WORLD RESOURCES INSTITUTE

teri

ISSUE BRIEF

CASE STUDY

COMMUNICATING MODELED INFORMATION FOR ADAPTATION DECISION MAKING

SREEJA NAIR, SNEHA BALAKRISHNAN, SURUCHI BHADWAL, SAMBITA GHOSH, G. J. LINGARAJ, ARABINDA MISHRA, ASHOK MISHRA, AJAY BHAVE, ANNEMARIE GROOT, CHRISTIAN SIDERIUS, CATHARIEN TERWISSCHA VAN SCHELTINGA, HESTER BIEMANS, EDDY MOORS, TANYA SINGH

INTRODUCTION

The HighNoon project, which began in 2009, set out to assess the impact of the retreat of Himalayan glaciers and expected changes in the Indian summer monsoon on the distribution of water resources in Northern India.[1] The project's aim was "to recommend appropriate and efficient response strategies to enable adaptation to hydrological extreme events." The project used information from scenarios generated by regional climate and hydrological models and integrated this with stakeholder perspectives to identify and prioritize adaptation strategies.

By examining the HighNoon project, this case study explores how adaptation-relevant information can best be packaged and disseminated to different users and audiences at the state, district, and block levels. It also explores what kinds of information are of most interest to different stakeholders and how different information could contribute (or not) to adaptation decision making.

ABOUT THIS SERIES

This case study is part of a World Resources Institute project, Information for Climate Adaptation in South Asia: Identifying User Needs. Each of the case studies in this set explores an aspect of information use in adaptation decision making. The goals of this series are twofold:

1. provide insights into how information (such as climate projections, stakeholder interviews, and environmental monitoring) can be used to support adaptation decisions; and

2. guide investments by national governments and their development partners in information systems that can inform decision making around risks related to climate change.

This case study series was supported by the UK Department for International Development. Case study authors used the same framework of guiding questions for their research, which consisted of literature reviews and interviews. The case studies accompany a World Resources Institute working paper, "Information for Climate Change Adaptation: Lessons and Needs in South Asia," and the conclusions from a 2-day workshop convened by WRI and Development Alternatives, a research and action organization, in Delhi in April 2012. Both documents and the other case studies can be found at http://www.wri.org/project/vulnerability-and-adaptation/information.

Field Sites

Field sites for the HighNoon project were selected along the upstream (Udham Singh Nagar district and Delhi), midstream (Allahabad district), and downstream (Kangsabati Basin covering the districts of Purulia, Bankura, and West Medinipur) stretches of the Ganga Basin (see Figure 1). Delhi was selected as a case site as the city-state depends on water from the Ganges (via Tehri dam) for its drinking water and power supply. Delhi, however, presents an urban case study with an administrative structure and stakeholder profiles very different from the other field sites and thus is not discussed in this essay. The district of Udham Singh Nagar in Uttarakhand state has the largest area of cultivated and irrigated land in the state. The population of the district lives largely on agriculture, but the area is prone to floods. Allahabad district in Uttar Pradesh state is prone to droughts, and its location downstream of the industrial district of Kanpur adversely impacts water quality, agriculture, and health. The population of this district also relies largely on agriculture for its livelihood. The populations of the districts of Purulia, Bankura, and West Medinipur are similarly dependent on rain-fed agriculture. The region is prone to drought, and during monsoon season (*kharif*), which is also the main growing season, the frequent delays in rains hamper agricultural productivity.

