TROPICAL RESOURCES

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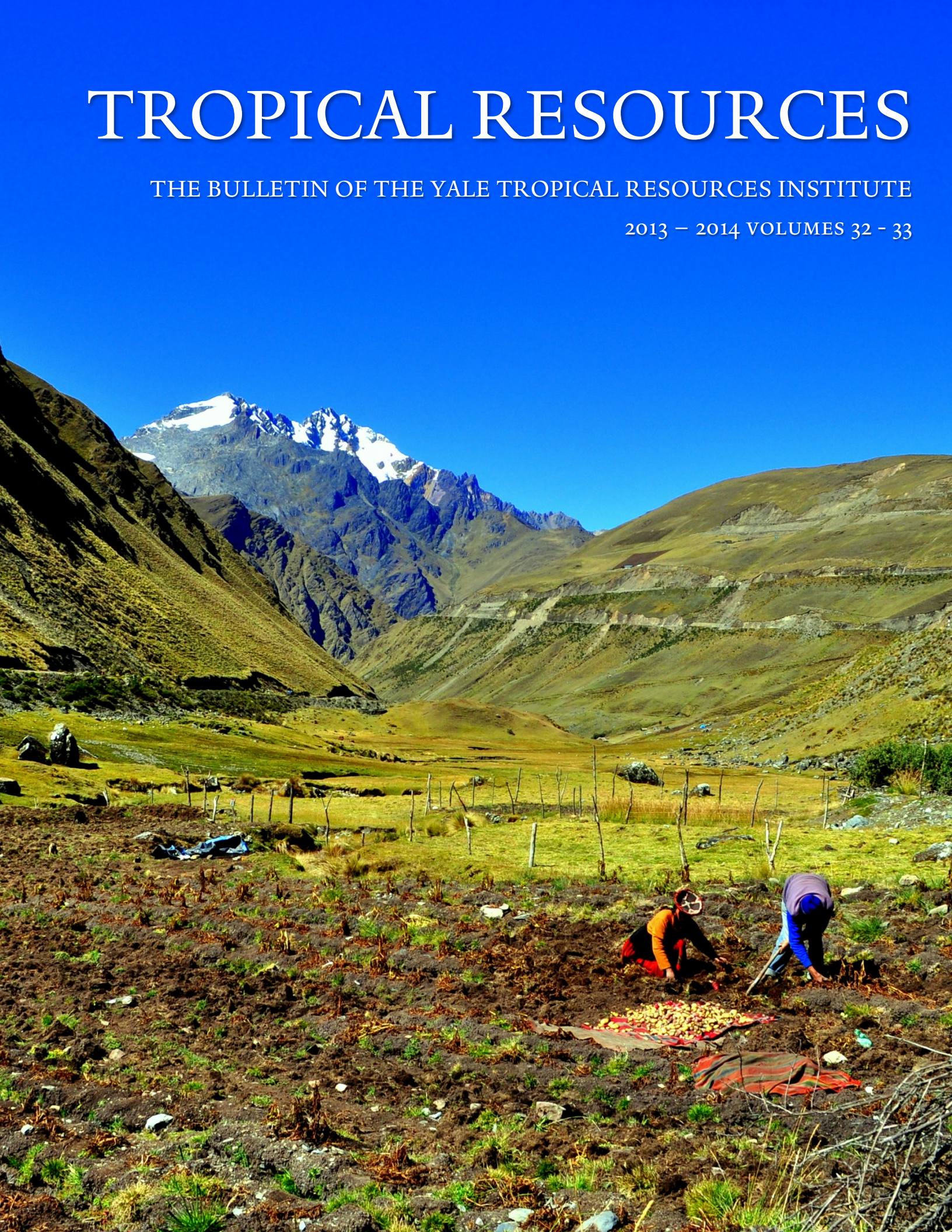

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The Bulletin of the Yale Tropical Resources Institute
Volumes 32-33, 2013-2014

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Please access the 2013-2014 Bulletin at environment.yale.edu/tri in order to view maps, graphs, photographs, and figures in color.

Mission

The Mission of the Tropical Resources Institute is to support interdisciplinary, problem-oriented research to understand and address the most complex challenges confronting the management of tropical resources worldwide. Lasting solutions will be achieved through 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.

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 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.

TRI News Updates

Simon Queenborough named new TRI Musser Director

Simon Queenborough replaced Michael R. Dove as Director of TRI in July 2014. Dr. Queenborough (BA (Hons), University of Cambridge; MSc, Royal Botanic Garden Edinburgh and University of Edinburgh; PhD, University of Aberdeen, all UK), is Lecturer and Research Scientist in the School of Forestry and Environmental Studies, and joins us from The Ohio State University where he was an Assistant Professor.

Dr. Queenborough spent three years in an Ecuadorian hyper-diverse Amazonian rain forest documenting the flowering and fruiting ecology of 16 co-existing species of Neotropical Myristicaceae (nutmeg) trees. He then spent three years researching links between annual plant dynamics and the socio-economics of farming in the rather less diverse lowlands of the United Kingdom. He has held research positions at the University of Sheffield (UK), the National Center for Ecological Analysis and Synthesis, UCSB, and The Ohio State University (USA).

He has published 25 articles in international peer-reviewed journals. Dr. Queenborough's most recent article is a meta-analysis of studies testing the Janzen-Connell hypothesis that specialist natural enemies, such as herbivores and pathogens, maintain diversity in plant communities by reducing survival rates of conspecific seeds and seedlings located close to reproductive adults or in areas of high conspecific density. Other widely-cited work includes his detailed studies of tree reproduction, seedling survival, and niche differentiation in the Myristicaceae tree family at his long-term field site, and investigating links between socio-economics and ecology.

Dr. Queenborough's current research interests include understanding mechanisms of diversity, breeding system evolution and resource allocation in plants, and quantitative methods in population dynamics. He currently teaches a tropical field course, statistical analyses and graphics in the software R, and a graduate seminar in forest ecology.

Simon Queenborough, Ph.D.
Mrs. John (Elizabeth W.) Musser Director, Tropical Resources Institute
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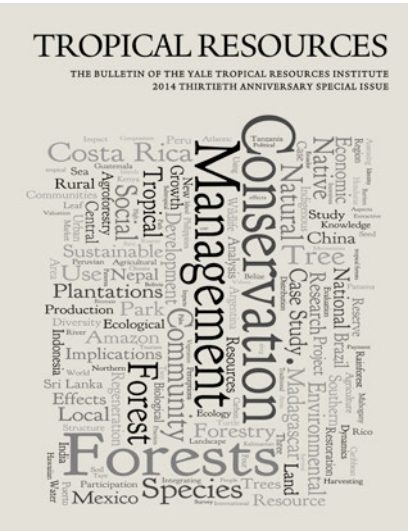
TRI Releases 30th Anniversary Special Issue



TRI has released a digital Special Issue of *Tropical Resources* to commemorate our 30th Anniversary year (2013–2014). The Special Issue features a selection of nineteen articles that have been published in *Tropical Resources* and its predecessor, *TRI News,* over the past three decades.

From the 1980s, the Special Issue features *TRI News* articles by Ramachandra Guha (1987), Mark Ashton (1988/89), Daniel Nepstad (1989), and Laura Snook (1989). From the 1990s, the Special Issue features *TRI News* articles by Eleanor Sterling & Betsy Carlson (1990), Erin Kellogg (1991), Miguel Pinedo-Vasquez (1993), Janet Sturgeon (1994), Maureen DeCoursey (1994), Hugh Raffles (1995), Anne Rademacher (1999), and Andrew Mathews (1999). Finally, from the 2000s, the Special Issue features *Tropical Resources* articles by Amity Doolittle (2003), Angela Quiros (2005), Dora Cudjoe (2005), Richard Chávez (2006), William Collier (2010), Hui Cheng (2010), and Stephen Wood (2011).

The Special Issue opens with a retrospective article by TRI's first faculty Director, William Burch, Jr. (also featured in this print edition of the Bulletin), which recounts the origins of TRI. The Special Issue is prefaced by a Foreword from TRI's Outgoing Director, Michael R. Dove, which places the selected articles in historical context. It is available on our website at environment.yale.edu/tri.

Introduction to the Double Issue

Dana Graef and Jeff Stoike
Outgoing TRI Program Managers

This double issue of *Tropical Resources* (Volumes 32–33), published during TRI's 30th Anniversary year, features research articles by fifteen TRI Fellows who conducted fieldwork in 2012 and 2013. These articles draw from diverse disciplinary perspectives and are rooted in fieldwork that spans Africa, Asia, and Latin America. Yet underlying the articles in this issue are common interests and concerns: how do development and conservation initiatives influence both social and ecological communities in the tropics?

In recognition of our 30th Anniversary, we open this issue with a retrospective article by TRI's first faculty Director, William Burch Jr., "The More We Circle Back, The More We Circle Back – TRI At 30" (also featured in our digital 30th Anniversary Special Issue). As Professor Emeritus Burch describes, in the early years of TRI, groups of students traveled to Puerto Rico for field training. Yet over the years, TRI's geographic scope has expanded. TRI has transitioned to a dispersed group of students who carry out fieldwork every year throughout the tropical world. In this issue alone, a dozen countries are represented, from Tanzania, India, and Indonesia to Bolivia, Argentina and Brazil.

Following Professor Emeritus Burch's article, we present fifteen research articles by TRI Fellows. These are divided into four sections: Communities & Consumption, Climate & Energy, Water & Marine Issues, and Conservation. Section I, Communities & Consumption, features research that engages with grassroots perspectives in different ways. Lauren Baker analyzes the politics of indigenous responses to oil extraction in the Peruvian Amazon. Erin Beasley examines distinct representations and understandings of food security and food sovereignty in Bolivia. Caitlin Doughty describes a native tree species conservation initiative in the Peruvian Andes. Ashwini Srinivasamohan analyzes experiences surrounding waste in a middle class urban environment in India.

Section II features articles by TRI Fellows whose research is related to themes of Climate & Energy. Yiting Wang examines the cultural and political factors involved in the adoption of liquefied petroleum gas cookstoves in India. In his study of a renewable energy company in Brazil, Tom Owens asks how community engagement is used as a tool to promote wind projects. Rauf Prasodjo utilizes a comparative perspective to assess the challenges of integrating greenhouse gas emission reduction targets into land-use planning policies in Indonesia and Brazil.

Section III represents an emerging research area for TRI: Water & Marine Issues. Jessica Brooks studies barriers to the use of recently introduced rainwater harvesting systems in Haiti. Through modeling and mapping, Beth Tellman links remote sensing imagery of forest cover change to impacts on flooding in inhabited watersheds in El Salvador. Ambika Khadka also utilizes a modeling approach to examine the impact of a range of possible land-use changes on surface run-off, peak flow and infiltration in China. Stephanie Stefanski studies the views of foreign and domestic tourists regarding threats to a marine reserve in Argentina.

Finally, Section IV brings together a group of articles that represent a founding theme of our school: Conservation. Kelly Stoner reflects on the process of designing and implementing a long-term monitoring program for large carnivores in Tanzania. Matthew Bare provides a synthetic survey of forest restoration projects in the Colombian and Ecuadorean Andes. Yufang Gao analyzes distinct, yet evolving, perspectives on the ivory trade in China. Lastly, Ellen Arnstein conducts forest biomass estimates in Bolivia, which have implications for carbon sequestration.

The themes represented in the following pages—food, water, forests, wildlife, energy, and people—are evocative of topics that TRI Fellows have investigated over the past three decades. Yet each article also responds to contemporary methodological tools and environmental concerns. Together, these articles suggest a final question to consider while reading the following pages: how are *tropical resources* utilized and understood—not only by students at the Yale School of Forestry & Environmental Studies, but by distinct communities, citizens, companies, and nations? Many potential answers to this question are suggested in the articles that follow. We hope you enjoy!

TRI Research Sites Represented in This Issue

Argentina:	Stephanie Stefanski
Bolivia:	Ellen Arnstein Erin Beasley
Brazil:	Rauf Prasodjo Tom Owens
China:	Yufang Gao Ambika Khadka
Colombia & Ecuador:	Matthew Bare
El Salvador:	Beth Tellman
Haiti:	Jessica Brooks
India:	Ashwini Srinivasamohan Yiting Wang
Indonesia:	Rauf Prasodjo
Peru:	Lauren Baker Caitlin Doughty
Tanzania:	Kelly Stoner Yufang Gao

The More We Circle Back, The More We Circle Back—TRI At 30

William R. Burch, Jr.
Emeritus Hixon Professor of Natural Resource Management
Senior Research Fellow—FES Yale University

Legends

Time markers are one of the most ancient and significant ways by which humans force order upon an ever changing world. In 2014 the Tropical Resources Institute (TRI) will mark its 30th year of service. Like other social institutions it cautiously approaches the middle of its life cycle wondering what the past might tell us about its future. Certainly it is a convenient point to recover and emphasize the legends about its origins. Like our families, religious organizations, educational corporations, sports teams and other organizations that we live within we want a consistent narrative that tells us about how our social commons came to be. We want a back story that gives us lessons learned from the mistakes made, hopes lost, visions won, legacies sustained. Like most extended families we have our jokes and anecdotes and stories we tell the next generation so it can follow or re-direct the next phase of the family legend. The stories we share give substance to our identity and strengthen the power of our efforts because they are joined in common interest. All communities whether family or scholarly need legends to sustain their bond and to resist the tendencies, internal or external, seeking their demise.

The narrative about the TRI start-up is certainly one part of its legend. There is no question that your individual work is attributable to your particular wit and wisdom and hard struggle. However, it is wise to remember the Hindu tree of learning where all the many people who have contributed to your effort surround you and up near the canopy are all the people who will be dependent upon the work you leave behind. It is that humble fact that informs the TRI legend. As Mercatante (1988:17) notes:

> Legend, derived from the Latin word for 'to gather, select, read,' and similar to the Greek word for 'to gather,' is often confused with myth. As with myth, a legend is an anonymous traditional story passed on from one generation to another. But whereas a myth has gods and goddesses as its main characters, a legend has historical personages, such as Charlemagne, El Cid, Muhammad, St Francis of Assisi, or Billy the Kid.

He notes later that tellers of myths believe them to be absolutely true while a legend is not necessarily true. So our journey here is not the stuff of myth but one part of an ongoing legend to which the present and future will amend and refer to and feel ownership and even a push of pride.

Origins

As the first faculty director of the Institute I have one perspective on the origins, hopes, structures and contributors in its evo-

lution. My part of the legend begins in the late 1970s and ends in the early 1990s. To me it is less a story of particular individuals but rather a coming together of many to form a community dedicated to serving local people in their tropical environment and the training of future natural resource professionals to carry out their practice. I will try to note many of the ideas and persons who made this venture possible and some of the trials and tricks of survival it followed. If I have forgotten some persons or events it is not intentional but more the slide of time passing through an opaque vision filtered by the rear view mirror.

The legend originates with student demand for the School to be a major force in challenging global trends in natural resource conservation. This demand was powered by an angry ecologist, two activist deans and a troop of Peace Corps vets and other revolutionary students that moved a modest School of Forestry fully onto a global stage. My role was as a translator and cheer leader of these several voices.

Ecologist Herb Bormann along with Gene Likens and other colleagues at the Hubbard Brook Long Term Ecosystem study project were demonstrating the global linkages of insults to the earth. They determined that Acid Rain killing lakes in northeastern forests came from energy plants in the Midwest. They saw the biogeochemical impact of many timber cutting practices as non-sustainable and connected this to the high rates of deforestation in tropical forests with critical global consequences. They made ecology an experimental science serving complex human ecosystems. Herb wanted to have more attention given to the tropics and along with Tom Siccama organized student field trips to Puerto Rico over Spring Break to raise awareness and give some empirical base for understanding such ecosystems.

Dean Francois Mergen had been working on forest genetics in tropical forests for some time. In 1969 he led a multidisciplinary team to work with the Bombay Natural History Society on research needs for sustaining the habitat of the last refuge for the Asian lion in the Gir Forest, Gujarat, India. He organized a major conference on Tropical Forestry in 1981 that brought leaders in the field from all over the world. He guided the School toward a broader outlook in changing its name to School of Forestry and Environmental Studies. The idea of environmental studies was to open the participation of students in humanities, arts and social sciences as equal and necessary parts of international ecosystem management efforts.

Dean John Gordon expanded upon the prior efforts and gained a substantial grant in 1983 from the Mellon Foundation to start TRI. He encouraged the recruitment of students from tropical countries and supported our bidding on a major USAID project in Nepal. He encouraged the faculty to appoint experts in tropical ecology from abroad and within the US to spend time on campus. He bypassed the usual faculty dissembling as to why such broadening of the program might not work. He listened, questioned and made things happen. TRI was established.

Drawing upon the prior work of Bormann and Siccama and the good connections in the El Yunque National Forest, the Institute followed the usual colonial approach—establish a headquarters, buy vehicles and equipment and set up shop for faculty and students in Puerto Rico. However, I had been working with the USAID in ways to have more use of social science theory and methods in tropical forest conservation and development projects. Further the student Peace Corps vets back from the frontlines of the tropical countries thought the Puerto Rico venue and the work planned for the TRI

was more like a Club Med for rich kids. We both felt that the developing world was a better venue for training future professionals and connecting with the realities of their future work environments.

I delivered our ideas with some passion to Dean Gordon. He then used his usual tactic of 'turn the whine into doing the time' and appointed me the first faculty director. With his help we moved the whole operation of TRI back to the School, saving a great deal of money. We then went about creating a truly global TRI program with an international advisory committee, linkages to other international programs, improved course offerings from experts in tropical affairs and a whole turning of the effort toward conservation and development that included the skills and needs of local tropical forest communities. There was ample room for pure science but the central tendency of the program was on conserving of the people and forests in the tropics.

This may not seem like a big shift to folk in 2014. However, it was a major change and seemed a threat to traditional practices of foresters and botanists working in tropical forest ecosystems in the 1980s. As Dean Gordon noted (1989:2):

> Another important dimension of the Institute's purpose is the theoretically coequal role of social science and policy analysis with biological and physical science in equipping professionals to work effectively in the tropics (or anywhere else)….there was at the outset fairly strong pressure to equate 'tropical resources' with 'tropical botany' or radically, with 'tropical botany, zoology and geography.' We resisted and even named a social scientist as our first Faculty Director.

We should underline the significance of appointing a social scientist as the first Faculty Director which was perceived both in and out of Yale as very radical, indeed. Thus the TRI legend had its birth in very revolutionary and creative challenges to received wisdom as it tried to follow a new and less frequently taken road in training new professionals.

Street 'Cred'

The major challenge was to demonstrate our street 'cred' for the Institute and our graduates from the program. We encouraged students to attend Dr. Harold Conklin's courses that included anthropological insights on swidden agriculture and the role of villagers in maintaining their forests. We made arrangements for scientists, such as Brian Boom, from The New York Botanical Garden to present courses on tropical botany and soils. Ram Guha, author of "The Unquiet Woods," was appointed a visiting scholar teaching social ecology. Mark Ashton's father provided us with a course on tropical ecology. We encouraged a distinguished group of tropical experts to be part of our Board of Advisors (see Appendix for the names). A faculty group served as in house advisors and I had an informal student advisory group who provided regular reality tests on our policies and plans. We signed Memoranda of Understanding with 28 institutions to develop a network of access between our faculty and students with those in tropical programs such as CATIE (Centro Agronómico Tropical de Investigación y Enseñanza) in Costa Rica and the International Centre for Integrated Mountain Development (ICIMOD) in Nepal.

I think the boldest move was our bid on and the winning of a contract with USAID to work with the Institute of Forestry [IOF] in

Pokhara, Nepal to help them restructure their curricula to be more effective with local forest communities. It was the first ever such bid by a Yale Department and was resisted by the grants people as not a 'proper' activity for Yale. It was a five year 8 million dollar effort and has been continued with several renewals since then. I was able to use the Finland Forest Master Plan for Nepal as a course assignment for my social ecology class. They did a most professional critique and the Dean of the IOF used their report in a demanding challenge to the producers of the plan for their failure to understand certain Nepali realities. Realities such as we did not need to produce more graduates, as the plan required, until the recent ones had jobs. Several US Land Grant natural resource departments tried to keep us out of the project claiming Yale did not have the necessary expertise. We won all of those battles and demonstrated the competence of our program and graduates.

Supporters

A graduate of FES, Bob Clausi, was the IOF project manager and found ways for us to bring IOF faculty to Yale and other US institutions for Masters Degrees. Other critical support in the early development stage of the Institute came from our Assistant Directors, Peggy R. King and Katherine A. Snyder. Both were creative and demanding leaders who believed in our mission. In 1989 Betsy McGean was Assistant to the Director, and along with other staff—Sonia Varley, Jeff Bopp, Alicia Grimes, and Jimmy Grogan—led in the expansion of the program. They along with many of our alums solidified the uniqueness of the Institute and its value in conservation of tropical human ecosystems (including trees, wildlife, water and other life forms). The late Joe Miller, School Librarian, organized an expansion of holdings in journals and books on tropical matters. At that time the only larger collection was the Commonwealth Forestry Institute at Oxford University.

The early support of the Institute came from a variety of sources. There was the initial Mellon grant and its renewal. An alumnus made a large anonymous gift to support TRI interns working in tropical countries. We gained a grant from the Tinker Foundation for work in Latin America. A program in underground forest microbiology was developed with support from the Mellon Foundation. The Pew Charitable Trusts funded a program for Continuing Education for Natural Resource Professionals. Short courses were developed for wildlife policy management in the tropics.

One side benefit of the TRI was that its work in Asia and Latin America provided a base for discussion about bringing these lessons learned back home. Our Urban Resources Initiative began when Dr. Ralph Jones, newly appointed Director of Baltimore's Department of Recreation and Parks and Burch were part of a Park Service review group. I was telling him about our work in Asia and he said, "How come you are not doing that here in our cities?" And we did under the guidance of John Gordon. Many of our tropical resources students like Erin Hughes, Bhisma Subedi and J.J. Jiler worked in Baltimore and returned to Asia as leaders of a new vision for connecting people to their natural systems. There are many other stories we could tell but that is for another time around another campfire. The legend is organic and will continue to grow though probably by persons other than 'Billy the Kid'.

Talking the Past, Thinking the Future

I want to draw upon some lessons learned from my work with TRI and URI [the Urban Resources Initiative] to provide some suggestions for future, post middle age TRI activities that the present participants might consider. The first suggests we give some thought on how to build more cumulative learning from the work of TRI interns and other researchers. The second is a consideration of accepting a wider array of report strategies and a logic of inquiry other than the present emphasis upon a pure science model. This latter suggestion will take longer to tell as my intent is to have us build a locally based, expanding population of ecosystem stewards who force a large vision upward rather than waiting for some top down abstractions from planners and policy makers to trickle in with even more abstractions that are disconnected from the daily lives of ordinary people.

I have read and listened to the excellent and hard won nuggets of knowledge our TRI interns have gained over the years. And like so much in academia this probable wisdom often enters some intellectual niche of forgotten good thoughts. Part of the problem is that there is no means of cumulative learning. This person's effort is dutifully reported and this person's effort is dutifully reported and yet there is little connecting thread that joins them together over time and place that results in a unified base of lessons learned. The Urban Resources Initiative has avoided some of that by remaining in the same venue and addressing similar issues over the years. If TRI had a few basic themes so that each unique effort could be joined to another and over time there would be an empirical base for coherent conclusions as to what works and what does not and how come. Presently, we seem to have excellent reports but they seem to begin and end with one specific fragment rather than combining to provide some general principles. In this sense we are like most development activities—grand ideas run for three years and then it is off to the next project with little or no connection to other interventions that were similar and whose failures and successes might help the next effort. Like the fabled wise people trying to describe the elephant we only concentrate on our own particular fragment. The elephant is only the trunk or the tail or the foot but what we need in human ecosystem policy and management are lessons about the whole elephant, of the whole ecosystem we are working with. Well it is a thought from the past that might help us to build a better future.

The second issue is not accepting the constraint of always pretending we are dependent upon the model of science and that no other will do. I do believe that science in theory and method is necessary for identifying basic mechanisms, however, it does not have sufficient heft for resolving the larger environmental and natural resource issues of this century. There is daily evidence that most of our most important decisions are not based upon the rational choice model. We do important things in certain ways because we are emotionally connected, and that trumps rationality most of the time. So why not be open to other modes of proof and presentation? Of course, some will remain with the science model but others of us might do an even more effective job with a model from disciplines of faith or law or poetry or painting or drama or essays. Suppose 10 or 20 percent of our interns say I do not trust or feel I capture the meaning of what I have learned by simply following the usual science-like way. And we could say, fine lets go

for a photo essay or a video story or a series of poems or a play about gathering water at the low caste village water spigot or planting trees on a common land near the village school. Or work with a local scientist and translate what that person does into the larger consequences or meanings for village life.

If we are to be students, policy analysts, planners or managers of human ecosystems our challenge is often greater than simply adopting the practices of reductive analysis found in physics and chemistry. Much as we might like to we are unlikely to have the same certainty for resolving the complexity of human ecosystems and getting it into a form that motivates persons within the reality of our political environment. Richie Havens who died in April, 2013 was a good friend of the School, he gave a concert in Sage Hall to help us raise money and to support his Natural Guard program for young kids to get contact with nature. He said "I am not an entertainer I am a communicator." He is a better model for many of our ecosystem professionals who need to be not just enumerators but communicators about sharing the enchantments of nature that they feel and why it is so very important for all to share in that enchantment.

Think of all the high level conferences, papers, meetings on global climate change— Kyoto, Rio, Bali, Copenhagen, South Africa and so on and the majority of the world's population remain unmoved or uncertain as to what they can do. Think of the regular reports by climate scientists and the 'inconvenient truth' about how little they have moved our attention. About 92 per cent of the research has been on establishing the biophysical measures of change and the possible causes of these changes. For the most part they have said the causes are human and their continued actions will cause great pain for humans. Yet only the remaining 8 per cent of research funds have been invested in human studies on necessary responses to these change forecasts. It is as if a bunch of guys in white coats got on an iceberg leaving Greenland with varieties of expensive instruments to measure change. As they head towards the Gulf Current they have excited arguments about so many parts per millimeter of up or down. Meanwhile the iceberg continues to melt. As they drift past New Jersey people on the shore are shouting 'your iceberg is melting, your science is not helping us. What do we do about our homes and communities in these new realities, how do we prepare to meet them and should we not stop air and water pollution just as a sensible practice?' Meanwhile the iceberg and attendant scientists melt into the warmer seas. And we still do not know what specific actions we can actually do in solving these environmental challenges within our frame of capability. The hard evidence suggests that our climate scientists are good calculators but not very good communicators. And that is a loss for all of us.

Our work in Baltimore, New Haven and village Nepal has tried to bring back enchantment with nature. Here our guide and monitor has been an association with artists who can expand our angle of vision and mix it with the depth of street wisdom from our colleagues in local communities. We ask different questions in different ways and give systematic legitimacy to these alternative and complementary sets of proof and data.

There are many examples where art and science complement and enhance our vision of the natural world. For example John Steinbeck goes out of Monterey to the Gulf of Mexico with his friends, marine biologists, on a research cruise where he is a most interested 'gofer' and chronicler of the voyage. In one aside Steinbeck is talking about the genetic imprint of the moon and tides upon our

behavioral rhythms and puts them within a context unique to our species. He says (1941:30):

> The imprint lies heavily on our dreams and on the delicate threads of our nerves, and if this seems to come a long way from sea-serpents and the Old Man of the Sea, actually it has not come far at all. The harvest of symbols in our minds seems to have been planted in the soft rich soil of our pre-humanity. Symbol, the serpent, the sea, and the moon might well be only the signal light that the psycho-physiologic warp exists.

This book, along with Rachel Carson's, "Silent Spring" and "The Sea Around Us" and Gifford Pinchot's 1900 "A Primer of Forestry" are other important examples of keeping the science but reaching beyond its fine metrics and rational structure to its larger meaning—a point within our enduring enchantment with the diversity, the beauty, the wonder of nature including our own.

Carson (1962:261-2) closes her detailed examination of the unintended consequences of a narrow use of science in the development of pesticide and chemical additions to our ecosystems. She says:

> The "control of nature" is a phrase conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man. The concepts and practices of applied entomology for the most part date from that Stone Age of science. It is our alarming misfortune that so primitive a science has armed itself with the most modern and terrible weapons, and that in turning them against the insects it has also turned them against the earth.

Steinbeck closes his wondrous science field trip with this note (1941:223):

> What was the shape and size and color and tone of this little expedition? We slipped into a new frame and grew to be part of it, related in some subtle way to the reefs and beaches, related to the little animals, to the stirring waters and the warm brackish lagoons. This trip had dimension and tone. It was a thing whose boundaries seeped through itself and beyond into some time and space that was more than all the Gulf and more than all our lives. Our fingers turned over the stones and we saw life that was like our life.

In the forest ecosystem management professions we have wilderness and timber people with rhetorical positions that assume an absolute division of values between them. Yet, it is more one of different poetic visions of the forest ecosystem. Though John Muir and Gifford Pinchot could not agree about wilderness they saw the forest ecosystem as something very different from those who only saw it as a commodity waiting to be fully exploited. Pinchot's utilitarian call of "greatest good, for the greatest number, in the long run" is a means for ensuring the perpetuation of wildlands that is different from a regulatory enactment. As for poetry, Pinchot's "A Primer of Forestry" might seem hard edged and technical yet it is replete with poetic visions of the whole forest. He notes (1900:7-8):

> The forest is the most highly organized portion of the vegetable world. It takes its importance less from the individual trees which help to form it than from the qualities which belong to it as a whole. Although it is composed of trees, the forest is far more that a collection of trees standing in one place. It has a population of animals and plants peculiar to itself, a soil largely of its own making, and a climate different in many ways from that of the open country.

He goes on to tally the many uses the forest provides to a progressive social and economic life from water to timber to fuel. Then says,

> The forest is as beautiful as it is useful….No one can really know the forest without feeling the gentle influence of one of the kindliest and strongest parts of nature. From every point of view it is one of the most helpful friends of man. Perhaps no other natural agent has done so much for the human race and has been so recklessly used and so little understood.

The tropical forest ecosystems see something of their future in the older urban forests in the United States. Here we see a landscape that is part wilderness, part playground, part community neighborhood, part recreation expressions, part large and dying trees with no understory and a necessary and imposed trend of poor management for both beauty and human benefit. This reflects the fact that conservation agencies are usually the first agency to have funds cut and the last to have funds restored. It is also a confused vision of what these spaces should be. Clearly these systems have been more the domain of horticulture (or the management of single trees) and recreation or tourism planners rather than one of ecosystem management. A consequence of neglect and despair mixes with great love and changing values brought by new migrant populations at the edges and within these forests.

For the essayist trying to understand and report on the future of tropical ecosystems these urban ecosystems provide a forward moving frame where an ever increasing human population with ever expanding expectations rests upon a very finite land base. The fluttering plastic bags caught in debris in a stream in rural Indonesia or Peru find an empirical base for tracking the meaning of future tropical systems with their cousins found in temperate urban ecosystems. These are not scientific proofs but rather metaphors that extend beyond the reach of science. The essayist's systematic method is the weaving of metaphors that give structure and process to a seemingly confounding richness of data.

