April 1st, 2022
12:00AM-13:30PM CET

Minutes of the Modeling Work Package Meeting

Organized by C. Dionisio Pérez-Blanco Ramiro Parrado and Arthur Hrast Essenfelder
Writing: Héctor González & C. Dionisio Pérez-Blanco

Meeting Agenda

1. Introduction
2. Session 1: Multi-system modeling framework – The TALANOA Approach
3. Session 2: Refinements to the TALANOA modeling approach
4. Next steps discussion

Meeting Attendants (19)

C.Dionisio Pérez-Blanco (USAL), Arthur Hrast Essenfelder (CMCC), Ramiro Parrado (CMCC), Héctor González-López (USAL), Laura Gil-García (USAL), Francesco Sapino (USAL), Gabriele Standardi (CMCC), Nina Graveline (INRAE), Paolo Mazzoli (GECO), Marta Debolini (INRAE), Issam Nouiri (INAT), Mohamed Fethi Ben Hamouda (INAT), David Dorchies, Ángel Sánchez (USAL), Roya Mourad (AUB), Rim Hazimeh (AUB), Abddrabbo Shehata (GPAI), Samir Sahal (CRDA Médenine), Guillaume Thirel.

Introduction

C. Dionisio Pérez-Blanco starts the meeting with a briefly presentation of the relevance of the WP3 which is focused on the modelling framework that are supposed to be used in Talanoa Water Project. Although this modelling framework is flexible, will must be developed considering some basic features that should be done by all water labs. It is proposed the protocol-based modular framework, which has already been used over the last five years in Spain and Italy and consists of the aggregation of modules such as climatic, hydro(geo)logic, agronomic, micro-, and macro-economic by bidirectional soft links. This modelling framework is supposed to be used for all water labs, so the collaboration among the different water labs will be needed in order to help those one that have not used this modelling framework.

Session 1: Multi-system modeling framework – The TALANOA Approach

Part 1

Ramiro Parrado presents the economic modules within a multi-system modeling framework. In this presentation are shown the different analysis scale (microeconomic and macroeconomic) as well as the way to link them (holistic vs modular), highlighting the advantages and disadvantages of using the different approaches. The holistic modelling approach allows an effective representation of the interdependencies between micro- and macro-economic systems, with the integration of the micro-economic system within the macroeconomic model, which avoids the need to assess shocks separately. Nonetheless, there are some limitations such as the limited spatial details and simplifications due to the wide range of study. On the other side, the modular approach, as the micro- and macro-economic modules works separately, allows to represent more detailed results from each module. Another advantage is the viability of representing feedback between both modules. This means on the other side, the need of calibrate and execute each system separately.

Then the CMCC's ICES (regionalized CGE model) is presented. This multi-region, multi-sector computable general equilibrium model is based on GTAP model and database and is characterized by representing the iterations of agents and markets within countries and as international trades.

As a modular linking approach, there are two main ways to proceed. The first one is the one directional link where the effects of impacts and policies are assessed allowing to produce aggregated indicators (e.g. GDP). Another alternative is to consider two-way feedback approach, in this case the information is exchanged between both models, the Partial Equilibrium model and CGE.

The protocol of coupling micro- and macro-economic models works as follow: i) the water policies are charged to the micro-economic model; ii) then the micro-economic model computed what are the changes in the value added; iii) these outputs are used as inputs in the Regionalized CGE model which outputs changes in crop's prices that change the original water policies. This loop protocol is applied until the feedback process reaches a convergence. Another example of application is using the land use changes instead of using changes in GVA.

Part 2

After the Ramiro Parrado presentation, Arthur Hrast Essenfelder presents the hydrologic-microeconomic modelling system. Although this presentation shows a specific methodology with specific models, it is flexible to be used with different models or modules considering the different specifications by each water lab.

The way of developing the integration between the economic and hydrology in this case is usually used at a watershed scale or river basin scale but could be developed for a wider scale. This framework connects three main modules: i) the microeconomic

module which is fed with a policy shock (e.g. reducing water use available);ii) the macroeconomic module that uses the land use changes output from the microeconomic module and give back as output the crop price changes (this is called human-human system), this trigger into new changes in land use through the microeconomic module that are used as input in the hydrologic module; iii) finally the hydrologic module gives feedback to the microeconomic module using as outputs the water available (this is called human-water system). This framework is able to be initiated with policy shocks also in the macroeconomic and hydrologic module, following the same loop.

Within this modelling framework SWAT is presented as the hydrologic model. This model uses at the first step the topography, soil type and land use of the area for the watershed delineation and its subdivision into sub-basins, so this information overlayed together form the HRU i.e. Hydrological Response Units. Into this network the Agricultural Water Demand (AWDUs) are added for adding the micro-/macro-economic information to the previous HRU becoming it into HERU.

