

Field Projects 1 & 2: Climate Information and Water Resource Management in Ceará, Brazil  
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These two field studies will complement a larger collaborative effort between the Government of Ceará and the IRI. Project 1 will study the behavior of individuals and groups associated with the Water Allocation Seminars (i.e., regular meetings involving stakeholders from associated water basins where water distribution for upcoming season is negotiated). Project 2 will study the use of climate information and the roles of participatory structures involving the parties who play a part in drought contingency planning. It will help to organize discussions and role playing among the different groups that are impacted by large scale water transfers and planning under uncertain future scenarios. In addition to effects of socioeconomic and production variables, both projects will study the influence of individual psychological characteristics and many participatory group structures on the use of climate-based information. Preliminary data have already been collected. Research results will be used by our Brazilian partners: including FUNCEME, the agency that produces and disseminates environmental information and conducts meetings related to drought contingency planning and COGERH, the group that organizes Water Allocation Seminars.

Project 1 will conduct surveys and in-depth interviews with members of groups associated with Water Allocation Seminars (WAS) as well as observe and analyze their meetings. Based on this data (i.e. survey results and field observations of behavioral tendencies and psychological biases) we will work with the WAS organizers to develop educational and decision support products that allow the participants to: 1) better understand the workings of the hydrological system they are a part of; 2) better understand the influence of climate on their region; and 3) provide a method for the organizers to present various water allocation scenarios that take future climate into account. This project complements ongoing research that looks at issues of equity in the water allocation process, and how new information may effect the distribution of benefits gleaned from water resources. It also recognizes that perceptions of equity in distribution and participatory power can play a strong role in alternative constructions of uncertain environmental information.

Project 2 will draw upon existing relationships with agencies and private groups that de facto are involved with drought contingency planning through their roles in large scale water transfers. Much of the decision making to date has been done without formal meetings or discussions involving (often competing) user groups. We have been encouraged to develop a process to bring these groups together to discuss water allocation options, again with a focus upon how climate information can be incorporated to reduce future uncertainty (especially of drought conditions).

In both Projects, attention will be paid not only to the influence of climate information in the process, but also to how different institutional configurations may facilitate/hinder participatory decision making. Based on information from ethnography and surveys and analysis of existing data we will work with Brazilian partners to design climate information/education products and conduct tutorials as the first phase in developing scenarios for WAS (Project 1) and in the role playing/focus group exercises (Project 2). These tutorials will take into account findings from the Center's other Lab and Field Projects that identify psychological biases. Thus the Ceará setting will also serve to validate the findings of other Center research.

## Field Project 1: Water Allocation and Decision-Making under Climate Uncertainty

Water Allocation Seminars provide an opportunity to study and influence a heterogeneous group of stakeholders connected by a shared natural resource that is directly influenced by climate. WAS choices are contested, involving motivated groups from different socioeconomic strata in the context of discussions concerning decision making (reservoir release amounts and timing) that could in principle be based in part upon scientific information (on hydrology and climate). This WAS participatory approach is new and still dynamic. Within this setting, we propose to analyze the impacts of proposed shifts in the water resource management of Ceará, NE Brazil, emphasizing the variation in benefits and costs across the suite of stakeholders who are affected, and focusing on the potential roles for climate information and for participatory decision making.

Understanding how proposed shifts in water allocation and reservoir system operation may affect all users, across a spectrum of scenarios, is critical for formulating equitable and efficient policy. Perceptions of climate and climate-related (e.g., streamflow) forecasts, of equity in distribution, and of other group goals play an important role in the allocation process, impacting responses to new information in the group decision making process. We will work jointly with relevant local policy makers to study these behavioral aspects and explore how to improve their decision aids, including educational products and scenario generators (loosely termed Decision Support Tools).

Three specific types of recently considered policies that may influence the WAS process in the Jaguaribe and Metropolitan basins will receive the bulk of analytical attention in this project: Policy 1) basing reservoir releases upon streamflow forecasts based upon climate information; Policy 2) providing improved seasonal-to-interannual precipitation forecasts to all water users; Policy 3) changing the role of participatory water allocation seminars in the release decisions.

Our analysis will be based on intensive study of Ceará's participatory water allocation process. Twice a year approximately 120 representatives of diverse stakeholder groups from the private, public and water management sectors, linked by shared water use from connected reservoirs, gather together. They are presented with scenarios for the upcoming season's water availability taking into account climatic factors. They then negotiate—through a full day of discussion in a large seminar room—release amounts for each reservoir and use priorities for upcoming months. Consensus is attained through dialogue, with a moderator from the state water operations agency. If verbal agreement is not unanimous, a vote is taken. Our partial understanding of this process has already motivated a significant addition to climate-based forecast products, a transformation of climate relevant information into the streamflow forecasts relevant for these water decisions.