Paul Ehrlich's wonderful book on "Human Natures, Genes, Cultures, and The Human Prospect" (2000:45) notes:

> We know why biodiversity is disappearing—the primary reason is that homo sapiens is destroying natural habitats, and our capability of so doing…is largely due to our cultural evolution. Knowing how a vast array of species, including our own, evolved and how these species shaped one another and their environments may help us to staunch the flow of extinction and even to regenerate some of our lost biological heritage.

The novelist, Cathleen Shine (1999:196) takes these ideas of evolution to a more personal level. She has her central

character, Jane, pondering the characteristics of her own evolution and that of her relationship with her long time friend while on a trip in the Galapagos that includes a visit to the Darwin research center. She says to her friend, Martha:

> The research center was a touching, deeply human place. I, of course, saw it as a metaphor for all human endeavor. Martha, of course, objected strenuously to such an interpretation. But what else can you say about a place in which people devote their lives to breeding endangered tortoises other people have spent centuries endangering?...There was a slide show in the visitors' center about the threat of feral dogs to baby iguanas and the threat of feral goats and donkeys to the vegetation the tortoises needed to survive. Mrs. Tommaso was visibly distressed by this presentation. 'the poor'…she stopped, unable to decide which species to worry about first—the iguanas? the dogs? And those sweet-looking donkeys!—stunned by cognitive dissonance as by an electric shock.

We need these different angles of vision if we hope to understand and to work with the eternal complexity of ecosystems. When we first began our work in Baltimore we sought out a local artist who might work with us to both direct and to monitor our work. We were lucky to find Stephie Graham, a photographic artist, who became more and more enthusiastic with her mission and gave us both hope and deeper understanding about our work. She saw the enchantment and the despair and why we could replace some of the latter with much of the former. By the third year of our work in the neighborhoods she had enough material where we hosted in the Mayor's administrative building foyer her photos of our interns and the kids from the neighborhoods and projects. We found money for transport and brought the kids and parents to this showing. The mayor even appeared and shook hands. Reflections upon reflections that gave purpose and meaning to our data and our work and gave the kids and their families a great sense of real worth. We were not chopping up the system but were part of it.

I think such a vision nicely fits the next cycle of the TRI legend.

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Appendix 1. TRI Advisory Board

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I. COMMUNITIES & CONSUMPTION

Of Ants and Tigers: Indigenous Politics Regarding Oil Concessions in the Peruvian Amazon – The First Year of "PUINAMUDT"

Lauren Baker, Ph.D. Candidate

Abstract

In this article, I analyze the first year of a nascent indigenous movement in the northeast Peruvian Amazon that adopted the name PUINAMUDT – "Amazonian Indigenous Peoples United in Defense of their Territories." While the movement's goal to defend territories was broad, their primary focus was to raise awareness and seek political action to address detrimental social and environmental impacts from 40 years of oil operations in the region. Drawing on indigenous metaphors about the power of ants, I critically analyze the strengths and limitations of increased efforts at regional unity and state-focused advocacy. On the one hand, increased unity has been successful in achieving increased state and media attention to indigenous concerns with oil concessions. However, advocacy efforts are also hindered by a "politics of truth" that questions and contests indigenous assertions about environmental and social impacts from oil. Despite limitations, indigenous advocacy and indigenous narratives about how ants can claim victory over tigers are potentially significant in and of themselves for the ways that they point to different forms and expectations of power relations and political leverage.

Introduction

In June 2010 a 500 barrel oil spill slicked down a large stretch of the Marañón River in the northeast Peruvian Amazon, staining the shores and waters of more than 40 communities along the way. In October 2011, indigenous leaders representing many of these communities gathered at the annual Congress of the Cocama indigenous federation ACODECOSPAT (the Cocama Association for Development and Conservation San Pablo de Tipishca) to discuss the status of a legal complaint they collectively filed earlier in the year in regards to the 2010 spill, as well as to set the federation's agenda for the following year.

It was in this context that the communal president from the town of Tarapaca presented a story about ants and tigers. In this story, a tiger sat down directly on the nest of the *Isula* (a large species of ant that is known

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for its painful bite) to eat a meal, and was bitten by the *Isula*, after which he ran around, yelping in pain. After realizing he had been bitten by an ant, the tiger got very angry and declared war on the ants. The *Isula*, the king of the ants, agreed to the battle and they both left to gather their forces—the tiger gathered the animals on his side, and the *Isula* gathered the ants on his side. On the day of the battle the attack call was yelled out, and the animals began to stamp their feet, while the ants crawled up the bodies of the animals and began to thrash around in their noses, eyes, and all of their other openings. Before long, the tiger yelled out that they surrender, and he and the other animals ran away. Thus, the ants were triumphant as the winners of the war.

In listening to this David and Goliath story being told, I could not help but wonder if the leader was using the ants and the tiger as an allegory for their own struggles with the Argentinean oil company, PlusPetrol, especially following the aforementioned 2010 oil spill. Sure enough, the communal leader went on to make this connection explicit:

> This is what I wanted to tell you, my brothers—this example of the ant and the tiger. We are launching a fight…against a monster that has a lot of money, that has a lot of power, and is using its power to meddle with all levels of government, in everything—everything that we call big, right? … We are referring to the company, PlusPetrol—we have decided to denounce them for the harms they have committed over 40 years, so you look at them and say, we are little ants in front of them. But if we unite as we are doing today and we begin to strengthen ourselves as we need to do, we will win—we will overcome this situation, this monster that we say has so much power…Just as the ants beat the tiger and his whole army, with all of his power, we too can win.

The metaphor of ants was also raised by the president of the primary national indigenous federation for Amazonian indigenous peoples in Peru, known as AIDESEP—the Interethnic Association for the Development of the Peruvian Rainforest. During a February 2012 meeting of roughly 60 indigenous federation leaders that was held in AIDESEP's Lima office, AIDESEP's president, Alberto Pizango, called the leaders over to share a few words about "operation ant" *(operación hormiga)*. He described how ants, among all animals, have the best capacity for communication—even over humans. Ants, he said, can emit a signal from 15 kilometers away that will call his brothers to his aid, and "there are no broken telephones—all of them go there."

In both stories, the leaders describe ants as tiny and often underestimated, yet having distinct strengths, especially strength in numbers. This suggests that indigenous peoples, similarly, can find strength in the face of seeming invisibility—especially if they join together. This call for unity is not new, but is difficult to achieve among indigenous communities and federations that are located in remote areas of the Peruvian Amazon. That said, there was a surprising upsurge in efforts at unity among indigenous federations in 2011 – 2012 that was important in increasing the visibility of indigenous communities and of indigenous concerns with social and environmental impacts from oil activities in the northeast Peruvian Amazon.

Apart from unity, the strength of the bite of the *Isula* was also key to the ant's victory

over the tiger—it was the pain of the ant bites (as they thrashed around in all of the openings of the animals) rather than the animals stamping their feet that won the war. The question is, if the ants are indigenous peoples in this metaphor, what constitutes the "bite" of indigenous communities, and how much of an effect can indigenous advocacy efforts really have on oil industry policies and practice? In the remainder of this article, I examine both indigenous unity and bite during the first year of advocacy of a regional coordination effort that adopted the name PUINAMUDT: Amazonian Indigenous Peoples United in Defense of their Territories.

The First Year of PUINAMUDT

PUINAMUDT arose in early July 2011 when leaders from nine indigenous federations came together to discuss their thoughts about key threats to their territories and livelihoods, especially the actual or potential social and environmental impacts stemming from oil concessions located in indigenous territories. In order to articulate their key concerns, these leaders drafted a "common agenda" for "Amazonian Indigenous Peoples United in Defense of their Territories," which included demands for recognition and respect of the rights to their territories and resources, respect for indigenous organizations, a rejection of new extractive industry concessions, and the end of legal persecution of their leaders for defending their rights. Leaders of the newly launched coordination effort soon went on to distribute this agenda at the regional and national levels, including at public forums held in Iquitos in July and November 2011 and through meetings with regional and national government officials. Notably, leaders of the movement were able to present the agenda to high-level government officials, including to the Prime Minister, the Vice President, the Minister of the Environment, the Vice-Minister of Energy for the Ministry of Energy and Mines, and a number of congress people during trips to Lima in September 2011, January 2012, and August 2012. As a result of these advocacy efforts, indigenous leaders were able to bring about a Multi-Ministerial Commission and a Congressional working group to examine concerns with oil in Loreto. They were also able to reach an agreement with the regional government of Loreto to fund a series of environmental analyses to test for water contamination resulting from oil activities.

Strengths and Limits of Indigenous Unity and Advocacy

Returning to the metaphor of ants and tigers, what does the first year of activities of PUINAMUDT tell us about indigenous unity and "bite"? A first finding is that unity was important in increasing visibility for indigenous communities and their concerns with oil operations in the northeast Peruvian Amazon. While individual federations had previously conducted advocacy about oil activities in their specific watersheds, this was the first time a concerted effort was undertaken to call attention to impacts across multiple watersheds over a 40-year time span. These efforts at unity seemed to have paid off, as evidenced by their increased traction with government officials at the regional and national levels to examine contamination from oil operations.

On the other hand, a potential limitation of increased unity was that indigenous leaders spent increasing amounts of time outside of their communities and watersheds, and more time in regional and national capitals, some of whom took up primary residence in regional capitals like Iquitos. This tendency

contributed to critiques that were issued by a range of company and government officials that federation leaders do not accurately reflect or represent community views and positions. Many oil company and government representatives instead asserted that, in their experience, communities were generally supportive of oil activities since they brought increased employment and material benefits, and that the most appropriate and legitimate form of engaging with indigenous communities was to communicate and negotiate directly with community members, rather than federation leaders. Federation leaders countered these positions, suggesting that companies were engaging with "divide and conquer" tactics rather than respecting indigenous institutions. This debate and power struggle suggests that unity has its limits when structures of representation are actively contested as illegitimate or irrelevant.

When it came to indigenous "bite," or actions to defend their territories from oil contamination and other threats, it was evident that the leaders of PUINAMUDT focused their advocacy on state institutions. Given that the tiger in the ant and tiger story represented the oil company, it may seem unexpected that indigenous advocacy was directed primarily at the state. However, this approach was strategic in so far as it recognized that the oil companies would not be present in the region without state approval, and that company practices (or malpractices) were shaped by state regulations and oversight (or lack thereof). The focus on the state also reflected the limited advances in actions that were directed at the companies themselves, such as the aforementioned legal complaint about the 2010 oil spill directed at PlusPetrol, which was quickly dismissed by the courts for lack of evidence. A final driver for the focus on the state had to do with the rights-based approach that was frequently employed by indigenous leaders. Indigenous leaders often made their demands in terms of internationally recognized human and indigenous rights, and international law is structured in such a way that it is the responsibility of states, rather than private companies, to recognize and ensure that such rights are respected.

Indigenous state-focused advocacy was also subject to limitations. First, the Multi-Ministerial Commission and Congressional working group were tasked with investigation and recommendations having to do with the oil industry, but had little power to enact policy changes. This is important given the broader political context in which the central government continued to promote oil concessions as a national priority. Additionally, the rights-based claims of indigenous leaders were undermined by state positions that oil operations did not actually have negative social or environmental impacts. For example, many government representatives suggested that contamination was minimal or non-existent and that the few oil spills that did exist were generally attributable to vandalism by the indigenous communities themselves, as opposed to negligence or degraded pipelines. This litany of arguments served to marginalize and minimize indigenous assertions about contamination and rights violations, impeded broader recognition that a problem exists, and ultimately limited the possibilities for meaningful social and political change.

Conclusion

The first year of PUINAMUDT reveals that, in addition to forging a higher degree of unity than ever before when it came to the issue of oil, indigenous leaders were also faced with the difficult task of attaining official acknowledgement that oil operations

Photograph 1. *Indigenous leaders heading up a public march in Iquitos in November 2011 to protest oil contamination in Loreto. Banner text reads* "40 years of oil exploitation in Loreto. Wonder of the world—thanks to the blood of indigenous peoples. Indigenous peoples united in defense of their territories."

were in fact negatively impacting the environment and their communities. Put another way, indigenous leaders were forced to engage in a "politics of truth" (Foucault 1980: 133)—to declare their assertions about the social and environmental impacts from oil operations as the actual truth in the face of alternative narratives being fore-fronted by government and company officials that oil operations did not harm the environment and greatly benefited indigenous communities. Along these lines, during meetings in Lima, indigenous leaders frequently demanded that government officials visit the zone to verify the harms and see "who's really lying" about the impacts. Furthermore, in the face of continued government assertions that oil brings development, indigenous leaders like Alfonso Lopez Tejada have countered, saying that

> We have had 40 years of extraction in our territories—but if this is development we want you to show us even one community that is developed. We have problems with education, with health care. For us oil has not signified development—it has signified abuse, sickness, and death.

While Peruvian government officials and the broader public ponder which assertions

they consider to be closer to the truth, oil companies continue to forge onward with exploration and extraction in the over 70% of the Peruvian Amazon that is currently superimposed with oil concessions. Meanwhile, indigenous peoples continue to take the lead of ants as they seek alternative forms and definitions of power that may be held not only by the tigers of the Amazon, but also by the seemingly diminutive underdogs.

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Non-profit Perspectives on "Food Security with Sovereignty" in Cochabamba, Bolivia

Erin Beasley, MEM 2014

Abstract

International narratives commonly position food sovereignty as an alternative framework to food security in the context of agricultural development. This paper examines the ways that non-profit organizations (NPOs) in Cochabamba, Bolivia, perceive their projects in terms of international narratives around food security and food sovereignty. While food security is often simplified to mean "the ability to eat," food sovereignty in Bolivia has taken on a common meaning of "national food independence." While neither of these simplifications fully represents the distributional concerns of either framework, NPOs continue to work to increase food access and access to information and political and financial resources to address local obstacles to farming. My analysis of institutional publications and key-informant interviews indicates that agricultural NPOs in Cochabamba identify differing values of these two frameworks for their projects, but most often discuss "food sovereignty" and "food security" as complementary and related terms.

Positioning Food Sovereignty as an Alternative Framework

Literature on food sovereignty describes the term as a political response to the inadequacy of food security policies to ensure equity, control, and self-determination within rural food systems around the world (Schanbacher 2010, Boyer 2010, Patel 2009, Chappelle et al. 2013, Rosset 2003, Wittman 2010). Food security was originally presented by the United Nations Food and Agriculture Organization (FAO) in 1975 as "the availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO 2002). Continued global issues of undernourishment, distributional inequity of production, and exploitation of labor and natural systems for agricultural production caused farmers, activists, and academics to question the effectiveness of the food security approach. Using these shortcomings as the starting point for discussion, food sovereignty is frequently raised as an alternative framework to food security (Patel 2012, Perfecto et al. 2009:207, Altieri 2009).

The development of food sovereignty as an "alternative" was raised by La Via Campesina's international alliance of peasant farmers, the Movimento Sem Terra (MST) landless farmer movement in Brazil (Navarro 2002, Altieri 2009), as well as other international activists and scholars. Food sovereignty advocates emphasize improved control of resources by local residents through demo-

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cratic participation, especially by farmers' groups. The collectivist discourse developed by La Via Campesina is what Rosset and Torres (2013:6) describe as a *"diálogo de saberes,"* an "emergent" response to the inadequacy of the food security approach. It is an acknowledgement of shared obstacles faced by marginalized groups across international borders. From that mobilizing political process, a more extensive definition took form at the 2007 International Forum for Food Sovereignty, where food sovereignty was defined collectively in the Nyéléni Declaration as

> The right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations…. Food sovereignty prioritizes local and national economies and markets and empowers peasant and family farmer-driven agriculture. (Via Campesina 2007)

This marked a shift from earlier definitions of food sovereignty that drew on entitlements and responsibilities of the state (Via Campesina 1996 in Menezes 2001:30) to a focus on food producers and consumers. Patel (2009) critiques the statement for including everyone, but in some sense, its inclusivity supports a call for civic engagement against consolidation of power in food systems. The Nyéléni Declaration emphasizes local self-determination and avoids placing the state as ultimate arbiter.

As food sovereignty discourse gained political traction in Latin America, countries including Peru, Ecuador, and Bolivia reasserted the state's role as the central institution responsible for ensuring food sovereignty (Dávalos-Saravia 2013:7, OAS 2012). An uncertainty remains, however, as to whether food sovereignty will focus on sub-national determination of local food production or national-level independence. These two trajectories will not only affect producers, but also the social space in which NPOs can support small farmers.

Policies of "Food Security with Sovereignty" in the Plurinational State of Bolivia

In the midst of a polarizing global debate between food security and sovereignty, the Plurinational State of Bolivia specifically incorporated both tenets in the country's national policies. In 2006, "food sovereignty and security" was included in the country's National Development Plan, and expanded further in 2008 with the approval of the Food Sovereignty and Security Plan (Dávalos-Saravia 2013). Legislative recognition of "food security with sovereignty" came in 2012 with the passage of Law No. 144: Agricultural and Community Revolution[1] (Ley 144 de la revolución productiva y comunitaria) and Law of Mother Earth[2] (Ley de la madre tierra). Approval of these laws made Bolivia one of the first countries to recognize food sovereignty in national policy.

The political context of Bolivia is helpful in understanding why the state would embrace two seemingly opposed terms as part of national policy. First, the food security framework continues to have policy relevance: Bolivia is consistently considered the most food insecure country in South America; 27% of children under five are undernourished (Coa and Ochoa 2009:213). Even with the emergence of food sovereignty

as a policy alternative, it does not specifically establish a right to food (Schmidhuber and Tubiello 2007:19703), an issue which is of interest not only to Bolivians, but also central to the mission of the dozens of international aid organizations operating in the country to ensure food access. This simplified representation of food security as "access to food" keeps the term relevant to Bolivian policy.

The addition of food sovereignty principles into national policy occurred through participation of civil society and non-profit organizations, particularly after the 2006 election of the MAS (Movimiento al Socialismo) political party (Dávalos-Saravia 2013:3). From that process, several priorities for agriculture were included in the country's Development Plan: "Improve land tenure and access; Change land use patterns to create more rural equity, decrease poverty, and conserve natural renewable resources; Expand irrigation as the primary "input" for agriculture" (ibid.: 9) These priorities address control of land and production processes through democratic means—basic principles of La Via Campesina's food sovereignty discourse. Such policy narratives aligned with the political platform of the MAS party, and also with academics, practitioners, and civil society advocates who promoted development alternatives through agroecology,[3] decentralization,[4] and revaluation of indigeneity and indigenous ways of knowing.[5] Such narratives for alternative agricultural policies often evolve from an articulation with farmers, researchers, and activists (Bebbington 2004, Zimmerer 1993, Gudeman and Rivera 1990).

National politics around state sovereignty influenced the country's notions of food sovereignty, in addition to civil society participation. After President Evo Morales' election in 2005, the national government built its political platform around state sovereignty, specifically from foreign extraction and finance. Morales nationalized private oil and gas companies operating in the country in a move to establish state control over natural resource wealth and to use revenues to fund social programs (Rochlin 2007:1330). Such sovereignty narratives minimized extra-national claims to resources and reinforced the state's authority to retain control over the rule-setting process. The governmental connection between national independence and food sovereignty is reflected in an explanation by Cochabamba's legislative assembly: "Within the agricultural economic policy that [Bolivia] is advancing, one of the principal goals is to achieve food independence, in other words, all of the food eaten by Bolivians should be produced in the country as a way of not depending on other nations" (Brigada de Asambleístas de Cochabamba 2013). This simplified governmental perspective represents a different definition than both international and local farmers groups, but it parallels national narratives of self-determination. The government narrative around food sovereignty places the locus of control with the national government, prioritizing national consumption needs over localized trade advantages that might take food to higher-paying international buyers.

Food Security and Sovereignty Narratives Within the Non-profit Sector

In 2013, I held key-informant interviews with directors and administrators of thirteen non-profit organizations in Cochabamba, Bolivia, working to support smallholder farmers. I also collected information from visits to project sites, published materials, and public events. The organizations included foundations, non-governmental organizations, research institutes, and one civil society group. All had their primary office in

Cochabamba. Some of the organizations had been operating for decades, while other groups were just starting to do projects and workshops. While respondents reflected on multiple themes across the NPO sector, the remainder of the article will focus on stated perceptions of "food sovereignty" and "food security" in the context of their organizations.

Similar to the national policy, which was informed by civil society groups and non-profits, most institutional respondents discussed sovereignty as an *addition* to food security in terms of their programmatic goals. None of the respondents focused solely on food security, but the simplification of food security as "food access" was ubiquitous. A common response indicated general acceptance of both ideas:

> To me, they're two terms with a lot of propaganda. Sovereignty means that everything that a person eats comes from their country. For food security, it doesn't matter where it comes from, but I have to eat something. You could say that in our projects, we're aiming for both of these things at the same time—sovereignty in the sense that you decide your diet, that what you eat is clean, and security in the sense that you eat.

A smaller group of respondents recognized both concepts, with a preference towards sovereignty, as reflected in the response below from another non-profit director. Here the director uses the combined term "sovereignty with security" in reference to revaluing local cultivation practices. However, he goes on to mention additional projects only related to food sovereignty.

> Right now, we're focusing more on the theme of sovereignty, sovereignty with food security, and mostly on the topic of vegetables…[we want to help] to revalue methods, and forms of production at the community or individual level… we developed informational workshops to see what the negative effects of monocultures were, in terms of deterioration of the soil and people's diets. That is, sovereignty more than food security.

Here, sovereignty refers not only to diet, but the conditions of the soil and cultivation that influence dietary outcomes. This comment references meanings of food sovereignty beyond the simplification of "food independence" found in the public sector. For other organizations, comments on food sovereignty are used to invoke distributional aspects of the food system such as the agrarian reforms and political gains of the landless farmers' movement (MST) in Brazil. Another NPO director saw food sovereignty as a way to justify national laws that place controls on corporate-owned agriculture and genetically modified crops. Others used the term to encourage increased adoption of modern farming technologies for domestic food production (rather than export markets).

The director of an organization with a long history of developing projects with communities describes the collaboration with 18 other organizations to develop projects around food sovereignty:

> There are four project areas, all under the theme of food sovereignty. The solution [of the project] was to increase their [agricultural] production—improve and increase production of potato and wheat, which are currently the two highest-value

> crops in that region, and to increase the production and conservation of quinoa and amaranth in the region. Those aren't their main crops, but they already grow them there. At the same time, there are family gardens under the theme of food security and sovereignty. Within the family gardens, in the project plans they also established school gardens in two of the three communities.

In this case, the projects around food sovereignty include improved and increased production of wheat, potato, amaranth, and quinoa. In the context of this conversation, I understood the increased production to be for in-country consumption. Initiatives around home and school gardens were characterized under the combined term of "food sovereignty and security," indicating that these projects provided food and increased control over local nutrition.

Conclusions

Far from oppositional, national policy and local implementation of food sovereignty and food security take on complementary forms among NPO practitioners in Cochabamba, Bolivia. At the national level, neither food security nor food sovereignty are endogenous policies: they are both actively debated concepts, implemented in a hybridized, dynamic political context. The interaction of international food policy frameworks within national politics resulted in the simplification of two policy ideas (food sovereignty and security) that originally manifested concerns for equity, but the NPO sector ultimately expressed more nuanced equity issues under the theme of "food sovereignty," while their perception of food security remained focused on "having food to eat."

While there is not a significant peasant movement rallying around food sovereignty in Cochabamba today, it would be incorrect to assume that the issue is being ignored. In some sense, many of the mobilizing ideas of food sovereignty in this region have already been fought and institutionalized, both in the recent past and during longer-term historical struggles for agrarian land reform and political representation of rural and indigenous groups. The ideas are also institutionalized through the work of NPOs, who contract their services to local communities, creating an evolving demand for projects based on national politics, international discourse, and local realities. NPOs both influence and respond to those demands with diverse technical services, advocacy, and articulation with international discourse around food policy. In that sense, sovereignty issues are woven into the very fabric of Bolivian culture and politics. As long as the space for democratic participation remains open, NPOs and communities will continue to negotiate and reinterpret the practical meanings of food sovereignty and food security in this region to include values-based concerns of food production.

Endnotes

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2. Plurinational State of Bolivia. 26 June 2011. Law No. 144 "Ley de la revolucion productiva comunitaria agropecuaria." Accessible from http://www.gacetaoficialdebolivia.gob.bo/normas/buscar/144
3. AGRUCO (the Agroecology University of Cochabamba) was formally established in 1985, indicating the institutionalization of

agroecology and promoting research using an agroecological framework. Today, AGRUCO is an active research institute within the local public university, Universidad Mayor de San Simon.

4. The Ley de Participación, was passed in 1992, creating a process of citizen planning that required funding for development projects to be approved through municipal processes. One of the goals of decentralization was to give communities more self-determination over local development.
5. For further readings on the politics of indigeneity in Bolivia, see Ticona (2010) and Postero (2013).

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Examining Participation and Power Between Local Actors in the Peruvian Andes: Andean Ecosystem Association and the Indigenous Communities of the Vilcanota

Caitlin Doughty, MESc 2014

Abstract

Many of the problems faced by international organizations intending to create conservation and development projects are lack of stakeholder engagement, limited local knowledge, and restricted time. This can be further complicated by donor demands that may or may not align with project goals. Local organizations focused on conservation often have an advantage in creating projects because they understand local power relations, share local discourses, and are involved with communities for extended periods of time. Twenty-one *comunidades campesinas* in the Vilcanota Mountain Range are involved in a local conservation project aimed at protecting the endangered *Polylepis* forests. A local non-governmental organization, Asociación Ecosistemas Andinos (ECOAN), works with these communities to encourage conservation and economic development. In contrast with the failures of international projects, ECOAN has implemented a successful project that has expanded *Polylepis* forests while supporting the development of communities. Community members believe that their relationships with ECOAN, *Polylepis* trees, and the development project have benefited their lives. However, this success is challenged by ECOAN's obligation to translate their work according to donor demands. Data for this project was gathered through interviews with community members, ECOAN staff, and donors, as well as participant observation.

Introduction

The cramped, frigid, concrete community center was transformed into a colorful, warm productive space upon the arrival of Quechua leaders from twelve communities of the Sacred Valley in Peru. Like me, they had left their warm beds before the sunrise to travel by foot, car, and bus to a small town called Pisac in order to participate in a meeting with the local conservation organization, Asociación Ecosistemas Andinos (ECOAN). The purpose of the meeting was to discuss the establishment of a conservation area network between communities. ECOAN staff members facilitated the meeting in the local language, Quechua, but the bulk of the discussion and decision-making came from the community representatives.

Originally from a rural town in Southern California, Caitlin Doughty holds a BA in environmental studies from UC Santa Cruz. Prior to graduate school she advocated for indigenous rights in the Amazon and has focused her studies at F&ES on understanding how to make conservation and development projects better for local people. A Master of Environmental Science graduate, Caitlin will continue to work at the interface between human rights and environmental issues.

Photograph 1. *Community leaders discuss a conservation area network amongst themselves.*

The scene above is just one example of the collaborative relationship I observed between ECOAN and the communities in which they work. The observations were a part of my research, evaluating the ECOAN *Polylepis* conservation project. My evaluation concentrated on the conservation organization's interactions on two fronts: with local communities and with national and international donors. The idea for this research grew out of reading extensive literature on the failures of international conservation and development projects resulting from their inability to understand local power relations and discourses. I argue that as a local organization, ECOAN is better positioned to overcome these difficulties and is able to have a successful project (measured through the amount of forest protected and restored while maintaining a working relationship with communities) as a result of their ability to understand and work with local complexity. At the same time, they are encouraged by their national and international donors to translate their work according to donor demands.

Theoretical Context

There is an extensive literature on why conservation and development projects fail to meet their goals. Cornwall (2003) and Kothari (2001) discuss development projects that view communities as a homogenous unit when in reality these communities have complex social and financial structures as well as varied interests. By failing to address different power dynamics, such as the exclusion of women (Cornwall 2003), projects run the risk of increasing disparities that are already present (Kothari 2001:146). Twyman (2000) and Van der Ploeg (1993) describe how developers' disconnect with local communities increases project failure. Twyman (2000: 330) writes on how communities fear that expressing disapproval of a project will result in a reduction of the benefits directed towards them. Van der Ploeg (2002) argues that developers, assuming they have superior knowledge, displace local knowledge oftentimes to a project's detriment. All four pieces offer insights on why international developers are unable to con-

nect with local communities and thus are limited in their ability to implement a successful project.

David Mosse's work on the ethnography of aid provides a base for understanding the relationship between ECOAN and their donors. Mosse (2004) argues that policy is impacted by development, which is itself organized through complex relationships and the will to maintain them (648-651). At the same time, developers use policy ideas and language to interpret the results of their work (ibid.: 661). Thus, the relationship between developers and those who create policy for developers is a complex mixture of give and take and, in the end, a form of miscommunication (ibid.). Donors are a part of the political interpretation process, influenced by policy in their decision on which projects they fund and how they describe the results of a project (ibid.). For example, Mosse writes that there is a tendency to describe projects as failed or successful without taking into consideration the actual results of the projects (2004: 662). Rather, failure is a result of their inability to successfully articulate themselves within the policy framework (ibid.: 662).

Background

ECOAN was established in 2000 by two Peruvian biologists studying the destruction of *Polyelpis*, a high altitude tree that is home to several endemic bird species. Their studies motivated them to found a conservation organization and work with over twenty *comunidades campesinas* (peasant communities) in the Vilcanota Mountain Range outside of Cusco on restoring and protecting the endangered *Polyelpis* forest. The *Polyelpis* project includes activities such as yearly tree plantings, developing state recognized conservation areas, and implementing community development initiatives such as solar panel and greenhouse installation. Initially, the project was funded by international donors, including the Inter-American Foundation (IAF) and the American Bird Conservancy (ABC), but is now concentrated through a two million dollar endowment established at the Peruvian-based donor institution, Fondo de las Américas (FONDAM). Financial support for the endowment comes from Conservation International (CI) and FONDAM.

Methodology

For this research, I visited three communities in which ECOAN works: Abra Málaga, Rumira Sondormayo, and Patacancha. These communities were chosen specifically for their differences and relation to ECOAN. Abra Málaga is a remote community without electricity or frequent visits from tourists and has the longest standing relationship with ECOAN. In contrast, Patacancha and Rumira Sondormayo have electricity and receive day visits from tourists multiple times a week. Most of the men have worked in tourism as porters for Machu Picchu treks. Both communities have been a part of the conservation project for ten years. Abra Malaga and Rumira Sondormayo both have legally recognized private conservation areas. Patacancha does not.

