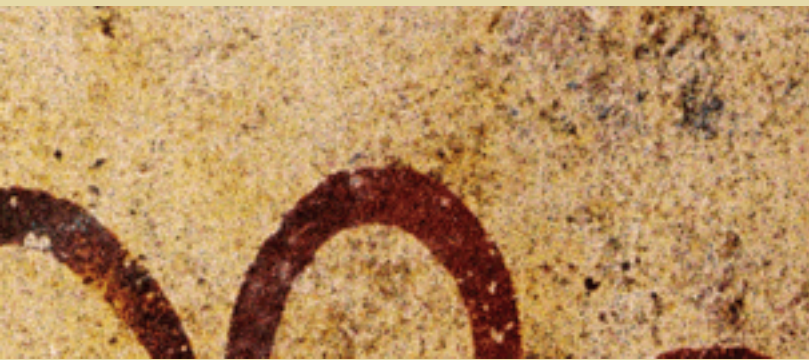


NEW TOOLS SIMPLIFY
DECISION MAKING IN COMPLEX
MOUNTAIN ECOSYSTEMS



“IF WE WANT TO CRACK THE
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FIELDS ARE EMBEDDED”

PAMELA ANDERSON, CIP DDG FOR RESEARCH

Ji Qiumei is one of the first Asian researchers to be trained in the use of a new series of modeling tools designed to help policy makers make better decisions about the management of mountain ecosystems. Her training also makes her one of a small but growing cadre of Asian scientists equipped to take on the challenge of capturing the bigger picture of the systems in which agriculture is embedded.

In 2002, Ji completed 24 months of training at CIP headquarters as part of her PhD dissertation. Ji, who is Tibet’s first woman to get a PhD in



agricultural science, used her dissertation research to conduct an inventory of natural resources on the Tibetan Plateau.

“The Qinghai-Tibet Plateau is Asia’s water tower,” says Nyima Tashi, Director General of the Tibet Academy of Agricultural and Animal Sciences (TAAAS). “We once assumed that the best way to spend our resources would be in animal production and crops, but Ji’s modeling

