TROPICAL RESOURCES

THE BULLETIN OF THE YALE TROPICAL RESOURCES INSTITUTE
2010 VOLUME 29

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Yale Tropical Resources Institute

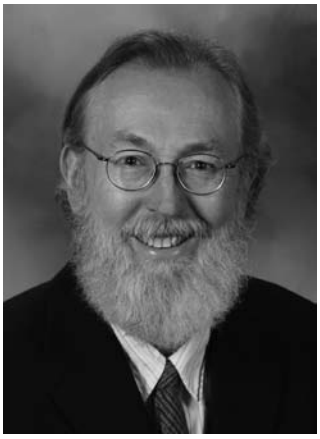
Mission

The Mission of the Tropical Resources Institute is to support interdisciplinary, problem–oriented, applied research on practical solutions to 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....

Michael Dove named new TRI Director



Michael R. Dove replaced Lisa Curran as Director of TRI in July 2009. Professor Curran left Yale to assume a position at Stanford University. Professor Dove (B.A., Northwestern University; M.A., Ph.D., Stanford University) is the Margaret K. Musser Professor of Social Ecology, Professor of Anthropology, Curator of Anthropology in the Peabody Museum of Natural History, Co-coordinator of the joint doctoral degree program between F&ES and the Department of Anthropology, and member of the founding Steering Committee of Yale's new Climate and Energy Institute. His research focuses on the environmental relations of local communities, especially in South and Southeast Asia. Over the past 36 years, he has spent more than a dozen years in the field in Asia, carrying out long-term research on human ecology in Borneo and Java, developing government research capacity in Indonesia, and advising the Pakistan Forest Service on social forestry policies.

His most recent books are Conserving Nature in Culture: Case Studies from Southeast Asia (co-edited with P. Sajise and A. Doolittle, Yale Southeast Asia Program, 2005), Environmental Anthropology: A Historical Reader (co-edited with C. Carpenter, Blackwell, 2007), Southeast Asian Grasslands: Understanding a Folk Landscape (editor, New York Botanical Gardens Press 2008), The Banana Tree at the Gate: The History of Marginal Peoples and Global Markets in Borneo (Yale University Press, 2011), and Complicating Conservation: Beyond the Sacred Forest (coedited with P.E. Sajise and A. Doolittle, Duke University Press, 2011). He is currently working on a book on the history of the anthropological study of climate change and another book (co-authored with D. Kammen) on The Anthropology and Physics of Conservation and Development.

Research and teaching interests include the anthropology of climate change and the cultural and political aspects of natural hazards and disasters; political dimensions of resource degradation; indigenous environmental knowledge; contemporary and historical environmental relations in South and Southeast Asia; the study of developmental and environmental institutions, discourses, and movements; and the sociology of resource-related sciences. Professor Dove sits on the advisory boards of Yale's Agrarian Studies Program, Council on South Asian Studies, Council on Southeast Asian Studies, and the International Affairs Council.

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The State of Tropical Resource Studies at Yale/F&ES, 2009-2010

The research carried out by F&ES Master's and Doctoral students can be viewed as a snapshot of current work on tropical resources. Based on fieldwork carried out within the past year, supported by TRI and Compton fellowships, and informed by their coursework and reading of the latest literature, their research pushes the boundaries of current knowledge. Their work tells us where the field of tropical resources is today and where its going in the near future. Some of the best work carried out over the past year by F&ES students is published here, divided into five main themes: biodiversity, indigeneity, conservation and development, waste management, and challenges of 'translation'.

I. Re-thinking biodiversity in field and forest

The impact of agricultural modernization and homogenization on tropical biodiversity is the primary focus of the papers by Collier, DuVal, Paul, and Redondo-Brenes, and it is a secondary focus of most of the other papers as well. These papers grapple with the tension between economic development on the one hand, promoted by mono-specific cultivation of exotics, and conservation on the other hand, favoring diverse, native species. Adding to this tension is the relative lack of research on native species versus exotics. Whereas planned development, even ecological restoration, often diminishes biodiversity, many community-based management systems are shown to have increased it, creating counter-intuitive linkages in some cases between cultural and natural landscapes. Historical research and perspectives prove to be central to understanding human maintenance of biodiversity.

The first paper in this section, by William Collier, takes a historical perspective on climate stress and African agriculture, looking in particular at its agro-biodiversity. One of the most-discussed, projected deleterious effects of global climate change is on food crop agriculture in Africa, much of which is marginally productive to begin with. Collier's study, in the Rift Valley Province of Kenya, shows that climatic variability, in particular drought, is nothing new to the region or its farmers, nor is ill-advised government policy. Collier shows that colonial and post-colonial government policies that promoted the mono-cropping of maize, an exotic, have made farming communities much more vulnerable to drought. In contrast, a traditional and still-existing practice of home gardening, using a highly diverse mix of native, drought-resistant crops, increases the resilience of the farming system by spreading and lessening risk.

The next paper, by Ashley DuVal, sheds light on human management of diversity among non-timber forest products, in particular the now-globally famous açai palm. DuVal studied the management practices and robust seed exchange networks surrounding a locally favored variety of the palm, called açai branco, in the state of Amapá, in northern Brazil. Branco was introduced into her study community 45 years ago, but active selection and refinement of the variety continue to this day. DuVal's study shows the role that smallholders can play in intra-specific crop diversity. It specifically shows how informal exchange networks can promote domestication and maintenance of agro-biodiversity.

The third paper in this section, by Gillian Paul, is a study of the resistance of native trees to insect herbivores and pests. The use of native tree species in forest restoration projects has been limited by fears of the purportedly greater vulnerability of native species to native pests. In theory, exotic species are supposed to have the advantage in this regard. Growing awareness of the limited ecological benefits of exotic tree plantations is leading scholars to re-think the native versus exotic calculus, but there has been limited research on this subject to draw on. This prompted Paul's study of herbivory and leaf traits of native trees in plantations in central Panama. She found low levels of herbivore damage and insect damage that was largely a function of phenology and successional stage.

The fourth and final paper in this section, by Alvaro Redondo-Brenes, which is a study of native, mixed-species tree plantations in the Path of the Tapir Biological Corridor in Costa Rica, continues with this theme. This study was also motivated by increasing concern over the ecological downside of exotic, single-species tree plantations, and by the dearth of research on the growth characteristics of mixed plantations of native species. Redondo-Brenes shows that the native tree plantation provide better habitat for a more diverse

fauna and can thus play an important tole in environmental conservation as well as economic production.

II. The continuing evolution of indigenous environmental politics

The next set of papers contains new insights into the role of indigenous people, identity, and knowledge in tropical resource management. The complexity and modern 're-invention' of indigenous identity has long been a subject of interest, but the analyses presented here by Marian Ahn Thorpe, Lauren Baker, and Roopa Krithivasan show a more complicated picture emerging. Their papers show that as modern society's perceptions of indigenous peoples have changed, the ways that indigenous people perceive and articulate their own identity have also evolved. This evolution involves political re-positioning that does not simply oppose indigenous communities to metropolitan society in all cases, but often entails collaboration and finding of common ground.

Marian Thorpe's paper, the first in this set, addresses the challenge of modernization and development to the rights of indigenous peoples, and the evolving way that these peoples are asserting their identity to meet this challenge. The context of Thorpe's study is the opposition of the indigenous Ngäbe to mining and hydro-electric development on their traditional lands in Panama. The specific focus of Thorpe's study is the contemporary re-invention of an indigenous martial art form, called balseria, as a symbolic political tool in this opposition. The way that balseria is staged mocks the national society's views of native peoples. The Ngäbe's reinvention and deployment of this cultural form reflects the fact that the axis of contest of most concern to them has shifted from intra-tribal politics to national politics. It also reflects an historical progression from capitulating to the national society's derogatory stereotypes of them to boldly challenging their accuracy and authority.

The next paper in this section, by Lauren Baker, addresses the contest between the nation-state and the private oil sector, on the one hand, and on the other hand the indigenous peoples of the Peruvian Amazon. This is an old and ongoing contest, and as a reflection of the way it has evolved, the state is now claiming that the methods of oil exploration and exploitation that it supports are new and more benign for local communities and the environment than the methods used in the past. Indigenous communities dispute this assertion of a break with the past, however, arguing that state engagement with them remains rooted in an old and unwelcome pattern of strategic pay-offs and a lack of any real dialogue or participatory decision-making. At the root of this contest between the indigenous peoples and the Peruvian state is a struggle over sovereignty, which is exacerbated by the "double movement" of oil exploitation: it simultaneously reproduces and undermines the state.

The third and final paper in this section is concerned with forest/wildlife conservation and indigenous people in India. Roopa Krithivasan's study focuses on two recent policy developments in Nilgiri District, in Tamil Nadu, India: the establishment of 'critical tiger habitats' (CTH) and the passage of the Forest Rights Act (FRA) strengthening the forest rights of the indigenous, tribal adivasi communities. The response to CTH and FRA by tribals and non-tribals is in many respects counter-intuitive, which neatly captures the complex evolving political dynamics of indigenous identity. As the political capital of indigenous peoples has waxed in India, their public image has undergone an about-face; but it is non-indigenous elites who have been foremost in seizing the political implications of this. Whereas the tribal communities have legal forest rights now, they often do not have the political means to exploit them. In contrast, the non-tribal elites have the means but not the rights. The stance of the tribal peoples is further complicated by their traditional allegiances to non-tribal elites and by their new-found, growing faith in the state government. As a result, the stance of tribals toward the CTH and FRA act is often determined less by their own resource-use patterns and more by the stance of their patrons and state representatives.

III. Balancing conservation and development

The issue of sustainable development, the balance between conservation and development, continues to be a focus of scholarly interest, as reflected in three of the contributions to this issue, by Christine Trac, Eliezeri Sungusia, and Benjamin Blom. Balancing the environmental good for the wider society, on the one hand, and on the other hand the economic costs and benefits borne by the proximate human communities, continues to be a challenge. One important theme in current studies of this subject is the increasing realization that local communities are not monolithic with respect to conservation and

development issues. A second theme is that the human and environmental setting is not static but dynamic, and therefore the balance between conservation and development must continually be re-examined and re-worked. And a third theme is that development interventions driven by climate change concerns are not immune to the now-familiar social, economic, and political challenges to other conservation projects.

The first contribution in this section is Christine Trac's study of two government programs in southwest China, one a conservation program and the other an anti-poverty program. The first involves reforesting crop lands with a species of magnolia, and the second involves replacing subsistence-oriented maize with market-oriented gooseberry. Since the bark of the magnolia is also marketed, the two programs together represent a considerable reorientation of the agricultural system from a subsistence to a market focus. For this and other reasons, many farmers would not go along with the two programs but for the fact that government subsidies over-ride their economic shortcomings. In addition to decreasing the ecological and economic resilience of the agricultural communities, these two programs effectively devolve much responsibility for environmental conservation and economic development off of the shoulders of local government and onto rural households. In this sense, these state programs are characteristically modernist (or post-modernist) in making increasingly hard-pressed segments of the rural population responsible for their own governance.

The second study here, by Eliezeri Sungusia, is a contribution to the economics of community-based natural resource management. It focuses on the Wildlife Management Areas (WMA) of Tanzania, which were introduced in 1998 to promote both wildlife conservation and community economic development alongside the country's formal protected areas. Sungusia's goal was to calculate the economic cost of WMA to communities, using contingent valuation surveys. If this cost can be accurately calculated, then policy interventions can focus on providing economic benefits that exceed that cost so as to win community buy-in to the WMA. Sungusia finds that this economic calculus is complicated in practice by the fact that communities are heterogenous with respect to costs and benefits and this, combined with local political dynamics, makes benefit-sharing problematic.

The third and final contribution to this section is Benjamin Blom's study of early planning and implementation of REDD interventions (from "Reduced Emissions from Deforestation and Degradation") in the Malinau District of East Kalimantan, Indonesia. The social, economic, and political environment in Malinau is not neutral with respect to such interventions. Land rights are contested, there are inter- and intra-village differences in interest, and there are extra-local as well as local pressures on forest resources. If REDD programs are unthinkingly applied in such situations, they may actually exacerbate not mitigate deforestation and degradation. To succeed, Ben argues, REDD programs must be explicitly dual-purposed, targeting issues of equity and governance as well as forest conservation.

IV. The 'waste' of modernity

The next section of this issue deals with one of the ills of industrialization, modernization, and globalization, namely waste, and in particular new types of waste and new patterns of circulation of waste in the tropics. The article by Nashaat Mazrui deals with the problem of waste produced by medical institutions, which is one of the ironic downsides to the upside of modernity. The second contribution to this section, by Fauziah Rochman, on electronic waste, or e-waste, raises increasingly important issues of waste disposal crossing the global North and South. The final article, by Hui Cheng, looks at issues of waste generated by one of the most controversial new uses of coastal lands in the tropics, shrimp farming.

The ill-treatment of medical waste in less-developed countries is an emerging global problem, and it is the subject of Mazrui's analysis. With the goal of establishing a base-line of waste-treatment that could be used for developing future policy, she carried out a questionnaire-based survey of 418 medical facilities in Nairobi, Kenya. Mazrui found many problems with treatment of medical waste. In addition to lack of recycling, record-keeping, and segregation of waste types, she found, notably, that many medical facilities simply contract general waste collectors, who take their waste to public dumps. She also found that even when medical facilities incinerate waste on-site, it is done without pollution controls, and the resultant ash is often sent, again, to public dumps.

The second paper in this section examines the problem of another new category of waste,

discarded electronic equipment, hence the label 'E-waste'. Fauziah Rochman examined a complex, multi-tiered system of recycling of used personal computers in Yogyakarta, Central Java. The computers fed into this recycling system come from both Indonesian sources and from overseas. E-waste in northern, industrialized countries becomes a valuable resource when imported into a country like Indonesia. But this economic value is offset by health concerns raised by the processing of E-waste, replete with numerous toxic elements, in this as yet unregulated and unmonitored sector.

The final paper here also deals with waste from an industry embedded in the global economy, namely shrimp farming, which has grown tremendously in the past several decades. Whereas tragedies like the December 2004 Asian tsunami have alerted us to the cost of losing coastal vegetation torn up for shrimp farms, less attention has been given to the farms' impact on the local environment through pollution. Hui Cheng argues that shrimp farming is here to stay, so the need is to make its environmental impact as benign as possible. To that end, she carried out controlled experiments with aquaponics, demonstrating how cultivation of halophytes in shrimp ponds can significantly decrease nitrate pollution.

V. Problems of 'translation'

As a number of the studies in this issue show, in this increasingly globalized world issues of tropical resource-use often involve social, economic, and political relations across different hierarchical levels – e.g., local, national, and global communities. As resources or the policies pertaining to them cross hierarchical levels, problems of translation of concepts not uncommonly arise – and these are the subject of this final section. A defining example of such problems are the challenges posed in implementing the (earlier mentioned) globally developed REDD schemes in local forest communities in the tropics, which is the subject of Katie Hawkes' study. There are problems of simple incommensurability between modern systems of planning and local systems of knowledge and practice, as illustrated by Kasey R. Jacobs' study of the same topic. All attempts to implement global policies at the local level are based on popular but often seriously flawed understandings of community, non-governmental organization, and nation-state, as documented by Hawkes. Translation across hierarchical levels is also frequently complicated by North-South political dynamics and biases, which is one of the topics of Dana Graef's contribution. Graef's study also shows how relationships that cross hierarchical levels can complicate our analytical attempts to delineate the boundaries to the resource-use systems. A comparative, historical perspective is enormously helpful in unraveling such complications, as also demonstrated by several papers elsewhere in this issue.

Dana Graef's paper compares two key historical moments in the engagement of Cuba with the global political-economic system. The first is the late eighteenth century contest between the Spanish government and local farmers for control of Cuba's cedar forests; and the second is the withdrawal of the Soviet Union's economic subsidies in the early 1990s and the greening of Cuban agriculture in response. Graef's analysis of these two historic moments illustrates the convoluted history of environmentalism. On the one hand, the colonial Spanish policy of conserving forests, in the face of local peasant encroachment, was externally imposed and also self-interested (the Spanish wanted to protect supplies of cedar for naval use). On the other hand, the contemporary policy of organic agriculture is nationally directed but it incorporates global environmental concepts into local practice. This historical and multi-level analysis thus shows that environmentalism can assume multiple, quite different faces.

The second paper in this section, by Katie Hawkes, is, like the earlier-discussed paper by Benjamin Blom, a study of current efforts to implement REDD projects in Indonesia, a country that has been an early and enthusiastic supporter of this practice. Everything that Hawkes finds on the ground, however, calls into question many of the premises of global REDD policy-making. Whereas REDD projects are premised on a homogeneous local forest community, for example, the reality in Indonesia – which is also attested to by a number of the other studies in this Bulletin – is very different. Indonesian NGOs, which are supposed to play a key role in implementing REDD projects, also encompass great diversity in aims and outlooks – except for the fact that they all say that they are "unlike other NGOs". Finally, the REDD premise of a monolithic, non-partisan, effective state, is also not met by the reality of Indonesian government today. Hawkes concludes by observing that all of the actors involved in implementing REDD projects in Indonesia today have different views of what REDD projects are supposed to be. The only commonality, Hawkes adds, is the salutary one that all of the actors are well-intentioned.

The final paper here, by Kasey Jacobs, is a study of the current and future prospects for adaptation to climate change among the Minangkabau of West Sumatra, Indonesia. Jacobs found that whereas the local government in her study area did not explicitly address such adaptation, they were well-versed in problems of adaptation to environmental perturbation – as are a number of local NGOs. Governmental and non-governmental institutions alike in this region conceptually lump together challenges of coastal management, disaster response, and climate adaptation. Cases like this challenges the utility and perhaps also the validity of the way that the global climate change science and policy community defines and bounds its problem area. Jacobs concludes with the recommendation – which bears emphasizing only because it is so resolutely ignored in much current policy-making – that efforts to implement global policies concerning climate change adaptation and mitigation should begin with existing institutions and programs.

VI. Conclusion

Many of the papers in this issue of TRI's Bulletin address familiar subjects, but they do so in unfamiliar ways. They reflect new ways of approaching and thinking about these subjects; they represent a new generation of scholarship on tropical resources. They tell us, for example, that the nature/culture divide is not simple. They show us that the actors in resource-use systems, whether local communities or nation states, are not monolithic; and that oppositional politics are often complicated by collaboration and cooperation. They demonstrate that tropical resource landscapes, peoples, and theories are not static, they are ever-changing, evolving. They also remind us that there is continuity with the past, even with such seemingly novel phenomena as climate change.

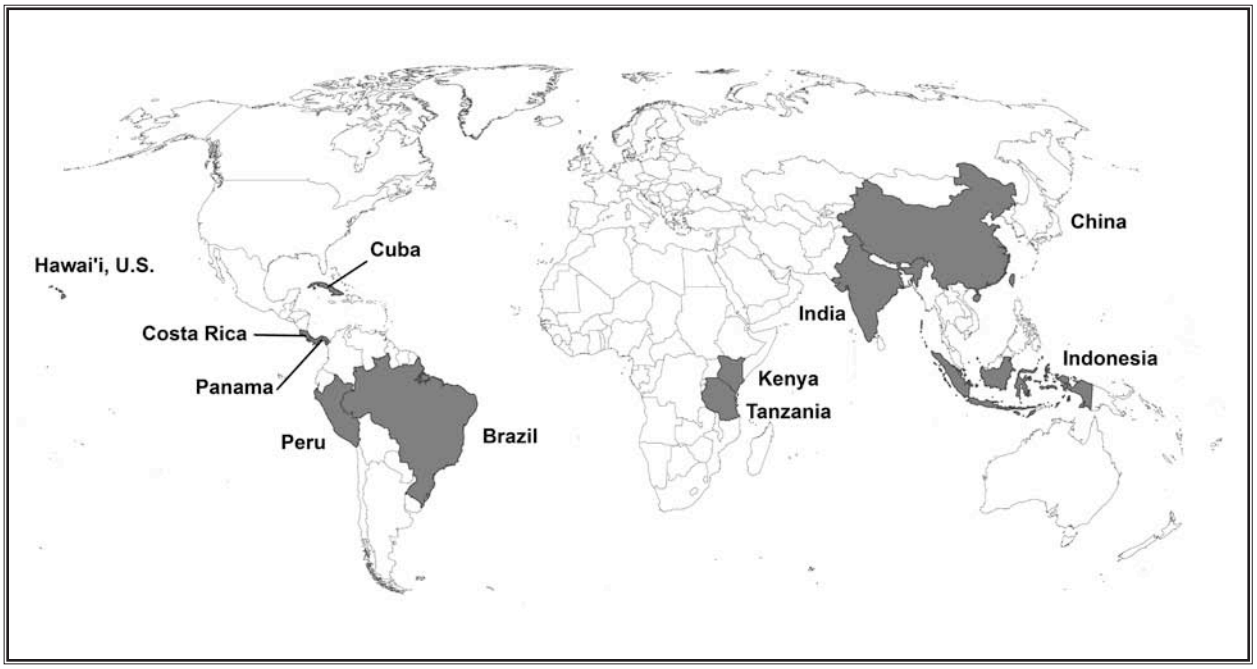
A Word from Nathaniel Delafield, outgoing Program Manager

As I begin this letter for the TRI Bulletin, now as outgoing program manager, I am sitting on a plane bound for Madagascar. I am tired and somewhat saddened by a week of goodbyes to the FES community that has taught me so much since welcoming me in 2008. Throughout the past two years as TRI Program Manager, I have had the opportunity to work with a great many master's and doctoral students. I have seen their research projects evolve from initial conceptualization, to successful proposal writing, to the challenge and discovery inherent in field-based research, and finally to analysis and write-up after students return from the field. Watching these research projects evolve has been inspiring and has helped me think about how my own work in Madagascar fits into the issues of tropical conservation and research. I have been working with vanilla and clove farmers in a remote Northeastern region of the country for close to six years. This year, I am going back to the field to embark on a new project that seeks to link local farming networks with international markets and genetic biologists seeking to develop new approaches to sustainable agriculture. The goal of the project is to look holistically at the long-term sustainability of the vanilla industry in Madagascar, now facing threats from crop disease, changing climate conditions and volatile market prices. If successful, the project will improve market linkages between end users of this specialty product and the rural livelihoods of farmers that depend on the sale of such products to meet their basic needs.

In the complex agroforestry system where vanilla grows in this region, cloves, coffee, fruit trees, breadfruit and native species commingle on small plots to create a planted forest environment where people and vanilla thrive along with extraordinary biodiversity. The contribution of each agricultural species is unique, but in their diversity a dynamic environment emerges from which animal habitat, ecosystem services and economies emanate. Though I learn more with each visit, it seems to me that there is wisdom in this approach to agriculture, and metaphor; vanilla farming is part technical expertise, part art form, part meditation. The intense focus on the vanilla vine is never decoupled from the softer view of all that grows nearby. Likewise, environments cannot be decoupled from the communities that depend on them for their livelihoods. My work in Madagascar will continue to be informed by the insights of TRI Fellows and faculty alike, who demonstrate the value of cultivating interdisciplinary approaches for the many challenges facing the global tropics.

I thank Dr. Michael Dove, TRI Director, and Dr. Lisa Curran, former Director, for their encouragement, guidance and support during my time at Yale University. I hope to keep in touch and can be reached anytime at nathaniel@FTFtrading.com. *October 2010*

2009-2010 TRI Fellows' and Compton Fellows' Research Sites



The research projects of the TRI fellows and Compton fellows listed below are featured in this year's Bulletin:

Brazil: Ashley DuVal

China: Christine Trac

Costa Rica: Alvaro Redondo-Brenes

Cuba: Dana Graef

Hawai'i, U.S.: Hui Cheng

India: Roopa Krithivasan

Indonesia: Benjamin Blom, Katie Hawkes, Kasey Jacobs, Fauziah Rochman

Kenya: Will Collier, Nashaat Mazrui

Panama: Gillian Paul, Marian Ahn Thorpe

Peru: Lauren Baker

Tanzania: Eliezeri Sungusia

Note: The delineation of international borders on this map does not represent endorsement of any particular national boundary.

I. RE-THINKING BIODIVERSITY IN FOREST AND FIELD

Colonial Maize and Climate:
Limits of Agricultural Development for Adaptation in Rift Valley, Kenya

William Collier, MESc 2010

Introduction

Concerns about global climate change have brought heightened attention to the potentially dangerous impacts of climate variability on farming systems in Sub-Saharan Africa. Increased variability in rainfall, resulting in more drought and flood events, will have drastic impacts on agricultural production throughout Sub-Saharan Africa (Boko et al. 2007; Schlenker and Lobell 2010). In Kenya, the Ministry of Agriculture anticipates that increases in rainfall variability and temperature in the Rift Valley will negatively impact the production, availability, and accessibility of cereal crops nationwide (Waigwa 2009). The consequences of these predictions will be most acute in terms of famine and food shortages.

Climate variability and drought, however, have been reoccurring characteristics of Kenya's climate for hundreds, if not thousands, of years. Famine and food shortages have been intimately woven into the lives of the Kenyan people. These events are not only linked to climatic activity; they are also deeply historical and political.

In this article, I examine the recent history of agricultural development in Kenya through a case study of Uasin Gishu District in Rift Valley Province. I discuss several historical adaptations to climate variability embedded within the broader political economy of Kenya. In doing so, I bring to question the orthodox views driving agricultural development in Kenya while exploring alternative avenues for future development and climate adaptation.

Local populations in the Rift Valley have adapted to variable climatic conditions over hundreds of years. A variety of indigenous farming techniques and cultural practices helped to manage risk in times of climatic uncertainty. Colonial expansion in Kenya replaced many of these historical coping mechanisms with much riskier monoculture maize and cash crop systems. Today, many smallholder farmers in Kenya are highly vulnerable to climatic shocks that disrupt maize cultivation. During these times, farmers turn their attention, and labor, to small gardens beside their homes. These homegardens resemble the indigenous systems that flourished before colonial encroachment, and they may provide an avenue to adapt to future changes in climate that has been largely overlooked by national policies and research objectives.

Study Site

Kenya has a total geographic area of approximately 580,000 sq km, containing a diversity of agro-ecological zones including humid and semi-humid plateaus, highland steppes, semi-arid zones, and arid lands (Fig 1). Within each zone exists a similarly diverse suite of livelihood strategies that coincide with local cultures and environmental conditions, ranging from sedentary agriculture to nomadic pastoralism. Over 70% of the land in Kenya is considered arid or semi-arid, restricting crop agriculture to the coastal, central, and western regions of the country. Agriculture is the single-most important sector in the Kenyan economy, accounting for more than 50% of economic product and more than 80% of employment (Bates 2005). The major staple crop producing regions in the country are found mainly

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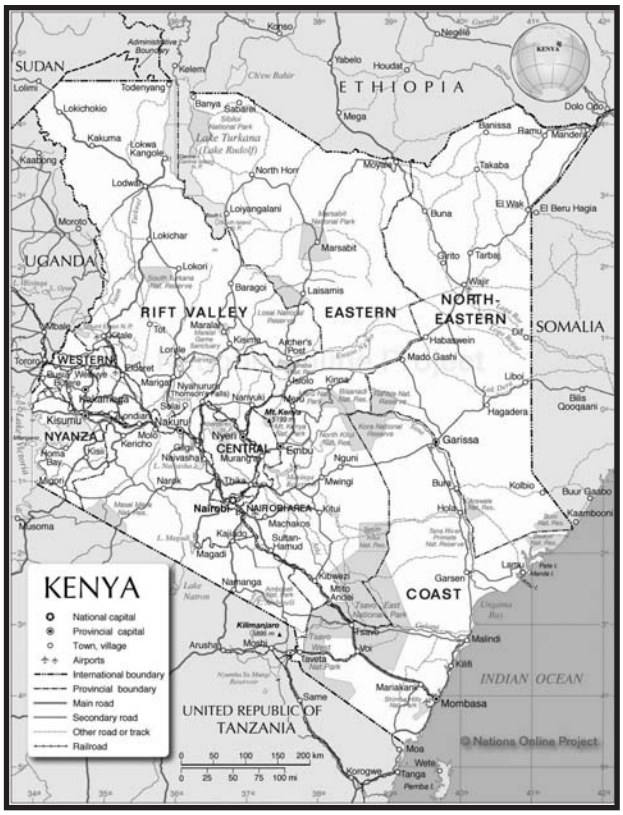

Figure 1. Political map of Kenya. Fieldwork was conducted in Moiben Division, Rift Valley Province, located northeast of Eldoret. Map courtesy of Nations Online Project.

in the Western Province and the Rift Valley Province, the latter of which is the location of my field site.

Uasin Gishu is located in the Rift Valley, commonly known as the breadbasket of the country, and provides an exceptional laboratory to analyze agricultural development in Kenya. In the modern Kenyan economy, more than 70% of the staple cereal crops of maize, wheat, sorghum, and millet come from the region. The fertile Rift Valley contains a variety of agro-ecological zones, consisting mainly of an upper-highland wheat and barley zone and a lower-highland maize, pyrethrum, and sunflower zone. Uasin Gishu lies approximately 400 km northwest of Nairobi.

Interviews with small, medium, and large-scale farmers as well as political officials, environmental professionals, and government employees form the basis of the study. Interview data are contextualized with archival documents and missionary memoirs pertaining to agriculture and climate. In corresponding research, I employ agricultural and meteorological statistical analyses to elucidate broader historical trends of agricultural development in the Rift Valley.

Agricultural Development in Uasin Gishu

Pre-colonial agrarian history

The diverse agro-ecological zones in the Rift Valley have provided fertile soils and favorable climatic conditions to farmers for thousands of years. The Nandi are believed to be one of the earliest dominant ethnic groups in the Rift Valley, at least since the mid-sixteenth century (Kipkorir 1978). Nandi were primarily agriculturalists that grew tremendous varieties of millets and tubers, a stark contrast to their famous nomadic contemporaries, the pastoral Maasai. Nandi farmers grew mainly eleusine, also known as finger millet, and raised small livestock such as goats and sheep (Kipkorir 1978).

While in-depth information concerning cultivation practices is sparse, it is clear that Nandi grew a variety of grains for food, beer, and trade (Kipkorir 1978). There is also evidence that trade in foodstuffs between different tribes in the Rift Valley was a common practice, especially during times of heightened climate variability. Along with traditional crops and agricultural techniques, trade and storage of grain were highly specialized forms of risk aversion during times of

environmental hazard or uncertainty for Nandi.

Colonial rule and New World crops

Western exploration and expansion in Africa had a profound influence on agricultural and economic development. Perhaps one of the longest-lasting relics of this encroachment was the establishment and proliferation of Western cereals and cash crops. Maize (*Zea mays*), a New World cereal crop, first appeared in East Africa following mercantilism and formal colonialism in the sixteenth century, when Portuguese settlers grew it along the Swahili coast (Fig 2) (McCann 2005). It slowly became a staple of the local diet, and by the mid-nineteenth century, maize was well-established as a principle crop in Swahili trade caravans and agricultural systems throughout the region (McCann 2005). Early maize agriculture in Kenya was characterized by highly localized variation in breeding and cultivation. Maize was originally incorporated into traditional mixed plots and swidden systems (Kipkorir 1978).

In the early part of the twentieth century, British settlers started growing maize in larger quantities, and colonial landowners used maize, a cheap food source, as the main form of sustenance for their African farm laborers. During the period from 1900-25, maize gradually became a staple food in the Kenyan diet, which was previously dominated by the millets, tubers, legumes, and kales commonly found in traditional farming systems (Republic of Kenya 1966). During this time, maize cultivation shifted to increased uniformity and standardization. Small farms with highly localized variability were replaced with large monoculture plantations. Maize and wheat became substitutes for the traditional varieties of sorghum and millet. This evolution from local variation to homogenization is a defining characteristic of both maize production and agricultural development in colonial Sub-Saharan Africa (McCann 2005).

