TROPICAL RESOURCES

The Bulletin of the Yale Tropical Resources Institute

2007 Volume 26

In This Issue

TROPICAL RESOURCES INSTITUTE

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About TRI

Articles

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Yale Tropical Resources Institute: Envisioning Synthesis and Synergy

Mission

The Mission of the Tropical Resources Institute is the application of interdisciplinary, problem-oriented, applied research to the creation of practical solutions to the most complex challenges confronting the management of tropical resources worldwide. Lasting solutions will be achieved though the integration of social and economic needs with ecological realities, the strengthening of local institutions in collaborative relationships with international networks, the transfer of knowledge and skills between local, national, and international actors, and the training and education of a cadre of future environmental leaders.

Vision

The problems surrounding the management of tropical resources are rapidly increasing in complexity, while demands on those resources are expanding exponentially. Emerging structures of global environmental governance and local conflicts over land use and environmental conservation require new strategies and leaders who are able to function across a diversity of disciplines and sectors and at local and global scales. The Tropical Resources Institute aims to build linkages across the natural and social sciences and among government agencies, academia and practitioners, enabling the formation of successful partnerships and collaborations among researchers, activists and governments. The Tropical Resources Institute seeks to train students to be leaders in this new era, leveraging resources, knowledge, and expertise among governments, scientists, NGOs, and communities to provide the information and tools this new generation will require to equitably address the challenges ahead.

Dear Readers,

As editors of the 2006-07 Tropical Resources Bulletin, we are very proud to present this year's issue. The topics and voices included in this volume represent the breadth and wealth of knowledge of the students at the Yale School of Forestry and Environmental Studies. They also provide a glimpse into the challenges that are emerging in the realm of environmental management and the new perspectives on developing solutions to those challenges.

The majority of this year's authors tackled research on topics of a social nature, where environmental problems and the social dynamic interact. Only a few of the stories are set in the Western Hemisphere, and the topics are sufficiently broad that they range from the conservation of caterpillars to the proper promotion of a protected area. Almost all boil down to a fundamental topic that pervades the discussion at F&ES: environmental issues can be solved more readily, sensitively and permanently by engaging local communities and developing consensus and ownership of solutions.

The first set of articles consider the difficulties inherent in the development and maintenance of protected areas, which are swaths of land or ocean set aside by governments, communities or nonprofit organizations (NGOs) for the purpose of protecting flora and fauna. Alvaro Redondo, who focuses his research in his homeland of Costa Rica, describes the challenges of connecting a series of protected areas for the purpose of establishing a biological corridor, while considering the needs and desires of the local people. Catherine Benson discusses particular marine protected areas in Papua New Guinea and the need for better communication between NGOs and local landowners, claiming that an organization's declaration of protection does not necessarily mean it is protected or that it has not been protected in the past.

Conservation of water is another topic of great concern to the F&ES community, and is justly represented among the TRI fellows. Jessica Albietz, a TRI fellow from 2005, conducted research on the impact of slash and burn agriculture, known as *savoka,* on the water quality and quantity in a set of watersheds in Madagascar. Looking at a much more urban setting and political framework, Kathryn Neville outlined the impact of the Asian currency crisis on the structure of two newly-privatized water companies in the Philippines, arguing that the internal management strategies of the companies and the regulatory structure were factors that caused one to become crippled while the other survived.

Two authors focused on differences, similarities or interconnectedness between rural and urban areas. Jennifer Lewis describes how the emerging market of açaí affects the way island communities along the Amazon River connect socially and economically with the larger metropolitan area of nearby Belém. Comparing indoor air quality in rural and urban environments in China is the focus of Ruoting Jiang's work, through which she found a substantial public health concern in rural households due to biomass consumption.

The social implications of conflict and resource extraction in rural areas of Nepal and Bhutan are also examined. Rachelle Gould outlines the local impact of the lack of proper management of a highly valued resource in the highlands of Bhutan, a fungi-infected caterpillar valued for its

medicinal properties. Across the border in Nepal, Krishna Roka researched the community forestry institutions to determine how they were impacted by the conflict between the government and the Maoists.

One of the authors tackled an exceedingly difficult issue, but one that affects almost all social science researchers in the environmental field. Brandon Whitney describes the inner conflict experienced by a researcher when observing an NGO making a decision that impacts a local population without consulting those people. He argues for the development of a hybrid role, through which social (and other) scientists conducting research are allowed to be engaged in an issue and offer knowledge and opinions while documenting the situation.

This volume clearly reflects TRI's philosophy of supporting leaders that can effecively cross the traditional boundaries between disciplines, taking a more holistic approach to environmental issues by engaging the human element. For many of the authors, this has been an exciting and unique opportunity to explore research areas beyond their previous training. In that sense, these articles are the product of their willingness to take risks and venture into unknown territories, which required learning new skills and seeing new perspectives. The effort has paid off, as for many this marks the beginning of a truly interdisciplinary career. Please enjoy!

Alicia Calle, MESc 2008 and Colleen Morgan, MEM 2007

TRI director Lisa Curran awarded John D. and Catherine T. MacArthur Fellowship

Lisa Curran, professor of tropical ecology and director of the Tropical Resources Institute at the Yale School of Forestry & Environmental Studies, has been awarded a five-year John D. and Catherine T. MacArthur Foundation Fellowship.

In announcing the award, the MacArthur Foundation said, "Through diplomatic skill, cultural sensitivity and rigorous scientific acumen, Lisa Curran synthesizes concepts from the natural and social sciences to forge new, practical solutions for sustainable natural resource extraction and development…. By developing consensus and fostering communication between diverse stakeholders, she is substantially increasing protection efforts in endangered regions."

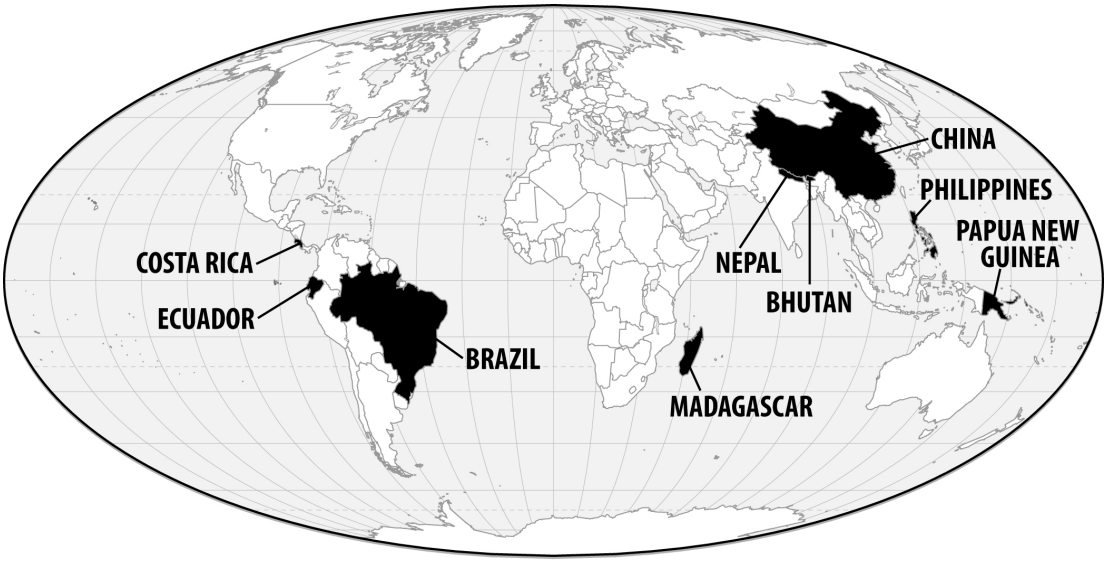
Curran has focused her research on the forests of Borneo and the ecology of its most economically important family of tropical timber, Philippine mahogany. She has worked to devise new strategies to address deforestation and its devastating environmental consequences. Curran and her research team study the structure and dynamics of tropical forests using satellite remote sensing, field ecology, ground-based surveys and analysis to learn how the environment is altered by human activities and to improve the management of these forests by integrating scientific knowledge with the sociological, political and economic realities on the ground. She has been instrumental in the establishment of national parks in Indonesia and has worked to counter illegal logging and the corruption that allowed it to take place.

"I've had an unusual career trajectory," Curran says. "I tend to be a problem solver, which requires me to think outside the box. I've had to use creative ways to acquire the information I've needed to address the issues in this emerging new field, sustainability science. I understand the needs of the activist seeking change, but fundamentally I am a scientist, seeking knowledge. My research is collaborative and interdisciplinary. I provide sound science so Indonesians can address these complicated issues. I provide training and information for them."

Curran is one of 25 MacArthur Fellows. Others include a developmental biologist, sculptor, country doctor, jazz violinist and deep-sea explorer. All were selected for their creativity, originality and potential to make important contributions in the future. The recipients will each receive $500,000 in unconditional support over the next five years.

The John D. and Catherine T. MacArthur Foundation is a private, independent grant-making institution dedicated to helping groups and individuals foster lasting improvement in the human condition. For more information, visit www.macfound.org.

2006 TRI Fellows in this issue



Bhutan:	Rachelle Gould
Brazil:	Jennifer Lewis
Costa Rica:	Alvaro Redondo Brenes
China:	Ruoting Jiang
Ecuador:	Brandon Whitney
Madagascar:	Jessica Albietz
Nepal:	Krishna Roka
Papua New Guinea:	Catherine Benson
Phillipines:	Kate Neville

Implementation of Conservation Approaches in Human-Dominated Landscapes:

The Path of the Tapir Biological Corridor Case Study, Costa Rica

By Alvaro Redondo-Brenes, MFS 2006, PhD Candidate

Introduction

One of the main problems of protected areas is their isolation within fragmented and often human-dominated landscapes (Powell et al. 2000; Sánchez-Azofeifa et al. 2003). Biological corridors have been proposed as a strategy for maintaining plant and animal populations in fragmented landscapes by connecting isolated patches with strips of habitat (Bennett 2003; Tewsbury et al. 2002), but their efficacy is still highly controversial (Tewsbury et al. 2002). Overall, most studies supporting the use of corridors seem to be either built more on intuition than on empirical evidence, or they are too species and landscape specific (Beier and Noss 1998; Tewsbury et al. 2002). Additionally, studies addressing the effect of fragmentation on wildlife conservation in the tropics have focused mostly on the fragments themselves, ignoring species distributions in surrounding areas, particularly those dominated by humans (Ricketts et al. 2000; Hughes et al. 2002; Daily et al. 2003; Horner-Devine et al. 2003; Pereira et al. 2004). Therefore, research is needed to assess the effectiveness of biological corridors as connectors within fragmented landscapes and consequently their usefulness as conservation tools.

Despite being recognized as having one of the most developed protected area systems worldwide (Groom et al. 2005), isolation of most of these sites in the fragmented landscape remains a major challenge in Costa Rica. The Path of the Tapir Biological Corridor (PTBC) is an example of a local initiative aiming to achieve connectivity between large protected areas. Development and deforestation in the region have created a fragmented, human-dominated landscape that constitutes the main barrier to achieving biological conservation in the region. My research objective in the PTBC is to assess the effect of the landscape's different components on the conservation of mammal and bird species, keeping in mind that land-use patterns, political and socio-economic aspects may be limiting factors as well.

In this paper I present the PTBC as a case study of a conservation approach in a human-dominated landscape. I describe several aspects of the corridor, such as its design and implementation, conservation programs, threats to biodiversity, stakeholder engagement and economic incentives. In developing the paper, I held occasional interviews with the main participants involved in process. I also participated in environmental education activities organized by the local NGO ASANA (Amigos de la Naturaleza del Pacífico Central y Sur de Costa Rica), which coordinates the PTBC, and in a workshop organized by Lindsay Cannet from

Alvaro Redondo-Brenes is from Cartago, Costa Rica. He has a BSc in Forestry Engineering from the Instituto Tecnológico de Costa Rica and a MFS from the Yale School of Forestry and Environmental Studies. Before coming to F&ES, he worked at La Selva Biological Station (Organization for Tropical Studies) in Costa Rica from 1998 to 2002 and he also studied English in 2003 at the University of California, Santa Cruz as a Fulbright fellow. Now he is a doctoral candidate in Tropical Forestry & Conservation at F&ES.

the Tropical Agricultural Research and Higher Education Center (CATIE). Finally, I focused on the PTBC analysis of data presented in books written by Bennett (2003), Anderson and Jenkins (2006), and Hilty et al. (2006).

Background on the Path of the Tapir Biological Corridor

The PTBC is located in southwest Costa Rica and is a part of the Mesoamerican Biological Corridor (MBC). The corridor's main objective is to create a network of sites favorable to fauna and flora between the forests of the Osa Peninsula and Golfo Dulce, including Corcovado National Park. These forests connect with those located in the Los Santos Forest Reserve in the Talamanca Mountain Range (Figure 1). The PTBC area covers approximately 82,000 ha, inhabited by 10,000 people in 55 rural communities. This mosaic of human-dominated land uses includes primary and secondary forests, native and exotic forest plantations, agriculture, pastures, bamboo, oil palm plantations, ecotourism projects and others.

The PTBC is one of Costa Rica's most diverse regions, as was confirmed by a Rapid Ecological Assessment. A total of 2,700 plant species representing 10% of the country's total plant diversity were identified, as well as 173 mammal, 26 amphibian, 46 reptile and 191 bird species (ASANA-TNC 2000). Moreover, 400 avian species were found in the area in the last three annual bird counts. The PTBC provides habitat to some endangered animal species such as margay *(Leopardus wiedii)*, ocelot *(Leopardus pardalis)*, jaguar *(Panthera onca)*, scarlet macaw *(Ara macao)*, spider monkey *(Ateles geoffroyi)*, squirrel monkey *(Saimiri oerstedii)*, great curassow *(Crax rubra)*, and endemic tree species such as *quira (Caryodaphnopsis burgeri)*.

Conservation in the region has been undertaken through seven National Wildlife Refuges and more than 30 private nature reserves, all of them established after 1995 (Ewing, J, pers. comm., June 2006). Most local people work in agriculture, and recently ecotourism has been gaining importance as an alternative source of income. However, as land prices have increased, land ownership is shifting from local farmers to wealthy foreigners. Costa Ricans have either become employees of the new owners, or migrated to larger cities in Costa Rica or to the United States and Europe. This poses a new challenge for the region, as

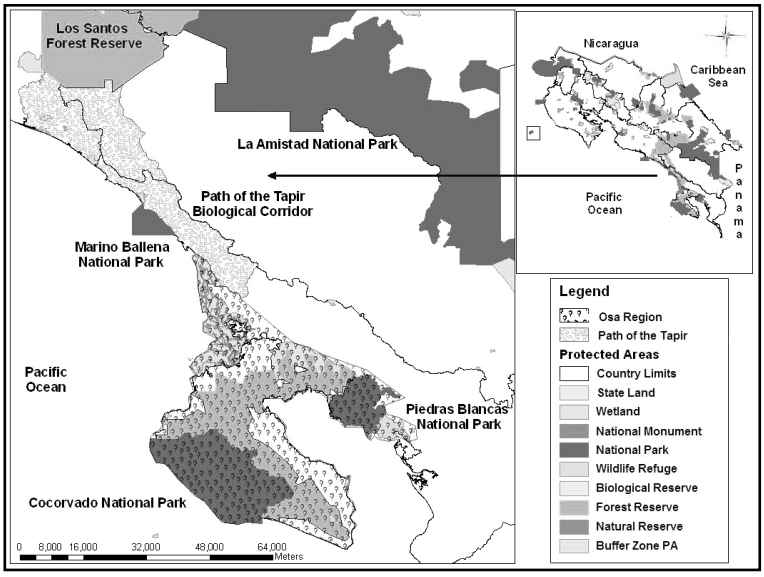


Figure 1. Location of the Path of the Tapir Biological Corridor and the System of Protected Areas in Costa Rica
(Source: INBio 2006; ASANA GIS layers)

Photograph 1. Establishment of tree nurseries in local communities provides the seedlings for recovering forest cover and connectivity on degraded lands. Local people and volunteers from the Tropical Forestry Initiative (TFI) program have planted over 40,000 trees of 35 native species as part of their restoration ecology program in PTBC. The photo shows ASANA's coordinator Cristian Valenciano at work with a volunteer from the TFI.
Photo A. Redondo

protected areas are interspersed with private lands. Therefore, in order to avoid land use change and ensure connectivity among all protected areas, it is essential that the corridor's conservation plan provides adequate incentives to landowners, particularly as land is bought and sold.

Design, planning and implementation

To implement an effective corridor there are several key factors: definition of concrete goals, appropriate design and management, identification of obstacles, support through the process and development of effective incentives (Bennett 2003; Anderson and Jenkins 2006; Hilty et al. 2006). Conservation awareness in the PTBC began early in the 1980s, and the creation of ASANA was the first step to implement the corridor. ASANA has not only addressed conservation issues, but has also worked to develop community-based sustainable projects. In 1996, the idea of the PTBC was first brought to consideration, but it was officially recognized by Costa Rican authorities only in 2000. The corridor design encompassed high elevation lands to protect water sources for local consumption and a matrix of high and lowlands to protect habitat for hundreds of species. The PTBC is one of the few projects where a Rapid Ecological Assessment was carried out to justify its importance as a conservation and development tool in Costa Rica (Ewing, J. pers. comm. July 2006).

The strategy for the creation of the PTBC consisted of three elements. The first encourages landowners to formally create one of several types of biological reserves: a) National Wildlife Refuges like Hacienda Barú and La Merced; b) informal reserves with no particular government recognition such as Oro Verde Biological Reserve and Rafiki Safari Lounge; c) land held in reserve through payment for environmental services (PES); d) land protected by environmental easements. A second element encourages and assists landowners in the protection of their reserves. This is accomplished through environmental education in surrounding communities, and by creating covenants that allow the National Parks Foundation (NPF) to hire official park rangers whose salaries are later reimbursed by reserve owners and neighbors. The final element encourages the creation of natural corridors along rivers, streams and fences in lands not currently in reserve, allowing connections between forest

Photograph 2. As part of the environmental education program school children learn organic farming practices.
Tres Piedras School, PTBC.
Photo A. Redondo

patches. This is being accomplished through environmental education and public awareness (Ewing, J. pers. comm. October 2006).

The PTBC organizations strive to achieve four major goals: (1) restore natural habitats to encourage the return of terrestrial and marine endangered species such as the leatherback sea turtle *(Dermochelys coriacea)* to the forests and beaches they inhabited half a century ago, and protect existing species by allowing local populations to become more robust, (2) halt deforestation and restore forests in order to complete the corridor and protect water sources, particularly in watersheds and groundwater recharge zones (Photograph 1), (3) encourage local communities to value resources and use them sustainably, and (4) create interconnecting forest reserves between the existing network of forest and wildlife reserves.

Specific conservation programs have been developed by the PTBC organizations to accomplish its goals in the region. These are important steps in the implementation of the corridor's design (Anderson and Jenkins 2006). The main programs include: (1) Environmental education in more than 32 schools and workshops for local adults help build a better understanding of sustainable forest management (Photograph 2). In addition, within the PTBC road signs caution drivers about the presence of wildlife species and inform people about the existence of the corridor (see Photograph 3). (2) Promotion of land conservation areas through Payment for Environmental Services (PES) is done in collaboration with the government (for more details about PES see Redondo-Brenes and Welsh 2006). (3) Community-development projects provide better revenues to local people through sustainable agricultural practices. (4) Coordination for the development of aqueduct associations ensures proper watershed management and supply of drinkable water to locals. (5) Training and approval of 130 voluntary local game wardens provides an *ad honorem* patrol for the regions. (6) Efforts are done to monitor and protect sea turtles and other flora and fauna species. To date, some of those programs are working well and others still need more funds to be properly implemented.

Despite these programs, biodiversity in the region is still threatened by development, deforestation, illegal logging, poaching, hunting and lack of law enforcement. Foreigners and tourism projects are being attracted to this area, as real estate developers buy the land from

locals. Cutting the forest and building new roads and residential areas result in increasing fragmentation. Moreover, despite a reported decrease in hunting over the last three decades (Ewing, J, pers. comm. June 2006), the problem persists because hunters continue to come from communities outside the corridor.