USE OF MODELED INFORMATION FOR ADAPTATION

The HighNoon project generated a wide variety of qualitative and quantitative information to inform the development of site-specific adaptation strategies. Stakeholder consultations at the field sites played a central role in understanding the climate information required for adaptation decision making. The consultations were conducted by the project team through semi-structured interviews designed to elicit information on key climatic hazards, vulnerabilities, impacts, and adaptive capacities (focusing on the agricultural and water sectors). The stakeholders at the state level included officials from line departments, nongovernmental organizations (NGOs), and academia working on research and development issues; at the district level, they included officials from line departments and officers from vulnerable blocks within these districts responsible for implementing state programs and policies related to climate-sensitive sectors; at the community level, they included the village heads, village elderly, farmers, women, and agricultural and non-agricultural laborers. Following the consultations, half-day multi-stakeholder workshops were conducted at the district and community level. The consultations were intended to help stakeholders reflect on trends in historic climate hazards, understand climate change vulnerability and impacts, and assess their own adaptive capacity for future climate risks.[2]

At the workshops, stakeholders' own experiences and perspectives regarding risks, vulnerabilities, and socioeconomic development were supplemented by information about potential future climate change risks identified by climatic, socioeconomic, and biophysical models. Modeled information was of the following key types.[3]

- **Regional climate scenarios:** Models PRECIS (Providing Regional Climates for Impact Studies) and REMO (Regional Model) were used to obtain improved regional climate information (25km*25km resolution) for India and the Himalayas. Using the A1B scenario,[4] four model runs were used: two for the period from 1989 to 2050, and two for the period from 1970 to 2050 using daily data for radiation, temperature, relative humidity, precipitation, snowfall, and wind.

- **Snow runoff and glacial runoff:** Information on snowfall and temperatures from climate models provided inputs for the calculation of snow runoff and glacial runoff. The use of models such as land-surface model JULES (Joint UK Land Environment Simulator), global dynamic vegetation and hydrology model LPJmL (Lund-Potsdam-Jena managed Land Dynamic Global Vegetation and Water Balance) and SWAT (Soil and Water Assessment Tool) provided estimates of the meltwater contribution in the Ganges Basin.

- **Regional and local socio-economic dynamics:** IMAGE (Integrated Model to Assess the Global Environment), a global integrated assessment model, was used to generate global climate and socioeconomic scenarios. These were compared to state- and district-level scenarios generated for northern

FIGURE 1

LOCATION OF CASE STUDY SITES

Retrieved from http://www.eu-highnoon.org/case-studies

The HighNoon project generated a wide variety of qualitative and quantitative information to inform the development of site-specific adaptation strategies.

India—including changes in demography, economic growth, industrialization, and agriculture intensification—to assess their influence on the availability and use of current and future water resources. Regional and local scenarios were developed and compared with global scenarios to reduce the scale biases. The local scenarios were also used during stakeholder workshops to encourage attendees to make adaptation decisions based not only on the climate-related information but also on possible future changes in socioeconomic conditions. In some cases this helped to identify "low-regret options." Two scenarios were developed for the socioeconomic projections for all the project sites[5] —business as usual (BAU) and alternate (ALT) —considering changes in demography and economic growth as the key drivers. To address uncertainties, BAU and ALT scenarios were grouped with different climate scenarios and used along with a "what-if" exercise to assess suitable adaptation priorities under different scenarios. Also, assumptions used for developing these scenarios were shared with the stakeholders. In their efforts to integrate modeled types of information into participatory decision-making processes, the project team avoided directly using model outputs, which it viewed as too technical for stakeholders to use in decision making. Instead, model-based information was customized differently for different stakeholders depending on the role of this form of information in their decisions to deal with climate change risks and impacts.

CUSTOMIZING, SHARING, AND USING INFORMATION

Through interaction with a wide variety of stakeholders, the project team developed four general strategies for customizing modeled information for dissemination to various information users.

1. **Iterative engagement with stakeholders.** The project team developed information products relevant to specific information users through repeated consultations (semi-structured interviews and workshops, discussed in the preceding section) with those users.

2. **Localization of information.** Production of information materials in vernacular languages by the project team enabled broader distribution and access. Stakeholders also engaged most actively with site-specific information. This included, for example, information related to migration trends, groundwater management and regulation, land tenure laws, and land use.

