LIÈGE université
Gembloux
Agro-Bio Tech

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Madame KET Pinnara,

Titulaire d'un diplôme d'ingénieur en génie rural,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 22 janvier 2019, à 14 heures précises (personne ne sera admis après cette heure),

en l'auditorium TOPO 1 (Topographie, Bât. 3),

Passage des Déportés, 2, à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Assessing irrigation water saving for crop production based on combined in-situ and modelling approaches in Cambodia ».

Le jury est composé comme suit :

Président : Prof. P. LEJEUNE, Professeur ordinaire,
Membres : Prof. A. DEGRE (Promoteur), Prof. S. GARRE, Prof. J.-T. CORNELIS, Dr C. OEURNG (Institute of Technology of Cambodia), Dr S. VANG (Deputy Director of Cambodia Agriculture Research Development Institute, Cambodge).

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Summary

In recent decades, climate change is the major constraint for agricultural production in Cambodia and leads to future concern of food security. Improving effective irrigation management, especially for the non-rice crops is urgently needed. The aim of this thesis is to contribute the development of vegetable production during dry season in Cambodia. The specific objective of the research is to optimise irrigation water use on-farm level in Cambodia. Specifically, we focused on developing methodology on i) characterising soil hydraulic properties and ii) exploring the best irrigation scenarios for vegetable irrigation. Two growing season experiments of lettuce were conducted during 2016 and 2017 in five farm fields in Chrey Bak catchment, in Kampong Chhnang Province in Cambodia. Two approaches have been made to achieve the irrigation water saving purpose. Firstly, a method using soil water model, HYDRUS-1D was used to estimate inversely the soil hydraulic functions in the unsaturated zone. The field data (i.e., irrigation, weather, and lettuce growth data, soil permeability) of the five experimental fields having different soil textures, loamy sand, sand and loam were collected and measured to feed the selected model. To generate the soil parameters, primary inverse data for the objective functions are measured soil moisture dynamic and soil water retention curve using combined soil moisture sensor, 10HS and soil potential sensor, MPS-2. Our analysis results showed that the inverse modeling have successfully estimated the soil water retention curve and soil water dynamic with a reasonable accuracy by comparing to the observed values. However, the uncertainty of the simulation and data measurement were observed. In the second study approach, to explore the irrigation water saving, the water driven model, AquaCrop was selected for simulating irrigation scheduling under water-stressed conditions. At the first step, the crop growth parameters of lettuce were calibrated by using field data from two fields having sand and loam soil textures during experimental growing season in 2017. Then, the scenarios of irrigation scheduling having two main categories were developed. The first category varies the thresholds of stop irrigation points under different no water stress and stress conditions. The second category involves using deficit of field capacity also under water stress condition. The results of the calibration of the crop growth were quite satisfying. Meanwhile, the results highlighted limitations of model, particularly in defining heat stress and root depth of the vegetable. Furthermore, results of irrigation scheduling scenarios show the capabilities of the model to point out the optimum water saving alternatives under limited water conditions. Overall, this PhD thesis opened the perspectives of improving irrigation management for increasing crop productivity in Cambodia.