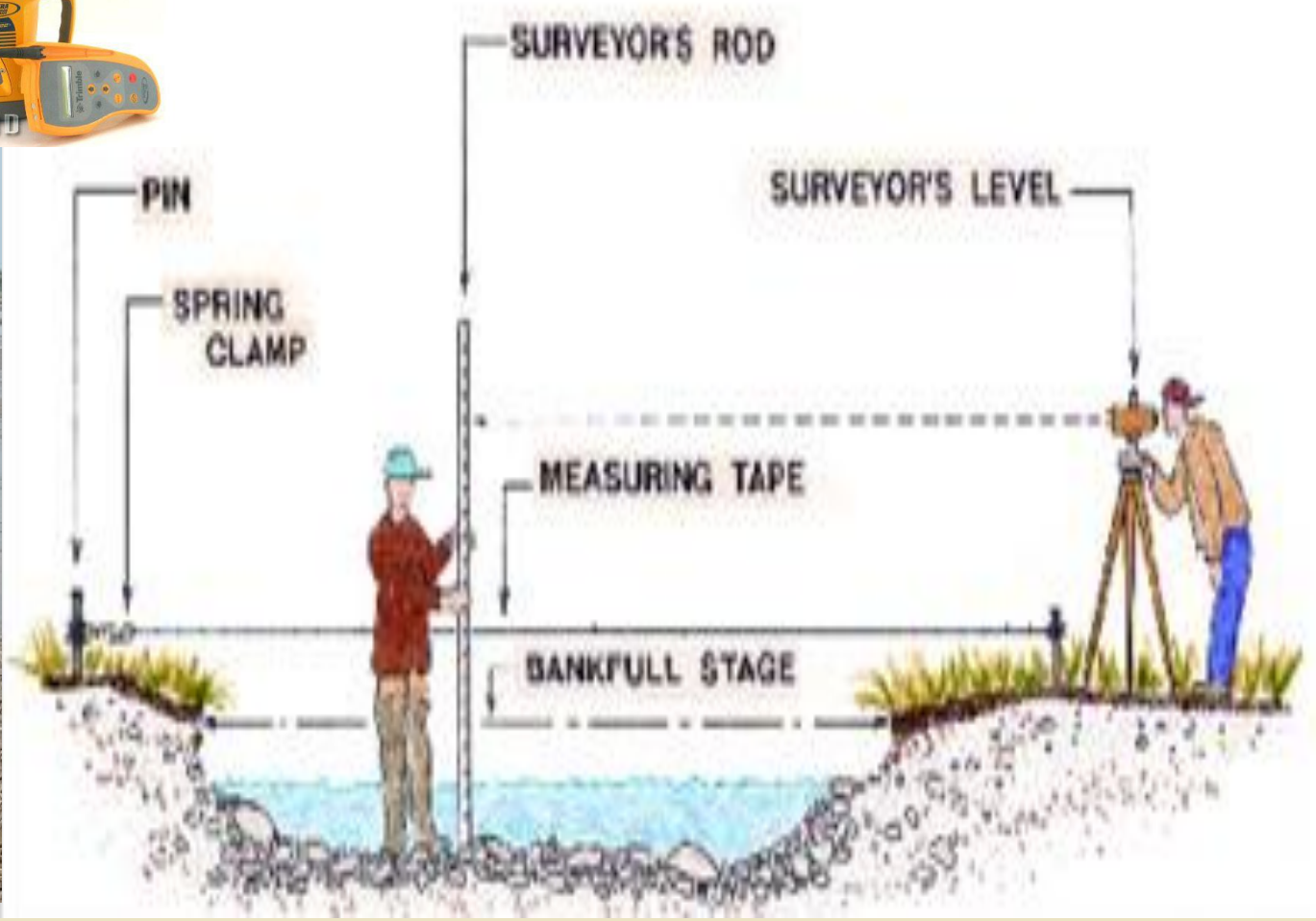
- LI5 > 85% - constant rate
- LI5 < 85% VRT rate
- Seeding according to zoning rate (level, low & high)
- Base rate = (base rate dry + extra rate) *1.25 /%germination rate