3. **Brevity.** The most useable information products to HighNoon stakeholders tended to be short and clear with targeted information, including fact sheets, maps, and simple graphs (showing precipitation trend lines, for example). The products also informed stakeholders of reference documents on the project website, which provided further details.

4. **Clear communication of uncertainties.** The communication of uncertainty was critical, since the quantitative characterization of uncertainty that accompanies most model outputs typically was not easily understandable by stakeholders, especially at the district, block, and village levels. Instead, the project team exposed stakeholders to a set of plausible future scenarios (both biophysical and socioeconomic) in the form of "what-if" questions, along with the assumptions underlying each scenario.

Below we describe in more detail how modeled information was presented by the project team, with attention to three key uses of the information: communicating trends, envisioning the future, and exploring adaptation options. We also discuss different stakeholder responses to the information at state, district, block, and village levels.

Communicating Trends

Sharing information (e.g., biophysical or socioeconomic) on trends was found to be a useful way of initiating discussion of climate change impacts and adaptation responses. Brief fact sheets presented outputs of socioeconomic projections (both from downscaled global projections and district-level analyses), along with projections for water demand, food demand, and implications for health at the state and district level. Simple graphic representations of modeled trends were frequently used in stakeholder consultations to support vulnerability assessment and identification of adaptation options (see example in Figure 2). Geographic information system (GIS) mapping showed the stakeholders state- and district-specific scenarios.

At the community level, simple trend lines or pictorial representations of information, or sometimes simple verbal communication (changes in key variables presented in qualitative or quantitative terms) proved to be effective ways to share information. Farmers were typically interested in information on a few known variables, such as temperature and rainfall, that affect their livelihoods directly. At a higher administrative level, people understood and demanded aggregated data, such as changes in river flow or changes in water demand.

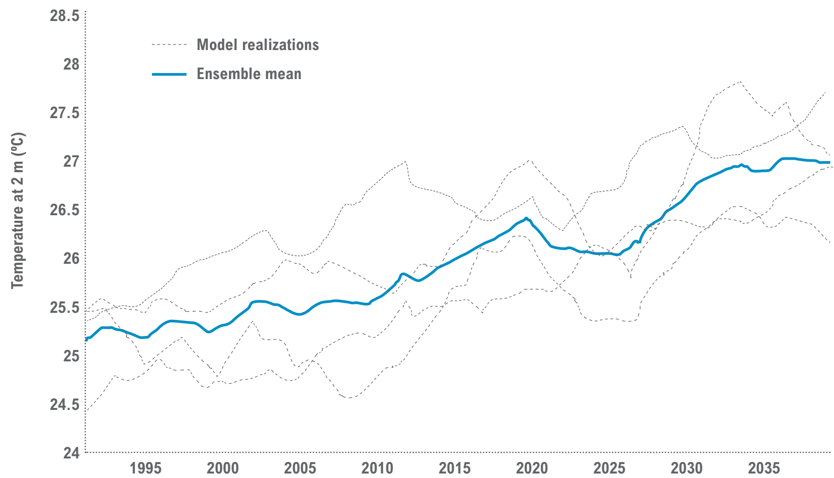
Modeled information was not always necessary to initiate discussion of vulnerability and adaptation. Presentation of data from observed records of temperature, rainfall, and water demand was often sufficient to accomplish this goal, especially at the community level. Stakeholders at the district and community levels could relate future changes to current vulnerability.

Envisioning an Uncertain Future

To help stakeholders think practically about climate risks and vulnerabilities, consultation sessions amalgamated trends from the climate, hydrological and socioeconomic models to create a more integrated picture of the future. For example, maps of projected changes in population, economic growth, and water demand helped ensure that stakeholders considered implications of changing socioeconomic trends when discussing the impacts of a changing climate and water availability for uses such as agriculture. Timeframes of interest varied among stakeholders and were evident in their choice of adaptation options.