I conducted 41 interviews in these communities and carried out participant observation. Additionally, I interviewed all of the ECOAN staff in the Cusco office that work on the *Polyelpis* project (6 people), and employees at ABC (1 person), and FONDOM (3 people). I approached this research as a third-party reviewer, not affiliated with any of the groups involved, but I received logistical support from ECOAN in the form of introductions to communities and permission

to attend meetings.

Findings and Analysis

Hector,[1] one of the biologists from ECOAN, operated the handheld GPS as Alberto, the president of Rumira Sondormayo, indicated where the irrigation line should be placed. Hector showed Alberto how to use the GPS and then listened as Alberto explained why the irrigation line needed to be located in a certain area between four homes. Hector had the technical knowledge while Alberto understood the intricacies of the local social, climactic, and agricultural environment. The scene illustrates the relationship between ECOAN and the communities in which they work. Rather than entering communities under the assumption that they have all of the valuable knowledge, ECOAN focuses on exchanging information.

All of ECOAN's projects depend on local participation for success, measured as the number or area of trees restored and protected while maintaining a collaborative relationship with communities. For example, every year ECOAN holds planting events in the communities. Everyone, from children to women to elders, participates in planting *Polyelpis* seedlings in areas that the community has designated for conservation. Participants receive monetary compensation for their work and it is organized like a traditional group workday known in the region as *faena*. Alberto explains "We get paid 20 soles sometimes 15. It depends on the category; if they are children they get 5 soles." Community members also manage the *Polyelpis* nurseries and any benefit programs funded by ECOAN. During my stay in Patacancha, I worked alongside community members on an ECOAN irrigation project that was co-managed by community members and ECOAN employees. Hector, of ECOAN, wanted to make the relationship clear to me, stating "We will not start a project unless there is local leadership . . . it is their project so they need to help do the work." The inclusion of communities helps create a feeling of ownership.

In addition to including local knowledge and leadership in their projects, ECOAN understands local political dynamics. This is due to two main factors: (1) ECOAN staff members are from nearby Andean communities and thus speak the local language, Quechua, and understand local community dynamics, and (2) they have been working in a majority of the communities for over ten years and are well known and trusted. One example is with women. Though women are invited to all of the meetings, attendance is minimal. Over lunch, the ECOAN Project Coordinator and Administrator explained that though women do not come to the meetings, they have a significant influence on decision-making. This is because men consult their wives at home after which a decision is finalized. Though this is not the case in all households, it was a process that I was able to observe while staying with families. While an outsider may see the women as disempowered, ECOAN understands that their participation is included, if indirectly. When talking to women directly, they informed me that they attend the meetings but do not talk. Victoria of Patacancha said "They [ECOAN] speak and report on the project."

The relationship between ECOAN employees and community members is essential. Of the six employees of the Cusco ECOAN office, three spend a majority of their time in the field. All 41 community interviewees knew at least one of the ECOAN employees by name. Ernesto of Patacancha stated, "First I knew José, afterward Hector and Jorge. They work with ECOAN. They are good people." As the opening scene to

this section illustrates, conversations about ECOAN's work are not one-sided. During an informal conversation, Alberto, the youthful President of Rumira Sondormayo, expressed that the decisions of community members are incorporated into ECOAN's actions and decisions (Alberto, Personal comm., July 4, 2013). He also emphasized that on numerous occasions his community had declined projects (Alberto, Personal comm., July 4, 2013). Unlike the findings of Twyman (2000), Alberto did not express fear of losing benefits due to declining projects. This further demonstrates the collaborative relationship between ECOAN and the communities in which they work.

Though the relationship between ECOAN and communities appeared positive there are difficulties. When ECOAN first entered the communities and told them that they could no longer use *Polyelpis* for firewood and building material, the communities did not immediately listen nor agree. It is only with time that ECOAN has built trust and understanding. Despite the longstanding relationship, it is continually a balancing act between their desire to maintain a strong relationship with communities, conserve trees, and appease donors. In contrast to the relationship with communities, the relationship between ECOAN and FONDAM is still building.

From the ECOAN perspective, the FONDAM process for funding can be frustrating and complicated. José, one of the staff biologists, admitted that he prefers field work to being in the office working on donor paperwork. ECOAN employees expressed that receiving funds from FONDAM is more challenging than it was with ABC and IAF. This is likely a factor of the relatively new relationship between ECOAN and FONDAM.

FONDAM considers ECOAN a relatively new organization without extensive experience in the field. One of the environmental specialists at FONDAM who is the main person of contact with ECOAN, expressed the organization's frustration with the FONDAM process: "I think its previous funders or donors are not as demanding as us." She went on to explain that ECOAN initially had difficulties working with the FONDAM software, processing their applications, and providing the appropriate backup documentation proving their work in the field. FONDAM's Director of Environment discussed how ECOAN has many improvements to make such as relating their work to the market. For him, there "has to be a market, even for social services there is always a market." The Director of Monitoring and Evaluation at FONDAM emphasizes that the work must continue beyond the initial establishment of the project with activities such as surveillance. With ECOAN for example, he asks "once the project is established and functioning, what are the activities that will be done to protect the conservation areas?"

While the relationship between ECOAN and the communities stands in stark contrast to the lessons provided by the literature, the relationship between ECOAN and their donors does not differ greatly from the findings of Mosse's work; there is a breakdown of clear, un-politicized communication (Mosse 2004). ECOAN understands its project in terms of the work it is doing with communities and does not necessarily relate it to some of the data that FONDAM requires. For example, the Director of Monitoring and Evaluation emphasizes that surveillance is needed to ensure that the conservation areas are continually protected. ECOAN monitors their work through continuous interactions with the communities but does not necessarily consider this surveillance. Without explicitly translating their actions into the donor's

terminology, FONDAM may lose some of the significance of ECOAN's work.

This is further complicated by ECOAN's role as an arbiter between donors and communities. One example is the confusion within communities about ECOAN's origin. During an interview, Juan of Patacancha asked, "Which country is ECOAN from?" when I replied Peru, he then wanted clarification, "They are not foreign?" Thus even though ECOAN appears to have a good relationship with community members they are still viewed as outsiders, at least by some. One physical example of a possible area of confusion is the signs ECOAN constructs in communities which include not only ECOAN's logo but also ABC's, CI's, and FONDAM's, none of which have interacted directly with communities.

Development projects are another potential source of contention. With the relationship that ECOAN has established, community members maintain partial ownership over the projects that are conducted in their communities including deciding which projects they are interested in pursuing. Since ECOAN is dependent on FONDAM for *Polylepis* project funds, they must receive approval from FONDAM for these projects. When FONDAM does not approve of a project, ECOAN is forced to communicate to communities that they cannot support the project that the community wants, thus potentially damaging their relationship. During an interview with the ECOAN Project Coordinator and Administrator, this topic arose: "FONDAM does not want to support pasture management and animal handling ... because for them it is not a priority ... for them, the private conservation areas are priority." And while private conservation areas are also ECOAN's priority, they simultaneously understand that community needs also need to be a priority for a project to be successful.

ECOAN is thus caught in the middle of working with both community and donor demands. The relationship between ECOAN and FONDAM is new and building. While FONDAM views ECOAN as a new, young organization, ECOAN views the requirements of FONDAM as unnecessary and strict. Fortunately, FONDAM is patient and ECOAN is willing to learn. Ultimately, ECOAN is learning to translate their work into donor language which has the potential to reduce the time and effort available for project activities in the field. Perhaps once they are able to do this, they will be better positioned to convince FONDAM to fund other community demanded projects.

Conclusions

The ECOAN case study provides an example of the potential for local organizations to overcome challenges faced by international development and conservation agencies. They respect and are able to learn from local knowledge and politics while combining their own technical knowledge. The result is a successful conservation project that includes the expansion of protected areas within communities. The relationship between ECOAN and FONDAM further illustrates how relationships with donors can complicate local projects. This case study should encourage us learn from and support locally organized conservation projects.

Endnote

1. The names of community members, ECOAN staff, and FONDAM staff have been changed for confidentiality.

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Middle-Class Environmental Subjecthoods Around Waste in Chennai, India

Ashwini Srinivasamohan, MESc 2014

Abstract

Over 5,000 tons of waste are generated per day in Chennai—an Indian state capital of over four million residents—which are disposed of in two open refuse dumps. In reaction to the sobering degree of waste generation and (mis)management, pockets of activism are emerging in Chennai with the middle classes playing a significant role. While much scholarship on Indian middle classes has focused on middle-class activism via organizations and associations that invariably disenfranchise the poor (Baviskar 2003, Harris 2011), this paper explores *individual* environmental subject formation around waste among middle classes, and the implications on class and caste dynamics. This paper draws on an ethnographic study conducted in Chennai from May to August 2013. The study focuses on middle-class residents in two neighborhoods, Mylapore and Mayor Ramanathan Chettiar (MRC) Nagar, and is a part of a larger project on the materialities of waste in Chennai.

Introduction

The heat was boring down on the dusty roads of Chennai, an Indian state capital of over four million residents. Ram, an informal waste worker, and I took solace from the relentless sun after having spent the morning collecting recyclables from overflowing dumpsters and curbside "unofficial" dumps.[1] His tricycle cargo rickshaw was stacked neatly with tired burlap sacks bulging with recyclables, which in their previous lives were milk sachets, fizzy soda cans, clinking bottles of spirits. A flea-ridden goat rummaged through plastic bags of wilting food that lay around the dumpster. The noisome stench of refuse wafted toward us. But this dumpster, for all its grittiness and grime, is a source of income for Ram and a visible, politicized point of contestation for the residents of the surrounding gated communities.

It is through such frames of reference, informed by interactions with informal waste workers who are working to reclaim and revalue waste on a daily basis, that I approached the central aim of this study: to understand environmental sensibilities in regards to waste among Chennai middle classes. The middle classes are being slated as responsible for the increased generation of waste, given increased consumption and the correlated industrial patterns of production, but they are also politically active and influential in social and environmental initiatives. Thus, the study asks, how does environmental thought and action around waste manifest among Chennai middle classes? In what

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ways are politics of class and caste embodied within discursive practices around waste among middle classes?

This paper draws on a three-month ethnography conducted in Chennai from May to August 2013, consisting of semi-structured and informal interviews of residents in Mylapore and MRC Nagar, two middle-class neighborhoods. In addition to the middle classes interviewed, the study also draws on interviews of politicians, activists, and informal waste workers, as well as the author's attendance and participation in public forums around waste, informal waste working, and private meetings between local activists and their stakeholders.

This paper is neither a comprehensive analysis of waste environmentalism in Chennai, nor a prescription for resolving the city's perennial crises around waste. Rather, it is an ethnographic invitation to understand the discursive capacities of environmental subject formation around waste among middle classes in Chennai with a focus on recycling and composting practices.

Waste and the Indian Middle Classes

Over 5,000 tons of waste are generated per day in Chennai, distributed between two open refuse dumps in low-income, wetland areas.[2] Given the physical constraints of these dumps to sustain the sheer quantity of garbage, as well as the ongoing political tensions surfacing around low-income residents' health suffering due to the dumps, there is a robust discussion underway on a municipal level on finding technoscientific solutions (e.g., waste-to-energy plants). There are also, through the media and local NGOs, budding efforts to encourage sounder waste management practices (e.g., home composting, engaging informal waste workers) among residents.

The middle classes are of focus here because they are highly influential, not only in a consumer sense, but also culturally and politically. Numerous scholars have acknowledged the difficulty in defining the Indian middle class, not least because of its multitudinous and diverse nature (Fernandes 2006; Nisbett 2007). While consumer analyses of Indian middle class tend to focus on its notable contribution to economic growth (cf. Albett et al. 2007), they elide cultural and political implications of the class. Thus, ethnography is essential to understand the political, economic and social processes that underwrite middle class actions, notably in relation to, but not exclusive to, environmentalism.

One methodological parameter employed in this study was to select informants based on their residence in gated communities, which are representative of a form of residence popular among the Chennai middle classes (an observation based on conversations with real estate developers for a prominent real estate firm, Ceebros). Additionally, as established in other cities of the global south (Caldeira 2000; Low 2001), gates are important physiospatial boundaries that map onto the social hierarchical boundaries; they dictate who comes in and goes out, who (and what) stays in and stays out; what is acceptable outside and what is deemed unruly inside.

Middle Class Environmentalisms

Amita Baviskar (2003) has famously articulated how Indian middle-class *bourgeois environmentalism,* in the form of intraclass alliances with the state, invariably disenfranchises the urban poor that tend to occupy public spheres in the name of creating clean and green public spaces. While this may hold true in Chennai, the present study attempts

to understand more on an individual level the process of subject formation toward an environmental sensibility and the implications on class and caste relations. To this end, it is helpful to consider Arun Agrawal's (2005) study on how Kumaoni Indians' participation in governmental regulatory schemes influences environmental sensibilities; he argues that actions—as opposed to solely values and beliefs—are what drive environmental sensibilities into consciousness. Applying Michel Foucault's (1991[1978]) concept of *governmentality*—where the government exerts influence upon behaviors of the population not through coercion and violence but through systems of power that encourage subjects to govern themselves—to the environment, Agrawal introduces *environmentality* to unpack how "technologies of self and power are involved in the creation of new subjects concerned about the environment" (Agrawal 2005: 166). Below I consider Agrawal's notion of environmental subject self-formation in relation to middle class action and inaction around waste, through the examples of recycling and household composting.

Recycling

While there is no institutionalized recycling in Chennai, the informal recycling economy is robust, which includes the thousands who rummage through street bins and dumps as well as those who run "waste paper marts," where recyclables are monetarily compensated according to weight. The study found the level of participation among middle classes in recycling to be minimal. Most indicated that the compensation is too low—about Rupees 5 (US$0.10) per kilo—or because the act of recycling took too much effort to segregate at the source.

But for those who do practice recycling, it tends to be through the disciplining of their domestic laborers, who are instructed to keep plastics and papers segregated at source and then given the recyclables to sell for their own benefit. Middle class environmental subjecthood is then contingent upon the actions of their domestic laborer, which they presume to be driven by economic motives as well as a sense of obligation to them. The middle classes tend to see this as a favor they do for their domestic laborers: "She [the maid] gets to earn a few extra rupees; so, we help her out like that," said one Mylapore resident. Waste for the middle classes is a form of currency and a means of disciplining the domestic laborers, to not only ensure that they effectively render waste invisible from within the private quarters but also that they engage in practices not directly stated in their professional agreement, such as selling the household recyclables.

Bharat, an elderly man in a Mylapore gated community, explained to me that he and his wife "help her [their maid] here and there, giving her leftover food, so we expect she'll throw the garbage away properly, sell these things for money." The expectation that the domestic laborer be compliant is thus both about a sense that they are obligated to the employer in nonfinancial ways, but also that they must invariably be drawn to any source of additional income as menial as it may be. However, I discovered through conversations with domestic laborers in these households that they traded in the recyclables for money—but only if significant enough in value. Light-weight items they just dispose of in the trash. Thus, there is a fundamental disconnect between the middle-class expectation of the domestic laborer's engagement in recycling and what is actually happening, because of an assumption that those of lower class are a) indiscriminately motivated by their impoverished state and b) that they feel a sense of obligation to the

middle classes as their employers. Regardless, the middle classes are attempting to articulate a sense of environmental subjecthood that relies on the actions of their domestic laborer, bringing to bear the extension of interclass relations into environmental praxis.

Household Composting

Insofar as the middle classes are articulating environmental behavior around recycling by "conducting conduct" of their domestic laborers, the middle classes are also disciplining themselves—through household composting. As Gay Hawkins observes, "Waste captures the attention not simply of those in desperate need but also those able to imagine different uses" (2006:74). This creative zeal to *transform* the wasted into something productive is evident among the middle classes in Chennai, seen in the gravitation toward developing home composting initiatives (c.f. Anantharaman 2014). In contrast to recycling through domestic laborers, composting offers middle classes the opportunity to be in control of the waste, and to participate in the process of its revaluation. However, even in the process of disciplining themselves into being environmental subjects, the middle classes are also disciplining those around them in more direct contact with waste (e.g., domestic laborers, gardeners, gatekeepers).

Priya, a housewife and trained engineer, started composting in her MRC Nagar gated community a few years ago. In response to her mother's complaints regarding Priya working closely with waste, she employed the community's gardener to haul the organic matter and turn the compost. "But it was also because of the waste itself," Priya explained. "Waste is for the maids, not the homemakers." The physical stuff of waste thus is a reification of a class and caste divide—certain people are designated in society to deal with waste—but is also one that is being challenged by the emergence of household composting among middle classes.

Priya, like other middle class residents in both Mylapore and MRC Nagar who have started composting, has disciplined herself into an environmental subject around organic waste. Also implicated in the process of composting is disciplining those who *already* work closely with waste, similar to the practice of recycling via domestic laborers. In Priya's case, the maid—who keeps the compostables separate—and her gardener—who transports and turns the compost—are, significantly, a part of the process that requires the most physical contact with the stuff of waste. Thus, even within middle-class environmental sensibilities toward self-initiated composting is present a concatenation of power relations that reproduce and challenge the politics of deeply-entrenched caste and class divisions.

Conclusion

To explore emergent forms of environmentalism among middle classes, this paper has studied two modalities of knowledge and praxis around waste among middle classes with a focus on the private, household sphere: recycling and self-initiated composting. The paper has shown that middle-class narratives around recycling indicate deeper-seated interests in educating their domestic laborers to be environmental subjects on their behalf. With household composting initiatives, there is a gravitation toward closer contact with waste but still appears to be an asymptotic relationship because of a continued deferral to the caste system which implicitly sanctions that those of lower caste are somehow responsible for the management of waste. This paper has provided a snapshot of

the environmental practices around waste in the middle class, and is part of a larger project on materialities of waste in Chennai. Further empirical and ethnographic research is necessary to elucidate both underlying cultural and political processes shaping the phenomena observed here, but also to cast light upon other emergent forms of environmental praxis around waste among Chennai middle classes.

Endnotes

1. Informal waste workers, also known as "scavengers" or "ragpickers," refer to individuals who reclaim recyclable materials from dumpsters, as in this case, or at refuse dumps, as well as those individuals that run or work at "waste paper marts," establishments at which individuals can exchange recyclables for money, by weight.
2. Waste is defined in this study using Vinay Gidwani and Rajayasree Reddy's (2011) framework: "[Waste] is a mobile description of that which has been cast out or judged superfluous in a particular space-time. *It is a technical and political artifact that gathers force in its performativity*" (2011: 1649). Waste is a social being, following Arjun Appadurai's (1988) concept of how goods, things, "stuff," are vessels by which states, individuals, and NGOs articulate identity, negotiate power, and influence the cultural production of urban space. As Joshua Reno (2009) has articulated, this study approaches trash as an artifact with deeply-imbricated political, economic, and cultural processes that influence notions of personhood and social relations.

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II. CLIMATE & ENERGY

Negotiating Access: The Social Process of Liquefied Petroleum Gas (LPG) Cookstove Dissemination Intervention in Himachal Pradesh, India

Yiting Wang, MESc 2014

Abstract

For decades, governments and aid agencies have disseminated millions of improved cooking devices and fuels to address a variety of environmental, health, and livelihood issues in the developing world. This paper is an ethnographic case study of a liquefied petroleum gas (LPG) cookstove intervention by a community-based organization, Jagriti, to disseminate LPGs to hill women in the Indian state of Himachal Pradesh. I conducted a combination of household surveys, participant observation, and semi-structured interviews with villagers, Jagriti's director, and local gas agencies managers. The undirected diffusion of LPG made its way along the webs of caste delineations, income levels, and the social networks of field promoters. I argue that removing barriers of access for the poorest of the poor is a negotiated and contested social process. Despite Jagriti's efforts to enhance access to LPG, realizing the full extent of its benefits depends on fundamental improvement of the gas delivery infrastructure and socio-economic conditions of the marginalized.

Introduction

For more than 10 years, a Tempo truck has carried cylinders of liquefied petroleum gas (LPG) to villages in Lag Valley in the Indian Himalayan state of Himachal Pradesh. Usually on the 16th and 30th of the month, the truck drops off refilled gas cylinders at roadside shops and picks up empty ones. Villagers hike up or down for as much as 30 minutes to retrieve the full bottle and pay the shop owners a 20-rupee handling fee. More than 600 households were customers of the gas distribution agency in Kullu town by July 2013.[1]

The initial spread of LPG cookstoves in Lag Valley was largely the result of efforts by a community-based organization called Jagriti ("awakening" in Hindi), based in Kullu town. In this article, I use an ethnographic case study of Jagriti's program to detail the processes of dissemination and adoption of LPG and the challenges of maintaining sus-

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tained use. I highlight how the diffusion of LPG during its initial and undirected stage made its way along the webs of caste delineations, income levels, and the social networks of the field agents themselves. I show how access to and enjoyment of modern energy services are a much-negotiated social process.

Research Method

From June to August 2013, I carried out a combination of household surveys (n=38) and ethnographic research. This involved semi-structured individual and focus group interviews, and participant observations in eight villages in the Lag Valley and in Jagriti's office.[2] About 90% of the surveyed villagers established LPG connections and acquired LPG stoves through their membership in women's saving and credit groups (WCSGs), created and supported by Jagriti.[3] The story of the initial process of stove diffusion is reconstructed through the accounts of Mamta Chandar, Jagriti's director, the village women, and the gas agency managers.

Negotiating Barriers

Access to clean and reliable energy service is fundamental to sustainable development (Ailawadi and Bhattacharyya 2006, Pachauri et al. 2012). Smith et al. find that LPG "reliably produces much lower air pollution" and "emits far less" greenhouse gas than kerosene and poorly combusted and non-renewable solid biomass (2005: 21). The common definition of 'access' includes both physical access to fuel and equipment, and real access in terms of the household purchasing power, the cost of fuel and equip-equipment, and access to a fully functioning energy market (Pachauri and Spreng 2004). In this article, I will show that this definition of 'access' stops short of capturing the dynamic socio-political barriers that determine who can fully enjoy the benefits of the service.

Jagriti's mission is to empower the "poor, disadvantaged hill women."[4] In 2000, it launched an initiative to reduce women's drudgery by promoting energy-efficient cooking devices. One of the programs was to encourage the adoption of LPG cookstoves to replace the traditional biomass burning stoves. According to Mamta, the reasons for choosing LPG were manifold: "It is cleaner, easy to operate, better for health and above all is, and was at that time, a social status symbol." Sleek aluminum LPG stoves with knobs to turn on and off the fire stand in clear contrast with the prevailing traditional stoves (*chulha* in Hindi) that are made of mud, stone or metal tripod (Figure 1). Another common stove used for heating and cooking is the tandoor stove made as a metal box with a built-in smoke pipe.

The hurdles to LPG adoption are multifaceted, too. While state-owned oil companies supply LPG from both domestic production and import, the distribution network is a hybrid of public and private players. The government contracts private dealers to run the gas agencies, who are then responsible for establishing LPG connections and delivering cylinders to end-users. Little incentive exists for gas agencies to extend delivery into rural areas where demand for LPG is low and overhead costs are high (D'Sa and Murthy 2004). Although structural disadvantage continues to exist, rural LPG connection is increasing slowly (ibid.). In Himachal, the percentage of LPG-dependent rural households increased from 21.8% in 2001 to 32.7% in 2011, while that of firewood-dependent declined from 72.2% to 64% (Census of India 2011).

Figure 1. *Note the LPG stove and the red gas cylinder in the upper two photos, as well as the tradition metal tripod stove (left) and the tandoor stove (right) in the same kitchen. The cylinder was stored in the cabinet in the lower right photo. The woman on the lower left photo preferred cooking the thick* bhatura *bread on her mud* chulha*, even though she too had a LPG stove.*

The standard application process for an LPG connection is quite burdensome. According to gas managers in Kullu and the neighboring town of Bhundar, the process consists of the following steps:[5] First, the aspiring LPG user comes to the gas agency to fill out an application form, bringing with her one form of proof of residence (e.g., ration card, electricity bill), and one form of ID. She then goes to the post office to get a date stamp on a letter issued by the gas agency, officially confirming her applicant status. Then she goes to the district court for an affidavit—a customer declaration sanctioned by the court stating that the resident does not have a second gas connection in the house.[6]

After the application is approved, the woman receives an LPG registration card and pays 1450 rupees ($24 USD) as a security deposit for the first cylinder. For households below the poverty line (equivalent of $1.25 USD/day), the fee is reduced to 800 rupees.

Normally the agency sells the entire package for 4000 rupees ($65 USD) including one gas stove, rubber pipe, cylinder regulator, deposit for cylinder, and installation charges. Adding a second cylinder—which allows uninterrupted usage during refills—costs another 1800 rupees ($30 USD). If she already has her own stove, a 200-rupee "check-up" fee is applied in addition to the security deposit. Market price to refill the standard residential 14.5 kg cylinder is around 1000 rupees ($16 USD), compared to 450 rupees with subsidy. In comparison, daily non-agricultural wage in rural Himachal is around 250 rupees.

To overcome some of the hurdles, Mamta convinced the Kullu gas agency to start delivery in Lag Valley, assuring its owner that hundreds of households would sign up through Jagriti's subsidy program. She then negotiated with LPG and pressure cooker dealers to buy stoves in bulk at reduced costs and later arranged delivery into the villages. Mamta also told women to prepare the required documents before she transported them to the agency, which eased the application process significantly for the villagers.

Diffusion of LPG

Dissemination of the information about the LPG subsidy progressed through Jagriti's WCSGs. Jagriti hired "group organizers" (GOs) from among the village women, who typically are from the higher Rajput caste (under the official category of *Other Castes*).[7] Each GO oversees the activities of about 20 WCSGs. GOs are tasked with spreading the information of the LPG program among the WCSGs.

This process of word-of-mouth dissemination of information initially skewed the distribution toward higher castes and wealthier households. During the initial phase, the GOs were mainly reaching out to WCSGs in their own higher caste villages. "It was a big lesson for us that reaching the poor is not easy," recalled Mamta. She attributed the bias to GO's caste affinity. Subsequently, Jagriti installed a new policy to ensure that lower castes (or "Scheduled Castes" in the official term for the 'untouchables') also had the opportunity to buy LPG stoves. Jagriti requested that the women contribute less than half of what the agency would charge for an entire package. It encouraged the groups to lend money to members to purchase stoves. Group lending as a financing mechanism was initially limited since the groups had little savings and members did not have enough trust for each other. Almost all households interviewed paid the package cost without borrowing from the group.

One WCSG leader from a relatively lower caste village shared what happened after the GO told her that her group of 18 members was allocated four slots in 2002:[8]

> We had a meeting to discuss the matter. Most people did not want LPG because they were afraid of explosion and that if they get gas, their ration status might be revoked.[9] Jagriti gave us three days to raise money and you have to fill the forms and prepare the documents. After these processes, some people quit.

This suggests that more political-economic barriers exist even after information has reached the poor. There were also incidents of higher caste women spreading rumors about the danger of the LPG, especially those offered at such low rates, to their lower caste neighbors. Mamta speculated that this was probably a reaction of the higher caste women feeling "left out" because they were not WCSG members. She and the

GOs went into the field frequently to raise awareness, demonstrate how to use LPG properly and safely, and to address confusions (e.g., regarding the ration status).

Challenge of Delivery and Sustained Use

Utilization of LPG remained low despite perceived benefits, mostly due to the high cost and logistical difficulty of refilling gas. The average number of refills for the previous year of the surveyed households was 3.5 cylinders, or 0.6 cylinders per capita.[10] The national average remained around 7 – 8 cylinders per household since 2006 (Ranjan 2012).

LPG cookstove users universally appreciated how fast it cooked and that it did not blacken their dishes, saving them time and effort in fire preparation and pot-scrubbing, compared to traditional stoves. However, LPG usage was selective: mostly to make tea and rice, to a lesser extent daal (the common bean soup), and almost never roti (the Indian bread in almost every meal). These dishes required constant high power, and people were used to the taste of roti made over *chulha* or other wood-fired stoves. Some women said LPG gave roti a bad taste. Furthermore, LPG stoves were used mainly to save time: when the cooks were hurried, hosting guests, or heating up leftovers. This selective usage, according to users, was a means of rationing gas. For them, spending too much disposable income on LPG was not economical when the villagers had fairly stable access to firewood and a large family requiring significant amounts of cooking.

Refilling cylinders was a challenge itself. Users had to drop off their empty cylinders at the shop before the scheduled delivery date, though sometimes they were too busy to be on time. Truck delivery could be delayed for several weeks, according to villagers, while the gas agency explained that delay could be caused by a shortage of supply or bad weather and road conditions. One shop owner once misplaced the women's gas ration cards and stopped offering handling service. A shop could simply be too far. One woman said she went to the gas agency to demand delivery to her village of Baagan, which was a 5-km steep climb from the main road, but the gas agency refused on the grounds of "not enough demand." Most LPG users desired a second cylinder but were not ready to spend more money, especially without subsidy.

Conclusion

Micro practices and processes captured through this ethnographic exercise—aspects that are often neglected in policy formulations—cumulatively affect the poor's access to and enjoyment of modern energy services. Jagriti's intervention to ensure vertical diffusion of a new technology suggests the importance of understanding social stratification. While some see low demand for LPG and high overhead costs as de-incentivizing better gas service, I argue that low demand largely comes from rural residents' sense of inaccessibility. This inaccessibility takes the form of bureaucratic procedures to apply for connection, irregular delivery of refills, precarious arrangements with shop owners, and existing socio-economic inequalities within the rural areas as well as between rural and urban areas. Removing barriers of access for the poorest of the poor is a much negotiated and gradual social process. It requires intentional planning and sustained support to bring the marginalized out of their structural predicament on the part of both government and private development actors.

Endnotes

1. Gas manager of Kullu town, personal communication, 23 July 2013.
2. The majority of the interviewees in Lag Valley were married female. In a few cases, the couple participated in the interview together. The household survey was part of a larger study to measure gender and livelihoods impact of clean cookstoves, commissioned by the Global Alliance for Clean Cookstoves.
3. The rest bought the LPG via official means, did not possess one, or were non-WCSG members.
4. See Jagriti's website http://jagritikullu.org/about.php
5. Managers of gas agencies in the towns of Kullu and Bhundar, personal communication, 23 July 2013 and 26 July 2013, respectively.
6. There are ways to get a second connection under the household if any member is living somewhere else (e.g., husband or children); students studying in town can get a second connection of a 5 kg cylinder.
7. Jagriti had hired several GOs from scheduled caste but they did not stay long.
8. Resident of Lag Valley, personal communication, 27 July 2013.
9. Being in "ration status" means you live below a certain poverty line. People were concerned that if they showed the government they could afford a LPG, they would not receive subsidized rations.
10. On average, the surveyed households had 6 members in one family unit, as determined by who eat in the same kitchen.