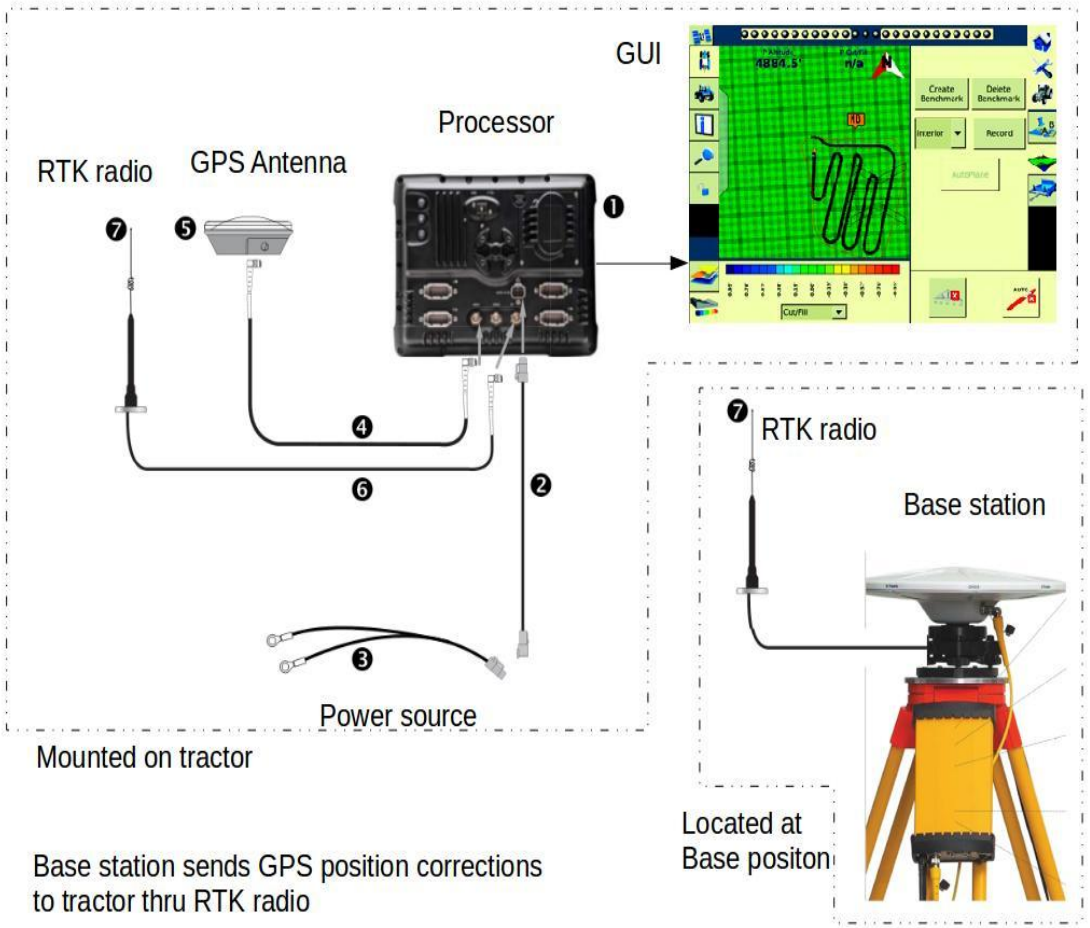
Water depth (cm)	% Seed Add-up
0	0.0
2.5	12.2
5	18.2
10	24.3