FIGURE 2

ANNUAL MEAN TEMPERATURE AT 2M VARIABLILITY OVER ALLAHABAD REGION, FOR A1B SCENARIO



Simple graphic representation for temperature projection under climate scenario A1B, used for a stakeholder workshop in Allahabad district

At the community level, simple trend lines or pictorial representations of information proved to be effective ways to share information.

Some options, though yielding large environmental benefits, were ranked low on the priority list by the communities because these options affected farmer profits, therefore compelling decision makers at higher levels to think of alternative options.

The project team also needed to communicate the uncertainties related to the modeling outputs. At the state level, this was done by sharing a set of plausible future scenarios and the assumptions considered for each. Even without quantitative information on potential changes, stakeholders at the community level were able to set priorities with only directional information. Team members did this by posing "what-if" questions such as, "What options can be prioritized if the rainfall decreases and temperature increases, or rainfall decreases and population increases?" A set of "what-if" questions also gave district and local level stakeholders a directional sense of climate and socioeconomic projections and likely impacts. The objective of these questions was to ensure that the stakeholders understood the limitations of the modeled information and acknowledged the possibility of more than one future (via scenarios), which mandates a flexible planning and decision-making process. (For example, "What if the temperature rises by 1.5° C, or what if the monsoon starts one month later? Do you see the need for different response measures?") In a rising-temperature scenario, stakeholders suggested the use of heat-tolerant crops and livestock varieties; in scenarios of increasing rainfall variability, stakeholders suggested measures for water conservation.

At the community level, it was difficult for participants to consider "possible futures" that differed from current circumstances. For example, in Udham Singh Nagar, the communities do not consider limited water availability as a threat in the future, since there are currently ample groundwater reserves. At the district level however, over-extraction of groundwater was better understood, and it was considered a stressor likely to aggravate water demand and long-term climate change impacts. For the team, this information came from initial stakeholder consultations and secondary literature reviewed to increase understanding of the case study regions.

Exploring Adaptation Options

Stakeholders at various levels preferred discussing options they already knew or had experience with, including cases in which they were familiar with the potential benefits or maintenance costs of the investment. This was especially true at the community level. However, participants at both the community and higher decision-making levels also demonstrated an interest in understanding new options. For example, they were interested in learning more about good practices or strategies that yielded benefits in other regions facing similar issues. Thus, the project team felt that the discussion facilitators should bring information on adaptation options to the consultation, as it may help stakeholders consider new options that could help them adapt. Some options, though yielding large environmental benefits, were ranked low on the priority list by the communities because these options affected farmer profits, therefore compelling decision makers at higher levels to think of alternative options.

Techniques for ranking options, such as the analytical hierarchy process,[6] were of limited use at the district and local level because they require high facilitation skills. The facilitators thus employed simpler methods, such as pairwise or preference ranking[7] to guide discussions at the district and community levels.[8] Priorities set by communities revealed a clear preference for options providing immediate benefits and addressing current risks.[9] For instance, communities saw water-storage structures as a higher priority than measures like afforestation that take longer to provide perceivable benefits.

District- and state-level stakeholders focused on impacts and adaptation options confined to their mandated areas of function (often sectorally defined), making identification of cross-sectoral adaptation options difficult. However, the state-level consultations brought in a longer-term perspective, considering changes in the climate and associated impacts such as the melting of glaciers and changes in surface water flows. Results from community-level interactions were shared with the district-level stakeholders, and results from community- and district-level prioritization were shared with state-level stakeholders to obtain their feedback.

CONCLUSIONS

Modeled information must be communicated simply to be useful, especially at the district and community levels. In this study, broad estimates, providing a directional notion of changes in key climatic variables, were most appropriate for discussions of future vulnerability. This highlights the value of tailoring information for specific users (regarding trends, uncertainties, etc.) for robust adaptation decision making.

While model outputs can play a useful role in initiating adaptation discussions, these alone are less helpful in identifying and adopting adaptation measures. Additional information—such as the cost and feasibility of undertaking the adaptation action, as well as capacity development needs—is often required to motivate communities to take action.

