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[4] CGIAR, IFPRI This model is being developed as part of the IFPRI BioSight project, coordinated by Siwa Msangi, in collaboration with CIHEAM-IAMM.

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1 Introduction

The development of bio-economic models responds to the need of tools able to represent in a consistent way different dimensions of Agricultural Systems, integrating different scale levels as well as impacts concerning agro-ecologic issues, socio-economic ones and indirect effects of other nature, such as global environmental impacts.

Most bio-economic models use outputs of bio-physical models (Flichman, 2011) to generate part of the parameters of the model. A small number of models including the bio-physical processes in the same code, usually apply empirical bio-physical relations, adapted only to the specific case that is studied. When bio-physical models are used to generate data to be introduced in the bio-economic model, it is not possible to fully simulate the dynamic interactions between the economic and the bio-physical dimensions of the whole model. In the majority of cases, the bio-economic models of this type are static, creating to some extent a lack of consistency.

On the other side, when only a simplified empirical approach is representing the bio-physical issues, the model cannot be easily adapted to a different context (Holden *et al.* 2004)

The development of DAHBSIM uses an accumulated experience in this type of models, and intends to introduce some specific improvements in relation with previous work in this field, essentially through its dynamic character and the possibility of application in different contexts, as it is developed in a generic way using a modular structure.

DAHBSIM is designed to capture some key features of developing countries rural areas. Some aspects of this work present a particular interest from a methodological perspective:

The fact that DAHBSIM is built in a modular and generic manner allows applying it in different contexts. The potential user will be able to use all or part of the modules. The architecture of the model may include new modules if it appears necessary to do so. The development of this model is done in the context of collaboration between IFPRI and CIHEAM-IAMM.

2 Materials and Methods

DAHBSIM is a model applying a Dynamic-recursive optimization approach: an inter-temporal optimization is performed, the results of the first period are observed and recursive equations (Summary biophysical model) are introduced before the second optimization, for taking into account the effect on resources of the production choices of the previous year. This procedure is repeated for all periods. There is a moving horizon then, the model takes into account future but reinitializes at each iteration the initial conditions, changed as a function of the previous choice. Inside each step, the inter-temporal optimization does not take into account the changes in the state variables (yield and externalities per activity) defined by the previous use of the soil. These changes are introduced in the following step, when state variables (water and nitrogen content of the soil) are reinitialized. Only the first year results of each iteration are considered at the end.

The model simulates farm household level decisions; market prices are defined exogenously.

Model features are coded in a generic and modular way to ease application to different farming systems and household types. The core modules comprise the common features of the model: (1) objective function; (2) cropping module; (3) biophysical module; (4) farm module and (5) household module.

Apart from these core modules, all other modules can be activated or deactivated depending on the application at hand. Presently, a livestock module is also available. Modules for perennial crops will also be developed. Thanks to its modularity, DAHBSIM can be easily extended and adapted to answer new policy questions.

The main outputs generated from DAHBSIM are land use, production activity levels, input use, farm income, time allocation decisions, household food and non-food consumption, and environmental externalities (as joint products). These outputs are translated into indicators to measure the impact of policies.

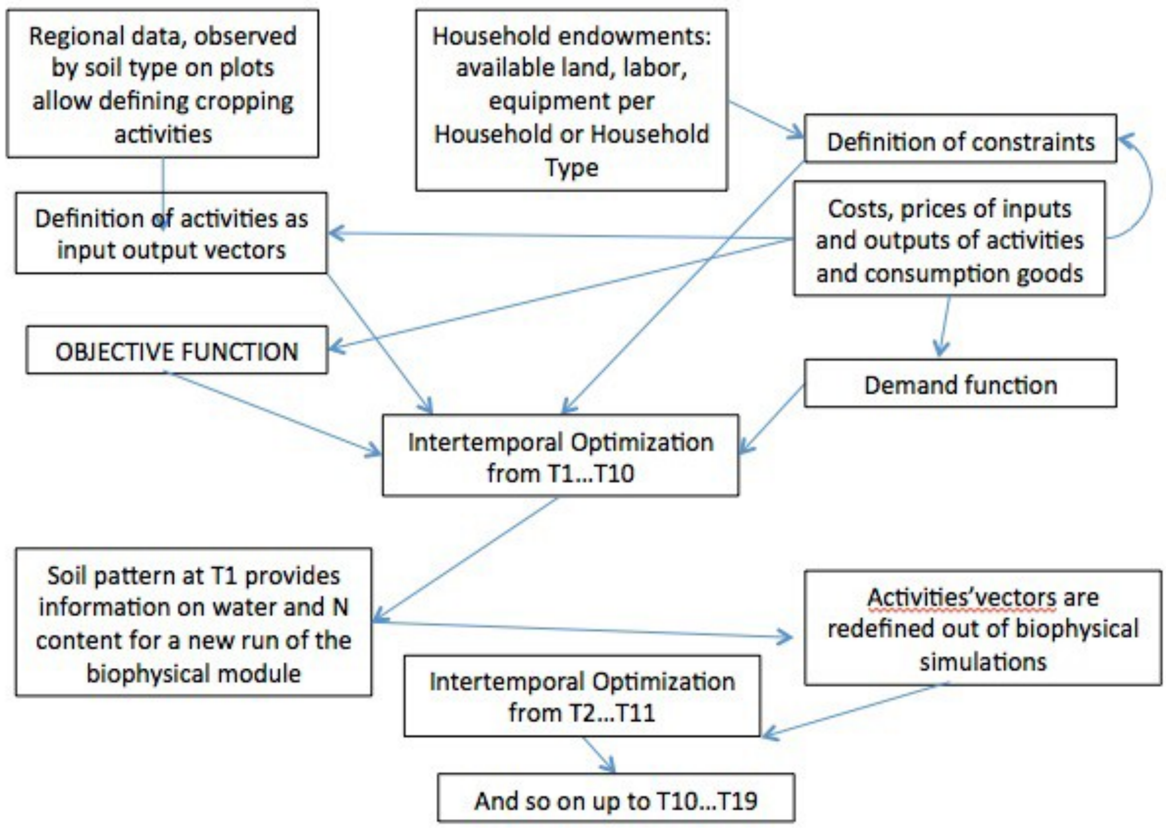
DAHBSIM can be applied to individual households (either real households or household types) or spatial regions. Results are provided at the household level or aggregated to higher spatial scales (department, region…).

The Dahbsim model has a modular structure.
• The biophysical module computes in its first part the water stress coefficient in year 1. And in its 2nd part it computes the water stress coefficient for the next years. A similar procedure is used concerning nitrogen.
• The crop module contains the equations describing the cropland allocation, the labor use, the rotation constraints, etc.
• The farm module contains the equations defining the resources constraints.
• The household module contains the equations defining household demand and time allocation
• A livestock module computes the feed requirements of different type of animals and has consistent feed-backs with the rest of the model, taking into account balances of feed consumption as well as manure for crop fertilization.

3 Results

Actually, there are not still results of any application; the results are the current development of the model. The following scheme shows the principal flows of the model, only considering cropping activities.

Simplified DAHBSIM scheme for cropping activities



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