The Berg River Case Study

Estimating and Comparing the Benefits and Costs of Avoiding Climate Change Damages in Natural Resource Sectors in Developing Countries

J.M. Callaway[1], M.E. Hellmuth[1], J.C. Nkomo[2], D.A. Sparks[2] and D.B. Louw[3]

Project Objectives

The broad objective of AIACC Project 47 is to develop the capacity to estimate and compare the benefits and costs of projects in natural resource sectors that reduce the expected damages from climate change in Southern and West Africa. There are two parts to this project. The first consists of using well-established principles from economic benefit-cost analysis to develop a framework to estimate the economic benefits and costs associated with the expected climate change damages avoided by a development project that does not take climate change into account. Then, these benefits and costs can be compared to the case where planners incorporate expected climate change into the project assessment. This framework is reported in Callaway (2003). The second part consists of demonstrating this methodology in two project case studies, one in The Gambia and the other in South Africa. This paper reports on the South African case study, which is examining the benefits and costs of avoiding climate change damages through structural and institutional options for increasing water supply in the Berg River Basin in the Western Cape Province.

The Berg River Case Study

The upper Berg River is an economically important water supply system in the Western Cape that provides the bulk of the water for household, commercial and industrial use in the Cape Town metropolitan region. It also provides irrigation water to cultivate roughly 15,000 hectares of high value crops, primarily deciduous fruits, table and wine grapes and vegetables both for domestic and export use with strong multiplier effects in the domestic and national economy. As the population of the Metropolitan Cape Town region grows the competition for water in the basin has become even more intense as farmers have shifted production toward highly valued export crops and the government searches for solutions to make good on its promise to provide a minimum amount of "free" water to all households to meet minimum daily requirements.

Recently, the government of South Africa commissioned a new dam in the Berg River basin, in effort to alleviate the problem of increasingly scarce water supply for the Cape Metro Region. The commissioning of the new Berg Dam was a controversial and lengthy process. The government is also moving towards the creation of competitive markets for water in the basin (and elsewhere) under the new National Water Act (1998). Planning for both options has, up until this point, failed to take into account the possibility that the build-up of greenhouse gases in the global

[1] UNEP-RISØ Centre, Roskilde, Denmark
[2] Energy and Development Research Centre, University of Cape Town, South Africa
[3] Department of Agricultural Economics, University of the Free State, Bloemfontein, South Africa

atmosphere is affecting and will continue to affect the regional climate, potentially reducing existing runoff in the Basin.

The AIACC AF47 group is collaborating with regional grower's associations in the Berg River, as well as with the Department of Water Affairs and Forestry (DWAF). Both groups have shown considerable interest in the project as the explicit costs and benefits of adjustment measures to climate change have not been previously examined in the region.

Case Study Objectives

In that general context, the objectives of this study are to develop and implement the necessary analytical tools to:

- Estimate the potential impacts of alternative climate change scenarios on water supply and demand in the basin through changes in runoff, evapotranspiration and surface evaporation,
- Translate these physical impacts into monetary losses (or gains) for different groups of farmers and urban water users,
- Estimate and compare the benefits costs of the storage and water market options of avoiding climate change damages, with and without accounting for expected climate change in the ex ante planning for these options.

Methods

The study team is currently modifying an existing spatial equilibrium model of the Berg River Basin (Louw, 2002) for use in an integrated environmental-economic assessment of climate change. The current model includes all of the major water supply sources in the basin, as well as detailed farm-level irrigation water uses for important crops and livestock, and urban water demand in the Cape Town Metropolitan region. The most important modifications to the model consist of:

- Incorporating the inter-temporal features of reservoir storage for both major storage reservoirs and on-farm water storage, so that the model can be used to assess climate change impacts over time,
- Creating a hydrologically realistic, but simplified spatial representation of the physical and man-made water-supply system in the basin,
- Improving the hydrologic aspects of the model to allow
  - Incorporation of stochastic streamflow ensembles from the WatBal rainfall-runoff model (Yates, 1996) and
  - Calculation of return flows, reservoir evaporation and conveyance losses,
- Addition of investment functions for new reservoir capacity,
- Development of on-farm water-use intensity estimates for different temperature regimes, and
- Development of scenarios to reflect changes in water demand over time due to population and agricultural commodity market developments.

Implementation

Once modified and verified, the model will be used to assess the physical and economic effects of a number of alternative runoff scenarios, associated both with the historical climate, recent climate anomalies, and equally plausible changes in climate for the Basin. Each of these scenarios will be run for the following options:

- No water markets, no additional storage,
- Water markets, plus additional storage (both planned and optimal),
- Additional storage (both planned and optimal), no water markets, and
- Both water markets and additional storage (both planned and optimal).

The results from these sets of simulations will make it possible to estimate both the monetary value of the climate change damages without the various options and the monetary value of the benefits and costs of avoiding these damages through the various alternatives. This information can then be used to isolate the benefits and costs of planning for expected climate change, versus not planning for it, over a range of subjective probabilities for each climate change scenario. One can also extend this approach (as shown in Callaway, 2003) to analyze the variation in optimal reservoir storage capacity over the same range of probabilities and then find the ex ante reservoir capacity that leads to the minimum level of regret, both in terms of planning for climate change that does not happen ex post and not planning for climate change that does occur ex post.

Conclusion

The methodology being used in this study – ex ante, ex post planning – is not new. It has been used in one form or another to evaluate natural resource development projects under risk and uncertainty associated with historical climate variability. Nevertheless, planners in natural resource sectors often seem mystified about how to incorporate the uncertainty associated with climate change into their current projects. One of the most important benefits of this project hopefully will be to de-mystify the problem by demonstrating how existing tools and approaches can be modified slightly to integrate climate change into the assessment of natural resource development investments in South Africa and The Gambia. While the South African case study will consider a relatively developed watershed, with competing urban and agricultural users, the Gambian case study focuses primarily on evaluating the effectiveness of a variety of agricultural adaptation options in reducing the vulnerability of a spectrum of rural farmers to climate changes.

References

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