MINISTRY OF AGRICULTURE AND FOOD SECURITY

INSTITUT PENYELIDIKAN DAN KEMAJUAN PERTANIAN MALAYSIA
MARDI

Malaysia's Experience In Promoting a Climate-Resilient agricultural sector

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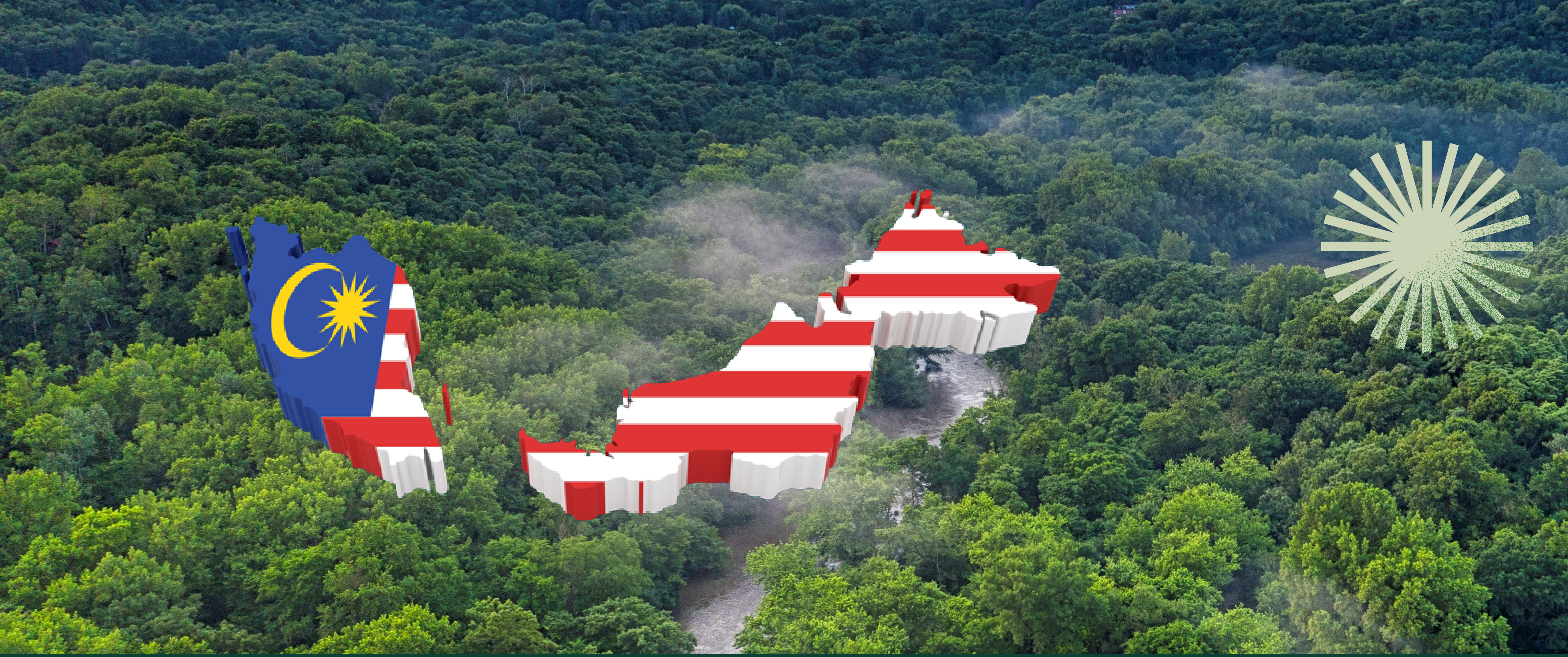
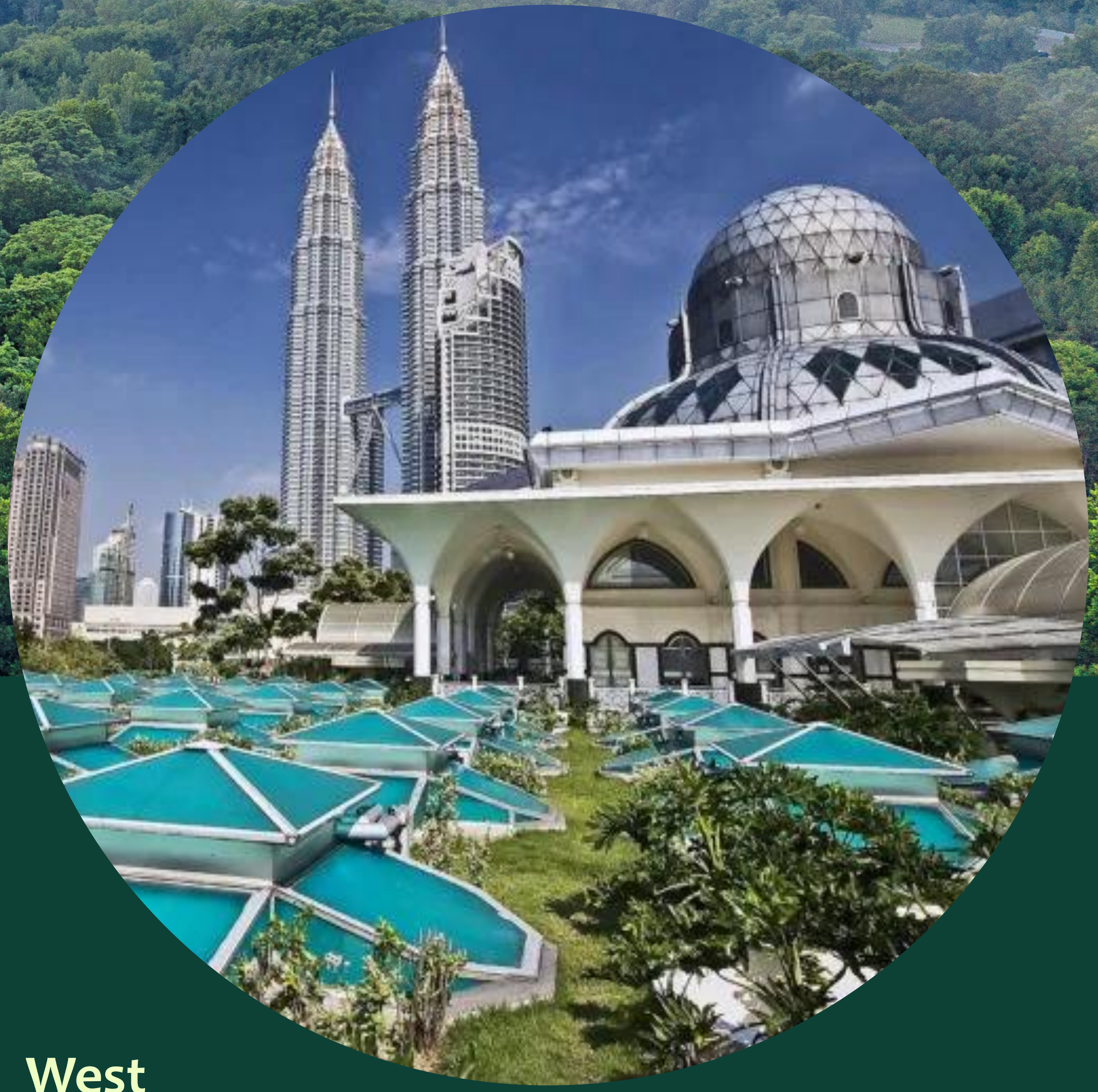




Introduction

- Malaysia is located in the Southeast Asia region, lying just north of the Equator
- Composed of two noncontiguous regions: Peninsular Malaysia, also called West Malaysia, and East Malaysia, which is on the island of Borneo
- It has a land area of 330,241 km2 with about 8,840 km of coastline and over 879 islands.
- Consists of thirteen states and three Federal Territories.
- Malaysia's population reaching 32.5mil in 2019.