Different results obtained in previous studies are shown for demonstrating the relevance of using this modelling framework.

Q&A

Paolo Mazzoli asks about the customization of the SWAT model in order to compliment hydrology and economy within the model, then Arthur Hrast Essenfelder replies that is not necessary to use SWAT for linking both economy and hydrology inputs, it depends on the study area characteristics (e.g. in groundwater dynamics studies, SWAT is not the most indicated), the main thing here is to understand how the protocol works and be able to reproduce it with different hydrologic or economic modules. Arthur Hrast Essenfelder highlights as well that there is not feedback between human and water systems, the impacts of the humans over the environment are considered external.

To this discussion C. Dionisio Pérez-Blanco explains that the outputs expected from each water lab through this modelling approach are presented in the Task 3.2.

Marta Debolini asks about what variables are considered for water resources management in SWAT apart of the land use changes, due to in Frances they have permanent crops. To this Arthur Hrast Essenfelder answers that it depends on the different hydrological model that are used, in the case of SWAT it is possible to assign the growing crop season and add information referring to the fertilizers, but in the case of this modelling framework where we must to link the economic and hydrologic modules, the variables used are the water used by farmers for irrigating and which sort of crop is growing in each specific piece of map.

The second question of Marta Debolini is regarding the way of introducing the economic agents into the hydrologic module, ¿is it possible to represent the farmers crop choice? To this C. Dionisio Pérez-Blanco replies that indeed the crop change choices are represented since the farmer behavior is the main variable from the micro- and macro-

economic models and in a modular approach like the case of the hydroeconomic approach is the key variable to be exchanged between both modules.

Nina Graveline suggests incorporating agronomic model in order to assess the crop production in more detail beyond just the water stress. Arthur Hrast Essenfelder adds that SWAT is able to simulate this crop production as well.

Issam Nouiri asks about how to proceed with crops of trees that depends on the groundwater instead of hydrologic dynamics. The second question is referring to with sort of economic information is needed for the economic agent layer for overlaying it with the land use, soil type and slope layers in SWAT. Issam Nouiri adds that in their case study they barely have surface water, they are focus on the groundwater availability and they use to this end a coupling between WEAP and MODFLOW for manage the water availability and simulate the groundwater dynamics, ¿ Is the integration of SWAT needed in this case?.

Arthur Hrast Essenfelder answers that in this case for sure will be needed to change the hydrologic module. It is a good point to start the research investigation to know how to link the groundwater with the economic module. To the second questions replies that the economic information is a special overlayed of the economic agent with the characterization of the study area. In the case of Spain there is not information for each piece of land, there are aggregation of farmers that behave in a same way. To the third questions Arthur Hrast Essenfelder thinks that is not necessary to add SWAT to the coupling between MODFLOW and WEAP and offers himself to have a call in order to understand how this models work and help with the integration with the economic modules.

C. Dionisio Pérez-Blanco adds that it has no sense to change all models that Issam Nouiri are using, just keep using the current model and improving them with the macroeconomic that could have a better suitability with WEAP.

Session 2: Refinements to the TALANOA modeling approach

Ramiro Parrando presents the data exchange in TALANOA-WATER. First, it is highlighted the possibility of adding another output from the micro-economic model which serves as input to the macro-economic model as suggested Nina Graveline. Another question is the addition of more macroeconomic model's outputs to the crop's prices such as input prices (e.g. primary factors, fertilizers, etc.), so any suggestion will be helpful. Then the alternatives of different setups are shown. These alternatives are the static setup which triggers into short-term horizon or Dynamic setup which triggers into medium- to long- term horizon and could be possible to assess the Climate Change impacts. In this last case would be needed the consideration of including dynamics in model-linking. To linking the models different sort of links are suggested such as recursive linking where there is not a convergence in each year and link with convergence in each year. Another alternative is adding an external impact like Climate change.

Nina Graveline suggests adding fertilizers as the microeconomic model outputs.

C. Dionisio Pérez-Blanco presents the main two key challenges of TALANOA WATER Project. The first one is the system linking and how to link different modules for water management. The second challenge is the uncertainty assessment, so the suggested procedure in Talanoa water should be the development of more than one model for making ensemble multimodel that allows to assess the model and coupling uncertainty.

Q&A

Paolo Mazzoli asks about what the next step within each water lab should be. C. Dionisio Pérez-Blanco answers that the idea is to start a round of contacts with all water labs in order to identify the different characteristics and needs from each case study and stablish the approach within the proposed framework. Another point is take a conversation with stakeholders as well regarding to the selected approach and discuss the most needed scenarios for each case study.