Another main constraint for the PTBC to achieve biological conservation is insufficient funding. During a workshop in June 2006, local people mentioned that they lacked the funds to continue some current projects and to implement new ones. Other problems such as weak law enforcement, some cases of corruption by government organizations and little interest in controlling these factors, still persist in the region. In fact, local farmers highlight the authorities' negligence to enforce the law against developers and other landowners as one of the obstacles to success of the PTBC.

Stakeholder engagement and economic incentives

Large-scale conservation projects in private and human-dominated landscapes require participation of local people and they have to receive economic incentives to ensure their support (Anderson and Jenkins 2006). Support to the PTBC project by its participants stems from the fact that they were taken into consideration during the design of the corridor's objectives. For example, since water quality and quantity are important issues for the people of the region (Welsh 2006) and a water protection approach has proved to be an effective tool for biodiversity conservation as well (Redondo-Brenes and Welsh 2006; Redondo-Brenes 2007), the corridor leaders chose to include water as a priority in their plan.

According to Newcomer (2002) the PTBC participants can be grouped into three main in-country clusters: community organizations, government and landowners. Community organizations include cooperatives, foundations, women's groups, environmental groups, agricultural groups, community development associations and the PTBC Coordinating Committee. The government is represented by a local liaison between the PTBC program and the Ministry of Environment (MINAE). National ministries and municipal government agencies have direct interests and influence on the program (Newcomer 2002). The PTBC consists of three municipalities (Aguirre, Osa, and Perez Zeledón), and three conservation areas (ACOPAC, ACLA-P, and ACOSA) led by MINAE, but to date only the municipality of Aguirre, and the conservation areas ACOPAC, and ACLA-P to a lesser extent, are supporting their conservation and development initiatives. Finally, landowners can be divided into those

Photograph 3. Road signs within the PTBC caution drivers about the presence of wildlife species and also inform people about the existence of the corridor.
Photo C. Valenciano

who participate in conservation and those who don't. The latter, mostly developers, constitute one of the main threats to biodiversity conservation in the area. A fourth group not mentioned by Newcomer (2002), consists of individuals and institutions that fund specific conservation and development projects within the PTBC. Among them are AVINA Foundation, Cedarena Land Trust, Costa Rica Conservation Trust, the Mesoamerican Biological Corridor Coordinating Committee and the United Nations Development Programme (UNDP).

Participation of local landowners and their willingness to maintain forest cover will determine the future success of the PTBC project. The fate of the existing biodiversity in the region depends on landowners' management decisions, so attractive economic incentives are necessary to ensure their engagement in conservation practices (Anderson and Jenkins 2006). The PTBC organizations help landowners find these incentives for sustainable land management. For example, they offer guidance in obtaining PES from the government (to date more than 3,500 ha of forest are under protection through PES), funding for community-development projects and technical assistance to address water management and other conservation issues. Additionally, local landowners can benefit from conserving their lands through ecotourism (Valenciano, C. pers. comm. July 2006).

Final remarks: recommendations to the PTCB organizations

Of the more than 30 corridors in Costa Rica, only six currently have well-defined organizations with boards of directors and are implementing their conservation programs in the field. The PTBC is one of them (Cannet, L. pers. comm. June 2006). This section will discuss those limiting factors that still need to be addressed in order to accomplish conservation and community development objectives in the PTBC.

Lack of public awareness limits the implementation of the corridor's design (Anderson and Jenkins 2006). According to Welsh (2006), less than 50% of the local people interviewed within the corridor in 2005 knew or had heard about the PTBC. Thus, it is essential to work more in promoting the corridor at a local level. Well-defined leadership is one of the PTBC's strengths, which should be linked to strong institutional coalitions and broad public support (Anderson and Jenkins 2006) in order to ensure long-term success.

Law enforcement needs to be strengthened as public support for the corridor implementation process grows (Anderson and Jenkins 2006). Sustainable resource management along the whole corridor requires support from municipalities and conservation areas not currently working within the PTBC objectives. As mentioned above, strong institutional coalitions are fundamental to accomplish conservation goals, especially in human-dominated landscapes. Since only municipalities and MINAE can make decisions about new infrastructure development, their participation is the key to achieving conservation in the region. Only they can control development projects to avoid further habitat fragmentation, and do more careful land-use planning within the PTBC.

The PES scheme currently used in the region to encourage conservation needs some re-structuring. Poor funding, medium-term time frames (e.g. PES contracts range from five to 10 years), and some mismatch between conservation areas defined by MINAE and conservation priorities within each region, are some of the flaws of the program. Thus, either the government should create a better framework for the PES, or the PTBC organizations should look for alternative funding sources to provide economic incentives to owners willing to preserve their land.

To date, most of the biological information for the corridor is lacking. It is important to evaluate how the PTBC may affect native species in the landscape. What can serve as connectivity for one species may act as a barrier to movement for other species (Bennett 2003; Hilty et al. 2006). This issue will be addressed in my dissertation thesis, studying mammal and bird species and their habitats within the corridor. It is essential to establish which species are present, what their habitat requirements are, and how much of it is available. Meanwhile, the PTBC organizations need to continue working on habitat conservation and restoration. Food sources for different wildlife species should be established to avoid conflicts with local farmers. And given that the PTBC region is bisected by roads, building road-crossing structures could provide connectivity between flora and fauna populations and decrease road kills.

Costa Rican institutions and international NGOs need to realize the potential broader implications of the PTBC's conservation effort. The corridor aims to provide connectivity for flora and fauna between Corcovado National Park and other large protected areas. Unless this is achieved, most large endangered species in Corcovado will become isolated and doomed to extinction in the long run. However, while millions of dollars are being invested in the adjacent Corcovado, poor external economic support currently limits many of the PTBC's conservation programs. So not only do they require more external support but all organizations within the corridor need to make a clear and concerned effort to accomplish the desired connectivity.

Acknowledgements

I thank Cristian Valenciano, Jack Ewing, Steve Stroud, Pedro Porras, Juan Ramon Segura (ASANA & Hacienda Baru), Elizabeth Deliso (MESc 06 - Field Assistant), the Odio and Sequiera families (Rancho La Merced), the Duarte family (Oro Verde), the Boshoff family (Rafiki) and the local people for collaboration during my field work and for sharing all their knowledge with me. I also thank the GIS department at INBio for providing the land use layers for PTBC. This project was supported by the Tropical Resources Institute, the Council for Latin American and Iberian Studies, and the Center Field Ecology Pilot Grant at Yale University.

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Wildlife Management Areas in Madang Lagoon, Papua New Guinea:

Creating or Claiming?

by Catherine Benson, MESc 2007

Introduction

In October 2005, my Google protected areas alert showed several links to the creation of new protected areas in Papua New Guinea (PNG). As I clicked on the links, I was already wondering if this issue could be my master's research topic in Summer 2006. I had no idea that the timing of this press release would be the focus of my efforts to understand who was actually achieving conservation in PNG.

The statement, issued by the World Wildlife Fund (WWF), proclaimed: "The government of Papua New Guinea announced today that it will gazette 12 new protected areas covering some of the country's most biologically diverse forests, wetlands and coral reefs" (WWF 2005). The creation of these new protected areas would increase the amount of land protected in Papua New Guinea from 2.7% to 4%, in line with the Government's commitment under the Convention on Biological Diversity to eventually protect 10% of total land.

Catherine Benson graduated from Colby College with degrees in Biology and Environmental Policy. She worked for three years at the World Resources Institute on environmental governance issues in Africa. Later she worked as a Research Associate with the Advocates Coalition for Development and Environment in Uganda, analyzing natural resources decentralization and poverty. After graduating from F&ES, Catherine plans to pursue a PhD at the University of Michigan, looking at the role of non-government organizations in community-based conservation.

This announcement by the Government of PNG and WWF mirrors a global trend towards increasing the amount of land in the protected estate in developing countries. While such goals often mention local community involvement, global conservation efforts may not facilitate local participation or ensure that rural communities receive benefits from conserving their resources. In PNG, where 97% of the land is owned communally, approval and consent of local communities on conservation issues is legally required although it may not occur in practice. My research project examined whether or not local communities participate in the decision-making process surrounding the creation of protected areas in PNG, and the roles of non-governmental organizations (NGOs), such as WWF, in driving or facilitating this process. As a result of PNG's unique land tenure system, I was interested in whether or not local landowners were significantly involved in the creation of protected areas.

Research site

There are currently four registered Wildlife Management Areas (WMAs) located in Madang Lagoon: Laugum, Sinub, Tab and Tabad (Photograph 1). These are the first four of 12 new Protected Areas (PAs) announced by the Government of PNG and WWF in October 2005 (WWF 2005). They represent 27% of the total area of Madang Lagoon (Jenkins 2002). Approximately 16 additional areas have been identified by communities as potential WMA sites.

I conducted research in Madang, Papua New Guinea. Madang Lagoon, located on the north coast of PNG, is four km wide and 16 km long (Jenkins 2002). The population of the lagoon is 7,323, according to the 2000 census data (NSO 2002). The average annual population growth rate in Madang province is 3.7% (NSO 2002). The population in Madang Lagoon is largely dependent on fishing and farming, and a small percentage works in the nearby RD Tuna Canning Factory or in Madang Town. Increasing fish harvests, both for local consumption and for sale in the market, are becoming a concern and are one reason cited by local landowners for creating marine protected areas. Tourism in Madang Lagoon is limited; the majority of tourists are divers. A few landowners are employed by the diving industry and land-owning clans receive payments from non-local dive operators for letting tourists dive on their reefs.

PNG's reef ecosystems are the richest on earth, particularly in terms of invertebrate species abundance (Sekhran and Miller 1995). Madang Lagoon is the most ecologically diverse lagoon on PNG's north coast (Jenkins 2002). The ecological habitat is composed of coral reefs, mangroves and seagrass. The reef fish within the 1,085 hectares of Madang Lagoon are considered to be of local, national and global importance (Jenkins 2002). Eight hundred and fifty-eight reef species have been recorded within the lagoon. These species are representative of 57% of PNG and 14% of world reef species (Jenkins 2002).

In addition to its ecological diversity, Madang Lagoon contains areas of cultural and historical importance for the populations of Riwo, Sek and Siar. Local landowners within the lagoon respect traditional *masalai* and *tambu* areas within the lagoon, where no fishing zones were previously protected for generations.

In terms of scientific research, Madang Lagoon is one of the most studied marine areas in Melanesia because the Christensen Research

Photograph 1. Tab island is one of the four currently registered WMAs located in Madang Lagoon. This is the most ecologically diverse lagoon on PNG's north coast composed of mangrove, coral reef and seagrass habitats.
Photo C. Benson

Institute (CRI) was previously located there. CRI provided a facility for scientific and marine studies from the early 1980s until it closed due to financial mismanagement in 1997 (Jenkins 2002). However, CRI did not conduct research on local communities and resource use. According to Jenkins (2002: 8), "no studies have been carried out on the socio-economic values of Sinub Island (and the other Wildlife Management Areas) to the local resource owners." Joshua Cinner, a marine biologist, has incorporated some socio-economic research into his studies by conducting surveys in the villages of Krangket and Riwo (Cinner 2005; Cinner et al. 2006; Cinner and McClanahan 2006).

My study is among the first to examine local community perceptions of conservation throughout Madang Lagoon, in both coastal and inland communities. To do so, I used a diverse set of social science research methods including interviews with all communities in Madang Lagoon.

Research methodology

Data collection consisted of over 200 semi-structured interviews with local landowners in Riwo, Siar and Sek villages, all of which are within Madang Lagoon. These communities are relatively close and villagers share the Bel *tok ples* language; they are usually aware of conservation initiatives or fishing practices in other villages. Interviews were conducted in *tok pisin* with the help of a research assistant, and included landowning clans both within and outside the WMAs. Landowners were questioned on seven broad topics: land and land ownership, fishing and marine tenure, creation of conservation areas, knowledge of conservation legislation, interactions with NGOs and government, and overall ecological health of Madang Lagoon, including water and sanitation issues. Topics were selected to allow a general understanding of conservation in Madang Lagoon and the degree of local landowner involvement in the process. Key informant interviews were conducted with anthropologists, dive operators, donors funding projects in Madang Lagoon and PNG, national and international NGO staff, and they were complemented by participant observation notes and conversations with other researchers.

My overall goal was to identify recommendations to ensure better relationships between communities, protected areas and NGOs that will be applicable not only for PNG but also for other countries currently increasing their percentage of protected areas to meet global biodiversity conservation commitments.

Results

Local landowners are generally both interested in and knowledgeable about conservation. They express willingness to conserve their land and their sea, so their children will have similar access to resources. Some mention declines in fish catch over time and believe conservation has been beneficial by increasing fish yields since the creation of the WMAs in their area. Still others regard conservation as a way of attracting tourism revenue or NGO projects into their region, and so view conservation as a development apparatus from which they can potentially benefit.

Different communities and individuals expressed diverse opinions about the role of NGOs in local conservation. While many people interviewed did object to the existence and power that NGOs had in their communities and in conservation, others appreciated their work. While it is impossible to generalize these relationships, the biggest complaint I heard in Madang is that NGOs do not provide communities with alternative livelihoods when presenting them with ideas for conservation. This is illustrated by a quote from someone in Riwo: "It's a big thing to not ruin land or sea; WMAs

are good but we must have a place where we benefit, where we catch fish and are able to have a livelihood" (Interviews in Riwo, 9 August 2006).

My research highlighted the existence of traditional forms of conservation prior to the involvement of international conservation NGOs. One Sek man explained the connections between traditional conservation and today's WMAs by saying, "Traditionally, everyone knew and talked about the demarcations and not going into someone else's reef….No WMA, no set of rules written on managing resources. Here, it's shared and talked about at community meetings" (Interviews in Sek, 9 August 2006). International conservation NGOs are now replacing these traditional forms of conservation by more "official", legally recognized WMAs in Madang Lagoon.

While each WMA I examined had some previous form of traditional conservation or local landowners interested in conservation, none of them were created without outside assistance from researchers, national environmental law groups or international NGOs. In Madang Lagoon, the first WMA in Riwo was created when a village elder contacted an American marine biologist, now working with Wetlands International, about options for conserving their land and sea. The biologist then met with local landowners and explained the different types of protected areas under PNG conservation legislation. WWF then became involved in working with the PNG Department of Environment and Conservation to gazette these areas. In this example, an outsider was needed to explain the legislation, pay the gazettal fees and negotiate the process with the government.

In my discussions and interviews with landowners and NGOs working in the area, I learned that the WWF notice that I read back in October 2005 was written long after the marine biologist spoke with landowners in Madang Lagoon in 1997. These WMAs were designated by local landowners in 1997 with Wetlands International, officially gazetted by the Department of Environment and Conservation in 2000, claimed by the WWF press release in 2005 and recognized at a "launch" in 2006. These efforts have been recognized by the international conservation community as achievements in the creation of marine protected areas, yet it remains unclear if they have resulted in any on-the-ground changes.

Conclusions

My research in Madang Lagoon suggests that, despite progressive conservation legislation and a high degree of local control over land tenure, "official" conservation in Papua New Guinea is still driven by external sources. While local landowners may respect traditional *tambu* or *masalai* no-fish areas where fishing is prohibited by clans, these same areas have been recently declared marine protected areas by NGOs through official gazettals. Some clan members have worked with NGOs in this process while others remain unaware of the shift from traditional to legally recognized conservation. While local landowners were not all included in or aware of the decision to create WMAs, their future inclusion will be critical to the long-term viability of the initiative in Madang Lagoon. This communication gap is an obstacle to effective conservation, one that NGOs and other institutions must address.

Agrawal and Redford (2006: 17) argue that "what is often at stake is not [biodiversity] conservation, but who gets to claim it and use it, the institutional arrangements regulating its use, and allocations for losses and gains from use." Their statement is illuminating on the ways in which biodiversity conservation in Madang may be more about *claiming* conservation than *achieving* conservation. My research findings show that local landowners traditionally respected *tambu* or *masalai* areas. But international conservation NGOs have sought their

legal recognition as marine protected areas, claiming credit for "creating" conservation in areas where traditional forms of protection were already in place. It is unclear, however, if on-the-ground management practices have changed as a result of this official recognition.

This example suggests that in international biodiversity conservation circles, claiming of conservation may be becoming more important than actual conservation. International NGOs seem to be focusing more on the creation of such areas while neglecting the implementation and enforcement of WMA management plans. For instance, on the Tab Island WMA created by Siar landowners, dynamite fishing and deforestation continue despite rules forbidding such practices in the Management Plan. If international conservation NGOs are committed to biodiversity protection and livelihood sustainability, they should play a role in actual implementation of WMA management plans and in facilitating enforcement by local landowners, rather than simply playing a peripheral role in the creation of the WMA and taking credit for such protection.

Finally, tensions exist within Madang Lagoon among conservationists, dive operators, landowners and researchers. International conservation NGOs contribute to existing tensions by failing to communicate with these stakeholders. In order for these WMAs in PNG to achieve their conservation and livelihood goals, greater coordination among all groups is necessary. International conservation NGOs could provide a greater service by helping to coordinate conservation perspectives within Madang Lagoon and ensuring enforcement of agreed upon objectives. Such a role would demonstrate to local communities that these NGOs do care about conservation.

As my research shows, past resource management within the lagoon was dependent on strong inter- and intra-clan and village communication. By failing to communicate changes in resource management to local communities, NGOs are undermining a strong, local social institution that they could strengthen to the advantage of both conservation and their position within the region.

In the global literature on protected areas there is a growing emphasis on quantitative measures of success, such as the 2010 Convention on Biological Diversity benchmarks for protected areas and the Millennium Development Goals. Furthermore, emphasis is placed on the creation of protected areas rather than on their management or monitoring. West and Brockington (2006: 610) say "protected areas are increasingly becoming one of the benchmarks by which conservation activity is measured." They also suggest that "protected areas are coming to form a way of thinking about the world, of viewing the world, and of acting on the world" (2006: 609). Whether or not PAs are effective means of conserving global biodiversity, their creation remains as the primary mechanism to achieve it conservation; "protected areas are often viewed as a critical component in the race to preserve biodiversity" (Agrawal and Ostrom 2006: 682) and "the cornerstone of strategies to conserve biodiversity worldwide" (Brechin et al., forthcoming).

All of these statements recognize the central role of PAs in international biodiversity conservation and suggest that major conservation efforts have coalesced around PA creation. As my research in Madang Lagoon suggests, the current emphasis of the NGO conservation community on PA creation, without providing the necessary support for enforcement and implementation, may not lead to long-term global biodiversity conservation.

Acknowledgements

Amity Doolittle, Michael Dove, Gordon Geballe, Stephanie Ogburn, and Brandon Whitney were instrumental in designing and analyzing this research. Fredah Dabel was an invaluable research assistant and Jim Robbins facilitated this research. I also appreciate the willingness of everyone in

Madang Province to participate in my research and to teach me about their area. Funding for this research was provided by the Coca-Cola World Fellows Program, the Council on South East Asian Studies at Yale, the Tropical Resources Institute at Yale, and the Jim Leitner summer research fund.

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Watershed Protection for Ecosystem Services in the Makira Forest Area, Madagascar

by Jessica Albietz, MEM 2006

Introduction

Madagascar's farmers have been accused of being the "proximate agents" of land conversion in one of the world's "hottest" biodiversity hotspots (Myers et al. 2000).

The area around the Masoala Peninsula in northeastern Madagascar experiences some of the highest population growth rates in the country. Common land uses in the rainy region are paddy rice production, cattle grazing, and mixed hillside agriculture called *savoka*. This study used the paired watershed comparison method to look at the ecological impacts of land use on the water quality and flow in the Andranomena River basin, part of the Antaninambalana River watershed. Nine months of monitoring data of water quality, flow patterns and rainfall showed that the sub-watershed with uniform mixed hillside cultivation/*savoka* land use exhibited significantly higher water temperatures and exported significantly greater amounts of Total Dissolved Nitrogen (TDN) and Total Suspended Solids (TSS) than the undisturbed forested sub-watershed. The study also revealed that the cultivated sub-watershed experienced a significantly greater "flashiness" during rainfall events, or in other words, an increased ratio of runoff to rainfall when compared with the undisturbed forested sub-watershed.