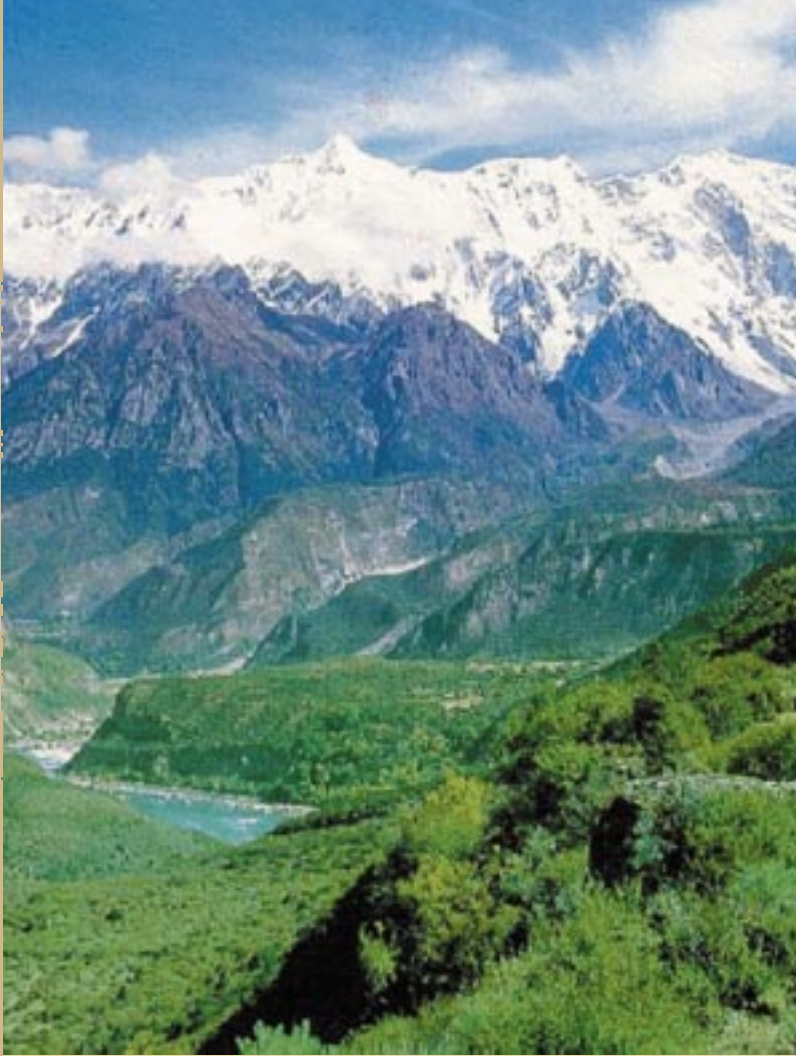
HI-TECH GEAR FOR HIGHLAND RESEARCH

The environmental health of mountain and hillside areas has a direct impact on the availability and safety of human drinking water, on our food supplies, and, increasingly, on political stability, says Hugo Li Pun, CIP's Deputy Director General for Corporate Development. In an address to a special session of the United Nations General Assembly at the launching of the International Year of the Mountains, Li Pun, an expert on highland agriculture, noted that the importance of mountain ecosystems was first highlighted at the Earth Summit in 1992. The major issues addressed there were summarized in Chapter 13 of Agenda 21, the Rio Declaration on Environment and Development.

"The Rio Summit generated the political will to undo hundreds of years of mismanagement and neglect. Ironically, at the time, we didn't really have the tools to act," he says. Since then, researchers have armed themselves with new hi-tech gear, including computer models that can accurately analyze the health of mountain ecosystems and help governments and local communities make more informed decisions about managing natural resources.

Some of the biggest improvements since Rio have been in the area of information and computers, Li Pun notes. E-mail and the worldwide web, combined with the development of computer simulation models, have created opportunities to exchange information and exciting new ways to solve problems.

Researchers are also better able to judge the potential of new technologies before they commit resources to them. For example, last year CIP social scientists, working in tandem with GIS specialists and crop scientists in Africa, used satellite imagery and newly installed geographic information software to calculate the potential of new crop varieties to alleviate malnutrition in the East African highlands. "In the past, it might have taken years to gather that kind of information, if it could have been done at all," Li Pun says.



THE QINGHAI-TIBET PLATEAU IS ASIA'S WATER TOWER. WHAT HAPPENS THERE DIRECTLY AFFECTS THE HEALTH OF THREE OF THE WORLD'S MAJOR RIVER SYSTEMS.

work showed us that our priorities ought to be in maintaining the integrity of our water supplies.”

Water is an important and sometimes controversial issue in the Himalayas. What happens on the Tibetan Plateau directly affects the health of three of the world’s major river systems—the Yangtze, the Mekong, and the Brahmaputra.

“Our analysis showed that Tibet’s farming systems are not designed to take advantage of our water resources in a way that benefits local people or our neighbors,” Ji says. The country’s strong focus on maximizing agricultural output is literally spending down its water resources and diminishing the quality of the supply for people downstream. Efforts to maximize the number of

animals that farmers produce, she says, have led to overgrazing and soil compaction, which in turn increases run off and erosion.

Ji notes that if policy makers would encourage animal producers to operate only in those areas that are best suited to the task, and then factor into the analysis water-related revenues over time, the policy environment would likely change, as would Tibet’s priorities for agricultural research.

HONEST BROKERS

“Modelers are like honest brokers,” says CIP modeler Roberto Quiroz. “If they do their jobs correctly they’ll come to the process without an agenda, without preconceived notions.”

“With modeling you can test different options up front without committing resources,” adds Quiroz. “It’s a money saver, especially in mountain environments where it’s often difficult to measure things in one place and extrapolate the data to another. With modeling you can look at things from a systems perspective.”

Quiroz notes that until recently, modelers had little reason to take on assignments in highland areas. Changes began to occur with the political commitment provided by the 1992 Earth Summit in Rio, as well as the availability of new satellite images provided by NASA and the