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The Local Socio-economic Impacts of Wind Power Development in Northeastern Brazil and the Potential for Conflict or Collaboration Between Developers and Communities

Tom Owens, MEM 2014

Abstract

Brazil is quickly developing a robust wind power sector while concurrently undergoing a historic drought in the northeastern regions. Drought conditions lowered water tables at hydroelectric dam sites, which Brazilians rely on for roughly 80% of their electricity demand. Wind produces peak output during the dry season when dam levels are low. Many communities that might benefit from local wind development are also among the poorest and most vulnerable. Local energy development, however, is often met with skepticism and resistance from local populations. This paper examines two case studies of wind development from Cumbe, in the State of Ceará and Alto Sertão, in the State of Bahia. Most notably, the Brazilian company Renova recently developed Alto Sertão I and II, the largest wind facilities in South America. Renova engages the local community by acquiring land leases for wind tower siting and by creating Catavento, a voluntary 4 million dollar community driven impact fund for local environmental and economic development projects such as herbal laboratories, bee keeping facilities, and a women's yucca collaborative. Renova's community engagement efforts are still in the early stages, but their company model and internal culture may be replicable in other Brazilian communities.

Introduction

In the last five years the Brazilian government has created a swell of support for wind power development by liberalizing markets to welcome developers and manufacturers from India, China, the United States, Spain and elsewhere. New Brazilian companies such as Renova, a renewable energy company are also taking hold and pushing for local energy development. Most of this development is happening in poor northeastern states which have some of the strongest and most consistent winds globally (Rose 2011:1). Brazilian wind farm projects recently produced some of the cheapest electricity prices in markets worldwide. Prices for wind in 2011 even sold below the price of natural gas with the help of a number of gov-

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ernment incentives and a recent auction system for new electricity generating projects such as gas, wind, small and large hydropower (Lacey 2011:1). The country has set goals to build more wind power than the rest of South America combined by 2023 (Martin 2014:1).

Brazil's rise in the renewable energy sector and as an emerging market has demonstrated that strong state and market goals can drive clean energy development. However, Brazil has a long history of land grabs and community displacement around energy projects, especially ethanol and hydropower development. Some local communities have questioned the development and compensation of landowners living near Brazilian wind farms (Brown 2012:3). As a result of the research I conducted in 2012, I asked: how can wind farm development in Brazil break the traditional energy paradigm that can leave local communities less informed, less involved, and disempowered in the decision making process? How can the demands of local citizens and policy makers be met while ensuring this development is truly clean and just for all parties?

Recent History of Wind Development in Brazil

The Brazilian wind development boom has not gone without its fair share of local opposition. The largest wind farm in the Brazilian state of Ceará is in the small fishing village of Cumbe. Some Cumbe residents were initially encouraged by the promise of local jobs, as well as increased local revenue for schools and health care. Others quickly grew skeptical and opposed the initial development by filing litigation and staging road blockades, one of which lasted 21 days (Brown 2012:5). According to Brown's 2009 survey, fifty local Cumbe residents from various backgrounds actively opposed the wind project (ibid.). The remaining 50% of residents were either lukewarm or indifferent towards the development (ibid.). Many cited restricted access to their fishing areas, high dust levels, broken promises of employment and underfunded social projects as their reasons for opposition (Brown 2012:7). This level of community opposition can overwhelm a company's outreach efforts when development moves too quickly without the requisite community meetings and slow buy-in process.

Findings and Analysis: Alto Sertão

In July 2012, I visited Renova's Alto Sertão wind park in the State of Bahia during the park's inaugural month. The site became the largest in all of South America in 2012; it hosted 400 turbines and was large enough to eventually power 540,000 households (Ordóñez 2012:1). The three towns neighboring Alto Sertão are Caetité, Guanambi and Igaporã. Located in the high desert of Central Bahia, they have roughly 150,000 residents combined. The area is home to many farmers, elderly people, and others whose income is dependent on social programs. For many, their land is their sole property (New Economy 2013:1). Many farmers live by subsistence, planting crops and surviving on as little as $168 – $420 USD annually (Ordóñez 2012:1). Local residents said droughts have increased in intensity and duration and the region recorded the driest January in 60 years in 2014 (Sciadone 2014:1). In speaking with one local resident in July 2012, she said they have not seen any measurable rain in a year's time. This has led to low crop yields including yucca or manioc, the primary local staple crops. Yucca yields during 2012 were dwarfed in comparison to

Photograph 1. *Learning about the yucca flour milling process.*

previous years. As droughts increase and climate change encroaches on this desert region, residents are finding it difficult to live on smaller yucca crop yields that are sold for lower market value.

I met with Renova officials in Caetité onsite and in Salvador at their corporate headquarters. Representatives boasted as much about the social development aspects of the wind farm as the energy they produced. Renova developed a voluntary four million dollar annual social investment program named Catavento, which funds local projects in the areas of socioeconomic, cultural, environmental and organizational development (Pers. Comm., 27 July 2012). The company website states, "the intention is to combine efforts and facilitate what has already been diagnosed and organized by the community itself, to materialize the actions more quickly" (Catavento Program 2012). Catavento projects include a "Museum of Archaeology (MASB), a Festival of Performing Arts House, music and theater workshops, professional trainings, recovery and preservation of public drinking water sources, composting, a plan for developing local food and medicinal supply chains, beekeeping facilities, an herbal laboratory, shares of rural entrepreneurship and technical assistance, among others" (ibid.).

Renova representatives remarked that all Catavento programs came directly from ideas within the local community. Representatives said local residents would make demands at town meetings, which the Brazilian government requires for new energy development projects (Pers. Comm., 27 July 2012). At one town forum, a local resident spoke about his concerns over the roughly 500 native medicinal plants in the region that had yet to be categorized and might provide local mar-

Photograph 2. *Farmland with wind towers of Alto Sertão in the background.*

ket opportunities. In response to this demand, Renova hired a naturalist to work with residents to categorize and study the native plants and determine their viability for outside markets (Pers. Comm., 27 July 2012).

In a recent interview, Ney Maron, Sustainability and Communications Director at Renova Energia, said, "Over 300 families benefit from the [wind] leasing policy. We work, literally, in people's backyards" (The New Economy 2013). He explained that once lands are actually leased, families can keep using those areas, earning new income from the rent while continuing to receive the gains they get from plantation or husbandry. By 2008, when the company first arrived in the region, annual income per capita had reached about $1300 USD (ibid.). Two years later, some landholders with areas leased by the company had annual incomes of more than $3400 USD (ibid.:1). This stands in contrast to restrictions around the Cumbe wind facility. Residents there were restricted from accessing their traditional coastal fishing areas.

I met with workers at the nearby women's yucca cooperative who were hard at work in a small room husking their crop. Although the state of Bahia had provided capital to build their facility and provide machinery, government officials stopped visiting as the initial government investment ran out. Through the cooperative, the women recognized that there were kinks in the supply chain that limited them from getting a fair value for processed yucca meal. In the government's absence and through the Catavento program, Renova is injecting capital to allow the women to reach more stable markets and receive just compensation.

I also met with a number of local landowners, all chosen by Renova's staff for short interviews. Renova built new houses for several families since their old ones were too close to the wind towers. These families were very receptive to my visit and showed me through their house room by room. Many appeared very proud of their new homes and spoke of the financial opportunities of receiving $2350 USD annually for each tower on their property. One local landowner is paying for one of his eight children to attend medical school in Salvador through the fund (Ordóñez 2012:1). Another elderly woman I spoke with remarked that her son was initially skeptical of the company's intentions and refused to lease his property. Instead the company changed their siting plans and placed more towers on her property.

In speaking with one of Renova's staff sociologists, he reminded me of the challenges of building support amongst landowners, especially given the size of the wind farm. He seemed to serve as an internal advocate, reminding the company that development "done right" takes due time and proper input from local communities. When asked if other wind development companies have sociologists on staff who understand local dynamics, he shook his head with disappointment. He knew his position with Renova was rare in a country fraught with land disputes. However, he said that collaborative local energy development was challenging given financial and construction deadlines. Brazilian energy contracts require that power producing stations come online by a given deadline or face penalties. In this case, it was contracted to deliver power as of July 1, 2012 (Pers. Comm., 30 July 2012).

Photograph 3. *Family in their new house courtesy of Renova.*

There is often friction and tension when a development as large as Alto Sertão moves into a new region. There are currently five wind companies developing in the local region, all with varying community outreach strategies (Renova Energy, Iberdrola, Polimix, Atlantic, and EPP). Contract research by Gilmar Ferreira dos Santos counters the claim that Renova is a transparent and just corporate citizen (Ferreira dos Santos 2012). He claims that the local residents are largely unaware of the provisions in their leasing contract and are prohibited from seeking independent third party counsel (ibid.). The seventh clause of Renova's landowner contracts states that if you wish to rescind, you will be subject to a fine of roughly one million USD and be forced to pay for the cost of each tower on your land. Turbines are also located in common use zones, which he fears could limit future cattle grazing and farming near the turbines. In the village of Brejo dos Padres in the municipality of Morrinhos Guanambi, residents claim that Renova destroyed an archeological site during construction and withdrew excess water resources in the drought region (ibid.:1). The shortage of water resources will continue to be one of the greatest challenges to the region.

Conclusion

There are many illuminating lessons and questions from Renova's development in the Alto Sertão region. Sustainable energy development must be led with community interests at the core. Transparent processes and public forums help residents have a voice in the process. Brazilian state laws mandate that public forums be held to address development concerns and that owners on wind tower properties be duly compensated if their land is legally titled. However, as evidenced by the Cumbe case, local concerns can be easily glossed over when development is on the fast track. The Catavento program, despite the relatively small size of the impact fund, is an experiment in bridging local voices together with developers through the prospect of enhanced economic opportunities. This program is kept in check by local "born and bred" development teams who work directly with residents and trained social scientists that help develop collaborative processes. This helps deliver the concerns of community members to the internal company decision-making process. It is doubtful, however, that all of these concerns can be addressed in the face of tight project development deadlines.

Finally, the Catavento program is intended to fund social and economic programs through several rounds over the lifetime of the wind farm. Residents can rely on the prospect of several rounds of Catavento funding as they face the financial challenges of growing a business, building supply chains, and attracting visitors to the region. However, Brazil is going through several years of weak financial performance and is struggling to attract foreign investment for capital-intensive energy projects. In the future, it may be difficult for a growing company such as Renova to develop timelines that allow for maximum community input and set aside capital for local projects.

This research relied heavily on the voices of Renova and chosen community members from their ally groups and in no way encompasses the voices of those affected by Alto Sertão. More research that engages other key stakeholders might better encapsulate the challenges and opportunities found here. Regardless, Renova's receptivity to local demands and its collaborative funding process bring some hope to the area. The community will need more than just clean energy to

combat increased droughts and unstable crop yields in the future.

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Land-Use Planning for Climate Change? Subnational Case Studies from Brazil and Indonesia

Rauf Prasodjo, MEM 2014

Abstract

Ambitious national greenhouse gas emission (GHG) reduction targets were made by both Brazil and Indonesia in 2009. The expansion of oil palm plantations in Indonesia and soybean farms in Brazil that are often linked to deforestation could deter efforts to achieve these targets. Land-use planning activities at the subnational level might be a potential existing mechanism to regulate the expansion of these agricultural commodities and assist both countries in achieving their GHG commitments. However, initial research on the Provincial Land-Use Plans of West Kalimantan, Indonesia and the Socioecological Zoning Process of Mato Grosso, Brazil indicates that planning tools are subject to highly complex debates and are affected by political processes. In both case studies, a multitude of interests are involved, making it extremely difficult for successful sustainable development to occur and the climate change agenda to effectively permeate into subnational policy.

Introduction to Problem Definition

Climate Change Objectives in Brazil and Indonesia

In 2009, both Brazil and Indonesia internationally committed to significantly reduce their greenhouse gas (GHG) emissions by approximately 40% each (Government of Brazil 2008, DNPI 2011, Wadojo and Fishbein 2011, Russell and Kotorac 2012). While GHG emission commitments are being made, national targets are also being created to increase economic growth in the agriculture sectors of both countries (Boer et al. 2012, Strassburg et al. 2012). The expansion of agricultural commodities, such as oil palm in Indonesia and soybeans in Brazil, has caused land-use changes and has increased GHG emissions through deforestation (Sheil et al. 2009, Jepson et al. 2009).

In order to pursue a more sustainable development path and to achieve GHG emission reduction goals in the time period stated, policy revisions should already be evident at the subnational level. Spatial and land-use planning activities are key elements in achieving sustainable development, mitigating GHG emissions, and addressing the consequences of climate change (IPCC 2007,

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Stern 2007:432, Wilson and Piper 2010). This paper provides preliminary analysis of the complexities in achieving outcomes that would reduce GHG emissions through existing planning activities in Brazil and Indonesia. These countries were chosen because of the high levels of deforestation occurring due to the agricultural sector, the similarity in GHG reduction commitments that these governments have made, and subnational land-use activities currently being conducted in both countries.

Methodology

Subnational land-use planning processes are currently being conducted in the state of Mato Grosso, Brazil, through the Socioeconomic Ecological Zoning (*Zoneamento Sócio-Econômico Ecológico,* ZSEE) and in the province of West Kalimantan, Indonesia through the provincial spatial planning (*Rencana Tata Ruang Wilayah Propinsi,* RTRWP). The ZSEE and RTRWP could potentially be used as a way for both of these countries to reach their GHG targets. However, the political stalemate encountered by these states in the political stakeholder process caused improved land-use plans not to be enacted and passed through law. This paper examines the rationalities, conflicting goals, and limits of land-use planning by reviewing existing literature and theories of planning. I place emphasis on the different actors involved in the process of land-use planning to highlight the difficulties surrounding such activities. I collected primary documents and conducted semi-structured interviews during the summer of 2013 in the capital cities of both states. Interviews were conducted with key actors in the state government, the private sector, environmental and social non-governmental organizations in order to gain key information on the process and current status of the subnational land-use plans. Interview questions were focused on obtaining data on the chronological implementation of land-use policy and identifying the roles of major institution and actors involved in the development of the land-use plans.

Theoretical Literature

Planning: A Tool to Reach Convergence?

The utopian vision of the contemporary planner is described by Campbell (1996: 296), in which he states that the planner must reconcile at least three often-opposing interests to "grow the economy, distribute this growth on equitable terms, and protect the environment and ecosystem." The difficulties of planning are often considered "wicked problems," which are complex, multifaceted and dynamic in nature (ibid.: 201). What may seem to be the solution to one problem could result in the creation of another problem in a different area. Campbell's concept holds for planners who face the debate of sustaining the "triple bottom line" between economic, social and environmental factors. He argues "the challenge for planners is to deal with the conflicts between competing interests by discovering and implementing complementary uses" (ibid.: 300).

In practice, planning constitutes a social and political process that involves many actors and stakeholders, each representing their own interest (Friedmann 1987: 25). In the political arena, this is where Friedmann's dual role emerges and Campbell's environmental protection paradigm of planning goals are heavily debated among various competing actors. The concept of sustainable development lies in the middle of a triangular sphere in which planning processes serve as a tool to obtain goals of economic growth, social justice, and environmental protection.

Obtaining outcomes that constitute a balance of the different axis of sustainable development becomes the topic of debate.

Case Studies: Preliminary Findings of Land-Use Planning Activities in Brazil and Indonesia

The ZSEE in Mato Grosso Brazil

Land-use planning in Brazil is identified as the ZSEE process. This executive version of the ZSEE was submitted to Mato Grosso's Legislative Assembly in March 2008 for public consultation. The state parliament consists mostly of deputies closely associated with the agribusiness sector who believed that the ZSEE was too heavily focused on environmental conservation and the allocation of land for indigenous communities.[1] They argued that the ZSEE would put the agriculture sector at a disadvantage, preventing economic development and prosperity.[2] The Legislative Assembly then passed a ZSEE version of their own, which would allow conservation areas and indigenous lands to be converted for agricultural purposes. In response, there was a major public outcry from civil society organizations, universities, and social activists of the state. In turn, this led to the rejection of the bill by the national government and a Public Civil Action case brought to the Specialized Court on Environmental Defense *(Vara Especializada de Defesa do Meio Ambiente)*. To date, Mato Grosso still remains without the ZSEE.

The ZSEE process in Mato Grosso provides an example of the difficulties of various political and civil society actors in constructing a policy tool to converge ideas, interests and positions on planning. Using the ZSEE in Mato Grosso as a tool to achieve GHG reduction has not been implemented by policymakers. Brazil's 2008 National Plan on Climate Change states that approximately 16% of the target emission reductions by 2020 are to be done in the agriculture sector (Russell and Kotorac 2012), in which 64% of these reductions are to be realized by decreases in the expansion of agriculture including in Mato Grosso. However, there has been very little discussion of incorporating the federal government's climate change targets and strategies for GHG mitigation with state level policies such as the ZSEE.

The RTRWP in West Kalimantan, Indonesia

Much of the debate regarding the provincial land-use planning in Indonesia, RTRWP, surrounds the amount of Forest Estate that should be released by the Ministry of Forestry to the jurisdiction of the local governments (mainly district governments for economic development purposes).[3] Approximately 60% of the total area of West Kalimantan is currently classified as Forest Estate.[4] The remaining area is classified as Non-Forest Estate (*Areal Penggunaan Lain*, or APL). The primary purpose of this land includes the development of settlement areas and agriculture activities. As of December 2013, the Ministry of Forestry has not approved the suggested changes of the RTRWP made by the local government of West Kalimantan to the Forest Estate (Directorate General of Spatial Planning 2013). The Ministry of Forestry is concerned about the various different claims made by the provincial parliament and civil society organizations with regard to the optimal amount of Forest Estate that should be released for development. The executive government and private sector want more areas allocated for development and agriculture, however the local parliament and environmental non-governmental organizations have highlighted

their concerns if such policy were implemented.[5]

The district governments and the private sector have advocated for the expansion of agricultural commodities—particularly oil palm—by proposing the conversion of Forest Estate areas to APL. Most agricultural commodities such as oil palm can only be legally planted in APL areas. The provincial government of West Kalimantan reports that the total area of oil palm currently planted reaches 880,000 hectares, making it the largest agricultural commodity in the province (Bappeda 2013: 42). Furthermore, it is estimated that more than 4.9 million hectares of land is allocated or is undergoing some type of oil palm concession process (Yuntho et al. 2013: 27). Due to the income generated through taxes and sales revenue, it is in the interest of the district government and private sector to obtain more land to be allocated as APL.

The oil palm sector is recognized as a major source of GHG emissions (Sheil et al. 2009, Bappeda 2013). The Local Action Plans for Reducing GHG emissions, the primary government document attempting to achieve West Kalimantan's GHG mitigation goals, acknowledges this problem (Bappeda 2013: 38). However, mitigation plans in the Local Action Plans for Reducing GHG emissions do not provide mechanisms to tackle the massive emissions attributed to the conversion of forest for oil palm expansion (ibid: 43). The current strategy to address this issue is to reduce the amount of Forest Estate being converted to APL.

Analysis

The case studies from Brazil and Indonesia reflect a wide range of societal issues that are ill-defined and that depend on subjective political judgments for resolutions (Rittel and Webber 1973: 160). This relates to Campbell's previously mentioned "wicked problem" concept (1996). Planning tools often do not become an instrument for action or change, but rather serve as an arena for contestation between economic growth objectives, social equity concerns and environmental trepidations (Campbell 1996, Bulkeley 2006, Owens and Cowell 2010). Similarly, this is seen in the ZSEE process of Mato Grosso and the RTRWP of West Kalimantan, where zones of development and conservation are so heavily debated that neither side can reach a point of convergence.

Market rationality has steered economic and policy concepts in countries such as Brazil and Indonesia through neoliberal ideals over the last half-century. However, this rationality is challenged by social and environmental advocates, who trigger trickle-down effects in society towards better environmental stewardship. In both the ZSEE and RTRWP planning activities, various actors influence resource control through zoning processes within state-level administrative boundaries. All actors attempt to simplify and legitimize the control of resources for market, social equity, and environmental interests. Actors argue that they try to take into consideration a multitude of interests even when there is only one that prevails (Acselrad 2002: 173). In the case of Mato Grosso, the agriculture sector and state parliament argue that they passed their version of the ZSEE in the best interest of the economy of the state, even though agricultural expansion was evident. In West Kalimantan, the oil palm sector and executive government wanted more land for development as well.

These mapping processes start a new locus of negotiation where conflict over access and rights to resources emerge. The expected outcome is for a convergence of interests placed within a policy tool of delineation to

develop, where actors compromise their standpoint in order to reach some sort of result. However, territorial land-use planning is often argued to be a "utopian fiction in practice" because of the complexities of representing social relationships and narratives of people's interaction with the land (Vandergeest and Peluso 1995: 389). Thus, as seen in Mato Grosso and West Kalimantan, the bureaucratic processes and the multitude of government institutions result in deadlock. Unfortunately, development activities do not stop, and continue without agreed upon plans and common objectives (such as the climate change mitigation attempts) in place.

Conclusion

There is very little evidence that climate change mitigation and adaptation policies are being integrated in the highly political land-use planning activities by the subnational governments of Mato Grosso, Brazil and West Kalimantan, Indonesia. Though climate change policies are being made at the state level, they appear to be excluded from major planning activities of the state. There is thus major uncertainty regarding the attainability of climate change commitments being made by heads of state of each country. The differing interests involved in these land-use planning and zoning processes have caused there to be no convergence of economic, social and environmental objectives, as shown by the inability for the ZSEE of Mato Grosso and RTRWP of West Kalimantan to be enacted.

Endnotes

1. Based on an interview with Michele Sato, Professor at the Universidade Federal de Mato Grosso conducted by author on July 4, 2013.
2. Based on an interview with Irene Dowarte of the Environmental non-governmental organization Instituto Centro de Vida (ICV) conducted by author on May 31, 2013.
3. Based on an interview with Hermawansyah of Yayasan Gemawan and Deman Hura of LPS-Air conducted by author on July 10, 2013.
4. According to Forestry Decree SK.259/ Kpts-II/2000
5. Based on an interview with Syarif Izhar Azhuri of the Provincial Parliament of West Kalimantan conducted by author on July 12, 2013.

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III. WATER & MARINE ISSUES

Failure and Potential: Rainwater Harvesting in a Rural, Mountainous Haitian Village

Jessica Brooks, MESc 2014

Abstract

Access to safe water in rural Haiti is currently limited. In some rural mountainous areas, spring capping or rainwater harvesting systems (RWHS) may be the only feasible options for increasing water access toward the Millennium Development Goals. Previous studies have suggested that increasing at-house safe water access may provide more health benefits than improving a more distant source. A potential at-house water source, RWHSs, have been constructed in some rural areas of the Artibonite Department, Haiti, but the usage and acceptability of these systems have yet to be studied. This study assessed the use of rainwater collected at houses and rainwater harvesting systems intended for community use. Semi-structured interviews with RWHS managers and owners and surveys at systematically-sampled households were conducted in summer of 2013. RWHSs intended for community use face social and financial barriers, such as unwillingness to pay, ineffective delegation of management, and inequitable accessibility and allocation, and the preference for drinking rainwater varies within this case study village. The comparison of barriers encountered with the community-intended RWHSs to those of private RWHSs in this village suggests that rainwater is not wholly undesired, but that the maintenance experience and household-level need may determine the success of outcomes.

Introduction

For Target 7.C of the Millennium Development Goals, the proportion of the population with "access to safe drinking water" is measured by reported use of an improved drinking-water source. In Haiti, this indicator has *decreased* in both urban (88% to 77%) and rural (51% to 48%) areas since 1990 (JMP 2013). While these numbers reflect the disparity between urban and rural areas, access to an improved source also varies between Haiti's departments.[1] A survey conducted by the U.S. Center for Disease Control in May 2012 determined that only 42.3% of households in rural areas of the Artibonite Department use an improved source—approximately 6% less than the national average (Patrick et al. 2013). The significance of this water and sanitation service deficiency has been made particularly appar-

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ent by Haiti's cholera epidemic, which began in October 2010 in the Artibonite Department. More than 650,000 cases and 8,000 reported deaths have since occurred in Haiti (Patrick et al. 2013).

In some rural areas of the Artibonite Department, rainwater harvesting systems (RWHSs) have been constructed. However, they only narrowly appear in survey statistics on reported primary water sources (Patrick et al. 2013, Patrick et al. 2012). The usage and acceptability of these systems in comparison to other water sources has yet to be studied in the Artibonite Department. This case study assesses the current use of rainwater collected at households and in cisterns intended for community use in one rural village that is primarily reliant on an unprotected spring. Rainwater usage is compared to safety perceptions and drinking preferences held by the households selected by random sampling and households purposively sampled for ownership or management of a RWHS. The findings suggest RWHSs intended for *community* use are ineffective for improving drinking water access as implemented in this case. However, potential remains for rainwater to be more beneficial if better targeted and managed.

Theoretical Literature

A primary objective of the Five Year Plan (2011 – 2015) of DINEPA, Haiti's national water and sanitation authority, is to increase rural water supply (Republic of Haiti: National Directorate for Water and Sanitation [2011] in Gelting et al. [2013: 669]). Geological, financial, technical, and infrastructural factors limit options for increasing safe water access in some rural areas to either capping a primary spring (i.e. constructing an impermeable barrier, typically concrete, at the point where spring water emerges from the ground) or building rainwater harvesting systems. Spring capping is shown to be ineffective for ensuring safe water quality in the Artibonite Department, contributed to by warm groundwater temperatures and poorer natural filtration due to the presence of shallow karst aquifers (Wampler and Sisson 2010, Patrick et al. 2013). Some primary springs may also not be suitable for capping due to the close proximity of a stream or river, which increases the potential for contamination of surface water and of the cap being washed out in a flooding event.

Furthermore, interventions that protect or treat water at the source (e.g., spring capping) may not be fully effective for improving health outcomes. Water can be recontaminated during transportation and storage (Wright et al. 2004). A randomized control trial in Kenya demonstrated that spring improvement led to a 60% reduction of E. coli contamination at the source, but only a 24% contamination reduction in water being stored at the households (Kremer et al. 2011). Point-of-use water treatment and safe storage are thus necessary to ensure safe water consumption in places without clean and reliable piped water (Mintz et al. 2001).

Spring capping may not significantly improve the health of spring users due to the unchanged distance to households, maintaining the difficulty of obtaining adequate water quantity for hygiene practices. When the primary water source is 30 minutes away or more, water usage volume has also been shown to dramatically decrease (Cairncross 1987). Households with water access outside of their house plot are less likely to practice regular hand-washing compared to those with piped water to their plot (Curtis et al. 1995). Hygiene practices reduce diarrheal disease, the second leading cause of mortality of children under five years of age (Wardlaw

et al. 2010). In 26 countries in Sub-Saharan Africa, households with a 15-minute shorter walk, one-way, to the primary drinking water source had an average of a 41% relative reduction of diarrhea and 11% relative reduction of mortality for children under 5 years of age, controlling for education, wealth, employment in agriculture, and seasonality (Pickering and Davis 2012). RWHSs, however, may serve as a feasible at- or near-household water supply to supplement existing sources.

Background of Study Location

The village selected for this case study sits along a mountain ridge top. At the bottom of this ridge is the spring that the residents of the village use for potable water. This uncapped spring resides very close to the river, which is used for laundry, bathing, and watering animals. The exposure of this spring and its proximity to the river was especially concerning in early August 2013 during a cholera epidemic in a nearby village. The village formerly had access to other springs along this river bank, but river flooding filled in the springs and washed out the one capped spring.

This village was selected as a case-study due to the existence of several RWHSs. Two RWHSs intended for community use collect rainwater at two local churches. Both systems were facilitated by the same Christianity-oriented NGO and built in 2001 and 2003, respectively. Further, two households have functioning small "jars" (smaller, round, concrete containers for above-ground storage of rainwater collected off of household roofs) that were built around 1986. Additionally, a neighbor of one of the churches had a RWHS constructed at his household by hiring a mason.

Methodology

Semi-structured interviews were conducted in the summer of 2013 with the NGO director responsible for facilitating construction of the RWHSs at the churches, the local managers responsible for maintenance of these systems, and the households with private, professionally-built RWHSs. These interviews provided detail on the rainwater harvesting systems' construction procedures, financing, structural specifications, on-going cleaning and other maintenance, intended use and accessibility, and any existing problems. An oral survey allowing for open-ended answers was also conducted at 13 households selected by systematic random sampling to determine access to and use of RWHSs, drinking water preferences, and treatment practices.

Findings

The findings of this case study include the maintenance, accessibility, and use of two rainwater harvesting systems intended for community use. The village's varied usage of rainwater as a drinking water source is also presented.

Management and Accessibility of the Community-Intended RWHSs

The community-intended RWHSs in this case study were each built on church property (one Catholic, one Protestant). The churches are the two largest buildings in the area, and the Protestant church is beside a school. The intent was to provide domestic water access for everyone, regardless of church involvement. However, both RWHSs' accessibility is infrequent and unreliable. Both systems are within a fenced area, and the one at the Catholic church has an

additional locked structure around the spigot. The Protestant church cistern is primarily used by the pastor and his family, who live in the church, as well as a manager and the volunteer schoolteacher. The keys to the Catholic cistern are held by one man ("the manager") who received the position by his previous involvement in the church. To provide keys to more than one person would be "a management problem," according to him. Because of the limited water availability, there is a perceived need to monitor water extraction from the cistern to reduce waste and overuse. However, this is a burdensome responsibility for one person without compensation, as the Catholic cistern manager noted: "I would not be available to give them water every day since it is not a job." Consequently, water access is limited to one day per week Sunday; when there is enough rain; and to specific large requests, such as for masonry work. "I don't have time otherwise," he said. People are unwilling to pay for cistern water, and the manager asserts this should not be mandated.

When accessible, the use of cistern water for drinking also varies. The manager and pastor's daughter at the Protestant church use the cistern water for drinking. The Catholic church cistern manager, however, did not trust the water quality as he felt he was unable to clean the system often enough and did not treat it. He also tells users not to use the water for drinking. The distrust of the Catholic church cistern water quality was further observed in household interviews. In one interview, a man stated, "They don't clean the basin. When it is clean, we can drink it."

Perceptions of Rainwater for Drinking

This project found that rainwater is not a preferred drinking water source for most people in this village. Those who did not drink rainwater off their own roof or from a cistern typically complained of cleanliness problems or a bitter taste and some stated it causes stomachache.[2] Some comments suggest spring water is seen as safer than rainwater. For example, one informant said, "I prefer the spring water since we would have to treat the cistern water from time to time." Rainwater is not always seen as poor quality, however. According to one informant, rainwater is "the best water" because it comes "from above." Despite this opinion, this informant retains a stronger preference for spring water: "Even when we have rainwater, we would go to the spring for drinking water."

Though most households in the area do not use rainwater for drinking, notable exceptions were encountered. Two of the surveyed households consistently use rainwater for drinking, and both are composed of elderly household members, some of which are also physically disabled. All three private RWHS owners also drink their collected rainwater, yet they have household members who are physically able to collect water from the spring.

Analysis

The heterogeneous demand for rainwater and lack of social structures to support continuous access and adequate system cleaning are barriers against an effective maintenance and financing system for these community-intended RWHSs. The significance of the social, rather than technical, aspects for equitable, collective water management has previously been shown (Mosse 2004). Failing to recognize the current social structures has, in other cases, led to project failure (West 2006:150). Whether such barriers can be changed to facilitate *community* rainwater harvesting is worth questioning.