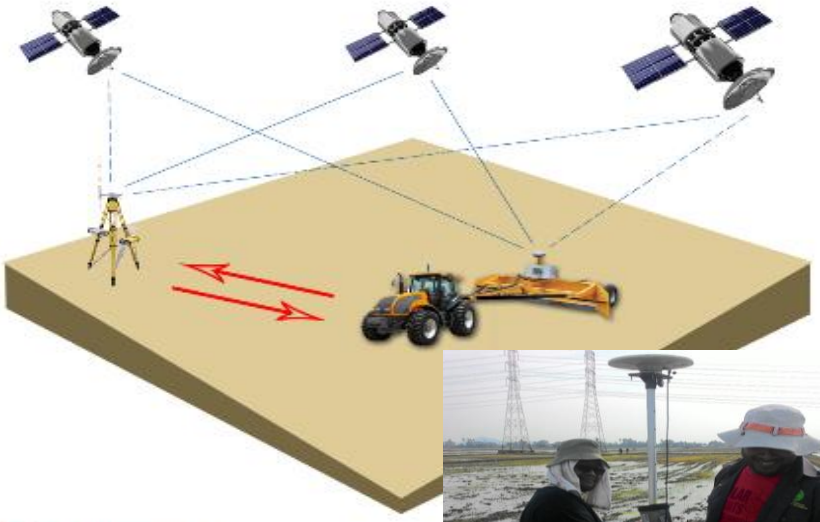
VRT Applicator

Laser Land Levelling System



GPS Land Levelling System

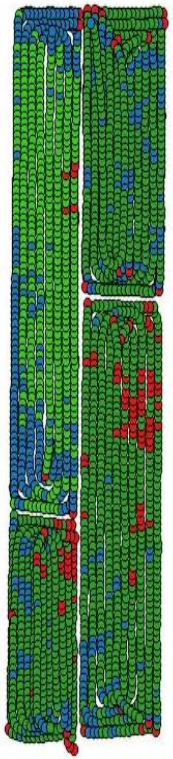




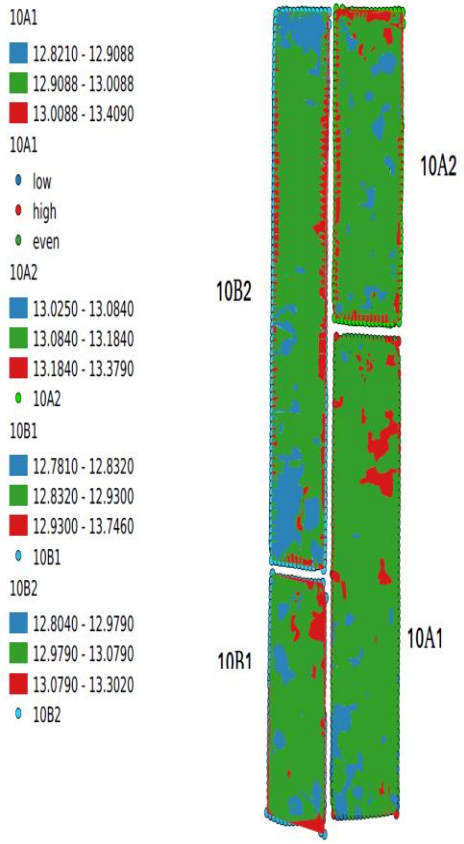
Accuracy of ± 2 cm vertically and ± 1 cm horizontally

