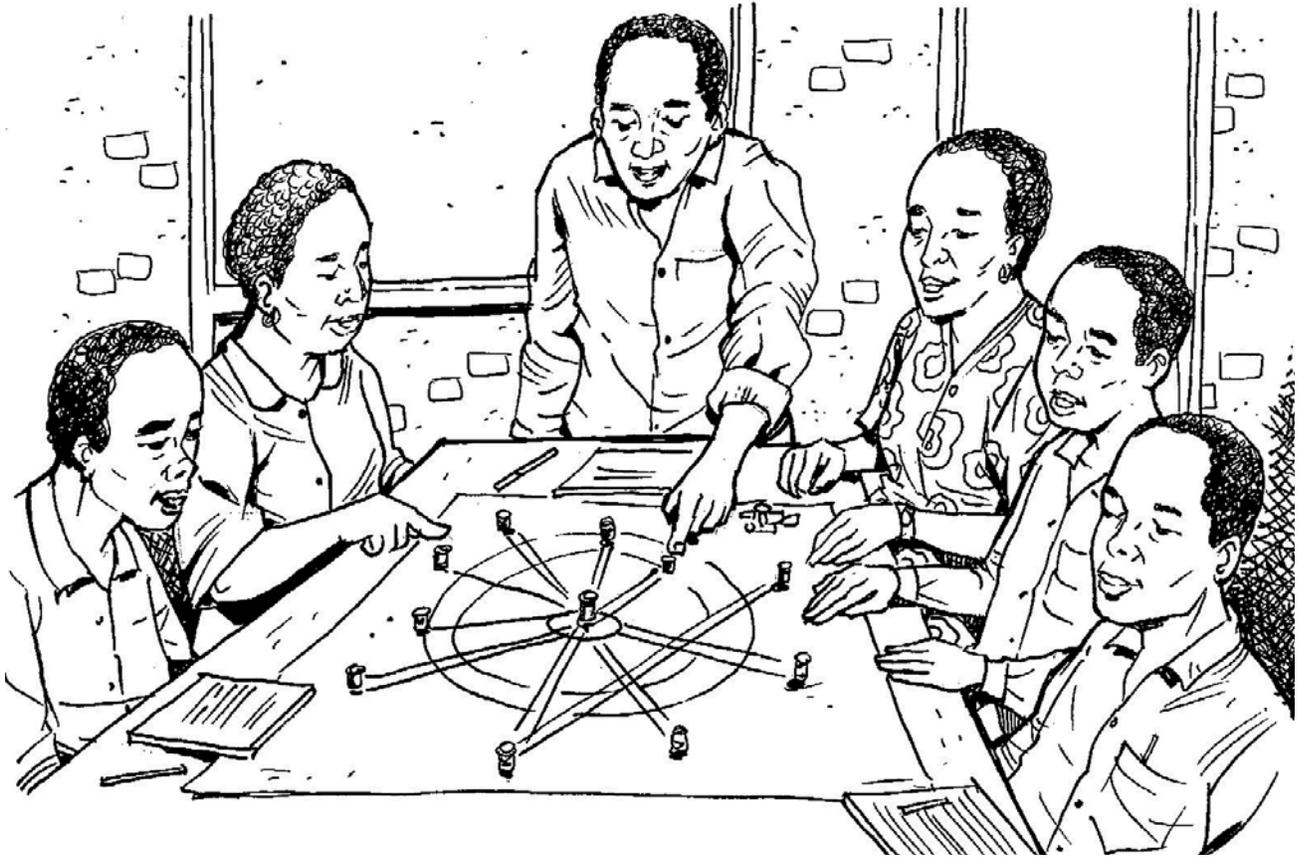# Integrating Governance and Modeling for Better Use of Water Resources

Land and water resources in river basins need to be managed in economically efficient, environmentally sustainable and socially acceptable ways if they are to remain productive. Integrated simulation models, developed in close collaboration with multiple stakeholders, can help. One such research effort by the CGIAR Challenge Program on Water and Food (CPWF) is the project "Integrating governance and modeling". The project made use of computer models and Net-Map. These were found to be very useful in understanding interactions and fitness of solutions in addressing governance problems. Multi-stakeholder governance structures such as river basin management boards benefit from access to policy-relevant information about the economic,

social and environmental impacts of different options for managing water resources. The tools were tested in project sites in the upper east region of Ghana (representing the early stage of basin development) and in the Maule region of Chile (representing the advanced stage of river basin development). The way farmers interact with and react to changes in their economic and natural environments was simulated using computer modeling or the Mathematical Programming-Based Multi-Agent System (MP-MAS) developed by Hohenheim University in Germany. The project collaborated with stakeholders, such as water-user associations and members of irrigation and agricultural administration.

