EC/FAO programme on
"Linking information and decision-making to improve food security"
(GCP/GLO/243/EC)

Workshop on FAO-MOSAICC
Rome, 17-18 Feb 2011
Main lessons from the discussions

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In the framework of the EC/FAO Programme on "Linking information and decision making to improve food security" (GCP/GLO/243/EC), the FAO Climate Impact Team, within the Climate, Energy and Tenure Division (NRC), is developing an integrated toolbox called FAO-MOSAICC (for MOdelling System for Agricultural Impacts of Climate Change) to asses climate change impacts on agriculture at national levels in a view of decision-making support.

In the framework of the development of FAO-MOSAICC, a 2-days workshop was organized on the 17th and 18th of February 2011 at the FAO Head-quarters in Rome. The first day consisted in a meeting with the partners involved in the development of the models and the different components of MOSAICC in order to review together the achievements realized during the first year and discuss the way forward. The second day was dedicated to the presentation of the prototype to potential users. Discussion sessions were also organized to discuss the implementation of MOSAICC from the user point of view.

During these two days, a number of questions, issues, ideas and suggestions were raised and discussed with the participants. This report recounts the main themes that emerged from the discussions.

For additional information on FAO-MOSAICC please visit the website: www.fao.org/climatechange/mosaicc.

1. Day 1 15.00-16.00: Discussion on validation and impact study design (Moderator: H. Kanamaru)

The objective of this session was to discuss the different issues related to design of integrated impact assessment studies and the conceptual questions pertaining with the utilisation of models output to the models downstream.

One of the main topics during this session was the issue of ***spatial resolution and extent*** throughout the chain of models. As these two factors can be different from one model to another consistency must be a concern, especially when running the most upstream models. Moreover, the level of abstraction must be consistent with the scale of the study and the purpose of the analysis. For instance the level of abstraction will be different if the focus is on a country or on a district. The level of generalization is limited by the characteristics of the models. Indeed each model has an associated range of spatial resolution for which it has been designed to run at and for consequently which the results are the most accurate and the most meaningful. The same question applies for the ***temporal scale and resolution*** of the study. Another aspect to consider in the determination of the spatio-temporal scale and resolution of the impact assessment studies is the amount of data generated. This can be a constraint when doing large-scale processing.

A second important question was the issue of estimating the ***uncertainties*** generated by single models but also their behaviour throughout the chain of models. For some models estimation of the uncertainties is rather straightforward (e.g. downscaling, AURELHY, yield functions), for others the estimation is less obvious. One workaround to assess the levels of uncertainty in the system is to perform a set of simulation with artificially modified input data (e.g. by +/- 5%), or with combinations of different inputs/assumptions/scenarios and compare the results.

The third main question was related to the need for ***guidance*** for the users. Indeed, the models and the system as a whole has a certain level of sophistication and guidance is indispensable in order to understand how the models work, how they are integrated in the system and how the data will be used down the chain. Guidance is also needed for the two topics described above, namely the definition of the spatial-temporal scale and resolution and the estimation of the uncertainties.

Regarding to the flowchart a number of participants raised the question on how to link directly the crop models together with the hydrological model. In the current version of the flowchart, the outputs of both parts are sent to the economic model. The reasons of this choice are multiple. A full ***integration of the crop and the hydrological models*** require to model a number of additional processes (location, types, capacity and efficiency of irrigation schemes, water transfer from harvesting facilities to irrigated areas, ground water, water uptake, choices on the allocation of the water resources between agriculture and other sectors such as households and industries) at a very fine spatial and temporal resolution to be utilizable by the crop models. A consequence of this is that the calibration data would be hard to gather, if only it exists, and the number of assumptions needed to make future projections would be very large. This level of sophistication is very interesting but not so relevant for country-wide studies. From the MOSAICC development point of view, such an integration of the models in the state they currently are would be time and resource consuming.

Instead, the solution proposed in the current MOSAICC is simpler and more flexible but also requires a bit of analysis from the modeller. The projections produced by the crop models should be interpreted as the yield (tons/ha) that would be observed in the different administrative level based on the characteristics of the crops, the local conditions and under climate change scenarios (plus a few other assumptions). In case of irrigated crops, the models projects yields under the assumption that the crop does not experience any water stress at all and computes the water requirement. What the model does not do is to determine where the different crops are cultivated and over what area (as there is no land use model), whether they are rainfed or irrigated. However the productions for each crop (crop mixes) in each sub-national division and the water consumption for the irrigated crop can be dealt with in the economic model, using constraints on agricultural land and water use. With its higher level of aggregation, the number of assumptions needed (basically on share of the water resources allocated to irrigation and efficiency of the irrigation system) is lesser but the simulation is still meaningful at national level.

Finally an interesting question from the user point of view is to analyze what are the ***weights*** of the different choices and scenarios used at different steps along the chain in the final outcome. The system can be used to make this kind of analyses, for instance by testing the sensitivity of the models and the system as a whole to some of the parameters.