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Background

The northeastern part of the island has some of the last remaining large tracts of primary eastern rain forest in Madagascar (Green and Sussman 1990). In this region, the Antongil Bay watershed includes the Masoala Peninsula and the Makira Forest Area, and contains approximately 50% of the 12,000 plant species identified in Madagascar (Meyers et al. 2005). With its headwaters in the Makira Forest area, the Antaninambalana River flows into Antongil Bay, an important habitat for humpback whale breeding (Figure 1).

In addition to irrigation for rice farming, the Makira Forest Area's watersheds provide important environmental services for aquatic and riverine fish habitats. The local populations rely heavily on fish as a major source of protein, and the development of the fisheries in Antongil Bay "remains an important potential regional opportunity for alternative employment" (Meyers 2001).

Unfortunately, the way local populations manage their land can affect water quality by

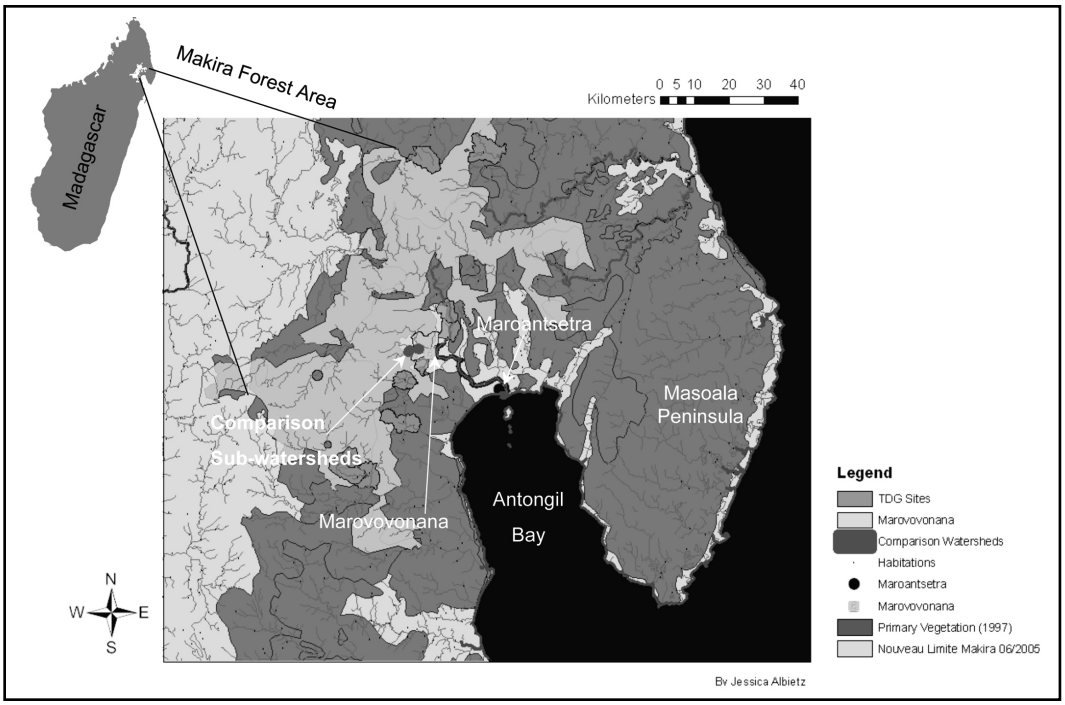


Figure 1. Makira Forest Area, Madagascar

altering watershed hydrology, nutrient loads, channel geomorphology and sediment load (Bruijnzeel 2004; Kramer et al. 1997; Meyer et al. 2003). The conversion of tropical forest to shifting cultivation and heavy grazing has been observed to cause flooding and erosion in many parts of the world (Photograph 1). Forest cover provides watershed protection insomuch as the forest regulates the rate at which water moves into streams and regulates total water runoff (Kramer et al. 1997). Forests tend to increase infiltration and soil retention, thereby promoting groundwater recharge and reducing runoff (Landell-Mills and Porras 2002).

Changes in the vegetation near a stream reduce the amount of rainwater and runoff that the stream network can absorb before it floods, so deforestation increases streamflow, which may cause flooding. In tropical forests, Bruijnzeel (2004:195) found that "the removal of more than 33% of forest cover resulted in significant increases in annual streamflow during the first 3 years." In Madagascar, deforestation has increased discharge of the small headwater streams, causing channel scouring and more frequent and intense flooding (Meyer et al. 2003). That same report indicates that channels altered in this way are less effective at recharging groundwater, trapping sediment and recycling nutrients.

Less groundwater recharge often results in a lower base flow in the streams, or less water during drier seasons. In eastern Madagascar, a study comparing the hydrology of a watershed under natural forest cover with a watershed under cultivation showed a reduction of base flow in the farmed area by a factor of 2.5 to 3 (Brand 1997). Of course, base flow during the dry season also depends on vegetation type, soil infiltration capacity and climate (Bruijnzeel 2004).

Introduction to study location

In eastern Madagascar, a region that experiences heavy monsoon rains and periodic cyclone activity, there is mounting concern aided by anecdotal evidence that increasing rates of deforestation are causing greater flood-

ing. These floods periodically damage agricultural crops, such as those located in alluvial plains along streams and rivers.

Research in the Mantandia area of eastern Madagascar recorded increased runoff in watersheds cleared for swidden agriculture (Kramer et al. 1997). The sub-prefecture of Maroantsetra in the northeast experiences a humid and hot climate with annual rainfall around 3,000 mm and an average annual temperature of 24˚ C (Brand et al. 2002). This region is also the third largest rice growing region in Madagascar, but productivity is limited to one growing season due to the lengthy rainy season, during which it is impossible to cultivate rice. For rice cultivation, flooding problems are more detrimental than lack of water (Brand et el. 2002).

Methods

To study the relationship between land use and water quality and quantity, three water monitoring stations were installed in basins with different land uses. Land use characteristics, stream temperature, conductivity, sediment load, discharge rate, rainfall and total dissolved nitrogen were measured. While one water sampling station was located at the discharge point of the Andranomena River basin, two of the water monitoring stations were installed on small comparison sub-watersheds that flowed into the Andranomena River (Photograph 2). The two comparison sub-watersheds on stream 2 and 3 consisted of approximately equal catchment size, elevation difference and slope and had uniform land use throughout the catchment. Catchment 2 was composed of mixed hillside cultivation and catchment 3 consisted of undisturbed forested land.

From July 2005 through March 2006, the water was sampled systematically, twice a month, at the base points, to create a stream hydrograph and water quality data set. To compare the immediate response of the different catchments to rainfall events, or their "flashiness", the stream hydrographs of the watersheds were separated by rainfall event. Geomorphic stream assessments were also conducted, including the analysis of stream substrate, slope, canopy cover and entrenchment, to acquire information about water flow and flood patterns for the three river basins.

Photograph 1. Zebu grazing on forest land that was burned and cleared for pasture in the Andranomena River basin.
Photo J. Albietz

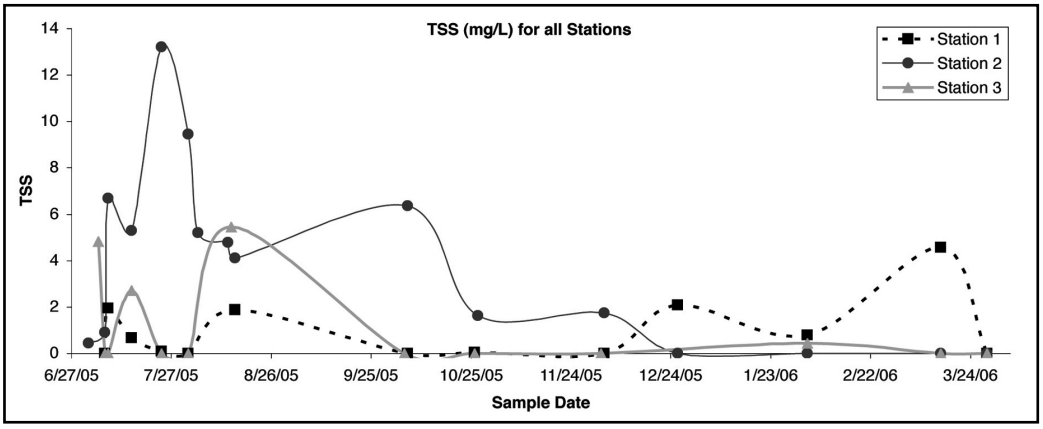


Figure 2. Total Suspended Solid (TSS) load sampled from three study watersheds

Results: Water Quality Analysis

Savoka agriculture is causing flooding, soil nitrogen depletion and decreased water quality in the region (Photograph 4).

Sediment samples

Statistical analysis of the yield of Total Suspended Solids (TSS) in stream 2 and 3 showed that stream 2 had a significantly (T-value: 2.42, P-value: 0.024) greater TSS load compared with stream 3 (Figure 2).

Photograph 2. Water monitoring station 2 installed in the *savoka*/mixed hillside agriculture sub-watershed. *Photo J. Albietz*

Sediment analysis for percent organic carbon (POC) greater than 0.7µm showed that, although the average POC load was slightly higher in stream 2, it was not a statistically significant difference (T-value: 0.73, P-value: 0.47). After factoring in the average discharge of both study catchments, there was not a statistically significant difference between the POC yields ($g/m2*day^{-1}$) (Figure 3) or TSS yields ($g/m2*day^{-1}$) of the two small comparison watersheds (POC yield T-value: 0.03, P-value: 0.97; TSS yield T-value: 0.59, P-value: 0.56).

Though it was not statistically significant, the calculations of average POC and TSS yields for the comparison catchments did show a higher daily average yield of POC and TSS in the cultivated study catchment 2 (Table 1).

Total nitrogen

Using blank samples during the total dissolved nitrogen (TDN) analysis, the TDN detection limit was calculated as 0.13 mg/L. Only the values above the detection limit of the analysis were reported (Figure 4). Statistical analysis using a t-test showed that there was a significantly (T-value: 2.29, P-value: 0.032) greater amount of TDN carried by the water in the cultivated catchment 2 (Table 1).

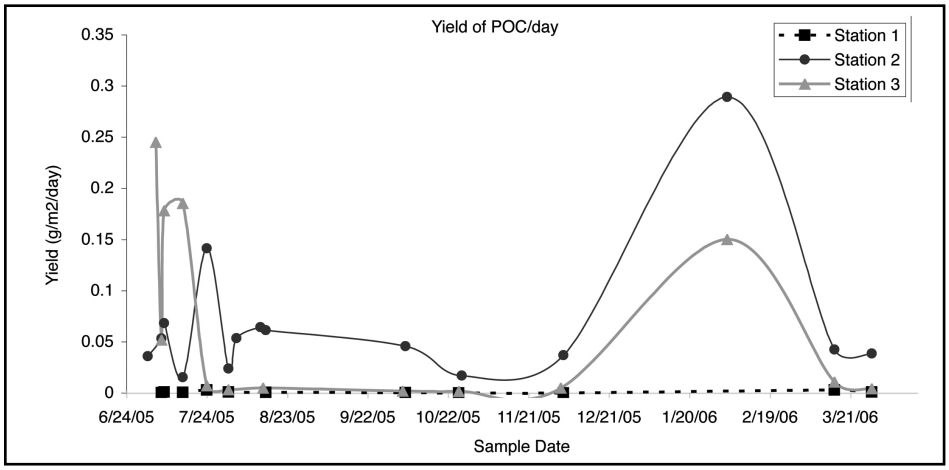
Variable	Station	Mean	St. Dev	T-Value	P-Value
TSS Load (mg/L)	2	3.74	3.89	2.42	0.024
	3	1.04	1.98		
TSS Yield (g/m^2*day^{-1})	2	1.59	1.84	0.59	0.56
	3	1.1	2.51		
POC Load (gC/L)	2	0.1126	0.0608	0.73	0.47
	3	0.0957	0.0655		
POC Yield (g/m^2*day^{-1})	2	61.6	68.4	0.03	0.97
	3	60.7	87.8		
TDN Load (mg/L)	2	0.457	0.331	2.29	0.032
	3	0.228	0.198		
TDN Yield (g/m^2*day^{-1})	2	0.238	0.245	1.64	0.11
	3	0.098	0.217		
Temperature (°C)	2	22.59	1.4	2.34	0.029
	3	21.577	0.874		
Conductivity (µS/cm)	2	44.43	8.96	0.36	0.72
	3	43	11.6		

Table 1. Results of comparison for stream 2 (*savoka*/cultivated) watershed and stream 3 (forested) watershed

Temperature and conductivity

A t-test was also used to compare the temperature and conductivity values recorded with the portable YSI meter at every sampling interval. The results showed that the average conductivity in stream 2 (44.43 µS/cm) was higher than that in stream 3 (43.0 µS/cm), but it was not statistically relevant (T-value: 0.36, P-value: 0.72). However, the stream analysis produced results showing that water temperature was statistically greater (T-value: 2.34, P-value: 0.029) in stream 2 than stream 3 over the sampling period (Table 1). The average temperature of stream 2 was 22.59˚C, while stream 3 had a compared to stream 3's mean temperature of 21.57˚C.

Figure 3. Yield of Particulate Organic Carbon (POC) from three study watersheds



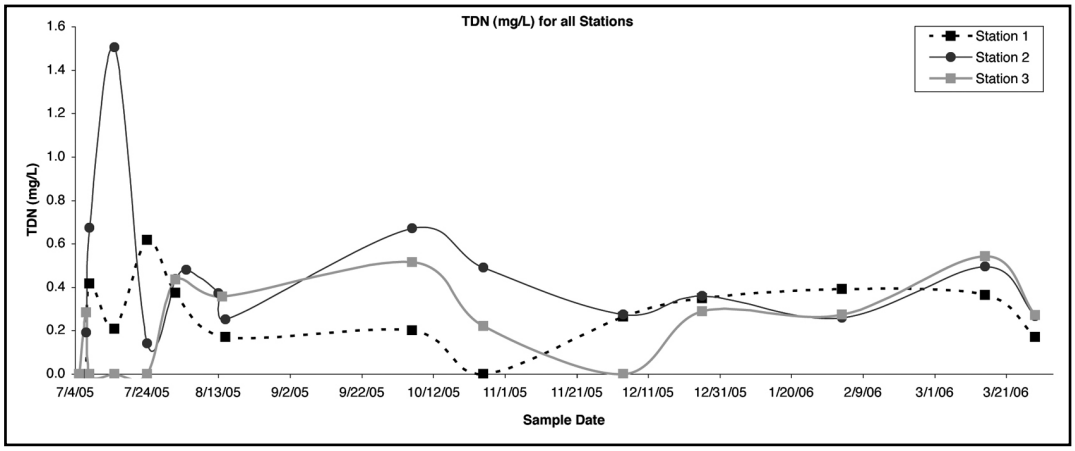


Figure 4. Total Dissolved Nitrogen (TDN) load for three study watersheds

Rainfall-runoff analysis

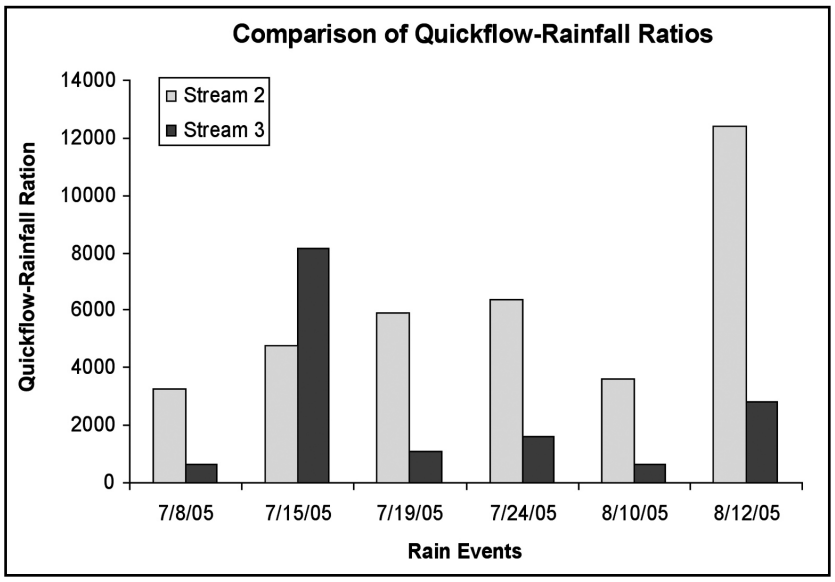
The flow hydrographs for the two subwatersheds were separated into surface flow and base flow, and were found to have six rainfall events in common with corresponding water level changes. The rainfall events were evenly spaced throughout the sample period for rainfall and water level change. Overall, the rain events produced a greater amount of surface runoff in relation to rainfall in catchment 2 than in catchment 3 (Figure 5). The surface flow to rainfall ratio was higher in catchment 2 for five of the six rain events, indicating that more rainfall in the catchment runs quickly over land than is absorbed. This causes the catchment's hydrograph to appear "flashy" in comparison to the slower response catchment 3.

Discussion

Land use

The Maroantsetra region lowlands are cultivated for rice, but many hillside forests are cleared for *savoka*, the most common land use

Figure 5. Flashiness calculated for the comparison watersheds



practice in the basin. Often the forests are cleared by slashing and burning, and then the hillside is cultivated with a mix of potatoes, papaya, cassava, manioc, pineapple, bananas, vanilla, cloves and coffee (Photograph 3).

A 2001 Landsat ETM satellite image of the area was used in conjunction with data collected in the field to determine the land use in the Andranomena River basin. Based on these analyses, the Andranomena River basin is made up of 84% humid forest cover, 7% *savoka* and 5% rice cultivation.

Water quality

This study found that *savoka* agriculture causes a significantly higher load of total suspended solids, total dissolved nitrogen and a higher average stream temperature. The total dissolved nitrogen samples showed differences in nutrient load according to land use, while the total suspended solid load measurements allowed a comparison of mechanical erosion rates in the sub-watersheds. Such increased sediment and nutrient load decreases water quality for downstream villages.

Deforestation for mixed hillside agriculture also decreases the nutrient retention capacity of the terrestrial ecosystem, since the majority of nutrients in an ecosystem are stored in vegetation. The slash and burn method of forest clearing releases mineral nutrients from the soil and into the waterways. Often excess nutrients in streams contribute to contamination and eutrophication of downstream rivers, estuaries and bays (Meyer et al. 2003).

High sediment and nutrient loads are harmful to fish populations because they stimulate algae blooms, which starve aquatic life of oxygen and sunlight (Landell-Mills and Porras 2002). Forest protection benefits fish populations by maintaining dry season flows and controlling sedimentation, nutrient loading, water temperature and water turbidity. Maintaining forest cover over streams and rivers also helps maintain cool water temperatures, food and pools for spawning and juvenile development of aquatic species.

Photograph 3. Landowner's wife harvesting potatoes for her family from study sub-watershed 2.
Photo J. Albietz

Fish serves as a major protein source for the population, so protecting the aquatic habitat is important to the watershed communities. Since the Andranomena River basin consists of many of the headwater streams to the Antaninambalana River and Antongil Bay, protecting the forested areas in this watershed is critical to the regional water quality.

Water quality at the larger watershed scale

Analysis of the samples from the Andranomena River station showed that the enhanced nutrient and sediment levels from the *savoka* cultivated watershed were diluted at the larger watershed scale. Currently, only about 7% of the 70 km^2 of land area in the basin has been converted to *savoka*. However, as more deforestation takes place in the watershed, this study indicates that the water quality and flow regimes will be detrimentally impacted.

Water flow

Increased "flashiness" in the rivers may have an impact on the nutrition and livelihood of the watershed communities that rely on rice, the primary food staple. Less water infiltration and increased runoff not only causes more intense and frequent flooding, but it also limits the amount of water stored in the ground. Groundwater storage is particularly important for plants being cultivated during the dry season.

The Maroantsetra region's high population growth rate is increasing the demand for rice. David Meyers, a key conservationist in Madagascar, stated: "Rice is the key to life. Even in recent speeches from local officials they say that forests give us water, water gives us rice and rice gives us life" (pers.comm. David Myers 2006).

The communities also grow cash crops for export, including coffee, cloves and vanilla, which combine with the hillside agriculture and rice production to make up the major sources of nutrition and livelihood for the Andranomena River basin communities (Photograph 5). More intense and frequent floods and less groundwater storage can devastate crop production.