LAND LEVELLING SYSTEM & VRT SEEDING

Land levelling



Tractor Pathway

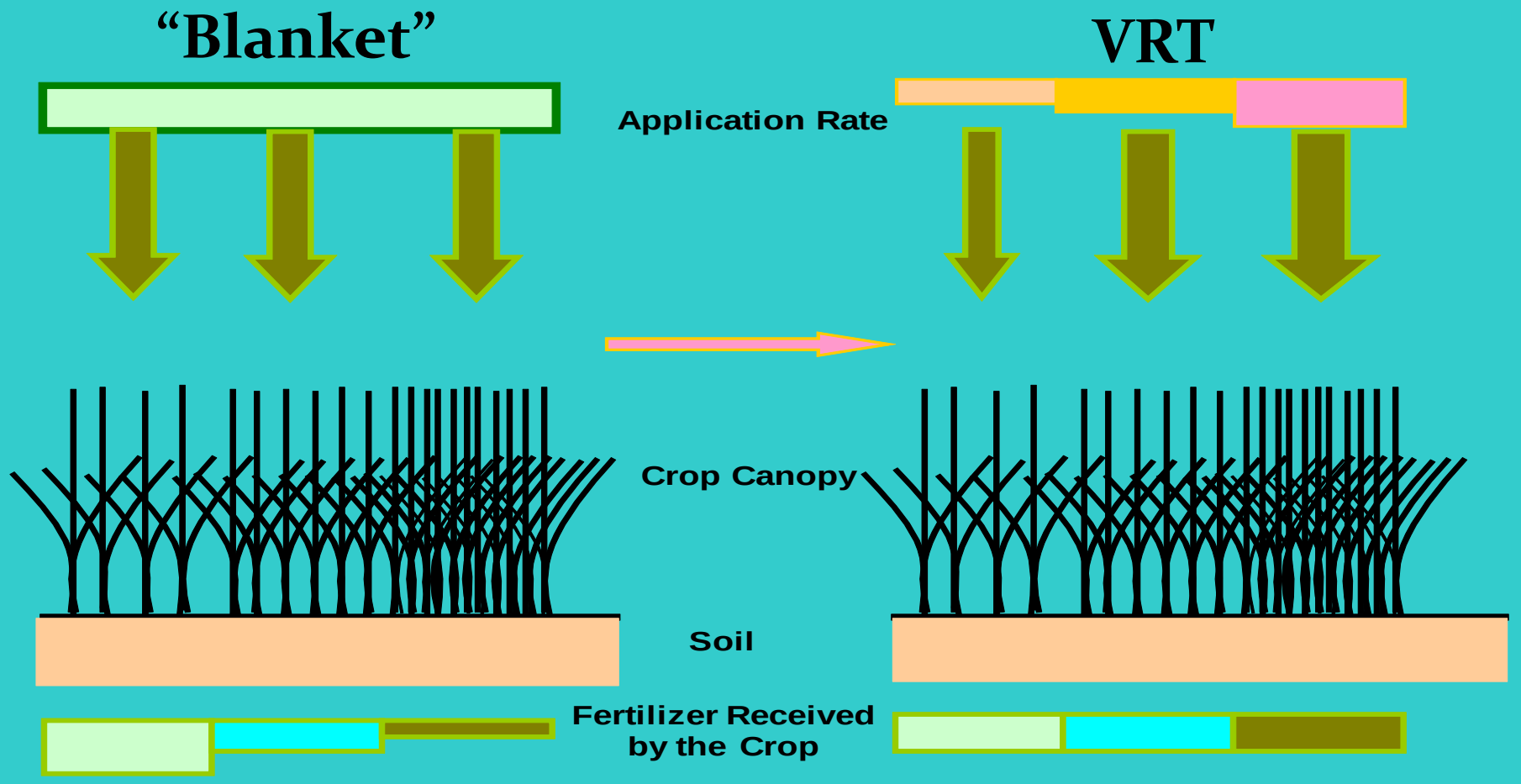


Contour Map

VRT Seeding

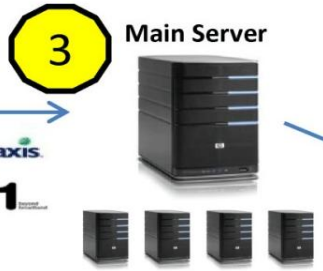
REDUCE FERTILIZER INPUTS

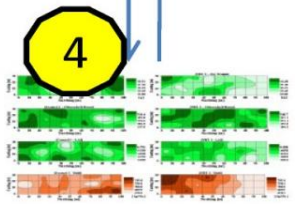
MANAGEMENT CONCEPT OF VARIABLE RATE FERTILIZER APPLICATION

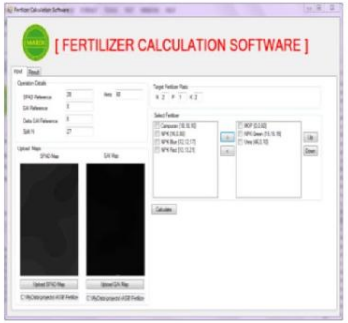


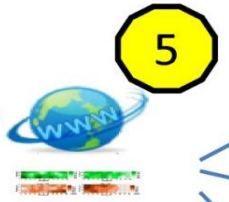
VARIABLE RATE FERTILIZER APPLICATION SYSTEM

