2010

Integrating Seasonal Climate Forecasts into Institutional Decision-Making Processes

David Watkins
dwatkins@mtu.edu

Recommended Citation

Brown, C., Baroang, K.M., Conrad, E., Lyon, B., Watkins, D., Fiondella, F., Kaheil, Y., Robertson, A.W., Rodriguez, S.J., Sheremata, M. and Ward, M.N., 2010. Managing Climate Risk in Water Supply Systems: Materials and tools designed to empower technical professionals to better understand key issues, IRI Technical Report, 10-15, International Research Institute for Climate and Society, Earth Institute at Columbia University, NY. Available at: https://doi.org/10.7916/D83T9Q27

WATER CRK EXERCISE 5
INTEGRATING FORECASTS INTO INSTITUTIONAL DECISION-MAKING PROCESSES[1]

November 24, 2009

OVERVIEW

It is often challenging to integrate climate forecast use into actual decision-making processes, even when modeling demonstrates significant benefits from its use. Decision-making processes are guided by both formal policy frameworks, and the particular institutional structures under which decision-makers must operate. In addition, water is shared across multiple stakeholders, who are often represented by specific government or private sector agencies. These agencies face different costs depending upon the outcome of a forecast, and different preferences for risk. Depending upon the institutional and political arrangements for how decisions are made, these stakeholder interests may figure more or less strongly in water allocation decisions.

Using role-playing to simulate a water allocation process involving multiple stakeholders, this exercise will help participants think through some of the above challenges, addressing the following three learning goals:

1) To understand and identify institutional constraints in making water reservoir management decisions based on climate information
2) To understand implications of the uncertainty associated with climate forecasts when decision-makers face differing costs and benefits that depend upon the climate outcome and the water allocation decisions made
3) To identify particular constraints in the participants' own institutional contexts that may need to be addressed in order to integrate climate forecast information, and to identify some of the possible steps that would be required to do so

HOW THE EXERCISE WORKS

This exercise is in two parts: 1) role play of a simulated water allocation decision process, with participants playing the roles of stakeholder institutions operating within a specified policy context and facing a defined set of decision options with differing costs and benefits; and 2) a discussion of the actual decision contexts and institutional constraints of the participants, drawing upon lessons from the exercise.

[1] *Exercise 5* accompanying Brown, C., Baroang, K.M., Conrad, E., Lyon, B., Watkins, D., Fiondella, F., Kaheil, Y., Robertson, A.W., Rodriguez, S.J., Sheremata, M. and Ward, M.N., 2010. Managing Climate Risk in Water Supply Systems: Materials and tools designed to empower technical professionals to better understand key issues, *IRI Technical Report, 10-15*, International Research Institute for Climate and Society, Earth Institute at Columbia University, NY. Available at: https://doi.org/10.7916/D83T9Q27

Part I. Role Play

Background: Institutional and Policy Context of Ganta[2] Reservoir

The Reservoir System

Water from the Ganta Reservoir is shared between three users:

1) a municipal water agency, serving a major urban area;
2) an irrigation agency supplying water to farmers who use the water to grow rice; and
3) a power agency that sells hydropower. For this urban area, the Ganta Reservoir is the primary source of water; other sources are negligible.

For farmers, the reservoir is the only source of irrigation water during the dry season, which, when sufficient water is available, is the most important production season for them. Ganta is one of several reservoirs supplying hydropower to the grid, which relies primarily on coal and oil, but hydropower is an important supplement, particularly because this power can be sold in a newly privatized power market.

The October-November-December period (OND) is the most important for reservoir inflows. There is substantial interannual variability in rainfall, such that in some years, there is insufficient inflow to meet both agricultural and municipal needs. On the other hand, when rainfall is above normal, there may be sufficient water to generate hydropower as well as meet both agricultural and municipal needs. Seasonal forecasts of reservoir inflow can be generated for OND with reasonable skill, and these are available from the meteorological agency.

Water Policy and the Allocation Process

According to existing law, farmers have first claim on the water from the reservoir, which is located in their province. However, the law also states that during times of "water scarcity" (which is not precisely defined in the law) reductions in irrigation water for the farmers can be justified to ensure sufficient municipal water supply. Water scarcity is not precisely defined in the law, and in practice, due to the growth of the nearby urban area, its heavy dependence upon the reservoir's water, and its political influence, it is not uncommon for irrigation water to be reduced to assure municipal supply. Hydropower generation has a secondary priority, and is only generated if the water needs of farmers and municipal users are expected to be fully met.

A water management agency is responsible for deciding upon water allocations, following existing law. Formally, they make decisions on water allocation once every three months, following a rule curve. When the water level in the reservoir falls below the established rule curve, then reductions must be made in the water allocations for either municipal or agricultural use. When the level is above the rule curve, hydropower generation may also be allowed, but requires permission from the water agency.

To arrive at an allocation decision, the water management agency creates scenarios using a reservoir model capable of integrating the seasonal forecasts of reservoir inflow prepared by the meteorological agency. These scenarios combine possible allocation schemes with seasonally forecasted reservoir inflows to arrive at a probabilistic estimate of the water level at the end of

[2] The institutional and policy context for this exercise is loosely based on the Angat Reservoir in the Philippines, which has also been the basis for some of the previous exercises.

the OND period. This is used to determine an expected reliability for the reservoir, based on the probability that the reservoir level will be above the rule curve at the end of OND. Five basic allocation schemes can be considered (see the Excel-based decision support tool provided with this exercise). These range from supplying full water allocations for municipal and agricultural use and generating hydropower, to reducing both agriculture and municipal water supply, with no hydropower generation.