Policies for monoculture cash crops

Droughts, and the resultant disputes over food policy, have played a fundamental role in contemporary Kenyan politics and agricultural development (Bates 2005). One of the earliest colonial agricultural policies influencing maize development occurred as a result of a severe drought and widespread food shortage in 1918-21. In 1921, the colonial government undertook measures to increase food supply, developing policies to stimulate agricultural production. The government "unhesitatingly recommended that farmers should

Figure 2. Desiccated maize field, Moiben Division, Rift Valley, Kenya. A field of maize intercropped with beans is withering due to insufficient rains. Photo by William Collier.

concentrate on the growing of maize" (Republic of Kenya 1966,6). The area under maize production increased to a record high by 1928, and for the first time in the agrarian history of Kenya, a dominant system of maize production emerged (Fig 3) (Republic of Kenya 1966). Fifteen years later, maize development was, again, catalyzed as the result of a near-famine that occurred in 1943-44. This time, however, the colonial government questioned the policies created several years earlier. The Director of Agriculture stated "the correct policy would be to return at the earliest possible moment to a reduced production of cereals and an increase in leguminous and other crops" (Republic of Kenya 1966, 10). But due to the urgency of the situation and the resources available, the government concluded that there was "no alternative to giving all possible encouragement to the production of maize and other cereals" (Republic of Kenya 1966, 10). Thus, although the government recognized the limitations to mono-cropping cereal crops, and although it was suggested to develop other avenues of agricultural development, the colonial government concluded that the only practical option was to develop a system of increased dependency upon maize.

In 1966, just four years after independence in Kenya, a government commission was established to inquire into the status of maize in the country (Republic of Kenya 1966). The commission concerned with the future of agricultural production and development in independent Kenya, quickly criticized the previous colonial regime, stating, "The unwisdom of the policy of monoculture agriculture had not become apparent as of yet" (Republic of Kenya 1966, 12). The newly formed independent government recognized that the previous agricultural development path was unwise. But now, after more than four decades of independence, policies promoting monoculture cereals and cash crops still dominate agricultural development in the Rift Valley and throughout Kenya.

Future Climate Adaptation

Homegardens and climate variability

Farmers in the Rift Valley commonly keep several small gardens beside their homes. These gardens contain a variety of kales, legumes, and tubers, the crops that dominated Kenyan farming systems before establishment of cash crop agriculture. These vegetables are intercropped and grown in a variety of small plots around the homestead, increasing the nutritional base and diversifying the risk of crop failure across multiple plots and configurations. Beyond the

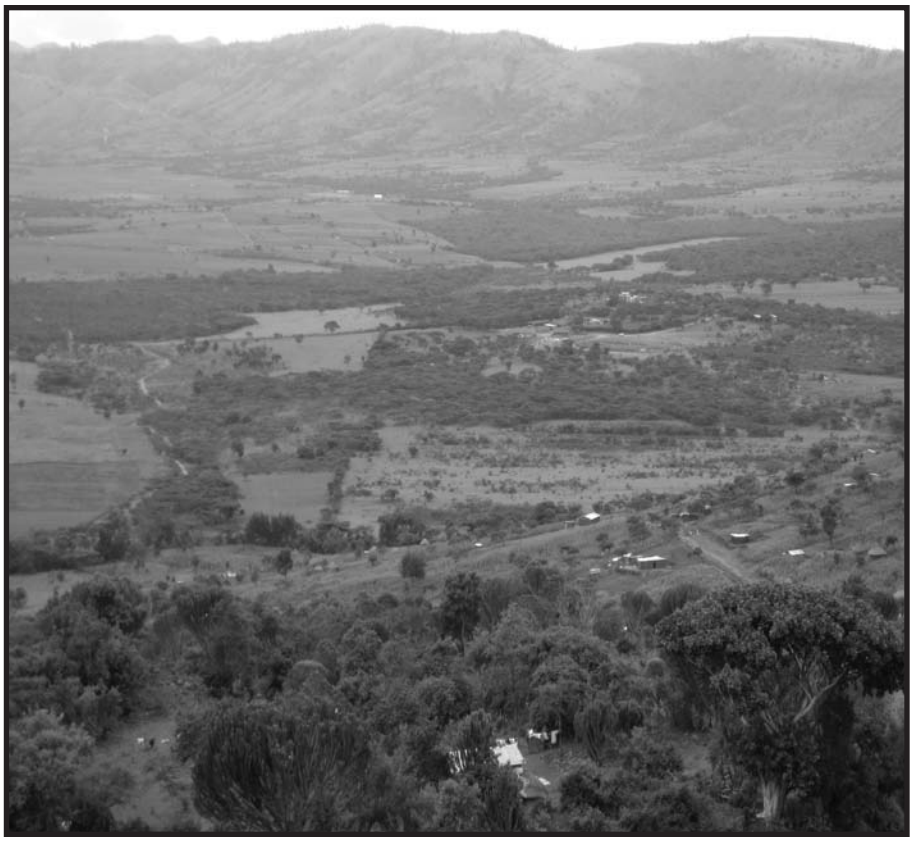

Figure 3. Agriculture-forest mosaic in Moiben Division, Rift Valley, Kenya. The agricultural landscape is dominated by large tracts of maize and wheat. A relic of a colonial plantation is located in the center of the valley. Photo by William Collier.

Figure 4. Home garden in Moiben Division, Rift Valley, Kenya. This small home garden -- containing pumpkin, kales, cassava, maize, and bananas -- provides a diverse source of subsistence for smallholder farmers during drought and climate variability. Photo by William Collier.

small, green mosaic of vegetables, these homegardens also provide a window into the broader history of agriculture in Kenya. Well-adapted to the climatic and environmental conditions, these crops exhibit a variety of characteristics advantageous for farmers. Above all, they are hearty, quick growing, and resistant to drought.

When weather conditions are unfavorable, farmers throughout the Rift Valley shift their daily labor schedules to spend significantly more time working in these small gardens, leaving the larger, less manageable fields of maize and wheat to wilt for fodder. These gardens not only represent the current success and survival, but also the indigenous environmental knowledge passed down from previous generations. These agricultural systems flourished for thousands of years in Kenya prior to colonial encroachment, and the knowledge, skills, and techniques developed to make them successful are a testament to their heritage.

Agroforestry techniques and systems, such as homegardens, can provide a wide range of nutritional and economic benefits to Kenyan farmers. Historically, home gardens have proven advantageous for spreading risk, diversifying the economic base, and providing increased sources of nutrition to Kenyan families (Fig 4). Similar to smallholder farmers in Indonesia, homegardens in Kenya provide an avenue for farmers to rely on and develop their own resources despite the transformations of the colonial experience (Dove 1990).

Implications for adaptation

As the impacts of climate change are anticipated to exacerbate food insecurity, there will be a need to balance short-term measures for hunger relief with long-term strategies for adaptation and resilience. It is important to recognize the complex economic, environmental, social, and political contexts of agricultural development and food security in Kenya. Understanding the historical roots of traditional agriculture and the contemporary consequences of a monoculture agricultural system may provide insights on how to adapt to future climate threats, while revolutionizing agriculture to increase food security in Kenya.

In the past two decades, agricultural scientists and policy planners have heralded the rapid advancement of maize as a major food crop in Africa. Agricultural economists have viewed the dominance of maize in East Africa as a miracle of the free market (McCann 2005). Even Nobel Laureate Norman Borlaug, father of Asia's wheat-and-rice-

based agricultural Green Revolution of the 1970s, argues "the technologies and new crop varieties to launch Africa's own Green Revolution, with maize adoption as its most visible expression, are already in existence" (McCann 2005, 11). But climate change adaptation initiatives that focus exclusively on new varieties of maize and increases in national crop productivity will not solve current and future food crises. They may very well continue to perpetuate a system that increases the vulnerability of poor smallholder farmers.

In Kenya, historically, concerns about food supplies have been manipulated to consolidate political power (Bates 2005). But over the last century, there have been voices warning of problems with colonial and contemporary agricultural policies, urging officials and policy-makers to move beyond unwise and vulnerable policies and investments. There have also been voices describing the daily struggles that emerge from a system of continued dependencies. Yet these are merely whispers from a far-off village, a message inaudible on the bustling paved streets of downtown Nairobi.

Current rainfall shortages in the Rift Valley have strained food supplies throughout the country, affecting more than 10 million people, one quarter of the total population. Food security is not expected to improve with the anticipated impacts of climate change. But the urgency of the situation and the need to act should not cloud our understanding of the historical, political, and economic circumstances in which 10 million people are hungry and 20 million people are trapped in a sea of maize.

Acknowledgement

This research was made possible by the generous support of the Yale Tropical Resources Institute, the Yale Jubitz Family Endowment, and the Yale Carpenter/Sperry Fund. Special thanks to the following people and organizations: the residents of Moiben Division, Kenya; Williams Kiptoo Bwambock; Dr. Michael R. Dove; Dr. Robert Bailis; Climate Change Adaptation in Africa Research Center (IDRC); Dr. J.C. Nkomo; Dr. Evans Kituyi; Victor Orindi; Kenya Ministry of Agriculture; Kenya Ministry of Science, Technology, and Higher Education; Kenya Ministry of Natural Resources; Office of the President of Kenya; Kenya Meteorological Department; University of Nairobi; Moiben Farmers Marketing Federation.

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Açaí Branco:
Maintaining Agrobiodiversity through a Local Seed System in the Amazon Estuary

Ashley DuVal, MESc 2010

Introduction

In a rural community situated along a tributary to the Amazon river in the Brazilian state of Amapá, a farmer pointed out two varieties of the açaí palm, (*Euterpe oleracea*, Mart.), his primary cash crop, growing side by side. While he called one açaí branco and the other açaí preto, I struggled to comprehend the differences between the palms, both laden with dense clusters of jade fruits. The difference was subtle, I would learn, and virtually indiscernible to all but the farmer responsible for harvesting the fruit of these palms. The oily palm fruits of the common variety açaí preto would first ripen to a deep shade of purple-black, then continue to develop on the tree until the dark fruits obtained a dusty silver sheen. The fruits of açaí branco however would remain a pale shade of green as they ripened and would finally develop a light silvery gloss over what otherwise appeared to be an unripe fruit, a difference that was virtually undetectable from the ground 20 meters below these tall palms. With no other identifying features than the fruit's lack of purple pigment, the identification of açaí branco versus unripe açaí preto represents a highly localized form of knowledge, as only the harvester who regularly ascends the trees to collect the fruit in their açaí stand can definitively identify the variety. Locally valued forest product varieties such as açaí branco can offer valuable insights into the processes of selection, adaptation and diffusion and the role that small holder producers play in domestication of crop and forest product resources. My research explores the seed exchange networks and management practices associated with the production and diffusion of açaí branco in this community.

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Background

The role of açaí branco assumes greater significance in the context of the global açaí boom of the last 10 years, which has made the word açaí and its trademark purple color a household term. The transition that açaí has taken from local staple food to international commodity, or 'fashion fruit' (Brondizio 2008), began once açaí had already become well established in the urban centers of Amazonia. From there, it permeated to other urban centers in Brazil in the form of a sorbet desert or energy food, exported in frozen pulp and mixed with guaraná syrup and other fruits to supplement it with sugars and caffeine while disguising its unusual earthy flavor. Although export demand for açaí is quickly growing, the largest demand for açaí is still regional where the food retains its cultural and dietary importance.

Açaí branco is neither grown nor marketed outside of the Amazon estuary. Its production is so regional that açaí producers in the Amazonian state of Maranhão refer to it as 'açaí branco of Pará', and venders in the açaí stalls of Macapá report that most is imported from Pará. Açaí branco is frequently described as 'more delicious' than açaí preto, with a flavor similar to 'avocado with milk' (Weinstein 2000). Furthermore, it is claimed to lack the heavy, lingering, and sleep-inducing effects that açaí preto is renowned for, including the characteristic distended 'açaí belly' and in this regard is often referred to as 'açaí lite'. Those who process açaí claim that the pulp is of thicker consistency, a sign of higher quality (personal observation 2009). Many of these claims are supported by the differences in composition between açaí branco and preto. As its color would appear to indicate, açaí branco lacks the anthocyanin content of its purple counterpart, although it has higher oil content (Rogez 2000). Açaí branco also has a reduced iron content, a quality believed to account for its ability to be mixed with other foods and not cause indigestion. In the context of a staple food, the higher digestibility and fewer dietary restrictions associated with more oil and less iron serve an important function.

Açaí branco has been noted in various written

accounts for the last 35 years (Calzavera 1972), though rarely meriting more than a line or two about its presence in the urban marketplaces of the Amazon estuary such as the Feira de Açaí, and its relatively higher prices (Weinstein 2000, Azevedo 2005, Brondizio 2008, Smith 2002, Xavier et al 2005). Despite its persistent regional demand and local importance, açaí branco has merited little of the formal study or genetic improvement work and breeding that the predominating purple variety has been receiving. While EMBRAPA, the Brazilian Agricultural Research Agency, began genetic evaluations of açaí branco, the work was discontinued citing 'lack of interest or a viable market' (personal communication, S. Padilha June 2009). To date, no study has been conducted on the management, production, and exchange of açaí branco and little remains known about this evasive variety. Açaí branco is not necessarily a new variety in Macapá – while acaí branco has been present for as long as the urban açaí venders interviewed could remember, it has always been primarily imported from Pará, becoming available only in the months that correspond with the growing season of Pará (personal communication, August 2009). Due to its extreme rarity, the pricing has always been a little higher than the purple counterpart, and for the last two years the price of açaí branco in Macapá remained fixed between R$60-80 for a sack, while the price of preto bottomed at less than R$20 during peak season. Despite its regionally limited market, there exists a strong financial incentive to plant açaí branco.

In the context of this paper, açaí branco is explored in the theoretical framework of an informal seed system. While the formal seed sector represents the vertically organized production and distribution of approved and tested seeds, with the intention of improving yields based on standardized spacing and inputs, informal seed systems are locally organized, based upon traditional knowledge, and guided by

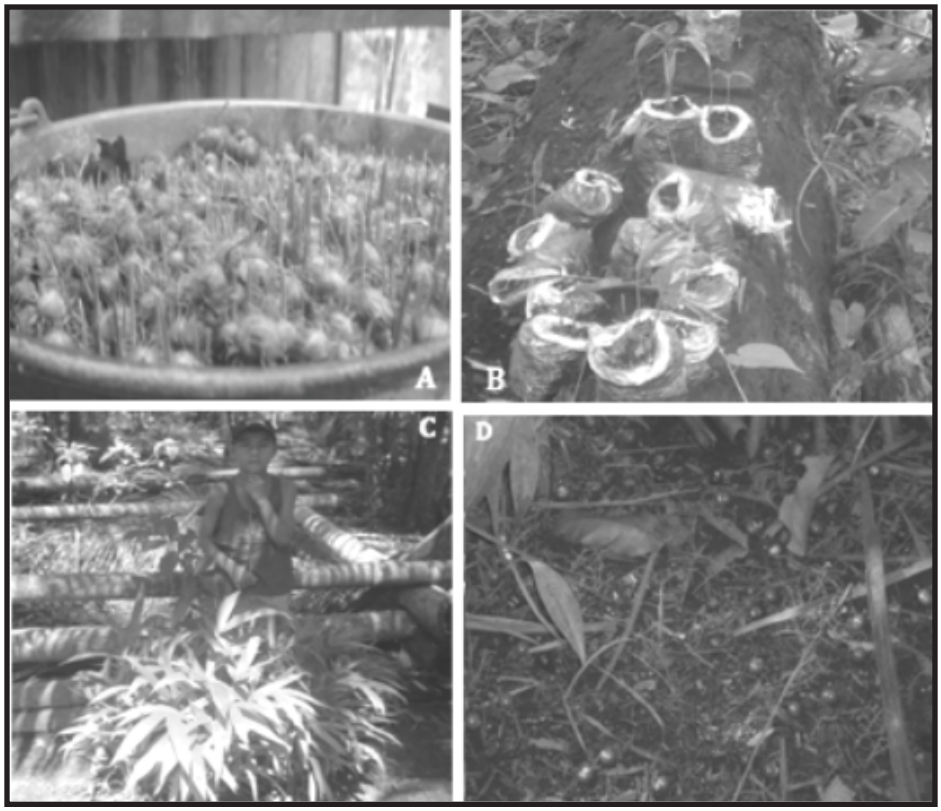

Figure 1. Açaí Branco Planting Techniques: (a) Seeds of açaí branco are set aside in buckets to germinate after the pulp has been removed. (b) Seedlings of açaí branco are separated into plastic bags until they are large enough to transplant in the ground. (c) Seeds of açaí branco are dumped in a pile to germinate in a sunny environment close to the house. (d) Seeds of açaí branco are cast onto the forest fl oor and left to germinate.

prevailing market forces (Douglas 1980). Informal seed systems often perform an important role in the distribution of new varieties, maintenance of crop genetic diversity, and in meeting local needs. The two systems, formal and informal, can be viewed as complementary, often by necessity (Almekinders et al. 1994). Around the world and particularly in rural regions, the formal seed system rarely surpasses 10% of a farmer's supply, leaving farmers to develop all other seeds and planting material (Heisey 1990, Wierema et al. 1992). According to Almekinders et al. (1994), the three most important components of a dynamic seed system for small farmers for small farmers in developing countries include (1) variety use and development, (2) seed production and storage by farmers under local conditions, and (3) seed exchange mechanisms. These three components will serve as the foundation for an analysis of açaí branco as a dynamic informal seed system.

Site Selection

The community where this study took place is located in the state of Amapá in Northern Brazil, 37 km from the capital city of Macapá where community members transport açaí to be sold 6 days a week. This community consists of 37 households, and has a very recent land history and well-documented land cover transitions since it was converted from ranch to predominantly açaí-managed agroforest in the last 50 years (Raffles, 2002). Furthermore, the community members all maintain secure land tenure, and the majority rely upon açaí as their primary source of income, though often supplemented with other activities such as shrimp and fishing or retirement and fishing pensions.

Methods

This study was conducted using a mixed methodology approach over two field seasons in June of 2008 and August of 2009. The first field season consisted of participant observation within a household during the peak of açaí harvesting operations, and informal interviews with a number of community members who worked in the harvesting and transport of açaí. The following year, structured and semi-structured surveys were held with 16 community members and 5 urban venders using random, purposive, and snowball sampling techniques to select key informants. The outcomes included a social map documenting seed exchanges between community members as well as with neighboring communities, and 16 completed questionnaires on individuals' production, management and preference data

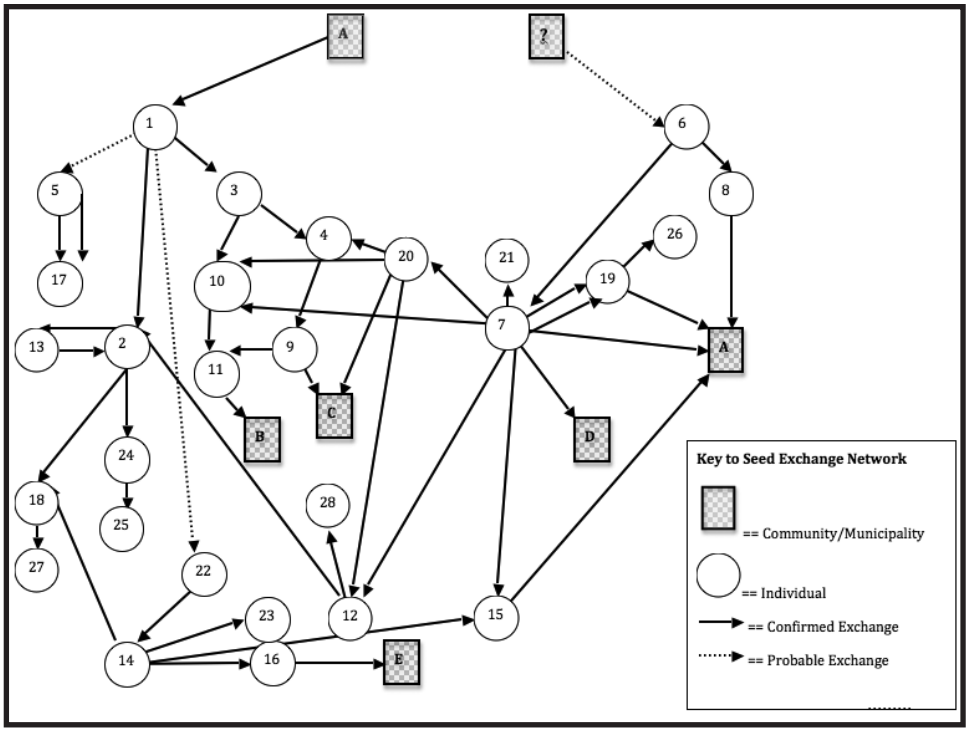

Figure 2. Map of Açaí Branco Seed Exchanges

Results and Discussion

The data collected and management practices observed support the classification of açaí branco as a dynamic seed system in accordance with the three components established by Almekinders et al. (1994).

Variety Use and Development

Presence and use of the variety açaí branco was prevalent throughout the community. Out of the 16 households surveyed, 100% of respondents claimed they had planted palms of açaí branco in their açaí stands, or acquired land on which the variety had already been planted. Located on a tributary of the northern Amazon River, the community was subjected to strong currents that carved farther into the river bank each year, often carrying away tracts of the most intensively managed home garden and stands of açaí along with it. Thirteen of the households currently had açaí branco, while the 3 households that did not had lost all of their acaí branco to high floods over the last 10 years, the most recent occurring in 2009. All 3 households without mature açaí branco had already planted seeds or seedlings or had seeds they were planning to plant that year in the rainy season. In total, 11 of the 16 households reported that they were still actively planting açaí branco in either their quintal home gardens, managed açaízais, and even the land holdings upriver in primary forest. Continual refinement and development of the variety was demonstrated by seed selection and exchanges that took place amongst households, even when they already had mature palms. When interviews were conducted in August towards the end of the açaí season, 5 separate exchange events had been documented for just this season. In one case, 5 vegetative cuttings of açaí branco had been gifted from Household A to Household B 8 years ago. This year, Household A bought 15 kg of branco fruit from Household B, and after processing the pulp to sell to the urban market, the seeds were set aside to be germinated and planted while the seeds originating from Household A's own açaí branco was discarded. It was reported by the head of Household A that the fruits purchased from Household B had superior quality pulp. This is just one example demonstrating the continued development and refinement of the variety branco, even after the type has saturated the community.

Seed Production and Storage Under Local Conditions:

Seed production is said to be more specialized when the seed is produced in separate plots (Almekinders et al. 1994). Informants frequently reported planting the açaí branco in stands spatially removed from açaí preto to prevent what they believed was a risk of cross pollination. Although the factors affecting its expression have not been studied, açaí branco displays the patterns of a recessive trait following Mendelian genetics, with only 20-40% of progeny in turn producing branco according to a controlled study in the EMBRAPA[1] experimental station (pers comm. Mochiutti 2008). To overcome these odds, many farmers reported to be planting only new seeds of açaí branco, with awareness of the low retention for this trait. The intensification of this variety is therefore a gradual and somewhat invisible process, considering that even in plantings made from all açaí branco seedlings, usually only about 30% will mature to express the trait.

The planting and establishment of açaí branco followed very different management pathways than açaí preto as well, beginning with the storage of seeds after processing the pulp (Figure 1). After processing the pulp from açaí preto, the seeds were typically cast away as livestock bedding or to stabilize muddy banks. Açaí branco seeds were retained after processing however, and would typically either be left to germinate in one of the techniques described in Figure 1, or become incorporated into a seed exchange system amongst and between communities. The germination of açaí branco in buckets and plastic bags represents a clear divergence from the management of açaí preto. As there is already abundant regeneration of açaí preto from fallen fruits, seedlings are simply transplanted into growing sites where space is available. Açaí branco is transplanted into cleared areas, such as sunny banks, where the light environment induces earlier production of fruits in the life cycle of the palm. All property owners surveyed with land holdings in the unlogged primary forest upriver reported casting seeds from açaí branco to intensify the varietal production under more humid and closed canopies, conditions linked with superior quality of the fruit pulp.

Seed Exchange Mechanisms of Açaí Branco:

According to Almekinders et al. (1994), there are essentially 4 sources from which a farmer can obtain seed. These include his/her own harvest, other farmers'

harvests, the local grain market, and the formal seed sector. Surveys revealed that the first three of these are utilized in the case of açaí branco, with the first and second being most frequently reported. The fourth, or formal seed sector for açaí, deals exclusively with açaí preto, as agronomists invest research and develop towards expanding production for export and promotion of year-round fruiting. The seed exchange networks traced in this study illuminate an interesting scenario in which açaí branco appears to have been introduced to the community from either one or two original sources, and in the course of 45 years, saturated the community, leaving a dynamic pattern of selection and intensification in its wake (Figure 2). Furthermore, one of the two individuals confirmed to have originally introduced açaí branco into this community reportedly acquired it through urban connections in Macapá (Pinedo-Vasquez, pers comm. Oct 2009). In the 45 years following the introduction of açaí branco, the two original seed sources have been passed between 36 individuals and diffused into 5 different communities and metropolitan areas via at least 44 unique exchanges, though likely more. Furthermore, seed exchange continues to remain strong even though all households included have the variety, indicating that continued refinement and selection is taking place within the community long after the original introduction.

Conclusion

The results of this study support the role of informal seed systems in crop domestication and maintenance of agrobiodiversity. This study showed that in less than fifty years, an introduced variety not only saturated a community through social and family networks of exchange, but was continually improved upon, selected for, and experimented with in line with tastes and preferences at the household and local market level. Furthermore, as seeds of açaí branco were reportedly dispersed and planted into tracts of unlogged, primary forest, the case of açaí branco represents a process in which agrobiodiversity has been transferred from urban market to field back to forest, inverting (or perhaps completing) a trajectory typically ascribed to seeds undergoing domestication. There is little likely future in export for açaí branco. It has found its niche in an environment where it is prized for its quality, consistency, flavor, and digestibility — qualities that quickly loose importance in a global market built upon a successfully promoted image rather than taste or quality. Without the high content of antioxidants, green açaí ceases to be 'açaí' outside of the amazon estuary. However, its very presence and proliferation within communities demonstrates an important fact — local values and preferences strongly affect the selection and management decisions that drive crop domestication. The local importance, individual preference, and higher pricing associated with açaí branco all appear to be factors driving production up, albeit through a slow and invisible process. The seed exchanges by which açaí branco is transmitted and selected between and within communities supports the role that smallholder farmers play in maintaining intraspecific crop diversity, as well as diversifying their economic options, in response to local tastes and preferences.

Acknowledgements

This work was made possible by financial support from the Yale Tropical Resources Institute, the Council on Latin American and Iberian Studies at Yale, the Society for Economic Botany, the Garden Club of America, the Earth Institute at Columbia University and the Columbia University Institute for Latin American Studies. I am very appreciative of the feedback and support provided by my advisors Miguel Pinedo-Vasquez and Mark Ashton, as well as guidance and consultation I received from Eduardo Brondizio, Nathan Vogt, Christine Padoch, and Chuck Peters. I am extremely grateful for the support and generosity of the communities where I worked, especially the families of Sr. Hillario Vilhena de Sousa and Sr. João Canella, and in particular the field assistance from Juciane, Pio, Edwison and Lediane.

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[1] Brazilian Agricultural Research Corporation

Tropical Native Tree Plantations:
An Investigation of Herbivore Damage and Species Selection in Central Panama

Gillian Paul, MFS 2010

Introduction

In the Republic of Panama, around 30% of forests were lost between 1950 and 2000, largely due to conversion into agriculture and pasture lands. Recently, many of those agricultural and grazing areas have been abandoned, allowing the opportunity for natural regeneration and reforestation. Of Panamanian lands converted to timber plantations, an alarming 89% of stands are planted with exotic trees (Craven et al. 2007). In Latin America as a whole, reforestation efforts focus on the planting of well-known exotic trees of *Pinus, Eucalyptus*, and *Tectona* species (Evans and Turnbull 2004). These exotic trees are favorable to plantation foresters because of the ease of managing a stand with simplified nursery practices, management techniques, and harvesting times (Piotto 2008). Although often economically profitable, these systems offer fewer ecological benefits of restoration for organisms that depend on resources such as fruit, nectar, and habitat structure provided by native species (Hartley 2002).

In comparison, native species plantations have been demonstrated to better promote biodiversity and improve site quality (Lugo 1997). In Panama alone there are more than 100 native species valued for timber and other uses (Wishnie et al. 2007). Scientists and research institutions have been increasing their study of mixed native species plantations, but those plantations are still rarely used as a means of forest restoration. For my research, I was excited to investigate native species plantations in Latin America and evaluate how the selection by humans of tree species for planting relates to vulnerability to damage early in plantation establishment.

One bottleneck to plantation forestry as a means of reforestation can be reduced survivability and productivity of the trees due to herbivory. Native timber trees may be more susceptible to the native insect herbivores in a region. Additionally, unlike the detailed recorded literature about pest control practices of pine, eucalyptus, and teak monocultures, there have been fewer research studies investigating pest control for native timber plantations (Butterfield 1995). Although exotic species can have damaging insect outbreaks, native species plantations may be hard to control for herbivory because there are much fewer resources available on pest control practices to guide landowners and forest practitioners.

Tree species selection, which can be different depending on the particular region of the world, is likely to have a strong impact on the vulnerability of the plantation to insect damage and affect the success of the overall reforestation effort. Some tree species have evolved different mechanical and chemical characteristics to minimize insect consumption, thereby reducing the stress of herbivory on the photosynthetic abilities of plants (Coley and Barone 1996; White and Scott 2006). Research on the ground is needed to evaluate how adaptations of different species, in the form of leaf traits, affect the resistance of those trees to insect damage.

For my research, I analyzed the leaf area damage for 5 native timber-value tree species in Panama: *Terminalia amazonia, Dalbergia retusa, Pachira quinata, Tabebuia rosea*, and *Anacardium excelsum*. These species are valued for their timber in Panama and are representative of a diverse range of families, light tolerance, and growth habits. The objective of this study is to identify if there are differences in the foliar herbivory between these native tree species and evaluate how well measured leaf traits relate to the susceptibility to insect damage. By evaluating the leaf adaptations of the native tree species for resistance to herbivory, I seek

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Photo 1. The rolling hills of the Agua Salud Plantations of native tree species in central Panama

to draw comparisons on the relationship between the protective mechanisms and the extent of insect defoliation.

Methods

My research was conducted in central Panama at the site of the Agua Salud Project, a project formed as a partnership by the Smithsonian Institution and Panama Canal Watershed Authority to develop viable strategies for the restoration of forestland and ecosystem services on degraded lands. The 2008 establishment of the Agua Salud plantation provided an excellent opportunity to compare insect defoliation of leaves among native tree species planted in 47 hectares of previously abandoned pasture. The land use history of the land consists of corn, rice, and other crop cultivation as well as pasture grazing until recent land abandonment (<10 years ago).