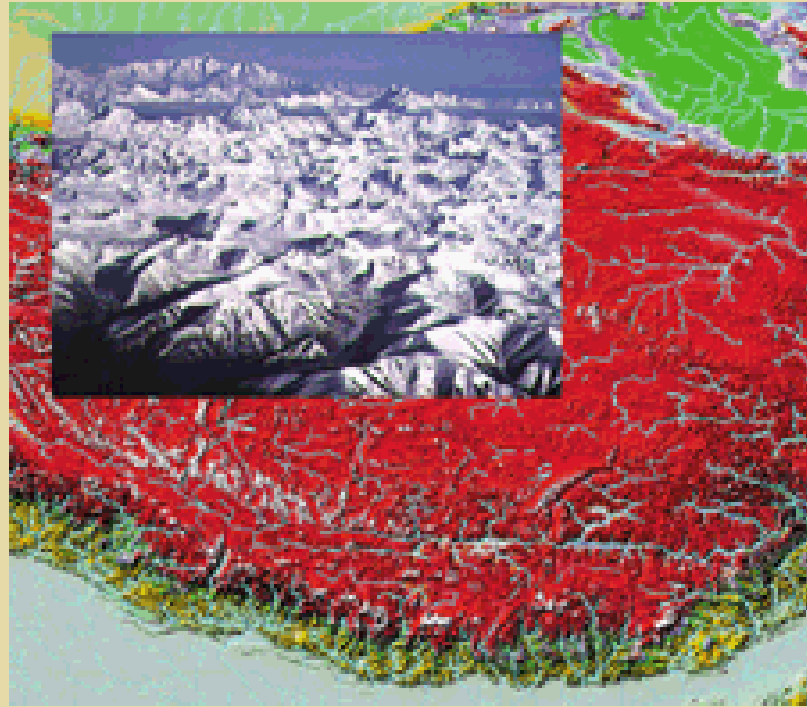
European Space Agency. Nonclassified satellite images, however, are not sufficiently detailed to allow scientists to draw accurate conclusions, Quiroz says.

MOVING TO ANOTHER LEVEL

One of the key features of the CIP models is that they have the capacity to downscale satellite imagery to the watershed level and take into account tiny variations in terrain and climate. “What the CIP modeling team and its partners did was develop tools that can interpolate solar radiation, rainfall, and temperature data taken from historical weather station data and contrast it with the images derived from satellite photos. That was really the key,” he says.

Case in point: For years, researchers used expensive and hard-to-construct runoff plots to measure soil erosion. If you want to measure runoff in a watershed accurately, however, you need an unmanageable number of such plots to account for changes in terrain. In this particular case, the breakthrough came with the construction of mathematical models that describe the energy released when a raindrop hits the soil and then contrasts this information with variables such as soil type, rainfall patterns, and plowing techniques. The variables

MODELING TOOLS—INCLUDING SATELLITE IMAGERY AND GEOGRAPHIC INFORMATION SOFTWARE—ARE HELPING SCIENTISTS TO UNDERSTAND COMPLEX SYSTEMS, SUCH AS TIBET’S HYDROLOGICAL NETWORK.



are put into mathematical equations that eliminate the need to physically measure runoff. The model also tells you how long you can crop the area without eroding the land’s capacity to produce food.

“We thought that if we developed tools that could help policy makers make better predictions we could increase the impact of traditional crop and animal research and in the process save development agencies a great deal of money. That’s why we got into modeling: to build tools to help people who make difficult decisions,” Quiroz says.

CIP’s Deputy Director General for Research, Pamela Anderson, is emphatic about the need for

NOMAD HERDERS IN TIBET ARE JUST ONE COMPONENT OF A DIVERSIFIED LAND USE SYSTEM THAT DEPENDS ON—AND AFFECTS—THE STABILITY OF WATER SUPPLIES.



such tools. “I’m not suggesting that we should stop working in the traditional areas of plant breeding or integrated pest management,” says Anderson. “We need to continue strengthening our core competencies. But, in addition, we need to target our work at the system level. That means developing analytical and modeling tools to increase our understanding of complex, dynamic systems, and training people to use those tools.”

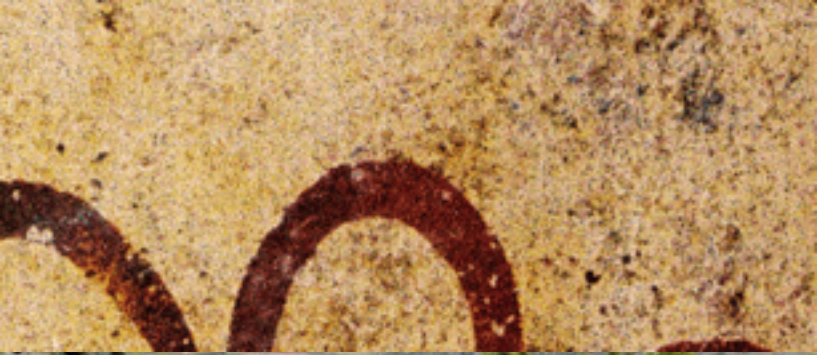
The Ecoregional Fund to Support Methodological Initiatives, the Swiss Agency for Development and Cooperation, and the CGIAR Systemwide Livestock Program are among those who have acknowledged this

need by allocating funds to support the CIP modeling research.