Recommendations

Although the percentage of land cover of *savoka*/mixed hillside agriculture is relatively low in the Andranomena River watershed, this study shows how the forest conversion negatively impacts watershed hydrology and water quality. Jürg Brand's 2002 socio-economic study reported that farmers in the Maroantsetra region were "clearly aware" of the effects of sedimentation and flooding on rice productivity: the study found that 53% of rice growers reported a negative relationship between sedimentation and productivity, and are willing to contribute to efforts to reduce flooding and erosion. The median willingness to pay amounted to 25 kilograms of rice per household annually, or about USD $4 (Brand et al. 2002).

The Andranomena River basin communities were not part of the Brand study, but the characteristics of those studied are similar. It is likely that the Andranomena communities would also be willing to contribute to efforts to reduce watershed "flashiness" and erosion. A positive next step for the communities would be to hold a meeting with the stakeholders to discuss the results of this study and how the

Photograph 4. Erosion at the top of the sub-watershed where forest cover was removed for cassava and banana cultivation.
Photo J. Albietz

Photograph 5. Girl harvesting greens from sub-watershed 2 to boil and eat wth rice for dinner (and a sugarcane stalk for a snack). *Photo J. Albietz*

results could inform more sustainable land management to protect water resources. Management schemes may differ among the communities, but it is important they are developed locally.

The most promising development in the region to protect water resources is limiting new rice production to the floodplains where it already exists. The Wildlife Conservation Society and Peace Corps volunteers promote the System of Rice Intensification (SRI). Since this program was not developed from within the communities, traditional rice growers have been slow to accept it.

Surplus rice can be sold in the towns and the money earned can be spent on purchasing vegetables and meat to supplement their rice diet. Backyard gardens or community gardens near the villages should also be promoted to improve nutrition in the local diet, especially since vegetables are expensive to purchase in town.

Conclusion

Since the island of Madagascar was colonized 2000 yrs BP, forest cover in the eastern biome of Madagascar has declined by at least 63% (7.4 x 104 km^2) (Green and Sussman 1990). The results from this study show the types of impact that land use change can have on important watershed function, such as maintaining water quality and flow. Though the primary land uses compared in this study were undisturbed forest and *savoka*, results showed that the latter type of land use change has a negative effect on soil fertility and water quality in the Andranomena River basin.

Hopefully, these results will inform a watershed and/or forest management plan for the Makira region and help prioritize land use regulations to improve and maintain water quality and flow regimes. A watershed plan can also build capacity in the community to monitor natural resource changes by carrying out participatory hydrologic assessments. Since healthy headwaters are critical to the healthy function of Antongil Bay, land use conversion in the upper watershed has a large impact on the livelihood of others in the Makira-Masoala region of Madagascar.

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Management Strategies and Institutional Barriers:

An Analysis of Public-Private Partnerships in Water Management in Metro Manila, Philippines

by Kate Neville, MESc 2007

Introduction

Faced with a high debt load, an ageing water system, and a rapidly growing city, the government-run Metropolitan Waterworks and Sewerage System (MWSS) of the Philippines was ill-equipped to provide service to the city of Manila. In the early 1990s, bolstered by its efforts in privatizing the energy sector, examples of seemingly successful public-private partnerships (PPPs) for water in other developing countries, and the global enthusiasm for private sector participation (PSP) in infrastructure and utilities, the Filipino government examined options for involving the private sector in water provision (Dumol 2000; Fabella 2006; Riedinger 1994).

The government split the city into two zones, and signed concession agreements with private consortia to provide water and sanitation services. The concessionaires, Manila Water and Maynilad, had vastly different corporate outcomes: the former has achieved high levels of coverage and service, while the latter has reverted to temporary government control and will be bid out to a new company. This contentious privatization history has been chronicled by many researchers (see Montemayor 2005; Dumol 2000; Chavez and Malaluan 2005; Rosenthal 2001), since the results in the two zones differed so dramatically. In this paper, I argue that the differences were due primarily to the interaction between three key factors: the Asian currency crisis, debt allocation in the contract design, and internal management strategies. Despite similar social and regulatory environments, Maynilad was unable to achieve the level of success of Manila Water as a result of the interplay of these three elements.

This paper consists of three sections: the first analyzes how the contract-dictated debt allocation led to problems during the currency crisis. The second section examines the effect that internal management strategies had on the companies' abilities to cope with problems. The third argues that, while the regulatory structure was not ideal, it should not be considered a primary reason for contract failure. However, this last section also notes that a different regulatory structure might have mitigated some of the problems. The conclusion offers general recommendations for water provision contract design and management, and speculates on what the outcomes in Manila might be had the zones of the companies been reversed.

Kate Neville completed an undergraduate degree in biology at Queen's University, in Kingston, Ontario. She subsequently worked as a research assistant in Ontario, Costa Rica, Nebraska, and Mississippi, before starting a Master's of Environmental Science at Yale. She plans to continue her current work on water policy and governance in a doctoral program in Political Science at the University of British Columbia in Vancouver, Canada.

Debt structure and tariff limitations

The debt structure has been cited by Maynilad as a significant factor in its contract failure in Manila (Esguerra 2003). In addition to other fac-

tors, the currency devaluation did present a barrier to the company's operations. The unequal division of debt was intended to balance the need for capital investment across the two zones, since the East Zone had less existing infrastructure. The contract designers assumed that Manila Water would have a greater need for immediate investment in expanding the system (IFC 1996); however, the initial analyses underestimated the investments in repairs that would be needed for the existing pipes in the West Zone.[1]

The Asian financial crisis occurred in 1997, only a few months after the contracts had been signed (Radelet et al. 1998). The value of the Philippine peso in relation to the American dollar dropped by half, which effectively doubled the dollar-denominated debts carried by both companies (Esguerra 2003). Even in a stable economy, the apportionment of 90% of the debt to Maynilad would have posed challenges, but this currency devaluation was a crippling blow. Prior to the financial crisis, the company had been struggling to secure adequate funding, and had not yet received long-term investment. The sudden change in its financial standing resulted in an inability to attract stable investment apart from a series of bridge loans.[2]

The contract included processes for tariff adjustments and rate re-basing (Inocencio and David 2001), but the allowances in the agreement were not sufficient for a change of the magnitude experienced in the Philippines. The companies had agreed to a condition where they could recover currency losses over the length of the contract, instead of recouping them immediately.[3] In retrospect, this compromise was not prudent, and contributed to Maynilad's inability to continue its operations. Manila Water's lower levels of debt and greater levels of secured financing meant that it was better able to withstand the currency crisis.

One problem faced in tariff setting and adjustment is that there are strong social pressures—either real or perceived—for tariffs to be kept low. This can be attributed in part to the view of water as a human right (Razzaque 2004). In general, an unwillingness to set appropriate tariff levels for cost recovery constrains an operator's ability to attain economic viability. During the currency crisis, the private utilities in Manila could not turn to the government coffers to cover the additional debt. Their only recourse for recovering losses was higher tariffs, but that path was limited by the constraints of the contract.

Internal management strategies

Manila Water faced some initial tension between the former MWSS employees and the new private sector employees. However, once they completed their restructuring strategy, these conflicts subsided, and the decentralized structure proved to be effective. The horizontal structure of management meant that managers were given substantial autonomy, which increased the company's efficiency and local accountability. Flexible responses within the company were therefore possible, which allowed for context-appropriate responses to problems in specific neighborhoods (Zerah 2000).

In contrast, Maynilad initially focused on contract requirements rather than corporate structure. By doing this, it ended up with longer-term problems of burdensome bureaucracy and inflexible problem solving mechanisms.[5] Less autonomy also meant that there were fewer areas in which individuals could make substantive changes, which did little to encourage an environment of innovation, productivity and efficiency.

The Manila Water strategy of decentralized authority and managerial autonomy provides incentives to individuals within the system (Beer and Weldon 2000); thus even when there are external shocks, adaptive behavior at multiple levels is possible. The experiences of Maynilad and Manila Water provide support for the claim that internal reorganization and good corporate management are critical factors for reform success. Privatization (or corporatization,

regardless of the public or private status—Smith 2006) does not equal good management; there need to be mechanisms to allow for a transition from government to corporate management that specifically facilitates their integration. This is particularly important when companies are awarded contracts to provide essential services like water.

Regulatory system independence

While an independent regulatory board in Manila might have mitigated trouble more effectively, it would not have prevented the problems resulting from the interaction between external shocks and internal management. Moreover, the problems with the MWSS Regulatory Office (MWSS-RO) may not have been the form but the composition. That is, it may not have been the lack of independence of the regulatory office that hindered decision-making powers, but instead the lack of training and experience of the appointed officers. Conflicts between the regulatory officers caused further problems with reaching and abiding by regulatory decisions.

A legislatively-created regulatory agency, rather than one established through a contract, might reduce problems with political interference in regulation in developing countries; however, independence does not necessarily quell fears of regulatory capture, nor does it ensure that parties find the regulatory decisions fair and prudent. Although the concession agreement in Buenos Aires was regulated by an independent agency, the contract still became mired in political and financial controversy (Loftus and McDonald 2001).

Regardless of the independence or subsidiary nature of a regulatory board, it could be beneficial to have a "shadow regulator," from a country with effective water management, to help with the transition to a corporate water provision system.[6] This shadow agency would monitor the regulatory processes, and would be able to advise or step in when problems arise. While regulatory processes were a contributing factor to the problems in Manila, contract failure in the West Zone should not be attributed to poor regulation.

Conclusions and implications

Despite apparently similar social, political and regulatory conditions (IFC 1996), Manila Water and Maynilad realized very different contractual outcomes. The differences that allowed Manila Water to emerge from its troubles more successfully than Maynilad were primarily contract design, debt allocation and the effects of the currency devaluation, in conjunction with dissimilar management strategies.

An illuminating thought-experiment in this situation is to speculate whether Manila Water would have been better able to cope with Maynilad's situation. While it is difficult to determine the relative magnitude of the roles of management and financial problems in leading to the contract outcomes, it is plausible that Manila Water would have been better able to recover than Maynilad. Management practices would not have prevented the impact of the currency fluctuations on debt loads; however, different managerial approaches might have changed the financial decision-making processes and expenditures in the early stages of the contract. Moreover, the interactions with regulators might have been less antagonistic in light of different personalities. In the opposing situation, it is unlikely that Maynilad would have realized similar successes to those of Manila Water in the East Zone, given its internal conflicts. While the situation might not have culminated in contract failure, as it has in the West Zone, Maynilad would have been unlikely to replicate Manila Water's success in securing financing and improving service.

Given that the negative effects of currency fluctuations have been seen in several utility privatization agreements (Bayliss 2002; Davis 2005; Rodríguez-Boetsch 2005), there needs to be

greater explicit recognition of the effects that economic shifts can have on utilities' cost recovery and debt repayment. This may involve allowing temporary increases in tariffs, short-term government assistance, or requiring parent companies in consortium agreements to use their assets to cover costs. Potential risk mitigation mechanisms include insurance against currency losses and escrow accounts that provide a source of funding during crises. This latter approach might require that governments allow companies to charge higher-than-normal water tariffs, so that they can put aside these funds.

Increased communication with water users might allow the community to better understand the expenses associated with running water services. This might result in an environment where consumers were willing to allow temporary tariff increases, as they would not feel that increased prices were leading to increased profits without providing better service. Removing tariff-setting from the political realm, where it may be a contentious issue for politicians worried about attracting votes, could be beneficial for setting more appropriate water prices. The concerns about high tariffs for the poor could be addressed through cross-subsidies, alternate arrangements for specific neighborhoods, or income transfers outside of the water sector.

A different type of regulatory agency might have been more effective in dealing with the crisis and might have been able to establish mechanisms to mitigate the problems; however, even better regulation likely would not have overcome the management and financing problems experienced by Maynilad. While conceding to tariff increases earlier in the process might have been beneficial to Maynilad's ability to secure financing, the company's problems were not exclusively financial; moreover, even independent regulation would not have altered the uneven debt structure which contributed to the problems experienced by the company.

The lessons learned from water sector reform efforts will need to be understood as urban centers grow and water scarcity intensifies. While a rulebook for developing water provision systems is not advisable, since appropriate natural resource management is context-specific (Merrey et al. 2005), it is important to identify processes that facilitate flexibility and accountability. The cases in Manila suggest that greater awareness of global financial market impacts on water utilities is necessary, and that specific insurance mechanisms may be needed for the water sector. Moreover, they illustrate the importance of focusing on good management for water utilities, rather than on the public or private nature of the organization (also see Budds and McGrahanan 2003).

Acknowledgements

I owe a debt of gratitude to many people who went out of their ways to assist my research, including B. Gentry, S. Olmstead, M. Delos Reyes, R. Alikpala, M. Flor, K. Seetharam, B. Agawin, V. Rivera, C. Beriña-Kim, P. Cases, R. Villaluna, J. Esguerra, H. Coulby, D. Fernández, J. Dorado, J. Chavez, M. Manahan, N. Malaluan, M. Dela Pena, M. Zantua and R. Basilio. C. Morgan offered helpful comments and valuable feedback on this manuscript. Funding was provided by the Coca-Cola World Fellows program, the Hixon Center for Urban Ecology, the Yale Tropical Resources Institute, and through a Fulbright-OAS Ecology Initiative Award.

Endnotes

1 Interview with an official associated with Maynilad, 2006.
2 Interview with an official associated with Maynilad, 2006.
3 Interview with an official associated with Maynilad, 2006.
4 Interview with an official associated with Manila Water, 2006.
5 Interview with an official associated with Maynilad, 2006.
6 Suggestion during an interview from an official associated with Maynilad, 2006.

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Sticky Methods, Social Frictions and Advocacy:

The Researcher Inside Social Movements

by Brandon C. Whitney, MESc 2007

The notions of right and wrong can be invoked not only in relation to the truth, but also with regard to the cause of social justice
Kirsch 2002: 193

Introduction

As a social science researcher, working with political and social movements focused on human rights and/or environmental justice often means that one is intimately engaged with the very organizations fighting for marginalized populations. This situation presents a world of moral and methodological challenges for the researcher, and raises serious questions about the role (or possibility) of objective scientific engagement with social movements. I argue that the researcher must plan for and engage these challenges and opportunities before the research begins, but must also prepare to be reflexive-in-action as challenges continually arise. This article will discuss some themes that emerged during the process of doing my research, rather than share products of my research. That is, I am going to talk about my methods rather than my data.

Brandon Whitney graduated from North Carolina State University with dual degrees in Biology and Political Science. His past experience in conservation and community development based in natural and social science and the humanities, has helped him understand and appreciate interdisciplinary approaches. He has been involved in diverse projects such as large-scale landscape ecology of corridors and edge effects, small-scale community development and NGO-building, rural environmental education, GIS-based conservation mapping of rare ecosystems and urban community-based forestry in public parks.

Doing science within social movements

To gain a more nuanced perspective on a social movement—that is, something more than an observer from the outside—the researcher often has to be positioned inside a movement. Organizations and institutions that work with marginalized people, against the odds of political and power structures, and sometimes under the threat of danger or harm, are often not keen to open their doors to academic scrutiny. Researchers, therefore, have to "prove themselves" as an unthreatening presence; often this means presenting themselves as an ally or advocate. Sometimes this is an honest position, sometimes it may not be. I take up the case of the well-intentioned advocate who is also trying to do rigorous research, and I will use my own work as an example.

My research examines a US-Ecuadorian NGO (non-governmental organization), with offices in San Francisco and Quito, working with several indigenous groups in the south-central Amazon of Ecuador on organizational strengthening, political advocacy and territorial management.[1] What started as the "accompaniment" of a single indigenous nation by a group of metropolitan donors and advocates in the US and a professional team of Ecuadorians based in that nation's capital, has grown into a complex set of partnerships between a US-based funding and advocacy alliance, an Ecuadorian non-profit organization and seven Amazonian indigenous nationalities. Through a variety of methods—primarily multi-sited institutional ethnography, participant observation and detailed interviews—my research seeks to understand the nature of these NGO-

Photograph 1. NGO staff working with indigenous political leaders in the field.
Photo B. Whitney

indigenous partnerships across spatial scales and, particularly, the role of discourse about indigenous peoples and conservation in such transnational relationships. I explore how such discourse is connected to new understandings of power, identity, agency, representation and interdependence in the Ecuadorian indigenous context.

I will return to my own work soon, but I want to connect my thinking to some helpful ideas from scholars who have engaged these ideas of research and advocacy within social movements. I have borrowed terms in this article's title from recent thinking by two individuals. "Stickiness" is a term that geographer Paul Robbins uses to describes the mysterious quality in a researcher that forces her to attempt to be ethical and scientific, engaged and removed, and advocate and critic, all at the same time (Robbins 2004). Robbins claims that such stickiness "causes livelihoods, advocacy, and research to cling together" and thus presents "a puzzle for appropriate and progressive work" (Robbins 2004: 201). "Friction" is a word employed by anthropologist Anna Tsing to characterize the capacity for creative productivity that comes out of collaborations between groups that are socially or culturally different (Tsing 2005). Of such collaborations, Tsing writes, "they are also the stuff of emergent politics: they make new objects and new agents possible" (Tsing 2005: 247).

A researcher in the context of a social movement has the tendency to wear multiple hats, to feel pulled in different directions, to be conflicted by personal and professional roles. It is this "stickiness," which affects researchers' methods and actions in the context of social "frictions" inside social movements, which I want to explore. Social science methods, particularly ethnography, allow for much subjectivity on the part of the researcher, but usually attempt to follow the convention that ethnographers should try to be as unobtrusive in the lives of their subjects as possible (Jorgenson 1989; Emerson et al. 1995; Stewart 1998; Bernard 2002). However, the stickiness of her methods and the friction of her involvement may lead a researcher inside a social movement to question such conventions. Becoming more involved in the movement she studies may allow the researcher to generate unique data by "exploit[ing] the tensions between participation and observation," but it may also allow her

to alter the movement itself (Harrington 2002: 56). In my understanding of social science advocacy, I focus on the latter possibility. For simplicity, I will consider the two extreme orientations toward involvement: choosing to focus entirely on one's research and to focus entirely on the social movement.

The researcher as "Scientist"

Taking the position of the scientist means that one places her faith in the nature of her research and its ability to contribute to bettering the position of marginalized populations vis-à-vis the movement. In other words, she is choosing to value her research above the movement, its struggles and participants—at least in the short term. This stance may be based on the premise that the researcher can continue to be a disengaged observer of reality rather than a participant in that reality. The researcher might take this stance because, ultimately, she feels that more good will come of exposing, criticizing or reforming some element or practice of a particular organization through research, than could come from her involvement in the social processes she is observing.

In one example from my own research, I found myself observing a staff meeting about planning, monitoring and evaluating the NGO's work with their indigenous partners. Numerous projects for the coming year were being discussed, including the potential addition of new work areas such as cultural preservation projects. It occurred to me that it would perhaps be better for some or, ideally, all of the indigenous nationalities to be present during this discussion of their own future involvement. Had I decided to wear my scientist hat in this moment, I might have chosen not to say anything. This observation—their failure to include indigenous voices—would provide valuable insight for my research. While I might have felt conflicted personally, the choice to make a suggestion would have colored my interactions with the organization for the rest of my fieldwork. Moreover, it would affect my objectivity as a scientist.

The researcher as "Advocate"

Taking the position of an advocate (at least as I have characterized such a role) would mean that one sees herself as a participant in the social movement, as an ally—expert or otherwise—on behalf of those marginalized populations with whom she is working. In other words, she is choosing to value the movement, its struggles and participants above her own research. Such a stance might be based on the premise that a researcher cannot be a part of an organization or institution without affecting some degree of change, and that she has a responsibility to be conscious of such change, both in terms of its impacts and its value for her research. A researcher might choose this position because, ultimately, she feels that more good will come of her conscious and careful involvement in the social processes of which she is a part than from her research results. Such a self-aware researcher may understand that more conscious political engagement with the social movement might alter the character of her data, but decide to turn the question on its head. Rather than "How is my involvement going to affect my data?" she might ask, "How will my lack of involvement affect the marginal populations I work with?"