From May until August 2009, I collected data on the herbivory and leaf traits of young tree saplings of the timber trees *T. amazonia, D. retusa, P. quinata, T. rosea*, and *A. excelsum*. Among the 47 hectares of mixed native species on the landscape, I worked in 15 by 15 tree single-species plots. For the first half of my study, herbivory on a tree level was estimated through a combination of two factors, digital analysis of area damaged per leaf and an estimate of leaves damaged per plant. Instead of collecting leaves for herbivory analysis, my method of digitally measuring herbivore damage was uniquely designed to let a leaf remain on the plant. This was necessary because the sample size needed to get an accurate evaluation of leaf damage on the plant would have necessitated the collection of a large portion of the photosynthetic area of theses young tree saplings. Also, for measurement of herbivory I looked at different categories of herbivory (chewing, skeletonizing, mining, shelter rolling, and gall rolling) that give insight into the functional feeding groups of insects causing the leaf damage.

The second half of my study consisted of the collection of leaves for leaf trait analysis. On separate trees in each plot, four leaves from each tree were collected and stored in a cooler to retain leaf moisture. Within 4-12 hours from collection, I tested the leaves for leaf toughness, a measurement of puncture strength that gives an indication of the relative ease at which an insect can penetrate the surface of a leaf for consumption.

Next, I measured the fresh leaf area using a digital scanner. Leaf samples were dried and weighed to calculate specific leaf area (SLA). SLA, fresh leaf area divided by dry leaf mass ($cm^2\ g^{-1}$), is known to decrease with leaf age as the leaves harden due to the higher density tissue, thicker lamina, and stronger veins associated with low-SLA leaves (Moles and Westoby 2000). Finally, leaves were ground and measured for carbon and nitrogen values by means of thermal combustion. Larger nitrogen and smaller Carbon:Nitrogen ratios suggest more palatability and nutritional value of the leaf to feeding insects.

Results and Discussion

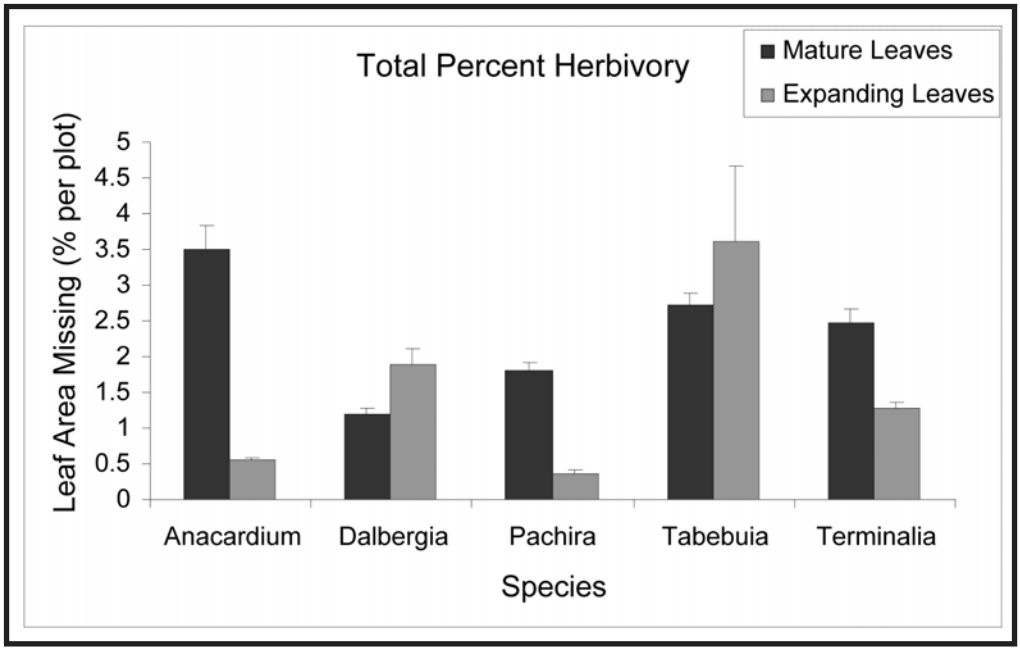
Overall, the herbivore damage was less than 5% of the leaf area per plot for each species. These five species were originally chosen because of their vigor in native species plantations in other areas of Panama (van Bruegel, in press). Even though leaf damage was low, there were significant differences among the species (Fig. 1). The damage to *A. excelsum* and *T. rosea* was significantly higher than the other species, while damage to *D. retusa* and *P. quinata* was significantly lower than the other species. *Anacardium excelsum* and *T. rosea* also had more diversity in the types of insect damage than other species.

The correlations between leaf traits and herbivory is depicted in figure 2. Contrary to my hypothesis, the species with higher herbivory demonstrated higher leaf toughness and lower SLA. However, leaf toughness was not found to be a significant predictor of insect damage in this study. It is possible that the toughness of these species at their current age is not high enough to deter herbivores and thereby is unrelated to their palatability. The C:N ratios demonstrated a significant positive correlation and nitrogen values exhibited a significant negative correlation with herbivory. Similar to leaf toughness, this finding – that leaves with higher herbivory had lower leaf nitrogen – was different from my predictions. The small differences in herbivory between species may be confounding the trends in the leaf traits. Also, for future study, evaluating the presence of secondary defense mechanisms, or toxic compounds in the leaves, will be important in understanding the low levels of herbivory.

One interesting finding, perhaps more important than leaf traits I measured, was that insect damage related to the phenology and successional state in which the species is found in the forest. *Anacardium excelsum* was the only plant with evergreen leaves. Young leaves had low levels of herbivory and higher toughness values that other species. Mature leaves of this species demonstrated the highest herbivory and variety of damage types while also exhibiting the highest toughness and the lowest nitrogen concentration. Literature on *A. excelsum* suggests that leaves of this species have higher phenols, a type of chemical defense, than many other species in Panama (Coley et al. 2002). It is possible that the higher toughness and lower nitrogen content protect leaves while they are young and unhardened. The higher rates of herbivory could be because this evergreen species has leaves exposed and available for eating for longer time than leaves of other species.

Herbivory in the other species relate to the successional state in which those trees are found in the wild. *Pachira quinata* is a mid-successional

Figure 1. Total Herbivory (standard error bars) for mature and expanding leaves



species, growing to canopy dominance in the period between the initial forest and the later mature forest. The herbivory of *P. quinata* was relatively low in comparison with the other species, even though it exhibited the lowest leaf toughness in both expanding and mature leaves. More research is needed to determine the chemical defenses of *P. quinata* beyond leaf nitrogen.

The high herbivory values for *T. rosea* and *T. amazonia* may be related to the early-successional habitat of those species. Being early successional, they likely invest their resources in quick growth at the expense of protection against herbivores. Because of the high toughness and low SLA exhibited in these species, they may depend primarily on these mechanical defenses more than energy intensive secondary chemicals. There were two plots of *T. rosea* in which high amounts of rolling herbivory were found on young, expanding leaves. These plots were not in spatial proximity on the landscape. Therefore, the presence of rolling herbivory is likely due to two separate infestations of rolling insects specifically attracted to young *T. rosea* leaves.

Dalbergia retusa is a late successional, leguminous species. In the leaf trait analysis, *D. retusa* exhibited the highest nitrogen content, but also maintained the lowest herbivory in mature leaves. Although higher nitrogen concentrations can be more nutritious to animals, this species clearly demonstrated a higher resistance to insect damage after leaf maturation. Late successional trees often grow in the shady understory while faster growing species exhibit dominance early in forest succession. Their position in the shady understory can be a favorable habitat to herbivores; therefore, it is understandable that *D. retusa* would be more adapted to resist herbivory. As long as this shade tolerant species also grows well in the high-light environment of abandoned pasture, then it is a wise choice for use in a native species plantation.

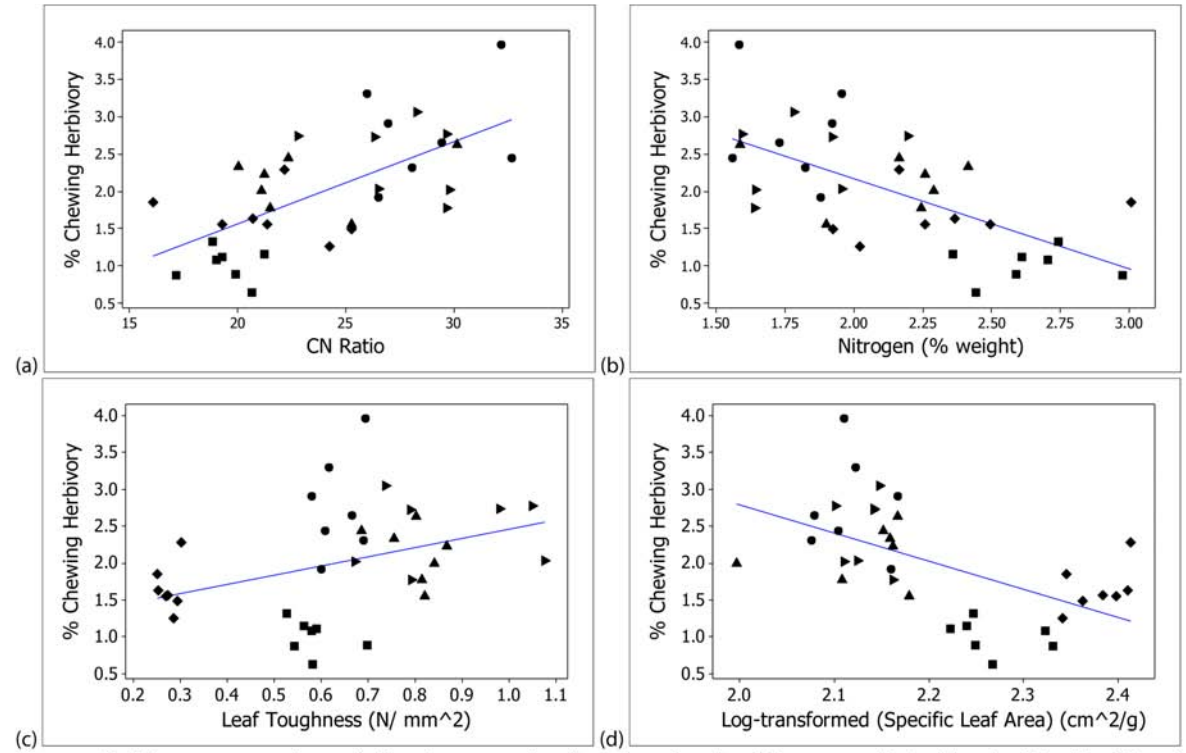


Figure 2. Linear regression of five tree species for chewing herbivory predicted by leaf traits. Chewing Herbivory vs. (a) C:N ratio (R^2 = 42.5%, $p < 0.001$). (b) Leaf Nitrogen (R^2 = 41.5%, $p < 0.001$). (c) Leaf Toughness (R^2 = 12.2%, $p = 0.040$). (d) Specific Leaf Area (R^2 = 27.5%, $P < 0.001$). Data points labeled by species: (■) *Anacardium excelsum*, (■) *Dalbergia retusa*, (◆) *Pachira quinata*, (▲) *Tabebuia rosea*, (▶) *Terminalia amazonia*.

Conclusions

This research is meant to serve as a resource for forest managers and practitioners choosing species for tropical forest restoration and plantations. Tropical forest plantations are important for timber production, clean water supply, carbon sequestration, and habitat for biodiversity. Native species plantations can serve as catalysts for forest rehabilitation in degraded tropical areas while providing environmental and economic benefits to the region (Parrotta et al. 1997). Instead of relying on a few well studied exotic tree species, forest managers worldwide can use tree characteristics in their considerations for selecting trees native to their own region.

In their first wet season in the ground, the native species in this study demonstrated low levels of herbivore damage. Of course further research will need to determine if this trend continues; however, this finding is a good sign for the viability of native species plantations. For selection of species, choosing late successional species that are also light-tolerant, such as *D. retusa*, may help reduce the palatability of their trees to feeding insects. Further investigation is needed to evaluate chemical defenses in these species beyond leaf nitrogen.

It is my hope that the results of my study can inspire the use of native species for other plantation projects and encourage further research aimed at providing forest managers with insight into the ecological considerations for selecting plantation species most likely to survive early in plantation establishment.

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Small-Scale Restoration Efforts Using Mixed-Tree Plantations in the Path of the Tapir Biological Corridor, Costa Rica

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Introduction

Even though tree plantations are established with a stronger focus on economics, they can play an important role in biodiversity conservation. Tree plantations not only reduce pressure on natural forests (e.g. timber production), but they can also provide habitat for wildlife species as well as restore degraded landscapes and sequester carbon (Lamb et al. 2005; Carnus et al. 2006; Redondo-Brenes and Montagnini 2006). To promote biodiversity, mixed tree plantations using native species are becoming more common in practice (Lamb et al. 2005). Most mixed species plantations consist of fewer than five different species and are established for either short-term cover crops or long-term plantations (Mansourian et al. 2005).

Some of the advantages of mixed plantations include reduced competition due to differences between nutrient and resource uptake, sunlight requirements, diversification of products, as well as increased overall biodiversity of the plantation (Guariguata et al. 1995; Piotto 2008). Some disadvantages include the potential for interspecific competition that can negatively affect growth, and a complex management system that is needed because of different species in the mixture. However, these advantages and disadvan- tages depend on the interactions between the specific characteristics of the plantation species (Piotto 2008), which makes research investigating the interactions between native species in plantations necessary.

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The present study assessed growth patterns and potential uses of native mixed-tree plantations established in the Firestone Center for Restoration Ecology (FCRE), Costa Rica. The FCRE is a biological reserve, and an educational and research center that is a part of the Path of the Tapir Biological Corridor (PTBC). The PTBC, an 80,000-ha human-dominated region and one of the most diverse areas of the Pacific rainforest of Central America, is a local initiative that promotes managing the local resources in a sustainable manner (Redondo-Brenes 2007b). Information from this study provides a better understanding of the compatibility between various types of native species that have been used in restoration efforts. Moreover, because the FCRE is located within a biological corridor, information about the performance of these tree plantations will be useful for landowners, managers, and conservation biologists to assess the use of mixtures for restoration, and/or for conservation purposes (e.g. habitat, connectivity, or acting as buffer zone of forested reserves) in this and other regions with similar ecological characteristics.

Methods

Study site description

The FCRE is a 60-ha biological reserve located in Barú of Aguirre, in the Southwestern region of Costa Rica, near Dominical beach (Fig. 1). Annual temperature varies from 23 to 33 °C. Annual precipitation is around 4100 m. Prior to the establishment of the FCRE, the property had been lowland tropical rainforest, which was cleared between the 1950s and 1960s for cattle ranching. Restoration efforts began in 1993 through reforestation with native and exotic species, bamboo, and allowing natural regeneration to occur by itself in other parts of the property.

Currently, the FCRE property is divided into various abandoned hardwood plantations, banana, peach

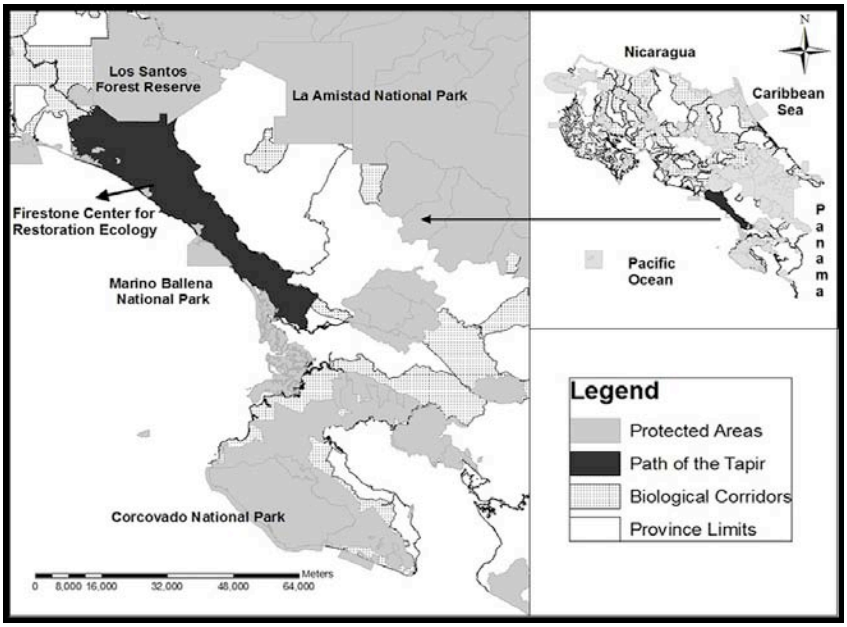

Figure 1. Location of the Firestone Center for Restoration Ecology within the Path of the Tapir Biological Corridor, Costa Rica

palm, and bamboo plantations, as well as natural regenerating forest.

The FCRE tree plantations were 12 years old at the time of this study and were planted with environmental purposes rather than timber production. The plantations assessed included the following species: *Terminalia amazonia* (amarillon), *Astronium graveolens* (ron rón), *Aspidosperma spruceanum* (manglillo), and *Tabebuia rosea* (roble de sabana) (Table 1). Plantation A is composed of the *T. amazonia* and *A. graveolens* species. Plantation B is the mixed species plantation of *T. amazonia, A. graveolens*, and *T. rosea*. Plantation C is comprised of *T. amazonia* and *A. spruceanum* species.

Out of the four species planted, *T. amazonia* is the species that has been used most in the country (Streed et al. 2006: Redondo-Brenes and Montagnini 2006; Redondo-Brenes 2007a; Calvo et al. 2007). However, although the other three species are also important species being planted in several locations in Central America, there is limited amount of research available on their growth characteristics, making this study relevant for reforestation programs. All of these species are of high timber quality.

Plot establishment and data analysis

Four permanent sampling plots were established within each of the three plantations. Every plot is a made up of 30 planted trees arranged in a 6-tree by 5-tree rectangle. At each plot, the diameter at breast height (dbh) and tree height were collected for all 30 trees, and any additional trees resulting from natural regeneration within the plot with a dbh greater than 5 cm. A calibrated diameter measuring tape was used to measure tree dbh (1.30 meters above the ground). Tree height was calculated using

Table 1. Descriptions of tree species grown in mixed plantations at the Firestone Center for Restoration Ecology in the Southwestern Pacific region of Costa Rica

Species	Common Name	Family	Native Distribution	Growth and Habitat
Terminalia amazonia	Amarillón	Combretaceae	Mexico to South American and Antilles	Canopy tree, found on slopes, can grow in variety of soils, regenerates in open areas, can grow at high altitudes (1100 m).
Astronium graveolens	Ron rón	Anacardiaceae	Mexico to Bolivia and Brazil.	Canopy tree, usually found in flat or moderately sloping areas and tolerates a range of soils, grows well with partial or full shade, often found in dry forests.
Aspidosperma spruceanum	Manglillo	Apocynaceae	Southwestern Costa Rica to Peru and Brazil	Sub-canopy tree, usually found in humid, well drained areas.
Tabebuia rosea	Roble de sabana	Bignoniaceae	Tropical region of Central America	Sub-canopy tree, usually found in dry forests, however, spread in humid habitats

Source: Jiménez-Madrigal et al. (2002).

	Tree Density (n/ha)	Standard deviation (n/ha)	Survivorship (%)
Plantation A (n = 4)			
Terminalia amazonia	450	110	82
Astronium graveolens	468	136	85
Other species	46	40	NA
Plantation B (n = 4)			
Terminalia amazonia	423	115	76
Astronium graveolens	225	42	80
Tabebuia rosea	240	38	87
Other species	93	106	NA
Plantation C (n = 4)			
Terminalia amazonia	390	38	71
Aspidosperma spruceanum	165	210	30
Other species	46	40	NA

Table 2. Tree density and survivorship of four tree species in three mixed-plantations at the FCRE, Costa Rica

a calibrated clinometer.

Average dbh, total height, and basal area were calculated for each plot and at the tree level for each species. Mean annual increments (MAI) of these variables were calculated over the 12 years of growth by dividing the current values by the plantation age. One-way analyses of variance (ANOVA) were used to determine the statistical significance for differences in dbh, height, and basal area. In addition, Tukey's pair-wise comparisons were used to determine statistically significant differences within each variable for each plantation group.

RESULTS

Survivorship

Because the tree plantations were abandoned since establishment, mortality and therefore tree density is the result of natural selection and competition (self-thinning). Survival rates varied among species and plantations types (Table 2). The 50% survivorship in plantation C contrasted with the 83% and 80% of the mixtures in A and B, respectively. The species with the highest survivorship was *T. rosea*, which had an overall survivorship of 87%, and the species with the lowest survivorship was *A. spruceanum* (30% survivorship). However, *A. spruceanum* may reach 100% mortality in the coming years because most trees in the mixture with *T. amazonia* were dying at the time of our assessment. The overall survival of *T. amazonia* in the three mixtures and *A. graveolens* in two mixtures were 77% and 84%, respectively.

In all plantations, there were eight species from natural regeneration larger than 5 cm in diameter, growing in between the planted trees, increasing plant diversity. From the eight species naturally regenerated, *Tachigali versicolor* is listed as an endangered tree species in Costa Rica, enhancing the conservation value of these plantations.

Tree growth

In mixed-tree plantations, performance of the mixtures varied a lot, and we know little about it, especially for tropical nations. For instance, plantations A and C had the largest values for diameter, height, and basal area (Table 3, Fig. 2). Plantation A had the highest overall average basal area, and Plantation B had the lowest; but these values were not statistically different in between the three types of plantations (Fig. 2).

Performance of the species within the mixtures and across plantations also varied when comparing the four species. Overall, *T. amazonia* had the significantly highest values for diameter and total height across species and mixtures (Table 3, Fig. 2). Across all the plantations, *T. amazonia* was also the greatest contributor for the overall basal area of each mixture. The other three species generally had lower diameter and height averages, and their contribution to basal area in the different mixtures was low in comparison to *T. amazonia*. Due to its high mortality *A. spruceanum* had the lowest input to the stand basal area among the four species.

Table 3. Average diameter at breast height (DBH) and average height of four native species planted in three different mixtures at the Firestone Center for Restoration Ecology, Costa Rica.

	DBH (cm)	DBH Growth (cm/yr)	Height (m)	Height Growth (m/yr)
Plantation A (n=4)				
Terminalia amazonia	26.7±(0.1)a	2.1	21.7±(0.8)a	1.4
Astronium graveolens	9.5±(0.4)b	0.9	8.8±(0.2)b	0.6
Plantation B (n=4)				
Terminalia amazonia	17.9±(1.5) c	1.6	18.5±(0.7)c	1.3
Astronium graveolens	11.4±(1.7)bc	0.9	10.5±(1.8)b	0.7
Tabebuia rosea	6.4±(0.9) b	0.5	5.6±(1.1)b	0.4
Plantation C (n=4)				
Terminalia amazonia	26.5±(0.6)a	2.2	22.2±(0.5)a	1.5
Aspidosperma spruceanum	6.2±(2.2)b	0.5	9.4±(3.2)b	0.6

Means are significantly different when followed by different lower-case letters within the column ($p < 0.05$).

Discussion

Performance of the mixed plantations

Data from these mixtures of tree species provide some relevant new information to the data already obtained in other projects. For instance, no previous studies have assessed mixtures of *T. amazonia,* which is characteristic of wet lowlands, with three species that are more commonly found in dry forest landscapes. This is important because the need to develop knowledge for other species mixtures, even from different regions. Overall, all of the three abandoned mixtures part of this study had basal area values lower than managed mixed-tree plantations in the area (Leopold 2005) and in other regions of the country (Redondo-Brenes and Montagnini 2006). However, at the species level, the basal area averages of the *T. amazonia* were similar to other mixed plantations of similar age in Costa Rica (Redondo-Brenes and Montagnini 2006; Redondo-Brenes 2007a). *Terminalia amazonia* showed the best growth of all of the species across all of the mixed plantations, corresponding with previous studies that have shown this species performing well in mixtures (Carpenter et al. 2004; Redondo-Brenes and Montagnini, 2006). Moreover, comparing with pure stands of similar ages, *T. amazonia* had higher diameter and height averages than plantations from Northern Costa Rica (Redondo-Brenes 2007).

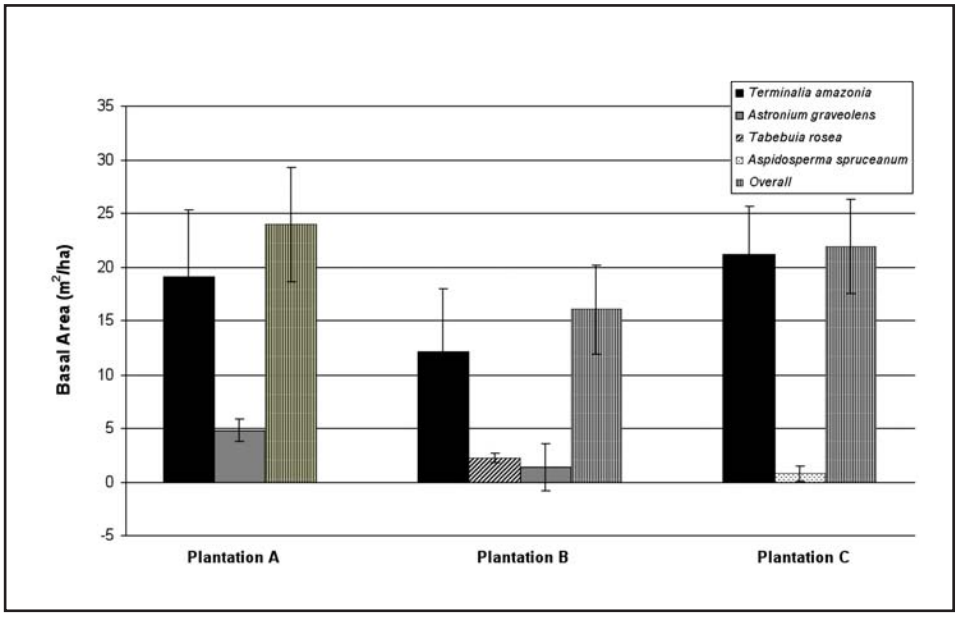

Figure 2. Basal area for three mixed-plantations at the Firestone Center for Restoration Ecology, Costa Rica.

The drastic difference between the growth of the *T. amazonia* and the other species within the plantations suggests that the *T. amazonia* may have been out-competing the other species for nutrients and other resources. However, because *A. graveolens*, *A. spruceanum* and *T. rosea,* are considered slow-growing species (Jimenéz-Madrigal et al. 2002), these species may be growing at a natural rate. Yet the average dbh for the *A. graveolens* at these plantations was much lower than the values obtained in another study. For example, *A. graveolens* on a mixed, 6-year-old plantation had an average dbh of 8.01 cm (Piotto et al. 2004a), which is higher than the 6.3 cm average dbh of the *A. graveolens* in the 12-year-old plantations at the FCRE. Also, another study observed *T. rosea* to have an average dbh of 9.34 cm in an open pasture setting (Piotto 2007), which is also higher than the average dbh from this study.

In spite of the slow growth of the *A. graveolens* and *T. rosea,* the survivorship of these two species was high (Table 2). This suggests that despite their inability to reach the canopy, they are still able to survive under the canopy formed primarily by *T. amazonia*. Conversely, the *A. spruceanum* had very low growth and high mortality, suggesting that this species and *T. amazonia* should not be planted together in mixtures.

Mixed plantations for conservation and restoration purposes

As mentioned above, initially, plantations had been created with a stronger focus on economics rather than environmental rehabilitation. In fact, a greater emphasis has been placed on creating plantation monocultures, mainly consisting of exotic tree species that are known to have rapid growth rates (Leopold et al. 2001). Exotic tree species were often used within hardwood plantations of the past due to the easy availability of information regarding the species' needs, growth information, and success rates, with approximately 30% of the species used for plantations being of the *Pinus* and *Eucalyptus* genera (Carnus et al. 2006). These types of species, when planted in large scale monocultures, generally require simple management since all of the trees mature at the same time, and the timber is of market quality (Mansourian et al. 2005). Despite the benefits of monoculture plantations, research suggests that they only provide limited ecological benefits, especially in regards to secondary forest regeneration and mixed plantations (Carnus et al. 2006; Redondo-Brenes and Montagnini 2010).

As a result of these concerns about exotic monocultures, use of native species on mixed plantations has been recommended for biodiversity conservation by several authors (Parrotta et al. 1997; Leopold et al. 2001; Leopold 2005; Carnus et al. 2006; Redondo-Brenes and Montagnini 2010). It has been observed that plantations promote the regeneration of under story species by shading out grasses, increasing nutrient richness of topsoil, allowing the growth of more sensitive tree species, and creating a microclimate that attracts seed dispersers (Cusack and Montagnini 2004) and other wildlife species, increasing overall biodiversity (Carnus et al. 2006).

Even though data for this study is from a small-scale restoration program, the information from these mixed-plantations can be useful for stakeholders who want to reforest their lands for restoration purposes either within a biological corridor or in any other landscape with similar ecological features. At the regional level, the PTBC conservation efforts are being undertaken through 30 private reserves that are isolated in the landscape (Redondo-Brenes 2007b). Either mixed plantations or natural regeneration can be used to connect these forest fragments, avoiding large scale pasture lands that are less likely to provide a suitable habitat for wildlife.

Any habitat type other than native forest that can be suitable habitat for wildlife species should be considered of interest in restoration and conservation efforts. For instance, the PTBC is home for more than 450 bird species (more than 50% of Costa Rica avifauna), and it has been estimated that tree plantations can provide food sources or habitat for more than 150 bird species in the region. Moreover, it was found that bird species utilize more native plantations (*T. amazonia* – 123 species) more than exotic ones (*Tectona grandis* – teak – 104 bird species) (Redondo-Brenes and Montagnini 2010). Similar results were found also in Kenya, where native plantations provide better habitat to wildlife than exotic species (Farwing et al. 2008). Therefore, native mixed plantations may play an important role to biodiversity conservation in the corridor by increasing species richness at the landscape level, improving connectivity across the landscape, and buffering existing forest fragments.

The present study not only summarizes growth patterns of four species planting on mixtures, but also it provides another perspective of some ecological benefits plantations can provide in our current human-modified landscapes.

Acknowledgments

The authors would like to thank the Firestone Center for Restoration Ecology, Pitzer College, Swarthmore College, the Tropical Resources Institute at Yale, and the Yale School of Forestry and Environmental Studies for their support to carry out this project.

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II. THE CONTINUING EVOLUTION OF INDIGENOUS ENVIRONMENTAL POLITICS

Carry a Big Stick:
Performing Indigenous Identity in Panama City

Marian Ahn Thorpe, MESc 2010

Introduction

I noticed the long wooden pole several times over the course of the morning. I was in Panama City, Panama, attending a rally of indigenous activists, and had noticed the pole making its way through the crowd in the hands of a stout indigenous man in his forties. Two details in particular caught my attention: one, this was the only pole in the crowd – no one else had brought such an object, and two, the owner of the pole seemed very pleased to be holding it. Every so often, when the gathering of mostly Ngäbe and Naso indigenous people would cheer "No to mining! No to the dams!," the man would drop the end of the thick pole onto the cement floor of the pavilion in noisy agreement. He took obvious enjoyment in hefting the long cylinder, in letting its resonant thuds ring out in response to the crowd's cries. Curious, I watched it meander through the group of about 100 protesters and wondered if the object had a meaning or purpose. Soon I heard the word "*balsería*" and realized that the pole was part of the Ngäbe traditional sport. The rally-goers would soon be treated to a demonstration of *balsería*.