1. Introduction

AGRICULTURE AND CLIMATE CHANGE

Agriculture plays a crucial role in Malaysia's development:

- It serves as a key pillar of the national economy by supplying agricultural products for the domestic market.
- It generates employment opportunities, particularly for communities in rural areas.
- It contributes RM101.5 billion (7.1%) to Malaysia's Gross Domestic Product (GDP).
- It supports national and global food security by ensuring a sufficient and stable food supply.

Climate Change Projection by 2100

01. AVERAGE ANNUAL AIR TEMPERATURE

- The current average annual air temperature is between 26.0 °C and 27.5 °C
- Temperature may increase between 0.5 °C and 0.8 °C by 2046 (early-century); 1 °C and 1.5 °C by 2073 (mid-century), and 1.7 °C - 2.1 °C by 2100 (late-century)

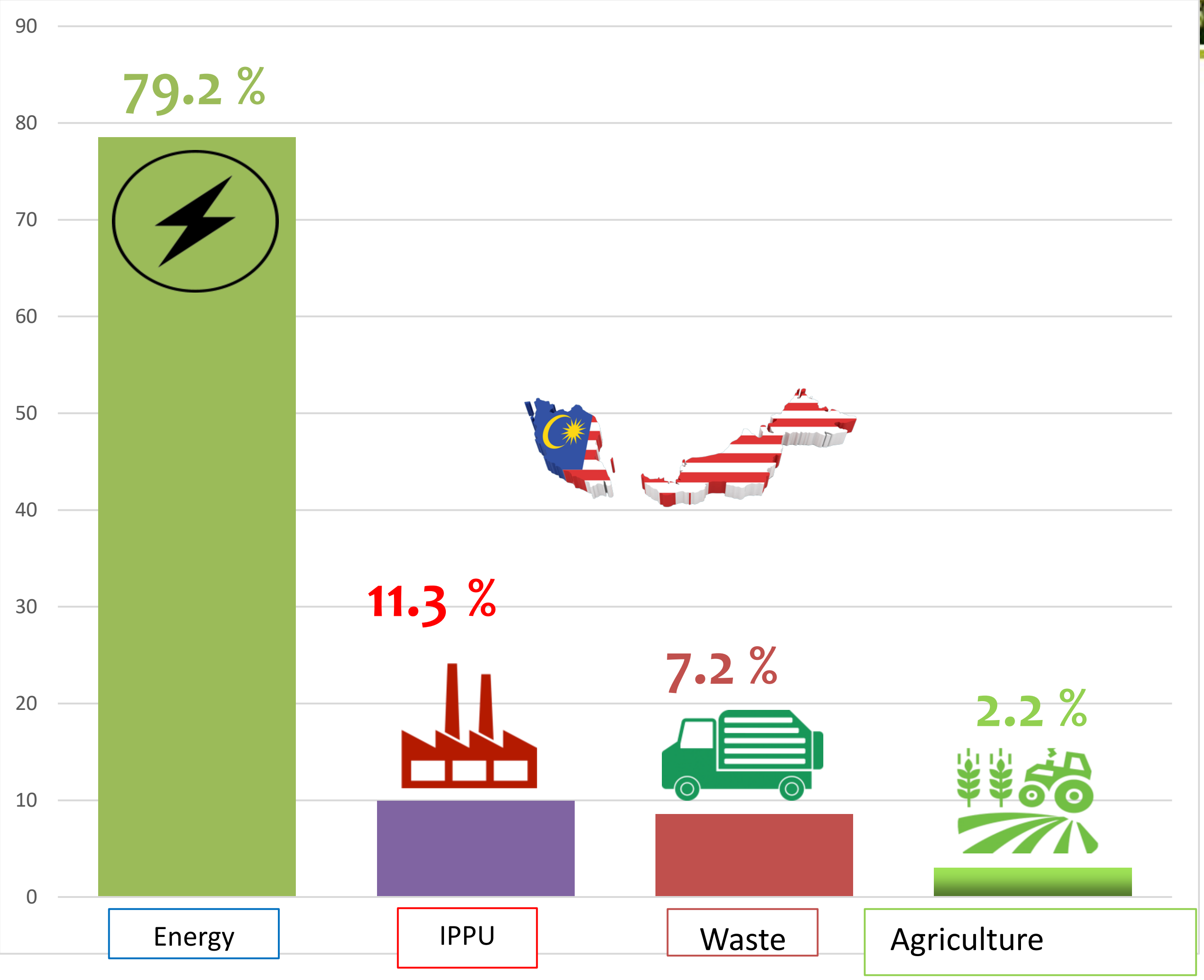
02. ANNUAL RAINFALL

4

- Current average annual rainfall in Peninsular Malaysia is between 2,500-2,700 mm and projected to increase up to 8% by 2046, 12% by 2073, and 13% by 2100
- Current average annual rainfall in Sabah and Sarawak is between 2,500 - 3,500 mm and projected to increase up to 15% by 2046, 19% by 2073, and 25% by 2100

Source: Nc4, 2024

GREENHOUSE GAS INVENTORY OF MALAYSIA



Summary of GHG Inventory for 2021

Sector	GHG Emission/Removal ($Gg\ CO_2$ eq.)
Energy	259,666.83
IPPU	37,028.35
Agriculture	7,310.04
LULUCF	-212,284.33
Waste	23,667.15
Total (Excluding LULUCF)	**327,672.37**
Total (Including LULUCF)	**115,388.04**