At the end of September, the water management agency holds a meeting involving all three stakeholders. Possible allocation choices are discussed, based on the scenarios developed using the decision support tool. During the discussion, **stakeholders have full information** about the forecasted inflow, as well as about the costs or benefits that each will face related to each allocation scheme (see below). The water management agency makes the final decision about water allocations. This decision guides water allocation throughout OND, and no changes can be made until January (for the sake of simplicity in this exercise).

Costs, Benefits and Relative Influence of Stakeholders

Each of the three water users face a particular set of costs or benefits, depending upon the allocation scheme chosen and the actual inflow to the reservoir. These are described in the Cost Matrix. The Matrix shows the costs to stakeholders (or, in the case of hydropower, a benefit) during OND, which depend upon the allocation scheme chosen, and then in JFM, which depend upon a combination of the allocation scheme chosen plus the actual inflow to the reservoir. **There are no institutional mechanisms for sharing costs of a particular allocation decision.**

As shown, the greatest costs occur when the water level falls below the rule curve (shown as dark orange). It is in order to avoid these possible future costs in JFM that certain stakeholders may advocate allocation schemes in OND that reduce water allocations to certain users. OND reductions are cheaper than JFM reductions because advance planning allows users to keep down costs. For example, when the municipal agency reduces water use during OND, they are able to order water tankers early at a lower cost, schedule water supply reductions ahead of time, and perhaps even offer extra incentives to its customers to reduce their water use. On the other hand, if the water level falls below the rule curve, the municipal agency must reduce water use immediately, leaving no time to plan ahead. For the farmers, reducing their use of irrigation water in OND is also less costly than in JFM. In OND, some farmers delay or reduce their plantings, and have the opportunity to make alternative plans, whereas when water is reduced in JFM, farmers have already invested time and resources in planting, and lose part of their crop.

There is a difference in the nature and degree of political influence of agricultural and municipal water users. The urban area has substantial political influence, such as the ability to call upon the President's office to encourage the water agency not to reduce their water allocation level. Farmers, on the other hand, have less formal political influence but are politically organized. When reductions to their irrigation water are threatened, they organize protests outside the municipal water agency, claiming that their water is being "stolen" for municipal water use. To counter these protests, the water management agency usually conducts a media campaign to soften their image, incurring additional costs.

Institutional Constraints for the Water Management Agency

The water management agency must follow current water laws (described above), while seeking to maximize overall societal gains from the reservoir (or minimize losses). Technically, the rule

curve dictates when water allocations need to be reduced, so formally, the task of the water management agency is to develop good reliability estimates and mandate reductions as required, and allow hydropower generation when possible. Farmers technically have first priority, but since "water scarcity" is not precisely defined, there is ambiguity about how water reductions are to be distributed. There are no institutional mechanisms to share costs of reductions, and the water management agency is subject to formal political influence from the municipal agency, and to political protests on the part of farmers.

The water management agency is risk-averse, and one result of this is that the rule curve is not always strictly followed. Sometimes, when the water level is very close to (but not below) the rule curve at the end of OND, the water agency will order reductions in water allocations to both municipal and agriculture users. These appear on the Cost Matrix in JFM under certain conditions in Schemes 1, 3, 4 and 5 as $0.5 million each for the irrigation and municipal agencies.[3]

Role Play Instructions

1. Participants (either individually or as groups, depending upon the number of participants) assume the following institutional roles:

- Water management agency: a government agency mandated to decide water allocations from the Ganta Reservoir across multiple uses, subject to the institutional and policy constraints described above
- Municipal water supply agency: government agency that oversees water supply to a major urban area
- Irrigation agency: government agency that supplies water to farmers who depend upon irrigation to grow their rice crops
- Power agency: the agency responsible for ensuring power production, including generating and selling hydropower from the Ganta Reservoir

2. Choose one of the four available sample years in the Decision Support Tool, and follow the "Instructions for Using the Decision Support Tool." Each participant reviews the institutional and policy background (above), the forecast and allocation schemes in the Excel spreadsheet, and the choices and associated costs/benefits described in the Cost Matrix.

3. The participant representing the water management agency will call a meeting with the three stakeholders to discuss various water allocation scenarios. The stakeholders may advocate certain allocation schemes, but in the end, the water management agency representative decides which scheme will be chosen for OND, based upon the information in the "institutional constraints section above.

4. After a decision is made, all participants receive information about the actual water levels in the reservoir by the end of December (available in the Decision Support Tool) and use the Cost Matrix to determine the costs they now face.

5. Repeat the role play for different years.

[3] In this instance, the equal sharing of these costs is assumed in order to simplify the possible cost outcomes in JFM in this exercise.

6. Discuss the outcome of the role play, considering some of the following questions: [SAMPLE LIST]

- Does the outcome maximize social gains (i.e., the net sum of costs and benefits to all stakeholders), compared to other allocation schemes that could have been selected?
- From each stakeholder's perspective, does this outcome minimize costs compared to other choices? Who "wins", and who "loses"?
- What factors were most important in determining the outcome of the decision? Do you think that the decision would have been made in the same way, regardless of the forecast, or not?
- How did the fact that costs of each allocation decision cannot not be shared affect the outcome of the decision?

Optional add-on to Part I: Exploring risk management-oriented institutional set-ups

It might be possible to develop a second part to this role play, using different institutional assumptions that include some form of compensation for giving up a water allocation, and/or an insurance scheme against a reservoir index. Then, participants repeat the role play, and compare the results to those obtained under the original institutional context.

Part II. Discussion and Application to Other Contexts

Following the role play, participants will discuss (in sub-groups and/or in a single large group) what they learned from the exercise, and apply it to their own circumstances. During the discussion, participants will:

- Identify key features of their own institutional context that make it different from, or similar to, the example used in the role play.
- Identify constraints that might be most important to address in order to integrate climate information using a risk management approach
- Discuss what steps would be required to address these constraints