GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES

AgMIP The Agricultural Model Intercomparison and Improvement Project

Mitigation and Adaptation Co-Benefits in Agriculture
~ MAC-B ~



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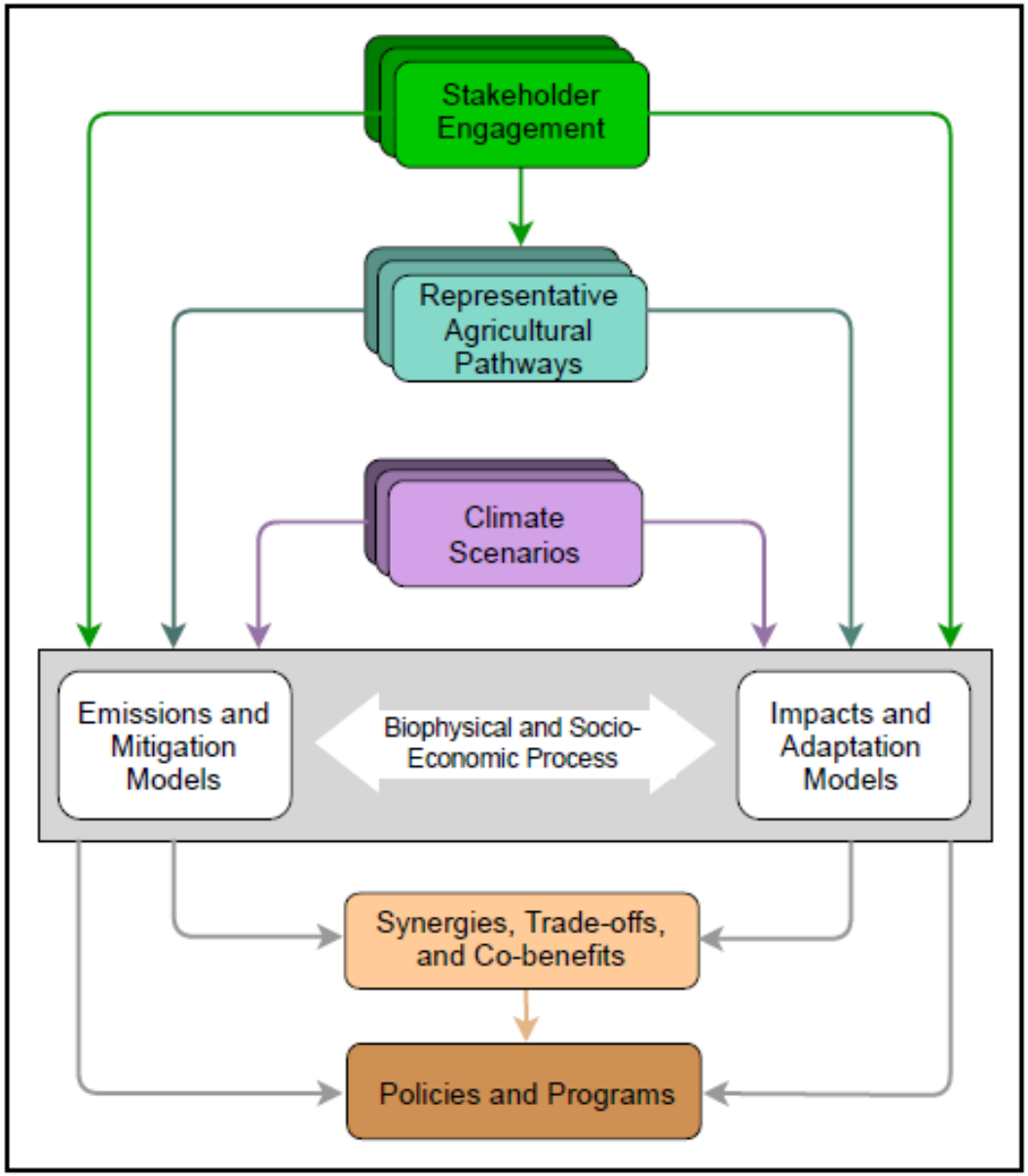
NASA

Mitigation and Adaptation Co-Benefits MAC-B

To promote climate change action and the SDGs, there is growing attention by policy-makers, stakeholders, and researchers on interventions* that contribute to both mitigation and adaptation co-benefits, trade-offs, and synergies

*e.g., soil carbon sequestration, sustainable intensification, crop-livestock systems

MAC-B Assessment Framework



Gender Nutrition Food Security

Capacity Building

MAC-B project aims to increase in-country capacity to co-develop information products of value to stakeholders

This involves continuing training and experiences using 'best practices' in both modeling and stakeholder engagement

Bangladesh MAC-B Seed Project Objectives

- Directly **integrate stakeholder feedback into MAC-B assessment process and co-develop feasible interventions** (focused on sustainable rice management and intensification) for mitigation and adaptation co-benefits.