Current R&D in MARDI

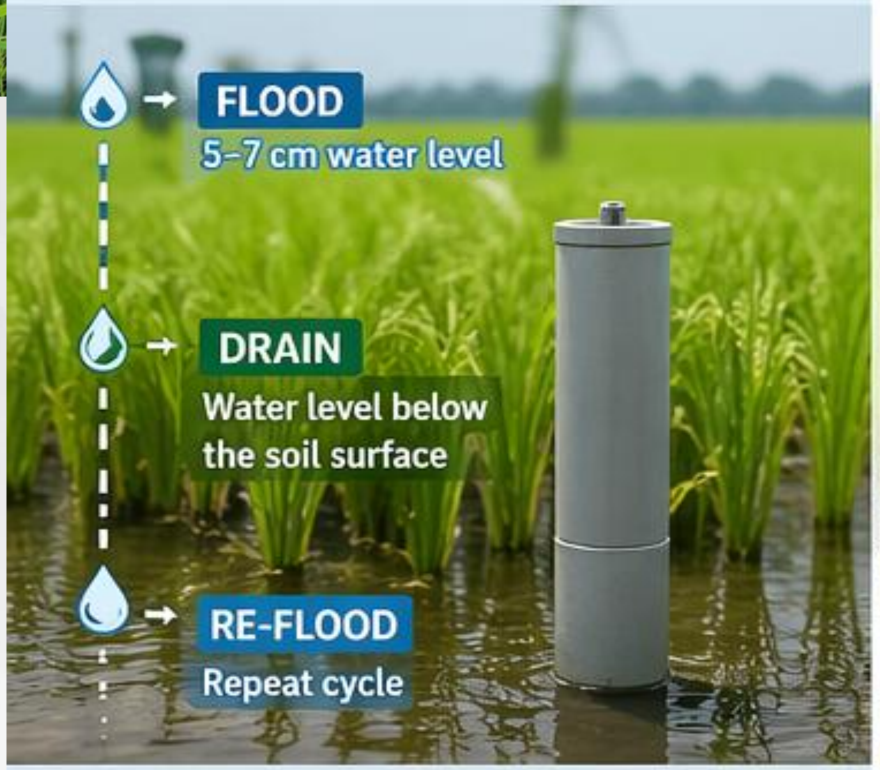
ADAPTATION AND MITIGATION STRATEGIES

- R&D undertaken in line with national policies on climate change and agriculture
- **Before 2016:** Improving the database collection for national greenhouse gas inventories
- **2016-2020:** Developing the adaptation and mitigation strategies through R&D for rice sub-sector through **Climate-Smart Agricultural Approach (CSA)**
- **2021- onwards:** Developing the adaptation and mitigation strategies through R&D for fruit crops, vegetables and livestock sub-sector
- Research conducted through grants provided since 10th Malaysia's Plan (currently 13th Malaysia's Plan- 2026 until 2030). Also other grants by the ministry and research funds.

Climate-Smart Agriculture Strategies
in the Malaysian Agricultural Ecosystem

by MARDI

1 Water Management in Rice Field
Alternate-Wetting and Drying (AWD)