Many scholars have noted that humans are constantly inventing and reinventing tradition in order to "legitimate or sanctify some current reality or aspiration" (Hanson 1989). *Balsería* is one such example. The Ngäbe (pronounced "NAH-bay") have practiced the sport of *balsería* for generations, but its cultural meaning seems to have undergone major shifts in the last fifty years. At its most basic level, *balsería* was a competition in which participants took turns throwing a long balsawood pole at each other's legs. The targeted person stood in place as the thrower circled around, lunging and feinting to catch the target off-guard. The target was not supposed to look directly at the thrower, so he had to anticipate the throw by watching his adversary out of the corner of his eye. If he failed to dodge the pole he suffered a nasty bruise. The most agile, quickest, and strongest players won the competition in the sense that they gained social prestige by proving their physical prowess (Young 1971).

Balsería also played an important role in strengthening relationships within and between family groups. The competitions would take place when one family invited a neighboring family to meet them on a specified date, usually about two months in the future. The hosting family would spend the two intervening months preparing food and drink for their guests, marshalling resources from every relative in order to provide for the event. The family's ability to provide food and drink for hundreds of guests affirmed their good social standing and heightened the family's status as community leaders. The guest family was required to reciprocate the invitation the following year, and received a similar social benefit from doing so (Young 1971). Anthropologist Philip Young therefore suggested that the sport played an important role in maintaining social ties between family groups, determining social hierarchies within and between communities (1971, 211-212). Of course, Young had to gather this information from the stories of his informants; he never actually witnessed a *balsería* competition because an emergent Ngäbe religious movement known as *Mama Tata* banned the practice in the 1960s. Young wrote that the religious group, which drew from a mix of Catholic, Evangelical, and traditional Ngäbe beliefs, apparently arose out of concerns about the increasing influence

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Figure 1. Demonstrating on the *Cinta Costera*. Ngäbe protesters in Panama City display banners that condemn hydroelectric dams and mining. The banners read "No to the Chorcha dam: God sends the waters to give life" (left) and "The *comarca* says no to dams and no to mining" (right).

of modern Panamanian society on Ngäbe life (1971). The religious movement instructed against visiting Latino towns, conducting sales or purchases with Latinos, and registering births and deaths with the local government (Young 1971). The movement also proscribed a number of traditional practices, such as *balsería*, which commonly included fighting and the production and consumption of alcohol (Young 1971). By the time Young arrived in Panama in the late 1960s, the practice of *balsería* had apparently disappeared. The *Mama Tata* movement replaced the pre-existing association of *balsería* with physical ability and social standing with a new association with sin and vice. More recently, reports from a few websites (Spink 2009; Balseria and Chica de Maiz 2008) and my experience in Panama City demonstrate that *balsería* has reemerged. While I cannot speak to *balsería*'s importance in other locations, when performed in Panama City, the sport again shifted meanings as Ngäbe communities protested the latest wave of modernity to crash against their rapidly eroding land and lifestyle.

I spent the summer of 2009 in a community called Soloy in the Ngäbe-Buglé *Comarca*, researching my master's thesis on local activism against international mining and hydroelectric dam projects. A *Comarca,* I learned from my background research, is an administrative region governed by an area's indigenous inhabitants. Panama has five of these regions, including the Ngäbe-Buglé *Comarca*, which was established in 1997 (Bort and Young 2001). The Ngäbe, Panama's largest indigenous group, share this territory with the Buglé (pronounced "boo-GLAY"), a much smaller tribe with common linguistic and cultural roots (*Población Indígena* 2000; Bort and Young 2001). Legal recognition has done little to address the financial, health, and environmental problems facing the Ngäbe and Panama's six other indigenous groups For instance, the fragile forest plots the Ngäbe have cultivated for centuries cannot sustain the rapidly growing Ngäbe population, so to supplement their small farms, many men find seasonal work on coffee and banana plantations in the highlands of Panama and Costa Rica (Bort and Young 2001). So far most families in the *comarca* are able to survive by pairing meager cash incomes from relatives working on plantations with subsistence crops coaxed out of the easily eroded mountain soils. But a new wave of mining and hydroelectric development threatens to undermine a way of life that is so tied to nature. According to a September 2009 document published by the Panamanian Ministry of Industry and Commerce, the government has received requests for exploratory mining permits for over two million hectares of land since 1990 (Solicitudes de los Minerales Metálicos 2009). That is over 25% of the country's land area. A map from the National Environmental Authority shows the western province of Chiriquí as a jagged white field dotted with fifty bright blue rectangles, each rectangle indicating the site of a proposed dam (ANAM 2008). Should the Ngäbe lose their land and water to mining or hydroelectric dams, they would lose their livelihood

and the traditions so closely tied to it.

Hundreds of Ngäbe activists and other indigenous and non-indigenous supporters responded to the impending mining and dam threats in October of 2009 by marching from the Ngäbe-Buglé *Comarca* to Panama City, a journey of 370 kilometers (*La Marcha* 2009).

Once in Panama City, the activists held a series of press events, including a day of cultural demonstrations on the *Cinta Costera* ("Coastal Beltway"), a brand-new public park running the along the ocean's edge of Panama City's poshest neighborhood (Fig. 1). New skyscrapers sparkled in every direction except to our east, where the Pacific Ocean glinted. The neck of enormous electric guitar emblazoned with "Hard Rock Café" thrust itself 49 feet in the air over a sidewalk outside a nearby mall. When I returned to Panama in October to observe the protests, I also observed that the decision to perform *balsería* in the heart of the capital city's homage to globalization imbued the sport with multiple layers of meaning beyond the traditional cultural significance.

As the speeches wound down in the pavilion on the *Cinta Costera*, the owner of the *balsería* pole beckoned other men out from under the shade of the pavilion into the tropical sun. The crowd followed and encircled the men, who prepared themselves by putting on their be-feathered straw hats, tying appliquéd headbands around baseball caps, or adjusting beaded collars around their shoulders (Figs. 2 & 3). The donning of traditional regalia helped underscore one of the intended purposes of the demonstration: the Ngäbe leadership was trying to promote Ngäbe culture to broader Panamanian society to bolster their claims against the government. Scholars have noted that indigenous identity and its associated cultural and environmental values are often tapped as a source of moral authority that validates the political claims of indigenous groups (Jung 2008; Li 2000). When the Ngäbe brought *balsería* to the *Cinta Costera* in downtown Panama City, they sought to invoke this moral authority by reinforcing their cultural uniqueness through their hand-woven hats, beaded collars, and *balsería*. By performing *balsería* on the national stage, the Ngäbe leaders took the sport beyond its traditional function of defining social relationships and gave it a new purpose: *balsería* became a signifier of a distinctively Ngäbe political and cultural identity.

But then the demonstration took on another meaning. I watched two acquaintances, Bernardo and Celio, enter the circle and face off. Bernardo held the five-foot-long pole lightly in his right hand and circled Celio in a series of slow, springing steps. Celio waited, feet planted, knees slightly bent, eyes and ears straining to follow Bernardo's orbit as he hopped out of Celio's field of vision. Suddenly Bernardo launched the pole at Celio's legs. Celio leapt out of the way

Figure 2. Dodging the balsa pole. Spectators watch as activists perform *balsería* at the *Cinta Costera* park in downtown Panama City

Figure 3. Lunging and leaping. Activists perform *balsería* at the *Cinta Costera* park in downtown Panama City. Behind the performers, a protester carries the flag of the Ngäbe-Buglé *Comarca* (left).

and the pole missed, hitting the ground with a dull, wooden vibration. Bernardo's throw had landed far away; he missed on purpose because this event was just a show, not the real thing. The other men took their cue from Bernardo and began not just demonstrating but performing. The event quickly became a farce as the actors settled into the comedic potential of their roles. They pretended to be raging drunk, with one man even going so far as to stumble over to a nearby flagpole, lean sloppily against it, and pretend to retch. Other men pretended to fight. Hats fell to the ground, beaded collars hung askew, sweat dripped from grinning brows and chins, and the Ngäbe spectators howled in delighted recognition.

Why would a group seeking political legitimacy play up vices like drunkenness and violence? The Ngäbe face a long history of discrimination in Panamanian society, including an enduring stereotype as drunks and fighters. Anthropologist Philippe Bourgois discussed racism and drinking and fighting amongst Ngäbe (formerly known as Guaymi) workers on banana plantations in northwestern Panama in the 1980s, saying, "In traditional Guaymi society ritualized fisticuffs known as *balsería* (*krun*) and kubruidi is an important institutionalized means of expressing individual valor and of cementing political patterns of leadership within and across communities. In the context of rotgut liquor and hostile non-Amerindians, however, it becomes a forum for public degradation. Sometimes up to a half-dozen staggering young men alternately pound one another in the face and fall in the mud in drunken slow motion with a crowd of non-Amerindians jeering them on" (Bourgois 1988). Given this history, why would Ngäbe activists parody drunkenness and fighting in their public demonstration of Ngäbe culture? The curious presence of comedic farce in the cultural demonstration pointed to another possible significance that *balsería* adopted when performed on the *Cinta Costera*. Like an in-joke shared amongst friends, the act of laughing at one's traditions in a public venue where other viewers do not understand the humor affirms group identity and strengthens the bonds between those who "get it." The allusion to knowledge and experiences beyond the grasp of dominant society also temporarily upends power relations when the members of the subjugated group demonstrate their facility with cultural landscapes from which members of the dominant society are excluded. Perhaps the *balsería* performance served this function: it allowed the Ngäbe to respond to their exclusion from Panamanian society by creating an alternative space in which they had the power to define cultural norms and set the terms of inclusion or exclusion.

As I watched the *balsería* pole graze the ankles of leaping man after leaping man, I reflected on the object's dynamic history. The pole was part of a cultural practice whose meanings shifted because of the *Mama Tata* religious movement, and whose

meanings are now shifting again in response to the needs of its practitioners. On the *Cinta Costera*, *balsería* became a symbol of Ngäbe political claims, a wooden thumb in the eye of the Panamanian state. It also became a symbol of power for activists who had come to Panama City to contest their exclusion from Panamanian society. *Balsería* will doubtless continue to adopt new meanings as the Ngäbe attempt to negotiate the terms of their relationships with the government and Panamanian society.

Acknowledgments

The author wishes to thank the Tropical Resources Institute, the Yale Agrarian Studies Program, and the Yale Center for Latin American and Iberian Studies for their generous support. Thanks also to Gordon Geballe and Amity Doolittle at Yale School of Forestry and Environmental Studies.

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Indigenous Perspectives on Oil Exploration Concessions in the Peruvian Amazon

Lauren Baker, PhD candidate

"First we want you to leave our home, then we will invite you to talk"

In the above quote, an indigenous leader in the Madre de Dios region of Peru joined his voice with that of others in the Native Federation of the Río Madre de Dios (FENAMAD) to ask Hunt Oil to "definitively withdraw from the Amarakaeria Communal Reserve since you do not have the indigenous community's consent" (Amazon Watch 2009). This is one variation of a perspective held by many indigenous leaders in the Peruvian Amazon in regards to oil exploration and exploitation concessions – namely, that communities should have greater say (and according to many, a definitive say) in whether and how oil exploration activities proceed in their communities. In this article, I intend to illuminate this perspective, along with several other common threads of concern held by many indigenous peoples regarding recent oil exploration concessions that have been established throughout the Peruvian Amazon.

Concerns about oil concessions in the Peruvian Amazon are not new, but have gained increasing prominence in recent years given the rapid and recent increase in oil exploration concessions. Over the past five years the Peruvian government has rapidly increased oil exploration concessions in the Peruvian Amazon, with concessions now covering around 75% of the Peruvian Amazon (Finer et al. 2008), up from around 15% in 2004 (Servindi 2009) (Fig. 1).

The promotion of oil has been linked to a vision of development at the national and regional level based upon the privatization and exportation of natural resources. This vision was made clear, for example, in the article "*El Síndrome del Perro del Hortelano*" written by the Peruvian President, Alan Garcia. In this article, President Garcia states that "any Peruvian can look around and see all the riches that exist and that are not being put to value…The reality is that we should put to use the resources that we are not utilizing…This is the best bet for the future, and the only way that we will achieve progress" (Garcia 2007). In this same article, Garcia also expressed an attitude that those that oppose concessions are also against national progress: that those that believe that "Peruvian petroleum should remain beneath the earth while the world pays $90 per barrel…prefer that Peru continues to import and continues getting poorer."

Despite promises of progress and well-being, many people living in areas newly overlaid by concessions have expressed concerns or opposition to the concessions. A particularly important group of stakeholders, given their high presence and their claims of ancestral rights to large areas throughout the Peruvian Amazon, are the many indigenous communities and federations. AIDESEP (*Asociación Interétnica de Desarrollo de la Selva Peruana*), the primary indigenous federation for the Peruvian Amazon has repeatedly denounced the superposition of hydrocarbon blocks over indigenous territories, especially in territorial reserves for the protection of isolated (uncontacted) indigenous peoples (Servindi 2008; AIDESEP n.d.). Other regional federations have similarly objected to oil concessions. For example, ARPI (*Asociación Regional de Pueblos Indígenas de la Selva Central*) decried the state's "aggressive policies to approve...oil and gas concessions in the Amazon" in "violation of the right to prior informed consultation and consent of the ancestral owners of natural resources and territories" and declared that they "join the national Amazonian position of AIDESEP to not permit the entrance of petroleum companies in the territories of Amazonian indigenous communities" (ARPI 2007). The Shuar Organization of Morona (OSHDEM), the Shapra Federation of Morona (FESHAM), and the Indigenous Association of Morona (AIM) have similarly warned that "we will not permit any more oil activities in the zone" (AIDESEP 2008). This is not meant to imply that all communities or federations have opposed the concessions. Indeed,

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Figure 1. A map of oil concessions in Peru. [Source: PerúPetro]

some communities have been allured by the ample promises made by the government and companies of benefits for local communities, which generally are negotiated between local communities and companies in an ad hoc fashion, with the possibility of including short-term employment and/or material benefits. Rather, the above references to denouncements are meant to illustrate that many communities and federations have raised concerns or opposed oil concessions in their communities.

Over June and July 2009, I went to Peru with two objectives in mind: 1) to gain a clear idea about indigenous perspectives on oil exploration concessions, including considerations about possible impacts or benefits; and 2) to make contacts and lay the groundwork for my doctoral dissertation research. This built upon roughly three years of following or otherwise engaging with this issue as a doctoral student and during my work at the Center for International Environmental Law in Washington DC. During the two months of preliminary research in 2009, I conducted extended semi-structured interviews with indigenous leaders in two regional federations in the northeast Amazonian province of Loreto, anthropologists or lawyers who had worked extensively with indigenous peoples in five non-governmental organizations (all of whom are key players at the national or regional level working on indigenous and environmental issues), a well-known Peruvian anthropologist who works in the Amazon, and a lawyer in the Peruvian Ombudsman's office who focuses on complaints having to do with indigenous peoples and oil exploration concessions. I also conducted supplemental or shorter interviews with staff in an additional four NGOs or research institutes (see Table 1 for list of institutional contacts). Finally, during this time I participated in several site visits, including a several day meeting of five Cocama indigenous communities that had been affected by oil exploitation.

Based upon this preliminary research, as well as literature reviews, I was able to identify four recurring themes, namely indigenous concerns regarding: (1) the concessioning process; (2) possible impacts from oil exploration and extraction (and failure to account for the range of indigenous values toward the land); (3) the legitimacy of the concessions, more generally, given indigenous prior claims to territories; and (4) possible violence or repression. In the sections that follow, I will touch upon each of these themes in turn, drawing upon interview data (all informants are kept anonymous to ensure their safety and confidentiality).

A first major driver of indigenous concerns was related to the concessioning process. In all of my semi-structured interviews, informants described a high frequency of dissatisfaction with the concessioning process – both the lack of consultation when the concessions were made to oil companies and what

was frequently described as a weak or inadequate consultation at later points in the process, such as during environmental impact assessments (EIAs).

One issue that is interesting in regard to concerns about inadequate process was that calls for better consultation by many indigenous leaders and federations often involved invoking the state's obligations to respect indigenous right to consultation detailed in Convention 169 (the "Indigenous and Tribal Peoples Convention") of the International Labor Organization ("ILO 169") (which has the "objective of achieving agreement or consent"; Article 6), and in some cases the right to prior informed consent, as has been endorsed, for example, in the UN Declaration on the Rights of Indigenous Peoples. This indicated that at least some discontent about consultation processes was related to or supported by ideas about indigenous rights.

In addition, the concessioning process also seemed to violate expectations about respect and fairness. One problem appeared to be grounded in differently held expectations and interpretations by the state and indigenous communities about what adequate consultation consists of or leads to, as was described by the following key informant:

> "Here in Peru, consultation has two interpretations – the interpretation of the government and the interpretation of the communities…The government says consultation occurs when: "I've decided to do something, so I will go and inform you. I will tell you that I am going to build a road, take the petroleum, [etc.] – there, I've consulted you." …The implementing legislation for the law on consultation requires that they carry out public hearings, invite communities and organizations, explain the project, and receive their comments. End of story; nothing more. This is how the state understands consultation. In contrast, what do the communities say? They say that for them, consultation is when you ask us what we think and we try to reach an agreement on what to do. If we are in agreement, then we go forward. If we say no, then it's no."

A final type of frustration over inadequate consultation included instances when companies either "divide and conquer" or "buy-off" some communities or community leaders, without consulting the wider community. This type of situation was described by informants in several interviews. For example, an indigenous leader in the Federation of Native Communities of the Corrientes River (FECONACO) described the position of the federation, that:

> "There needs to be prior consultation before concessions are made in their territories… The tendency of the government is to look for and convince 3 or 4 communities, those that are easiest or closest, but the indigenous perspective recognizes that our rights are collective; all of us need to

Table 1. Institutional Contacts for Interviews

Indigenous Federations	Institutional Contacts for Extended Semi-Structured Interviews	Institutional Contacts for Supplemental or Shorter Interviews
- Asociación Cocama de Desarrollo y Conservación San Pablo de Tipishca (ACODECOSPAT) - Federación de Comunidades Nativas del Río Corrientes (FECONACO)	- Centro Amazónico de Antropología y Aplicación Práctica (CAAAP) - Centro para el Desarrollo del Indígena Amazónico (CEDIA) - Derechos Ambiente y Recursos Naturales (DAR) - Iquitos regional office of Defensoría del Pueblo (the Peruvian Ombudsman's office) - Red Ambiental Loretana - Shinai - Anthropologist, Alberto Chirif	- Instituto del Bien Común - Racimos de Ungurahui - Instituto de Investigaciones de la Amazonía Peruana (IIAP) - Sociedad Peruana de Derecho Ambiental (SPDA)

> participate. In the Corrientes river there are more than 35 communities. You need to consult all, but this doesn't happen."

In another example, an informant described the anger and frustration of indigenous people in the Federation of Aguarunas Communities of the Dominguza River (FAD) and the Federation of Native Aguarunas Communities of the Nieva River (FECONARIN) once the oil company, Hocol, showed up in their communities with a contract signed by a few indigenous leaders over a year earlier. When the rest of the federation and the communities "found out that an agreement had been signed without any type of consultation…the people became furious and insulted them [the company, government officials, and the leaders that had signed the agreement]…and finally they threw them all out."

A second major theme raised in many of my interviews was related to concerns about impacts from oil exploration and extraction. By way of context, it is worth mentioning that there has been an effort by the Peruvian government and the companies themselves to create a "conceptual break" between new and old oil exploration and extraction, by distinguishing current oil exploration from previous oil extraction in the country. For example, in regards to mineral resources, generally, Peruvian President Alan Garcia has stated that "only a tenth of these resources are currently being exploited, because we are still discussing if mineral development destroys the environment, which is a *theme from the last century*… environmental problems today are basically from… yesterday" (Garcia 2007; emphasis added). Companies have also highlighted their plans to use lower impact exploration and extraction techniques, compared to those used in the past in Peru, such as reinjection of formation waters and the use of a new type of seismic testing that has smaller explosions, as a way to signal that current operations will have minimal impacts.

Despite assurances of minimal impacts from "new" oil exploration and extraction, informants in my interviews consistently cited that indigenous peoples were both knowledgeable about the previous contamination and lack of benefit sharing, and were concerned that they would similarly be harmed in this manner (Fig. 2). During my site visit to this area I heard many accounts of past and current contamination and minimal benefit sharing.

Concerns about impacts were not only limited to direct impacts from contamination or lack of benefit sharing, but also extended to concerns related to indigenous values toward the land that are not captured by the state or companies. For example, one indigenous leader and key informant stressed that:

> "For us, the subsoil…is not only about petroleum, gold, silver…but it also is where there is the mother of the land. Our mother is also there, and the spirits are there in the subsoil…the bones of our ancestors…

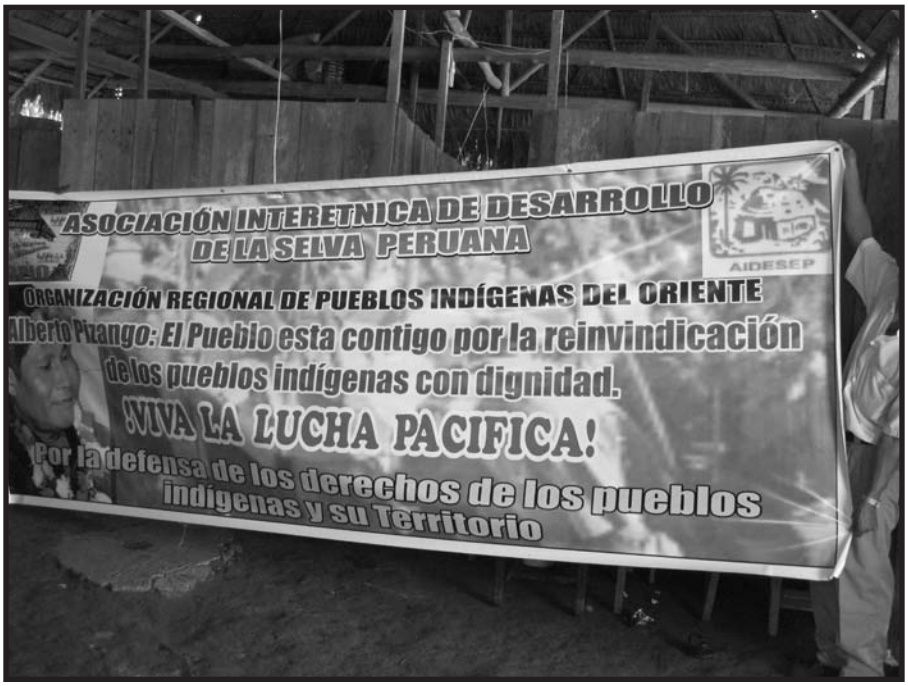
Figure 2. Oil tanker outside of San José de Saramuro, Marañon River, Peruvian Amazon. [Photograph by Lauren Baker.]

> the umbilical cords of our children…the place for future generations. This spiritual relationship that unites us with our territory, with our subsoil – they don't consider."

The frequency with which my informants highlighted these types of concerns indicate that many indigenous leaders and communities are unwilling to accept the "conceptual break" being promoted by the state and companies and are concerned about the myriad possible environmental and social impacts, and at least some are skeptical that the state or companies understand and respect indigenous values toward and connection to their lands and territories (values that are not captured in EIAs).

A third, notable trend was that for many indigenous peoples, the legitimacy of the concessions was questioned at a fundamental level given the claims of prior (and priority) control by indigenous peoples to their territories. For example, in one of my interviews with a well-respected Peruvian anthropologist, he stressed that a central point to understand about indigenous communities in Peru is that these peoples "have rights that are prior to those of the State" given that they are original to the area ("*por el hecho de ser originarios*"). The same idea was repeated in other interviews. For example, in one interview with an indigenous leader, she noted that "the state is recently created, as a state… we have lived here much before the state was created," as justification for rights based upon ancestral claims. In another interview, with an NGO-based Amazonian indigenous expert, I was told about the struggles of the Matsés peoples to defend their territory from oil and forestry concessions. These 14 communities, represented by their indigenous federation, declared in 2000 that they would close their territory to any concessions from the government, a position to which they have held firm, despite the continuing state claims to their territory, including for oil exploration. My informant also noted that while the Matsés are knowledgeable about state claims to resources that they do not accept such claims given that they are firm that this is Matsés' territory ("*los Matsés tienen bien grabado en sus cabezas que todo*

Figure 3. Post-Bagua conflict banner, indicating solidarity with national indigenous federation, AIDESEP, and former president of that federation Alberto Pizango, who fled the country and was granted political asylum in Nicaragua after being targeted for arrest under charges that included sedition and inciting rebellion. Banner text (excerpt): "Alberto Pizango: The people are with you. Long live peaceful struggles! For the defense of the rights of indigenous peoples and their territories." [Photograph by Lauren Baker.]



esto es territorio Matsés") that they continue to defend through monitoring crews ("*rondas de vigilancia*") and proclamations to close their territories to extraction.

A fourth and final issue that arose in many interviews related to concerns about violence and repression. This was particularly evident with the Bagua conflict from this summer. Within two days of my arrival in Peru there was a major confrontation between police and indigenous protesters in the north of the country, resulting in the deaths of over 30 police officers and indigenous people. This was followed by a rapid crackdown on leaders in the national indigenous federation, many of whom were targeted for arrest under charges of inciting riots/rebellion, conspiracy, sedition, and crimes against public peace and tranquility. The Bagua conflict also resonated with other situations in the northern Peruvian Amazon that I was told about in interviews, such as an incident in Andoas following an indigenous protest that resulted in the death of a police officer and community member. These types of conflicts and their aftermath certainly raised awareness about the volatility surrounding indigenous protest in Peru, and many of my informants described fears of additional militarization or future repression of indigenous communities or leaders.

My findings have confirmed that indigenous peoples in the Peruvian Amazon have many concerns about the recent oil exploration concessions in their territories, ranging from concerns regarding the concessioning process, possible direct and indirect impacts, the possibility of violence and repression, and for many, a questioning of the legitimacy of the concessions themselves. Rather than being accepted as a necessity for national progress, the concessions have both revealed and provoked tensions between the state and many indigenous communities. There are also early indications that oil exploration concessions in the Peruvian Amazon are feeding into what geographer Michael Watts has termed the "double-movement," in which concessions for natural resources provide both a "centralizing force that makes the state more visible" but simultaneously "discredit the state and its forms of governance" (Watts 2004). The types of concerns identified above, especially those that call into question the state's claims at a fundamental level, indicate that this is not a situation that will be easily resolved through technical fixes or nominal negotiation. What remains to be determined is how these tensions between state and indigenous claims to resources in the same territories can or will be addressed, and the role of national and regional indigenous movements in asserting claims – questions that are both pressing and ripe for further study.

Acknowledgements

I would like to thank the generous support of the Tropical Resources Institute, Coca Cola World Fund and Agrarian Studies Program to fund this research. Thanks also to colleagues and friends in Peru and Washington D.C. that have in one way or another helped my thinking and research on this topic, including Andrew Miller, Matt Finer, Carlos Soria, Percy Summers, Hernan Coronado, Alberto Chirif and Alfonso Lopez. At Yale, I would like to acknowledge the academic support of my co-advisors, Michael Dove and Robert Bailis, as well as additional faculty support from Doug Rogers, Libby Wood, and Amity Doolittle, and additional thanks for comments on previous versions of this paper from peers in Michael Dove's Fall 2009 Society and Environment class and the Social Ecology doctoral lab.

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In Search of the True Adivasi:
The Politics of Land Rights in Mudumalai Wildlife Sanctuary, India

Roopa Krithivasan, MESc 2010

Who is a Tribal? Who has rights to live, use, and protect the forest, and who doesn't? To whom is the Tribal allied, and whom does she/he oppose? Obviously, none of these questions is answerable, or at least will not be met with a single answer when posed to the multiple players involved in what is now the rather messy situation of land rights, forest access, and conservation in the buffer areas of Mudumalai Wildlife Sanctuary (MWLS) of southern India; for that matter, it may not even meet with the same response from the same person in different contexts. The situation at Mudumalai surrounding wildlife conservation and residents' rights hinges to a large extent on the ways in which the idea of "tribal" (or Adivasi) is constructed and navigated in relation to the "natural" environment and human-occupied landscape. This has become especially important in the face of the Forest Rights Act of 2006 (FRA), which promises greater autonomy and access to Adivasi communities and other groups that have traditionally used forests and their products for their livelihoods. The issue of Adivasi identity - and equally importantly of non-Adivasi identity - becomes crucial in understanding the complications that can and will present themselves in the implementation of the FRA, both at this site and elsewhere in India.

To complicate matters, in 2005-2006 the process to declare Mudumalai as a Critical Tiger Habitat (CTH) was also initiated. This expansion essentially proposed to increase the boundaries of the existing MWLS to include more habitat for tigers. This new area would then have designated "buffer zones" where limited human use is permitted, and "core zones" where access is restricted. This re-evaluation and re-allotment of land and land-uses, largely without the involvement or consent of affected communities, has been an additional cause of disagreement where political and community identities have come into play. This study is primarily concerned with what the implementation of the CTH and FRA will mean for indigenous land rights, and indirectly about what this means for the success of conservation efforts. The ecology of tiger conservation is not my main topic; however, the success of conservation efforts will be impacted by human attitudes, values and behaviors.

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Description of study area and field work:

Mudumalai is situated in the Nilgiri district of Tamil Nadu, India. It is of historical importance as one of the earliest established protected areas in India in 1940; ecologically important as part of a forested corridor (along with Wyanaad, Nagarhole, Badipur, and Satyamangalam forests) joining the biodiverse Eastern and Western Ghats; and culturally important as the home of five Adivasi communities, and as the junction of three linguistically distinct states, with large Muslim and Christian populations in addition to Hindus.

For three and a half months, from May 2008 to August 2008, I conducted ethnographic research in the Sigur Plateau adjacent to MWLS. This region originally lay outside the boundaries of MWLS; however, in 2007, Mudumalai was notified as a CTH, and Sigur was included in the buffer area. Around the same time, a new legislative measure known as the Forest Rights Act (FRA) came into being, which promised to convert de facto land rights in forested areas into legal land titles for Adivasis; most non-tribals are not eligible.

Both of these measures, as I will discuss later, have been highly controversial at the central government level. Adivasi rights activists argue that the forest department is notorious for its history of poorly managed conservation projects, and for its mistreatment of marginalized communities, and that the CTH is just another excuse to appropriate yet more land and displace yet more people. On the other

hand, conservationists argued that turning over forest land to Adivasis though the FRA would only lead to more destruction of forests, either directly by Adivasis, or because lands would be turned over to developers.

The purpose of my research was to investigate how these two highly publicized and controversial measures were being debated and discussed by those living in areas that would be affected by the CTH and FRA, and the causes for conflict surrounding these issues. Specifically, I was interested in understanding people's reasoning behind supporting or opposing the CTH or FRA. I hypothesized that CTH may be opposed by residents based on concerns about elevated levels of conflict with wildlife, and due to mistrust of the Forest Department. I also hypothesized that Adivasis would be highly in favor of the FRA, but that non-tribal residents would not. My research suggests surprisingly different trends.

I interviewed over 120 people, about half of them belonging to the Irula and Jenu Kurumba Adivasi tribes of Sigur, and the remaining belonging to non-tribal communities. These included the politically well-organized large-landowners (primarily farmers with over 10 acres of land, and tourism lodges), tourist vehicle drivers, local politicians, and forest department workers. Most interviews were obtained through snowball sampling. In addition, I attended a number of family gatherings, religious celebrations, and accompanied groups of people in their places of work, as a participatory observer.