- **Evaluate effects of interventions in current farming systems using measures of mitigation, adaptation and development benefits, i**ncluding greenhouse gas emissions, resilience to climate variability, farmer livelihoods, gender, and nutrition.

- **Evaluate effects of interventions on measures of benefits under future climate scenarios.**

- **Support policy development** by convening policy-makers round table to communicate findings and discuss policy implications for mitigation and adaptation programs and NDCs.

- **Strengthen capacity in all partners** in using and applying GRA/AgMIP MAC-B methods

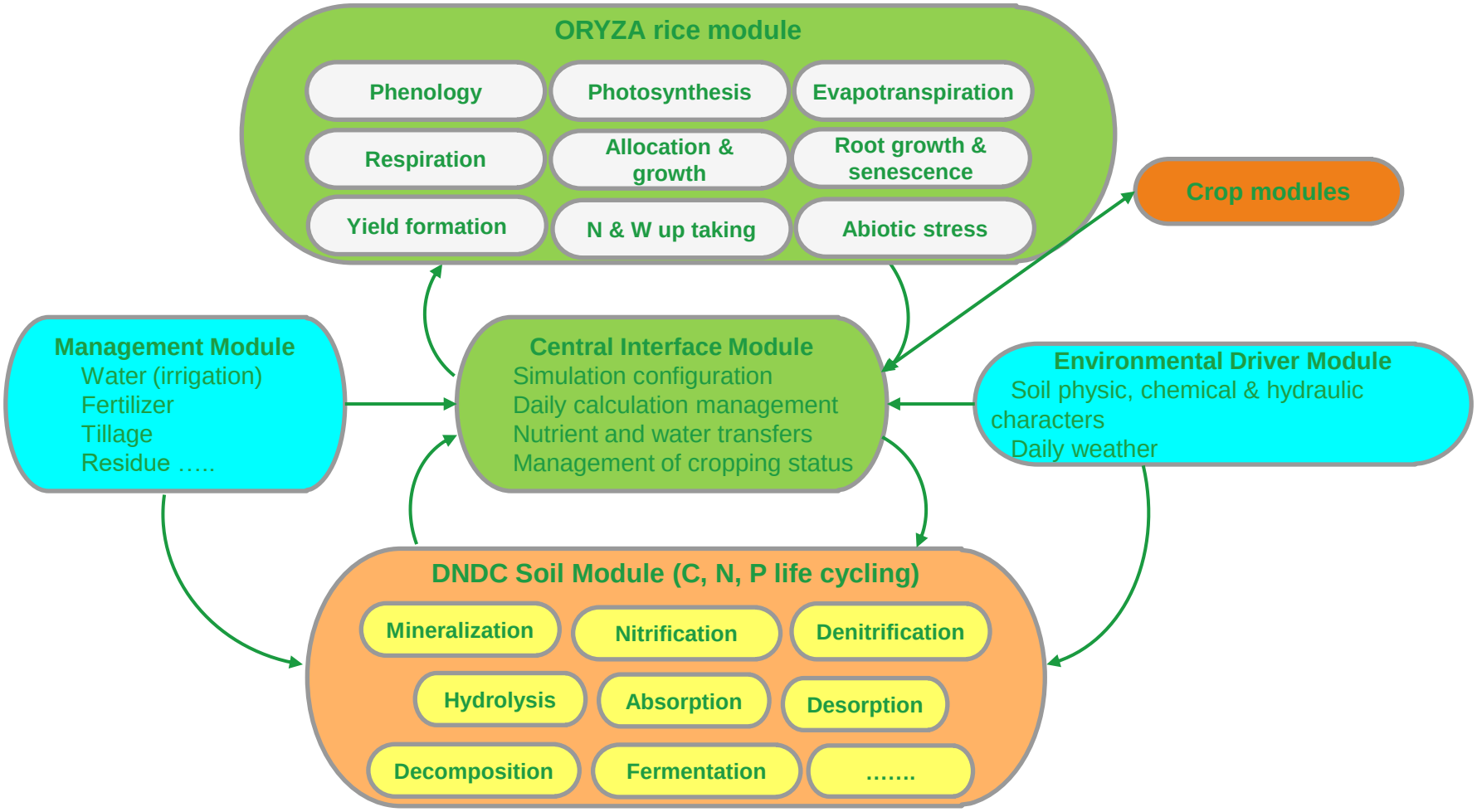
Models and Output Variables

- **GHG emissions**
  - Model: DNDC
  - N_2O, CO_2, and CH_4 flux rate (kg C/ha, kg N/ha)
- **Yields**
  - Models: ORYZA, APSIM
  - Yield per hectare (kg/ha)
- **Stability of yields**
  - Models: ORYZA, APSIM
  - Coefficient of variation of crop model outputs
- **Economic performance**
  - Model:TOA-MD model
  - Sensitivity to costs for aspects of production that contribute strongly to GHGs, such as N management and water management
- **Farmer income and percent poverty**
  - Model: TOA-MD
  - By strata

Data Sources

Data Type	Source 1	Source 2
Climate information	Bangladesh Meterological Department	AgMERRA, AgMIP archives
Economic data	Primary surveys and data maintained by CIMMYT	Bangladesh Bureau of Statistics (BBS) data
Crop practice data	Primary surveys and data maintained by CIMMYT	Bangladesh Rice Research Institute

Mitigation/Adaptation Rice Modules/Linkages



DNDC-Art/Applied GeoSolutions coupled rice-soil process-based model that analyzes biophysical processes of rice systems for mitigation and adaptation

Mitigation/Adaptation Rice Model Flowchart

Sustainable rice management represented by parameters

Crop: Variety, Seedling age, Direct-seeding/Transplanting, Density, Rotation

Management: Tillage, Nutrients and Residues, Water

Land: Soil type/fertility, Slope, Groundwater level

Weather: Baseline/future climate, $[CO_2]$, radiation, T, P, humidity, wind-speed, $[O_3]$

Scale: Spatial – Meters → Field → Region → Nation → Continent → Global
Temporal – Day → Season → Year → Decade → Century