Downscaling of modeled information (to the state or district level, for example) remains a significant challenge. Models helped stakeholders understand broad trends in climate change, demography, and economic development, but these trends were frequently less central to their decision making than site-specific information (especially at the district, block, and village level).

ACKNOWLEDGEMENT

The observations in this report are based on the findings of an ongoing study titled "Adaptation to Changing Water Resources Availability in Northern India with Himalayan Glacier Retreat and Changing Monsoon." HighNoon is an EU-funded collaborative project among European, Indian, and Japanese institutes.[10]

Modeled information must be communicated simply to be useful.

ENDNOTES

1. Project website: http://www.eu-highnoon.org/introduction

2. At the district level, apart from observations based on recorded temperature and rainfall in the last 30 years, climate and runoff projections were also used to guide stakeholders into the discussion of suitable adaptation options to deal with future risks. The stakeholders also participated in vulnerability assessment tools such as "climate hazard trend analysis," where they reflected on the current climate in their region. At the community level, simpler methods such as group discussion using visual aids (such as picture cards that help stakeholders easily relate to climatic changes and associated impacts) were used to help participants understand climate risks and vulnerabilities and identify relevant adaptation options.

3. Retrieved from HighNoon project website, www.eu-highnoon.org/.

4. The A1 emission scenario describes "a world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies." The A1B scenario, a subcategory within A1, is characterized by a balance across various sources of energy. See http://www.ipcc.ch/ipccreports/tar/wg1/029.htm.

5. These socioeconomic scenarios were developed by TERI and comprise population and GDP projections until 2050 at a district level for the states of Uttar Pradesh, Uttarakhand, and West Bengal. Change in population and economic growth were considered to be drivers for changes in demographics and for food, water, and health care. Two scenarios were created: BAU, based on extrapolating historical population growth trends assuming specific fertility rates and replacement by 2050, and ALT, based on high-estimate population projections and associated changes in economic growth and demand for food, water, and health care.

6. Defined in T. Saaty. "Decision Making with the Analytical Hierarchy Process," *International Journal of Services Sciences* (2008): 1(1), as "a theory of measurement through pairwise comparisons and relies on the judgements of experts to derive priority scales. It is these scales that measure intangibles in relative terms" (83).

7. C. Berg, C. Beck, G. Beckmann, C. Chimbala, C. Erko, A. Fleig, M. Kuhlmann, and H. Pander, *Introduction of a Participatory and Integrated Development Process (PIDEP) in Kalomo District, Zambia,* Vol. 2, *Manual for Trainers and Users of PIDEP,* ed. Centre for Advanced Training in Agricultural and Rural Development, Humboldt University Berlin (Weikersheim: Margraf, 1997).

8. A pairwise or preference ranking process consists of a matrix with two similar lists of items (one listed in the reverse order), each being compared directly against the others until these are ranked from the highest to lowest. Pairwise ranking enabled stakeholders to identify priorities among a range of plausible adaptation options.

9. The project team attempted to also undertake the pairwise ranking of criteria, but it found that this both makes the process more complex for the stakeholders and is more time consuming.

10. Details on partner institutes available at http://www.eu-highnoon.org/organisation/participants.

ABOUT THE AUTHORS

Sreeja Nair is an Associate Fellow at The Energy and Resources Institute, New Delhi, India
Contact: sreejan@teri.res.in

Sneha Balakrishnan is an Associate Fellow at The Energy and Resources Institute, New Delhi, India
Contact: Sneha.Balakrishnan@teri.res.in

Suruchi Bhadwal is a Fellow at The Energy and Resources Institute, New Delhi, India
Contact: suruchib@teri.res.in

Sambita Ghosh is an Associate Fellow at The Energy and Resources Institute, New Delhi, India

G J Lingaraj is an Associate Fellow at The Energy and Resources Institute, New Delhi, India