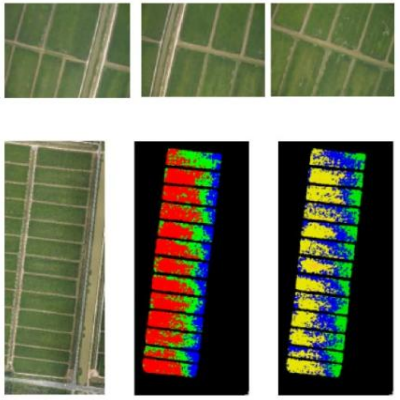
Ground truth – 9 sampling points

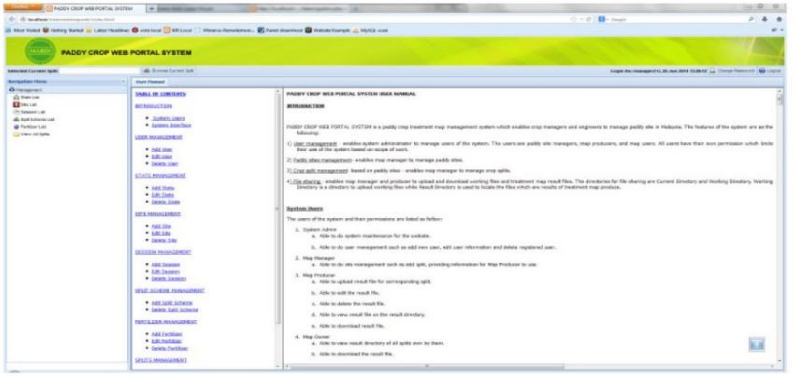












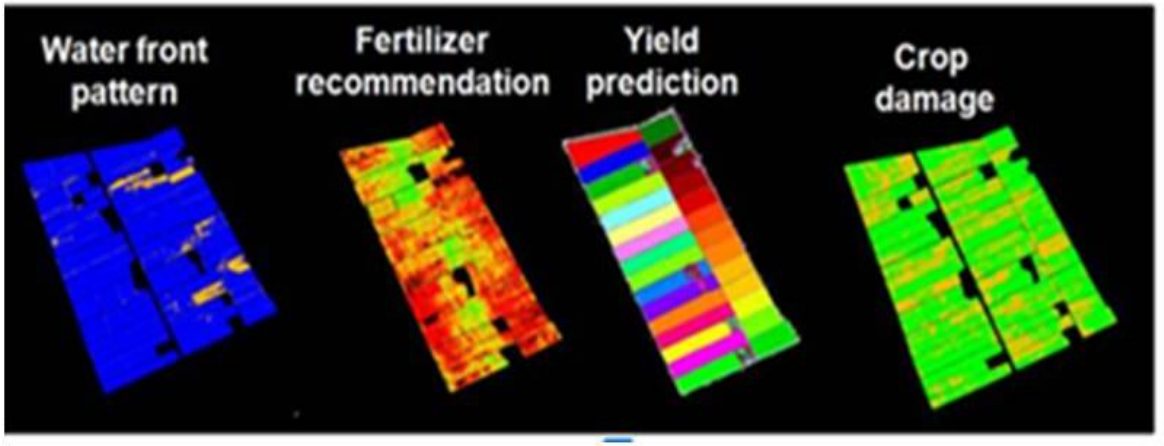
1. Crop image captured
2. Captured crop image uploaded to server
3. Image processed in the server to produce SPAD and GAI map
4. GAI treatment map by treatment map producer system
5. Access by user through treatment map web portal

VRT FERTILIZER APPLICATION

Fertilizer application following the schedule:
(1 day- Data collection; 1 day – Analyze Data; 1 day – Fertilizer Application)