In my own example of the staff meeting, were I wearing the advocate hat, I would have chosen to say something about the lack of indigenous participation in the planning efforts. Not saying anything would have been to shirk my ability and responsibility to help make small changes that I believed would benefit the participants of the social movement. While I might have felt conflicted professionally, the choice not to say anything—however valid from a research perspective—would have been to ignore the best interests of the indigenous

people and their struggles. I would have been choosing my own interests as a researcher over those individuals I am ultimately working to benefit.

Searching for middle ground: the advocate researcher

Clearly, the previous discussion is a bit polarized; researchers inside social movements obviously will not always be able to see things as such diametrically opposed choices. We are always at once both a bit scientists and somewhat advocates. But, how do we choose the best possible combination? The "middle ground," a term used by scholars of indigenous movements in the Amazon, means much more than simply reaching some intermediary point between two extreme or conflicting views. Rather, the point is that we find "a mutually comprehensible world characterized by new systems of meaning and exchange" ([White 1991] cited in Conklin and Graham 1995: 695). There is no foreseeable position in which a researcher could anticipate every instance in which her authority as a researcher or allegiance as an advocate will be challenged. We must then—all of us involved in this sort of work—move toward more constructive and open forms of engagement so that we can push the envelope of both research and advocacy far beyond an either/or scenario.

Ideally, we would work in a milieu between academic institutions and their civic counterparts engaged in social movements to create new middle ground for research, learning and just, effective practice. The very notion of a "mutually comprehensible world" of research and advocacy suggests that the researcher cannot create such a space alone; it is a negotiated space, and the organization must also be involved in recasting the role of the researcher. Such an arrangement, however, will take much time and energy. However, I do not mean to claim that there is an onus on researchers to create this space based on their instincts—clearly their methodological training should better prepare them for such situations. But, methodological considerations such as these are not well fleshed out in the social sciences. As one anthropologists writes: "That the community under study influences the direction of ethnographic research has become axiomatic in the era of reflexive anthropology, although the politics of cooperation and collaboration have yet to receive similar or sufficient attention" (Kirsch 2002: 183). Training for new social scientists ought to continue pushing the boundaries of their fields.

In the meantime, individual researchers can (and, I argue, should) take it upon themselves to begin seeking a middle ground between research and advocacy. Indeed, by recognizing our own limits and impacts, and by scrutinizing our own interactions with our multiple institutions, we become agents in the creation of our own middle ground. To the extent that we can anticipate better collaboration with the social organizations we do our research with, we should also approach our collaborations as a space to innovate mutual understandings. Furthermore, in the spirit of advancing the boundaries of research within our disciplines, we should make these methodological characteristics of our engagement clear in our writing and in the dissemination of our findings.

In the case of my own research, consider again the situation in the staff meeting I described above. What should I have done? The point I want to make is that there is not necessarily a single correct answer. What did I do? I decided to try and wear both hats at once by letting the process conclude as it had, hearing out the rest of the conversation and watching the meeting come to an end. Later, I approached the director of the NGO and gave her my suggestion, explaining that I was speaking both as an individual who cared deeply about our shared cause—supporting the strug-

gles of the indigenous peoples—and as a social scientist who was trained to be a critical observer. The director was very receptive to my suggestion. Throughout the remainder of my research, I had other opportunities to express to the staff my views on their monitoring and evaluation process, and began giving my opinions openly during meetings. Through these and other conversations, I continued to negotiate—more and more openly each time—my role as both a scientist and an advocate. It is my honest judgment that, while certainly not a perfect situation, I got better research results and was a more constructive presence for the organization through my efforts.

We may, in our individual circumstances and with our own understandings of what is possible, become "advocate researchers"—we can each move toward more reflexive social science research. I do not argue for a certain methodology or approach, because I believe in the emergence of new ideas during the process of confronting the diversity of challenges that researchers will undoubtedly encounter in this kind of work. Rather, I wish to encourage other students to seriously consider the questions I have raised before they embark on their research and think proactively about how to answer them—not only once in the field, but also during the conceptualization, planning and writing phases of their projects.

Endnotes

1 Following common practice in ethnography, I choose to protect the organization and its staff by not revealing names.

Acknowledgements

I would like to thank Dr. Amity Doolittle for her help in articulating some of the points in this article, Alicia Calle and Colleen Morgan for their thoughtful editing and comments, and my colleagues Catherine Benson and Stephanie Ogburn, who helped me work through earlier versions of these ideas.

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Peri-Urban Identity in Amazônia:
Forgotten Component of Local Development

By Jennifer Lewis, joint MA-MEM 2008

Introduction

During my first day on the forested island of Combú, located in the Amazon delta region of Northern Brazil and 20 minutes by boat from the bustling metropolis of Belém, the local school teacher speaks of her challenge: "if he isn't taught to value his space, he won't value who he is." She recognizes the dearth of local identity and its potential value for the development and ecological future of this island. She embodies one key link between generational identity formation and the growing schism between rural and urban spaces.

This research addresses the creation of complex identities in the peri-urban space. I draw on field work conducted in two such communities of Belém, Brazil during the summer of 2006. The findings reveal a multifaceted landscape of identity that accounts for culture, environment and economic productivity options along the rural-urban trajectory. This identity can be seen as fundamental to future education, development and conservation initiatives within this unique place.

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Urbanization in Amazônia

Regional trends of urbanization in Amazônia reflect continual movement of people in response to economic, environmental, political and cultural stimuli. Work questioning the rural contextualization of the Amazon "last great frontier" myth highlights the underrepresented genesis of new urban centers (Godfrey and Browder 1996). The transition from rural frontiers to urban economies creates boom towns resulting from erratic resource cycles and adaptation as people seek opportunities in articulated market spaces. The largest two cities in the Amazon, Belém and Manaus, serve as commercial centers and export ports located on major waterways.

Urbanization trends are accompanied by growth in peri-urban environments with unique hybrid features. Job acquisition is often coupled with traditional rural practices: subsistence agriculture, forest extractivism and fisheries that provide staple foods and raw materials to cities. The city of Belém do Pará has a metropolitan population of over 2 million people and is surrounded by a convergence of asymmetrical peri-urban realities. The northern and eastern edges of the city are expanding to advance industrial development, while the western and southern edges, bounded by the Guamá River, are typified by forested island communities linked by daily economic and cultural interactions with Belém.

Peri-urban interface

The complex interconnections between cities and their surroundings are not typically reflected by the dichotomy of "urban" and "rural" environments. The evolving definition of the peri-urban interface reflects the complexity of factors contributing to this intermediate landscape, including access to resources, daily economic dependence on urban centers and consequences of industrial expansion. One prevailing definition classifies them as "areas located at the urban/rural interface, on or near the periphery of a defined urban administrative or legal boundary, either inside or outside of a designated general plan area, and often, characterized by informal settlement, with uncertain tenure and minimal if any servicing" (Smit et al. 1996: 6). Alternatively, Stoian (2005) describes the "peri-urban nexus" and the underlying flexibility, adaptability and viability of these spaces as unique yet integrated systems. Recent work further rejects clear-cut divisions within the theoretical "notion of an approximate continuum" (Simon et al. 2006: 10). The gradient is thus dynamic and capable of shifts, revealing a diversity of asymmetrical patterns and processes.

Currently, the literature does not consider creation of identity in places neither urban nor rural. The study of the unique peri-urban interface becomes pertinent as large cities face development challenges in response to growing urban populations and as communities within these locales address increasing cultural diversity.

Identity can be defined as the personal and collective self-perceptions that create a "place in the world" (Kearns and Gesler 1998: 4). A geographical concept of place in conjunction with perceptions of experienced place creates the self-ascribed personal and community identity. Place is itself a social relationship, always in what Hugh Raffles (2002) refers to as the "flow of becoming." Amazon rivers can be seen as a symbolic representation of this journey of identity, as people move through space, channeling past practices, imaginations and belief systems into new locales.

Methods

Two peri-urban communities were chosen for this qualitative ethnographic research: Combú and Boa Vista. Criteria used for study site selection were relative distance from Belém, exclusive use of the port "Porto da Palha" for sales, comparable community size and dependence on açaí as a principal crop. In each community a formal questionnaire was completed by 50% of the households selected randomly, which corresponded to 35 interviews in Combú and 72 in Boa Vista. This methodology also included open-ended interviews and participant observation. Additionally, purposive interviews were conducted with community leaders and secondary sources in Belém.

Identity and the peri-urban environment of Belém

This section examines identity construction in the peri-urban interface and identifies four categories that emerged through this research for conceptualizing space: a destination point for migrants, a jumping point for residents, a dynamic intermediate space and an economic opportunity. There is often significant overlap, variation and double meaning found within and between households, indicating rich heterogeneity of perspective when defining identity of place.

Destination point for migrants

The peri-urban interface is a destination for many rural migrants that journey in search of work opportunities. The majority come from rural communities in the Pará state or

from northeastern Brazil, a region associated with poverty, lack of arable land and significant out-migration. Family connections often provide the initial contact for migrants to the peri-urban zone. This was particularly apparent in the remote properties of Combú, where significant in-migration had occurred for at least two generations from the community of São Sebastião de Boa Vista, located in the interior of the Marajó Island. One interviewee stated that "Marajó does not have anything to offer people and I came to Combú because I had family members living on the island," thus creating a family network between rural and peri-urban communities.

Land availability and urban market access provide economic incentives for rural migration. Oftentimes wealthy landowners are responsible for "bringing the parents" to Combú and Boa Vista in order to work the land. Specific work offers included gardening projects, heart-of-palm and açaí harvesting, ceramic tile craftwork and construction. Alternatively, independent migration was stimulated by a lack of production opportunities in interior communities. These migrants equate migration with survival, envisioning subsistence forest practices unavailable farther inland away from markets and cities.

One interviewee recognizes his need to migrate from the northeast, but rejected Belém as his possible destination in search of work. After rubber production diminished in the Ceará state, migration was necessary, yet he states "the city does not have work for me, given my lack of formal education." Several respondents concur that moving from farther interior to a similar rural area required less adaptation than making a transition to the city. Individuals that historically relied on extractivism and hunting find it is easier to procure food in the peri-urban forested area surrounding Belém. A sense of security prior to arrival facilitates cultural association of previous home and future destination (Photograph 1).

Photograph 1. Typical households on the forested banks of Combú Island.
Photo J. Lewis

Jumping off place for future city residents

The peri-urban identity is also conceptualized locally as a space with nothing positive to offer, a perspective essentially defined by a rejection of place. This valuation of the city over the peri-urban reality is centered on jobs and education and the simultaneous socio-cultural hierarchy which equates future with the city. Urban-based jobs are valued more than rural labor as indicated by one interviewee: "working with açaí doesn't have a future, the future is in Belém. Looking for work means going to Belém." One young parent defined moving out of Boa Vista as moving forward with his life, indicating the space as one which held little opportunity for him and a community from which he was seeking to escape.

Most families with young children actively encourage them to study in Belém to "choose a better future" as insurance for future economic security. One respondent hopes that his three children will finish university and become professionals: "if it were up to me, they would definitely not stay on the island." The upcoming generation views peri-urban communities as places to leave behind, articulated by one respondent, "those that live in the rural areas do not have the conditions to go to the city and those that have been able to leave have a little more studies." The types of education young people are choosing has an impact on this evolving conceptualization of the region. One university accounting student suggested that after she graduates, it will be imperative to move to the city because "it would not be logical to invest so much time and money into my studies and then afterwards not use that information in a job."

Dynamic intermediate space

The peri-urban interface is also envisioned as an intermediate space with urban-rural articulations, actively maintained by its inhabitants. This view combines a symbolic "home" or valued living site with a daily dependence on the urban center. Twenty one percent of households across both communities indicate daily travel to and from Belém and 59% indicate traveling to the city up to six times per week. Households relying on supplemental income from the city often report daily travel by one of their members for jobs such as manual labor, construction or domestic work (Photograph 2).

Many current students traveling daily to Belém for education stated their preference to live in Combú and Boa Vista in the future.

Photograph 2. Daily commute to Belém from peri-urban islands for agricultural sales or work opportunities is common for many families. *Photo J. Lewis*

One respondent studying health administration in Belém suggested that even though his studies might prevent him from obtaining a job in Combú, there is a good chance that he will elect to live at home and travel daily to work in the city. Another student and nurse technician strongly prefers to live with his family on the island, even if this means leaving Combú at 6:30 am in a family boat and returning at 11 pm. The dual identity of home and future maintains associations across peri-urban and urban geographies.

Economic opportunity

Increasingly the peri-urban identity is defined as an investment both in terms of subsistence and future income generation. Production in peri-urban regions can increase household resilience as forest product-based income provides the "seed" for future generations to access education (Stoian 2005). The principal product currently being exploited in northern Amazônia is the açaí (*Euterpe oleracea*) palm berry. This case study provides interesting insight into the belief that the peri-urban zone will provide household economic sustenance.

During the last 25 years, regional urban market demands have led to local land use intensification and increasing importance of açaí agroforestry (Brondizio et al. 2002). Since 1990, açaí has become popular nationally and internationally as a fashion health food, and as the market continues to grow it affects production decisions within the Amazon region (ibid).

The two study sites exhibit significant variation with regard to açaí investment, yet both currently supply açaí to the regional urban market. The trends in both communities are to continue planting and implement management strategies, like clearing old palms and removing brush that inhibits açaí growth. Historical reliance on subsistence açaí extraction in Combú has resulted in a matrix forest system. Most new planting is currently occurring in Boa Vista, where land has traditionally been used for slash-and-burn manioc production. Across both communities, açaí planting by residents and new migrants illustrates the shifting texture of the landscape as a result of increased dependence on the fruit.

Currently, 48% of respondents in Combú suggest that açaí provides enough income to sustain household quality of life without need to consider migration, compared to 16% in Boa Vista. This discrepancy between communities can be partly explained by the relatively recent insertion of Boa Vista producers to the regional markets. Even so, there is hope in both of these communities that sales and income will continue to increase. One can surmise that the quick economic return afforded by açaí investment is the principal reason for residents and migrants to continue investing in the land and remain in the peri-urban zone. In this sense, connection to place is strongly related to short-term productivity and increase in land value associated with açaí production.

Connection to the land is embedded within this peri-urban identity. One recent migrant to Boa Vista indicated that he views açaí production as a fun sport at which he is particularly skillful. He appears torn between knowing that açaí can provide him money for the future, wanting to teach his young son a skill he holds as essential to his identity, and, on the other hand, wanting his son to study and prepare for a life beyond manual labor. A consciousness is thus created within the adult generation that the security currently provided by açaí might make possible significantly different futures for the upcoming generations. Planting represents insurance and patrimony for the future because açaí increasingly provides a stable family income. Much of this açaí production is strongly correlated with reinvesting in education.

Conclusion

This research highlights the disconnect that exists between respondents own preferen-

ces and their hopes for future generations. While there was uncontested preference to live in the peri-urban communities coupled with a common sentiment among adults that the city is hard to adjust to, the overwhelming majority of parents say that they want their kids to go to the city in the future.

The local teacher's commentary reflects a fundamental goal of linking experiences and perspectives across geographies and generations as she couples community history with future vision. Increasingly, local and regional leaders are also recognizing the need to emphasize local identity and associated community values as underlying goals for development and ecological conservation within this peri-urban zone. Ultimately, recognizing the heterogeneity of the peri-urban interface is critical to a future in which the rich cultural and environmental heritage of these islands is preserved by the local families and future generations that recognize and actively live these identities.

Acknowledgements

This study was made possible by grants from the Tropical Resources Institute of the Yale University School of Forestry and Environmental Studies, the Agrarian Studies grant fund, the Georg Walter Leitner Program in International and Comparative Political Economy and the Coca-Cola World Fund, through Yale University. Data collection and community contact would not have been possible in the allotted time frame without the assistance of two research assistants, Jorginho and Prazeres. Finally, I would like to acknowledge the institutional support from the Amazon Institute of People and the Environment and editorial support from Amity Doolittle, Alicia Calle, Colleen Morgan and Meg Arenberg.

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Effects of Indoor Particulate Matter Pollution from Biomass Fuels Burning:

A Case Study in Six Shenyang Households, Northeastern China in Summer Season

by Ruoting Jiang, MESc 2007

Introduction

Visitors to Liaozhong County, a rural county near Shenyang city, the capital city of Liaoning Province, will be struck by the sight of piles of corn stalks stacked in front of each home. Approximately 90% of the households in this county rely on corn stalks for cooking and heating. The combustion of corn stalks generates dense smoke in the kitchens, where the rural cooks who participated in the study spend approximately 5.5 hours per day on average cooking. During that time, smoke causes acute symptoms such as coughing, lachrymation, etc, which are understood as "a part of life" by rural cooks. A major component of the smoke is particulate matter.

Particulate matter, also known as PM, is a complex mixture of extremely small particles and liquid droplets found in the air. The US Environmental Protection Agency has grouped PM pollution according to particle size: coarse particles (PM_{10}) are larger than 2.5 micrometers and smaller than 10 micrometers in diameter; and fine particles ($PM_{2.5}$) are 2.5 micrometers in diameter and smaller (US EPA 2007). The smallest particles are a particularly serious health problem because they can penetrate deep into the lungs. Previous epidemiological studies have linked PM with a number of negative health outcomes, including irritation of the airways, coughing, difficulty in breathing, decreased lung function, aggravated asthma, heart attacks and premature death in people with heart or lung disease (Smith et al. 2000; Bruce et al. 2000; Ezzati et al. 2001; Berg et al. 1991; Burchfiel et al. 1986; Chilmonczyk et al. 1993; Mitchell et al. 1993; Taylor et al. 1995).

Assessment of human exposure to PM pollution in the indoor environment is crucial given the fact that most people spend 70% to 90% of their time indoors (Wallace et al. 2003; US EPA 1996). The major indoor sources for PM include biomass burning, smoking, burning of candles, cooking and penetration of outdoor particulate matter. Among these, combustion of biomass fuels, such as wood, crop residues, dung and charcoal, has been considered as a major contributor to the burden of diseases in many developing countries (Chai and Cheng 2002).

In Chinese rural households, around 61% of the population relies on biomass fuels as the primary source of domestic energy (Biomass energy use and emission in China, ESCAP Virtual Conference 2003). The consumption of biomass fuels is not only due to its availability and economic efficiency, but also because it is a cultural tradition. Indoor air pollution

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caused by burning wood and fires inside homes has been identified as the major health hazard in rural households. The joint statement issued by World Health Organization (WHO) and United Nations Development Program (UNDP) indicated that each year smoke from cooking in poorly ventilated homes claims 1.6 million people's lives in developing nations. Results from a study conducted in three rural counties within An Hui Province in China showed that the levels of indoor PM_{10} in homes burning biomass fuels were 1.6 times higher than the maximum levels allowed by the US Environmental Protection Agency (Pegg 2003). However, the lack of air quality data from China's rural areas makes indoor PM pollution from combustion of biomass fuels one of the most serious yet least studied environmental health problems in China.

To understand this problem, I spent the summer of 2006 performing research on the measurement of indoor PM concentrations and personal PM concentrations in six households of Shenyang city, the capital city of Liaoning Province, northeastern China. Three of the households are located in the rural areas of Shenyang city and the rest are located in Shenyang metropolitan areas. The three families in rural areas consume biomass fuels as domestic energy while the three urban homes do not. By comparing the concentrations of indoor PM concentrations and personal PM concentrations between rural homes and urban homes, I aimed to explore the effects of biomass fuel combustion on indoor air pollution and human exposure.

Results from this study show that rural homes using biomass fuels for cooking experienced significantly higher levels of indoor PM_{10} than urban homes using natural gas. Particles were produced primarily from combustion of biomass and the process of cooking. Additionally, rural cooks were exposed to significantly higher levels of personal $PM_{2.5}$ compared to rural non-cooks, urban cooks and urban non-cooks. This is due to the fact that biomass burning in kitchens during cooking periods is associated with overall higher levels of indoor particulate matter pollution, rural cooks spent longer time in the kitchens (to burn biomass and to cook), and that rural kitchens lack air pumps which are present in most urban kitchens.