AWD reduces water use, methane emissions and maintains rice yield.

2 Biomass Management through Microbial Straw Degradation

Enhances soil health, reduces burning, lowers greenhouse gas emissions and improves nutrient cycling.

3 Development of Climate-Resilient Rice Varieties

Resilient varieties ensure food security and sustainable productivity under changing climates.

4 Local Cattle Breed Improvement – Lower Emission Intensity

Improved local breeds mean lower emission intensity and sustainable livestock production.

Together for a Climate-Smart and Sustainable Agriculture

- Reduce Greenhouse Gas Emissions
- Conserve Natural Resources
- Enhance Productivity and Resilience
- Ensure Food Security for Future Generations

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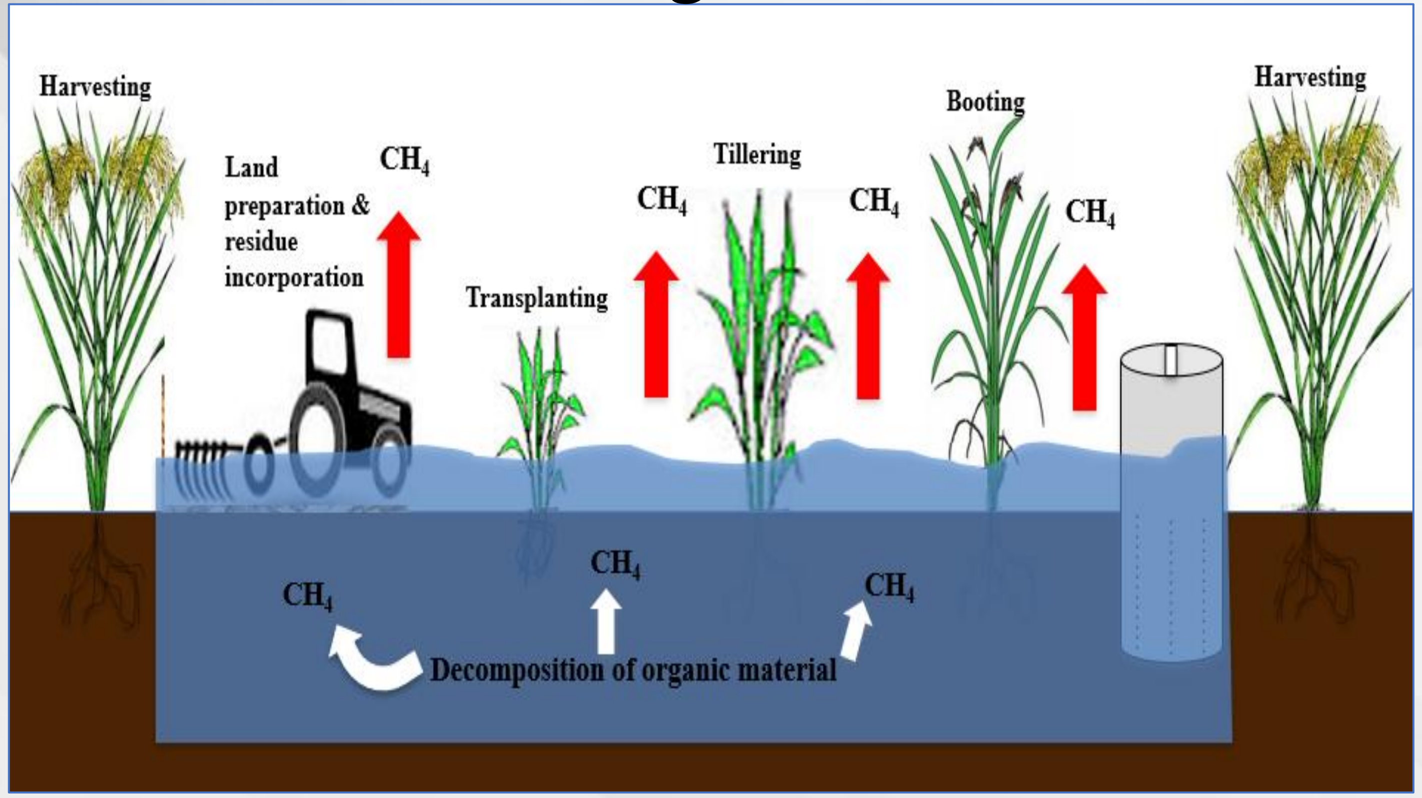
Research • Innovation
Partnership • Impact