In this village, those involved in the church RWHS maintenance are all men. However, women and children bear the burden of water collection, and households comprised of elderly and disabled individuals rely on their grandchildren, family, and neighbors to bring or share water when in need. These individuals could most benefit from reduced effort in water collection for domestic use, yet they are not the most involved (if they are at all) in ensuring the continued functionality of the system.

The stated reasons against drinking rainwater is most often taste and cleanliness, though involvement in ensuring cleanliness of a RWHS seems to play a role that, for some, may overcome dissatisfaction with the taste. While elderly and disabled individuals have greater demand for at-home water, those with private RWHSs are young and have multiple able-bodied household members. One private RWHS owner and the Protestant church RWHS's manager and pastor's daughter cited personally managing the cleanliness of the system as a reason for trusting the RWHS water for drinking. Further research would be needed to assess if individuals who currently prefer not to drink rainwater would change this preference with personal management and protected rainwater storage, rather than collection in open buckets. As Agrawal (2005) argues, beliefs may be formed from experiences, rather than actions being determined by prior beliefs.

The private RWHSs cases provided in this study suggest the potential of at-house systems in providing a more appropriate system for rainwater harvesting and possible broader impact. Those with private systems reported sharing a bucket of water with those who needed it and came to borrow one, and this was confirmed in household surveys. In one interview, I was corrected by my wording choice for inquiring if the household had ever "borrowed" water from a neighbor: "We don't borrow; we share as neighbors."

Conclusion & Recommendations

This case study highlights social and financial barriers for two community-intended rainwater harvesting systems located at separate churches in a rural Haitian village. These barriers include unwillingness to pay for community cistern water, uncompensated and ineffective delegation of management, and inequitable accessibility and allocation. However, comparing the barriers encountered in the community-intended systems to the current use and maintenance of private rainwater harvesting systems in the same village suggests that rainwater is not entirely undesired, but that the social institutions and direct experience impact the outcome.

The NGO director that constructed the community-intended RWHSs expressed interest in providing tough tanks (large, plastic, enclosed drums) to households in this village in the future. Because some households may not be interested in at-house rainwater harvesting, however, specific consideration for groups the most in need may afford more appropriate and effective outcomes. Rather than simply providing the materials, such a program could provide technical assistance and improve access to materials for more extensive guttering to increase water quantity collected, as well as access to enclosed storage containers to protect water quality and reduce and prevent mosquito-breeding sites. The use of local materials, especially items that are easily repaired and replaced by the owner, as well as technical training are necessary – though likely not sufficient – components for long-term sustainability. Appropriate materials may be best discerned through assessment of self-constructed systems within this village,

as well as other similar villages.

Greater utility of RWHSs for community use in this village may be possible through an improved management structure that better considers the constraints and aims to address the greatest need. The greatest need includes the aforementioned groups of individuals, but also critical times in which water-related health risks are greatest and time-savings from reduced water collection is most needed. The rainy season, particularly May through July, is the busiest work period for agriculturalists and is also when water-related diseases (e.g., cholera, typhoid) are highest. If the cistern water cannot be a safe and acceptable drinking water source, it could be used for hand-washing to mitigate health risks. Tippy Taps are a cheap and efficient hand-washing device, which only need to be refilled every few days, depending on usage. Further educational programs that connect RWHSs to these uses and times would be needed.

Endnotes

1. Haiti's administrative boundaries include 10 départements at the highest level, which are further broken into arrondissements and then communes.
2. Three households in two other villages also mentioned stomachaches.

Acknowledgements

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Land Use Change and Ecosystem Service Sheds: Where Does Deforestation Impact Flood Mitigation in El Salvador?

Beth Tellman, MESc 2014

Abstract

Country-scale studies and statistics of deforestation fail to capture the impact of land use on the watershed scale. The discourse of Forest Transition Theory (Mather 1992) to explain patterns of deforestation and reforestation in the tropics inadequately addresses spatial patterns of land use vital to understanding hydrologic ecosystem services. This article revisits Forest Transition Theory in the context of El Salvador, a place undergoing rapid land use change and vulnerable to flooding. As El Salvador recently passed its first national land use and zoning law in 2011, watershed science can influence decisions at this critical time. This article focuses on quantifying land use dynamics from 1992 – 2013 with remote sensing and analysis of the impacts on local hydrology for three peri-urban watersheds. A transition from forest to urban land use in the headwaters of the study sites has reduced flood mitigation services. Understanding hydrological impacts of land use change is an important part of comprehensive strategies for local NGOs navigating local land use processes to protect ecosystem services.

Introduction: Flood Mitigation, an Ecosystem Service at the Watershed Scale

Understanding how land cover and land use, such as forests, affect biophysical processes is key to planning sustainable landscapes that can support human well-being. Forests provide ecosystem services on discrete biophysical scales defined by a "serviceshed," where ecosystems provide benefits to specific beneficiaries over a determined area (Tallis et al. 2013). The location and scale of a forest is essential to understanding the ecosystem services it might provide. Yet global statistics on deforestation are often aggregated at the country level, obfuscating the places where loss and gain in forest cover most acutely impact ecosystem services. Country-scale studies of deforestation fail to capture the impact of land use on the watershed scale, the serviceshed of flood mitigation.

Country-scale studies are often used to support Forest Transition Theory (Mather 1992), which explains patterns of deforestation and reforestation in the tropics. This article revisits Forest Transition Theory in the context of El Salvador, a place that is un-

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dergoing rapid land use change and is vulnerable to flooding. As El Salvador recently passed its first national land use and zoning law in 2011 (Decree #644, Government of El Salvador), watershed science can influence land use decisions and planning, which may erode or protect flood mitigation ecosystem services. My research quantifies land use dynamics and explores the potential impacts on local flood hydrology to inform this planning process for CORCULL (the Watershed Rescue Committee of La Libertad), a local NGO. After reviewing the literature on Forest Transition Theory and the implications of land use change on flooding in El Salvador, this article quantifies land use change on three peri-urban watersheds and discusses implications of local flood hydrology for the land use planning process.

Forest Transition Theory in El Salvador

Mather's Forest Transition Theory (1992) describes the drivers of reforestation in developed countries as either economic transition or forest scarcity. Economic development transition implies that increased urbanization and intensification of production of agricultural lands allows other agricultural land to lie fallow. Lower population growth reduces demand to continue to expand agricultural land. The forest scarcity transition is driven by official government policies and programs to "save the forest." While Mather mused that this may be occurring in the tropics, political ecologists have challenged and refined this theory in the context of El Salvador (Blackman et al. 2012, Hecht and Saatchi 2007, Hecht et al. 2006).

Studies by Hecht et al. (2006) and Hecht and Saatchi (2007) support the theory of a forest transition in El Salvador, estimating a 22% increase in low density forest cover, and a 6.5% increase in dense forest cover from 1990-2000. By analyzing this change with socioeconomic statistics, the authors found areas of reforestation to be highly correlated with areas of high outmigration rates (ibid.). As Salvadoran families become more dependent on remittances for cash, it may preclude the need to farm as a source of food and income. Furthermore, globalization, trade policies, and poor agrarian reform policies have caused a severe drop in agricultural prices, providing a further incentive to abandon farms. Hecht and Saatchi (2007) assert that the forest transition in El Salvador represents an opportunity for conservation.

However, this country-scale analysis does not capture spatial patterns of deforestation on a watershed scale. Other studies indicate that driving forces of land use change in El Salvador stem from the Salvadoran civil war (1980-1992) and natural disasters, which drive urbanization and reduce population density in rural areas (Halliday 2006). Likewise, recent studies identify urbanization and international agricultural trade as global drivers of deforestation (DeFries et al. 2010). These urban land transitions, especially peri-urbanization (Seto et al. 2012), can greatly impact ecosystem services, including flood mitigation.

The forest to urban transition is the land cover change that most increases flood risk, as impervious surfaces such as cement allow for little infiltration. The effects of urbanization on flood mitigation are especially detrimental on peri-urban fringes near cities, which tend to be near catchment headwaters (Hollis 1975, Shuster et al. 2005). Thus, conversion from forest to urban cover near the headwaters of a watershed poses the greatest threat to losing the ecosystem service of flood mitigation and may accelerate flood risk of downstream populations.

Land Use Change on Peri-urban Watersheds

While studies such as Hecht et al. (2006) have used remote sensing to capture reforestation and deforestation dynamics in El Salvador over the past 20 years, none focus on the effects of deforestation on hydrological function. The Salvadoran Ministry of the Environment (MARN) has become increasingly concerned about the impacts of deforestation on the fringes of San Salvador and increasing flood vulnerability. MARN estimates that a 20% increase in urbanization from 1990-1999 increases peak flow up to 70% in small floods and 10% in extreme events in San Salvador (Erazo 2010). MARN emphasized a need for further research on impacts of land use and land cover change in peri-urban watersheds, three of which I selected for further analysis (see area of interest in Figure 1). The Comasagua, Jute, and San Antonio watersheds (~40, 20, and 22 km^2 in area) have a mixture of humid and dry tropical forests on mostly andosol volcanic soil type, which has high infiltration rates and capacity for flood mitigation.

This research site, the Cordillera del Balsamo, a mountain range with coastal watersheds whose headwaters are on the fringe of San Salvador, is the operational region of CORCULL. CORCULL is interested in the hydrologic function of land use, as its main mission is to develop and implement watershed management plans to protect water resources and reduce risk for the region. Hydrologic studies are especially important now, as El Salvador recently passed its first zoning law in 2011 (Government of El Salvador), providing a 5-year policy window for

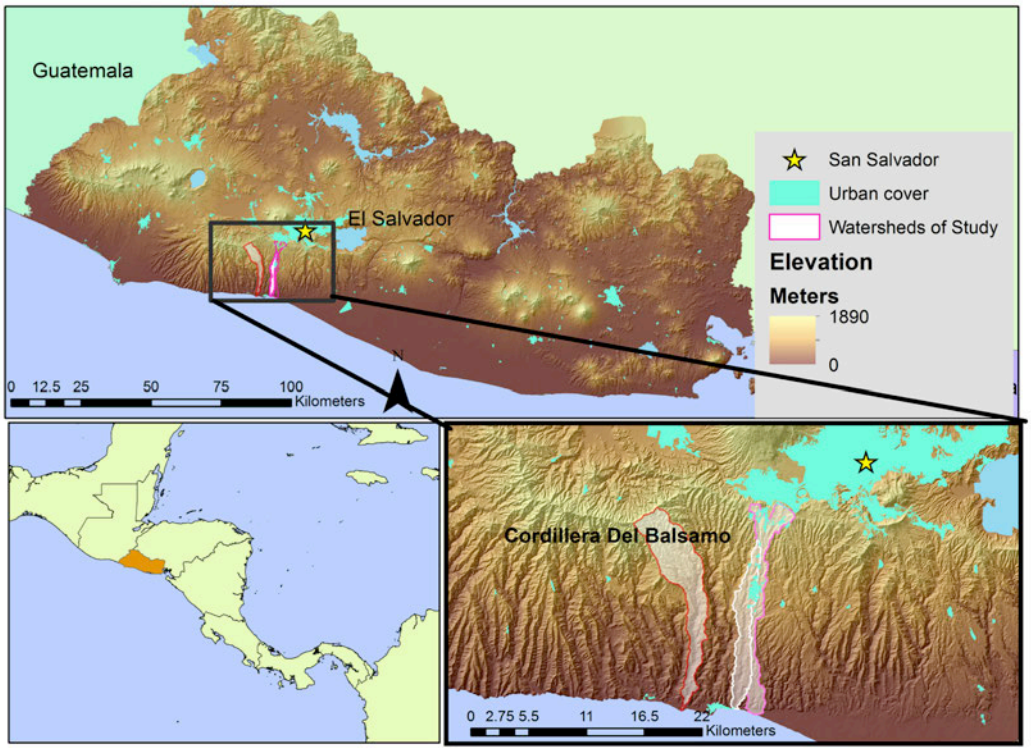

Figure 1. *Map of El Salvador in Central America. Region of peri-urbanization near San Salvador, inset. Map by author. (Elevation and urban area data from the Salvadoran Ministry of the Environment. Watershed delineation by author.)*

municipal governments to develop land use plans.

Methods

I obtained Landsat satellite images for the Cordillera del Balsamo area for 1992, 2011, and 2013 at a 30-meter resolution. I chose 9 land cover classes based on hydrologic response (Su 2000). The original land cover classes were further divided into 12 land uses based on fieldwork and community land use workshops with CORCULL.[1] I performed a supervised classification for these 12 land classes with representative field data using a Maximum Likelihood algorithm. The 2013 land use map (Figure 3) reflects the final classes, including dense urban, medium urban, residential, agriculture, pasture, bare ground, coffee forest, riparian forest, secondary forest, mangrove, mines, and parks. CORCULL facilitated participatory workshops with communities living in the watersheds to identify errors in the 2013 land classification. Errors were verified with additional field visits to confirm actual land use and manually correct the image.

Results

Figure 2 represents the percentage of major land covers in each of the studied watersheds (Comasagua, Jute, and San Antonio) for 1992, 2013, and projections according to the 2030 development plan (FIDSL 2005). The map in Figure 3 shows detailed land use for 1992 and 2013 in the three watersheds. The Comasagua watershed showed the strongest trend of reforestation in the 19-year period from 1992 to

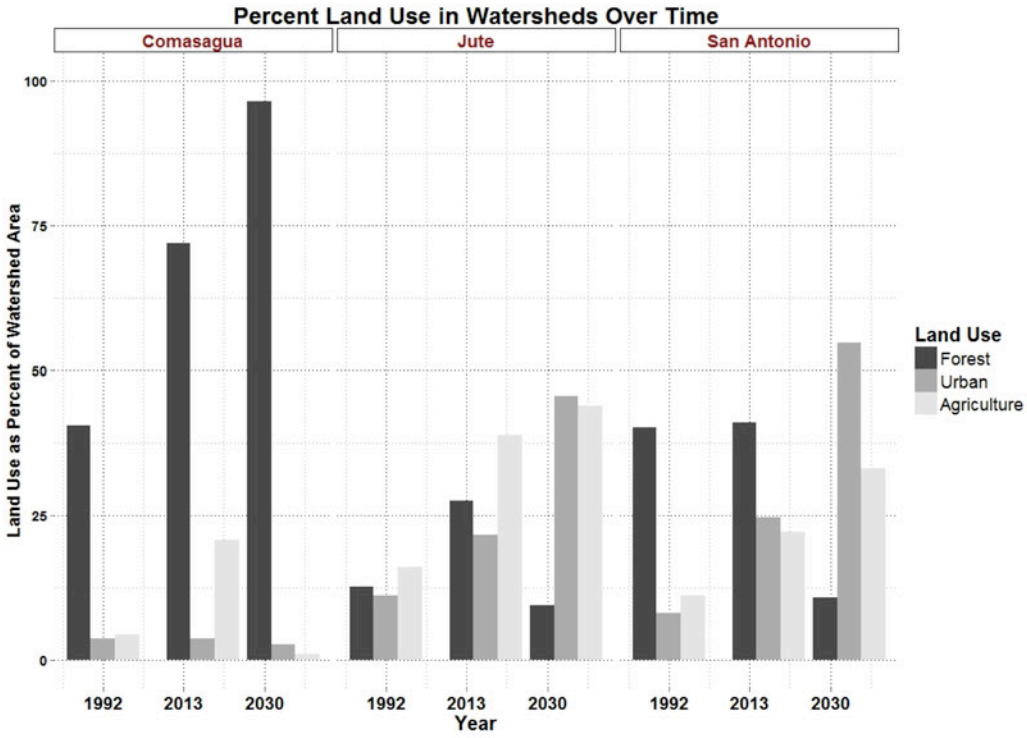

Figure 2. *A graph showing major land use, urban, forest, and agriculture as a percentage of area for the Jute, Comasagua, and San Antonio watersheds for 1992, 2013 and 2030. 1992 and 2013 data taken from remote sensing land classification, and 2030 from the Salvadoran Government Land Use Plan.*

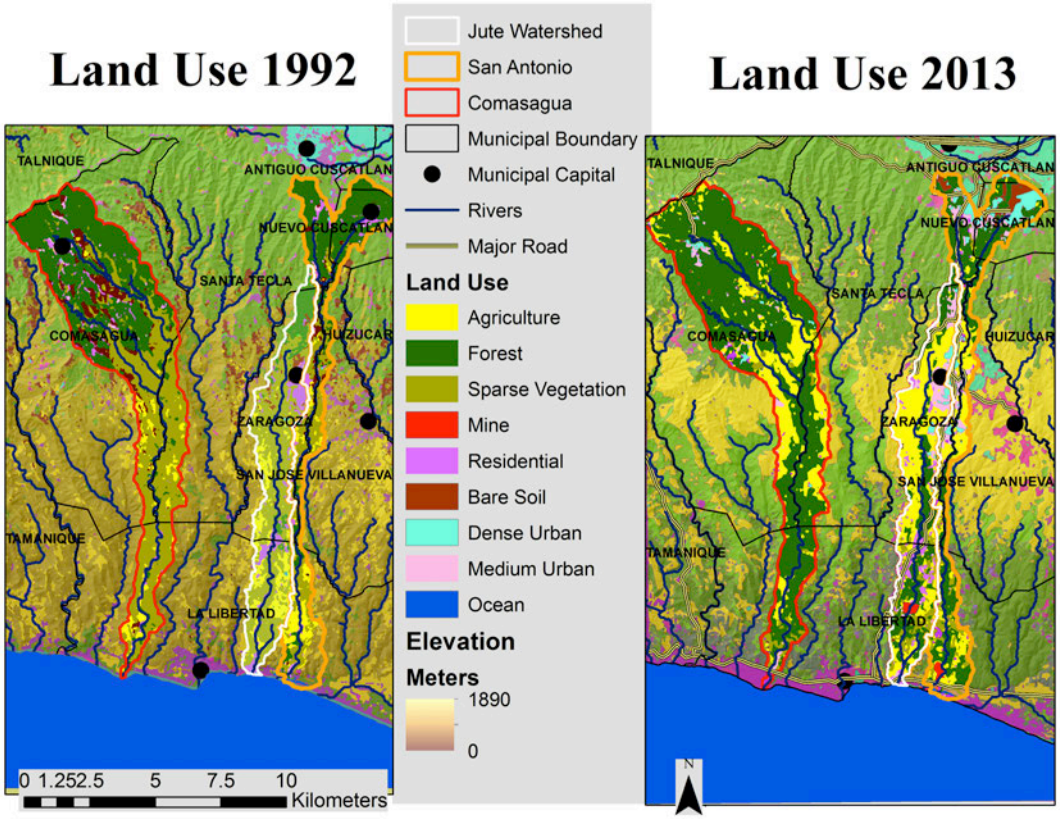

Figure 3. *Land classification map results for 1992, and 2013. Data analysis and map by author.*

2013, while San Antonio and El Jute showed moderate reforestation in the middle and lower portions of their respective watersheds. Urban land uses (dense, urban, and residential land uses together) have increased cover from 11% to 21% of the El Jute watershed, and from 8% to 25% of the San Antonio watershed. This means total urban cover has *doubled* in the El Jute basin and *tripled* in the San Antonio basin. While forest cover slightly increased, this secondary forest growth occurred in lower parts of these basins on sparsely vegetated and agricultural lands. Urban growth has occurred at the expense of coffee forest at headwaters for these two catchments.

Hydrological Implications of Land Use Change

The land use change data for this region suggests that while El Salvador may be gaining secondary forest regrowth in rural areas, urbanization is replacing forested headwaters of the San Antonio and El Jute watersheds. The rapid transition from coffee forest to urban land use has occured in part because the land at the headwaters of the San Antonio/Jute watersheds has become attractive for development. The cool climate (16 – 20° C), high elevation, forest cover, proximity to the capital and a major highway make this

land appealing for upscale housing and shopping. In addition, as coffee prices and support for the agricultural sector have decreased since the 1960s (Tellman et al. 2011), land has become less profitable for agroforestry and has been sold to major land developers. Comasagua, on the other hand, has strict municipal codes preventing deforestation and protecting coffee forest, preventing the land use transition seen in neighboring watersheds.

Forest transitions matter most to people in peri-urban watersheds such as San Antonio and El Jute, where flood risk may be greatly increased. Land use changes in El Jute and San Antonio watersheds have implications for the flood vulnerability of the 12,000 people who live in the downstream communities located in the floodplain. I am testing the hypothesis that this land use change is decreasing infiltration rates and exacerbating flooding in the San Antonio and El Jute watersheds with hydrologic and hydraulic models. Preliminary results for the El Jute watershed indicate that discharge rates at the peak of Hurricane Ida (a larger than 100-year storm that hit El Salvador in November 2009) have increased by 4 – 15 % as result of land use changes over the past 20 years. The largest increases in discharge are immediately downstream of dense urbanization built on previously sparsely vegetated or forested andosol soils with high infiltration rates.

One emblematic example of dense urbanization is the housing development of Los Cumbres, which is inhabited by upper class Salvadorans and foreigners. Los Cumbres paved over andosol soil and destroyed the ecosystem service of flood mitigation that

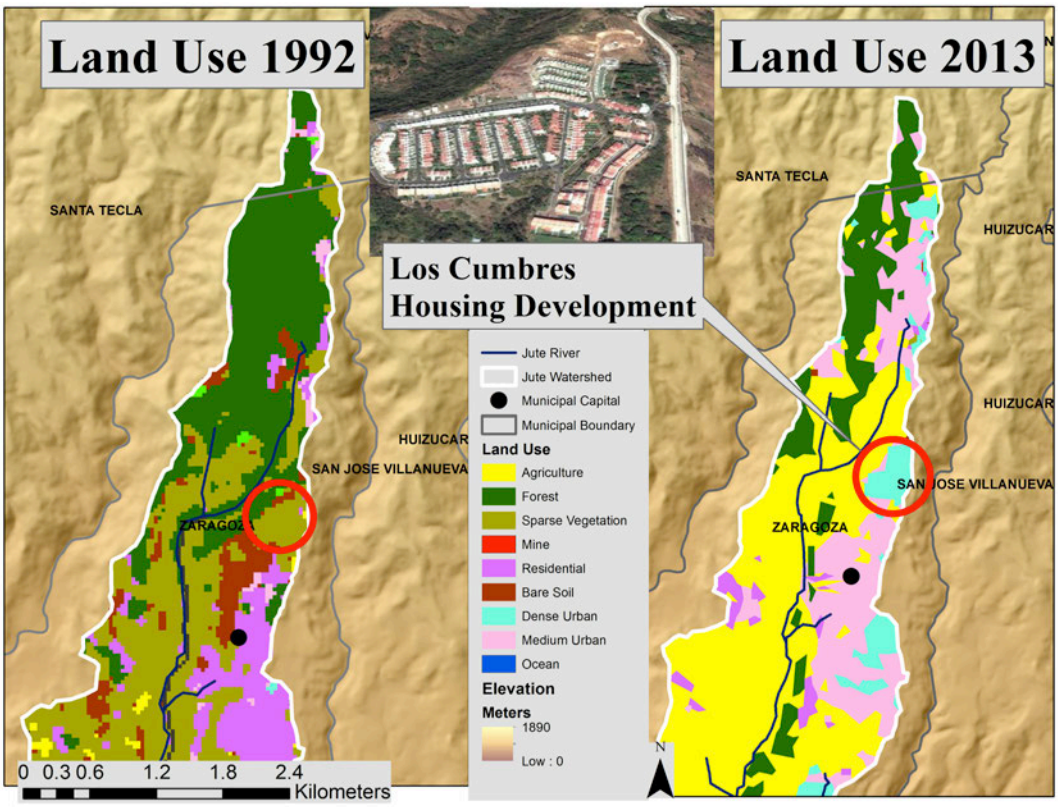

Figure 4. *Area of land use change and streamflow change in the El Jute Watershed due to urbanization. Map by author.*

this vegetated area in the upper watershed previously provided to poor local communities that have lived downstream for decades. Figure 4 shows the location of this land use change in the upper Jute watershed, and an inset of the Los Cumbres housing development.

Fieldwork to collect stream data and run participatory mapping workshops corroborated model results and gave insight into how changing disaster vulnerability affects the lives of Salvadorans living in the floodplain. One deforested hill slope in the El Jute watershed, which had been recently cleared for a large housing development, collapsed onto several small community homes during the last major storm in October 2011. While the developer rebuilt the damaged homes, the community continued to work with CORCULL to push local and regional government to stop the development project. Community leaders asserted that events such as these floods were larger and more frequent every year in part due to urbanization, *"porque el agua ya no se consuma cuando llueve"* ("because the water is no longer absorbed when it rains"). My modeling efforts quantify these changes and add scientific analysis to the experiences local Salvadorans have been trying to communicate to their government for years.

As the San Antonio/El Jute watersheds urbanize, the need to understand the links between land use change and impacts on the watershed is imperative. The national government's priorities for development in this region include projections for increased urbanization to 2030; they differ greatly from CORCULL's vision for land use and conservation. CORCULL's land use plan for the region is being constructed at the appropriate ecological scale, one watershed at a time, with hundreds of community members over dozens of participatory workshops.

While CORCULL's plan is conceived at the correct biophysical scale to consider hydrologic ecosystem services, the watershed scale does not match the political land use planning scale. A watershed is determined ecologically, not politically. Zoning plans are written and approved by each municipality, whose zoning districts and politics are incongruent with the watershed scale. The ecological properties of a watershed imply that the decisions of municipalities upstream affect those downstream. This means the supply of flood mitigation (upper watershed) is located in a separate municipality from the demand of the flood mitigation service (lower watershed). The lack of a National Water Law currently prevents these downstream communities from taking legal action against developers whose constructions upstream affect their flood vulnerability. While my results inform CORCULL's land use plan at the watershed scale, implementation of scientific recommendations at the appropriate political scales is another challenge.

Conclusion

Modeling ecosystem services at the right scale is a useful first step to manage resources for environmental services. A careful analysis of land use changes in El Salvador reveals that while the country may be increasing its forest cover by 6.5% for dense forest (according to Hecht et al. 2006), deforestation at headwaters near the capital may be changing local hydrology. Forest Transition Theory obscures changes at a local level, by focusing on secondary forest recovery on a country-wide scale. In El Salvador, increases in urban cover by nearly 100% have displaced forests in upper watersheds near the capital city, producing consequentially detrimental effects for rural people downstream. Using country-level reforestation statistics as an

indicator of decreasing environmental degradation in places like El Salvador ignores the scale at which environmental change matters for essential ecosystem services like flood mitigation.

Localized studies of environmental change in El Salvador can inform policy for local land use planning at the municipal scale, to match restoration of ecosystem services at the watershed scale. As municipalities develop their first zoning plans, hydrological modeling and remote sensing can add important information for decision-makers. However, understanding the biophysical changes in an ecosystem services shed is only the first step. Well-constructed watershed policy and increased community are necessary to make promise of the science of watershed management a reality.

Endnote

1. Adding data in addition to satellite imagery for classification, such as slope and elevation, is crucial to determine which forest land cover is used for coffee farming, such as forest cover over 800 m (Munoz-Villers and Lopez-Blanco 2008). Other data, such as brightness, greenness, and wetness bands helped distinguish urban cover from fallow agricultural land (Kauth and Thomas 1976).

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Predicting the Effects of Different Land-Use Scenarios on Water Availability Using a Hydrological Model

Ambika Khadka, MESc 2013

Abstract

Water availability is a serious issue facing many communities and nations around the world due to rapid urbanization and population growth. Hydrological indicators can be used to assess how land-use changes affect water availability. I used the Soil and Water Analysis Tool (SWAT) to predict the effects of land-use changes on surface runoff, infiltration, and peak flow in the Xinjiang River, China, sub-watershed with six land-use scenarios. The major finding of the study is that the presence of forests helps regulate wet-season peak flow. The hydrograph with presence of forest is gradual, thus suggesting a reduction in flood potential in the wet season and water scarcity in the dry season. Installation of earthen ponds in the outlets of sub-basins with higher surface runoff provided the most significant hydrological improvements. The study will provide essential information to aid decision-making in long-term land-use planning to protect water resources, and to mitigate the effects of water scarcity and flooding.

Introduction

Rapid urbanization and other land-use changes related to population growth alter the hydrological regime by increasing the peak flow and volume of surface runoff, while decreasing infiltration (Sahin and Hall 1996). In the 1980s, after most of the existing vegetation was removed for firewood and industrial use, the Xinjiang River basin area was called the "red desert of southern China" (Zheng et al. 2008). The devastating floods of 1981 and 1998 in the Yangtze River were thought to be caused by removal of vegetation in the hills (Wei et al. 2008). In the last two decades, the population centers in southern China have expanded at the expense of forested areas and floodplains. This region has faced extreme water scarcity and flooding, which the government blamed on loss of tree cover as a result of rapid urbanization (Khadka et al. 2013). These catastrophic floods spurred hydrological research and motivated China to adopt the Natural Forest Conservation Program (NFCP). The objectives of the NFCP include restoring natural forests in ecologically sensitive areas

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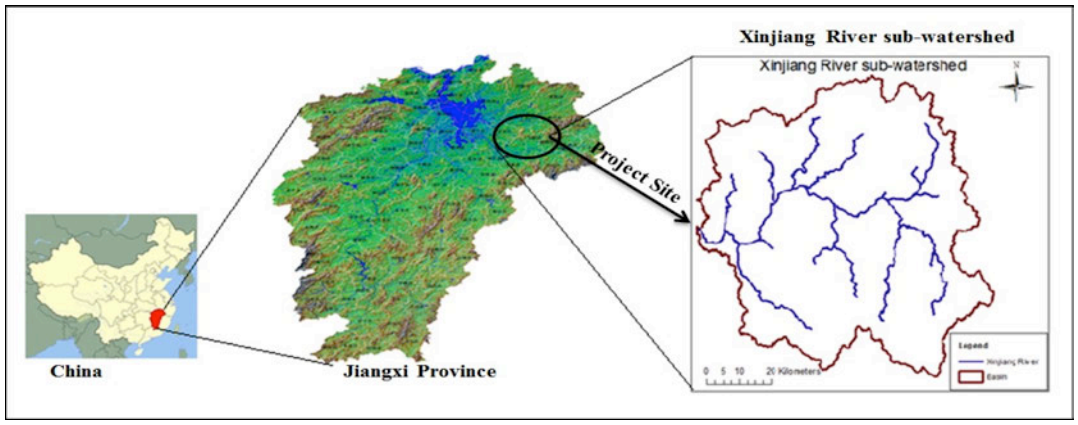

Figure 1. *Project site.*

such as headwaters of major rivers (ibid.). The NFCP program resulted in the reforestation of denuded hills in the region starting in 1998.

Knowing the hydrological responses to forest cover changes is essential to the question of how ongoing land-use changes influence water availability, potential of flooding, and water scarcity within a watershed. The purpose of this paper is to predict how different land-use scenarios affect the water availability in China's Xinjiang River sub-watershed using a hydrologic model. The model represents and quantifies the water movement and distribution within the watershed which can be used to create optimal water management options for decision-making processes.