### Guiding Questions

- What roles do stakeholders play in release choices through water allocation seminars and how could agency scenarios and rainfall forecasts affect consensus and actors' choices?
- For agencies to evaluate water management options, e.g. use of forecasts or water rights, which form and content of scenario simulations best support actual decision processes?
- How do historical uncertainty, perception of climate variability and current climate forecasts affect production decisions?

We will employ a variety of methods at different phases of the research project, moving toward the goal of informing the development of a decision support tool and using this tool as a vehicle to elicit feedback from policymakers. The general sequencing of our approach is as follows:

- 1) Survey Instruments To Gather Data
- 2) Analysis Of The Relevant Datasets
- 3) Ethnographic/Qualitative Research

We have completed much direct observation of these participatory processes during exploratory ethnographic fieldwork efforts funded by the government of Ceará. We also want to characterize stakeholder patterns of and rationales for water use. We started the work by interviewing policy makers and water management groups, along with participant observation in and analyzing video tapes of water allocation seminars. Our surveys start with the construction of a typology of stakeholders involved in water allocation in Jaguaribe-Metropolitano (henceforth J-M) area.

This identification of groups includes their activities, how they organize themselves and are referred to by policy makers, their spatial distribution and their perception of climate variability and predictive skill. The survey will add detail to the criteria that groups use for current decision making, including their technological limitations, and their perceptions of future directions for their activities as well as the water allocation process. The surveys will also contain questions that will enhance our understanding of the psychological factors and influence of group dynamics on stakeholder strategies for adjustment to water availability and information.

While much information can be gleaned from surveys, interviews, and of course their analysis, still further understanding can be gained from coding of the observed behaviors during the WAS. Existing video tapes of four Seminars will be used to develop a coding scheme and train coders. Content analyses of subsequent Seminars will identify naturally occurring framing of discussion issues and analyze them as follows:

- reference points and aspiration levels (vary by background? goal? individual/groups?);
- regulatory focus (e.g., government toward prevention, private towards promotion?);
- time-horizon (which participants use multi-year frames?);
- experiential processes (recent vivid events or projections of the future have influence?);
- and representation of events or consequences (level of specificity or abstractness).

We also will compare individual assessments of water situations (prior to the seminar meetings) and group deliberations and decisions during the seminar, with focus on mechanisms that foster the emergence of group goals. This type of information, analyzed in close collaboration with the local stakeholders, should lead to the production of more appropriate educational materials and decision support aids as well as to increased knowledge of the implications of different structural participatory configurations for facilitating consensus on water allocation choices in the region.

## Field Project 2: Role of Climate Information in Drought Contingency Planning

There is a movement within government and civil society toward increased transparency in decision making that involves a public good such as water. Bulk water transfers are currently made in Ceará involving stakeholders from industry, agriculture and state and local government in a relatively ad hoc fashion (i.e., neither systematized negotiation nor water rights now exist). Such transfers become highly critical during drought conditions which leave at least some groups in a state of unanticipated shortage. Among water decision makers discussion about rationalizing the decision making to promote transparency and equity and utilize climate forecasts is ongoing.

An enhanced process for transfers will facilitate drought contingency planning beyond traditional roles of stockpiling emergency supplies for the more remote rural areas and launching drought resistant seed programs. This has the potential to involve urban water users, including industry, as well as representatives of the more marginalized rural areas, in a single decision process. We have been asked to play a role in informing a transition to such a process. Under the uncertain climate conditions that include recurrent severe droughts in this region, decisions on allocation have large scale impacts (rising as rural-urban competition for water increases). With support from COGERH and others, we intend to conduct exercises that bring together representatives of the key different user groups in an experimental setting to study how different sorts of climate information (including none) influence their responses and negotiations and infer what type of institutional arrangements (e.g., group composition) may be optimal for group decision making.

Our analytical approach here overlaps with but differs from that described in Project 1. A major difference is that for Project 1 the WAS are already established While here we would orchestrate the experimental decision groups and thus control their composition and other characteristics. In an experimental setting we could also vary the nature of the details of the information provided, ranging from basic hydrological system information to forecasts and even allocation strategies. This will allow for more tightly designed study of impacts of instrumental group configurations from an organizational psychology perspective. As in Project 1, background research involving interviews and participant observation will inform the design of educational/tutorial information, scenario development aids and choices in group formation, though here we will not use surveys.

We will overlap with Project 1 in our interest in the recording and coding of group discourse, with attention paid to the psychological factors that influence reception and interpretation of climate information. Because of the ‘experimental’ nature of the interactions, more emphasis will be on the instrumental/organizational factors that facilitate negotiation and consensus. However, as in Project 1, we are also extremely interested in the choices that the individuals (representing groups) will make during these experiments. They will be a first indicator to policy makers of how these types of groups might behave if such water decision processes were implemented, including how choices might change as the composition of the participating groups is varied.

We are exploring software packages that allow players to negotiate in real-time, recording their decisions. We would then modify the program to suit the needs and specifics of our experiment, for instance testing reactions to water management mechanisms based on climate information.