The project also led to the development of an innovative method for research and organizational development, called Influence Network Mapping (Net-Map), to support the establishment of the White Volta Basin Board in Ghana. Net-Map was subsequently integrated in the participatory impact pathway analysis (PIPA) approach and is now being used by international research and development organizations and universities worldwide.

Using Net-Map to work with stakeholders

Net-Map (http://netmap.wordpress.com) is a participatory research method, which combines elements of stakeholder mapping and ranking techniques with social network analysis. The method is particularly suited to find out how much influence different actors have (or had) on achieving defined outcomes, and what the sources of their influence on those outcomes are. Influence as defined in this context is based on Max Weber's definition of power, which holds that an actor can induce others to act according to his or her will, despite potential resistance from those actors. The method can be applied to individual respondents or groups.

In Ghana, Net-Map was applied to help board members to better understand the networks that they needed to rely on in order to pursue their development and environmental goals effectively. The application of the Net-Map method assisted the board in forming strategic partnerships with the district assemblies. Net-Map was also used as a diagnostic tool to analyze policy processes in Chile.

> **Net-Map is user-friendly because it is easy to learn and apply, appeals to researchers and implementers, allows for quantitative and qualitative analysis and focuses on questions that are of general concern as people attempt to achieve goals in social settings.**
>
> **Net-Map has been used in more than 25 projects in Africa, Europe and Asia; in projects involving the World Bank, FAO, IFAD, Red Cross, IFPRI, Inter-American Development Bank, ICARDA, African Peer Review Program, InWent, and ILRI; and in universities in the developed and developing world. Visit (http://netmap.wordpress.com/) for more details.**

> **In 2008, Eva Schiffer won that year's CGIAR Promising Young Scientist Award for developing Net-Map.**
>
> **The idea of developing Net-Map came to Schiffer after being involved in the CPWF PIPA workshop, where each project in the Volta Basin drew a network of actors on which their project had influence. Schiffer's original idea was based on her observation that the relative influence of different partners needed to be included in the network analysis. How Schiffer came to conceptualize Net-Map is an example of the potential for network meetings and workshops to lead to innovation.**

Refined and field-tested agent-based modeling tool using MP-MAS

The MP-MAS is a software application package for simulating land-use changes in agriculture and forestry. It is a combination of farm economic models and several biophysical models to simulate crop yield response. Household- and community-

level surveys were carried out in Chile and Ghana to generate data for MP-MAS. The surveys also provided in-depth data for studies on specific governance problems, using econometric methods. Stakeholder workshops were held regularly to ensure that the computer-based decision tools could be developed and validated in close interaction with the concerned stakeholders.

The project applied MP-MAS to develop a decision-support tool for the two river basin organizations. MP-MAS simulated how farmers interact with each other and react to changes in their economic and natural environment. A key innovation of the project was the development of the tool in close interaction with multiple stakeholders, including water user associations and members of the irrigation and agricultural administration. This interaction, which occurred through individual consultations, workshops and training sessions, ensured that the MP-MAS simulations addressed the needs and priorities of different stakeholders and took their local knowledge into account.

Agent-based simulation models have shown much promise in encouraging stakeholder interaction in natural resource management, especially in combination with role-playing games and other qualitative research approaches. But, to date, no practical experience existed with using agent-based simulation as a 'quantitative' interactive tool. This project is the first that coupled cutting-edge simulation software such as MP-MAS (an agent-based model) with WASIM-ETH (a process-based hydrology model).

Areas of policy change

Making optimum use of the Ancoa Dam

Using MP-MAS helped water user associations and the irrigation administration better understand how the benefits from investing in the proposed Ancoa Dam in Chile will be distributed. This will assist both the farmers and the administration to
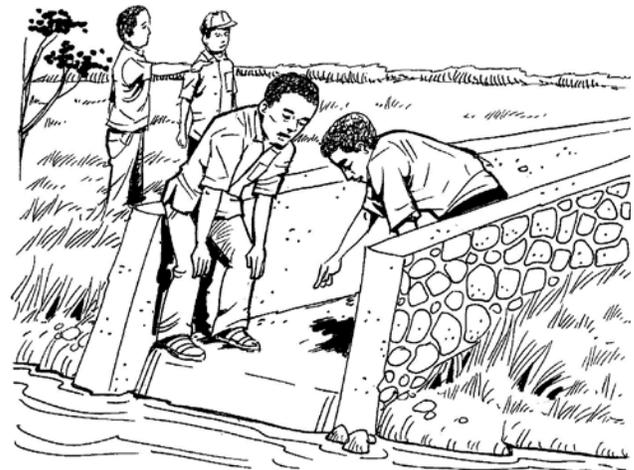
make optimum use of this large-scale investment. MP-MAS also showed that the government needs to pay more attention to reaching smallholder farmers when reforming the subsidy programs for irrigation investments. Smallholders with insufficient water rights, who benefit from unused water resources and spill-overs in the present system, may not only fail to benefit, but may even lose sources of income as a consequence of irrigation investments. This underlines the need to identify alternative income sources for them. Both the water user associations and the irrigation