AND MUCH MORE

“We’re working in a lot of areas now, but we’re probably best known for our tradeoff analysis work in Ecuador,” says Quiroz (see *Tradeoff modeling helps make critical connections*, page 32). “Before that particular study was released two years ago, most people thought that the pesticides used on potatoes had their greatest impact on the environment. Tradeoff modeling showed, however, that human health is also affected, so that pesticide policies in the Andes needed to be redirected to prevent poisonings and that investment in health care for farm workers who are exposed to the chemicals is essential.”

This is just one in a range of studies conducted by CIP modelers, including a project that produced a solar radiation atlas for the Peruvian national weather service. To construct the atlas, scientists gathered historical records from Peru’s weather stations and ran them through CIP’s climate interpolation model. Peru’s Ministry of Energy and Mines is now using the atlas as a guidebook in a project that will put in place thousands of solar panels to bring



TRADEOFF MODELING HELPS MAKE CRITICAL CONNECTIONS

Following on the success of CIP's pesticide tradeoff work in Ecuador (see CIP's Annual Report 2001), project scientists are preparing to use the tradeoff analysis approach to demonstrate the importance of coordinating research on environment, health, and natural resources. "Our hypothesis is that if you want to crack the cycle of poverty and resource degradation, you need to look at the way that food production interacts with health and the environment," says John M. Antle, a production economist at Montana State University and long-time CIP collaborator.

Antle believes that there are substantial connections between crop productivity, the health of farm households, and soil and water degradation. Until now, however, each of these topics has been treated by separate scientific disciplines and diverse government agencies



operating with independent agendas. "There's a clear correlation between poverty and short-term planning horizons, which means that people often don't make the needed long-term investments. If you're an African farmer suffering from tuberculosis or parasites, let alone AIDS, it's unlikely that you'll have the inclination to do much about the long-term health of your soil," Antle says.

Starting in 2004, Antle proposes to use an upgraded version of the tradeoff simulation model used by CIP in Ecuador to make the case to policy makers. "What we are proposing are two contrasting studies. One will investigate economic–health–environment interactions associated with pesticide use in the intensive horticultural cropping systems typical of the peri-urban agricultural zone surrounding Nairobi. The

other study will examine nutrition, infectious diseases, and land degradation in the Peruvian Andes, a more marginal agricultural environment." To accomplish these objectives the current generation of tradeoff modeling tools will be expanded and efforts will be made to acquire and use data more efficiently. Advances made in these areas over the past 5 years will be incorporated into existing software, Antle says.

The studies are unlikely to provide a quick technological fix, however. Rather, the research should facilitate a more complete understanding of existing strategies, as well as their limitations. "If a quick fix is out there we may find it, but a more likely outcome is that we can bring about a more realistic and balanced assessment of the technology and policy options that exist. That kind of assessment could help research administrators and policy makers take into account the health and environmental dimensions of agricultural systems."

To illustrate the point, Antle notes that if this type of integrated assessment of agricultural systems had been available in the 1970s or 1980s, agricultural policy makers might have invested more heavily in integrated pest management and natural resource management as complements to the introduction of high-yielding crop varieties. Those investments could have helped avoid some of the adverse consequences that are now associated with agricultural development based on intensively managed monoculture systems.

electricity to isolated mountain areas. The atlas will allow them to determine where solar radiation is sufficient to make investment in the panels worthwhile.

The atlas is also expected to benefit agriculture. Its maps will help agricultural policy makers target areas where Peru has potential to initiate intensive, competitive agriculture that will hopefully lift subsistence farmers out of poverty, Quiroz says.

CIP's modeling programs are available free of charge as CD-ROMs and on the internet, in interactive environments for distance education. To learn more, please visit CIP's Virtual World, an interactive website where researchers and development experts can communicate with CIP modelers and exchange experiences in a 3D environment (see <http://inrm.cip.cgiar.org/res.htm>).