Background

The Xinjiang River drains a 6,168 km^2 watershed (Fig. 1) within the Jiangxi Province, located in southeastern China at 28.500° S and 117.500° E. This part of China is undergoing rapid changes in land-use that is likely to affect its water availability. Shangrao and Yintang are two major cities that are expanding within the watershed. During my fieldwork in the summer of 2012, I observed that many stretches of the river floodplain are used for human habitation. The current land-cover is a vast stretch of urban area along floodplain, and pine cultivation on hills which were once heavily denuded. The river is located in a narrow valley between two mountains, Wuyi and Huaiyu. The site is in a wet climatic zone with mean annual precipitation of 1,878 mm with an average surface evaporation of 1,044 mm for the period from 1953 – 2002. The annual mean temperature of the watershed is 18°C in October, with a mean temperature of 37°C in July (Guo et al. 2008). The terrain is rugged; elevations vary from below sea level to 2,100 m.

Methods

The study methodology involved compiling a Digital Elevation Model (DEM),[1] soil properties, vegetation types, land-use and hydrological data of the Xinjiang River sub-watershed. The weather data for 2000 – 2010 from 15 stations around the study site was obtained from the National Center for

Table 1. *The predictive land-use scenarios used in the model for simulation.*

Scenario	Land-use type	Condition
Scenario 1	Land-use of the year 2000	Land-use map of the year 2000 from Land Management Survey Bureau, Jiangxi Province, 2000.
Scenario 2	100% broad leaf mixed forest	When scenario 1 is changed entirely to broad leaf mixed forest uses.
Scenario 3	100% urban	When scenario 1 is changed entirely to urban uses.
Scenario 4	50% broad leaf mixed forest, 20% agriculture, 20% urban, and 10% rangeland	When scenario 1 is managed as 5:2:2:1 (broad leaf mixed forest: agricultural land: urban area: rangeland).
Scenario 5	1km riparian buffer strips are created along the main river as well as all tributaries.	The 1km buffer is forested with broad leaf mixed forest. The 1km riparian buffer is an addition to the scenario 1.
Scenario 6	80,000m^2 earthen irrigation ponds are installed in outlet of sub-basins with maximum run-off.	The earthen irrigation ponds of various sizes are installed to collect 60% of the precipitation during flood months June and July for 60 days.

Environmental Protection. The Soil and Water Assessment Tool (SWAT) was used to represent the Xinjiang River watershed in order to predict the effects of land-use changes on surface runoff, infiltration, and peak flow. SWAT is a physical based model developed "to predict the impact of land management practices on water, sediment and agricultural chemical yields in large complex watersheds with varying soils, land-use and management conditions over long periods of time" (Neitsch et al. 2009). In order to test the accuracy of the model prediction, the predicted flow from the model was calibrated against monthly flow measurements made over a two-year period using the SUFI2 automatic calibration program (Abbaspour 2011). The calibration was performed by iteration and permutation of eight model parameters to mimic the Xinjiang River sub-watershed in the model. The eight parameters were then used in a predictive simulation of hydrology for land-use of the year 2000 and five other land-use scenarios as shown in Table 1. The year 2000 was used as a base year because it was the land-cover map generated by survey conducted by the Land Management Bureau of Jiangxi Province for the year 2000.

Findings

Table 2 shows the findings for land-use in 2000 and five other predictive land-use scenarios to show the effect of each land-use regime on hydrological components. The hydrological response of six land-use scenarios is represented as hydrological indices in Table 3.

Analysis

From Table 2, all scenarios with forest cover show a reduction in surface runoff, peak flow and an increase in infiltration. Surface runoff and peak flow are positively

Table 2. *Effect of six land-use scenarios on hydrological components*

Land-use scenario	Surface runoff in mm/year	Infiltration in mm/year	Evaporation in mm/year	Peak flow in m^3/second
Scenario 1	341	386	677	125
Scenario 2	149	454	733	120
Scenario 3	382	384	667	126
Scenario 4	230	433	705	123
Scenario 5	195	625	665	119
Scenario 6	183	554	666	112

Table 3. *Hydrological indices of six land-use scenarios*

Land-use scenario	Surface runoff/ precipitation	Infiltration/ precipitation	Evaporation/ precipitation	Peak flow/ precipitation
Scenario 1	0.49	0.18	0.33	0.66
Scenario 2	0.35	0.22	0.35	0.63
Scenario 3	0.50	0.18	0.32	0.66
Scenario 4	0.43	0.21	0.34	0.64
Scenario 5	0.32	0.33	0.35	0.60
Scenario 6	0.29	0.36	0.35	0.58

correlated with un-forested land in a watershed. Peak flow is the maximum flow of the season which directly contributes to floods. The model has predicted that with Scenario 1, 49% of total precipitation flows as surface runoff, 66% flows as peak flow to Xinjiang River, and only 18% of precipitation infiltrates into the soil in the form of groundwater (Table 3). Scenario 1 represents the condition in the Xinjiang River sub-watershed where most of the natural forests had been heavily deforested and replaced by scattered pines *(Pinus massoniana)* and grasses with low nutritional value (Cheng-Fan 1990) as a part of the NFCP project. Hills with no vegetation contributed to high surface runoff and peak flow into the Xinjiang River. The amount of precipitation that infiltrated in the form of groundwater was very low which suggests that less groundwater will be available to be used during dry season. As less water is available, the problem of water scarcity during the dry season still persists. When the entire watershed is altered to urban land-use (Scenario 3), the model predicts that the peak flow and infiltration rate remain the same and surface runoff increases by just 1%. The results are not very different from Scenario 1.

Many studies have indicated that soil compaction as a result of urban growth is more likely to influence flood responses than the presence of forests. On the small watershed scale the effects of human interventions such as deforestation, conversion to agricultural land, and urban area can be directly documented in terms of higher peak flows. Forest have reduced surface runoff by allowing water to soak into the ground, thus reducing flash floods and improving groundwater recharge in Scenario 2. Increased groundwater recharge increases water availa-

bility for the dry period of the year. However, the percentage of precipitation that becomes flow is reduced by 3% as compared to Scenario 1 (Table 3). The reduction in the flow is lower than expected, which might be due to steep slopes of the hills.

Infiltrated water on steep slopes moves rapidly through the soil due to gravity, still contributing to immediate flow and floods. Thus reforestation on steep slopes does not contribute to reduction in peak flow or floods. The model prediction suggests that a 1-km riparian buffer of mixed broad leaf forest (Scenario 5) has higher hydrological impacts by lowering the peak flow by 6% as compared to Scenario 1 (Table 3), thus reducing immediate downstream flooding. Forests on gentle slopes and floodplains are effective at reducing surface runoff contribution to the Xinjiang River and reducing immediate downstream flooding. Likewise, building ponds in sub-basins (Scenario 6) that contribute higher surface runoff proves very effective at holding water during the flooding season. The water holding capacity of the ponds reduces the peak flow by 8% as compared to Scenario 1 (Table 3). When the water is held back it percolates, thus reducing immediate floods downstream. The ponds provide water storage for irrigation and domestic uses during the dry season. The presence of forest in floodplains, gentle slopes, and building ponds in areas with high slope help to regulate immediate flood downstream.

Conclusion

My analysis shows the hydrological effects of land-use in 2000 and five predictive land-use scenarios on water availability. The model's findings suggest that the presence of forests and vegetation, especially on riparian floodplain and gentle slopes, reduces surface runoff by enhancing infiltration by increasing soil water content and recharging groundwater. This increases the water availability in the form of groundwater for use during the dry season. The four scenarios (2, 4, 5, and 6) showing changes in land-use within the watershed have a range of potential benefits for improving water availability and reducing the risk of floods downstream. Scenario 5 yields the most significant hydrological importance in terms of improving water availability by reducing surface runoff and enhancing infiltration. Scenario 6 yields the most significant hydrological improvement in terms of regulating flow and reducing immediate flood downstream. Thus the optimal water management scenarios that yield the most significant hydrological improvement are restoration and forestation of riparian buffers, and installation of earthen ponds on steep sub-basins. Restoration of riparian buffers at the expense of cities along riparian areas is impossible, so installation of earthen ponds is more realistic. They will be less disruptive to cities and could maintain the agricultural base within the watershed.

Endnote

1. Digital Elevation Model (DEM) is the data files that contain elevation of the terrain over a specified area, usually at a fixed grid interval over the "Bare earth". The interval between each of the grid points will always be referenced to some geographical coordinate system either latitude-longitude or UTM coordinate system (www.satimagingcorp .com).

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Integrating Tourism, Conservation, and Development: Perspectives from International and Domestic Tourists in Península Valdés (Patagonia), Argentina

Stephanie Stefanski, MESc 2014

Abstract

Historically hunted to near extinction, marine mammals are now the focus of international conservation efforts and tourism industries. However, pollution and fishery activity continue to place marine mammals, and the tourism industries that depend on them, at risk of extinction. The study site, Península Valdés, Argentina, is a World Heritage Site designated for its protection of marine mammal populations, including southern right whales *(Eubalaena australis)*, southern sea lions *(Otaria flavescens)*, and southern elephant seals *(Mirounga leonina)*. However, pollution degrades habitat quality and supports an abundant kelp gull population, both of which threaten the viability of the site as a nursery for southern right whales. Pollution and other environmental problems may further detract from the aesthetic qualities that attract thousands of tourists each year to the Peninsula. The present study collected 650 surveys on national and international tourists. Survey responses provide insight into international and domestic visitors' perceptions of environmental threats to the region, demonstrating that conservation is an important part of entrance fees and park management. The results of this study urge the Administration of Península Valdés and onsite tourism operators to dedicate resources towards sustainable operations and improved waste management to ensure the sustainability of tourism and development in the region.

Introduction

Historical overexploitation of marine mammals has led to modern-day challenges to their conservation in the face of growing conflicts with coastal development and offshore commercial activities. The presence of marine mammals generates economic value through the provisioning of aesthetic, cultural, and recreational benefits derived by a given region or community (Daniel et al. 2012). Although aesthetic and cultural benefits are difficult to quantify, tourism reveals recreational values for marine wildlife.

Tourism inflicts mixed effects on communities, ecosystems, and wildlife. Operations generate vehicle and boat emissions or compete with local communities for limited resources (UNEP and UNWTO 2012:19). On the other hand, tourism offers alternative

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livelihoods. Sustainable development through tourism can be achieved if governments, businesses, and communities work together to ensure inclusive and responsible management of parks and their wildlife. Studies show that tourists are willing to pay more for "ecotourism" destinations with sustainable tourism operations and local community involvement (ibid.:29). Such willingness to pay (WTP) estimates are captured through economic valuation techniques, which then inform park management.

This study collected information on international and domestic visitors' wildlife viewing and management preferences for Península Valdés, Argentina through such economic valuation survey methodologies. The results demonstrate the need for better resource management to ensure sustainability of development in the region.

Background

The study site, Península Valdés, is 4,000 km^2 and located in the Chubut Province of Patagonia, Argentina. In 1999, the area was designated as a protected UNESCO World Heritage Site for the conservation of marine mammals, such as southern sea lions *(Otaria flavescens)*, elephant seals *(Mirounga leonina)*, orcas *(Orcinus orca)*, and southern right whales *(Eubalaena australis)*. Residents, businesses, and the government are motivated to protect the site in order to sustain the booming tourism industry.

Tourism is a relatively new phenomenon in the Península Valdés region, beginning in the 1980s (Kuper 2009). The economic conditions of Argentina support domestic and international tourism. More than 90,000 domestic visitors entered Península Valdés during the 2013 whale-watching season (AANPPV 2013).

Academic research demonstrates that overfishing, incidental bycatch of marine mammals, tourism activities, and pollution threaten Magellanic penguins *(Spheniscus magellanicus)*, dusky dolphins *(Lagenorhynchus obscurus)*, and southern right whales *(Eubalaena australis)* in the Patagonian coastal region (Dans et al. 2003, Gandini et al. 2011, Markowitz et al. 2010, Rowntree et al. 1998, Sironi et al. 1998). While fishing activities contribute to direct mortality of marine mammals and birds, pollution generates a more pervasive effect over the environment.

The expanding population in Patagonia and a growing influx of tourists contribute to open-air waste disposal sites. Poor management of waste and fishery discards supplement the overpopulation of kelp gulls *(Larus dominicanus)* (Lisnizer et al. 2011). Since the 1990s, scientists have observed kelp gulls harassing and attacking southern right whales to eat the skin and blubber of these whales, particularly of young calves (Fazio et al. 2012, Thomas 1988, Rowntree et al. 1998) (Figure 1). More recently, scientists are observing an unexplained high mortality rate of southern right whale calves in the Península Valdés region, which reached a ten-year high in 2013 with 113 dead calves (Rowntree et al. 2013). While no single threat could push the population to extinction, entanglement in fishing gear, habitat degradation, and stressors such as gull attacks adversely influence whale survival, placing the viability of the tourism industry and southern right whale population in this region at risk (Fazio et al. 2012).

Although marine mammal populations in the Patagonian coastal region are recovering from historical hunting, the externalities of coastal development may hinder full recovery. As a result, the benefits generated by abundant marine mammal populations to

Figure 1. *Kelp Gull harassing or attacking Southern Right Whale calf. Photo credit: Stephanie Stefanski.*

community and tourism interests should be considered in resource management strategies.

Research Methodology

This study utilized a structured survey to collect information from tourists about socio-demographics, travel behavior, and perceptions about environmental problems. The final survey was distributed from July until October 2013, capturing the high season for whale watching and collecting 656 responses from international and national tourists. Surveys were conducted in Puerto Madryn, the main town for tourist accommodations, and in Puerto Pirámides, the main town for whale watching. The author and four trained research assistants conducted the surveys in English, Spanish, and French.

This study focuses on the final section of the survey, which addressed environmental threats and, more specifically, the phenomenon of kelp gull attacks on southern right whales. The section first presented a "warm up" question, "What environmental problems have you heard of in this region?" Respondents were then asked their familiarity concerning gull attacks on whales, followed by this statement:

> *There is evidence that kelp gulls, the most abundant bird in the area, have been attacking whales for food. Recently, government authorities in the province have decided to implement management actions to mitigate gull attacks on the whales.*

Tourists were asked if they would pay an additional charge alongside the entrance fee for a general plan to "reduce the kelp gull

population." This starting value was randomly assigned from five Argentinian peso (ARS) amounts [15, 25, 55, 75, 100].[1] Respondents were then asked how much they would pay for Management Plan A, which would improve local waste management in order to eliminate this source of gull alimentation. Supposing Management Plan A were not sufficient, respondents were then asked how much they would pay for Management Plan B. Plan B proposed reducing the gull population by shooting "attacker gulls," kelp gulls that have been observed specifically targeting whales as a food source (Fazio et al. 2012).

I used a proportion test to determine if the proportion of respondents who identified a certain problem was significantly different between the two groups (domestic and international visitors), using the prop.test() function in R 3.1.1 (R Core Team 2014). Values visitors were willing to pay were compared using a t test.

Results and Discussion

Environmental Problems

International and domestic tourists gave similar responses concerning perceived environmental threats to the Patagonian coastal region. In total, respondents listed one or more of eleven thematic problems (Figure 2). The most frequently cited problems were kelp gulls (13.87%), pollution (10.37%), and garbage (16.46%). These problems are related, given that unmanaged garbage has led to the overpopulation of gulls. Pollution was either tied to the presence of garbage or to the presence of factories, such as Aluar, an aluminum mining company located on the

Figure 2. *Perceived environmental problems in coastal Patagonia, international & domestic tourists*

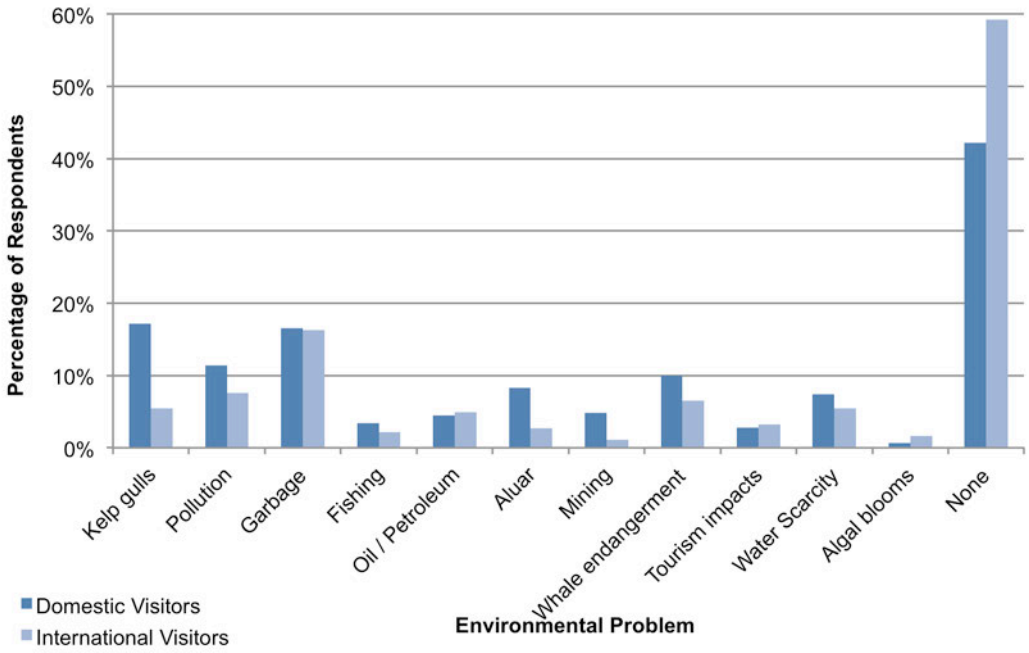

Table 1. *Perceived environmental problems in domestic versus international visitors*

	Domestic Visitors (N = 472, 72%)		International Visitors (N = 184, 28%)				
Environmental problem	**N**	**Proportion**	**N**	**Proportion**	**Chi square value**	**Degrees of freedom**	***p***
Kelp gull	81	0.17	10	0.05	14.271	1	0.0002
Pollution	54	0.11	14	0.08	1.7	1	0.1923
Garbage	78	0.17	30	0.16	0	1	1
Fishing	16	0.03	4	0.02	0.315	1	0.5748
Oil / petroleum	21	0.04	9	0.05	0.001	1	0.9717
Aluar	39	0.08	5	0.03	5.65	1	0.0175
Mining	23	0.05	2	0.01	4.195	1	0.0405
Whale endangerment	47	0.10	12	0.07	1.513	1	0.2187
Tourism impacts	13	0.03	6	0.03	0.008	1	0.9295
Water Scarcity	35	0.07	10	0.05	0.532	1	0.4656
Algal blooms	3	0.01	3	0.02	0.556	1	0.4557
None	199	0.42	109	0.59	14.825	1	0.0001

Table 2. *Management plan mean WTP estimates in domestic versus international visitors*

	Domestic Visitors (N = 472, 72%)		International Visitors (N = 184, 28%)			
Management Plan	$\bar{X}$	**s.e.**	$\bar{X}$	**s.e.**	**t**	***p***
General WTP (ARS $)	33.79	1.59	32.95	2.68	-0.28	0.78
WTP Plan A (ARS $)	37.05	2.73	36.51	2.69	-0.14	0.89
WTP Plan B (ARS $)	18.91	2.87	10.74	1.80	-2.42	0.02

highway between Puerto Madryn and Puerto Pirámides.

Table 1 shows the results of a chi-square test to determine if the proportion of respondents who identified a certain environmental problem was significantly different between domestic and international visitors. In general, responses were not statistically different. Significantly more domestic tourists stated that the kelp gulls (17%), Aluar (8%), and mining (5%) were environmental problems, while significantly more international tourists (59%) did not perceive environmental problems.

Perceptions of environmental problems often depend on individual experiences onsite. While local museums and tour guides present information on the adverse impacts of overfishing and pollution, it appears that most tourists are not well informed about environmental threats to the region.

In general, domestic visitors seemed more perceptive of regional environmental problems (mining, oil and gas extraction and transportation, and water scarcity) than international visitors (Figure 2). While this may reflect the strong effort undertaken by the Administration of Península Valdés each year to maintain the park and local surroundings, the high occurrence of "kelp gulls," "pollution," and "garbage" as stated problems suggests that these threats are the most visible and affect overall perception of the region. The highway connecting Puerto Madryn to the entrance of the protected Península Valdés area not only hosts Aluar, but also features dump sites for municipal waste and fishery processing plants (Figure 3).

Figure 3. *Open-air disposal waste sites and gulls off of the route between Puerto Madryn and Puerto Piramides. Photo Credit: Stephanie Stefanski*

Willingness to Pay

The average respondent was only somewhat familiar with gull attacks on whales (a score of 2.5/5, with 5 being "Very familiar" and 1 being "Not familiar at all"), but still willing to pay an additional entrance fee to manage the population. However, many expressed reservations about how the additional fee would be used, citing concerns about corruption and the current allocation of entrance fees. These concerns seem linked to a lack of familiarity with local politics and administration of funds, which could be made clearer through educational pamphlets and advisories about how entrance fees contribute to the maintenance of the park.

For the general plan, WTP was not significantly different between domestic and international tourists, generating a combined mean WTP of $33.55 ARS (US$ 5.87). In addition, WTP for Plan A was also not significantly different at the 90% level between the two groups, although the average value was slightly lower for international visitors, $36.51 ARS (US$ 6.46) (Table 2). Responses were significantly different between the two groups for Management Plan B. On average, domestic tourists were willing to pay an additional fee of $18.91 ARS (US$ 3.30) while international tourists only stated a WTP of $10.74 ARS (US$ 1.88). Nonetheless, these values are much lower than those given for the general plan or Plan A.

Although all WTP estimates seem low, they need to be accounted for within the context of current entrance fees. Entrance fees to Península Valdés are higher for international visitors than for national visitors. At the time of the survey (June – October 2013), Argentine tourists were charged $40 ARS (~ US$7.00) and international tourists were charged $135 ARS (~US$ 23).

Furthermore, respondents traveling with family stated that they would be unable to visit the park if the entrance fees were significantly increased. As a result, the average

WTP for the general plan and Plan A represent a percentage increase in the entrance fee of 84% and 92% for domestic visitors and 25% and 27% for international visitors, respectively. While domestic tourists were willing to increase the entrance fee by 47% for Plan B, international tourists would only pay an additional 12% increase.

It is clear that the WTP values for these plans are significant. Domestic visitors would almost double the current entrance fee if the additional revenue were devoted to improved waste management and, as a result, improved management of the kelp gull population. Although international tourists were not willing to significantly increase the entrance fee (many stated that the current fee was already too high), they were still willing to contribute a small amount towards improved waste management.

The WTP question presented three management plans, each addressing the most commonly cited environmental problems (pollution, garbage, gulls). Based on the responses, it is pertinent for the Administration of Península Valdés and for city authorities to work together towards resolving these issues. By managing local pollution and the gull population, both domestic and international perceptions of the region would improve. Such quality improvements could justify higher entrance fees, enhancing the welfare for the region, revenue flow of the park, and long-term viability of the wildlife and natural aesthetics.

Conclusion

Administrators and tourism operators are supportive of improved waste management and more sustainable tourism operations in light of these growing threats to the region and their economic livelihoods. The results of this study demonstrate external perceptions and pressures that may spur action to ensure sustainable business and waste management. Tourists' willingness to pay for additional entrance fees, in exchange for conservation of the site's wildlife and aesthetic qualities, can be incorporated into a cost-benefit analysis to estimate the potential net benefits of financing sustainable tourism, waste management, and wildlife management.

Tourism can support conservation and development. International and national visitors to Península Valdés are aware of environmental issues threatening its sustainability. International destinations can serve as a financing mechanism for conservation through responsible use of entrance fees and integrated management of coastal activities. While tourism can have negative effects on communities and ecosystems, these impacts can be mitigated through partnerships with local government and park administrators. For example, the report on *Tourism in a Green Economy* demonstrates that waste management and sustainable business operations have improved financial returns for the private sector, led to job creation, and contributed to overall aesthetics (UNEP and UNWTO 2012).

The results of this study demonstrate the importance tourists place on the protection of the ecosystem and wildlife found within "ecotourism" destinations, and their willingness to pay to ensure its long-term conservation. Economic valuation studies can inform park management and justify increased entrance fees as a means for conservation financing. The results of this study will provide a new set of knowledge for resource managers and policymakers. Park management should find ways to incentivize tourism operators and business owners to implement more sustainable business practices and ensure the long-term viability of the site and

the livelihoods of the communities living within and adjacent to its borders.

Endnote

1. $1 ARS is equal to approximately US$5.62 (July – October 2013)

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IV. CONSERVATION

Improving Conservation Monitoring by Designing Collaborative Research Programs: Lessons from a Camera-Trap Study in Northern Tanzania

Kelly J. Stoner, MESc 2014

Abstract

Quantitatively documenting the impact of wildlife conservation programs on their target species (i.e., wildlife monitoring) is an important component of non-profit program management. While statistically rigorous monitoring programs exist in the scientific literature, such programs are generally designed entirely within a quantitative framework and thus ignore valuable data and insight from other sources, particularly non-scientific participants. Incorporating this other expertise may, however, improve the outcomes of such monitoring programs. During my summer research with the African People & Wildlife Fund (APW) in Tanzania, I designed a long-term monitoring program for large carnivores. The first attempt failed. No cats were photographed during the two-week pilot phase. After incorporating local ecological knowledge with help from a team of local wildlife monitoring officers, the Village Game Scouts, the study photographed significantly more cats. By allowing for greater participation by scientifically untrained staff, I was able to create a viable and flexible monitoring study.

Introduction

There is growing recognition of the need for systematic wildlife monitoring by conservation non-profit organizations (Nichols and Williams 2006:668; Stokes et al. 2010: e10294; Walsh et al. 2012:335). Monitoring allows conservationists to determine the ecological success of their work. Much scientific literature focuses on the statistical assumptions underlying the design of wildlife monitoring programs (e.g., Pollock et al. 2002:105; O'Brien 2013:71). However, relatively little attention is paid to other assumptions that influence monitoring study design. There are a variety of socio-political factors that may challenge non-profit monitoring studies, including lack of capacity, resources, or organizational support and

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buy-in from staff. Overcoming the last of these, staff support and buy-in, is critical for the maintenance and success of long-term monitoring programs. However, even non-profits that manage to address these challenges may struggle to quantify or codify their strategies for doing so and thus lessons learned are not readily transferred across geographies or organizations.

When I arrived in Tanzania in June of 2013, I had two parallel goals for my work with the African People & Wildlife Fund (APW), a small non-profit focused on large carnivore conservation in the Maasai Steppe. My first goal was to establish a long-term monitoring program for large carnivores using camera traps. This well-documented method has been used to study many cryptic species, particularly large carnivores (see O'Connell et al. 2013 for further discussion). My second goal was to train APW's Tanzanian staff to manage the project after my departure.

While designing and piloting the camera trap study I encountered a major applied research challenge for which the scientific literature provided no solutions. I changed the process used to design and implement the study, which in turn corrected the problems we faced in our applied research. The product was a significantly more successful camera trap study design influenced by local ecological knowledge and supported by significant participation by APW's locally-trained wildlife monitoring staff. This case study exemplifies how both applied research and implementation processes must be understood and invoked to design successful non-profit based monitoring programs.

Findings

My responsibilities with APW began long before my plane touched down in Arusha. As a component of my work, I compiled a bibliography of scientific literature on both camera trapping as a method for estimating wildlife populations, and African carnivore ecology (e.g., Karanth and Nichols 1998:2852 and Balme et al. 2009:433). One of our primary study species, the leopard *(Panthera leo)*, is remarkably understudied using this method compared to other elusive and individually-marked large cats such as tigers *(Panthera tigris)* in India and jaguars *(Panthera onca)* in Latin America (Karanth & Nichols 1998:2860; Maffei et al. 2013:119). Despite the critical gap in leopard camera trap studies, the general framework for camera trap studies is well-enough established to now be considered one of the premier methods for studying wide-ranging and elusive species (Nichols et al. 2013:2).

This literature review served two purposes. First, it helped me become familiar with camera trap study design and implementation before arriving in country. The most important factor was the spacing and density of cameras across the landscape, which would influence the types of data we would collect and therefore our analyses. From this literature review, I identified a suitable method designed for a study of leopards in South Africa which could also be used to estimate abundance of lions *(Panthera leo)*, cheetahs *(Acinonyx jubatus)*, African wild dogs *(Lycaon pictus)*, and even spotted hyenas *(Crocutta crocutta)*. The literature review's second purpose was to provide source material for training manuals that APW would use to train wildlife monitoring staff in the future. The camera trap study is meant to be a long-term monitoring program that will run for the next 15 to 20 years, and thus the institutional capacity associated with the camera study must be easily transferable. This was particularly necessary given that I

would only be on the ground for 10 weeks. An unintended consequence of this literature review was that the process for designing the study was restricted to the material available in scientific publications, a limitation which would later hinder the collection of monitoring data.

During the first few weeks of my project, I spent time getting to know the wildlife staff at APW. James,[1] the wildlife monitoring officer and my work partner, was primarily responsible for all wildlife monitoring activity such as spoor (footprint) tracking and game counting and would lead the camera trap study after my departure. James received his masters of science in wildlife management from the Sokoine University of Agriculture and speaks fluent English and Kiswahili. The Village Game Scouts (VGS), a government-trained paramilitary team of eight local community members, were responsible for patrolling the village property and ensuring compliance with community-dictated laws about natural resource use. Their primary function was to prevent the creation of charcoal — a major cause of deforestation — but they also assisted on game counts and spoor tracking exercises. They would be integral in the continued maintenance of the camera trap study. Of the eight VGS, none had a college degree, only one was a woman, and only the leader, Robert, spoke English; the rest spoke Kiswahili and other local languages. Despite the disparity in language and scientific training, it was evident to me that the VGS had gained a great deal of ecological expertise on the wildlife that moved through the village land.

After sorting out the logistical details of the study, including the custom iron security boxes and cement-based poles on which the cameras would be fixed, James and I agreed to use the methods described in my literature to place cameras across the village land. We created a grid of cells with equal areas of 2 km^2, located the GPS location of the intersection of the cells, and placed a pair of cameras at each location as in Figure 1.