Study location

Shenyang City is located in the northeastern part of China at latitude 41°47'N and longitude 123°25'E (Figure 1). It is the largest city and also an important industrial base in northeastern China with a population of 7.2 million. The annual average precipitation of Shenyang is 721.9 mm and the annual average temperature is 8.1°C. The highest temperature is 36.1°C in July, and the lowest is -28.5°C in January. Three households were selected from Shenyang metropolitan area and another three were from Shenyang rural area in Liaozhong County. In the Liaozhong County, the primary occupations are crop cultivation and animal husbandry. Approximately 90% of all the households rely on agricultural products, corn stalks for example, as domestic fuels for cooking and heating.

Methodology

Monitoring of indoor and outdoor PM concentrations

Each of the six selected households was monitored on a daily basis for a continuous ten-day period. A short questionnaire was administered to each household to collect the basic information such as fuel type, kitchen location, cooking duration, cooking frequency, and presence or absence of an air pump in the kitchen. PM_{10} concentrations were monitored using P-5L2C Digital Dust Indicators (Beijing Binta Green Technology Co., LTD, China). For rural households, the monitors were placed

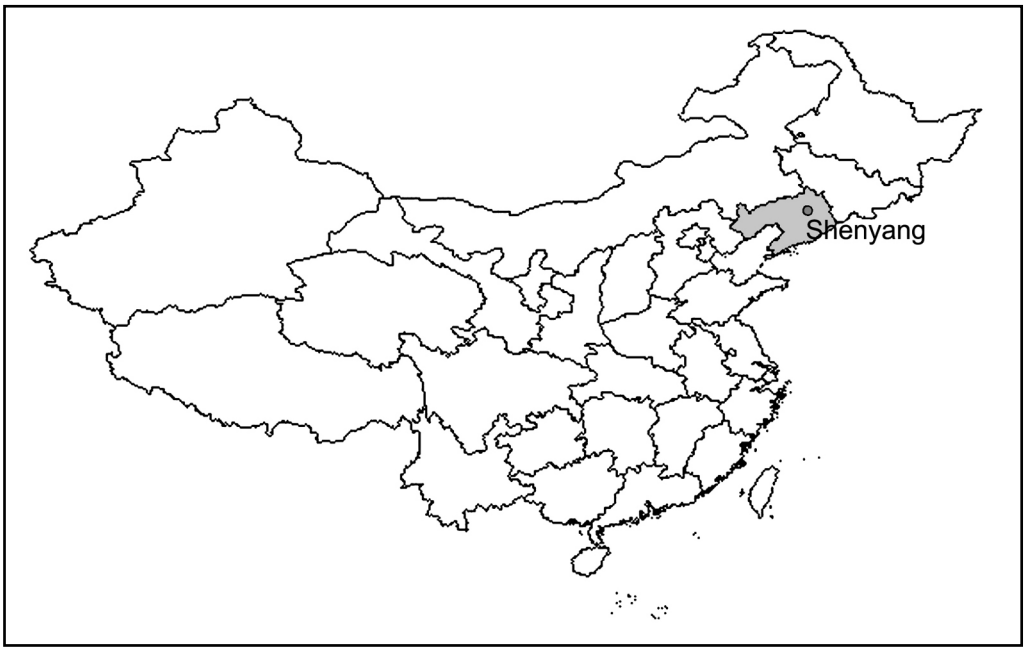


Figure 1. Map of sampling locations: Rural and urban areas of Shenyang city, the capital city of Liaoning Province, northeastern China

both in kitchens and in the house yards at a height of 0.6 meters. For urban households, the monitors were stationed in kitchens and sitting rooms at the same height. The monitors operated continuously for approximately 18 hours on a daily basis throughout the sampling period.

Monitoring of personal $PM_{2.5}$

Ten individuals participated in the personal monitoring of $PM_{2.5}$ including six cooks from six households and four non-cooks. Model AM510 SidePak Personal Aerosol Monitors (TSI, Co., MN, USA) were employed to measure personal exposure for $PM_{2.5}$. The small monitor was equipped with a personal pump and attached on the subjects' belts. The inlet of this monitor is connected by a short piece of tubing to the subject's breathing zone. Each subject was requested to carry the small monitor both indoors and outdoors for approximately 20 hours per day throughout the sampling period, except while sleeping, showering, and using the restroom.

Results

1. Indoor PM_{10} concentrations

PM_{10} concentrations were obtained from ten locations including three rural kitchens, three urban kitchens, three urban sitting rooms and one rural outdoor location. Figure 2 describes the overview of PM_{10} exposures at each location. Exposures to indoor PM_{10} in rural kitchens were significantly higher than outdoor exposure in rural areas and indoor exposures in urban households. Figure 3 describes the concentrations of PM_{10} during cooking times across households using different fuels. One way ANOVA (Table 1) showed that PM_{10} levels in kitchens using biomass fuels is significantly different ($p<0.05$) from levels in kitchens using natural gas. Combustion of corn stalks resulted in higher indoor PM_{10} pollution than use of natural gas.

2. Personal $PM_{2.5}$ exposure profile

All the participants of personal $PM_{2.5}$ exposure monitoring were divided into four

Figure 2. Distribution of PM_{10} concentrations at three rural households and three urban households, abbreviations: SRM, sitting room

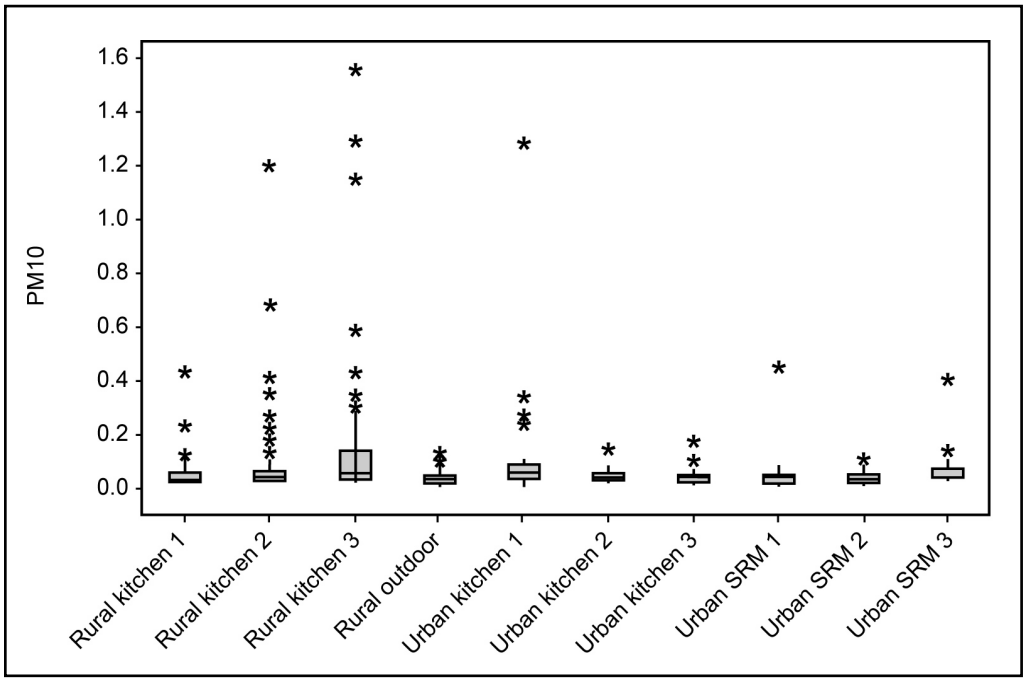


Figure 3. Distribution of indoor PM_{10} in kitchens using biomass fuel and natural gas

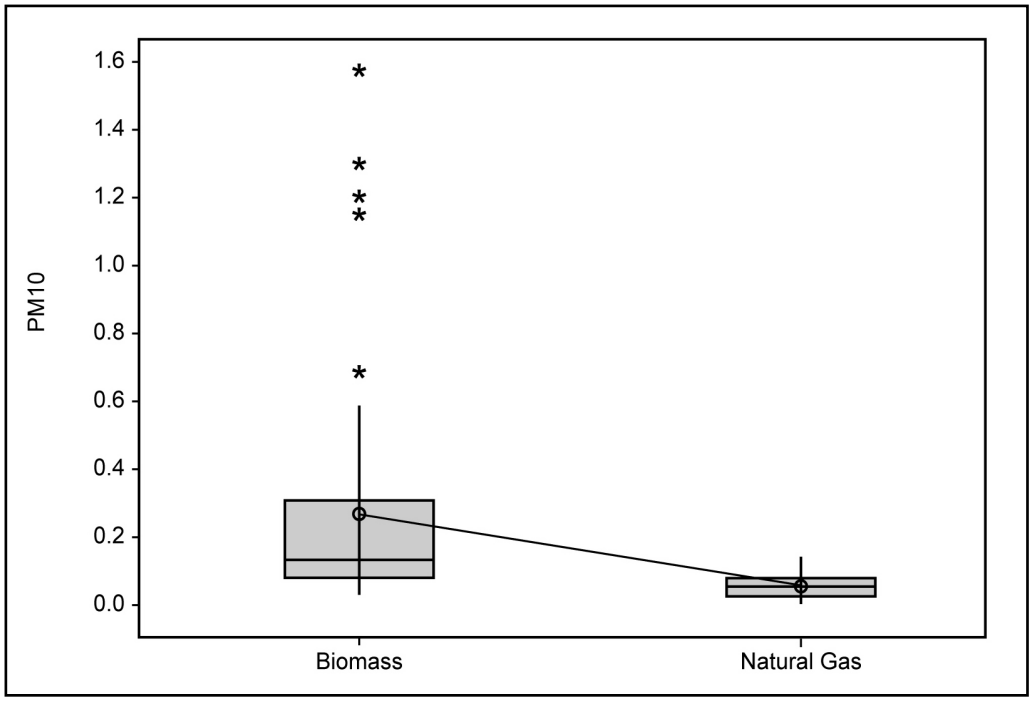


Table 1. Results of two-sample T test for indoor PM_{10} concentration in kitchens using different fuel types for cooking

	Concentrations of PM_{10} (mg/m^3)		
Fuel Types	**N**	**Mean**	**St Dev**
Biomass	52	0.2669	0.3376
Natural gas	43	0.0548	0.0294
P=0.000			

categories: rural cooks, rural non-cooks, urban cooks and urban non-cooks. The distribution of hourly personal $PM_{2.5}$ exposures in these four categories is shown in Figure 4 and describe in Table 2. One-way ANOVA (Table 2) showed that personal $PM_{2.5}$ exposure of cooks was significantly different ($p<0.05$) across kitchen fuel types (between rural cooks using biomass fuel and urban cooks using natural gas). Cooks using biomass fuels were exposed to significantly higher levels of personal $PM_{2.5}$ (0.1572 ± 0.2856 mg/m^3) than cooks using natural gas (0.0634 ± 0.0305 mg/m^3).

Also, personal exposures of $PM_{2.5}$ are significantly different ($p<0.05$) between rural cooks (0.1572 ± 0.2856 mg/m^3) and rural non-cooks (0.0538 ± 0.0318 mg/m^3). This is not surprising because compared to total non-cooks, rural cooks spent more time in the kitchen, where there were higher levels of $PM_{2.5}$ resulting from both the combustion of biomass fuels and cooking. However, no significant difference of personal $PM_{2.5}$ exposures in urban cooks and urban non-cooks was observed. This is presumably due to the fact that urban cooks use cleaner fuel (natural gas) for cooking, spend less time in the kitchen, and their kitchens all have air pumps.

Diurnal variability in personal $PM_{2.5}$ exposures was investigated by examining the differences in secondary $PM_{2.5}$ concentrations across a day. Figure 5 shows the daily variations of personal $PM_{2.5}$ exposures in the four categories: rural cooks, rural non-cooks, urban cooks and urban non-cooks. Significant peaks of personal $PM_{2.5}$ episodes, which correspond to the three cooking periods during the day, were found in rural cooks but not in other categories.

Discussion

This study, for the first time, has employed personal monitoring in conjunction with indoor monitoring to assess an individual's exposure to indoor particulate matter pollution for a cross-section of rural homes using biomass fuels and urban homes using natural

Table 2. Results of one-way ANOVA for personal $PM_{2.5}$ exposures in rural cooks, rural non-cooks, urban cooks and urban non-cooks

	Personal $PM_{2.5}$ (mg/m^3)		
	N	**Mean**	**St Dev**
Rural cook	123	0.1572	0.2856
Rural non-cook	45	0.0538	0.0318
Urban non-cook	47	0.0637	0.0292
Urban cook	94	0.0634	0.0305

Figure 4. Distribution of personal $PM_{2.5}$ exposures in rural cooks, rural non-cooks, urban cooks and urban non-cooks. The median is marked by a line within the box. The two whiskers outside the box extend to the smallest and largest observations with in 1.5IQR.

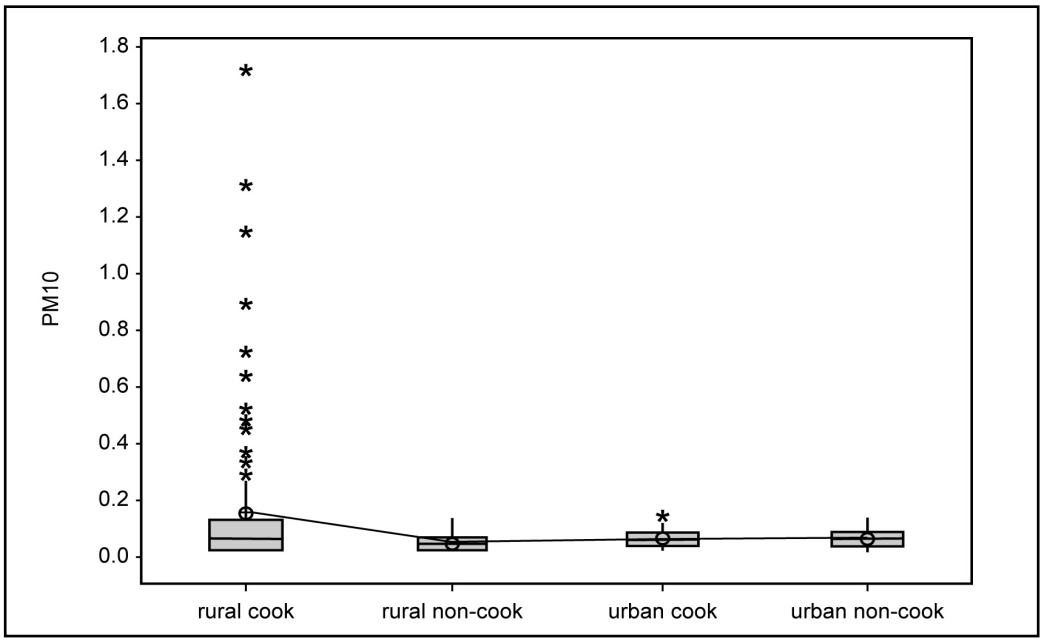
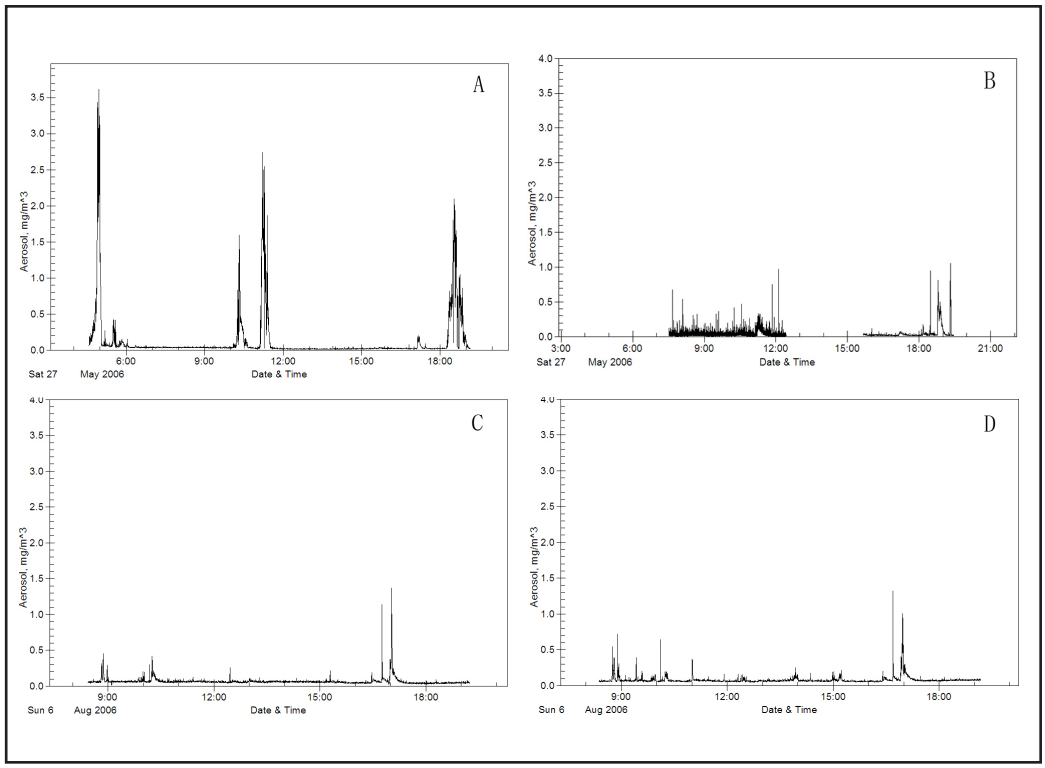


Figure 5. Daily variations of personal $PM_{2.5}$ in (A) a rural cook, (B) a rural non-cook, (C) an urban cook, (D) an urban non-cook. Data are based on PM concentration by second.



gas in the northeastern part of China. This monitoring scheme collected indoor, outdoor and personal PM concentration data which, when coupled with information on fuel type and pollution source, provides a better understanding of the nature of indoor PM pollution in rural and urban homes.

The findings of this project have important policy and program implications for China. Exposure to PM has been associated with a suite of negative health outcomes, such as acute respiratory infection, chronic respiratory disease, asthma, cardiovascular malfunction, lung cancer, low birth weight and increased risk of mortality (US EPA 2004). However, most rural residents who participated in this study were not aware of the air pollution resulting from the combustion of biomass. Seventy percent did not realize the health impact of indoor PM pollution. Therefore, results of this study provide necessary information to raise public awareness about the risk of exposure to the PM pollution resulting from combustion of biomass fuels.

Second, design and development of new technologies that improve energy efficiency and reduce indoor air pollution should be promoted by government. Traditional rural cook stoves are seldom effectively ventilated. This is due to the ignorance of the negative health risks posed by biomass smoke and the fact that people's desire to keep their homes as warm as possible. Therefore, improved cook stoves with long chimneys or air pumps in kitchens can improve ventilation and reduce human exposure to PM pollution. In the meantime, better design of housing structures is desired to keep living areas warm especially during winter.

A third possible solution is for rural communities to transfer to cleaner domestic fuel types, such as electricity, natural gas, and renewable resources such as biogas, solar energy and wind energy, instead of biomass fuels. While natural gas and electricity are much more expensive to use for cooking and heating, biogas seems to be a good alternative type of energy.

In 2005, Shenyang city promoted the installation of biomass gasification stations in several rural communities nearby. Ten new stations were built in Dong Ling County and Yu Hong County. Over 5,000 households began to burn biogas instead of biomass fuels for cooking. Follow-up investigations showed that these residents appreciated the shift from burning solid biomass fuels to consumption of biogas (Shenyang Technological News 2005).

Lower fuel prices and reduced indoor air pollution are some of the benefits of changing to biogas, as well as improved quality of life, health and the environment. As rural communities become aware of such benefits, they will be more willing to make that change.

Acknowledgements

I would like to thank the participants from Shenyang city and Liaozhong County. Thanks to Shenyang's environmental protection research agencies for their generous help. In addition, I am very grateful for the advice and encouragement I received from Dr. Michelle Bell, who has been very supportive to this study. Thanks to Dr. Amity Doolittle for her kind guidance, and to Teresa Colleen Morgan for her edits to this paper. This research was conducted through the funding support of Yale Tropical Resources Institute, the East Asian Studies Summer Research and Travel Grants at Yale, and Cameron Speth Fellowships.