Arabinda Mishra is the Director of the Earth Science and Climate Change Division at The Energy and Resources Institute, New Delhi, India

Ashok Mishra is a Professor of the Agricultural & Food Engineering Department at Indian Institute of Technology, Kharagpur, West Bengal

Ajay Bhave is a PhD Scholar at the Agricultural & Food Engineering Department of Indian Institute of Technology, Kharagpur, West Bengal

Annemarie Groot is a Researcher at Earth System Sciences - Climate change and adaptive land and water management group at Alterra WUR, The Netherlands

Christian Siderius is a Researcher at Earth System Sciences - Climate change and adaptive land and water management group at Alterra WUR, The Netherlands

Catharien Terwisscha van Scheltinga is a Researcher/Lecturer at Earth System Sciences - Climate change and adaptive land and water management group at Alterra WUR, The Netherlands

Hester Biemans is a Researcher at Earth System Sciences - Climate change and adaptive land and water management group at Alterra WUR, The Netherlands

Eddy Moors is the Group Head at Earth System Sciences - Climate change and adaptive land and water management group at Alterra WUR, The Netherlands

Tanya Singh is an Intern under HighNoon Project with The Energy and Resources Institute, New Delhi and Master's Student at Wageningen University, The Netherlands

REVIEWERS

We thank the following reviewers who contributed to the development of this case study:

Guy Howard, United Kingdom
Department of International Development

Amitabh Pandey,
Indian Institute of Forest Management

Clifford Polycarp, World Resources Institute

Rita Sharma, United Kingdom
Department of International Development

Neelam Singh, World Resources Institute

Roger Street, United Kingdom
Climate Impacts Programme

ABOUT TERI

A unique developing country institution with a global vision and a local focus, TERI was established in 1974. TERI's research activities in the fields of energy, environment and sustainable development are based on the firm belief that efficient utilization of energy, sustainable use of natural resources, large-scale adoption of renewable energy technologies, and reduction of all forms of waste would move the process of development towards the goal of sustainability.

TERI is deeply committed to every aspect of sustainable development, and undertakes scientific and policy research that attempts to integrate developing country concerns in the search for effective and equitable solutions to global environmental challenges. Project activities in TERI focus on formulating local- and national-level strategies to suggesting global solutions for critical energy- and environment-related issues.

ABOUT WRI

The World Resources Institute (WRI) is a global environmental and development think tank that goes beyond research to create practical ways to protect the Earth and improve people's lives. We work with governments, companies, and civil society to build solutions to urgent environmental challenges. WRI's transformative ideas protect the Earth and promote development because sustainability is essential to meeting human needs and fulfilling human aspirations in the future.

WRI spurs progress by providing practical strategies for change and effective tools to implement them. We measure our success in the form of new policies, products, and practices that shift the ways governments work, companies operate, and people act.

We operate globally because today's problems know no boundaries. We are avid communicators because people everywhere are inspired by ideas, empowered by knowledge, and moved to change by greater understanding. We provide innovative paths to a sustainable planet through work that is accurate, fair, and independent.

WRI organizes its work around four key goals:

People & Ecosystems: Reverse rapid degradation of ecosystems and assure their capacity to provide humans with needed goods and services.

Governance: Empower people and strengthen institutions to foster environmentally sound and socially equitable decision-making.

Climate Protection: Protect the global climate system from further harm due to emissions of greenhouse gases and help humanity and the natural world adapt to unavoidable climate change.

Markets & Enterprise: Harness markets and enterprise to expand economic opportunity and protect the environment.

In all its policy research and work with institutions, WRI tries to build bridges between ideas and action, meshing the insights of scientific research, economic and institutional analyses, and practical experience with the need for open and participatory decision-making.

WORLD
RESOURCES
INSTITUTE

10 G STREET NE
SUITE 800
WASHINGTON, DC 20002, USA
+1 (202) 729-7600
WWW.WRI.ORG