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

SOURCE: COMPENDIUM OF ENVIRONMENT STATISTICS, 2015
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. Total Consumption and Production of Paddy
2. Trade in the Paddy & Rice Industry
3. Average Yield of Paddy & Rice Industry
4. SSL of Paddy & Rice Industry
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
EFFECTIVE LAND LEVELLING & SEEDING

- Manual Survey
- Contour Map
- Treatment Map
- Trimble® FieldLevel™ II
- VRT Applicator

- 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

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Laser Land Levelling System
GPS Land Levelling System

Accuracy of $\pm 2$ cm vertically and $\pm 1$ cm horizontally
LAND LEVELLING SYSTEM & VRT SEEDING

Land levelling

Tractor Pathway

Contour Map

VRT Seeding

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MANAGEMENT CONCEPT OF VARIABLE RATE FERTILIZER APPLICATION

“Blanket” vs. VRT

Conventional vs. Precision Farming

Application Rate

Crop Canopy

Soil

Fertilizer Received by the Crop

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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
Fertilizer application following the schedule:
(1 day- Data collection; 1 day – Analyze Data; 1 day – Fertilizer Application)
CROP MONITORING USING UNMANNED AERIAL VEHICLE (UAV) SYSTEM

Water front pattern
Fertilizer recommendation
Yield prediction
Crop damage

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EARLY WARNING SYSTEM FOR BPH & BLAST DISEASE

EWS – BPH & Karah

Automated field data collection with Senlits

REDUCE CHEMICAL SPRAY

FiledServer

Wireless relay communication

Automated Weather Station & Telemetry System and field server

FARM MANAGEMENT
BPH Early Warning GIS Database & DSS

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PADDY POST HARVEST LOSSES (PHL) - MALAYSIA

1985

28.5% Losses (556K Tonnes)

1995

9.97% Losses (259K Tonnes)

• Improvement of technology
• New approach and practices

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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$_2$O
Carbon Dioxide, CO$_2$
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

Straw Cutter Mounted on Combine Harvester

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.


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