administration in Chile have decided to use MP-MAS for future planning and management.

Modeling shows that irrigation and water makes fertilizer much more profitable in Ghana helping farmers to move out of poverty.

Farmers in Ghana who have access to irrigation could triple their fertilizer use if they had access to credit, even if the fertilizer is not subsidized. Considering the international policy debate on fertilizer use in Africa, this is an important insight that shows how access to irrigation is in making fertilizer more profitable. MP-MAS simulation results also show that farmers in the semi-arid north of Ghana who do not have access to irrigation will not move out of poverty, even if they have access to fertilizer and credit, thus highlighting the need for giving them access to irrigation. MP-MAS simulations also indicate that pumping water directly from the river is not a viable option at current prices.

Governance is a major challenge to expansion.

The project revealed that, even though investing in small-scale reservoirs is a promising strategy to expand access to irrigation in northern Ghana, it is confronted by major governance challenges. A survey conducted under the project showed that out of 19 small reservoirs constructed with substantial donor funding between 2000 and 2006 in the upper east region of the country, only three were in fact used for irrigation. Problems in procurement and construction of the reservoirs were identified as major constraints, next to shortcomings in the required technical expertise. This project suggests that these problems be

addressed before donor agencies invest in new small reservoirs, for example, by strengthening the accountability of contractors and the irrigation administration to local water user organizations and their elected representatives.

Outcomes and impacts
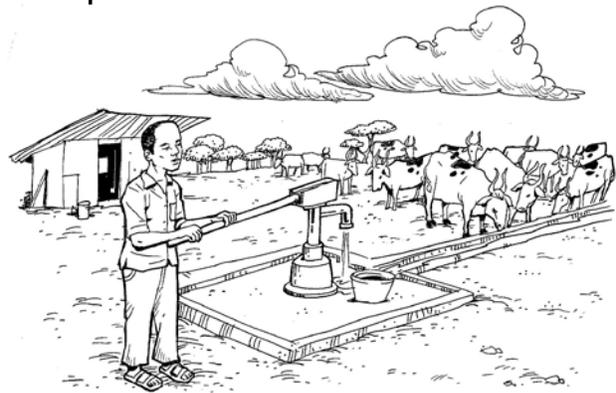
In Ghana, the project had three major impact pathways:

◈ When it comes to water governance, critical decisions and investments are undertaken at the district level. It is not necessarily those who are in the hierarchy who are most influential.

◈ The Ministry of Food and Agriculture can now use the information generated through agent-based modeling for designing agricultural programs.

◈ Donor agencies and the Ghana Irrigation Development Authority are at the center of the third impact pathway, which focuses on the improvement of small reservoirs.

Taken together, the three pathways have the potential to improve the use of a considerable amount of funding that the government and donors are planning to invest in the northern part

of Ghana. Moreover, the project has important messages for other countries in Africa that aim to use small-scale irrigation.

In the case of Chile, the project has four major impact pathways, which involve the following organizations:

◈ the National Agricultural Research Institute (INIA),
◈ the National Irrigation Commission (CNR),
◈ the National Agricultural Development Institute (INDAP), and
◈ the umbrella organizations of the water user associations in the region (JdVs).

INIA has become the host institution for the MP-MAS computer tools, and the other organizations have started to use MP-MAS to make informed decisions. The expected impact is a more efficient use of water resources in the region and a more equitable use of public funds spent on water resource development. The findings from Chile are also relevant to a range of other countries, especially those that are at a similar stage of river basin development and those that aim to follow the 'Chilean model.'

Conclusion

River basin organizations are complex governance structures that govern the use of important water resources all over the world. Their access to policy-relevant information is important for the negotiation and resolution of sustainability issues in their jurisdiction. MP-MAS and Net-Map are useful tools that help unearth information relevant to the river basin organizations' operations and predict outcomes from a whole range of possible options.

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Tags: PN40; Integrating Governance and Modeling

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