2. Day 1 16.15-16.45: Discussion on training and capacity building (Moderator: F. Delobel)

This session was planned to discuss the different aspects of the installation of the system and the capacity building from the trainer point of view. Most of the discussion was about the deployment of the system and the software architecture among the national institutions.

One first suggestion from the participants was to write up an exhaustive ***list of requirements*** for the host institution: hardware, software, human resources etc.

An important debate took place on the pertinence of the (full) ***decentralization*** of the system. The question is: should the system be duplicated in every country where it will be used? A number of arguments in favour of a full centralization at FAO headquarter were put forward. Firstly the centralization facilitates the control, the management and the maintenance of the models and the database. It has some clear advantages for bug fixing and updating the software: these operations should be done just once, however large the number of users. Moreover it would help solving a number of problems related to the capacity building component (installation of the system, training on the maintenance of the system) and reduce the cost of the deployment.

A complete centralization of the system also has some drawbacks. Firstly the centralization poses some problems related to the ownership of the knowledge and the data. Secondly the number of users and the amount of data generated by the models may rapidly bring problems of memory space and congestion on the central server. Internet connection and data transfer may be an issue in some countries, whereas a decentralized system could work on local networks. Finally the decentralization of the system increases the sense of ownership necessary to ensure the sustainability of the system, its exploitation by the national institutions and its consideration by the decision makers.

Intermediate solutions can also be considered to solve this question: some of the components such as the downscaling tool could still be centralized (in that case in Rome or in Santander). Alternatively, the system could be hosted by regional organizations.

Another comment was made on the development of the system and the interface. Orienting the development towards the user needs and possibly involving some users in the development would favour its sustainability in the countries.

3. Day 2 11.30-12.30: Typical country-scale implementation of the toolbox: Scientific contribution (Moderator: R. Balaghi)

This session was aimed at debating on what the needs of the users are, how MOSAICC could be used to help addressing some of the concern by generating data and what the requirements to deploy the system are. The discussion focussed mainly on the necessity of developing a use case and documenting the deployment in Morocco.

The ***use case*** would consist in a complete description of potential series of interaction between the system and the users, including the procedures and the protocols to produce various output relevant for the end-users. Comprehensive description of the deployment of the system, chronology, what can be done and what cannot also need to be described. The use

case would help showing what is required in terms of data, software, hardware, human resources and institutions, how the different players would be interacting, performing simulations, exchanging data, and what are the possible outputs along the chain. The use case would be very useful to show users the potential of MOSAICC for their own needs, as well as to anticipate on difficulties related to the deployment and the use of the system in a country.

Another main theme of the session was the importance of building a strong multi-disciplinary ***working group*** gathering experts from the institutions involved to run the models as well as the end-users. This working group should be able to link with the needs of the end-users and to coordinate the production of data. Clear identification of the key actors is essential before the deployment of the system. This working group should also be a starting point for capacity building. Inclusion of end-users in the process of capacity building together with the modellers can also favour the sustainability of the system and the full exploitation of its potential.

Some participants showed interest in a ***desktop version*** of the models. This is not a priority for the moment but in the future this can be developed, and it can be useful for many kinds of application, including education. One possible disadvantage is that the models alone have no graphical interface. Installing the whole system on a desktop computer maybe very troublesome knowing the large amount of software to install.

4. Day 1 16.15-16.45: Typical country-scale implementation of the toolbox: capacity building and organizational matters (Moderator: R. Gommes)

As many of the issues regarding to the deployment of the system and capacity building had been discussed earlier, the discussion diverted towards two related themes: the application of the system and its sustainability after installation in a country.

About the application of MOSAICC participants shared thoughts on how to connect with the ***farm level*** and to take account of their perception and their concerns. Farmers are indeed the final link of the chain who will have to cope with climate change impacts on their environment. Linking up with the stakeholders at different levels and the adaptation community can be useful in that perspective.

Besides its ‘classical’ use (impact studies), MOSAICC is also a mean to show what the gap to fill in a country are in terms of data and infrastructure (e.g. weather station network) and to identify measures to improve them. A deeper thinking on the ***other applications*** and ways of exploiting the potential of MOSAICC would be useful to promote the system to governments and institutions as well as to identify the institutions that could make the best use of it.

A last point related to the application is the question on how to transform the model outputs into ***practical information***, readily utilizable for the stakeholders. This gap must be taken into account in the strategy for system deployment and capacity building. A clear strategy is needed to identify the adaptation practitioners, stakeholders and decision makers, their needs and to define procedures involving the different players in order to bridge the gap between model outputs and actions in the field.