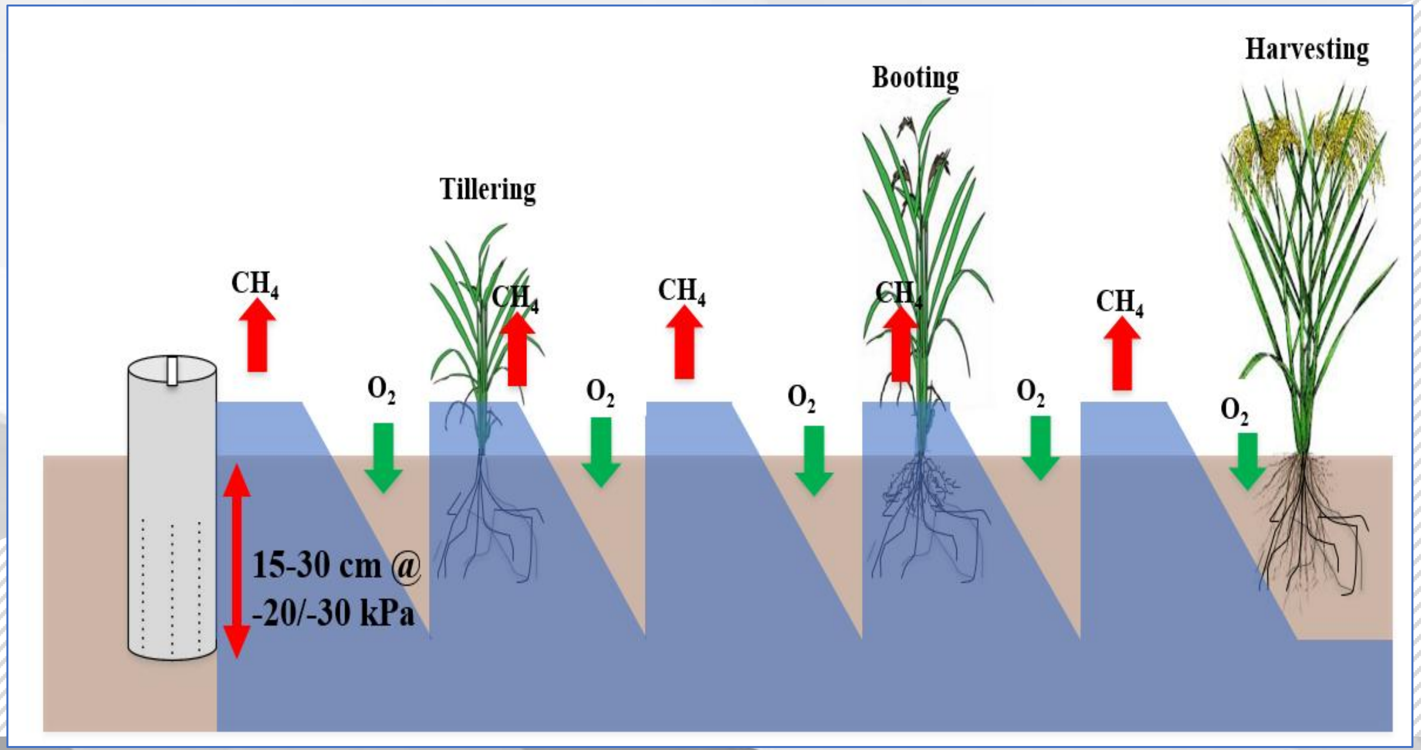
1. Water Management in Rice Field

Continuous flooding- Conventional



- When the fields are flooded, aerobic decomposition of organic matter gradually depletes most of the oxygen (O_2) present in the soil, causing anaerobic soil conditions.
- Once the environment becomes anaerobic, CH_4 is produced through anaerobic decomposition of soil organic matter by methanogenic bacteria (Wassman et al., 2009).

Alternate Wetting & Drying (AWD)



- Paddy plants only need to be flooded during the rooting and flowering stages, others are intermittently irrigated
- Safe-AWD is paddy fields are watered up to 5 cm & then re-irrigated when the water level naturally declines to 15 cm below the soil surface / -20 kPa
- Irrigation technique that reduces water use by 15-40%
- Reduces methane emissions by ~ 50%

Pilot Project on Low-Carbon Rice Production

- UNDER THE MINISTRY OF AGRICULTURE & FOOD SECURITY'S (MAFS) PROJECT GRANT IN 2024

- In line with the Malaysian government's commitment to reduce greenhouse gas emissions intensity by up to 45% based on gross domestic product (GDP) by 2030.

- Objectives: Developing a model plot using low-carbon rice cultivation technology using the Safe Alternate Wetting and Drying (SafeAWD) technique and straw management

- 53 ha area for application of ***safeAWD*** in IADA Pulau Pinang, IADA Barat Laut Selangor, MARDI SP – involving 44 farmers