CROP MONITORING - UAV

CROP MONITORING USING UNMANNED AERIAL VEHICLE (UAV) SYSTEM

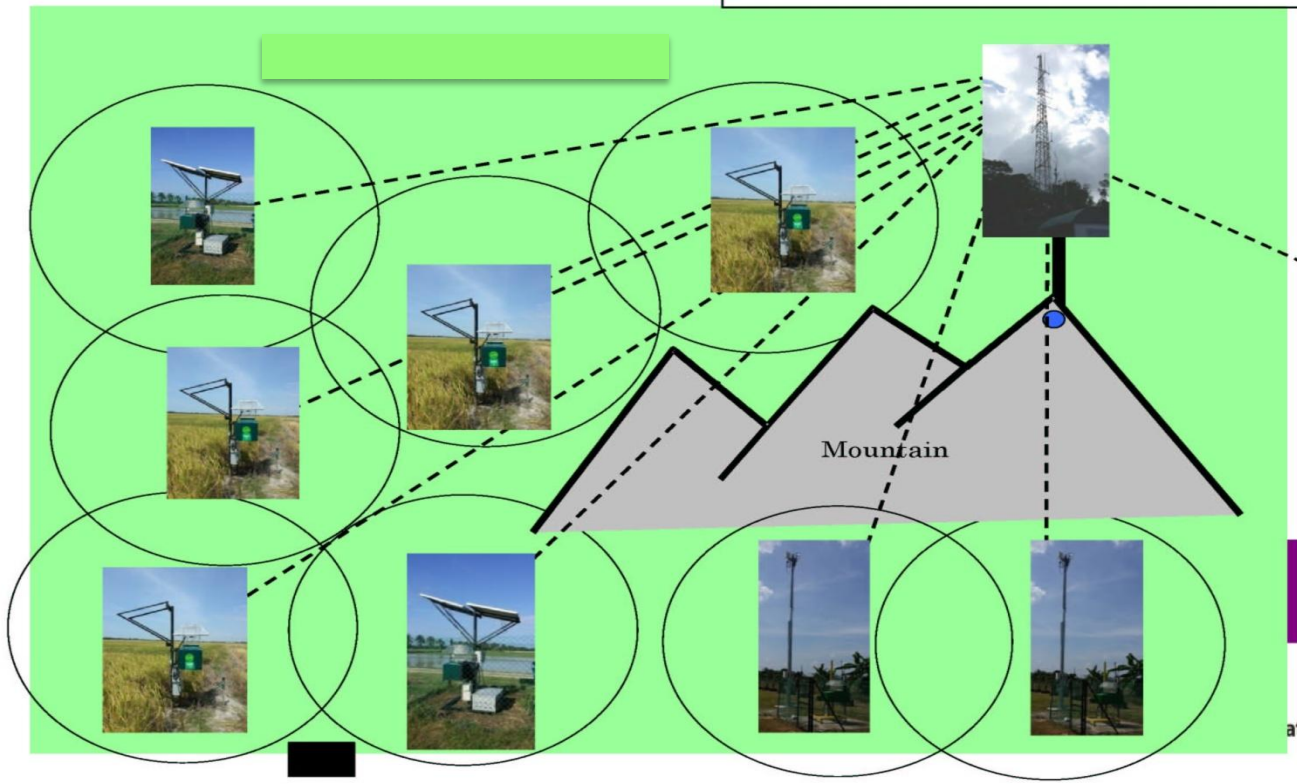


REDUCE CHEMICAL SPRAY

EARLY WARNING SYSTEM FOR BPH & BLAST DISEASE

EWS – BPH & Karah

Automated field data collection with Senlits



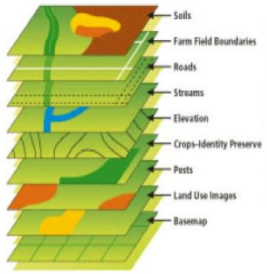
FiledServer ----- Wireless relay communication

Automated Weather Station & Telemetry System and field server

Early Warning

FARM MANAGEMENT

BPH Early Warning GIS Database & DSS



REDUCE POST-HARVEST LOSSES

PADDY POST HARVEST LOSSES (PHL) - MALAYSIA

1985

28.5% Losses (556K Tonnes

Storage (4% PHL)

Milling (6% PHL)

Drying (3.5% PHL)

Transportation (6.0 % PHL)

Harvesting (9.0% PHL)

- Improvement of technology
- New approach and practices

9.97% Losses (259K Tonnes

Storage (1.2% PHL)

Milling (2.4% PHL)

Drying (1.62% PHL)

Drying 0.37% PHL

Transportation (1.1 % PHL)

Harvesting (4.9% PHL)

2015

2) ADAPTING AND BUILDING RESILIENCE TO CLIMATE CHANGE

TAIL WATER REUSE SYSTEM FOR RICE CULTIVATION

Excess water flow into storage pond

During drought water from storage pond is pumped to field again

MECHANIZATION TECHNOLOGIES FOR AEROBIC RICE CULTIVATION

Row seeded aerobic rice with overhead sprinkler irrigation

Six-row aero seeder for small plot planting

Accord seeder for large scale planting

High clearance narrow wheeled prime mover for crop care and maintenance

3) REDUCING AND/OR REMOVING GREENHOUSE GASES EMISSIONS

MONITORING of GHG in Paddy Field

Closed Camber Method
8 am – 13 pm ((Interval ½ hr)