We determined the height and angle of the cameras depending on the location to improve the cameras' potential for capturing images of carnivores, and set the shutter speeds in order to maximize the number of images taken of each individual that passed

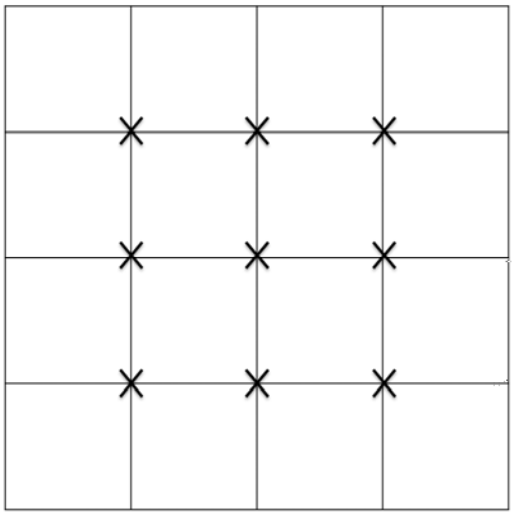

Figure 1. *The initial grid for placing cameras, where "x" indicates the location of paired camera stations. Each cell is 2 km^2, with sides 1414 meters by 1414 meters.*

the lens. While we suspected that some camera locations would not return many photos because they were in places not likely used by carnivores (i.e., the center of a savanna), others were in ideal locations, such as the bottleneck-like pass between two large hills. Since the randomness of the success of each pair of cameras was a critical factor underlying the statistical rigor of the method, we decided that leaving the cameras in unlikely places was scientifically appropriate.

We set the cameras and left them for a full two weeks before checking to see if any photos had been taken. Collectively the cam-

eras recorded 1,530 animal photographs during the test period. To our dismay, however, the photos could not be used to estimate leopard populations. Only six species were photographed in total and there were no photographs of any of the larger predators of interest in our study. Even our "ideal" bottleneck location only returned 800 photographs of dik-dik *(Madoqua kirkii)*, a tiny, domestic cat-sized antelope. The scientific study failed to meet our goal of photographing big cats.

Having invested so much time and energy into the project, James and I were disheartened that our cameras were not capturing images of the big cats. It *should* have worked, because it had worked before in other places. That night at dinner, James and the VGS struck up a conversation about the cameras. One of the scouts mentioned casually that the cameras were just not in places where the animals were; the carnivores had specific trails and places where they traveled across the village. After James translated for me, the scout's statement of our problem set my mind racing. There had to be a way to adapt the camera trap method to account for heterogeneity in wildlife movement across the landscape.

The next day, James and I sat down with Peter (APW's General Manager and logistics guru) to brainstorm ways to adapt the study. During our discussion, I referenced the scientific literature to examine again the reason for the study's geographic structure. Having the cameras regularly spaced ensured that no individual animal had a 0% probability of being photographed; i.e., that all individuals with territories in the study area had at least one camera located within their territories. From the literature on leopard ecology, I knew that leopard home ranges were much larger than two square kilometers and thus the cells were appropriately sized (see Stoner 2014:16 for further discussion). For this reason, I argued that the original grid should be maintained. The solution would lie in the placement of the stations themselves. But how to select the new locations?

Peter proposed we use Google Earth as a tool to assess the landscape from a bird's eye point of view. This would allow us to understand how landscape features might influence carnivore movements. After laying our grid over the study area, we started selecting and flagging potential sites for stations. It quickly became clear that our newest problem would not be finding the locations, but selecting from among many potential locations within each cell (Figure 2).

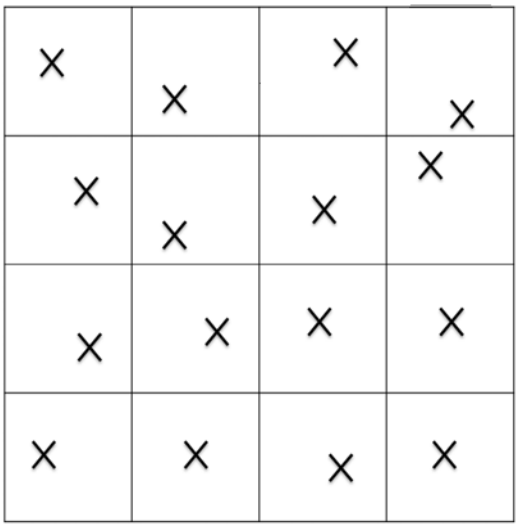

Figure 2. *The new grid in which the Village Game Scouts selected the locations of paired cameras, denoted by "x," within each 2 km^2 cell.*

For several days, James, Peter and I debated the merits of various strategies (i.e., placing cameras at the crossing of streambeds, or at bottlenecks through blocks of forest, or along roads) before I suggested that we allow the VGS to select the locations. Given their extensive patrols around the vil-

lage land, I argued that they had intimate knowledge of the landscape and the wildlife movements. Peter and James agreed to test the VGS' knowledge by allowing them to dictate the location of the camera stations.

The following day, we returned to the field with the scouts and the cameras. After examining all the potential sites in the first cell, I asked Robert his opinion on the best location for the camera station. After he identified the one the VGS thought was best, James turned to the ten-person field crew and instructed them to place the cameras. Robert and the VGS started protesting, asking why we were doing this instead of using our expertise.

"Well, our scientific process didn't work the first time so now we are going to do what you think is best, since you know this area better than we do," I said to him. At first Robert seemed skeptical, but after placing the third station he and the other VGS took more authority in the process. They stopped deferring to James and me before selecting a site, and started working directly with the field crew to place and test the cameras.

The results were both definitive and astounding. Another two weeks of testing resulted in more than 12,000 wildlife photographs. The cameras documented 131 photos of leopards and 7 photos of lions, as well as photos of 44 other species of birds and mammals found in the region.

These results allowed us to estimate a density of leopards between 11 and 19 individuals per 100 square kilometers, comparable to well-known national parks in other parts of East Africa. Furthermore, the VGS took on greater responsibility in maintaining the program following my departure from Tanzania. The program had succeeded in meeting both of my goals: to monitor large carnivore populations, and to build capacity amongst the staff at APW.

Conclusion

I have presented here a unique case in which a statistically rigorous and well-documented camera trap study failed to achieve its goal of estimating local carnivore populations, while a study that utilized the local ecological expertise of non-profit staff yielded valuable results. We assumed that scientific sources would be enough to inform the study's design. However in this instance adapting the implementation of the study and allowing for the inclusion of insights of scientifically untrained participants improved the local applicability of the camera trap method and improved its results. It was only by acknowledging our assumption that local knowledge had nothing valuable to contribute and changing our approach to designing the study that I was able to create an effective monitoring program.

Endnote

1. Names changed to protect privacy of the participants.

Acknowledgements

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Forest Restoration in the Tropical Andes: Active Conservation in a Biodiversity Hotspot

Matthew Bare, MF 2014

Abstract

The tropical Andes of Ecuador and Colombia is a biodiversity hotspot with less than 25% of native forest remaining. In the past few decades, numerous government and non-governmental organizations have instituted forest restoration projects, but there has been little synthesis of restoration actors and general trends. I reviewed 70 restoration projects and consulted with experts in the field to survey a history of forest restoration in the tropical Andes. In the region, most active forest restoration activities are focused in the montane forest ecosystem. Passive restoration is usually practiced in the high altitude páramo ecosystem, while restoration activities in lowland humid forest and dry forest are less common. Large-scale natural forest recovery is also occurring in the region due to economic and social trends. Reforestation has shifted over the past several decades from plantation style, using few, usually exotic species, to a greater focus on ecological restoration using a diverse range of native species. While early projects were state-operated, institutions involved in forest restoration have multiplied in the past decade. Climate change mitigation and adaptation are significant funding sources; regional payments for watershed services have recently become popular, and mitigation banks in Colombia represent a new potential mechanism for restoration financing.

Introduction

Worldwide, the area of degraded forest and abandoned agricultural land is growing, and reforestation, both passive and active, has the potential to conserve significant amounts of diversity, stabilize eroded landscapes, and sequester carbon (Silver et al. 2000). The forests of the tropical Andes are biodiverse yet extremely fragmented (Etter et al. 2008). While Colombia and Ecuador both rank among the top countries worldwide in total biodiversity (IUCN 2013, Chaves and Santamaría 2006, Mittermier et al. 1997), only an estimated 25% of original habitat remains in the tropical Andes (Conservation International 2014).

In order to maintain biodiversity, forest restoration is seen as a regional conservation priority. While restoration projects have increased over the years, few studies have reviewed the various types of projects in practice. Colombia has recently prepared a national plan for restoration (Ospina-Arango

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and Vanegas-Pinzón 2010), largely based on the Society for Ecological Restoration primer (SER 2004), but this guide has little background on field projects in Colombia. Ecuador has even less literature on the subject. This article therefore 1) evaluates the state of restoration science in the region, focusing on geographic, political, and ecological aspects of forest restoration projects, and 2) provides recommendations for the coordination and implementation of current and future restoration activities.

Methodology

To identify forest restoration projects in Colombia and Ecuador, I used internet searches and expert interviews. In Colombia, I consulted regional experts from the Center for International Forestry Research (CIFOR) for a comprehensive list of all major forest restoration projects in the country. In Ecuador, I used several years of personal field experience to identify and select projects. Research was restricted primarily to forest restoration activities in the montane ecosystems of the Andes of Ecuador and Colombia (mostly above 2,000 meters elevation), on projects with more than five years of implementation, and on projects with a native forest restoration goal. Timber plantations using exotic trees were excluded.

Project managers from various sectors (academic, government, NGO) were contacted for background information, project reports, and interviews. Seventy projects, primarily in the montane region, were identified and catalogued. Sixteen sites were visited, and semi-structured interviews were conducted with project leaders regarding history, regional context, implementation, challenges, and outcomes. Semi-structured interviews were also conducted with local experts in forest restoration and conservation. Written project plans, donor reports, and university theses were collected for further consultation. Project data was triangulated using these written reports, interviews with project managers, and third party interviews.

Figure 1. *Study area in Columbia and Ecuador.*

Findings

History of Reforestation Activities in Colombia and Ecuador

Forest restoration has grown and evolved in the past half century in the Andes. Organized government programs were rare until the 20th century (Gade 1999), when large government projects attempted to control mountain erosion from massive deforestation (Farley 2007, Young 1998). Many of these reforestation and afforestation plantations remain today, primarily eucalyptus *(Eucalyptus spp.)* and pine (most frequently *Pinus radiata* and *Pinus patula*). In Colombia, Cypress *(Cupressus lusitanica)*, native to Central America, and Andean alder *(Alnus acuminata)*, native to the Neotropics, are also planted

(Etter and van Wyngaarden 2000). In Colombia, many of these projects were implemented by autonomous regional corporations, while in Ecuador most projects were implemented by the Ministry of Agriculture.

State-Directed Forest Restoration Activities

In the 1990s Colombia's Ministry of the Environment initiated a reforestation project known as Plan Verde (the Green Plan). Implementation was channeled from the Ministry to the regional corporations, who then hired private contractors to reforest small plots on private agricultural lands. Few details about plantings exist, and the two evaluations that were commissioned lack basic project details; the evaluations also criticize the Ministry for lack of coordination and monitoring (Consorcio OTS/AP&A 2010). In Ecuador, reforestation activities in the 1990s and early 2000s were directed by the Ministry of Agriculture and Ministry of Environment central office in Quito, but responsibilities were transferred to provincial offices under the new constitution of 2008. Because of this transfer in responsibility, documentation for projects prior to the early 2000s was difficult to encounter.

In the past few years, however, several institutions have increased their capacity for forest restoration projects. In Colombia, autonomous regional corporations collaborate with the Alexander von Humboldt Institute to use climate change adaptation funding to conduct forest restoration activities, and the national park system has created a restoration department. In Ecuador, the Ministry of Agriculture created a reforestation program in 2008 known as PROFORESTAL, but it was cancelled after a few years. In 2013, the Ministry of Environment initiated a restoration component of SocioBosque, a successful payment for forest conservation program created in 2008 (de Koning et al. 2011).

Forest Restoration and Non-Governmental Sectors

Research universities contribute a significant volume of forest for restoration projects, although most are only a few hectares each in area. In Colombia, the Universidad Nacional and the Universidad Javierana have programs that work in the Bogota region; ICESI University in Cali also works in the western Andean region. Ecuador has less experience, mostly based in Loja in southern Ecuador. These research programs typically conduct baseline biophysical surveys and occasionally create pilot studies. In the Bogota area, some programs focus on solid waste material for soil remediation, while others focus on the rehabilitation of areas invaded by European gorse *(Ulex europea)*.

NGOs and international donors have also grown to play a major role in forest restoration (Andrade-Perez 2007, Meza et al. 2006, CESA-Intercooperation Suiza 1992). International NGOs often conduct forest restoration activities as a community component of their larger landscape conservation priorities; WWF - Fundación Natura in the Pastaza watershed in Ecuador, Flora and Fauna International in the Awa corridor of northern Ecuador, and Conservation International around Bogota serve as pertinent examples. Regional NGOs with significant restoration components include Nature and Culture International in the southern Andes of Ecuador near Podocarpus National Park, and (a different) Fundación Natura in the oak-montane forest of the central Andes of Colombia. In most of these projects, NGOs work with local communities to encourage native species restoration on marginal pastureland, often as fencerows and silvo-

pastoral systems, often as part of larger landscapes connecting protected areas.

Other regional examples that fit this category include the Instituto Alexander von Humboldt and the Global Environmental Facility around Quindio, Colombia; local NGOs and the Instituto Sinchi around Caqueta, Colombia; and Tropenbos and Fundación Ecohomonde in Azogues, Ecuador. Finally, in the Bogota area of Colombia the botanical garden (Jardín Botánico Celestino Mutis) conducts numerous forest restoration projects, focusing primarily on rehabilitation of city parks and areas invaded by European gorse *(Ulex europea)*.

Other regional projects include local government and NGO collaborations, many of which focus on watersheds for drinking water. One of the most studied examples of this project type is the water fund of Quito, Ecuador, FONAG (Benitez 2010, Wunder and Alban 2008). The success of the Quito program has encouraged other programs in the region including Loja and Cuenca in Ecuador and Cali, Medellin, and Bogota of Colombia (Goldman-Brenner 2012, Kauffman 2013). The Quito program has been operating since 2000 and reports to have restored approximately 2,000 ha of land in the last few years, largely in highland páramo. The Nature Conservancy is a key promoter of these water funds, often in collaboration with local governments, NGOs, and water utilities (TNC 2014).

Another sector of forest restoration projects are based on climate change mitigation and funding mechanisms such as the Clean Development Mechanism. In Ecuador, sever-

Photograph 1. Alnus acuminata *planting at seven years in the Colombian Andes. The site is former cattle pasture, now operated as a nature reserve by a Colombian NGO. (Photo Matthew Bare)*

al projects have been undertaken through the Profafor – FACE collaboration. Another recently started CDM project in Ecuador is the ChoCO2 project, facilitated by Conservation International and the local land reserve Maquipacuna. CDM projects in Colombia include the San Nichols project of the BioCarbon Fund of the World Bank (started in 2006 but not yet validated), the Chincina – ProCuenca project, and Más Bosques para Medellín, facilitated by the city of Medellín. All are mixed species reforestation projects initiated in 2009 – 2013 and located in the Colombian Andes. Smaller scale projects use the voluntary carbon market to sell forest carbon credits such as Mindo Cloud Forest, financed by RICOH paper. Other projects around Bogota such as Al Verde Vivo and Acción Verde reforest directly with donations from companies seeking to improve their environmental image. Finally, a new and growing sector of forest restoration comes from mining mitigation. Previously, site remediation had been voluntary, and some companies have restored or rehabilitated sites with active forest plantings, such as the Peldar sand mine in Cundimarca, Colombia. In 2012, the Ministry of the Environment issued a regulation requiring offsite forest mitigation to compensate forest loss from mining activities. In 2013, restoration methodology was still undefined, but this regulation offers significant potential for restoration funding, and groups such as Fundepúblico in Bogota are working to create markets for mitigation.

Analysis

Forest restoration has grown significantly in terms of the number of projects in the Andean region in the last two decades. Universities conduct baseline studies and pilot projects and provide a valuable source of data; university research is significantly more advanced in Colombia than in Ecuador. University data can prove very useful when connected with implementation by an NGO or government project, but studies are often ignored or projects are implemented with little baseline data. Coordinating bodies in Colombia such as the Alexander von Humboldt Institute in Colombia and the RIACRE – Society for Ecological Restoration network have the opportunity and the leverage to connect information and research with practitioners. In Ecuador, however, research and project implementation is becoming very centralized and civil society organizations are weaker. To ensure more successful restoration projects, greater research capacity and coordination is necessary.

Amongst NGOs, international NGOs often work in remote, high biodiversity areas, while local organizations often work closer to urban areas. This allocation of resources allows different groups to focus in different regions. In both cases, however, permanence of projects depends on the time commitment of the organization and the involvement of local governmental authorities. If an NGO leads the project and commits long-term, the project can better respond to changes in local government administrations, which are frequent. If NGO leadership is weak or short term, projects often run the risk of losing permanence when administrations change.

Regional watershed conservation payment for ecosystem service programs are an innovative method for financing local conservation, and have been successful in the tropical Andes (Echaverria 2012). Studies find the success of the reforestation component of these projects to be largely dependent on the framing of the payment or compensation mechanism (Kauffman 2013). International climate change mitigation and adaptation funding represents a significant funding

source, but these projects need to be paired with local institutions in order to achieve permanence, local buy-in, and long-term monitoring. Projects often run into complications when land ownership is unclear or changing. Ownership of the marginal agricultural lands targeted for these projects is often in flux, as the Andean countries undergo rapid urbanization. On top of this, Colombia is undergoing a process of land restitution after decades of rural violence and displacement.

International Payments for Environmental Services (PES), based on carbon, and local Payments for Environmental Services (often based on water) are very different in their governance and social structure. Both provide revenue streams for restoration, but where payments are local the economic support is usually coupled with societal support for restoration. In lowland Amazonian areas with potential for commodity agriculture (e.g., oil palm, soy), locally derived PES is usually insufficient to compete with these alternative land use options. In the mountains, however, locally derived PES may be sufficient because agricultural land use revenue (e.g., potatoes, cattle) is low.

Finally, restoration activities should be considered in the context of regional forest transition. In the tropical Andes, a significant amount of land is returning from pasture and agricultural use back to forest. A recent study (Sanchez-Cuervo et al. 2012) found 28,000 km² of area with increased vegetation cover from 2001-2010, approximately twice as much land as areas that had lost vegetative cover due to deforestation. Most of the reforested areas have occurred from agricultural abandonment in the Andean region (Figure 3), a finding consistent with analysis across Latin America (Aide et al. 2012, Rudel et al. 2009, Aide and Grau 2004). Steep mountain pasture and coffee areas are often the most marginal and are abandoned due to urbanization, low agricultural prices, and / or rural violence (Etter et al. 2008, Etter et al. 2006).

Conclusion

Forest restoration comprises an important contribution to biodiversity and landscape conservation in the tropical Andes, along with tree plantations and conservation of native forest fragments (Hall et al. 2011, Montagnini 2001, Parotta et al. 1997, Murcia 1997, Kattan et al. 1994). As illustrated in the larger landscape, active restoration projects may be a small component of a larger forest recovery dynamic. The ecological value of these passively restored forests compared with that of resource intensive, actively restored forest is a crucial point in restoration ecology (Holl and Aide 2011). Ecologically, natural reforestation of abandoned pasture is found to be facilitated where sites are close to adjacent forest and when some top soil is present, but not when seed sources are far and when top soil is removed (Uhl 1987, Aide and Cavelier 1994, Holl et al. 2000). In a biodiversity hotspot such as the tropical Andes, resources must be maximized to ensure the greatest conservation outcome; potential for passive restoration should be evaluated before active restoration plantings are implemented. Nevertheless, active restoration projects can provide valuable contributions in agroforestry systems, watershed conservation, and urban areas.

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Elephant Ivory Trade in China: Comparing Different Perspectives

Yufang Gao, MESc 2014

Abstract

Poaching of African elephants for their ivory has been unsustainably high in recent years. International conservation groups often attribute the problem to China's internal ivory trade. Chinese actors hold a wide variety of perspectives. This paper unveils the nuanced social context of the ivory trade within Chinese society. Data came from analysis of Chinese news articles, interviews, and participant observation. Chinese actors are generally organized around three perspectives: "pro-trade," "anti-illegal-trade," and "anti-all-trade." These different perspectives manifest themselves in the identities, demands, and expectations of different actors. "Pro-trade" and "anti-illegal-trade" are the dominant perspectives, while "anti-all-trade" is an emerging perspective. Internal factors such as the ivory auction ban and external foreign pressures influence the social dynamic. Long-term African elephant conservation requires a pragmatic and workable way to address the different perspectives in a manner that clarifies and secures the common interest.

Introduction

Poaching of African elephants *(Loxodonta africana)* has reached an unsustainable high in recent years (CITES et al. 2013). The International Union for Conservation of Nature (IUCN) reported that 15,000 African elephants were illegally killed at 42 monitored sites in 2012 (CITES et al. 2013). The estimated poaching rate has exceeded the natural population growth rate (CITES et al. 2013). This jeopardizes the global common interest in a viable future for African elephants (CITES 2010).

Yufang Gao has a longstanding interest in interdisciplinary research and practice of wildlife conservation. He is from China, and holds a bachelor's degree in Biology from Peking University. He focused his study at Yale F&ES on the social process of international ivory trade. Prior to his arrival at Yale, he worked with some of the most prominent Chinese conservation groups including Shanshui Conservation Center and Nyanpo Yutse Conservation Association.

The global community considers demand for ivory[1] a key driver of elephant poaching (CITES et al. 2013). Despite the fact that the international commercial trade in ivory has been banned since 1989 (UNEP et al. 2013), domestic ivory trading remains legal in many countries (Martin and Stiles 2008). Among all countries, China is the primary destination of illegal ivory (Underwood et al. 2013). Many non-governmental organizations (NGOs) assert that the Chinese ivory trade control policy is widely abused (EIA 2011, Gabriel et al. 2012). Furthermore, they believe China's economic prosperity has created a middle class with a huge demand for ivory, and this thereby fuels the elephant poaching in Africa. Chinese authorities disagree with these claims (CITES Management Authority of China 2012) and request that western societies take an objective view of the ivory trade in China (Anon 2014). The dispute is still ongoing. It is an all too common phenomenon

in many issues pertinent to China's growing influence over natural resources in Africa (Mol 2011).

In this paper I elucidate Chinese perspectives[2] on the elephant ivory trade. I analyze the Chinese actors and their respective demands and expectations, thereby distinguishing three perspectives currently existent in Chinese society: "pro-trade," "anti-illegal-trade," and "anti-all-trade." I discuss the social dynamics of different perspectives and their implications. I conclude with recommendations on adjusting the current social process (Lasswell 1970, Clark 2002) for the common interest.

Methods

Data came from multiple sources. In September 2013, I gathered ivory-related Chinese news articles on the Internet using news.baidu.com, the most popular Chinese-language search engine. I sought articles containing "象牙" (elephant ivory) in the titles. I reviewed all articles retrieved (n=2,753), and excluded non-relevant and duplicated results. Eventually, I focused on 1,327 articles published in newspapers, magazines, or news websites from January 2003 to September 2013. I recorded the titles, publication dates, and links to the web pages. I coded the themes of the articles into seven categories, and categorized the articles accordingly into seven groups (Table 1). Four groups are relevant to the discussion at hand: Group 1, "ivory arts and trade," represents the "pro-trade" perspective; Group 2, "ivory crimes," and Group 3, "government policy," represent the "anti-illegal-trade" perspective; whereas Group 4, "Chinese participation," concerns the "anti-all-trade" perspective.

In addition, from June 2013 through January 2014, I carried out extensive fieldwork in Kenya, China, the United States, Botswana, and Tanzania. In China I conducted formal and informal interviews with government officials and conservation practitioners. I visited legal and illegal ivory markets and had conversations with ivory traders and buyers. Moreover, I participated in the IUCN African Elephant Summit, and interacted with high-level Chinese government officials. All these experiences helped me to see and clarify the different perspectives presented in this paper.

Results

Chinese actors are organized around three perspectives: "pro-trade," "anti-illegal-trade," and "anti-all-trade." Different perspectives manifest themselves in the identities (who they are), demands (what they want), and expectations (matter-of-fact assumptions) of different actors (Clark 2002).

Pro-trade Perspective

Ivory professionals (e.g., ivory carvers, traders, collectors, and speculators) generally hold a "pro-trade" perspective. The Ivory Carving Committee under the China Arts & Crafts Association is an organized group representing the industry's interest. By the end of 2013, there were a total of 37 licensed ivory processing factories and 145 licensed ivory retail outlets in China (SFA, 2013). Apart from the "white" legitimate ivory facilities, ivory products are traded in the "black" unlicensed shops, and the "gray" live auction market whose legality is vague (Gao and Clark, *In Prep*).

The pro-trade perspective is reflected in the Group 1, "ivory arts and trade" articles (n=436). This perspective is embedded in the belief that ivory carving is a part of traditional Chinese culture that should be preserved. The Chinese Ministry of Culture des-

Table 1. *Different groups of Chinese news articles on ivory trade.*

Group	Number	Article Feature
1. Ivory arts and trade	436	Ivory culture, ivory carvers, and the auction, exhibition, collecting and investing of ivory artworks.
2. Ivory crimes	483	Chinese authorities combating ivory illegal activities, for example, smuggling, transporting, trafficking, and theft.
3. Government policy	26	Chinese government's responses to international criticisms (n=12), and the ivory trade control policy (n=14).
4. Chinese participation	23	Chinese participation in elephant conservation, including investigative reports written originally by Chinese journalists.
5. International news	186	Elephant poaching and ivory trafficking in foreign countries, as well as views and actions taken by foreign governments and international organizations.
6. Ivory in Archeology	119	Discovery of ancient ivory.
7. Others	54	Articles that do not fit into the categories above.

ignated ivory carving as a national intangible cultural heritage in 2006 (Chinese State Council 2006). Master ivory carvers believe it is their responsibility to transmit this heritage to future generations (Zeng 2012). The industry strives to promote ivory culture in exhibitions, newspapers, TV, and the internet.

Many ivory professionals think that ivory carving is currently undervalued. They argue that neither the demand for ivory nor the ivory price is high (Gao and Zheng 2012). They expect opportunities for value appreciation of ivory artworks, since ivory has many values that Chinese society cherishes and it is becoming rare in the market. The perceived monetary return has attracted a crowd of speculators to invest in ivory artworks. Speculators care little about the cultural and aesthetic aspects of ivory carvings. They support the ivory trade because they profit from the business.

Anti-illegal-trade Perspective

The Chinese government takes an "anti-illegal-trade" perspective. The authorities approve regulated, controlled ivory trading, but they are determined to "eliminate" the illegal trade. The State Forestry Administration (SFA) is the chief department in charge of the domestic ivory trade. The General Administration of Customs, the Ministry of Public Security, and the State Administration for Industry & Commerce are also involved in tackling illegal ivory activities. Their perspective is reflected in Group 2, "ivory crimes" articles (n=483).

This perspective is rooted in the belief of sustainable use of natural resources. It is manifested in the goal of China's ivory trade

control policy: "to attend simultaneously to elephant conservation and ivory carving culture preservation" (SFA 2008). To meet this end, the authorities apply coercive (law enforcement) and educational strategies to combat illegal trading and regulatory strategies to control the legal market.

Responding to international criticisms, the authorities often argue that western conservation groups and media use misleading and inaccurate information (CITES Management Authority of China 2012). This official standpoint is frequently expressed in Group 3, "government policy" articles (n=26). The authorities are concerned that exaggerated information (e.g., about ivory price and demand) can stimulate poaching and trafficking. They often note the other causes of elephant decline, such as habitat loss and human-elephant conflict. They also highlight the responsibilities of African countries. They demand respect and trust from the international community, and call for effective international cooperation.

Anti-all-trade Perspective

"Anti-all-trade" perspective promoters are some animal welfare and conservation NGOs. Almost all groups are the Chinese branches of international organizations. Among them, the International Fund for Animal Welfare (IFAW) is the most active. IFAW conducted several investigations about the ivory trade in China (IFAW 2006, Gabriel et al. 2012). Their reports are frequently quoted in Group 4, "Chinese participation" articles (n=23). In addition to IFAW, other participants include WildAid, the Wildlife Conservation Society (WCS), WWF, TRAFFIC, and The Nature Conservancy.

The anti-all-trade group generally believes that "if there is no trade, there is no killing". In the international arena, the organizations are calling for a moratorium or a ban on China's domestic ivory trade. Some of the organizations believe ivory trade is immoral and should never be approved, while others can potentially accept a regulated trade but think it is unrealistic to allow the trade at this moment. The organizations are trying to mobilize Chinese public support through a number of education campaigns. Their messages to the Chinese audience tend to be more conservative than what they advocate in the West. Their opposition to illegal trade is conspicuous, but their attitude towards legal trade is ambiguous.

Discussion

Chinese society is not homogeneous; different perspectives on ivory exist. "Pro-trade" and "anti-illegal-trade" are the dominant perspectives, while "anti-all-trade" is an emerging perspective. "Pro-trade" and "anti-illegal-trade" are interrelated. Their relative significance in Chinese online discourses indicates an evolving societal focus, as well as underlying power dynamics (see Figure 1). For example, in 2011 when the Chinese domestic ivory market was the most active (Gao and Clark, *In Prep*), there were twice as many pro-trade articles as anti-illegal-trade ones. In comparison, in 2013 (up to September), there were 2.7 times more anti-illegal-trade articles than pro-trade articles. This was probably because growing international attention on ivory trafficking pushed the Chinese authorities to strengthen their law enforcement efforts.

Perspectives are not static. At the close of 2011, the anti-illegal-trade SFA imposed a "ban" on the live auction market of ivory artworks. The ban has seriously impacted the market and restricted the increase of ivory prices (Gao and Clark, *In Prep*). This policy intervention affects the expectations of pro-

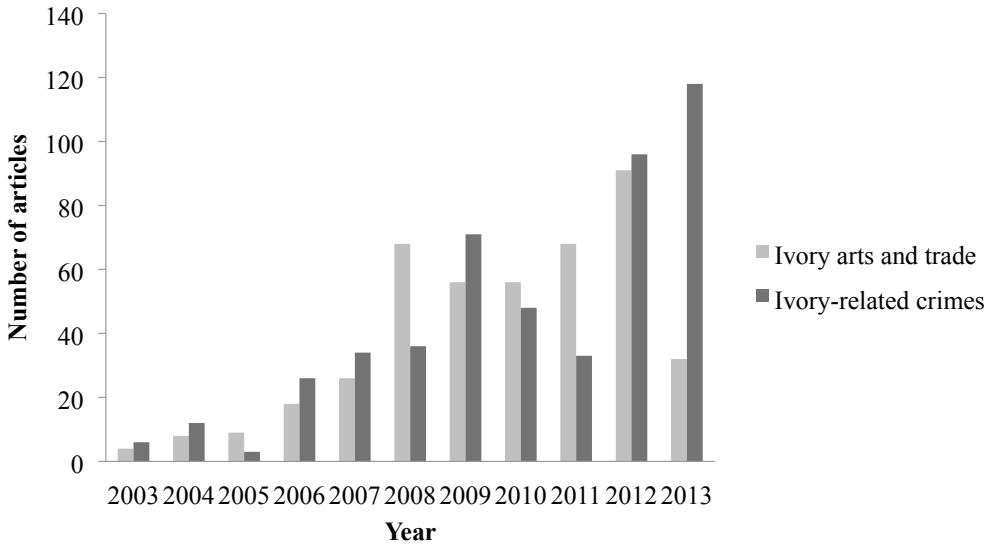

Figure 1. *Trends of "pro-trade" and "anti-illegal-trade" discourses from 2003 to 2013. In 2011 when Chinese ivory markets were the most active, pro-trade "ivory arts and trade" news articles were twice as many as anti-illegal-trade "ivory crimes" articles. In 2013 growing international attention on ivory trafficking pushed the Chinese authorities to strengthen their law enforcement efforts, which resulted in more "ivory crimes" news articles.*

trade groups. Some pro-legal-trade ivory traders—owners of licensed shops, for example—feel the auction ban boosts their business, as consumers are encouraged to buy ivory in the legal market (Zhao 2012). But for the speculators who previously took advantage of the policy loopholes, the ban frustrates them because it reduces liquidation opportunities and thus increases the risk of speculation (Anon 2012).