Critical Tiger Habitat and the Forest Rights Act: a brief introduction

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (FRA) attempts to "recognize and vest the forest rights and occupation in forest land in forest dwelling Scheduled Tribes and other traditional forest dwellers who have been residing in such forests for generations but whose rights could not be recorded." There are two kinds of rights accorded by the FRA. The most publicly known and controversial of these are title rights for cultivated land. Essentially, Adivasis can obtain legal rights for land which they have lived on and cultivated, but on which they were historically considered "encroachers" or "squatters". The FRA also contains clauses on community management for forest use and development, and entails the formation of village communities to make decisions collectively on forest use – a job previously left to the Forest Department. The buffer area of Mudumalai CTH is a type of forest to which FRA is applicable; the core is not.

What is important to note is that while Sigur has a mixed population, the majority of which is non-tribal, only adivasis (and a handful of non-tribals who have lived on the same plot of land for over three generations), are eligible. Other groups are not. While many non-tribal farmers and livestock owners in the area own land, a large portion have leases to land owned by the state which could, in theory, be taken away from them; many fear that this will be the case if the CTH is declared.

Critical Tiger Habitats are also a new development in India, following the local extirpation of tigers from Sariska Tiger Sanctuary in 2005. CTHs belong to the most stringent category of "forest land" controlled by the Forest Department, consisting of an inviolate "core" zone free of human presence and activity; and a "buffer" where certain activities, such as constructing new buildings, would be curtailed, but apart from that, major livelihoods such as farming, herding, etc would be allowed to continue as before.

Perceptions towards forests and wildlife:

My original hypotheses assumed that peoples' attitudes towards the CTH and FRA in particular would be strongly influenced by their attitudes towards forests and wildlife. I assumed, first of all, that the declaration of the CTH might represent to some a heightened concern about conflict with wildlife, particularly tigers but also elephants, deer, and wild pigs. I found this to be the case only nominally. Anecdotes with Forest Department employees playing a largely negative role -- ranging from stories of mild corruption, to serious violence and coercion -- were fairly common. Without a doubt, obvious exaggerations of the Forest Department's activities also exist. At a number of political rallies, flyers were handed out describing the process by which the Forest Department was secretively relocating dozens of tigers to Mudumalai, without sufficient wild prey available. Through such documents, and a number of discussions with locals, particularly non-tribals, it was evident that especially among non-tribals, the CTH represented not a greater threat from wildlife, but a greater threat of elevated Forest Department control over forests and wildlife. I will discuss later though, that this opinion is not shared by many Adivasis in Sigur.

A discussion of Adivasi and non-tribal identities

As discussed earlier, the historical viewpoint on "Adivasi culture" has been overwhelmingly negative, particularly in relation to forests: tribals are abjectly poor, and therefore destructive of forests. More recently, however, there has been a push, beginning with NGOs and extending into government, to recognize the rights of Adivasi communities. There has also been a move to change the discourse surrounding tribals from a negative image of an uneducated, backwards community to one of a people living in harmony with nature. This represents a sea change in social norms; Mudumalai is now at a crossroads where most individuals of non-Tribal communities hold their past prejudices towards Adivasis, yet understand that in the face of new norms of political correctness, they too must at least outwardly change their stance towards Adivasis.

More importantly, non-tribals are aware of the political implications of the new tribal identity, and how it translates into policy and government action. They recognize that the FRA is a move garnered towards promoting the interests of Adivasis; at the same time, Forest Departments throughout the country – which have historically been known for their mistreatment of marginalized communities – have started to offer a number of benefits to forest-dwelling Adivasi groups. Thus, non-tribals have found it advantageous, even necessary, to align themselves with, or even identify themselves as, Adivasis.

This is done in one of two ways: first, a non-Adivasi may claim that he or she has been historically allied with the Adivasis, and is therefore just like them. The argument is often similar to this: "everyone will agree that the Adivasis have been here for hundreds of years. However, they have worked for us and with us for hundreds of years. Therefore, we are just the same as the Adivasis" (V. Matthews, local politician*). That is, claims of indigeneity, historical relationships with the land and people, are used as arguments for tribalness. Secondly, non-tribals may claim that they currently live "just like Adivasis": they have little land, are dependent on the rain for their harvests and on the forests for their fuelwood, but are at the same time just as protective of the forests as Adivasis are supposed to be (Govindan, landed farmer*).

Therefore, these communities will argue that if the FRA is implemented, they should be given the same rights as Adivasis; similarly, if the CTH will bring in funds for development of Adivasi livelihoods, non-Adivasi communities should also benefit.

Ironically, and importantly, non-Adivasi land-owners who are not eligible under the FRA seem more supportive of it than do landless Adivasis, whom it is supposed to benefit. This appears to be because non-Adivasis feel that they should be treated to the same advantages as Adivasis, but also have the political clout to ensure that their ineligibility is overlooked. Thus, the situation is such: Adivasis have the legal rights but often not the means, while non-Adivasis have not the legal rights but the often political means and will to bend it to their advantage.

The elusive "Adivasi opinion"

While non-tribals and the Forest Department have very uncomplicated answers to what defines Adivasis, and what their opinions are, in truth Adivasis represent themselves and their opinions in individuals, ranging from those who are still primarily forest-produce gatherers and depend to a large extent on government welfare to meet their nutritional needs, to those who are well-educated, own farmland and property, and have children studying in colleges in nearby cities. Most lie somewhere in the middle of this range: they cultivate but do not own a few acres of land, are partially dependant on welfare (or "ration cards" which they are entitled to on the basis of their Scheduled Tribe status), and have access to local schools for their children.

There are varying levels of organization amongst the Adivasi communities. Irulas have an Association, which though very well organized in certain aspects (they are responsible for planning and coordinating a three-day, elaborate religious festival every year, which brings in visitors from all over the region), there is little consensus among them in the matter of the FRA. Jenu Kurumbas, on the other hand, represent a much smaller portion of the population; they often voice the complaint that as one of the most marginalized Nilgiri Adivasi communities, with relatively small numbers, they had little or no reason to become involved in political issues surrounding the FRA or CTH, where their voices would not be heard even if they had a strong position on it.

With respect to the CTH and FRA, most Adivasis show less concern for the changes in policy than do other communities. This partly may be attributed to the fact that they have for at least the past five or six

years, enjoyed increasingly positive relations with the government; most recently, all schedule tribes in the Nilgiris were some of the first beneficiaries of a government scheme to bring free LPG gas, television sets, and 2 kgs of rice into every home. Such measures have gone a long way in promoting positive relations with the government at large. While Adivasis (like most other communities) are skeptical as to the long-term relations with the government, which constantly undergoes upheavals, the general trend appears to be cautiously growing faith in government machinery. This includes cautious but growing trust in the historically reviled Forest Department, which has also in the past decade provided elephant-proof fencing around whole Adivasi hamlets, and has heavily subsidized agricultural inputs.

At the same time, a handful of Adivasi individuals have had positive relationships with non-Adivasis. Many have worked for the same non-tribal families for generations, mainly as farm-laborers or cattle herders. Others have benefited from the recent growth of hotels and travel lodges in the area, which provide employment. Very few of these jobs are permanent, and very few provide sufficient income to meet all the financial needs of a family. Yet this is still an improvement over past insecurity.

Due to these varied, often conflicting alliances held by Adivasis, they are in a unique, often uncomfortable position vis-à-vis the FRA and CTH. On the one hand, some individuals are fairly secure in their belief that these policies will most likely not have a negative impact on them, as the forest department's ethic shifts towards pro-Adivasi activities. At the same time, some have had mostly positive associations with non-Adivasi communities. As these non-adivasi communities have vociferously opposed the CTH, Adivasis are in the often uncomfortable position of "taking sides" between the Forest Department and non-Adivasi individuals and politicians. Thus some Adivasis often will take part in anti-CTH demonstrations, and express the opinion that non-Adivasis should also be included in the FRA. Others will cautiously take the exact opposite view. Additionally, the Adivasi communities are not particularly well-organized politically. Many are not literate (though most are fluent in three languages, one of which is an Adivasi language with no script), and thus local news does not always reach them first-hand. Their primary mode of information is through their local leaders (usually these are non-Adivasi), or (to a lesser extent) through mid-level forest department officers who regularly hold meetings in villages. On the other hand, Adivasi individuals who have had particularly negative experiences with the forest department, or with non-Adivasis, react in the opposite way. In short, Adivasi attitudes are based not on their feelings on these policies, but based on their attitudes towards the politically and socially dominant groups that support or oppose the policies.

Conclusions and Implications:

At the center of the CTH is the ecological concern over tiger conservation; to most non-tribals, it represents an increasing hold of the forest department. On the other hand, the department had seen increasing favor among Adivasis, who nevertheless also form opinions based on their associations with non-tribal groups who oppose the CTH. These non-tribals recognize the importance of the Adivasi identity in current politics, and attempt to use it to their advantage, particularly in obtaining rights under the FRA. Weak political organization among Adivasis means that a consensus on CTH and FRA will be reached slowly, at best. While this indecision to take a strong stance is seen by many in the Forest Department and in the Non-tribal community as indecisiveness, or a "typical" tribal tendency towards lack of concern, I would argue that this actually stems from a large number of strong opinions existing within what is often perceived as a homogenous "tribal" group. These opinions are based primarily on their past associations with politically powerful groups (the Forest Department or non-tribal communities). This is not necessarily a sign of subjugation to two powerful and manipulative groups, but a calculated position to improve their chances of a favorable outcome.

Adivasis are in a powerful position to determine the course of CTH and FRA, and they are not unaware of it. The FRA is becoming a more widely understood law by Adivasi communities; in large part due to the efforts of a small handful of NGOs which have been involved in tribal livelihoods for over a decade. If implemented correctly, and if increasing importance is given to community rights and not just to individual Adivasi rights, the FRA could prove to be an ideal means through which to manage forest resources in buffer areas. Similarly, increased transparency on the part of the Forest Department with regards to its plans for the CTH, and their active inclusion of all communities who stand to be affected by it, will go a long way in both ensuring an equitable outcome for the human residents, as well as a better chance for the survival of the tiger and other important Mudumalai fauna.

III. BALANCING CONSERVATION AND DEVELOPMENT

Retelling the SameStory in aSW ChineseVillage:
The implementation of environment and poverty programs with a common agricultural development plot

Christine Jane Trac, MESc 2010

"The climate here is very particular, it isn't hospitable for growing rice or wheat. For as long as I've been around we've all grown corn; even when my mother was a young girl, they grew corn." - Villager in Caoxiu Cun

Introduction

According to even the eldest farmers' recollections, the agricultural fields that decorate the mountain slopes in Caoxiu Cun have always grown corn. For generations, farm work has revolved around the planting of corn in spring and its harvest in autumn; until recently, this crop has dictated the pattern of agrarian land use around this region of Southwest China. In Caoxiu Cun (cun = village), the newly adopted practice of planting magnolia trees and gooseberry vines that has emerged in the past decade tells a tale of two recent state projects that are seemingly new but actually familiar models.

State programs in the name of environmental protection and poverty alleviation in the recent decade have effected change in villages across the nation. In Caoxiu Cun, the displacement of corn is telling of these efforts. The changes visible on the ground do more than just describe the households that are changing their planting choices, they also reflect the politics of the central government in these social and environmental efforts.

In this article, I first present a recent history of peasant agriculture in Caoxiu Cun and then I follow with an account of two programs encouraging change in agricultural practices in this particular village. This account builds from data collected in an ethnographic study conducted in Caoxiu Cun from June through December of 2009. With this information, I discuss the role of these programs in altering the household and rural agriculture. I argue that programs targeting rural farmland apply a common strategy – devolution of responsibility onto households – to achieve improved efficiency and ultimately to direct the transformation of subsistence farmland to fields of cash crops, a trajectory that resonates with modern agricultural development.

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Recent History of Peasant Agriculture in Caoxiu Cun

From the redistribution of feudal land to peasant households and then to its collectivization, the land rights of Chinese peasants shifted dramatically under the formidable leadership of Chairman Mao (1949-1976). But despite the tumultuous changes, the cultivation of farmland in Caoxiu Cun remained relatively stable. While villages across the country avidly planted grains and strove for preposterously high yields to meet national demands (Shapiro 2001), the cultivation of corn in Caoxiu Cun endured.

Corn was the staple food crop for collective consumption in this village until Deng Xiaoping (1978) opened China up to economic reform that catalyzed a change reaching out to even the rural landscapes of the nation. In local narratives told by Caoxiu elders, Deng is responsible for when and why life improved. Around the late 1970s and early 1980s,

Figure 1. Planted houpu.

land was reallocated to individual households, farmers began raising pigs, families could afford to eat rice, and a new variety of hybrid corn, suitable for feeding livestock, was introduced to the fields. Over the years, as households increased the number of pigs raised, a congruous increase in the cultivation of hybrid corn continued until households seeded most of their land with it. In the recent history of Caoxiu Cun, corn harvests shifted from feeding peasant mouths to feeding their livestock; with this transition people gradually phased out corn from their diets and gained enough access to cash to make rice-purchased-at-market the staple food. Hybrid corn has been fundamental to the household for supporting a livestock sector that in turn has proved important to the nutrition and economy of the household.

Situating Forestry and Poverty Within the Farm

This recent history of agriculture recounts an enduring story of corn cultivation fundamental to subsistence and market mechanisms of the households in Caoxiu Cun. In the past ten years, visible changes to cropland that correspond to a reduction in corn (and increase in planting of trees and vines) reflect the influential imprint of two interesting efforts in this village. The first is a massive state-sponsored conservation set-aside program to return cropland to forestland (Uchida et al. 2005); the second, a poverty alleviation program devoted to establishing a route for cash generation. In the following paragraphs, I provide more description of these programs and their implementation in Caoxiu Cun.

Grain-for-Green (also known as the Sloping Land Conversion Program)

Grain-for-Green was conceived after catastrophic floods hit China in the summer of 1998. Consistent with the beliefs that deforestation along the upper reaches of China's major river systems is to blame for the downstream disasters, the program focuses predominantly on the conversion of marginal cropland in order to reforest China's western provinces (Zhu et al. 2004). In 2003, implementation of the Grain-for-Green program reached Caoxiu Cun and all households became immediate participants. To encourage participation, the program subsizes farmers with cash subsidies (260 RMB/mu, approximately $37/mu; 15 mu = 1 hectare), and free tree seedlings. The conditions of the subsidies, however, are dependent upon how the land is converted.

When Grain-for-Green was first introduced to Caoxiu, seedlings of kudingcha (*Ilex latifolia*), a bitter tea tree, were distributed free to participants, however, reported difficulty with successful planting of the species resulted in village-wide agreement to instead independently purchase and plant houpu (*Magnifolia officinalis*). Houpu is a magnolia tree commonly cultivated for its medicinal bark (Figure 1). By definition of the State Forestry Administration, houpu stands qualify as 'economic forest'. Yet, these plantings in Caoxiu were recognized as

'ecological forest' granting households an eight-year (for ecological) rather than five-year (for economic) subsidy period as stipulated by the program.

Aside from the value given by the government subsidy, houpu also sells well at market (though the bark is harvested only after 15 years of growth). In 2009, it was purchased by middlemen for 40 RMB/jin ($5/lb.) and from experience the villagers have found the rate has stayed fairly stable, unlike that of the kudingcha tea leaves. It is for this reason that before Grain-for-Green began in Caoxiu, a handful of households already cultivated houpu. They used to plant houpu mainly on peripheral areas just outside their cropland; but now, rows and rows of this native species take up considerable tracts of cropland once reserved for corn (Figure 2). The immediate effects of this land conversion program were obvious – less corn, more trees. Every household participated in the land conversion that would ultimately grant them a seventy-five year lease to this newly forested land. Households converted substantial fractions of their cropland which has granted them more secure tenure over it.

Poverty Alleviation

In late summer 2009, Xicao was marked as a model site for poverty alleviation by the local government and county-level Bureau of Finance. The core component of the program – essentially the part that is expected to bring households out of poverty and to the fruition of wealth – invests in household cultivation of a fruiting cash crop, gooseberry (*Actinidia chinensis*). Prior to the introduction of this program, some households had already planted gooseberry vines after seeing the success of a neighboring village that planted the same variety of gooseberry (Figure 3). None, however, had risked supplanting all of their corn and cultivating that cropland with a new fruit commodity; at least not until the poverty alleviation program supported this household decision. By October 2009, every household was engaged in the planting of gooseberry seedlings on their recently harvested cornfields. The participation was immediate. Boxes of liquid fertilizer were distributed at first, then seedlings a couple of days later, and by the end of the week, the farmers had planted all the seedlings they had been allocated. During the first three years, the gooseberry vines can be intercropped among corn, but the program stipulates that after three years the land must be fully dedicated to planting only gooseberry vines. Corn must be abandoned, and livestock will have to (1) be raised from corn product purchased in town, and/or (2) decrease in number. Even the households of Village Group 3, that previously claimed the elevation and conditions of their cropland would not support the selected species of gooseberry, partook in the planting. This widespread involvement even amidst

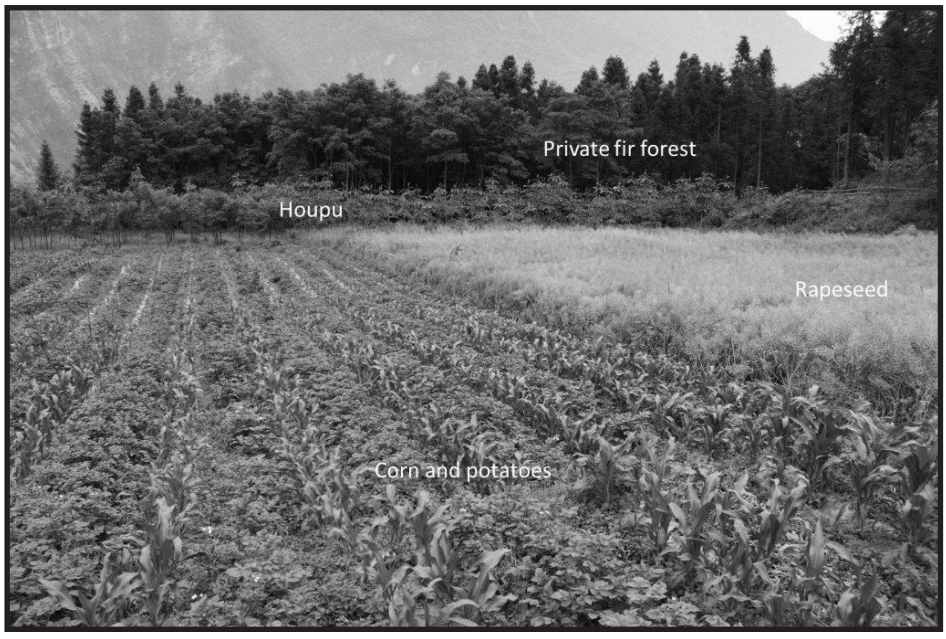

Figure 2. Household farmland in June. Alternating rows of corn and potato (left) and rapeseed (right). Houpu occupies the peripheral farmland in the back near the edge of the private household forest.

skepticism might be explained by one villager. This villager explains that planting gooseberries is in fact illogical, that it is only a good crop if they are able to sell all of it. Since it isn't something that can be stored for long periods of time it isn't particularly useful for the household. But since they must plant to get the program subsidy, they all plant.

Retelling the Same Story of Agricultural Development

Employing a common strategy

To a large extent, the implementation of Grain-for-Green and poverty alleviation in Caoxiu Cun has worked to shape households in a fashion similar to the agricultural and land reforms beginning in 1978. To increase productivity and efficiency of the household, the reforms focused greatly on decentralization of property rights and guaranteeing land tenure.

By devolving responsibility for reforestation onto households, Grain-for-Green distinctly diverges from conventional efforts that tend to engage in community-level interactions for shared environmental stewardship. The shifting of 'forestland' onto farmland has made individual households accountable for the outcomes; further, the idea of an economic forest has made it advantageous to think of cropland-turned-forest in economically efficient terms. What is more, foresting the land extends forest leases to agricultural land, giving households more secure tenure on their farmland. The poverty alleviation program has furthered economic treatment of the agricultural sector by promoting full commodity production over household subsistence demands. Both programs have made cropland into a space that is economically productive – supporting monetary valuation of land productivity rather than the intended ecological health of the land or the security of the household. The magnolia trees and gooseberry vines of both programs are found encroaching the household agricultural sector, a sector that has been treated as something that can be made productive and efficient. By making the household dependent on the cultivation of houpu and gooseberries, these two programs have effectively devolved responsibility onto the household. With that, the successful cultivation of these cash crops appears more meaningful for agricultural development than for forest conservation or poverty alleviation.

Common with agricultural reform, the two programs have all of the characteristics of a government scheme that creates the modern, self-reliant individual (Triantiafillou and Nielsen 2001). Moreover, it simultaneously drives peasants to self-manage China's forests and poverty. Subsidies in agricultural development in the past decade have come to replace a long-held agricultural tax system to relieve the stress on household economy, and as

Figure 3. Gooseberry harvest in the neighboring village. Successful cultivation of gooseberries in this village pushed the efforts to introduce gooseberry vine plantations to Caoxiu Village.

seen with Grain-for-Green and poverty alleviation programs, subsidies are guiding a particular sort of land use. Making clearly economic contributions to direct the agricultural sector of households, the government demonstrates its conviction that agricultural development is core to social and economic development (Xu et al. 2004). However, this same application of agricultural development in Grain-for-Green represents cash crop cultivation rather than reforestation, and thus this environmental effort appears only to be a convenient disguise for development (Escobar 1995).

Supporting the Subsistence base

Although the shift to hybrid corn in Caoxiu Cun marks agricultural reform and reflects a change in China's political climate, the cultivation of corn, regardless of the variety, is representative of consistent subsistence practices. Though hybrid corn replaced the fundamental food product grown for household consumption in the 80s, it fostered another food product now central to these peasant households – pork. Pork is valuable because it not only offers a source of protein but, additionally, a source of cash cultivation of hybrid corn for raising livestock has contributed greatly to the mixed subsistence character of the household. It has done so by simultaneously engaging the household in the market sector and supporting a subsistence sector. With corn the household never renders itself completely vulnerable to risk. With the introduction of houpu through Grain-for-Green, and gooseberry through poverty alleviation, the displacement of corn has reflected a clear movement from subsistence practices towards market engagement. The role of subsidies has been to displace any perceived risk in supplanting corn with forestland or fruit production, in order to guide the household farm to more economical practices. But according to Netting (1989), the household may be the most environmentally efficient and considerate unit. Therefore, in the interest of environmental conservation we should, perhaps, support the subsistence sector and not allow the capitalist scheme to extend to all ends. This challenges whether agricultural development methods can effectively direct environmental or social efforts in the most beneficial direction. Maybe we should be looking to the subsistence sector, rather than the market, to address social concerns such as poverty and environmental concerns such of forest restoration.

Conclusion

In this paper, I have attempted to reveal how China's modern approach to environmental and poverty programs resonate with simple agricultural development and how this strategy has implications for the household and the environment. Though this paper introduces more issues than can be expounded on in depth, I hope that it encourages some contemplation on the peasant household and its agency in influencing social, economic, agricultural, and environmental change, whatever label the program may have.

Acknowledgements

The data presented in this paper emerged from another study, my Master's research project, "Rural Energy Development as a Tool for Forest Conservation". The opportunity to conduct this project was made possible by the generous support of the Tropical Resources Institute, Yale Council on East Asian Studies, Yale CEAS Charles Kao Research Fund, Yale F&ES Carpenter-Sperry Research Fund, and Yale F&ES Leitner Fund. I would also like to acknowledge my advisors, Carol Carpenter and William Burch, for their incredible guidance and support. Finally, thank you to the TRI Bulletin folks for allowing me to present my work.

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Community-Based Conservation in Tanzania:
Getting the Incentives Right

Eliezeri Sungusia, MESc 2010

Introduction

Networks of protected areas (PAs) remain the single most dominant approach for conserving biodiversity in the tropics (Bruner et al. 2001). In Tanzania, PAs occupy about 24% of the country's land cover (WPT 2007). Generally, PAs have done a good job of sustaining much of the existing wildlife populations. However, the effectiveness of these areas is increasingly being questioned because of the following factors: (1) establishment of most PAs ignored species spatial dynamics and human encroachment (Gaston et al. 2006); (2) PAs exist as habitat patches with human settlements between them (Groom et al. 2006); and (3) growing human population and ensuing pressure on PAs (Groom et al. 2006). These issues create challenges for both wildlife and conservationists, and the latter has recently realized that eviction of the human population, as an approach for land conservation, comes with huge social costs and therefore is unfeasible.

Wildlife Management Areas: At What Cost?

To create a refuge for wildlife outside of the PAs and to open wildlife corridors, Wildlife Management Area policy was introduced in Tanzania in 1998. It was designed to encourage the involvement of local communities through the establishment of so-called Wildlife Management Areas (WMA). WMA are normally established on buffer zones of existing parks and along wildlife corridors. The objective of WMA is two fold: wildlife conservation and rural economic development (Songorwa 1999). WMA is established and managed by villagers through an Authorized Association (AA). The revenue generated from wildlife utilization (mainly trophy hunting) is shared between the AA and the government.

The policy acknowledges huge opportunity costs (the benefits from alternative land uses such as agriculture) associated with establishment of WMA. Many WMA are agriculturally marginal but others are on highly productive land. It follows that for WMA to make economic sense to landholders, inter alia, its benefits must exceed costs. This means that villagers must be paid to conserve wildlife habitat. So far, the amount of payment expected by villagers is unknown. Concurrently, there is a growing sense that Community-based Wildlife Management (CWM), of which WMA is a part, has failed to deliver both to the environment and communities (Blaikie 2006, Nelson and Agrawal 2008). The caveat is that communities must receive the payment they expect first for the ecological effectiveness goal to be realized.

In an effort to determine the amount of payment expected by villagers for the formation of WMA, I conducted contingent valuation surveys in villages forming two WMAs during the summer of 2009. The focus was to estimate the amount of payment/ compensation anticipated by villagers and assess the influencing factors. In this paper, I will discuss the latter.

Description of the Study Area

I conducted this study in the Idodi-Pawaga and Ikona WMA bordering Ruaha and Serengeti National Parks, respectively. The Idodi-Pawaga WMA, which is managed by the MBOMIPA[1] Authorized Association, is located in the Iringa Region and covers an area of 776.65 km^2 and involves 21 villages. The Ikona WMA, which is managed by the JUHIWAIKO[2] Authorized Association, is located in the Mara region and involves 5 villages. Ikona WMA falls squarely within the corridor used by wildebeests during their great migration between the Serengeti National Park in Tanzania and the Maasai Mara Reserve in Kenya.

Inhabitants of the two areas are farmers and livestock keepers. The average landholding is 2 hectares. Agriculture is mainly rain-fed and the recent

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shortage of rainfall has resulted in very low harvests, and food insecurity was a threat in many villages. Communities in villages forming Ikona WMA are well known for vimoro (singular kimoro) – smoked game meat. In almost every home I visited, I was invited for a lunch that included kimoro.

Methods

I used the Contingent Valuation Method (CVM) to determine factors influencing individual's WTP for no WMA on the village land. This method will provide insight on the magnitude of incentives required to trigger (behavioral) response from the villagers. For convenience, I have divided this section into three parts: (1) the Contingent Valuation Method, (2) the experimental design, and (3) the elicitation format. The three parts are described in turn.

Contingent Valuation Method (CVM)

CVM is a survey approach frequently used in non-market valuation studies to determine what people would be willing to pay (WTP) for a specified change in quality and/or quantity of a good being valued (Carson et al. 2003). CV surveys create a hypothetical market for the environmental goods and services otherwise not traded in the market. Respondents are then asked to state their WTP or Willingness to Accept (WTA) for the good in question (Hanemann 1991). Most researchers prefer asking WTP as opposed to WTA as the former appears to be more plausible to respondents (Carson et al. 2003). Commonly used CV questions formats are open-ended and closed-ended questions (Bateman et al. 1999). Closed-ended format, in particular double-bounded format, has been demonstrated to improve statistical efficiency of CV valuation and therefore most CV studies use this method (Hanemann et al. 1991). Despite its flexibility and ability to estimate total value (Carson et al. 2001), CVM is rife with controversy. Criticisms range from inconsistency of CV with economic theories to methodological. In a nutshell, CV is embattled with hypothetical and strategic biases (For details see Carson et al. (2001) and Hausman (1993)).

Experimental Design

In the Idodi-Pawaga WMA, study villages fall in six wards. I employed cluster sampling to cluster villages by wards. This was done purposely to minimize the cost (time and money) of visiting each of the 21 villages forming the Idodi-Pawaga WMA. In each ward, random sampling was used to select one study village, making a total of six surveyed villages. In Ikona WMA, member villages fall into two wards of Ikoma and Makundusi. I randomly selected one study village from each ward, making a total of two surveyed villages. In total, I managed to conduct 300 interviews. The plan was to focus on heads of household (husband and wife) but in many cases, it wasn't possible to meet with both heads of a family. In those cases, I interviewed the available head of household.

Elicitation Format

I used a closed ended double-bounded questions format to elicit respondent's willingness to pay for change from WMA to no WMA. The valuation question was designed to provoke respondents to weigh costs and benefits of doing without WMA. The enumerator read the valuation scenario and clearly informed the respondent that going back to no WMA would cost his or her household a certain amount of money. The valuation question (willingness to pay question) was preceded with several questions aimed at ensuring that the respondent understood the aspects of valuation questions and collecting respondent's socioeconomic characteristics.

Results and Discussion

Generally, 66% of respondents (n=294 households) strongly support WMA. Some respondents cited direct benefits, e.g. employment they have received, as the reason for their strong support of WMA. The majority cited anticipated benefits in the future as a reason for their response. One would expect the percentage of respondents who strongly support WMA to tally with those who feel better off in the presence of WMA. But only 60% of respondents reported that they were better off. The optimistic respondents who are currently worse off can be a reason for this discrepancy. The message here seems to be that not everyone in the community is happy with WMA on their village land. The few against WMA may actually be very influential in a community and destructive of wildlife resources, which further jeopardizes/compromises the success of WMA. With regard to the WTP question, only 20% said they would be ready to pay for a change to no WMA. One issue that should be noted clearly is that the majority of those who strongly supported WMA did so with the condition that some issues need to be addressed, including crop damages and benefit sharing. Crop damage, benefit sharing scheme, and annual income influence on individual's stated WTP are discussed

below. Other influencing factors, but not discussed here, include education level, age, relationships with WMA leaders, and major economic activity.

Crop damage

It's virtually impossible to contain African elephants (*Loxodonta africana*) within the boundaries of dry national parks and reserves when they can smell ripe corn, rice paddies, watermelons, or water on farms bordering protected areas. Thus, it's not surprising that 80% of African elephant's range lies outside of formal protected areas (Hoare 1999). Crop damage, mostly by elephants, is the major cause of anger among villagers. It stands out as a deal breaker on the relationship between villagers and wildlife (including wildlife authorities). In Tanzania no compensation is offered for crop damage or human loss caused by wildlife. However, the government offers some amount as a consolation for a loss of life, livestock, crops, or injury caused by dangerous animals. Due to serious underfunding and excessive red tape, many victims don't even receive the already paltry compensation available.

WMA appear to exacerbate the problem of crop damage by elephants. About 53% of respondents claimed more incidences of crop damage after WMA than before WMA. WMA enhances protection of wildlife. This gives elephants more freedom to enter village land and destroy crops and property. When elephants destroy a two-acre corn farm owned by a family, it means that family is going to suffer serious shortages of food until the next harvest. Indeed, it's nearly impossible to convince a family that elephants are a good thing to conserve and therefore they should support WMA.

