Course profile

Course code: CSA 5103
Course title: Crop Modelling
Credit hour: 2; Total Lecture: 32

Rationale:
Agricultural systems in coastal Bangladesh are vulnerable for climate change. Without adaptation to these changing conditions, food production could significantly reduce, affecting food security. During this course, students will learn how to quantify the effects of climate change on crop production. First, students will analyse how changes in weather, including temperature extremes and rainfall distribution, will impact crop yield using a crop growth simulation model. The analyses will be performed in the standard WOFOST model (/), and to be more specific, for the practicals Jupyter notebooks will be used (https://github.com/ajwdewit/pcse_notebooks). In the second phase of the course, we will focus on rising sea levels and salinization. The students will learn how to quantify salt accumulation in the soil and its effect on agricultural crops with the Swap-Wofost model.

Objectives: At the end of this course, the students will

(i) be able to explain the effects of climate change on agricultural production coastal Bangladesh;
(ii) be aware of existing adaptation practices and be able to explain how they may enhance agricultural production
(iii) simulate crop growth in the standard WOFOST model and the SWAP-WOFOST model;
(iv) use crop simulation models to evaluate the effects of both climate change and adaptation measures on agricultural production;
(v) interpret model results and uncertainties
(vi) visualize and communicate model results

Learning objective	**Course content**	**Teaching Learning Strategy**	**Assessment tools**
Describe the essential processes that are important in crop-climate interactions	Eco-physiological understanding of environmental (climate) effects on plants and crop production, including: 1) temperature, 2) water and 3) nutrients	Lecture Reading Q&A	Exam
Describe diverse adaptation options to minimize production risks in various farming contexts	Adaptation strategies in Bangladesh and abroad: crop choice, soil- and water management. Linking adaptation strategies to various farming- and environmental contexts.	Lecture Reading Q&A	Exam

Analyse the impacts of climate variability and change on agricultural production systems	Simulate crop growth in the standard WOFOST model and the SWAP-WOFOST model. Evaluate the direct effects of climate change (temperature, precipitation extremes, etc.) with the standard WOFOST model. Analyse the indirect climate effects (salinization) with the SWAP-WOFOST model.	Computer practical	Assignment Exam
Analyse the effects of various adaptation measures on agricultural production systems	Incorporate adaptation measures in the crop growth simulation models. Interpret the results and the uncertainties to evaluate the effectiveness of these measures in various contexts.	Computer practical	Assignment Exam
Visualize and communicate model results	Create a scientific poster from the results of one of the assignments. Visualize the results to make them attractive and easy to understand.	Lecture Computer practical	Poster presentation

References:

https://wofost.readthedocs.io/en/latest/_downloads/3c9337e7ab23207e5a5819689c79a889/WOFOST_system_description.pdf

Diepen, C.A., van, Wolf, J. and Keulen, H., van, 1989. WOFOST: a simulation model of crop production. Soil Use and Management, 5: 16-24.

Timsina, J., Wolf, J., Guilpart, N., Van Bussel, L.G.J., Grassini, P., Van Wart, J., Hossain, A., Rashid, H., Islam, S. and Van Ittersum, M.K., 2018. Can Bangladesh produce enough cereals to meet future demand?. Agricultural systems, 163, pp.36-44.

Wit, Allard de, Hendrik Boogaard, Davide Fumagalli, Sander Janssen, Rob Knapen, Daniel van Kraalingen, Iwan Supit, Raymond van der Wijngaart, and Kees van Diepen. “25 Years of the WOFOST Cropping Systems Model.” Agricultural Systems 168 (January 1, 2019): 154–67.

https://www.wur.nl/en/Research-Results/Research-Institutes/Environmental-Research/Facilities-Tools/Software-models-and-databases/WOFOST.htm

https://www.wur.nl/en/Publication-details.htm?publicationId=publication-way-353232393830

https://pcse.readthedocs.io/en/stable/