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Armed Conflict and its Impact on Community Forestry in Nepal

Krishna B. Roka, MF 2007

The day I arrived in Nepal was the last of the historic 19 days of anti-monarchy protest by the general public, civil society, political parties, Maoists and the international development workers throughout the nation. The same night, around midnight, the king stepped down and announced that he would hand over the power to the people, which eventually ended a decade-long bloody conflict. The political transformation was a great help to this research project, for I could meet the rebels and the army and safely travel to my study districts. I owe my greatest gratitude to the people of Nepal who made the change happen.

Background

This paper focuses on the impact of the armed conflict between the Maoist rebels and the Government of Nepal, which took place from 1996 to 2006, on the community forestry sector in Nepal. Armed conflict in any form affects resource governance, directly and indirectly. In Nepal the conflict impacted community forestry in several ways, mostly indirectly. This impact can be negative, positive or both, depending on the conflict's causes, actors involved, geographic location, duration and objectives.

Krishna Roka had masters degree in Botany and Sociology from Tribhuvan University, Nepal prior coming to Yale School of Forestry and Environmental Studies. He is pursuing his PhD at the Department of Agricultural Economics and Rural Sociology at The Pennsylvania State University. His research interests are focused on rural communities, poverty and natural resource governance in mountain communities in the Andes, and the Himalayas.

Researching the environmental impacts during the conflict was challenging due to security issues and the volatile political condition. Unlike most other studies of the impact of the war which have focused on economic impact, loss of lives and violation of human rights, my research examines the impact of the conflict on community forest user groups.

Conflict in Nepal started in February 1996 as an outcome of decades of dissatisfaction and frustration with the political system (Ghimire 2003). Social disparities based on caste, education, geography and economy created fertile ground for the Communist Party of Nepal (Maoists) to recruit the disadvantaged and marginalized population into the revolution. Over the 10-year period of insurgency more than 13,000 people died with a million rupees worth of infrastructure destroyed, resulting in a major economic setback for the nation.

By 2000, Maoists controlled all the rural areas of the nation, and the government was limited to its district headquarters in urban areas. In the later years the Maoists focused on toppling the monarchy. The conflict ended in April 2006 after King Gyanendra stepped down from power. After nine months, the Maoists joined the interim government in conducting a Constituent Assembly election to frame a new constitution.

Community forestry is one of the major forest managing systems in Nepal. The 1988 Forestry Sector Master Plan created the concept, which was legalized by the 1993 Forest Act and the subsequent 1995 Forest Regulation. The Forest Act of 1993 recognized Community Forest User Groups (CFUGs)[1] as autonomous bodies of citizens capable of man-

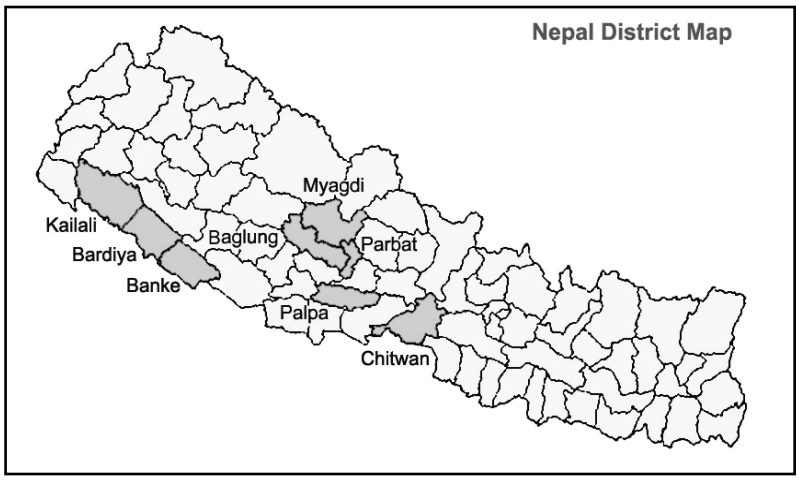


Figure 1. Map of Nepal with study districts highlighted
Source: ICIMOD, Kathmandu.

aging the forest. Income from the forest is used by the communities for conservation and development at the local level. The committee is formed democratically at the local level and is inclusive of all groups. So far, more than 14,000 CFUGs have been formed involving more than 35% of the population.

Federation of Community Forest Users Nepal (FECOFUN) is an umbrella body of the CFUGs and advocates for user group rights locally, nationally and regionally. During this period CFUGs were the only democratic institutions representing local people in the rural areas of Nepal (Pokhrel 2006, pers. comm.). In recent years, community forestry in Nepal has been recognized as the most effective natural resource management system due to its role in restoring degraded forest lands, conservation and empowering local people to manage and use the forest resources sustainably.

Because of this significance, I chose to study the impact of the conflict on that system. My objective is to study the effects from three major parties involved in the conflict—the Royal Nepal Army, the Government of Nepal and the Maoists. The separation between Army and Government is important, because the first was under the direct control of the King, while the latter is formed by political parties.

Statement of the problem

Nepal's Maoist rebellion is cited as being socio-political in origin, as a result of disparities across the social system. A few authors indicate environmental roots to the conflict (Bhurtel and Ali 2006), pointing to environmental degradation and agricultural production decline as the major cause of social unrest. However, the debate exists as to the exact cause of the conflict. Regardless of its foundations, the conflict affected the community forestry sector in multiple ways, like forest occupation by armed groups, restricting access, imposing taxes, arresting and abducting members of CFUGs and many more.

Study Site

I selected four districts (Baglung, Parbat, Myagdi, and Palpa) in the hilly region of Nepal and four in the terai[2] (Kailali, Banke, Bardiya, and Chitwan) of Nepal (Figure 1). The districts were selected on the basis of scale of Maoists activities, forest resources and accessibility during research.

Methodology

This research was conducted using three different methods:

1) Unstructured interviews with target groups such as forest users; district forest officials; army personnel stationed in the field and at the central level; Maoists leaders/activists, both local and national; NGO and international nongovernmental organization (INGO) staff involved in conservation; political analysts; officials of Federation of Community Forest Users Nepal (FECOFUN) at the district and national level; government forest officials and local villagers.

2) Secondary data were collected from sources such as media reports, program reports, books and other sources.

3) Field visits were conducted in the eight districts across the country, which included transect walks of the accessible forests, observation of the environmental impact, conducting interviews with government forest department staff and collecting data at the district forest offices and CFUGs regarding the community forestry program.

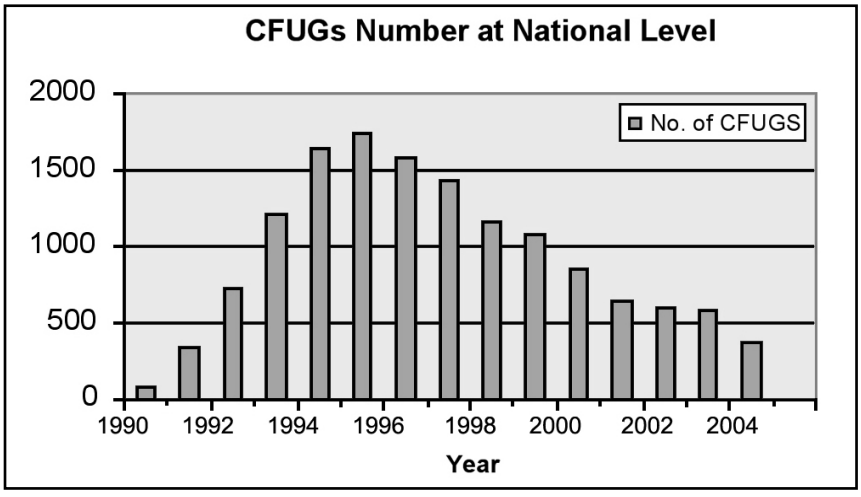
Results and discussion

This research found that community forestry was seriously affected during the conflict. The major impact was in their efforts in managing the forests and in the formation of new CFUGs. Moreover, as Figure 2 shows, the number of Community Forest User Groups (CFUGs) fell drastically as a result of the ongoing conflict, which resulted in reduced income to the communities. The Maoists, the Royal Nepal Army (now Nepal Army) and the Government played equal roles in the imposing changes that reduced the CFUG numbers during that period. Income from community forests declined due to the various restrictions that prohibited forest users from collecting forest products during the conflict (Figure 3).

Impact from the armed forces

The government of Nepal mobilized armed forces to control Maoist rebels in rural areas. In the process many posts were established in remote areas, which had been mostly forested. One senior army officer reported that, even though the posts were established near the forests, the forces never used wood for fuel, and cut timber only with the permission from the local management groups. But field observation and CFUG statements indicated this was not the case. The army officer made sure to add that during war safety and security are the primary concerns, so sometimes the forests surrounding the camps had to be cleared to

Figure 2. Number of CFUGs at national level
Source: Department of Forest, 2006



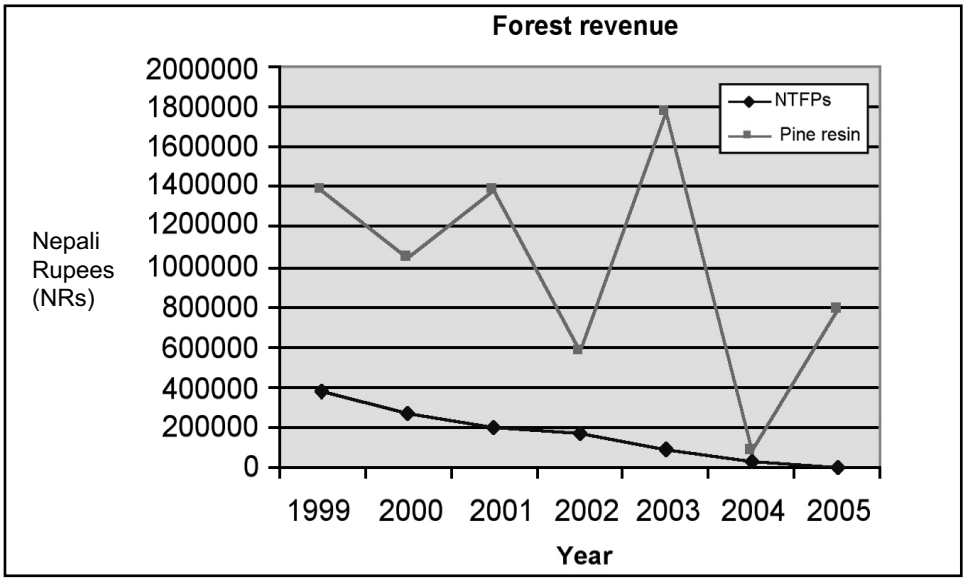
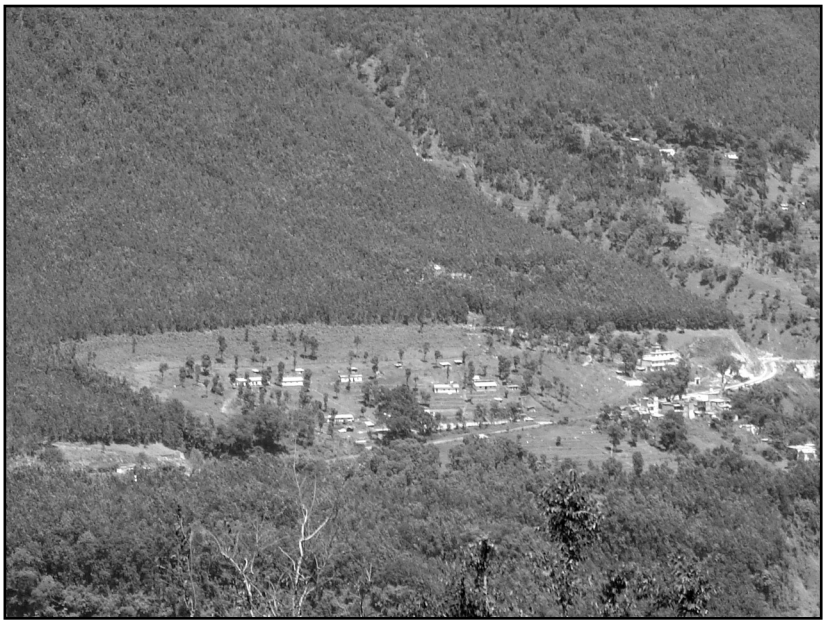


Figure 3. Revenue from community forests in Kailali district
Source: District Forest Office, Kailali, 2006

protect from Maoist attacks (Photograph 1) (interview with Army general, 2006).

Community forest users and local villagers interviewed expressed a different perspective regarding the army's activities. They claimed that the army excessively used its power during the conflict and cut the best trees from community forests without notifying the forest committee (Table 1). A CFUG member claimed that the army and police regularly cut trees from the forests, but the army denied these allegations. The forest users also said they were impacted by the army's declaration of restricted zones in forests surrounding the district headquarters and army camps. Such restrictions were imposed on numerous occasions,



Photograph 1. Security camp in community forest, Parbat district.
Photo by K. Roka

Table 1. Impact of the Royal Nepal Army on community forestry from the perspective of local community members

Positive Impacts
• Decrease in hunting in forest after the weapons were collected by the armed forces
• Illegal cutting decreased due to fear of getting killed during army operations
• Increase in wildlife and forests due to restrictions to access to forests
Negative Impacts
• Cutting of trees from community forests for bunkers, poles, fuel, construction projects, etc.
• Forest clearing near the camps and training in community forests. A report found this to be the case in 40 districts (Kharel 2005)
• Restricted access to forests in many districts
• Harassment, beating and insulting of CFUG members who were accused by the army of being Maoist sympathizers
• Freezing of financial activities of CFUGs intended to stop leakage of funds to rebels
• Mistreating locals who entered forests near camps, some cases of rape were reported
• Restrictions on meetings and gatherings of users groups
• Subordinating forest officials and capturing district forest offices and vehicles
• Army collaboration with timber smugglers in terai
• Army involved in wildlife hunting during patrolling

Information collected through interviews of user group members and forest officials in the study districts between May-August 2006.

sometimes three to four times a year and for months at a time (CFUGs members in Palpa, Parbat, Kailali, and Myagdi, pers. comm., 2006).

Table 1 shows that the user groups statements contradict the claims made by the army officials, which claimed the army did not adversely affect the forests. Despite all the impediments, the user groups continued their management tasks even during this period of intense tension by adopting various mechanisms to escape punishment by the army, such as: meeting at night, limiting mobility, and protesting against the army and administrative restrictions.

Impact by the government of Nepal

The political instability in Nepal between 1996 and 2006 had a profound effect on the community forestry sector. In addition to the on-the–ground impact caused by the presence of armed government and Maoist forces using forests as their bases, in 2000 the government passed a new Forestry Sector Policy which further controlled the forests and the CFUGs. Below key aspects of the new forest policy are highlighted:

—A 40% tax was imposed on the income from the community forests (from 10%).

—Large forested areas were not to be transferred to communities, but managed in collaboration with local leaders and government.

—Out of this collaborative management, local leaders would receive 25% and the government 75% of the revenue from the forest (Kanel et. al, 2005).

The new policy gave extra power to the local government and locally appointed rulers (regional and district). This power was used by many local political leaders to control the forest users through various means: freezing financial activities (bank accounts) of user groups claiming they leaked funds to the Maoists, giving

timber cutting concessions to their supporters or loyalists, and using income from the forests for personal purposes. At times the government officials, Maoists and forest contractors colluded during cutting of trees from community forests, by giving only the minimum price to the CFUG. One such extreme case was reported from the Sindhuli district (Karki 2006).

Impact by the Maoists

Of the three parties, this research reveals that the Maoists' actions caused the most substantial detrimental impacts to the community forestry sector. The Maoists lived in and around rural communities and forests, and therefore influenced resource governance. The Maoist leaders interviewed, both national and local, claimed they were not against forest conservation and expressed their preference for community forestry, saying they considered the system more inclusive, accountable and transparent. They also strongly urged that their people's government should be recognized by all institutions, including international non-governmental organizations (INGOs) working in their control areas and all CFUGs must be registered with them by severing connection with the government.

As a result of rebel pressure and demands, four major donor agencies including DANIDA, GTZ, DFID and USAID withdrew their programs from rural areas. When questioned about the withdrawal of international organizations that supported community forestry in various districts, the Maoist officials responded

Table 2. Impact of Maoists on community forestry

Positive Impacts
• Management became more inclusive and transparent.
• Participation of women increased
• Wildlife hunting decreased
• Illegal cutting in the hills decreased
• Change in attitudes of CFUGs towards minorities and poor members
• Donor agencies became more transparent and address issues of concern to local people
• CFUGs learned new measures to adapt during insurgency period: hiding financial transactions, remaining neutral, and protesting restrictions to access and tree cuttings
• Empowerment of indigenous communities on resource rights
• Eviction of forest encroachers from community forests in terai (Kailali district)
Negative Impacts
• Taxation of forest income in the range of 25-50%
• Extortion from user groups or members
• Abduction of members
• Forceful renaming of community forests to Maoist martyr's name
• Collaborating with timber traders in the terai
• Forced registration in the Maoist government formed at local level
• Forceful membership in the party and participation in Maoist gatherings
• Obstruction of community gatherings and discussions
• Remain silent if money is paid regularly even for illegal activities (timber cutting or harvesting of forest products)
• Displacement of people from the hills into the forests in the terai
• Maoists supporters occupying forest areas under the authority of the party

Based on interviews of CFUGs between May-August 2006.

that organizations that recognize their government and address genuine issues of the poor are welcome. However, they did not support organizations from nations that supported the autocratic regime that was the Nepalese government—especially those from the United States.

A number of the claims by the Maoists contradict those of the CFUGs. Maoist leaders acknowledged that they collect taxes from the community forests, but strongly rejected that they had any involvement in an illegal timber trade, as claimed by CFUGs. Table 2 delineates the impacts the CFUGs attributed to the Maoists. One Maoist leader said that the party has its own forest experts working on conservation in areas under its control (in the Rolpa district). He further added that Maoists did not clear forests for training, camping or living, but used natural clearings in the forest and lived in the villages. Leaders admitted to cutting trees during major attacks or for blocking roadways during strikes, but blamed all poaching and illegal wildlife trade on the Nepalese army.

The CFUGs adopted various measures to give continuity to the management activities. They postponed timber harvesting under extreme conditions, or invested the income from timber and non-timber plant sales at the local level (among villagers or in different projects) rather than in banks, limited mobility of the members, united to oppose rebel's demands or bargain for compromise, and organized rallies against the Maoists' activities. These measures gave organizational strength to the CFUGs to oppose the fighting groups' demands and actions in an effective manner, resulting in the withdrawal of the restrictive orders and the new Forest Act of 2000.

Conclusion

The insurgency had mixed impacts on community forestry in Nepal: they were mostly negative but there were a few positive effects. Even though the fighting parties claimed they supported conservation, their actions had an overall negative effect on the community forest management process. None of the forest users interviewed were positive regarding the actions of the state or the rebels, and they strongly accused both groups of using excessive force to meet their demands and utilizing various coercive means to control local people.

Faced with such challenges, community forestry grew stronger with the insurgency, adopting newer strategies and becoming resilient to different types of pressure in its commitment towards forest management. Nepal's conflict is a lesson for policy makers as it shows there is no substitute for local communities in managing resources and without collaboration with those communities all efforts towards conservation and development will not achieve the goals.

Endnotes

1 A CFUG is formed at the village level (all households using forests are included) to manage and use the forest. There is only one group for one forest. The group then formulates operation and management proposals and submits to the district forest office. After verification and approval by the district forest office, CFUG is legally recognized as autonomous body, and assisted in the management process. Each CFUG then forms one committee inclusive to different groups and gender as a governing body and representative of the whole group.

2 Terai is a plain in southern Nepal bordering India; it was forested until after the 1970s, when malaria was controlled and migration from the hills began.

Acknowledgements

I would like to thank Amity Doolittle (TRI, Yale) and Peter Otis (CDO, Yale) for providing funding to conduct the study. I also thank all the CFUG members and NGO and Forest officials in Nepal for their response to my queries during the study. I also thank Prof. Bill Burch, Colleen Morgan, Alicia Calle and Amity Doolittle for their valuable feedback during the course of this paper.