- SafeAWD project in IADA Barat Laut Selangor
- 21 farmers are involved in 28 ha paddy fields

- SafeAWD project in IADA Pulau Pinang
- 23 farmers are involved in 21 ha of paddy fields.

Low Carbon Rice Project

Key Findings

The AWD with straw removal compared to the flooded condition

- **Total GWP (Direct emission)**: **23** to **40% reduction**

- **Yield**: **increase** of up to **19% of nett yield**

- **CH4 Emissions**: **15** to **46% reduction**

In conclusion, the results indicate a positive correlation between implementing low-carbon practices and achieving sustainable rice yields alongside reduced GHG emissions.

This dual benefit reinforces the potential for these practices to be adopted widely, contributing to both food security and climate change mitigation efforts.

2 Microbial Decomposition of Rice Straw: A Sustainable Solution for Climate-Resilient Agriculture

1 THE PROBLEM

Rice straw is often burned in the field, releasing greenhouse gases and pollutants.

Incorporation during the wet season may not decompose well and is poorly mixed into the soil.

OPEN BURNING

GHG emissions and air pollution

CO_2
CH_4
N_2O

WET SEASON INCORPORATION

Poor decomposition, not well incorporated

2 THE SOLUTION

Using beneficial microorganisms such as *Trichoderma* sp. speeds up rice straw decomposition and helps reduce open field burning.

