Climate change impact on rice farming systems in Sri Lanka

[1]A**. S. Karunaratne, [2]S.P. Nissanka, [3]W.M.W. Weerakoon, [4]L. Zubair, A. Ruane, [5] and S. McDermid, [5]**

[1]Faculty of Agricultural Sciences, Sabaragamuwa University, Belihuloya, Sri Lanka. asha.karunarathne@yahoo.co.uk
[2] Faculty of Agriculture, University of Peradeniya, Sri Lanka
[3] Department of Agriculture, Sri Lanka
[4]Foundation for Environment, Climate and Technology of Sri Lanka,
[5] *NASA-Goddard Institute for Space Studies*, Columbia University, New York, NY

Abstract

The Agricultural Model Intercomparison and Improvement Project (AgMIP) is a major international effort linking the climate, crop, and economic modeling communities with cutting-edge information technology to produce improved crop and economic models and the next generation of climate impact projections for the agricultural sector. The coordinated climate-crop modelling project (C3MP) is one of the global assessments in AgMIP. C3MP mobilizes international crop modellers for a coordinated investigation of climate vulnerability and climate change impacts on agriculture aim to improve understanding of the impact of climate change on future agricultural production by utilizing site-calibrated crop models to coordinate projections of crop response under probabilistic climate change scenarios.

In line with AgMIP's attempts to develop adaptation to climate change for agricultural sector globally and regionally, the AgMIP-Sri Lanka project investigated the climate change impacts on rice based farming systems and adaptation strategies, led by the Stakeholder Institutes of Department of Agriculture and Agricultural Universities.

Commonly cultivated rice varieties (Bg300, Bg358, Bg357) in major rice growing region (Kurunegala) where information on rice production of farm families are available was selected for the present study. DSSAT model was calibrated using experimental data obtained from the Rice Research and Development Institute (RRDI). Rice yield was simulated for 104 farmer fields for two growing seasons (major and minor) for the base years (2012-2013), baseline period (1980-2010), and mid-century (2040-2069) for five GCMs (CCSM4, GFDL-ESM2M, HadGEM2-ES, MIROC5, MPI-ESM-

MR) of RCP-8.5 scenario. According to the C3MP protocol, 99 sensitivity tests were performed for Bg 300 and Bg 357 for RRDI experimental site in both major (maha) and minor (yala) seasons. Climate sensitivity tests were performed by adjusting historical climate to reflect changes to temperature, precipitation and [CO2].

The base year (2012/2013) RMSE for both seasons range around 1200-1300 kg/ha for observed (major-season 4289*kg/ha*; minor-season 3883*kg/ha*) vs simulated using DSSAT (major-season 4888*kg/ha*; minor-season 4410*kg/ha*). Compared to baseline period (1980-2010), a significant yield reduction of 14%, 12%, 22%, 12%, 17% for the major-season and 31%, 30%, 42%, 28%, 35% minor-season, for the above five GCMs, was observed respectively. C3MP Coordinators provided a bias-adjusted MERRA Reanalysis weather time series corresponding to the site. DSSAT model predictions were submitted via a provided template to the C3MP Coordination team. The archived results were vetted and fit with an emulator to estimate yield response surfaces. These response surfaces may then be used to analyze the impacts of projected climate changes.

The yield forecasting under selected GCMs for midcentury and 99 sensitivity tests for RRDI for commonly grown rice cultivars include probabilistic assessments of climate change impacts and the evaluation of key agro-climatic vulnerabilities. By coordinating these experiments, the C3MP community will also be able to produce regional and global maps of key climate impact metrics and indicators. C3MP results will contribute to high-impact publications and data products.

Key words: Rice production, climate change impacts, food security, adaptation, climate sensitivity