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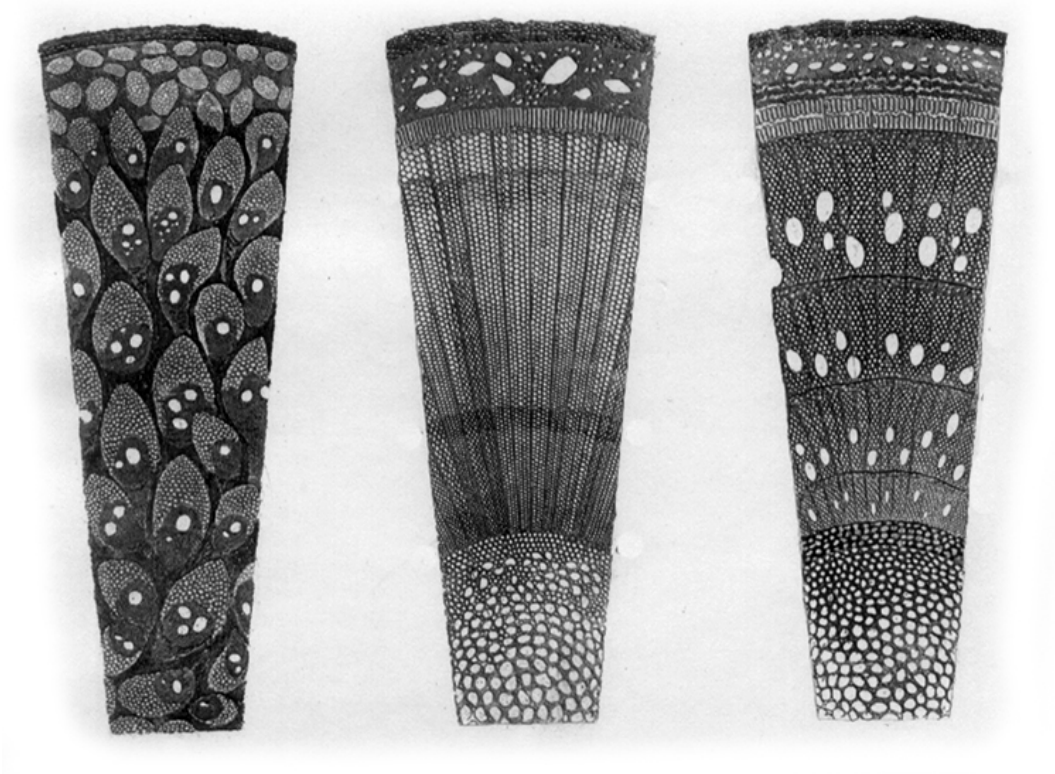

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Himalayan Viagra, Himalayan Gold?

Cordyceps sinensis brings new forces to the Bhutanese Himalaya

by Rachelle Gould, MESc 2007

Partly hidden in the thick rainy mist at 5,000 meters above sea level, a man crouches on hands and knees on the spongy soil. Elbows bent, head almost at the ground's surface, he searches in an old rock slide, huge boulders now entrenched in mossy dirt. Concentrating intensely, he performs a methodical eye-scan for about thirty seconds then low-leaps in a cat-like, practiced advance. Here in the high Himalaya, he and hundreds of his countrymen will spend weeks in search of their mini-fortune: the fungus-headed dead caterpillars that are bringing millions of dollars to the Kingdom of Bhutan.

The country of Bhutan, about the size of Switzerland, is perched in the Himalayan range and surrounded by China and India. With about 800,000 citizens, its population density is far lower than that of its massive neighbors. Bhutan is heralded as a bastion of ecological diversity, for its territory extends from the sub-tropical plains adjacent to India's Terai, almost at sea level, to some of the world's highest alpine habitat. Bhutan's progressive-thinking King explicitly includes environmental stewardship in the country's development philosophy, which has earned Bhutan an international reputation as a model of conservation consciousness.

Yartsa goenbub (Cordyceps sinensis), abbreviated in Bhutan as *bub*, is collected in what is perhaps the country's most emblematic environment: high altitude and rugged mountains, where life is physically demanding and spiritually imbued. *C. sinensis* is a fungus that parasitizes a moth larvae or, stated more graphically, a dead caterpillar with a mushroom growing out of its head. The fungal spores infect the live caterpillar as it feeds in late summer, and the mycelia take over its body after it has buried itself for winter hibernation (Photograph 1).

The fungus is a coveted medicinal product in traditional Tibetan and Chinese medicine. Known in the West as "Himalayan Viagra", its clinically proven effects range from increased sexual function to alleviation of amnesia, improvement of chronic bronchitis and asthma, and reduction of cancerous tumor size (Sharma 2004). The global marketplace began to highly value the species about 15 years ago, when the prowess of Chinese athletes who had ingested it gained international media attention. Since then, what was traditionally a moderate harvest for domestic use and the Chinese market has become a significant mini-industry in the Himalaya, earning the product another name: "Himalayan Gold".

Until 2004, Bhutanese law prohibited the collection or sale of *bub*. But enforcement of any law is difficult in the wind-whipped mountains where *bub* grows—a strip of jagged peaks and small frozen meadows along the oxygen-poor border with Tibet. Before 2004, primary

Rachelle Gould is a native of Southern California, and although she may not have lived there for a while, she will always have an affinity for the open air and the open hearts of her home state. She sees tremendous importance in challenging herself to see the world from many points of view. The opportunity to experience Bhutan to conduct this research changed her in ways she is still figuring out. She has lived and worked in Latin America for a number of years, and spent four years in Massachusetts while pursuing a BA in Environmental Science and Public Policy at Harvard. She plans to graduate from Yale in June 2007 with a Master's in Forest Science.

Photograph 1. *Cordyceps sinensis* before and after cleaning. Both the fungus and the caterpillar are medicinally valuable.
Photo R. Gould

collectors in Bhutan were Tibetan poachers and local yak herders, who supplemented income from their nomadic seasonal lifestyle with illegal sale over the border to Tibet. Thus money, in the form of dried fungus-infected caterpillars, was flowing over high mountain passes and into Tibet year after year.

In 2004 the Bhutanese government realized that valuable income was leaking through its borders due to its "no-take" policy, and created a system to regulate the collection and sale of *bub,* based largely on research such as that conducted by Namgyel (2003). According to a new policy, "local" Bhutanese can obtain harvesting permits for a nominal fee. But the definition of "local" varies throughout the country, and in some places, citizens who have never visited alpine regions receive permits and trek up in pursuit of their fortune.

Due to scarce and uncertain information on the biology of *C. sinensis*, the government has no guidelines for the creation of an ideal management regime—one that would allow for harvesting while sustaining the resource. The government's Renewable Natural Resource Research Centres are currently engaged in research on the biology of *C. sinensis*, but in the immediate term, the Division of Forests has implemented a precautionary policy. While the government does not explain the specific rationale behind the policy, the goal seems clear: to limit collection by imposing restrictions on both the duration and quantity of collecting. The main components of the policy are: collection is allowed for a limited period (in 2006, May 15 to June 15); collectors should leave in the ground two of every five specimens encountered; and all *bub* must be sold in a series of auctions that the government holds each summer.

Bhutan's National Environmental Report describes the land-based lifestyle of the herders as "a microcosm of sustainability" (NEC 1998). But with the recent possibility of a fungus fortune luring farmers from lower elevations to the alpine ecosystem, the iris-sprinkled yak pastures 5,000 m above the sea feel more footsteps per season than ever. As the glitter of the Himalayan gold rush brings new money into the alpine ecosystem, the herders' microcosm receives a jarring that Bhutan ignores at its own risk.

In the absence of detailed biological data about *C. sinensis* and social data about its collection, the precautionary policy described above is admirable. I followed collectors to investigate the on-the-ground reality of how

that policy is being implemented. By combining multiple information sources, I attempted to discover how the management of *bub* plays out on the ground.

Methods

I appraised two stages of the *bub* value chain: collection and marketing. My main methods were participant observation, semi-structured interviewing and key informant interviews.

To understand the collection stage, I trekked to one of the collecting camps (4,500 m) and collection sites (5,000 m) in the Bumthang district. I spent two days with the collectors and seven days in transit and in conversation with yak herders and army personnel. Since my interviewing was done in multiple situations—sitting at hearths in huts, climbing up steep trails, during tea breaks at collecting sites—I was unable to ask every question of each of 58 total respondents.

To investigate the marketing stage, I attended the two-day *bub* auction in the Bumthang valley (2,800 m). I interviewed a total of 23 people: sellers (farmers and herders), buyers (Bhutanese professionals), and government officials. In both of these situations, I used observation and semi-structured interview techniques.

To gain information on the status of management in Bhutan, I conducted key informant interviews. Interviewees included local government leaders (*gup*[1] and *dzongda*[2]), the district forest officer, the director of pharmaceuticals at the National Institute of Traditional Medicine and a Bhutanese government official whose doctoral research investigated the effect of the pre-2004 ban on collecting *bub*.

Results

The first consistent result of this research was that not a single collector adheres completely to the new policy. While no collector adheres to all requirements of the new policy, collectors more closely observed the time limit than the harvest limit. Even so, only 35% of collectors reported that they would finish collecting by the established end-date; the other 65% said they would continue harvesting for at least three days past the legal end-date.

The "leave two of every five" rule is even less closely observed: while every single respondent knew that he or she was supposed to leave some of the *bub* s/he found, not a single collector asked about the harvest protocol follows it. The "leave it" rule is difficult both to follow (for shivering collectors on their knees) and to enforce (for the 10 or 20 forest rangers patrolling expanses of mountainous terrain). Collectors' reasons for not following the rule fell into three main categories. The most dominant answer (given by 51% of respondents) was a frank question: "It's so difficult to find just one; when we find some, how could we just leave it?" (Photograph 2). Another 15% of responses expressed the same hesitancy to relinquish a hard-earned finding: "if we follow the rule and leave it, someone else will just come and pick it up" (Photograph 3). And 34% of respondents justified not following the rule because they believed that no matter how many people collect or how many each person takes, "they" will always miss one or two, leaving plenty for reproduction of the species.

A second result was that the majority of those interviewed knew relatively little of the biology of *bub*. While numerous respondents reported that "older" yak herders had knowledge of *bub's* biological details, I encountered none of these older generation sages. Of 53 collectors asked, 84% either had no knowledge of *bub's* biology or shared information inconsistent with the basic life cycle described above, which is essentially undisputed within the formal scientific community. Biological information is apparently available in some form, however, for the remaining 16% of collectors questioned called *bub* a mushroom and ex-

Photograph 2. *Bub* before harvest. The difficulty of finding *bub* is demonstrated by this individual just as the collector begins to remove it from the ground. Only the white part of the *bub* –a small spongy stick that blends in with the surrounding vegetation– is visible before harvest.
Photo R. Gould

plained that mushroom "seeds" (i.e. spores) affected another living creature in some way.

The third consistent result of this research was the yak herders' concern about the impact that these new collectors have on high alpine environment and, quite inextricably, on their livelihoods. The herders' comments about the changes in the past three years, since the legalization of harvest, were notably consistent. Every herder gave almost the same list of impacts: the new collectors degrade the meadow vegetation—which sustains the yaks and consequently the yak herders—by digging and overturning soil to extract *bub* and by bringing cargo horses that remain grazing in the meadows for as much as a month. They affect the scarce fuel source for humans by uprooting slow-growing shrubs for firewood (as opposed to pruning, which allows regeneration). And to personalize the insult, collectors arriving before the herders steal the firewood the herders had stashed to dry the previous year. Even more blatantly, they use the wooden shingles from the herder's huts, painstakingly hand-hewn and caravanned up from lower forested elevations, to fuel their campfires. One herder concisely summarized the comments of his fellow herders: "It's good that the government issues permits. But permits should go to people familiar with this environment. From the environment's point of view, the permit issued is more damaging."

In addition to those immediate impacts on their material livelihoods, for 67% of the herding families interviewed the most serious effect of the new collectors is the upset they cause to the spiritual forces in the mountains. In Bhutan, lakes, which are rare due to the dynamic topography, are the dwelling places of spirits and spiritual forces. But lately, water levels in the lakes have been lower and more unpredictable than normal. With a new shroud of respect and deference, these families quietly shared that the spirits are obviously not content with the new situation.

Discussion

My research highlighted three specific and yet significant concerns related to the current management of *bub* in Bhutan. First, the majority of collectors do not follow the policy's protocol, apparently because they do not see the logic in the collection rules. Second, most of those who are collecting know little about

the species' biology. Third, regardless of the impact of harvesting on *bub* in particular, the rush of people to the high alpine region presents a stress that the fragile habitat may not be able to long endure.

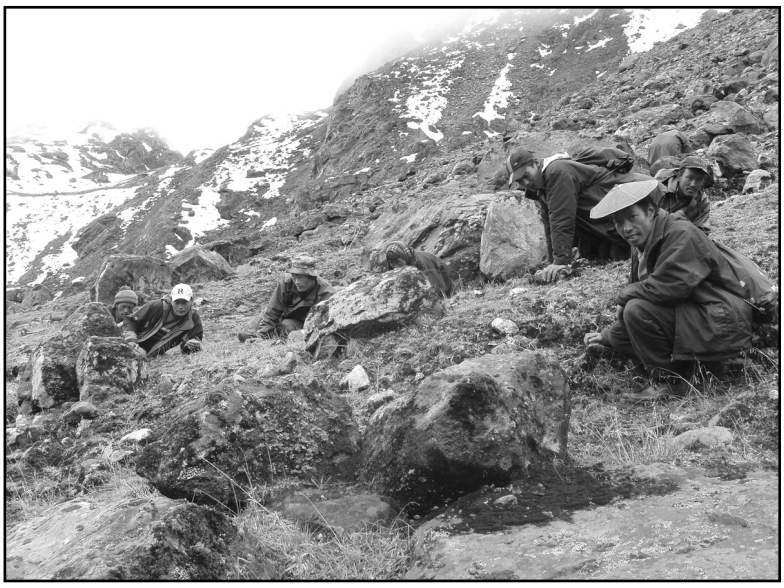
Bhutan does not need to look far for evidence that the economically and medicinally potent *bub* requires careful management. In neighboring Nepal, collection season has attracted thousands to the mountains, which has raised concerns about the sustainability of the recently-popular harvest (Sharma 2004). The significance of the product in the local economic and social context is also poignantly demonstrated by the fact that the Maoist revolutionaries currently challenging the Nepali government are funding a significant portion of their efforts by controlling the trade of *bub* (Roka 2006; Schweithelm 2006). He who controls *bub* has power.

In the minds of the yak herders, who arguably know this area best, the spirits have a clear message that should not be ignored. The new visitors to this ecosystem do not understand its uniqueness, its fragility. *Bub* has the potential to elevate the incomes of Bhutan's farmers, but this research suggests that if some change is not made, that potential may be trampled beneath the eager soles of happiness-seeking citizens. As my abbreviated foray into the collecting world proved to me, each *bub* is found at a cost of foggy kilometers trekked, fingers white with cold, wet and pebble-indented knees. The conservative harvest limits recently implemented may appropriately pave the way for a policy based on more detailed information, and they may appeal to international aid and environmental agencies. But the physical hardship necessary to collect combined with the gold-like value of the product make each individual collector understandably unwilling to let any *bub* sit quietly in the thawing dirt.

Conclusion

As more collectors rush to the gold at the top of their country's hills, Bhutan will be forced to deal with the harvest of *bub* more comprehensively. Global market forces have reached the prayer-flag-adorned mountain passes of Bhutan, and those forces present challenges that require proactive solutions.

One obvious step toward those solutions is underway. Bhutan is well aware of the need for further information on the biology of *bub*, and research teams understand more of its life



Photograph 3. Collectors in search of *bub*. A typical day's harvest varies greatly—from nothing at all to a few hundred fungus-headed caterpillars.
Photo R. Gould

cycle every year. This information will help to refine the specifics of the management regime that will allow for harvesting of *bub* without the destruction of its populations or the systems within which it lives. An important element of the research program will be to share both the questions and the results with collectors. That sharing will be especially important if the management approach described below is taken.

Even when a biologically logical management regime is determined, implementation of that regime may be a challenge. The issue of *bub* is a fairly classic instance of an open-access dilemma. Experiences with similar situations, although in entirely different contexts, suggest potential solutions. One such example with over 70 years of documentation is the lobster fishery in the state of Maine (Dietz et al. 2003). Maine's lobster fishermen are locally organized, territorial, and have established a system of bottom-up rules regulating the taking of lobsters; the result is a strong sense of stewardship toward the resource. That sense of stewardship is not present in Maine's groundfish fishery, which occupies the same area but which has been managed largely by the United States government. While groundfish stocks and catches "have never been so low," the lobster catch is "at an all-time high" (Acheson 2006).

At least one Bhutanese scientist identifies some type of community property rights scheme as the preferred option for the conservation of medicinal plants within the context of Bhutan today (Pradhan 2006). In much of Bhutan's varied landscape, traditional management regimes were based upon a user group's long-term perspective on resource use, which likely resulted from a sense of responsibility toward that resource. The current *bub* policy approaches such community rights to the resource with its limitation to "local" harvesters. Perhaps the next priority for Bhutan's Department of Forests is to uniformly define what its policy means by "local", and then to consider transferring a sense of stewardship of Himalayan Gold to those "locals". The best course of action with *bub* may be in Bhutan's own recent past, but will probably only surface if "locals" once again feel the honor and the responsibility of caring for the resource.

Aknowledgements

This research would have been impossible without the aid of so many. Professors Bill Burch, Paul Draghi and Mark Ashton—constant sources of wisdom, sanity, direction and profound insight shared simply. Dechen Dorji, my Bhutanese director and friend, an impressive combination of sage thinker and logistical mastermind. The staff of the Ugyen Wangchuck Environment and Forestry Institute, whose generosity and care facilitated research and life in innumerable ways. Forest Ranger Wangchuck Wangchuck, patient translator and summer-long research partner and friend. Dorji Wangchuck, flawless Forest Guard and impeccable guide, whose comfort, knowledge and friends in the wind-whipped mountains kept us safe and brought us many opportunities for learning and sharing. And lastly, so many collectors who, despite exhaustion and cold, shared their stories and their firesides.

Endnotes

1 Roughly equivalent to a mayor or county supervisor.

2 Roughly equivalent to a state or district governor.

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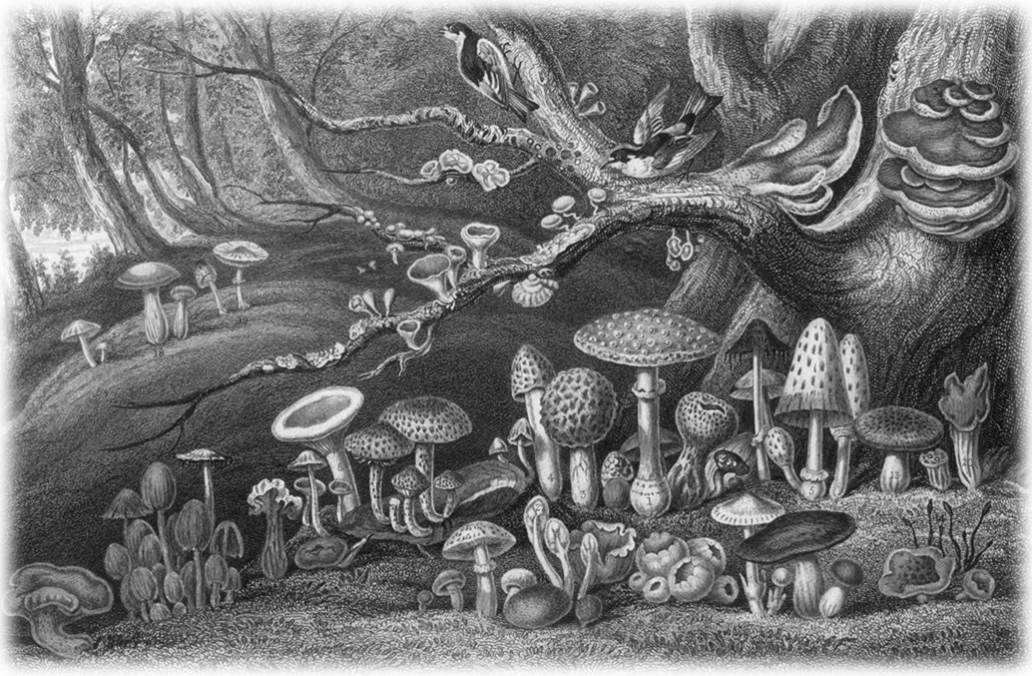

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