Rice straw + *Trichoderma* sp. Beneficial microorganism → Faster decomposition, better incorporation

- Reduces open field burning
- Promotes faster straw decomposition
- Facilitates better soil incorporation

3 PROVEN IMPACT

Microbial decomposition of rice straw can reduce methane (CH_4) emissions.

(Current studies showed 7–35% GHG reduction)

Conventional management — CH_4 Higher methane emissions

GHG REDUCTION

7–35%

reduction in GHG emissions (mainly CH_4)

through microbial decomposition of rice straw

Microbial management — CH_4 Lower methane emissions

4 EXTRA BENEFITS

Integrating decomposed straw improves soil health and farm productivity.

- Improves Soil Organic Carbon
- Increases Nutrient Availability
- Optimises Fertiliser Efficiency
- Supports Sustainable and Climate-Resilient Agriculture

Source: Hariz, M. A. R., Chen, S. S., Razak, P. R. A., Bakar, N. A. A., Shahrun, M. S., Zawawi, N. Z., & Saidon, S. A. (2019). Life cycle assessment in conventional rice farming system: Estimation of greenhouse gas emissions using cradle-to-gate approach. Journal of Cleaner Production, 212, 1526-1535.

3. DEVELOPMENT OF MALAYSIAN CLIMATE-RESILIENT RICE VARIETIES

Current rice varieties can only be cultivated under moderate conditions.

MARDI is currently developing new climate-resilient rice varieties that are tolerant to floods, salinity and droughts.

3.1 DEVELOPMENT OF LOCAL DROUGHT-TOLERANT RICE VARIETY

1. Local drought-tolerant rice varieties are developed by adding drought-tolerant genes or QTLs into elite rice lines.
2. Selected lines from the ASEAN Rice Network are tested under both dry and normal conditions.
3. The best lines are then evaluated in multi-location trials to identify high-yielding, drought-resistant varieties.

DRY CONDITIONS | NORMAL CONDITIONS

Goal: High yield, drought tolerant, and stable under changing climate.

3.2 DEVELOPMENT OF LOCAL SUBMERGENCE TOLERANT RICE VARIETY

1. MARDI developed a local rice variety that can survive floods by adding the Sub1 gene.
2. The new rice plants were tested in several stages, from lab screening to field trials in different locations.
3. Some lines, like MR253 and 4412, grew well and recovered quickly after being underwater for 21 days.

SUBMERGED FOR 21 DAYS | RECOVERED AND THRIVING

Goal: Survive floods, recover well, and maintain high yield.

3.3 DEVELOPMENT OF LOCAL SALINITY-TOLERANT RICE VARIETY

1. A local salinity-tolerant rice variety was developed by adding the Saltol QTL into elite local lines.
2. Plants were screened and selected under 6 dS/m salt stress.
3. The selected tolerant lines were evaluated through the ASEAN Rice Network to identify the best candidates for further introgression.

SALT STRESS (6 dS/m) | TOLERANT LINES

Goal: Tolerate salinity, sustain yield, and suit coastal areas.

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Science • Innovation • Impact

Building climate resilience for sustainable rice production and food security in Malaysia.

Tolerant to Floods | Tolerant to Droughts | Tolerant to Salinity

CONCLUSION

- Climate change is expected to significantly affect Malaysia's agriculture through rising temperatures and increased rainfall variability, requiring urgent and sustained adaptation efforts.

- Although the agriculture sector contributes a relatively small share of national GHG emissions, the rice sub-sector remains a key emission source, highlighting opportunities for targeted mitigation.

- MARDI plays a central role in advancing Climate-Smart Agriculture (CSA) through aligned R&D under national development plans and climate policies.

- Key CSA interventions, such as Alternate Wetting and Drying (AWD), microbial straw decomposition, and climate-resilient rice varieties, demonstrate practical and scalable solutions.

- Continued research, technology adoption and collaboration across agencies are essential to ensure long-term food security and sustainable agricultural development in Malaysia.".

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THANK YOU!

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