Income

There has been discussion in the literature about income elasticity (i.e. the change in demand for environmental quality due to change in income) of environmental improvements. McFadden and Leonard (1993) argued that income elasticity must be at least or greater than one because environmental protection is a luxury good. The negative income elasticity of environmental improvements is also possible (see Hanemann (1999) and Kristrom and Riera (1996) for more details). This means that respondents with

Figure 1. A family posing for a photo in Makundusi village, Serengeti District in Tanzania. Human population growth in villages around wildlife-rich areas is a major challenge to conservation.

relatively high income are expected to state higher WTP than those with relatively low income. This view is somewhat supported by this study in which a unit increase in respondent's annual income is predicted to have no effect on the individual's response to WTP question. But due to limited economic opportunities, low-income families may be willing to pay more for a proposed change if that would mean increased access to wildlife resources. Notwithstanding, the overriding factor seems to be the losses incurred by an individual that are associated with wildlife.

Benefit sharing

WMA can be thought of as an enterprise that is supposed to generate revenue through sustainable utilization of wildlife. According to WMA Regulations (2005), the generated revenue should be subjected to a benefit sharing formula. The Government will determine the formula from time to time. IRA (2007) established that only 40% of the revenue remains with WMA to be shared among member villages. The rest goes to the central government. This benefit-sharing scheme in favor of the government weakens the incentive and makes villagers feel cheated. Benefit sharing among member villages forming a particular WMA is a contentious area as well. Both Ikona and Idodi-Pawaga WMA constitutions dictate that revenue shall be shared equally among member villages. Confrontations arise because some villages consider themselves more endowed than other villages and therefore more deserving of a lion share of the revenue. A good example is Robanda village, a member of Ikona WMA. All respondents from this village want the benefit sharing formula reviewed in their favor. Robanda claims to be the most endowed of the five villages forming Ikona WMA and thus attractive to investors. Respondents lamented that Robanda used to make money before joining WMA due to a good number of investors in the village. The revenue must now be equally divided among five member villages, thus eroding the good money once enjoyed by this single village. As a result, pulling out of WMA is high on their agenda, but legal hurdles are currently too high to overcome.

Conclusion and Policy Implications

The debate on whether we should conserve biodiversity for its own sake (McCauley 2006) or for humanity's sake (Balvanera et al. 2001) is a relevant one. But one should not underestimate the power of the latter, namely the power of economic incentives to change behavior toward nature. For poor villagers, the expectation that they may ethically be obliged to conserve biodiversity is an oversimplification at best. WMA is one of the efforts recognizing the power of economic incentives to achieve conservation goals. The cornerstone of WMA policy, like other Community-based Wildlife Management schemes, is "the right to manage, use, dispose of, and benefit from wildlife resources" (Taylor 2009). The major caveat is that the benefit should be large enough to offset the costs incurred by landholders (villagers). Getting the incentives (benefits) right requires, inter alia, understanding of the interplay between different factors and villager's opinions toward WMA and the compensation expectations. These factors include but are not limited to crop damage by wildlife, level of education, level of income, benefit sharing formula, and opportunity cost of WMA to individual villages. A victim of crop damage by elephants expects compensation for the loss incurred. Equally so, a village doesn't expect a decline in income after joining WMA (e.g. Robanda village). Otherwise, how could villagers be expected to live in harmony with nature?

Also of relevance to policy is the need to look at WMAs and villages as heterogeneous institutions. Whenever possible, policies should account for variation in characteristics among and within WMAs. The amount of payment anticipated by villagers in Ikona WMA may not be the same as that anticipated by villagers in Idodi-Pawaga WMA. Within WMA, the amount of compensation anticipated by Makundusi and Robanda villagers (Ikona WMA), and Itunundu and Mapogoro villagers (Idodi-Pawaga WMA), may not be the same. Embracing such issues at all phases of policy formation and implementation may be a way forward in getting the incentives right.

Acknowledgements

I thank Prof. Robert Mendelsohn for advising this study and TRI Bulletin editors for their helpful comments on a previous draft. I thank Compton Foundation and Yale Tropical Resources Institute (TRI) for funding the study. The cooperation of villagers in the study area and everyone else who contributed to the success of this study is highly appreciated. Thank you!

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Notes

[1] MBOMIPA is an acronym and literally means "Sustainable Utilization of Natural Resources in Idodi and Pawaga Divisions".

[2] JUHIWAIKO is an acronym and literally means "The Society for Wildlife Conservation in Ikona".

Reduced Emissions from Deforestation and Forest Degradation (REDD) in East Kalimantan, Indonesia:
Barriers and Advantages to Project Equitability

Benjamin Blom, MF 2010

REDD in Indonesia and the Role of Communities

The Intergovernmental Panel on Climate Change (IPCC) claims that tropical deforestation accounts for 18% of annual global carbon dioxide emissions (IPCC 2007). REDD (Reduced Emissions from Deforestation and Forest Degradation), a framework to improve tropical forest management and conservation for the purposes of climate change mitigation, has therefore emerged as a major component of global climate change discussions. Indonesia, because of the extent and carbon density of its forests as well as its high rates of deforestation, is a major emitter of greenhouse gas emissions to the atmosphere (PEACE 2007). As a result, Indonesia has received significant attention for the potential use of its forests for global climate change mitigation.

REDD has the potential to provide significant benefits to forest-dwelling communities (Brown, Seymour, and Peskett 2008; Luttrell, Schreckenberg, and Peskett 2007). Despite this potential, some researchers have identified a major tradeoff between efficiency and equity in the future for REDD (Chhatre and Agrawal 2009; Seymour 2008). Projects that work intimately with business and government interests at the expense of forest-dwelling communities will likely have a greater efficiency in terms of carbon conserved per dollar spent. This is true in many contexts for 3 reasons. Firstly, forest-dwelling communities in many countries of the tropics have poor land tenure and land management claims (Boyd, Gutierrez, and Chang 2007; Lambin and Geist 2003). Secondly, governments and businesses control large tracts of land in the tropics, which may serve to make REDD projects on government and business-controlled land more cost effective than small, community-based projects (Seymour 2008). Thirdly, developing and implementing successful community-based REDD projects can be extremely difficult and complex (Blom, Sunderland, and Murdiyarso 2010).

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Research Objective

During the summer of 2009 I conducted research on REDD in Indonesia. The objective of this research was to identify, in a representative context, the likely barriers to and advantages of the inclusion of forest-dependent communities in the implementation and design of REDD.

Study Site

The study site for my field research in Indonesia was Malinau district, located in East Kalimantan province on the island of Borneo (Figure 1). Malinau district is inhabited by at least 18 ethnic groups, most of whom claim indigenous ethnicity (Moeliono and Limberg 2009). Despite widespread deforestation throughout Borneo over the past 20 or more years, 90% of Malinau (~3.62 million hectares) remains forested (Malinau District Government 2007).

Pressure currently exists for deforestation in Malinau, particularly for the establishment of oil palm and *Acacia mangium* plantations (Sandker, Suwarno, and Campbell 2007). As a result, Malinau's forests have received attention for REDD pilot project. One carbon project developer has attempted to move forward with a REDD project in a tract of primary forest straddling the watersheds of the Malinau and Mentarang rivers (Global Ecorescue 2007) (Figure 2). This forest is referred to as Long Ketrok protected forest by the Malinau district government.

Much has been written about the

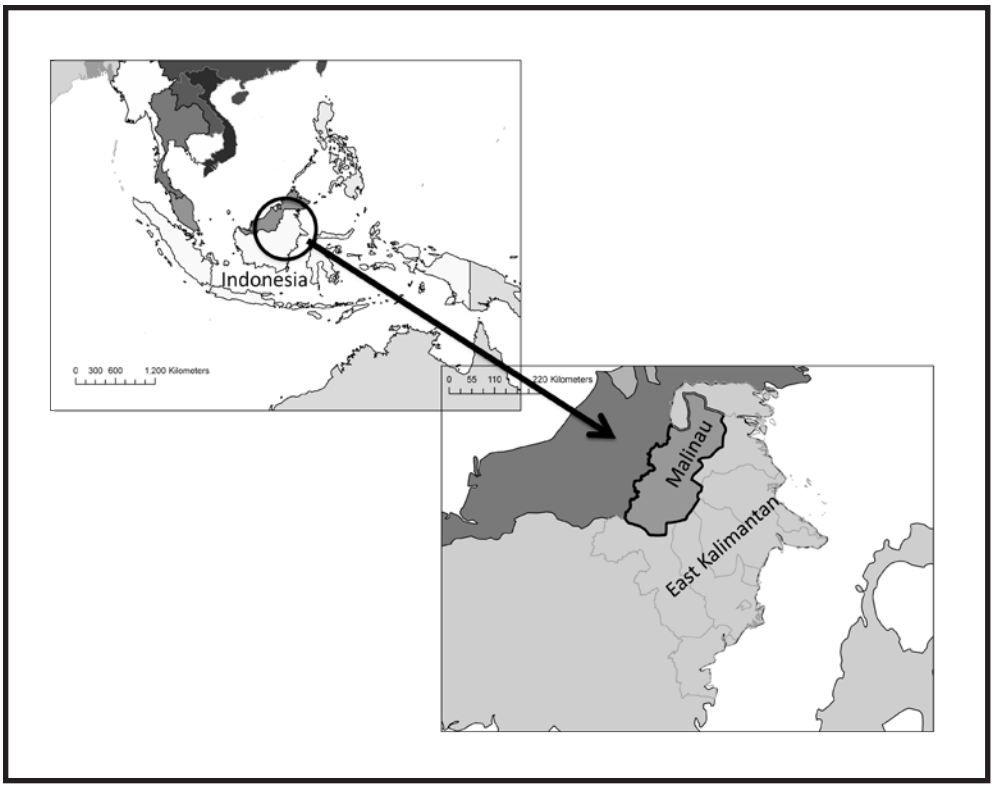

Figure 1. Location of East Kalimantan and Malinau district (shown by arrow within East Kalimantan) in Southeast Asia and Indonesia.

consequences of the process of decentralization that occurred in Indonesia following the fall of the Suharto dictatorial regime in 1998 (McCarthy 2004; Larson 2005; Moeliono, Wollenberg, and Limberg 2009). Following decentralization, district governments (including the Malinau District Government) were given the authority to grant forest concessions (called IPPK) and companies were required to negotiate terms with local communities prior to the start of forest operations. Since decentralization, local ethnicities have come to occupy many positions of power. The current distribution of power among ethnicities is largely a product of colonial-era policies, wherein the Dutch favored some ethnicities (i.e. the Merap) over others (i.e. Punan) (Moeliono and Limberg 2009). Despite the fact that many indigenous ethnicities are highly represented, the district government continues to be unresponsive to the needs of local, indigenous communities (Rhee 2009).

Methods

I conducted interviews in Bahasa Indonesia with village residents, as well as interviews in a mix of Bahasa Indonesia and English with ministers in the Malinau District Government and workers for REDD-implementing organizations. Village interviews were conducted in 5 villages that surround, manage and claim parts of the Long Ketrok Protected Area (Figure 2, Table 1). The total number of community interviews was 45. I attempted to interview men and women, village leaders and other residents, as well as a mix of ethnicities.

Constraints/Barriers to Equitable REDD

Land Tenure Disputes

In the district government, officials refer to the study site as Long Ketrok and consider the area to be under district government control. However, at the local level the name Long Ketrok is unknown and villagers believe individual communities control this area. Communities use this area for hunting and the collection of rattan, wood resins, medicine, and food. Despite the importance of access to Long Ketrok for local communities, the Minister of the Malinau Department of Forestry claimed that access to the site area would be restricted for anything other than ecotourism if REDD were to begin in the area. At the same time, many villagers consider their continued access to forest products from the primary forest a deal breaker in their decision to support REDD.

Land tenure conflicts between neighboring villages are another potential source of conflict that

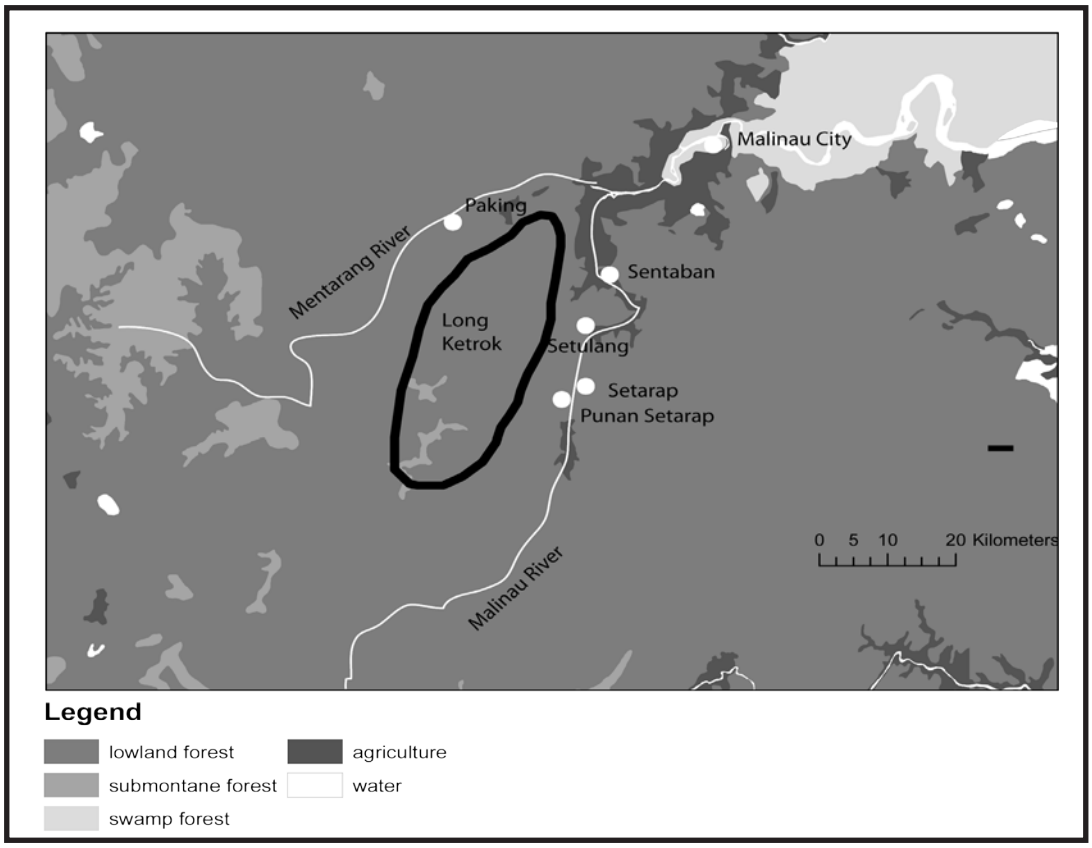

Figure 2. Study site within Malinau district, East Kalimantan. White dots mark villages where interviews were conducted at community level, except for the white dot to the upper right which marks the location of the district capital, Malinau City. The area outlined in black is approximately the extent of the primary forests of Long Ketrok. This area has been identified as a potential REDD site and is currently managed and claimed by all five communities, in addition to at least two other villages.

could be exacerbated by REDD. Incompatibility between customary land tenure and the tenure systems used by the government is a major source of these conflicts (Scott 1998). Nowhere is this more evident than in the disputes surrounding the land claims of Setulang. Setulang is a relative newcomer to the Long Ketrok area and expanded its boundaries through agreements made with the district government, not with the other villages in the area. Therefore, its claim to this area is considered to be illegitimate by neighboring villages. This land tenure conflict was frequently brought up during interviews, largely out of frustration with Setulang's rapid expansion and with the perception that outsiders (CIFOR in particular) facilitated this expansion. Despite the possibility for conflict exacerbation, the Minister of the Department of the Environment in Malinau predicted that Setulang would receive more REDD compensation than other villages.

Compensation Distribution Problems Within Villages

While problems arising from compensation distribution between villages could act as a barrier to effective and equitable REDD in Long Ketrok, compensation problems within villages could be equally problematic. Many village residents in Sentaban and Setarap claimed to worry about conflicts arising within their villages over the distribution of compensation from REDD. Not surprisingly, these villages are also villages where major intra-village conflicts exist between ethnicities and between village leaders and non-leaders (Table 1). Intra-village distrust is largely the result of experience with compensation from small logging concessions. In villages that received logging revenues, compensation mishandling was widespread (Limberg 2009). In Setarap, distrust and jealousy among ethnicities was so widespread that

Table 1. Data showing the demographics, livelihoods, accessibility and measures of likelihood of future conflict for the five villages where interviews were conducted during my fieldwork.

Village name	Paking	Punan Setarap	Sentaban and Long Kenipe	Setarap	Setulang
Year established	1985	2004	?	1909	1967
2001 number of families	176	24	40	61	209
2001 Population	322	168	186	258	841
2001 Area (km^2)	85.47	83.81	172.86	87.13	85.47
Number of villages in village area	3	1	3	1	1
Access	Metarang River	Malinau River	Road	Malinau River	Road
Travel distance from district capital (hours)	3	2.5	1	2.5	1.5
Major ethnicities	Mixed	Punan	Abai, Lundaye, Punan, Kenyah	Lundaye, Kenyah, Punan	Kenyah
Eco-tourism support from district	Yes	No	No	No	Yes
Major sources of income	Agriculture, timber revenues	Agriculture	Agriculture	Agriculture	Agriculture, Eco-Tourism, Conservation
Future additional sources of income	Eco-tourism, timber	Oil Palm, Acacia mangium plantations	Oil Palm plantations	Oil Palm, Acacia mangium plantations	Bottled water
Current Land Conflicts	None	Setarap	Setulang	Setulan, Punan Setarap	Setarap, Punan Setarap, Sentaban
Current intra-village conflict	No	No	Yes	Yes	No
Previous IPPK Concession?	Yes	Yes	Yes	Yes	No

the majority of Punan residents decided to start their own village on the other side of the Malinau River to strengthen their claims to traditional land. Ill feelings regarding this dispute are still prevalent in the village of Punan Setarap. If villages are given a major participatory role in REDD, then government officials and implementing organizations will likely choose to deal exclusively with village leaders for the sake of greater efficiency. Village leaders must handle compensation transparently and fairly in order to prevent intra-village conflict.

Deforestation rates are not the result of decisions made at the village level

Community participation in natural resource management has never been institutionalized in Indonesia because Indonesia's top-down approach to forest management is not compatible with community-based resource management (Nanang and Inoue 2000). In order for communities to manage their own forests, they must have the decision-making power to do so. Despite attempts at decentralization, the Indonesian national government retained control over particularly profitable industries, and Indonesia's

decentralization has always been characterized by institutional overlap and confusion (Larson 2005). Therefore, unless the entire system of top-down forest management is reconfigured, decisions that determine land use and management over large scales will continue to be determined without the input of communities. Residents in Paking village claimed that they believed that REDD could happen, but that it was the government and companies that cut the forest, not the villagers. Nearly all villagers interviewed claimed that the village would not clear their primary forest even if REDD does not happen. This suggests that, at least initially, the most effective and efficient destination for REDD funding may be the district government or companies, not the villagers themselves. However, these company and government-focused projects raise issues regarding project equitability and governance (see Conclusions section).

Advantages to Involving Communities in REDD

Establishment of a Future Constituency for Conservation

Interviewed residents in every village valued the conservation of forest for a variety of reasons, including the provision of forest products, regional climate moderation and the preservation of cultural identity. In many instances, villagers were highly supportive of initiatives to conserve forest and preferred compensation for conservation to compensation for logging, mining or plantations. One particularly pro-conservation advocate in Sentaban, when asked about her expectations regarding compensation said, "I don't worry or care about compensation. I want the forest for my grandchildren." A resident of Punan Setarap claimed, "Villages that have forest are cooler. People in villages that have lost their forest are sick."

The Long Ketrok area is one region where REDD could be used to gain a long-term, supportive constituency for forest conservation. Indeed, many of these villages claim that they have been conserving forest for centuries. The Kenyah people of Setulang refer to their system of conservation as Tane Olen and claim that this system has a history that dates back through their oral tradition (Figure 3, Iwan and Limberg 2009). If REDD were to be done without the participation and compensation of forest-dependent communities, REDD and conservation could come to be viewed as another form of resource appropriation. In this case, REDD would be similar to national timber and mining concessions that bypass the rights of local communities for the sake of greater project efficiency.

Is Pro-business/government REDD really efficient?

Without community support, REDD projects would be vulnerable to project disruption by uncompensated communities. As one Setarap resident claimed, "I don't worry about our village not receiving compensation because if we do not receive compensation the project will not work. We will end the project." This situation could lead to higher enforcement and monitoring costs that reduce efficiency, or to complete project failure.

From a development perspective, the inclusion of communities could serve to actually increase efficiency. Most village residents claimed that they would like their village to be compensated with development projects, instead of monetary compensation. The most common suggestions were to compensation in the form of medical or educational supplies or buildings. An inclusive REDD project could promote community development across multiple sectors, while also serving to ensure local support for REDD.

Conclusions

The way in which Reduced Emissions from Deforestation and Forest Degradation (REDD) is implemented as an institution in relation to previously existing institutions will likely have a major impact on its eventual success. The governance situation in Malinau is characterized by institutional confusion, corruption and distrust at every level of government. To simply graft REDD onto currently existing institutions will probably have very little impact on forest management practices. In fact, such a move could even serve to exacerbate current conflicts, corruption and resource expropriation. On the other hand, REDD could be a transformative institution that promotes good governance and cross-sector collaboration. The ability of REDD to do so is dependent on the ability of implementers to draw on lessons from previous attempts at institutional transformation (Cashore et al. 2007; Levin, McDermott, and Cashore 2008).

As mentioned previously in this article, a trade-off between efficiency and equity in REDD will likely be an important characteristic of REDD (Seymour 2008; Chhatre and Agrawal 2009). Some

researchers, including myself, believe that there is a moral obligation for REDD to significantly improve the lives of forest-dwelling communities (Brown, Seymour, and Peskett 2008; Luttrell, Schreckenberg, and Peskett 2007). If REDD is to be implemented in a way that ignores the warnings and requirements of local communities then REDD is probably not worth implementing at all.

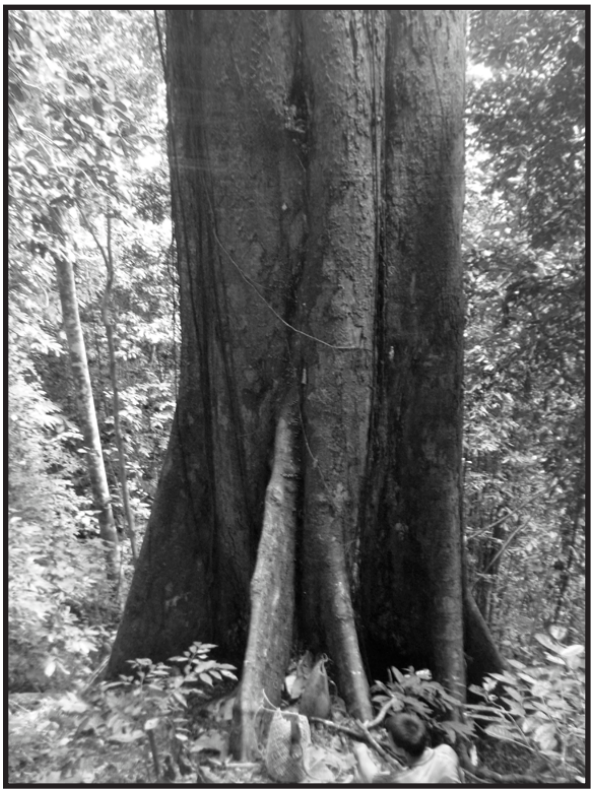

Figure 3. 4 meter (>13 feet) DBH Dipterocarp tree (*Shorea meranti spp.*) in Setulang's Tane Olen forest, which forms part of Long Ketrok Protected Forest.

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IV. THE 'WASTE' OF MODERNITY

Medical Waste Management in Kenya: Opportunities for Improvement

Nashaat Mazrui, MEM 2010

Introduction

I sat in a bus as we drove through the congested roads of Nairobi, exhausted after a long day in the field. Though I wished to fall asleep for the two hours that it takes to get to my destination, the activities of the day lingered in my mind preventing me from going into my slumber. I looked at my field notes for the fourth time and sighed. It was unbelievable that all the health facilities I visited that day had medical waste incinerators without adequate air pollution control devices. Residential areas surrounded most of the incinerators, and residents living there talked of choking smoke that seeped into their homes when the incinerator was operated. I closed my eyes for a while to comprehend the enormity of the health crisis. There is no doubt that it is a grave situation and, as a Kenyan, I consider it my responsibility to search for sustainable solutions to the crisis. Thus for the rest of my journey, I thought about the management of medical wastes in Kenya and how it could be improved.

Medical waste, also called bio-medical waste in Kenya, refers to waste produced in health facilities or research organizations during the diagnosis, treatment, or immunization of human beings and animals (WMR, 2006). The World Health Organization (WHO) classifies such waste into the following categories: infectious waste, sharps, pharmaceutical waste, chemical waste, genotoxic waste, radioactive waste, pathological waste, and pressurized containers (Pruss et al. 1999). Most health facilities worldwide prefer to incinerate medical waste as it has many advantages, such as sterilization of pathological or anatomical waste, volume reduction, and waste heat recovery (Hyland 1993). However, since medical wastes contain high amounts of chlorine in the form of disinfectants or plastic (polyvinyl chloride) (Hyland 1993), incinerating the material produces dioxins. These are chemicals that resist degradation and therefore bio-accumulate in the food chain. They are toxic to life and have been linked to the development of cancer, suppression of the immune system, cause of reproductive and developmental complications and endocrine disruption (Connett 1998; Darryl and Pat 1998). Dioxins enter the atmosphere as fumes. However, in an incinerator equipped with air pollution control equipment, most dioxins are concentrated in the fly ash, which is the fine solid removed from the flue stack (Diaz et al. 2005).

In addition to dioxin emissions, medical waste incinerators release considerable amounts of heavy metals that can be emitted as fumes, particles, and ash (Fritsky et al. 2001; Yuhas et al. 1994). Toxic discharged metals include cadmium, lead, mercury, chromium and arsenic (Singh and Prakash 2007). Chronic exposure to toxic metals can result in the suppression of hematological system, kidney failure, neurotoxicity, gastro-intestinal disorders, respiratory tract irritation, and cancer of the lungs and prostate (UNEP 2007).

The drawbacks of incinerating medical wastes have encouraged the development of alternative technologies for treatment and disposal. Although various new technologies are being considered world wide, only microwaving and steam sterilization seem to offer realistic alternatives to incineration (Lee et al. 2004). However, these two techniques do not completely sterilize pathological, radioactive, laboratory, and chemotherapy wastes (Lee et al. 2004).

Combining incineration and non-incineration technologies for medical waste treatment is therefore a good way of reducing pollution. It is thus not surprising that the regulations of Kenya, which aim to prevent the dumping of unsterilized medical

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wastes, call for the employment of incineration and steam sterilization before final disposal. However, an emphasis on only the treatment of medical waste is not sustainable in the long run. Wastes are merely residues that our economy has not yet learned to use efficiently (Graedel and Allenby 1995) and it would be advantageous for Kenya to explore sustainable ways of using medical 'residues'. Doing so will not only have environmental and public health advantages but will also create sustainable jobs in the country. Exploration of such alternatives first requires the establishment of baseline data on the generation rate, management practice, treatment, and disposal of medical wastes currently employed. My study therefore aims to establish this data.

Methodology

In an effort to collect this information, I worked in Nairobi from June to August of 2009 gathering data on medical wastes from health facilities. I choose Nairobi for various reasons: first, as the capital city of Kenya, it is the most populated and cosmopolitan of all cities in the country; second, the United Nations Environmental Program (UNEP) headquarters is located in Nairobi, which makes the city a place of environmental interest to the international body; third, Nairobi is the center of policy formation in Kenya and is the location of government office headquarters.

Using a questionnaire and two research assistants, I visited 418 health facilities in Nairobi during the three months of field research. I sought information on medical waste generation rate; the extent of segregating medical wastes; recycling and record keeping practice; and methods employed for treating and disposing of medical wastes. For the purpose of this study, health facilities in Nairobi were divided in to four classes: hospitals, nursing homes, dispensaries, and clinics (Table 1).

For the quantitative analysis, I used Minitab 15 to calculate the average quantity of waste generated in each facility. The values were then subjected to a t-test to establish statistical difference. Also, I calculated simple percentages for the management and disposal methods employed.

Results and Discussion

Quantity of wastes generated

Health facilities categorize wastes into two main groups: sharps and infectious wastes. Sharps are taken to be items that can cut someone while infectious waste was any solid waste that has come into contact with a patient's body fluid. Within these two groups, it was found that hospitals generate the highest amount of both types of waste and the figures were statistically different from those generated by the other three facilities (Table 2).

Results from this study suggest that the generation rate of infectious waste for Nairobi is on the higher side for a developing country when compared to documented rates (Diaz et al. 2008). This could be because of the poor segregation practice as explained below.

Waste management practice

The most common practice in 97% of the facilities in Nairobi is the segregation of sharps while all other kinds of solid medical wastes are mixed together. This practice leads to increased dioxin and metal emissions during the incineration process (Alvim-Ferraz and Afonso 2003a, 2003b). Additionally, many facilities consider broken thermometers as sharps, which leads to increased mercury content in the waste.

Recycling and record keeping is not popular in health facilities. I found that less than 10% of

Table 1. Categories and definition of health facilities.

Type	Definition
Hospital	A facility offering both in-patient and out-patient services and with more than 70 beds
Nursing homes	A facility offering both in-patient and out-patient services with less than 70 beds
Dispensary	A facility designed to offer out-patient services with many doctors serving the patients
Clinics	A facility designed to offer out-patient services with one doctor serving the patients

Table 2. Waste generated in each type of facility

Facility Type	Sharps (kg/patient day)	Infectious wastes (kg/(patient day))
Hospital	0.015	0.9
Nursing Home	0.0093	0.35
Dispensary	0.009	0.093
Clinic	0.014	0.169

the facilities recycle pharmaceutical bottles and only one major hospital recently began recycling paper. Yet, medical equipment can be reused if designed for recycling, and if it can withstand the sterilization process (Pruss et al. 1999). Plastic syringes probably have the greatest potential for recycling since they contain a high plastic content (about 85%) and contribute the highest proportion of total medical plastic wastes (Lee et al. 2002). Opportunities also exist in the use of anaerobic digesters to consume pathological wastes into biogas for energy and nutrient-rich slurry for fertilizer usage.

Only 35% of the facilities admit to keeping some kind of records on the amount of medical wastes generated. Record keeping is an invaluable practice that can aid a waste manager in setting targets for waste reduction, and also in developing analytical tools such as mathematical models to be used in decision-making (Agunwamba 1998). The lack of record keeping hinders the development of effective medical waste policy.

Waste Treatment and Disposal methods

This study found that most health facilities subcontract waste treatment and disposal to a private company. In fact, 41% subcontract to companies that are licensed to collect general waste while only 27% subcontract to companies licensed to handle medical wastes. Of health facilities that did not subcontract waste disposal, 21% incinerate on site and then regard residual ash as general municipal waste and 11% directly deposit all their wastes in open dumps.

Considering that most of the facilities

Figure 1. Children playing in a municipal waste disposal ground

Figure 2. Pigs feeding in a municipal waste disposal ground

subcontract the disposal of wastes to general waste collectors, a large amount of unsterilized medical waste actually ends up in dumps. Toxic ashes from incineration are also disposed here leading to water and soil contamination through leaching of the chemicals. Since Kenya does not have a sanitary landfill yet, the potential for toxic substance to leach is much higher than in countries with sanitary landfills. Additionally, the current dumps in Nairobi are accessible to children and animals (Figures 1 & 2) and thus exacerbate the harms of medical waste management.