Methane, CH_4

Nitrous Oxide, N_2O

Carbon Dioxide, CO_2

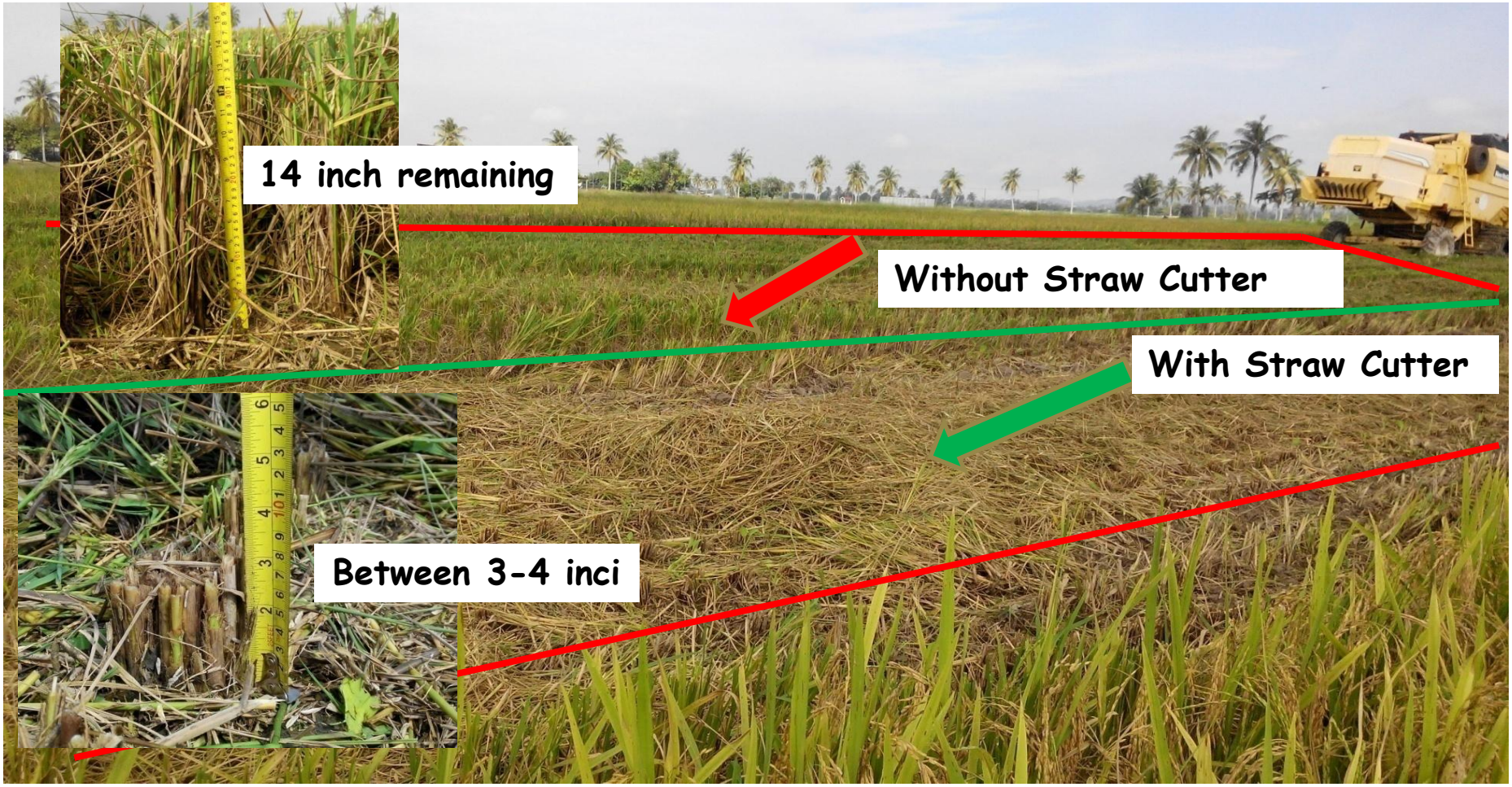
RICE STRAW MANAGEMENT TO REDUCE OPEN BURNING

Combustion of one ton of rice straw will produce 3 kg of particulate material, 60 kg of carbon monoxide, 1460 kg of carbon dioxide, 199 kg of dust and 2 kg of sulfur dioxide (Indian Agricultural Research Institute, 2012)

STRAW CUTTER MOUNTED ON COMBINE HARVESTER

Field testing during harvesting

Result of testing



Comparison of harvesting without and with straw cutter attachment

CONCLUSIONS & WAY FORWARD

Strengthening R&D Capabilities Towards CSA

- Field Mechanization
- Rice Precision Farming

International Linkages on CSA

- CSAM
- IEEE
- CGIAR
- ISPA

Malaysia government needs to actively pursue the CSA agenda

- Budget
- Policy

Thank you.

Mohd Syaifudin Abdul Rahman, Chan Chee Seng, Chubashini Suntharalingam, Mohamad Zabawi Abdul Ghani, Mohd Taufik Ahmad, Zainuddin Zakaria, Teoh Chin Chuang, Badril Hisham Abu Bakar, Asnawi Shahar, Mohd Shahril Shah Mohd Ghazali, Eddy Herman Sharu, Mohd Fairuz Md Suptian and Mohamad Aufa Bookeri

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