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Chapter 7- Climate Challenges to Water for Agriculture

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7





CLIMATE CHALLENGES TO WATER FOR AGRICULTURE

Climate Challenges to Water for Agriculture

Panel

Nguyen Hieu Trung

Dean of the College of Environment and Natural Resources,
Can Tho University, Vietnam

John (Jack) F. Shroder

Professor of Geography and Geology, University of Nebraska at Omaha

Donald Wilhite, Moderator

Director and Professor, School of Natural Resources,
University of Nebraska–Lincoln

The session addressed the challenges of climate change in Vietnam's Mekong Delta and the Western Himalaya and Hindu Kush regions. One speaker discussed how farmers cope with climate variability, what scientists can learn from them and how to develop large-scale strategies for the future. Another speaker discussed Afghanistan's challenging environmental problems and the consequences of glacial melting.

Impacts of Weather Variability on Rice and Aquaculture Production in the Mekong Delta

Nguyen Hieu Trung, Can Tho University, Vietnam

Although farmers in Vietnam's Mekong Delta adapt to current weather variabilities, they may be unequipped to deal with future changes in global climate, Nguyen Hieu Trung said. He presented results from a study investigating the impacts of weather variability on rice and aquaculture production.

To cope with seasonal flooding as well as limited water and salinity intrusion during the dry season, Vietnam developed a rice irrigation system using canals and sluice gates. Cropping calendars and diversification also were introduced.



Nguyen Hieu Trung

Today, in dry fields, farmers cultivate rice and fish together. Farming is typically done on a small scale, with most producers managing less than a hectare or two.

To date, the system yields well, but climate variability is predicted to increase temperatures, reduce rainfall and raise sea levels, threatening productivity in the delta.

Trung and his colleagues investigated the impacts of short-term weather variability on rice and aquaculture production to suggest adaptive strategies for the future. Using weather statistical series data from 1990 to 2008, participatory-community appraisals and individual household-structured interviews, the researchers analyzed the effects of weather variability on agriculture and aquaculture production to determine how farmers adapt to weather and climate variability.

The results indicate that farmers use a cropping calendar based on weather variables. For example, farmers recognize that every two to four years, low January temperatures and abnormally high February rainfall cause a 0.6-ton loss per rice paddy, which is consistent with statistical data. When the temperature increases 1 degree in aquaculture settings, shrimp yields decrease 0.7 ton per hectare.

The study illustrates that scientists can learn much from farmers about how weather variation affects their experiences and strategies. “This is very important for our assessment of the vulnerability of climate change in the future,” Trung said.

For rice production, farmers cope by integrating nutrient management to help rice better tolerate



Harvested rice bundles

weather anomalies and by using appropriate rice cultivars and cropping calendars. Farmers also irrigate using groundwater, which is illegal, and create field ditches to drain the surplus water and to prevent soil acidification, a problem in the Mekong Delta. To reduce temperature’s impact on aquaculture, farmers deepen ponds, adjust feed and exchange pond water for intensive *Pangasius catfish* culture. In shrimp ponds, farmers grow aquatic plants to stabilize the temperature and reduce water pollution. The household’s economic livelihood strongly influences coping measures; poor households are the most vulnerable, with low resilience to change.

Adaptation strategy is a time-dependent and location-specific learning process, Trung said. “We should have a systems approach, which includes an integral combination of agriculture production system and food security and livelihoods, and this approach should be from top down and bottom up.”

Climate Challenges to Water for Agriculture

Although rice does not always provide the highest income, it is extremely important for Vietnam's food security and will remain the delta's primary crop. Trung and his colleagues recommend providing farmers a choice of technological packages, such as adaptive cultivars, farming practices and integrated farming systems. In addition, farmers need crop yield forecasting and simulation models to identify measures to minimize weather variables.