Last, but not least, this study found that all except two facilities that incinerate medical waste are located in residential areas and do not have adequate air pollution control devices. As discussed earlier, incineration is associated with many negative environmental and health effects and it seems ironic that health facilities themselves are contributing to these problems.

Conclusion

Though this paper is by no means exhaustive, it helps identify important areas that require improvement if medical waste management in Kenya is to be made more sustainable. The following list outlines the salient conclusions and recommendations of the study:

1. The amount of medical wastes produced in health facilities of Nairobi is higher than the average amount produced from developing countries. Efforts to minimize waste production should be encouraged through recycling and reusing resources.
2. Segregation of wastes is poorly conducted in facilities, yet rigorous segregation will minimize wastes, pollutant emissions and allow for recycling.
3. In spite of the fact that recycling is almost never done in health facilities, opportunities for recycling pharmaceutical bottles, medical plastic wastes, and pathological wastes exist.
4. Keeping comprehensive records of wastes generation is the first step towards developing a waste management plan, but very few facilities in Nairobi keep records.
5. The legal awareness among waste managers in health facilities is limited, thus it is important for regulations to be publicized such that all those responsible for generating, handling and disposing wastes are enlightened.
6. Almost all incinerators in the health facilities have poor or no air pollution control devices. Therefore, adequate pollution control measures need to be employed.
7. The government should construct a landfill to minimize the leaching potential of incinerator ashes and other pollutants in municipal wastes.

Acknowledgement

I owe the opportunity to do this study to the Compton International Fellowship, the Tropical Resources Institute, and the Career Development Office at Yale School of

Forestry and Environmental Studies. I am also indebted to my advisors, Professor Thomas Graedel and Dr. Evans Kituyi, for their guidance during the development and implementation of the study.

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E-Waste in Indonesia:
The Case of Personal Computers

Fauziah Rochman, MESc 2010

Introduction

This research is an effort of identifying and characterizing an informal system that exists in the recycling of electronic waste (E-waste) in Indonesia. Yogyakarta, Indonesia was chosen as a location that reflects the transition from a traditional to a modern-consuming lifestyle. This condition epitomizes the consumption patterns that have been a common feature of most developing Asian nations in recent decades. As the nations develop and their economies grow, consumption of resources grows correspondingly (Hubacek et al. 2007).

E-waste is an emerging global environmental problem in the current world. While we are overwhelmed by inventions of modern technological gadgets, inventions of their recycling technology are considerably less. Proper electronics recycling is deemed as inconvenient, and they are also cheaper to dump rather than to process. Most of the time, these technological gadgets are not recycled. Instead, they are disposed far away from the source. For instance, developed countries, such as the United States, dispatch around 80% of their E-waste to Asia and Africa (Dahl 2002; Huo et al. 2007; Zoeteman et al. 2009)

Rapid economic growth coupled with a growing demand for consumer goods, has increased both the production and the consumption of electrical and electronic equipment in Indonesia. The growth in the consumption and production of these goods has been exponential in the last two decades, generating about 20 to 50 million tons of waste every year worldwide (Kapur and Graedel 2006; Pinto 2008; Liu et al. 2009). In this paper, I intend to explore and characterize the recycling of Personal Computers (PCs) in Yogyakarta.

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PC waste as a resource

Electronic waste or E-waste for short is a generic term encompassing various forms of electric and electronic equipment that have ceased to be of any value to their owners (Widmer et al. 2005). Generation of E-waste is recognized as the most rapidly growing waste problem in the world. With the increase of at least 3-5% per annum, the rate is three times faster than other waste streams (UNEP 2005). One of the largest electronic commodities produced and traded worldwide is the PC. About 500 million PCs reached the end of their service lives between 1994 and 2003. With that amount, they contain approximately 2,872,000 tons of plastics, 718,000 tons of lead, 1363 tons of cadmium and 287 tons of mercury (BAN and SVTC 2002; Beech 2009).

The abundance of electronic products causes their prices to decrease. With the increase of economic affordability and rapid technological innovations, it is now cheaper to purchase a new PC than to fix or upgrade an old one (StEp 2009). This would further shorten the life span of electronic products. As a consequence, older and outdated electronic items are becoming obsolete and are being discarded in significant amounts worldwide (Culver 2005; Wong et al. 2007).

E-waste is often richer in precious materials compared to natural sources. A ton of ore from a gold mine produces 5 g of gold on average, whereas a ton of discarded mobile phones can yield a minimum amount of 150 g. More than 80% of the weight of the composition of a whole PC set consists of silica (glass), plastics, iron and aluminum (MCC 1996; EMPA 2008; Yoshikawa 2008). These numbers demonstrate that we should not waste E-waste because they contain valuable resources.

Environmental and social cost of E-waste

Illegitimate movements of E-waste across borders pose an environmental equity threat. The issue is known to be responsible for environmental, health, social, and developmental conditions impacts worldwide (Iles

Figure 1. The collection and manual dismantling of CRT Monitors waste in Yogyakarta, Indonesia.

2004; Royte 2005; Kim 2006). Improper disposal and recycling of E-waste is common in many developing countries in Asia and Africa. With a lack of available waste removal infrastructure and the necessary technical capacities, E-waste recycling operations in developing countries are faced with challenges as well as opportunities (Toxics Link 2003; Davis 2006).

E-waste that is improperly disposed of or recycled tends to cause negative impacts on the environment and human health. There are concerns of the leaching of toxic components from E-waste. The toxic chemicals commonly used in electronic devices are metals and metalloids (e.g., arsenic, cadmium, chromium, copper, lead, and mercury) and organic chemicals such as Brominated Flame Retardants (BFRs). Cathode ray tubes (CRTs), for instance, may contain barium, cadmium, copper, lead, zinc, and several rare earth metals. Electronic devices, along with lead–acid batteries, are the major contributors of lead in the municipal solid waste stream (U.S. Environmental Protection Agency 1989; Yang 1993; Lee et al. 2000; Jang and Townsend 2003; White et al. 2003; Gordon et al. 2006; Li et al. 2009)

Toxic elements that leach into the environment and expose informal workers pose significant health risks. Elements such as cadmium and chromium are carcinogenic,while other metals such as lead, mercury and thallium possess a wide spectrum of toxicity that includes neurotoxic, hepatotoxic, nephrotoxic, teratogenic or mutagenic effects. E-waste has also been linked to a variety of health problems in developing countries, including cancer, neurological and respiratory disorders, and birth defects (Schuhmacher et al. 1997; Baker et al. 2004; Royte 2005; Davis 2006)

E-waste in Indonesia

The Indonesian government is aware that E-waste is a potential emerging problem in the country. E-waste in Indonesia is created by fast product obsolescence and replacement, as well as illegal importation. Field inspections by the Indonesian Ministry of Environment also found out that importation of E-waste occurs with misleading terms on importation documents. Common terms such as “mix metals scrap” or “plastic for recycling” are often used for E-waste as attempts to avoid Indonesian cross-border controls (Krishna 2003; Agustina 2007).

The flow of E-Waste in Indonesia can be followed through three interconnected pathways: newly purchased electronics; handing over electronics to second hand users; and the disposal of electronics. Lack of sufficient recycling facilities cause this waste to be passed through several informal phases. The presence of this informal economic cycle becomes the key to E-Waste Management in Indonesia, regardless of the actual resource potentials and the

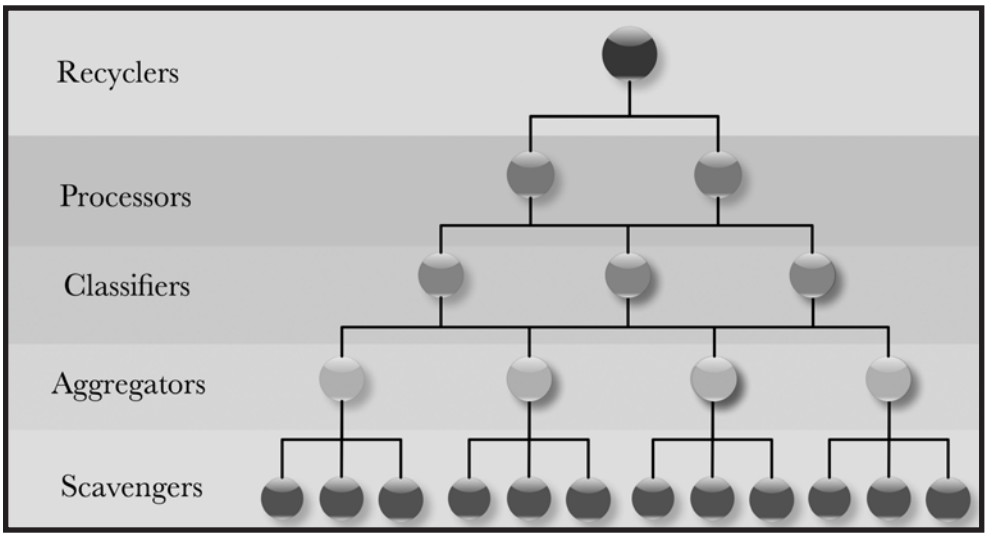

Figure 2. The hierarchy of the E-waste stream in Yogyakarta, Indonesia.

health impacts burden (Damanhuri 2006; Ali 2008)

The flow of PC waste in Yogyakarta

With a population of about 517,000, Yogyakarta is one of the major cities in Indonesia. The city produces approximately 250 metric tons of waste daily, of which E-waste is estimated to add up 1.2 tons (Fig. 1). From the current population of 517,000, 1.2 tons of E-waste generated daily is equivalent to a family of five discarding a PC every year. In this research, a PC set includes a CRT monitor, motherboard, Central Processing Unit (CPU), Random Access Memory (RAM), optical disc drive, hard disk, keyboard, and mouse.

In order to have a general comprehension of the PC recycling system in Yogyakarta, I conducted various interviews and research to identify actors throughout the waste flow. An initial study was accomplished in December 2008 to find out what has been done by the Indonesian Government. In the following year, from May to June 2010, I conducted field research in Yogyakarta city to collect data and understand the current situation. Through system characterization, I discovered a waste hierarchy in the process of PC waste handling in the waste stream. The waste hierarchy has five strata: scavengers, aggregators, classifiers, processors, and recyclers (Fig. 2).

The flow of PC waste in Yogyakarta is simplified in Figure 3. The process begins when a household and/or an institution intends to discard their PC. Typically, households sell their unused electronics to waste scavengers by informal transactions, while institutions sell their bulk discarded PCs directly to classifiers. Scavengers are on the lowest level of the hierarchy, making the lowest income out of E-waste recycling. They collect and purchase waste to be sold to waste aggregators.

Institutions such as universities and governmental organizations found it easier to directly send their discarded PCs to computer waste classifiers. There are two significant PC waste classifiers in Yogyakarta. To keep their businesses running, they maintain their networks with institutions and auction sales in the city. Major PC parts are also ubiquitous in secondhand or repair and refurbishment markets (Fig. 3). In these markets, valuable PC parts are dismantled and reused, while broken parts are discarded into public dumpsters mixed with other types of waste, which could later be collected by scavengers or end up in landfills.

Aggregators purchase whatever materials they considered valuable, without having specific preferences. An aggregator normally collects waste from 10-20 scavengers. Aggregators then separate the materials roughly into different groups, such as plastics, papers, and electronics. Then, the grouped materials are sold to various waste classifiers, such as PC classifiers. In a PC classifier, for instance, a monitor is dismantled and classified into parts based on their compositions, such as CRTs, plastics, metals, circuit boards, and batteries (Fig.

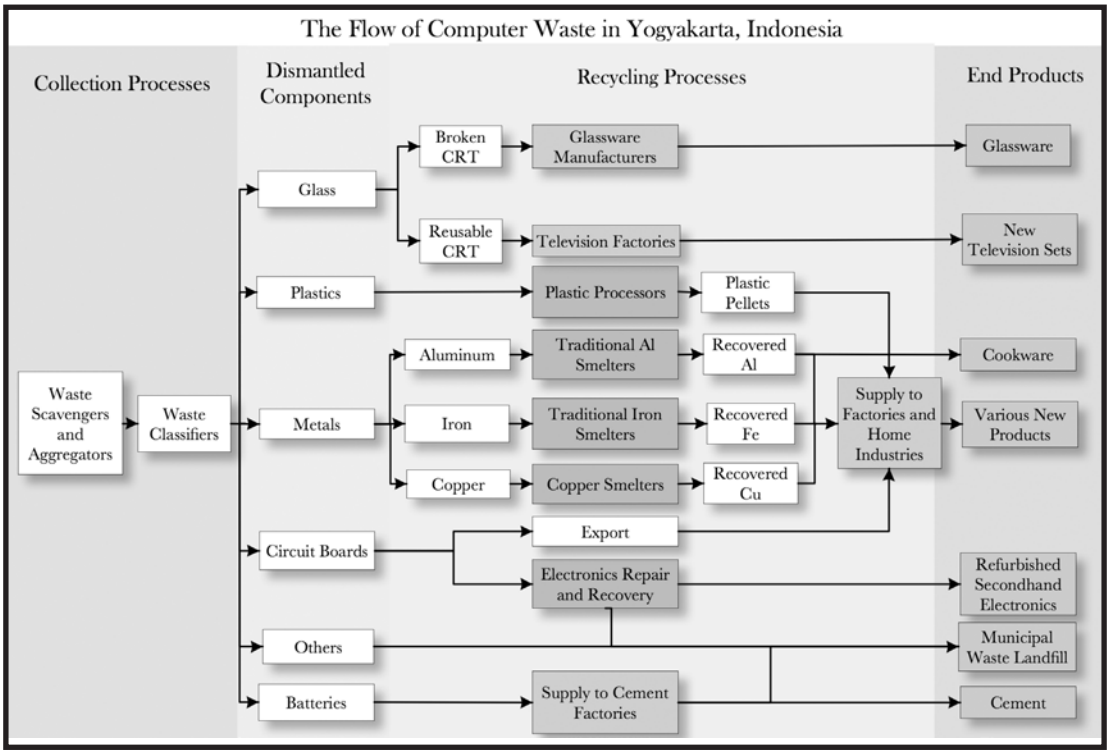

Figure 3. The flow of Personal Computers (PCs) Waste in Yogyakarta, Indonesia.

3). Workers in PC classifying businesses have no choice but to be exposed to the harmful impacts of improper manual dismantling techniques. Unaware of safety protections and procedures, they endure one of the largest health risks of E-waste handling.

Classified items are then sold to various processing industries. Processing industries process the bulk item into raw materials for industry supplies. One example of these industries is the plastic processing industry. Plastic parts from electronics are typically considered "hard plastics." This type of plastic is collected in sacks and delivered to the plastic processing industry. There are approximately 10-20 plastic processing centers in Yogyakarta that are mostly home industries. On average, they hire around 10-40 workers. "Hard plastics" are chopped up into pieces using a machine, dried, and finally processed into pellets. Processed plastics are packed in sacks and they become raw material supplies to many industries, both in and out of the city.

On the highest strata of the hierarchy are the recyclers. Often, recyclers are located outside of Yogyakarta, and even out of the country. They can be big companies or small home industries. Recyclers process raw materials supplied from processing industries into different products. One significant example is the reuse of CRT from discarded monitors for new television sets. In this case, the television industry is considered as a recycler, by recovering the function of waste to produce new products. Other recyclers are glassware manufacturers, aluminum cookware industries, and home industries that produce recycled objects such as glassware, aluminum cooking utensils, iron crafts, plastic bags, plastic buckets, and television casings.

The Economic Value of PC-waste in Yogyakarta, Indonesia

E-waste in Indonesia tends to be perceived as used objects that possess an economic value (Damanhuri 2006). An interesting fact discovered is that PC-waste is highly valued, that a scavenger would find that a CRT monitor would profit him as much as three to five days of scavenging other types of waste. This comparison is shown in Figure 4 where the economic value of PC waste (equivalent to other E-waste types) parts highly exceeds other types of waste such as plastic bottles, glass, cans, and papers. PC parts are also highly valued when they reach secondhand or repair and refurbishment markets.

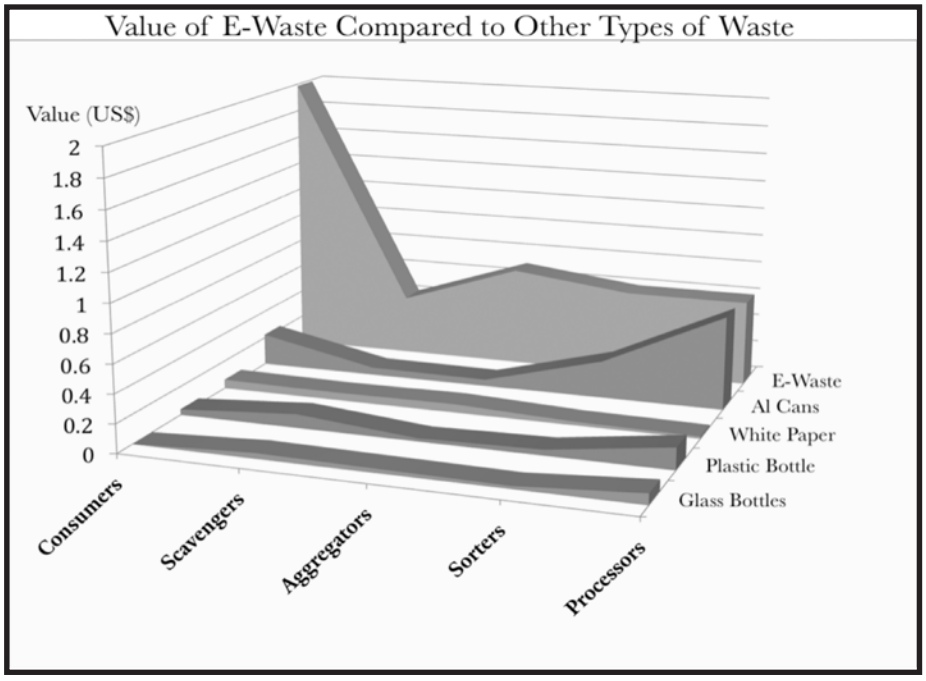

Figure 4. Value of E-waste (US$/kg) compared to other waste types in Yogyakarta, Indonesia.

The entire transactions of daily E-waste flows is approximately $2,500. This value is less evenly distributed, with scavengers benefiting and profiting the least. A scavenger makes around $13.62/week, an aggregator makes $35.70/week, and a classifier makes $300.00/week.

Income discrepancy is clearly evident in the business. Scavengers at the lowest level are key players in keeping the whole business running. Encompassing questions of health, environment, and recycling techniques, current analysis tends to understand the existing system as a way to obtain economic gains as opposed to addressing environmental concerns. With a high rate of unemployment, Indonesia is in an advantageous situation to be able to expand this kind of recycling business. Proper planning, evaluation, and technology could make E-waste recycling a potential business to be further developed.

Conclusion

The global issue of Electronic Waste (E-waste) has awakened the world to the importance of a proper waste management system. Rapid economic growth coupled with a growing demand for consumer goods has increased both the production and the consumption of electrical and electronic equipment. Serious attention to this issue has increased throughout the developed world, but there remains a lack of awareness within the developing world. Indonesia, as a developing country, lacks the technological and infrastructural capacity to deal with this type of waste and, as a result, this waste has been mobilized through several informal processes. From the research, I discovered that a large portion of E-waste is dismantled, recovered, and reused into different functional components for a variety of other items. Informal E-waste recyclers play a significant role in the recycling process. They can be grouped into E-waste scavengers, aggregators, classifiers, processors, and recyclers. Proper management of this system could bring further benefits to the environment and local economy, and help alleviate the potential harm that may be caused by improper handling of E-waste.

Acknowledgements

I would like to thank Professor T. Graedel, W. Ashton, B. Reck, R. J. Lifset, and M. Eckelman, whose guidance and support from the initial to the final level enabled me to develop an understanding of the research subject. I also gratefully acknowledge financial and institutional support from the Yale Tropical Resource Institute, The Council on Southeast Asia Studies, The Carpenter Research Fund, The F&ES Globalization Research Fund, and The Center for Industrial Ecology, for the work carried out in this study. I am

also indebted to The Indonesian Ministry of Environment, Basel Convention Regional Centre for South-East Asia, PT. Mukti Mandiri Lestari, StEP-NVMP E-waste Summer School Participants and Committee, and various informal waste sectors in Indonesia who contributed data and critical advice in the course of the study. Data collection and field research would not have been possible without the assistance of T. Zikri and HMI research assistants. Finally, my deepest thanks to M. Wiharjo and my parents for their endless support.

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Saltwater Hydroponics Atop Shrimp Farms:
Exploring a New Method of Reducing Environmental Impacts from Shrimp Aquaculture in Tropical Developing Countries

Hui Cheng, MESc 2010

Introduction

A few days ago on Facebook, the popular online social network, one of my former co-workers set his status as, "Well tonight was the final night for all-you-can-eat shrimp, so of course I took advantage. Even after a [Caesar] salad and a bread roll I still beat my record. 113 SHRIMP BABY!!!!!!" Jacob was referring to the annual "Endless Shrimp Fest" at Red Lobster.

For the past few years, Jacob has had 85, 96 and 105 shrimp in one sitting at his neighborhood Red Lobster. Seeing this Facebook status of his, I could not help but return a comment, for I have extensively studied both the societal and environmental impacts that result from shrimp farming. I wanted to get my point across in as few words as possible, hoped not to be condemnatory and wrote, "Farmed shrimp is destroying coastal habitats in the tropics. The US imports more than US$3 billion of it yearly (COP 2004). The largest shrimp farm is in Indonesia; it is the size of Hong Kong (Murphy 2000)."

The sad thing is not that Jacob replied, "To Hui, I think they should build more farms, the loss of coastal habitat is worth the tastiness that is in my belly." The sad thing is that Jacob and I were fisheries observers in the Bering Sea. He is a certified SCUBA diver and majored in marine biology in Australia. Despite all his knowledge and experience with coastal and marine natural resources, he does not seem to show concern about how his everyday actions could influence environmental integrity of coastal areas in foreign lands. His apparent lack of accountability is unfortunately widespread among people today, yet it is understandable. The intricate connectedness of our global resource flow blurs the linkages between our daily actions and the ultimate end result.

Hui Cheng holds BS Biology from University of North Carolina at Chapel Hill and worked as a fisheries observer in the Bering Sea and Central Pacific. Hui's environmental interests are coastal communities and coastal and marine ecosystems. Hui intends to work for the government on coastal and marine resources issues.

Impacts of Shrimp Farming

First, let's consider shrimp farming itself. Saltwater shrimp farming requires coastal land in the tropics. Shrimp is cultivated in earthen ponds filled with a mix of freshwater and seawater. The creation of these earthen ponds usually involves conversion from traditional agriculture land or native habitats such as mangrove forests and salt marshes (Fig. 1). The impact of land conversion is multidimensional. First, the power dynamics of the local community are altered along with the change in land use (EJF 2004). Social stability is undermined. In Bangladesh, locals who oppose shrimp farms have been raped, murdered, or endured harassment and intimidation (EJF 2004). Second, the ability for local food production is reduced and/or threatened, as local resources are geared toward commodity production (van Mulekom et al. 2006, Sarwar and Khan 2007, Stonich and Bailey 2000). Third, the ecosystem services that the destroyed native habitats provide are compromised (Primavera 2006). For example, without the natural vegetative barrier between land and sea, the vulnerability of coastal communities to tropical storms is increased (Barbier et al. 2008).

The shrimp pond water quality is maintained by constant water exchange with the surrounding environment. Freshwater is often used for this purpose, as shrimp is usually raised at salinity lower than that of seawater, which is 35 ppt (parts per thousand). The impact of constant water exchange is also multidimensional. Social conflicts can arise over competition for freshwater between shrimp farmers and other water users, such as traditional agriculturalists. Additionally , in locations where freshwater is drawn from underground

Figure 1. An aerial photo of a large-scale shrimp farm in Indonesia. Smaller canals crisscross the entire aquaculture operation and lead to larger waterways that exchange water directly with the ocean beyond the strip of mangroves in the background. Photo obtained from http://dinos.anesc.u-tokyo.ac.jp/Small/reference/R0010shrim-s.jpg.

aquifers, extensive withdrawals for shrimp farming have caused land to cave in (Páez-Osuna 2001).

The released saline water turns the surrounding soils and freshwater resources salty (Primavera 2006). Salinization of the soils reduces local biodiversity and renders the land unsuitable for traditional agriculture (EJF 2004, Haque 2006, Islam 2004). Salty freshwater sources further reduce the availability of resources to other users (Primavera 2006). Moreover, the released water is overloaded with suspended solids, treatment chemicals and excess nutrients from shrimp waste and leftover shrimp feed (ibid). The assimilation of this heavily polluted saline water into the surrounding ecosystems alters ecology and biodiversity (EJF 2004). The polluted water also causes eutrophication, the condition of water bodies receiving excess nutrient runoff that leads to reduced animal life, in coastal waters (Páez-Osuna 2001, Primavera 2006). Because many marine animals spend their early lives in coastal waters, the negative effects of eutrophication are eventually felt in marine ecosystems.

Shrimp farming is undoubtedly one of the most environmentally damaging food production methods, and the social impacts are not any less dramatic. Essentially, by consuming farmed shrimp from foreign lands, we import the tastiness that is in our bellies and export all the societal and environmental impacts to the low-income tropical countries that produce them.

Unabated Demand

Shrimp has been promoted by FAO (United Nations Food and Agriculture Organization) and similar organizations as a way to replace protein lost from the depletion of global fisheries (FAO et al 2006, Roheim 2004). This resulting increase in global shrimp demand in high-income countries coupled with diminishing wild shrimp stocks, in turn, resulted in the explosive expansion of shrimp farms in supplier countries. The enormous demand-and-supply is illustrated by US shrimp imports, which exceed US$3 billion of shrimp annually (Fig. 2) (COP 2004). Because the product is sold to consumers in high-income countries, shrimp farming is a lucrative

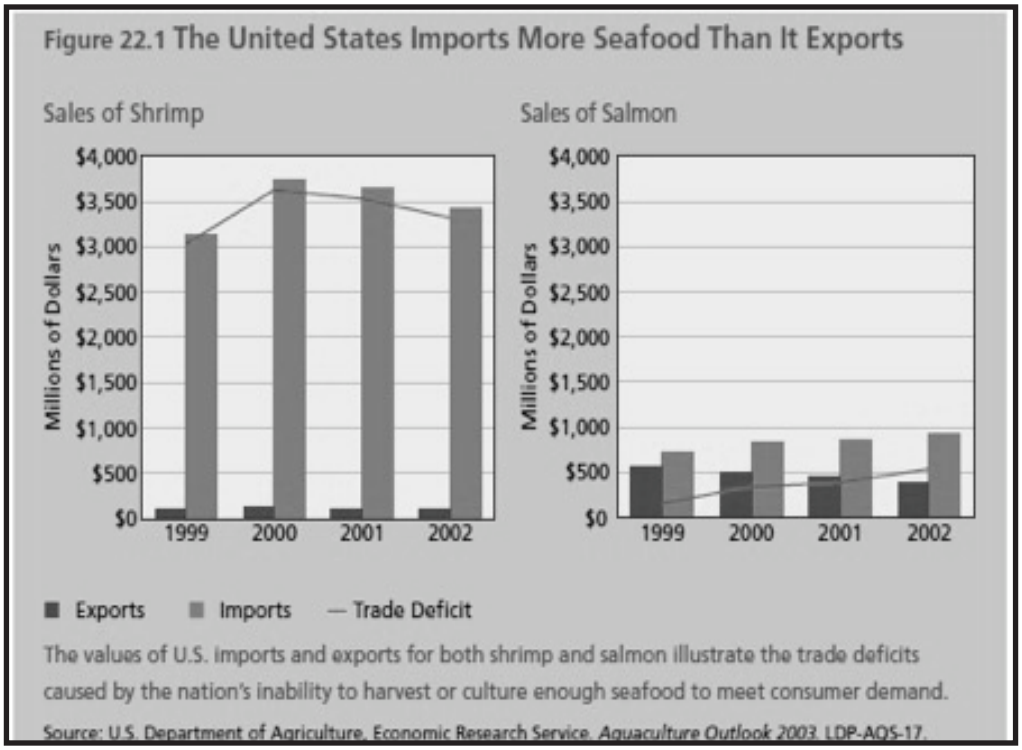

Figure 2. Breakdown of the United States annual seafood trade deficit. Source: COP, 2004. The most valuable imported seafood item in the US is shrimp, at over US$3 billion. Shrimp is followed by salmon, which is imported at less than US$1 billion.

foreign exchange earner in low-income countries of the tropics where technology is limited and environmental laws are lax (Stonich and Bailey 2000, van Mulekom 2006). As of 2001, it is estimated that one to one and a half million ha of land worldwide are under shrimp aquaculture (Páez-Osuna 2001).

Shrimp farming as an industry began in Asia, under the auspices of Asian Development Bank and the World Bank (Béné 2005). The industry has gradually made its way to Latin America and Africa. The major producers currently are China, Thailand, Vietnam, Indonesia, India, Brazil, Mexico, and Ecuador (Boyd 2008). Shrimp farming is, by this point, an unstoppable enterprise. Unless the demand for shrimp decreases, the producer countries will keep on supplying the commodity. Thanks to the marketing strategies of Red Lobster and others, such as Jacob's favorite "Endless Shrimp Fest," the demand is not likely to decrease.

So, what can be done? According to Seafood Watch of Monterey Bay Aquarium, the consumer can "make ocean-friendly seafood choices today" (2009).The Seafood Watch ranks seafood items: "Best Choice","Good alternative", or "Avoid". Imported farmed shrimp, considering our previous examination, is, predictably, on the Avoid list. But given that 80% of shrimp consumed in the US occurs in restaurants (Mangrove Action Project 2008), how are we to know where our shrimp is from in order to make ocean-friendly seafood choices?

Research Premise

My research is based on the following premise: Shrimp farming in tropical countries cannot be stopped due to enormous demand from the West and complex political economies. The numerous pervasive environmental impacts are caused by the need to maintain shrimp pond water. Thus, by improving the quality of the effluent, the discharged water, the impacts of shrimp farming would hopefully be reduced. In a nutshell, if we cannot stop it, how can we make it less environmentally damaging?

The most up-to-date Better Management Practices (BMP) for shrimp pond effluents are: "(1) comply with applicable effluent standards; (2) reduce

water exchange;(3) recirculate water on the farm during shrimp grow-out; (4) reuse water discharged when ponds are drained; (5) use settling basins to remove organic particles from draining effluents; (6) use mangrove wetlands to treat effluents; and (7) monitor off-site water quality" (Boyd 2008).

Of all the Better Management Practices, only BMP #6 actually removes chemicals and nutrients from the discharged effluent. However, the shortcoming of this BMP is that the absorptive capacity of the surrounding mangroves to clean the polluted effluent is greatly exceeded due to the diminishing wetlands and the increasing shrimp pond hectarage. In addition, the shrimp-producing low-income countries cannot technologically or economically implement many of these BMPs.

Experimental Concept

The concept of my experimental design is based on three questions: How can implementing a mitigation measure also be a direct economic incentive for the shrimp farmers? What will be low-tech enough for realistic implementation in these low-income countries? What will use the least amount of land? The third question stems from the hypothesis that if shrimp farmers had access to more land, they would convert it to more ponds rather than a mitigation measure, such as a settling basin.