Interventions: Characterized by changes in parameters

Parameters: Configured as simulation input files

Simulations: Interventions, baseline and climate change

DNDC-ORYZA simulation

+ Economic TOA-MD Simulations

Sustainable rice evaluation using DNDC-ORYZA outputs and outcome

Mitigation: GHG emissions

Adaptation → Food Security: Yield and yield stability; Farmer livelihoods

Evidence Base for Policies: Co-Benefits for Farmers and Development of Mitigation & Adaptation

Potential Next Step: Multi-country MAC-B Program

- Expand MAC-B projects to additional GRA countries
- Create set of protocols that can be used and modified by each country
- National stakeholder/policy-maker engagement
- Engage with other GRA research groups

Some Scoping Discussions

Bangladesh

Conduct seed project on sustainable rice intenstification management options to test mitigation and adaptation co-benefits.

Dominican Republic

Assess co-benefits, trade-offs and synergies for adaptation/mitigation in **current NDCs** for Caribbean Central America using representative farming systems to **identify gaps and needs**.

Peru

Perform *ex-ante* impact assessment analysis of potential adoption rates of **Alternate Wetting/Drying** to evaluate sustainable rice intensification in coastal and Amazon regions.

Vietnam

Conduct a **sustainable rice intensification regional integrated assessment** in the Red River Delta and Mekong River Delta rice-growing regions.

Zimbabwe

Characterize trade-offs in **mixed crop-livestock systems** and co-design mitigation and adaptation options for mixed crop-livestock systems under future challenges.

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Papers Invited for Special Issue

BMC Part of Springer Nature Search

Co-Benefits and Tradeoffs to Food Security from Mitigation and Adaptation in Agriculture

This thematic series will publish in ***CABI Agriculture and Bioscience***.

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Submission Deadline: 31 October 2021

Aims and scope: Research at the *nexus* of climate mitigation and climate adaptation in agriculture remains challenging, owing to both data and modeling limitations, as well as the

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