It is likely that diplomatic pressures resulting from international criticisms have enhanced decision makers' concern about China's global reputation and other long-term national interests, which therefore empowers the anti-trade groups. The Chinese government crushed approximately six metric tons of confiscated ivory in January 2014. This was unexpected by most NGOs. It happened partly because the ivory crush and its symbolic meaning are in accord with the dominant anti-illegal-trade perspective, which enjoys considerable political support among Chinese actors.

Awareness about ivory trafficking has substantially increased in the past two years. The anti-all-trade perspective is gaining momentum. However, a ban on domestic ivory trade remains elusive. The current social context is not conducive to a trade ban which would be a radical departure from existing policy. A moratorium may become possible if the legitimate part of the pro-trade group is convinced that the elephant crisis undermines their interests, as well, and the best solution lies in a temporary stopping of ivory trade. This necessitates a consensus on problem definition and it requires internal negotiations among government departments with different agendas. As internal and external pressures keep raising the stakes, it is not impossible that the central Chinese government will respond to the public request and take the ivory issue as an

opportunity to address other concerns (e.g., anti-corruption). After all, economically the ivory industry means little to China.

Conclusions

The ivory trade is a complex issue involving many different actors with various demands and expectations. The long-term viability of African elephants depends on whether participants in the policy process are able to find a workable way to resolve their different views and disagreements. A common goal is unrealistic, but understanding the differences and similarities can potentially improve communication and help find a common ground, based on which a broad and effective coalition for African elephant conservation may become possible.

Endnotes

1. "Ivory" refers exclusively to elephant ivory unless otherwise stated.
2. By perspective, I mean "a particular attitude towards something; a way of thinking about something" (Oxford's Advanced Learner's Dictionary).

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Forest Inventory and Quantification of Stored Carbon in the Bolivian Chaco

Ellen Arnstein, MEM 2013

Abstract

This research aimed to quantify forest carbon stocks for a payment for watershed services project in the Integrated Management Natural Area Rio Grande – Valle Cruceños, Bolivia. A tree inventory was conducted in Yumao, Bolivia, a transitional area between dry and Bolivian-Tucuman forest types, using eight 0.25 ha permanent plots to evaluate forest structure and floristic patterns and generate basic data about forest biomass and carbon sequestration. All trees with a diameter at breast height of at least 10 cm were sampled to provide information on their size (diameter and height), species, health, and coverage with woody vines; understory species were also measured and identified in sixteen subplots. This data was then used to calculate frequency and importance values at both the species and family levels. A total of 986 individuals, representing 52 tree species belonging to 24 botanical families, were identified. The forest was dominated by relatively few species, particularly *Phyllostylon rhamnoides*, *Anadenanthera colubrina*, *Pisonia zapallo*, *Calycophyllum multiflorum*, and *Ruprechtia apetala*. The estimation of biomass volume is essential to measure storage and flows of carbon in forest ecosystems. Since destructive measures to calculate biomass were not possible, the generalized allometric equations for dry forest developed by Brown (1997) and Chavé et al. (2005) were used with the result of biomass values of 48.12 t/ha and 61.93 t/ha respectively.

Introduction

Deforestation in the lowland plains of Bolivia is continuous and increasing primarily as a result of the expansion of agricultural activities which contribute not only to the loss of valuable plant and animal species but also to climate change; 80% of the greenhouse gas emissions in Bolivia are the result of land use and land cover change (UNFCC 2006). As a result, the incidence of extreme weather events that cause flooding or, conversely, reduced stream flow occur more frequently—a particular threat in the Rio Grande watershed. Given this problem, Fundación Natura Bolivia, which specializes in the development of financial mechanisms for conservation, has entered the voluntary carbon market to consolidate stocks of carbon in community forests. My research, therefore, aimed to take the necessary step of supplying the Foundation with biomass measurements with an application consistent with the Bolivian context. While various factors prevented measurements consistent with

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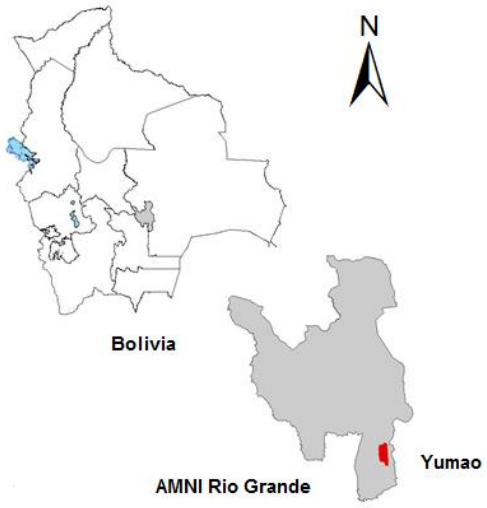
methodologies developed by organizations such as Winrock International, my research contributes to an improved understanding of the floristic patterns, composition, and forest structure of the transitional dry forest found in the study area of Yumao and offers a good starting point for further quantification of stored carbon.

Background

The mission of Fundación Natura Bolivia, formed in 1999, is to conserve critical ecosystems and improve the quality of life of Bolivian people through alternative financial mechanisms. Their central initiative is reciprocal water agreements where annual direct payments are made to farmers in return for forest conservation, ensuring the provision of water to downstream communities. The Foundation also offers compensation to farmers in the form of beehives and beekeeping training, fencing for their land, or fruit trees for every 10 hectares of protected forest. To date, more than 600 farmers have signed agreements to conserve more than 30,000 hectares of forest (Huayrana 2012).

The town of Yumao and the study area fall within the Integrated Management Natural Area Rio Grande – Valle Cruceños (Spanish acronym ANMI RG-VC). The ANMI RG-VC, located in the center of the Rio Grande watershed, was formed with the objective of conserving forests, lessening the impact of flooding and drought in the area, and protecting biodiversity while demonstrating the touristic potential of the valley's unique culture and history (Figure 1). Within its 734,000 ha area, five large ecoregions are represented: Tucuman-Bolivian forest, inter-Andean dry forest, Chaco Serrano, Gran Chaco, and the Yungas (Ibisch et al. 2002). Previous vegetation studies have found 36 vegetation series composed of 2,415 individual plant species including 55 that are endangered (Fundación Natura Bolivia 2009). The ANMI includes the municipalities of Cabezas, Gutiérrez, Samaipata, Vallegrande, Postrervalle, Pucará, and Moro Moro; according to the 2001 Bolivian census, the area has a population of approximately 69,000 persons for whom the principal activity is agriculture and ranching (Instituto Nacional de Estadistica 2001).

Figure 1. *The study area of Yumao*



Yumao is located within the Rio Grande Integrated Management Natural Area (AMNI) of Santa Cruz, Bolivia. The AMNI is highlighted in grey and Yumao is in red.

Yumao, located within the Gutiérrez municipality, is home to approximately 20 families, of which one third are indigenous Guarani. Yumeños are primarily subsistence farmers and fishers. However, Gutiérrez municipality has developed a tourism plan to promote sport fishing, ecotourism, and historical and cultural attractions with the hope of diversifying the local population's income, while contributing to the conservation of the natural patrimony that the region possesses.

There is some confusion as to the specific ecotype of the study area. According to one of the early biogeographies of the region, Yumao is characterized primarily as Chaco Serrano, with some traces of Gran Chaco (Cabrera and Willink 1980). The National Service for Protected Areas (SERNAP) describes the zone as a high-to-medium altitude mountainous area, and Navarro et al. (2007) describe the site as a transitional area between dry forest and Bolivian-Tucumano. Yumao receives less than 1,500 mm of precipitation per year and experiences a dry season that lasts more than five months. In terms of soil types, FAO's (2007) soil map classifies the area as BK2-C, a mixture of calcic cambisols and chernozems. Yumao covers approximately 6,000 ha but due to jurisdictional conflicts among *capitanías* (traditional Guarani land administration units) only about 1,600 ha are under conservation. It was with this area in mind that the study was designed.

Methodology

Sampling Methodology

Designed for silvicultural purposes, permanent sample plots are being used with increasing frequency to carry out qualitative and quantitative comparisons between study sites. They also offer the possibility to observe long-term changes in species phenology and forest dynamics. In this manner studies can show how forests respond to intervention; determine change in measured characters like trees' diameter at breast height, basal area, and/or volume; establish mortality and recruitment; and update forest carbon sequestration amounts.

Following the protocol developed by BOLFOR (the Bolivian Forest Service) (BOLFOR 1995, 1998; BOLFOR and PROMABOSQUE 1999), eight permanent

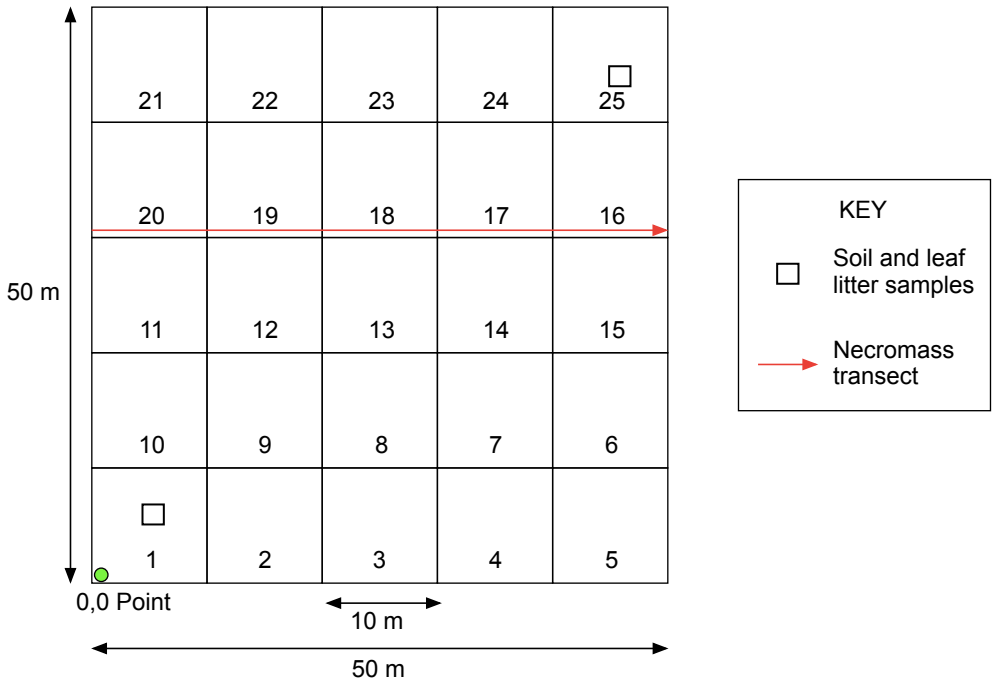


Figure 2. *Layout of permanent plots. Each 50m x 50m plot was divided into 10m x 10m subplots. Point 0,0 is located in the south-west corner of the plot.*

sample plots of 50 x 50 m (0.25 ha each for a total of 2 ha) were installed in Yumao to measure trees, bushes, herbaceous plants, soil, and necromass. Rather than taking GPS points for every tree in the plot, we took a GPS point at each plot corner and divided the plot into 10 m by 10 m subplots. In each subplot, the tree locations were recorded as x, y distances from the subplot corner (Figure 2).

Regarding degraded forest, conflicts exist among the protocols developed by BOLFOR; specifically, their 1999 protocol states that the plot location should not be changed if they fall within poor-quality forest. However, in another publication they recommend increasing the distance between plots by a factor of 1 to 1.15 if the plot falls within degraded forests or is too near to the study area's limit (BOLFOR 1995). The present study installed plots in forests that did not have evidence of burns or agriculture, increasing the distance between sites where necessary.

Measurement and Identification

Each tree with a diameter larger than 10 cm was marked with a numbered aluminum plaque, identified to species, measured (height, DBH) and characterized according to percent coverage by woody vines, health, canopy position, exposure to light, and crown quality. Dead trees were also measured but not marked.

In sub-plots one and twenty-five, located at the extremes of the plot, all the saplings and bushes measuring between 2.5 and 9.9 cm diameter were identified and their height and diameter were measured. We chose to locate the subplots as such because they would be in areas least disturbed from the process of delineating and measuring the plots. Vegetation samples were collected and pressed in the field. Each registered specimen was identified using morphological keys, the herbarium at the Museo Noel Kempff Mercado, and the expertise of Bolivian botanists.

Biomass Calculation

One approach to quantifying carbon biomass stores consists in inferring changes from long-term forest inventory plots. As such, regression models are used to convert forest inventory data such as height, DBH, and wood density as determined by tree species into an estimate of aboveground biomass (AGB). Ideally these allometric equations are developed specifically for the study area in question.

Unfortunately the dry forests of Bolivia, Paraguay, and Argentina lack specific regression equations, and developing them was beyond the scope of this study due to restrictions on harvest and time limitations. Instead, we chose to compare the most widely used generalized equations developed for dry forests:

$$AGB = \exp\{-1.996+2.32*\ln(D)\}$$

(Brown 1997)

$$AGB = .112 * (\rho D^2 H)^{.916}$$

(Chavé et al. 2005)

Differentiating the two equations is the fact that the Brown equation relies solely on the datum of DBH whereas Chavé's equation includes the tree's height and density as well.

Results

Forest Structure

The plots were distributed among flat, hilly and peak locations; some demonstrated past evidence of human intervention such as cattle pasture (Plot 3) and wood harvest (Plot 2). The canopy measured between 10 and 18 meters in height with a predomi-

nance of *Phyllostylon rhamnoides*, *Anadenanthera colubrina*, *Pisonia zapallo*, *Calycophyllum multiflorum*, and *Ruprechtia apetala* species.

The understory of the plots varied according to topography. For example, on the slopes vegetation was sparse and dominated by garabata *(Bromelia serra)* and cactus. In total, 52 tree species belonging to 24 botanical families were identified (for a full list see Appendix 1) of which Ulmaceae, Fabaceae, and Malvaceae have the highest importance values, based on their relative frequency, relative density, and relative dominance (Figure 3).

The incidence of new species became less and less frequent as the inventory was completed. This allowed us to assess the reliability of our inventory and could be used to extrapolate the total number of species that would be present in the entire study area. In terms of diameter, the structure of our sample site showed a reverse J curve, with a higher number of small-diameter trees in almost every plot (Figure 4).

Biomass and Stored Carbon

To calculate biomass according to Chavé et al.'s (2005) equation, which includes wood density, this study used Zanne et al.'s (2009) tables. Some regional species (e.g., negrillo, cuchimara, chichapi, lanza, athyana), which were not included in this source, were available from Argentina's National Institute for Industrial Technology (INTI 2012). If a species did not have a recorded density, the average of the genera, the family, or the entire list (0.639 g/cm3) was used (Dauber et al. n.d.). There was no density data available for the Cactaceae family so they were removed from the calculations. Standing dead trees were measured using the same methodology but only taking 70% of

Figure 3. *Importance value by family. Importance value is calculated by taking the average of the family's relative frequency, relative density, and relative dominance. In Yumao's forest Ulmaceae, Fabaceae, and Malvaceae have the highest importance values.*

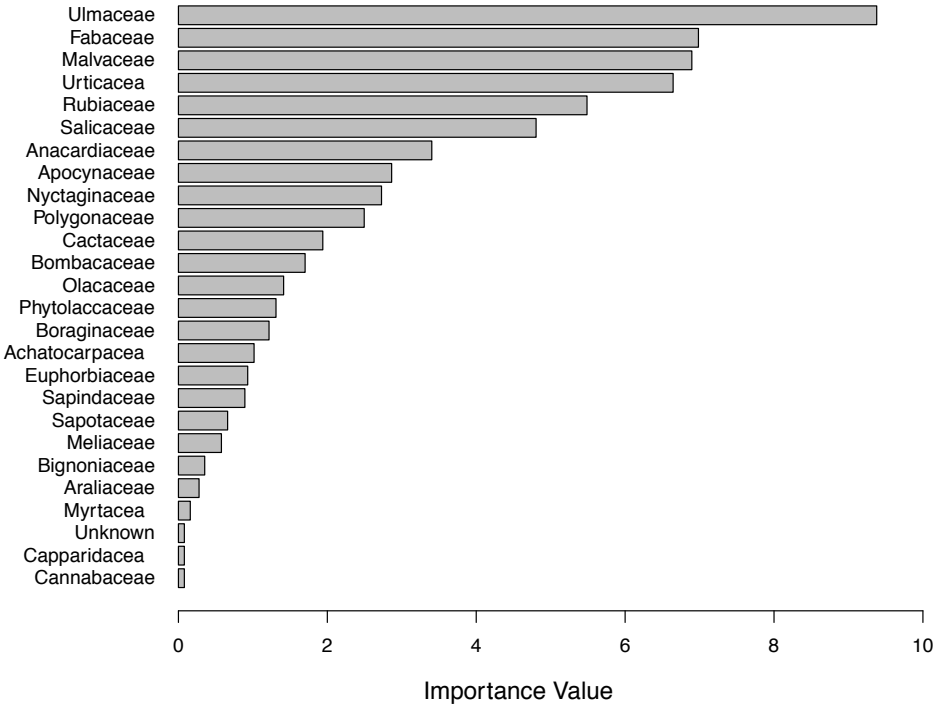
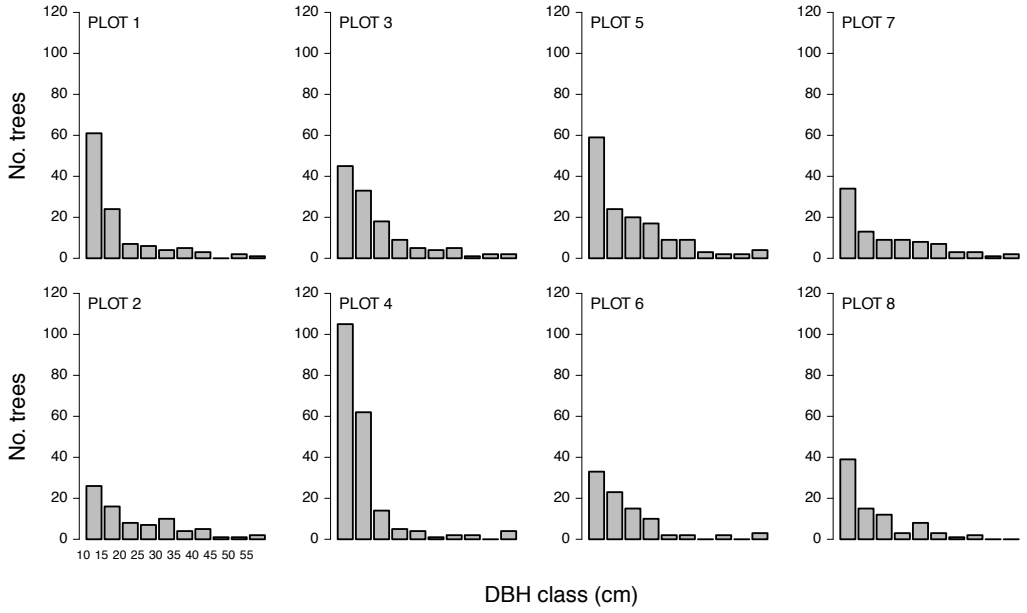


Figure 4. *Diameter distribution of Yumao forest. Our study area shows a higher number of small-diameter trees in almost every plot.*



the equation's result to account for decomposition and the subsequent loss of biomass.

Biomass is an approximate measure of the carbon contained in trees with DBH greater than 10 cm. Specifically, the carbon is roughly 50% of the aboveground biomass (Brown and Lugo 1992, IPCC 2006). The plots in Yumao (2 ha total) had a biomass—for live trees, dead trees, and shrubs—of 495.42 t following Chavé et al. (2005), and therefore carbon content of 123.86 t/ha) and 384.97 t following Brown (1997; or 96.24 t/ha of carbon). Biomass was also calculated for herbaceous plants, leaf litter, necromass, and soil but is not included in these figures.

Discussion

Forest Structure

The majority of the trees identified and measured in Yumao were those typically associated with topographic conditions unique to dry forests and the Chaco. Some species however, in particular those of the Cactaceae family, are more associated with Bolivian-Tucuman forest. In general, this combination of species indicates what Navarro et al. (2007) characterize as pre-Andean transitional dry and semi-arid Chaco forest. The incidence of new species became less and less frequent as the inventory was completed, which is what one would expect in a typical species accumulation curve.

Tropical dry forests are generally composed of smaller trees and are less diverse than tropical rain forests. In fact, on a scale of several hectares, tropical dry forests have approximately half the number of species found in wet forests (Murphy and Lugo 1986; Gentry 1995). Although family richness is due to the high variability between dry forests, which makes generalizations across areas difficult, the 52 tree species identified in Yumao fall within the parameters established by several studies across dry forests. For ex-

ample, Murphy and Lugo (1986) recorded a range of 35 – 90 species and Gillespie et al. (2000) noted between 34 – 81 species in a summary of eight studies over 28 lowland tropical dry forest sites.

In a forest the dynamics of growth and development of their populations is quite variable and a complex relationship exists between species and even between individuals of the same species. One of the indicators that can determine the degree of stability of a forest in time is the distribution of diameter sizes. Generally in wild multiple-age populations, individuals of smaller diameter are much more numerous than those of larger diameter. The structure of our sample site was consistent with this idea (Figure 4).

Biomass Estimation and Stored Carbon

Usually sample size is determined by admissible error on the estimate of the parameter of interest, in this case biomass. In terms of determining the biomass of the forest in Yumao, preliminary calculations revealed that more study plots are necessary. Using the formula,

$$n = \frac{t^2 \gamma^2}{d^2}$$

where the t-value is 2, γ represents variance, and the desired precision (d) is +/- 10, resulted in a recommendation for 44 or 90 plots in Yumao. The former figure only refers to the aboveground biomass, whereas the latter relates to all carbon sources including soil. The sample-size calculator developed by Winrock (http://www.winrock.org/Ecosystems/tools.asp) recommends setting up 42 study plots based on our preliminary data and according to the criteria developed for land-use land-change studies. In order to carry out a kriging calculation, a group of geostatistical techniques to extrapolate values from the study area, future studies in the AMNI RG-VC will require between 50 and 60 plots. It would therefore be misleading to compare our preliminary results with other more comprehensive biomass studies.

Recommendations

As part of the study done for Fundación Natura Bolivia, several recommendations were made in a formal report and presentation (Arnstein 2012). Foremost among them were: implementing the use of satellite imagery, reconsidering the use of permanent plots, and studying the specific context of dry forests in biomass measurement.

To facilitate fieldwork and improve the precision of measurements and subsequent carbon calculations it would have been useful to divide the project area into relatively homogenous strata of human intervention and/or elevation. Useful tools to accomplish this goal would be "ground-truthed" satellite images, aerial photographs and vegetation, soils, and topographic maps. I would also recommend that the locations of the plots be determined by map, sizing them to correlate with the size of remote sensing image pixels, such as Landsat.

The disadvantage of permanent plots is that their location can be known and can therefore be treated in a different way than the rest of the study site. In a community as small as Yumao it will be difficult to assure that this does not occur.

In regard to future carbon studies, according to Brown (1997), biomass estimations in the majority of forests can be based on trees with a diameter equal to or greater than 10 cm. However, for forests composed of shorter trees such as those found in arid areas like Yumao it is recommended that all trees with diameters above 5 cm be measured. Additionally, approximately three per-

cent of the trees measured were not broad-leafed species (i.e. belonging to the Cactaceae family) for which densities have not yet been calculated.

This research provided much information about forest structure and species composition in the under-studied transitional area between dry and Bolivian-Tucuman forest types. In addition, Fundación Natura Bolivia now has basic data about forest biomass in the area and a more solid methodology which they will use to expand the study to the entire AMNI-RG. The knowledge they continue to gather will be used to not only monitor forest growth and change but to also provide alternative carbon market-based financing mechanisms to support Bolivian smallholders.

Acknowledgements

This study would not have been possible without the support of Huascar Azurduy, Tito Vidaurre Sanchez, Maria Teresa Vargas, and Oswaldo Maillard of Fundación Natura Bolivia; Aquilino Molina Olivera and Ivan Linneo Forronda of Museo de Historia Natural Noel Kempff; CIAT Bolivia; funding from Yale's Tropical Resources Institute; and the gently mocking counsel of my ad-hoc advisors Gordon Geballe, Florencia Montagnini, Tim Gregoire, and Mark Ashton. This article is dedicated to the community of Yumao which housed me, fed me, and invited me to go fishing.

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Appendix 1. List of Trees: Common Name, Scientific Name and Family

Common Name	**Scientific Name**	**Family**
ajo ajo	*Gallesia integrifolia* (Sprengle) Harms	Phytolaccaceae
algarrobo	*Caesalpinia paraguariensis* (Parodi) Burkart	Fabaceae
bouganvilla, zapallo (plot 2)	*Bougainvillea modesta* Heimerl.	Nyctaginaceae
cacha	*Aspidosperma quebracho-blanco* Schltd.	Apocynaceae
café con leche, sombra del toro	*Sideroxylon obtusifolium* (Humb. Ex. Roem & Shult.) T.D. Penn	Sapotaceae
cala pierna, roble	*Amburana cearensis* (fr. Allen) A. Co. Sm.	Fabaceae
caracore	*Cereus sp.*	Cactaceae
caraparí	*Cereus comarapanus* Cardenas	Cactaceae
cari cari	*Acacia loretensis* Mac.	Fabaceae
cedro	*Cedrela lilloi* C. DC.	Meliaceae
chari	*Parapiptadenia excelsa* (Griseb.) Burkart	Fabaceae
chichapí	*Celtis chichape* (Gard.) Mig	Cannabaceae
chika chika	*Randia cf. boliviana* Rusby	Rubiaceae
chiki chiki	*Agonandra excelsa* (Griseb)	Opiliaceae
chorokete	*Ruprechtia triflora* Griseb.	Polygonaceae
coca de cabra	*Capparis speciosa* Griseb.	Capparidaceae
comomosí	*Bougainvillea stipitata* Griseb.	Nyctaginaceae
cordia, unknown 6	*Cordia alliodora* (Ruiz & Pavon) Cham.	Boraginaceae
cuchi mara	*Loxopterygium grisebachii* Hieron. & H. Lorentz	Anacardiaceae
cuchi	*Astronium urundeuva* (Allemao) Engl	Anacardiaceae
curupau	*Anadenanthera colubrina* (Vell. Conc.) Benth	Fabaceae
cuta	*Phyllostylon rhamnoides* (Poisson) Taub.	Ulmaceae
itapallo	*Urera baccifera* (L.) Gaudich. Ex Wedd.	Urticaceae
jichituriqui	*Aspidosperma pyrifolium* C. Martius	Anacardiaceae
lanza	*Saccellium lanceolatum* Hump. & Bonpl *(Cordia saccellia)*	Boraginaceae
limoncillo	*Ximenia americana* L.	Olacaceae
mani, tipilla (plot 1)	*Diplokeleba floribunda* N.E. Brown	Sapindaceae
momoki	*Caesalpinia pluviosa* D.C.	Fabaceae
negrillo	*Achatocarpus praecox* Griseb	Achatocarpaceae
palo blanco	*Calycophyllum multiflorum* Griseb.	Rubiaceae
palo cala	*Crotalaria cf. anagyroides* Kunth	Fabaceae
palo corcho	*Aralia soratensis* Marchal	Araliaceae
peroto	*Pseudobombax marginatum* (A St. Hil.. Juss & Cambess.) A. Robyns	Bombacaceae
pica pica	*Cnidoscolus tubulosus* (Muell. &Arg.) I.M. Johnston	Euphorbiaceae
picana	*Casearia gossypiosperma* Briquet.	Salicaceae
piñón	*Jatropha macrocarpa* Griseb.	Euphorbiaceae
pitajaya	*Cleistocactus cf. baumannii* (Lem.) Lem.	Cactaceae

quina	*Myroxylon balsamum* (L.) Harns	Fabaceae
quinilla	*Pogonopus tubulosus* (DC.) Schumann	Rubiaceae
sacharoza	*Pereskia sacharosa* Griseb.	Cactaceae
sawinto	*Myrcianthes pungens* (O. Berg.) Legrand	Myrtaceae
soto	*Schinopsis haenkeana* Engl.	Anacardiaceae
soto (plot 1)	*Schinopsis quebracho-colorado* (Schltdl.) F. Barkley & T. Meyer	Anacardiaceae
taijibo	*Tabebuia serratifolia* (Vahl) Nicholson	Bignoniaceae
tala	*Celtis iguanaea* (Jac.) Sarg.	Cannabaceae
tarara	*Myroxylon peruiferum* L.f.	Fabaceae
timboi	*Enterolobium contortisiliquum* (Vell.) Moronge	Fabaceae
tinajera	*Aparisthmium cf. cordatum* (Juss.) Bail.	Euphorbiaceae
tipa	*Tipuana tipu* (Benth.) Kuntze	Fabaceae
toborochi	*Ceiba insignis* (HBK) Griss & Semirsi	Malvaceae
trichilia	*Trichilia claussenii* C.DC.	Meliaceae
ulala	*Cereus hankeanus* K. Schum	Cactaceae
ulala (bush)	*Cereus cf. kroenleinii* N.P. Taylor	Cactaceae
uña de gato	*Acacia praecox* Griseb	Fabaceae
wauyacan	*Machaerium scleroxylon* Tul.	Fabaceae
wuayacan blanco	*Chloroleucon foliolosum* (Benth) GP Lewis	Fabaceae
wayabuta	*Ruprechtia apetala* (Cf) Wedd.	Polygonaceae
wayabuta (plot 1)	*Ruprechtia cf. exploratricis* Sandwich	Polygonaceae
zapallo	*Pisonia zapallo* Griseb.	Nyctaginaceae
unknown 1, unknown 5 (understory)	*Athyana weinmannifolia* L.	Sapindaceae
unknown 3 (understory)	*Allophylus edulis* (A. St._Hil & Camb.) Hieron. Ex. Niederl	Sapindaceae
unknown 4 (understory)	*Coursetia cf. brachyrhaphis* Harms	Fabaceae
unknown 5	*Simira macrocrater* (K. Schum) Steyerm	Rubiaceae

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