As far as the ***system sustainability*** is concerned, two aspects of the deployment were put forward to keep the system alive: the development of a sense of ownership and reaching a

critical mass of users. The first aspect, already discussed the day before during the discussion on the centralization of the system, can be increased by including the users in the development and the installation of the system. In addition, the critical mass of users could be reached by disseminating the system also in universities. This would also help the users becoming familiar with the tools during their curriculum. The discussion also treated the question of what would be the best host institution among universities and ministries and governmental agencies. The main arguments in favour of the ministries and governmental agencies are their access to the data, their mandate and their direct link with the decision makers. The main drawbacks are the possible volatility in priorities and possibly staff. Universities on the other hand, in addition to the increase in sense of ownership and number of users that they can generate through teaching, usually have experts to run the model and good technical capacities to maintain the system. They usually have perspective on longer terms. However their access to the data and their consideration by the stakeholders may be somewhat problematic.

Finally, the role of the ***regional centres*** for the sustainability of the system but also for data collection, sharing and harmonization, technology transfer, dissemination of the tools, centralization of the system, training and links with the decision-makers was discussed. Regional centres can also be useful partners to initiate dialogs among stakeholders.

5. Other issues and questions raised

In order to improve the modularity and the stability of the system and to facilitate bug tracking and future updates the technical requirements for the software can be reinforced. A list of rules and technical characteristics should be written-up and followed by the model developers for the future versions of the models as well as the new ones.

Morocco has been chosen as country for the use case and the deployment test. To what extent is this country representative of all the possible countries for which MOSAICC is intended for?

Conclusion and steps forward

The high level discussions held during the workshop yielded a large number of valuable lessons for the deployment of a system such as MOSAICC and it maintenance among national institutions. The next steps in the development of MOSAICC will be to finalize the integration of the tools and to consolidate the documentation, then to organize a round table in Morocco with all the potential partners at national level to discuss the needs of the different parties, what MOSAICC is capable of, how MOSAICC can be useful to address these needs and the paths to build a working group, deploy the system and work with it in a country in the long run. This full test in Morocco will be documented and serve as a reference for installation of the system in other countries. In addition, collaborations will be established with IRI, AgMIP, Agrhymet (CILSS) and IFAD to develop further the system and to deploy it in new countries.

Annex 1. Agenda

Day 1: Wrap-up on the toolbox development and integration

9.00-9.30	Status of the project *F. Delobel (FAO-NRC Division) and M. Evangelisti (Mesinet Servizi Informatici)*
9.30-10.00	Statistical downscaling tool for climate data *J.M. Gutierrez (Santander Meteorology Group, University of Cantabria)*
10.00-10.30	AURELHY R package *T. ElHairech (DMN, Morocco)*
10.30-11.00	*Coffee break*
11.00-11.30	STREAM Precipitation-runoff model *S. Peters/A. Vrielink (Water Insight)*
11.30-12.00	AquaCrop stand-alone version *P. Steduto (FAO-NRL Division)*
12.00-12.30	A command line version of AgroMetShell (WABAL) and planting dates with PLD *R. Gommes (JRC-FOODSEC)*
12.30-14.00	*Lunch break*
14.00-14.30	FAO-MOSAICC CGE Model *F. Reynes/O. Kuik (Institute for Environmental Studies, Free University of Amsterdam)*
14.30-15.00	Module integration: server, database, interface *M. Evangelisti (Mesinet Servizi Informatici)*
15.00-16.00	Validation and full-impact assessment study design *Group discussion (Moderator: H. Kanamaru)*
16.00-16.15	*Coffee break*
16.15-16.45	Implementation: trainings, costs and timing *Group discussion (Moderator: F. Delobel)*
16.45-17.30	Future improvements: spatial scale (national to regional), interoperability with crop forecasting software (AgroMetShell) etc. *Group discussion (Moderator: M. Bernardi)*

Day 2: Presentation of the prototype to potential partner institutions

9.00-9.15	EC/FAO programme on linking information and decision-making to improve food security *L. Russo (FAO-ESA Division) and P. Holmgren (FAO-NRC Division)*
9.15-9.30	Introduction of the participants *Round table*
9.30-9.45	Activities of the NRC Climate Impact Team *M. Bernardi (FAO-NRC Division)*
9.45-10.00	Toolbox methodology and software overview *F. Delobel (FAO-NRC Division)*
10.00-11.00	Brief description of the models and Q&A *All the model developers (Moderator: F. Delobel)*
11.00-11.30	*Coffee break*
11.30-12.30	Typical country-scale implementation of the toolbox: discussion on the scientific contribution (minimum data input requirements, resources and expertise needed, possible outcomes...) *Group discussion (Moderator:TBD)*
12.30-14.00	*Lunch break*
14.00-16.00	Typical country-scale implementation of the toolbox: discussion on organizational and capacity building matters (system installation and maintenance, tentative work plan and budget, training...) *Group discussion (Moderator: R. Gommes)*
16.00-16.30	Summary about future collaboration on MOSAICC implementation *M. Bernardi (FAO-NRC Division)*

Annex 2. Participants

Workshop on "FAO-MOSAICC" 17-18th February 2011			
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