On a larger scale, adaptive strategies must be implemented within the context of improving rural people's livelihoods and of ensuring food security at the household, regional, national and global levels. Strategies must include appropriate policies to enhance farmers' adaptability, and

they must integrate a top-down approach with the bottom-up vulnerability perspective approach. The integration of the two approaches has been limited.

The impacts of temperature and rainfall variability differ among crops and their development stages, and within regions and seasons. Local people have ways to cope with weather variability, but they have not fully identified adaptation strategies for rice and aquaculture in the event of climate change, Trung concluded. Vietnam must develop additional strategies for future hydrological changes from global warming and upstream dam construction that will bring less water to the Mekong Delta.

Change in the Western Himalaya and Hindu Kush

John (Jack) F. Shroder, University of Nebraska at Omaha

John (Jack) F. Shroder helped found the University of Nebraska at Omaha's (UNO) Center for Afghan Studies in 1972. Since then, he has been involved in numerous research projects on Afghanistan's environment and studies of glaciers in the Himalayas.

As director of the Atlas of Afghanistan Project in the early 1970s, Shroder became involved in Afghanistan's environmental problems, including deforestation and "deshrubification," overgrazing, salt buildup, desertification, soil erosion, increasing aridity and decreasing water supply in an extremely dry environment.



John (Jack) F. Shroder

Contributing to Afghanistan's problems is Bad-i-sad-o-bist-roz, or "wind of 120 days," which blows 100-knot winds from July through September, causing damaging soil erosion. Lakes, rivers and agricultural fields have dried up, leaving sand dunes vulnerable to the powerful winds. In addition, degradation of grazing lands in the mountains throughout Pakistan and Afghanistan causes mud flows during the monsoons, bringing rocks and boulders crashing down. Poor people are left to deal with this dry, hostile land.

Among many other projects, Shroder has been involved in flood modeling for NATO and mapping the Afghan-Soviet border before the Soviets invaded, work that recently drew the interest of Afghan President Hamid Karzai.

Glaciers are a major focus in the area, the importance of which has increased with predictions of glacial melting caused by climate change. Glaciers are important storehouses of water and are by far the biggest potential sources of water for humans in the future. About 10 years ago, the Global Land Ice Measurements from Space (GLIMS) Regional Center for Southwest Asia was created at UNO to monitor glaciers in Afghanistan and Pakistan. GLIMS eventually will be passed to the Afghans and Pakistanis.

GLIMS has found that many glaciers are in trouble, Shroder said. The Koh-i-Foladi glacier, Mir Samir glacier and others in the Wakhan Pamir have shrunk dramatically and many smaller ones have disappeared in the past 50 years. "This is not good news for Afghanistan because it means a gross diminishment of water

coming downstream, particularly for the late summer and the early fall crops," Shroder said.

In contrast, he discovered that some glaciers are actually growing in areas of the Himalayas. Two reasons explain the surprising phenomenon: 1) an increase in mass at high altitude, from such causes as numerous snow avalanches following an earthquake, and 2) melting at lower altitudes, which accelerates forward motion. More surging glaciers are occurring in the Himalayas than anywhere else in the world, an event that Shroder termed the Karakoram Anomaly.

In 2008, the Cryosphere and Hazards Workshop in Kathmandu, Nepal, brought together Indian, Pakistani, Chinese and American geoscientists to discuss the region's delicate water issues. Following the workshop, in which Shroder announced the Karakoram Anomaly occurring in Pakistan's glaciers, geoscientists determined that India's Karakoram glaciers, too, are growing because of greater winter moisture.

Threats remain. As permafrost warms, it melts the Himalayan slopes, causing large rockslides. One occurred in Hunza in January 2010, forming a massive lake that threatens to blow out and destroy bridges on the Indus River. The Tarbela, the world's largest earth-filled dam, also sits downstream and will either contain the water or be destroyed. "Change is coming in the Himalayas and Hindu Kush, just like it always has," Shroder concluded. "Drought in some places, too much water in others, and the change probably won't be quite what we expect anyway."