Sustainability of crop production systems in Thailand under future climate conditions

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Abstract

Agricultural systems are sensitive areas which would be influenced by the projected global warming and associated climate change. Despite uncertainties about the precise magnitude of climate change on regional and local scales, an assessment of the possible impacts of changes in key climatic elements on our agricultural resources is important for formulating response strategies. We present current research activities on sustainability of rice and sugarcane production systems under future climate scenarios using the CCAM model. In Thailand, rice and sugarcane cover approximately ten and one million ha, respectively, and support livelihood and drive the economic growth of rural and urban communities.

The CCAM regional climate model predicted that, during 2006-2024, the annual rainfall at Khon Kaen and Chiang Mai should increase by 20% and 50%, respectively, as compared to the annual rainfall during 1985-1999.

The DSSAT-CANEGRO 3.5 sugarcane model predicted similar ranges of cane yields for both locations. In Khon Kaen, U-Thong 2 and K84-200 sugarcane varieties gave a yield range of 29-52 and 39-51 Tonnes cane per hectare, whereas yields in Chiang Mai area are predicted at a lower range of 23-50 and 24-49 t/ha, respectively.

The CERES-Rice model predicted similar ranges of yield for both locations. In Khon Kaen, NSPT and RD7 rice varieties gave a yield range of 725-3,038 and 844-4,013 kg ha^{-1}, whereas in Chiang Mai area the model predicted a higher yield range, i.e., 2,700-7,883 and 3,200-10,213 kg ha^{-1}, respectively. However, one should bare in mind the predicted amount of rainfall and the relationship of more incidents of insect pests.

Both sugarcane and rice production systems are the major land surface modifications and will shape the Thai ecosystems in the coming decades. New incentives and policies for ensuring the sustainability of agricultural and ecosystem services will be crucial if we are to meet the demands of improving yields without compromising environmental integrity or public health.

The CDSS interface was designed to provide link between DSSAT4 models, using MapObject based GIS package, and the spatial databases to simulate crop yields and production at the provincial and watershed scales. The interface can be used to estimate yields and economic variables associated with different management practices under various climate scenarios for sustainability assessments. Simulation results can be analyzed using tabular statistics and thematic maps.

There is, therefore, potential and encouraging results to continue work on the simulation of complex sugarcane and rice production systems. Through international efforts such as ICASA, we will continue to improve the model's capacity in simulating the effects of pests on yield, which will allows users to improve model accuracy for simulation needs. We also will continue to improve the linkage between the model and user's interface in local languages such as Thai, Laos, and Vietnamese languages. Local languages are very important since more growers can be trained to use the model and the interface and more tests on the model can be carried out by the farmers and farmer associates.

KEYWORDS: ICASA, DSSAT4, CCAM model, CDSS interface, climate change, sustainability, rice production systems, sugarcane production systems.