Addressing these three questions, I explored the principles of aquaponics, the cultivation of plants and aquatic animals in a recirculating system. The only nutrient input in aquaponics is fish feed. The recirculating system incessantly circulates the nutrient-rich water from the fish compartment to the hydroponic plant compartment and back. The plants remove the nutrient from fish waste and leftover fish feed from the water, and the cleaned water is returned to the fish compartment. Aquaponics can reduce water demand of aquaculture and produce a second crop of food (Diver 2000, McMurtry 1997). As shrimp aquaculture is saline, halophytes, saltwater plants, would be utilized. In fact, halophytes grown in soil and irrigated with saltwater aquaculture effluent have been shown to remove significant amounts of nitrogen from the water (Brown and Glenn 1999, Brown et al. 1999).

Experimental Design

To provide direct economic incentives for shrimp farmers, I identified halophytes that are edible to humans. I selected the halophyte *Atriplex*

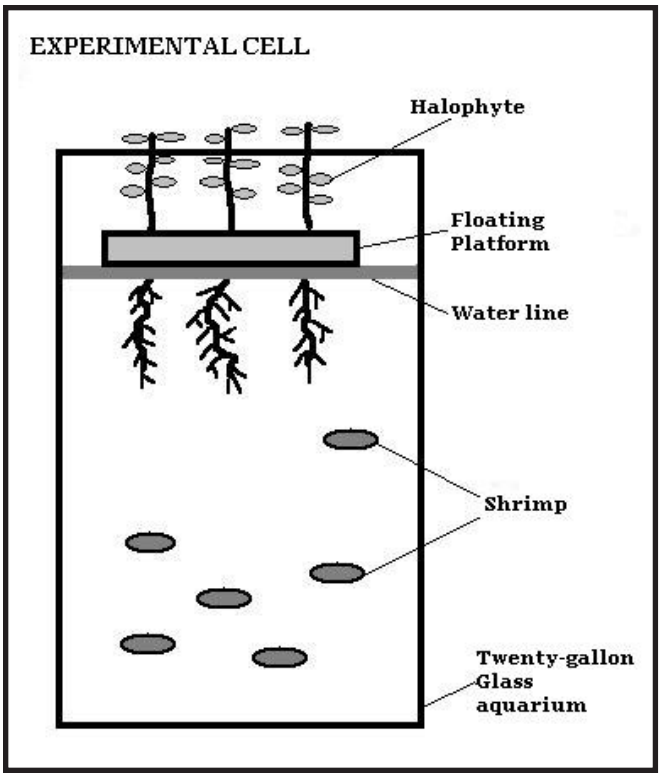

Figure 3. Cultivating saltwater plants and shrimp in the same space. Plants were grown in a floating platform that sits on top of the water. Roots were allowed to extend into the water. The only nutrient input to the system was shrimp feed.

hortensis, commonly called orache or mountain spinach. The plant is leafy and is regularly eaten in central Europe today. To devise something relatively low-tech and also save land, I eliminated the recirculating component of aquaponics and grew plants and shrimp in the same space. My resulting experimental design was that halophytes were grown hydroponically in a floating platform directly above the shrimp (Fig. 3).The experiment was conducted at University of Hawai'i at Hilo to simulate the tropical climatic conditions of actual shrimp farms. I tested five plant coverages: none (Control), Very Low, Low, Medium and High. I used complete block design and had six blocks with each treatment represented once per block for a total of 30 experimental cells (Fig. 4). Twenty-gallon glass aquaria were used as the experimental cells. Each aquarium was stocked with 18 seventeen-day old shrimp (Litopenaeus vannamei) post-larvae, matching the stocking density of 100 animals per squared meter in intensive shrimp culture. All aquaria were filled with the same mixture of seawater and county water to obtain a salinity of 20 ppt. The daily input of shrimp feed was the same for all aquaria. Over the course of eight weeks, I measured the concentrations of three forms of organic nitrogen in each system: nitrate, nitrite and ammonia.

I hypothesized that 1) nitrogen concentration in treatments with plants would decrease to a greater degree compared to control; and 2) nitrogen concentration in treatments of higher plant coverage would decrease to a greater degree than treatments of lower plant coverage.

Results and Discussion

The changes in concentration of nitrate were most interesting compared to the changes in concentrations of nitrite and ammonia. Nitrate concentration in treatments with plants decreased at a rate of at least 70% faster than that of Control (Table 1), which is in support of the first hypothesis. The nitrate concentration that showed the greatest rate of decrease was that of High plant coverage, at a rate of 118% faster than that of Control. Though High plant coverage had the greatest rate of decrease and Control had the lowest rate of decrease, the second hypothesis that nitrogen concentration in treatments of higher plant coverage would decrease at a greater degree than treatments of lower plant coverage was not supported. This, however, does not mean that higher plant coverage would not reduce nitrate concentration at a greater rate, as the plant coverage

Figure 4. A block in the actual experiment. Each block consisted of a 300-gallon tank that held five glass aquaria for temperature control. Each of the five treatments was represented once per block.

Treatment	Slope of nitrate changes over time	Slope of treatment/Slope of Control
Control	-0.0049	1
Very Low	-0.0087	1.78
Low	-0.0084	1.71
Medium	-0.0089	1.82
High	-0.0107	2.18

Table 1. Rate of nitrate decrease (slope of nitrate changes over time) was the least for Control and the highest for High plant coverage. Very Low, Low, and Medium plant coverage had similar rate of nitrate decrease.

Very Low, Low, and Medium were similar, all under 3%.

Though nitrate concentrations in treatments with plants significantly decreased at a faster rate than that of Control, the actual amount of decrease was minimal. This could be attributed to a few reasons. One possible reason is that the experimental system was too small. Each glass aquarium had 18 shrimp, which did not allow much nutrient input in the first place. Additionally, the small amount of nutrient might not have been enough to sustain the proper development of the plants, which may have influenced their ability to uptake nitrogen.

Second, glass aquaria do not have the earthen component of actual shrimp ponds. This could have led to a greater amount of suspended solids that affected the growth of the plants by smothering the roots because the solids did not have other attachable surfaces. Finally, the plants did not respond well to the hydroponic system. This could be partly due to the previous two concerns and/or the 20 ppt salinity. High salt concentration has the same effect as low water availability. Many

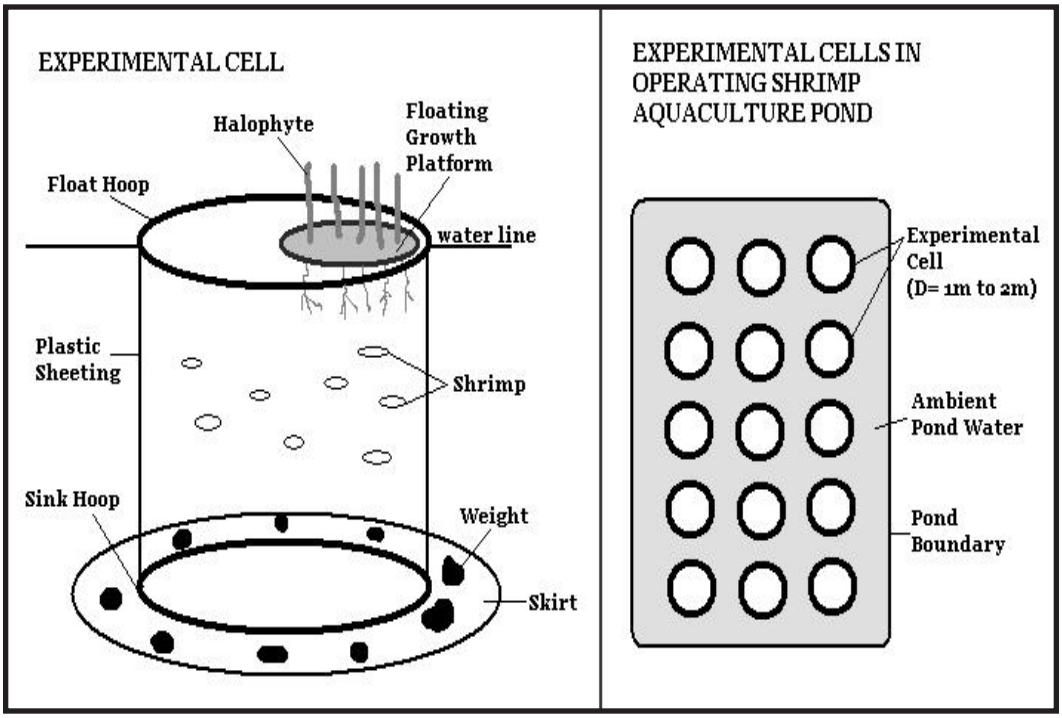

Figure 5. Hypothetical experimental set-up of halophyte hydroponics in a commercial shrimp pond.

plants developed leaves that resemble succulent plants, which are adapted to arid environments.

Conclusion

Despite the shortcomings in my experimental design that negatively influenced the growth and development of the plants, nitrate still decreased at a faster rate in treatments with plants. This suggests that halophyte hydroponics is capable of removing nitrate from shrimp aquaculture water.

It would be of value to utilize the concept of this experiment on a larger system, such as an actual shrimp pond (Fig. 5). I was not able to pursue the larger scale experiment due to logistical constraints unrelated to the experimental design. It is possible that *Atriplex hortensis* could respond more favorably to the conditions in an actual shrimp pond, as commercial ponds typically have salinities from 5ppt to 10ppt, which translates into more water available for plant uptake for growth. Also, different species of halophytes could be explored. Given that shrimp farming is wreaking havoc both socially and environmentally in tropical countries, as responsible consumers, we must find a feasible method to reduce its impacts.

Acknowledgements

I thank Yale FES faculty who provided research guidance: Dr. Peter Raymond, Dr. Helmut Ernstberger, Dr. Jonathan Reuning-Scherer, and Dr. Graeme Berlyn.

I thank my funding sources who made my experiment a reality: Tropical Resources Institute, Yale FES Summer Globalization Research Fund, and Carpenter-Sperry Research Fund.

For my experiment, I thank Lorenzo Juarez, President of Shrimp Improvement Systems for donating shrimp post-larvae. I also thank Dr. Kevin Hopkins of University of Hawai'i at Hilo for providing aquaculture guidance and research facility and Matthew Barton and Brett Rodomsky of UH Hilo for assistance in experimental set-up.

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V. PROBLEMS OF TRANSLATION

Cuban Environmental Paradigms:
Contemporary Agriculture and Colonial Forestry

Dana Graef, PhD candidate

Introduction

Since the early 1800s, Cuban agroecological history has been dominated by the sugar trade; large-scale monoculture led to extensive deforestation on the island and drove Cuban development and international relations (Funes Monzote 2008). Spanish colonial policy, American imperial interests, and Soviet support of Cuba revolved around the extractive industry, pulling the island into global networks of social and ecological exchange. International involvement in Cuba has led to conflicts between external demands for resources and local subsistence imperatives. In this article, I draw from archival sources, published research, and field interviews to consider two moments of socio-environmental transition in Cuba: the colonial forest policy debates of the late 1700s, and the sustainable agriculture movement that arose in the 1990s. [1] These periods represent the time immediately preceding Cuba's overwhelming transition to sugar plantations, and the years when sugar production plummeted after the collapse of the Soviet Union. While forest conservation policies were imposed by Spanish colonial powers, limiting local landowners' agency, sustainable agriculture was promoted by the national government, encouraging residents to cultivate land for subsistence. These cases illustrate distinct modes of interaction between local subsistence needs and broader environmental initiatives. Forest preservation and sustainable agriculture represent two strains of environmentalism in the context of globalization. While colonial forest preservation in the tropics has been described as an example of green imperialism (Grove 1995), Cuban sustainable agriculture has been described as a form of ecological resistance to global capitalism (Funes et al. 2002).

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Sustainable Agriculture in Cuba, 1990s – Present

The dissolution of the Soviet Bloc and disintegration of the USSR from 1989–1991 had reverberating impacts on Cuban society. During the 1970s and 1980s, agriculture in Cuba was a large-scale enterprise dominated by collective state farms cultivating sugarcane monoculture in the Green Revolution model, with the aid of imported pesticides, herbicides, fertilizers, and farming equipment (Rosset and Benjamin 1994). The country was a net importer of food and fossil fuel; the Soviet Union accounted for 70% of its trade (Rosset 1997, 19). The loss of Cuba's primary trade partner and the strengthened US embargo led to economic collapse, an energy crisis, and food scarcity. Widespread famine ensued, and the government declared the Special Period in Time of Peace (Hearn 2008). During the initial years of the Special Period, from 1989 to 1993, Cuban imports dropped from $8 billion to $1.7 billion (Maal-Bared 2006, 350). Food that had been imported was no longer available, and the lack of oil impeded the operation of farm machinery as well as the transport of food from rural farms to urban centers (Funes et al. 2002). Oxen replaced tractors in the countryside, as machines became inoperable.

By the early 1990s, the Cuban government responded by greening the revolution (Rosset and Benjamin 1994). Policies advocated chemical-free organic agriculture, promoting the establishment of semi-commercialized organic farms (*organopónicos*) and family-scale permaculture gardens within Havana's city limits (Premat 2009). The state granted usufructuary rights to individuals and cooperatives who were willing to convert vacant

urban plots into gardens for food production, a crucial shift in land policy that enabled the organic movement (Cruz and Sánchez 2001, 31).

The organic agriculture movement gained international attention for resolving the famine, yet food sovereignty remains a national concern. Recent hurricanes have decimated crops, and Cuba still imports as much as 80% of its food through re-negotiated pathways, including the United States (Pérez and Montano 2008). Reflecting the shift away from chemical inputs, one Cuban noted that "knowledge is the primary input for agriculture" in Cuba today. In the summer of 2009, another man questioned the large-scale potential of organic, de-mechanized agriculture: "oxen and earthworms aren't enough to feed 11 million people." A Cuban public official noted that due to material scarcity "organic agriculture was obligatory, but it's not just new techniques: it's another culture, another way of thinking… facing uncertainty, we don't have another option."

Addressing these tensions between ideology and necessity, Julia Wright (2009) recently argued that sustainable agriculture in Cuba has been driven primarily by the material lack of oil. While Cuban organic agriculture responded to acute material need, over the past twenty years a dynamic agroecological movement integrating rural and urban farmers, Cuban and international scientific researchers, government and NGO workers has emerged. The uncertainties of global trade have driven a re-conceptualization of agriculture in Cuba: it has moved from the countryside into the city, from large-scale monoculture to small-scale diversified crops, from an emphasis on exports to a focus on national sovereignty. While previous ideas and practices remain, Cuban understandings of agriculture have been complicated, and ideas of environmentalism have coalesced around the organic practices that emerged from necessity. In 2009, one peri-urban farmer expressed the dominant view of agroecological sustainability in Cuba: "to close our cycle" of resource use, focusing inwards. Another Cuban expressed the view that socialism may not be innately environmental, but no version of socialism can stop being environmentalist: "the challenge is to bring the environmental culture to the masses."

The initiation of the Special Period represented a significant separation not only from Cuba's recent ties with the Soviet Union, but from centuries of close exchange with colonial and imperial powers. While recent sustainable agriculture in Cuba encourages local production, during the late eighteenth century small-scale agriculturalists were limited by colonial policies of forest conservation. From the 1770s until 1815, Spanish colonial powers were involved in a protracted struggle with Cuban agriculturalists over the right to clear land (Funes Monzote 2008, 1). While local landowners wished to convert their forested land to agriculture for subsistence and commercial purposes, colonial government officials sought to preserve Cuban forests for the use of the Spanish naval fleet (Funes Monzote 2008, 2).

Eighteenth Century Colonial Forest Conservation [2]

The Spanish metropole sought to guard and control local timber extraction through a series of regulations. An edict in 1776 noted that it was illegal to cut cedar, mahogany, and oak without a license. [3] A government license was necessary to clear land for cultivation, and it was clarified that even with a license, cedars could not be cut unless they had grown to a sufficient height. Burning was prohibited. All households, no matter how small, were ordered to plant eight cedars that must be "cared for and always conserved for the service of the King and the public." Cedar was prohibited for use in buildings where another species would suffice.

As a consequence of edicts to preserve forests for the use of the colonial government, local residents did not have enough space for agriculture, and they had difficulty harvesting the wood that they needed for their own livelihood activities. For instance, an edict in 1798 noted that trees should not be "inconsiderately" cut down to obtain beeswax - a local subsistence activity. [4] The same document ordered that "no one requests, nor should permission be granted to cut more wood than they need for their buildings and machines…because to do otherwise would be to contribute to the destruction of the forests."

Top-down efforts to regulate deforestation fueled landowners' frustration and had limited success. In a letter written in 1798, a farmer complained that "industrious cultivators" from Havana had their "arms crossed," unable to cultivate the fertile land due to bureaucratic forest policies. [5] The same farmer suggested that regulations had driven up the price of wood: "since there have been regulations, or since there has been a subinspector, the price of wood has doubled…[because] we don't have anywhere to cut wood." Yet the farmer recognized the limits of a bureaucratic reach, with the comment that

"all of the [forest] guards of the world, and all of human vigilance, wouldn't be sufficient to stop those who cut down trees and destroy what they wish."

Spanish forestry regulations in late eighteenth century Cuba seem to support the historian Richard Grove's assertion that "the hypothesis of a purely destructive environmental imperialism does not appear to stand up at all well" (1995, 7). Colonial policies of family-level afforestation and attempts to limit land conversion from forests to fields are aligned with modern notions of environmental restoration and biodiversity conservation. However, the Spanish crown's motivation for forest conservation and restoration was explicitly utilitarian: conservation meant selective use by the privileged under regulated circumstances. Colonial policies of selective forest use also led to classificatory divisions of the Cuban environment. While some trees were designated for the crown, other species were acceptable for local use. The species most useful for shipbuilding — especially cedar — were subject to the most detailed regulations. While Spanish policies of forest conservation may not have been environmentally destructive, they do represent a utilitarian, selective view of nature. Trees were not conserved for their ecological value, but for future human use.

Trajectories of Cuban Globalization

In 1791, the Haitian revolution led to the exodus of plantation managers from Haiti, destabilizing the world's largest sugar producer at the time (Funes Monzote 2008, 41). Consequently, Cuba surged in importance as a locus of sugarcane production. In 1815, landowners won the fight with Spain for permission to clear their land, initiating a period of expansive deforestation across the island (Funes Monzote 2008, 1). Spain no longer valued Cuba for selective forest use, but for potential plantations. Throughout this transition, Spanish colonial powers continued to conceptualize Cuban natural resources for their productive and extractive value as part of a global system of commodity flows.

In 1830, the Spaniard Antonio de Berazas laid out his recommendations for strengthened Cuban–Iberian relations under the new framework of agrarian extraction. [6] He wished to impede the relationship between Cuba and the Americas, seeking to emulate the closeness of British–Jamaican relations. Antonio de Berazas viewed the natural world from a utilitarian perspective, describing nature as subject to human desires. He noted that "nature exists for man's favor on the surface, or beneath the earth, or in the atmosphere." To strengthen the links between the colony and the metropole, he wrote that it was necessary to eliminate "all ideas of distance, and to confound the differences between climates and products with reciprocal necessity." This tightened reciprocity was derived through trade. Specifically, products brought from Spain to the colony included "grains, broths, fat, salted meat, iron and metalwork, salted fish, potatoes, vegetables, rice, crackers, onions, and other small things that Spain could advantageously supply." In return Cuba could provide "coffee, tobacco, cacao, cotton, wax, woods, sugars, and honeys." In de Berazas' view, this exchange would lead to relationships "so intimate between the Metropole and the Colony - by one needing the other - that it would be difficult to be separated due to the unity of habits, customs, religion, language, laws, and government, which are the ties that bind humans from the cradle to the grave."

While the solidifying unity that de Berazas foresaw as a consequence of reciprocal necessity ultimately proved divisive, environmental and social consequences of the colonial relationship persisted long after Spanish rule was overthrown in 1898. By devoting land to sugarcane monoculture for international export, Cuba no longer produced sufficient food for its population. During the late Soviet period, Cuba imported between 44 – 57% of caloric intake per person (Moskow 1999, 127). As a consequence of the Cuban–Soviet relationship, the dynamics of food security on the island were profoundly unbalanced. The crisis of the Special Period resulted from unstable external exchange: Cuba's reliance on Soviet support was not reciprocated.

The severe consequences of external reliance have led to a heightened awareness of food production within national borders. Farmers draw even smaller boundaries of self-sufficiency: the goal of agroecology, one suggested in 2009, is to "fulfill the entire cycle on the farm." In the current mode of Cuban environmentalism, perceptions of agricultural sustainability draw increasingly internal boundaries of production. Due to the Special Period, "it was a strength to look inwards," one man noted in 2009. Yet this new "environmental culture" draws from global knowledge of agroecological techniques. International agencies seeking to improve food security in Cuba have contributed funding and project assistance from Australia, Canada, Germany, the United Kingdom, and the United States. In this way, the trajectories of environmentalism in Cuba have shifted from externally

imposed colonial policies for selective extraction to national policies that incorporate international environmental ideas into local agricultural practices. While some Cubans view the transition to agroecological methods as a temporary solution, other farmers express the firm belief that agroecological techniques have enabled greater autonomy, and in so doing, a relief from pervasive uncertainty.

Acknowledgments

Research for this article was carried out in Cuba and Spain during the summer of 2009 with funding from the Tropical Resources Institute, the Program for Agrarian Studies, and a Tinker Field Research Grant from the Council for Latin American and Iberian Studies at Yale. I would like to thank N. Delafield and H. Jump for patient and helpful editorial comments, and my advisors, M. Dove and E. Mayer, for their advice. Any errors are my own.

Endnotes

[1] To protect anonymity, quotes from personal interviews in Cuba are not attributed. All quotes are from fieldwork in the summer of 2009. All archival research was conducted at the General Archive of the Indies (Archivo General de Indias, hereafter AGI) in Seville, Spain. I have translated quotes from interviews and archives from Spanish into English.

[2] Following historical conventions for archival material, details are provided in footnotes.

[3] AGI. Ultramar 9, No. 1 – 17. Dr. Phelipe de Fonsdeviela y Ondea, Marques de la Torre. Forest edict given in Havana. March 7, 1776. All quotes in this paragraph from the same source.

[4] AGI, Ultramar 9, No. 1. Forest edict. December 11, 1798. All quotes in this paragraph from the same source.

[5] AGI. Ultramar 9, No. 1 – 6. Letter from Havana farmer. May 22, 1798. All quotes in this paragraph from the same source.

[6] AGI. Ultramar 147, No. 20. Letter from Antonio de Beraza. November 4, 1830. All quotes in this paragraph from the same source.

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United or Divided?
Stakeholder Perceptions of One Another and REDD

Katie Hawkes, MEM 2010

Introduction

Over the last two decades, the international community has implemented a series of "sustainable development" programs in developing nations worldwide. Broadly these aim to simultaneously raise quality of life and preserve ecosystem integrity. The latest in the sustainable development tradition is the REDD mechanism approved by the United Nations Framework Convention on Climate Change (UNFCCC) in 2007. Reduced Emissions from Deforestation and Degradation will, if implemented, reward developing nations in the form of carbon credits for the preservation of their standing forests (UNFCCC 2007).

As the newest proposed addition to the global carbon market and with billions of dollars, hundreds of thousands of acres of threatened tropical forest, and possible inclusion in the successor to the Kyoto Protocol on the line, the REDD mechanism has a lot riding on it. Although we are approaching two years since its acceptance by the UNFCCC in December 2007, proponents and critics alike have doubts as to whether this market-based conservation mechanism, often hailed as a win-win, will achieve its stated goals. Having become familiar with these uncertainties over the course of the preceding academic year, I spent the summer of 2009 conducting research in Indonesia, one of the countries most fervently in support of the REDD program and dedicated to seeing it realized. Through participation in a REDD conference, interviews with many key NGO and government organizers involved in developing REDD projects, and visits to communities hoping to adopt REDD as part of their management strategy, I addressed a number of questions related to the development of these projects in Indonesia. One aspect of my investigations that strikes me as particularly fascinating and in some ways unexpected – concerns the perceptions of different stakeholders in the REDD development process. In particular I will discuss the varying perceptions of governments, NGOs, and communities both between and within these groups, as well as the perception of REDD among all of these.

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Countries

Often in the literature on REDD and especially in news articles, country governments are portrayed as united fronts with consistent viewpoints and desires with regard to REDD. Additionally, as few but Karsenty (2008) acknowledge, many of the predictions concerning REDD take for granted that national governments act neutrally and in favor of their country's common interest. This, of course, assumes further that such a common interest even exists. She points out that "another odd vision, especially when referring to many developing countries, pictures a supposed ability that omnipotent governments…have to accelerate or slow down deforestation as they like for strategic purposes" (Karsenty 2008, 450). In short, much of the literature concerning REDD presumes not only that governments have internally consistent positions, but also that governments and their associated economies will quickly shift based on international decisions about reduced deforestation and carbon markets.

The reality of this situation, as Karsenty's subtle sarcasm conveys, is far from such a unified ideal. My experience – and many of my interviewees – established the Government of Indonesia to be a byzantine complexity of agencies, departments, ministries, working groups and other subdivisions, each with different and often conflicting goals, agendas, powers, and opinions. Interviews with several members of two different departments revealed that even within these agencies, opinions differed significantly as to how REDD should be developed, who should have input in the decision-making process, and who should benefit from these activities. Moreover, when asked about the difficulties that they or their organizations had faced personally, NGO and government stakeholders alike highlighted difficulties arising from this complexity in the Indonesian political context. These difficulties included the nebulous intricacies of land tenure classifications and uses; the hierarchical system of often

contradictory laws, decrees and permits; the disparate agendas and lack of communication between ministries; and the lack of clear leadership in Indonesia's progress with reduced deforestation projects. Overall, these accounts are a testimony to the distinct lack of unity within the Indonesian government as well as to the slow, tortuous process of policy development and implementation. It seems imperative that these disparities in goals, agendas, and communication be addressed before REDD can move forward effectively.

NGOs

Another group of stakeholders of which perceptions tend to be myopic are NGOs. Their roles are often obscured or blended together by discussions more focused on the development of frameworks for REDD. This relative obscurity of NGO participation in REDD development disguises a mind-boggling diversity of roles, goals, and understandings within this group. I interviewed members of five big, international NGOs (BINGOs), two national Indonesian NGOs, one international aid organization, one smaller international NGO, and one local Indonesian NGO.

When asked to describe their role within REDD project development, members of BINGOs described their organizations as "facilitators" or "catalysts." Members of the aid organization characterized its role somewhat laughingly as "complicated and bureaucratic." The national NGOs were more focused on research and advocacy. The local Indonesian NGO was largely concerned with the fate of forests near the community where its members lived and worked. Overarching goals of these organizations ranged from global to local in scope. These included objectives like improving forest governance and management, improving local livelihoods, climate change mitigation, community empowerment and advocacy, developing national frameworks for REDD, and more. Just within the spectrum of NGOs whose members I interviewed, I found those interested in maximizing profits from REDD as well as those who would never see a dime; both proponents and opponents of cap-and-trade, developing country involvement in emissions-reductions regimes, and REDD itself; and a range of definitions, explanations and understandings of REDD.

Perhaps the most interesting aspect of NGO perceptions revealed by my research concerns NGOs' ideas about one another. Intriguingly, several of the NGO stakeholders I interviewed described their roles and activities not only in terms of their own organizations but also in contrast to "other NGOs." Nor did all of these stakeholders necessarily have any particular "other NGO" in mind. Ostensibly they simply perceived themselves to be ideologically or practically at odds with the majority of other organizations. Interestingly, in my experience not one NGO stakeholder was correct in thinking their organization alone in its practices. Of course, this evidence is anecdotal at best, in sampling a handful of NGOs too small to make broad generalizations. However, it does raise noteworthy questions as to why NGO members feel the need to define themselves in contrast to their peer organizations, why these perceptions are often incorrect, and just who they consider their "peer" organizations to be.

Communities

Next on the agenda: the slippery concept of community. On one hand, there is a deep understanding in non-REDD academic literature on Indonesia and also among many stakeholders that communities are by no means a homogeneous group. However, somehow in REDD discussions "communities" become lumped together and contrasted with governments, NGOs and private corporations. This is especially true of discussions concerning possible benefit-sharing scenarios. As one NGO member illuminated, "community is a difficult term sometimes, because some communities aren't traditional or haven't lived in a place very long. It's difficult to determine who really has claim to land, and hard for rights to be established" (Ardiansyah 2009). As this observation illuminates, communities within Indonesia are distinguished not only by differing sociolinguistic, cultural and geographical histories, but also by differences in livelihood, different histories of interacting with the forest areas around them, and different land tenure duration (especially in the case of transmigrated communities or individuals). Accordingly, many stakeholders acknowledge the fact that REDD projects must be highly contextualized and subject to variation based on local histories and idiosyncrasies. Unfortunately, when it comes to developing policy frameworks for REDD project development and benefit sharing, discussions tend to lose sight of this heterogeneity. These fluctuating treatments of "community" raise an important question: can the need for internationally and nationally effective policy frameworks be reconciled with the need for locally flexible implementation?

REDD Perceptions

Such a discussion of complex and often contradictory perceptions of REDD stakeholders can be

aptly concluded with an examination of how REDD itself is perceived in this context. In my experience, understandings and explanations of REDD both differed from person to person and managed to share some commonalities. For example, although the practical "purpose" of REDD for organizations ranged from helping to halt the expansion of oil palm to mitigating global climate change, almost all stakeholders cited REDD as one of many tools to achieve their desired ends. Stakeholders likewise used a variety of definitions and explanations of REDD in conversation with communities or local governments. In general, though, these explanations were hyper-simplified and had varying emphases on the possible monetary benefits involved. Several interviewees discussed or implied significant difficulties resulting from communities and even governments gaining skewed expectations about REDD, its possible benefits, and its likely time horizon. However, in order to handle these dilemmas some organizations planned to educate people about REDD, while other organizations attempted actively to avoid discussing it with local populations. In sum, not only do different REDD stakeholder groups have diverse and sometimes opposing perceptions of one another, there is not even a semblance of consensus in the ways that REDD is understood, explained, or handled among these agencies.

What, then, has this exploration gained us, other than an understandable headache? I would argue that in addition to posing the questions raised in the text, these observations on the diversity of perceptions of REDD and its main stakeholders give us important insights into the way this system must be addressed in the near future. For example, these reflections speak to the paramount importance for stakeholders and academics alike to have a realistic view of the other actors involved in their activities, both within their own "group" and between these. Perhaps, as NGOs' incorrect assumptions about "other" NGOs imply, this goal could be achieved by a concerted effort toward greater communication and information sharing between stakeholders within groups, between groups, and between different scales of the same group (e.g. BINGOs and local NGOs). Another lesson we can draw from this text concerns the need for consensus on a definition of REDD. Of course different agencies' goals will always differ. However, the frequency with which popular misconceptions hinder progress could be reduced by national-level stakeholders standardizing a way of communicating REDD methodology to regional and local-level actors.

Lastly, I would like to share a lesson that I learned personally from these investigations, one I think particularly relevant to this discussion. As academics, environmentalists, concerned citizens and members of a global commons, we inevitably experience repetitive harangues on the drawbacks of large-scale attempts to change the way we function as a society. As we learn, critique, and hope to move in a positive direction, it is all too easy to mentally separate these discussions into Us and Them. We see this in NGOs defining themselves by looking down on one another; in the disparities between government agencies; in the strife between people, groups and organizations that have never met face to face or even spoken. Even I, impartial researcher that I am supposed to be, went in to my research with a set of expectations about the people I would meet, the information they would take into account, the assumptions they would operate on, and the conclusions they would come to. Disconcertingly – but happily – I found myself almost totally wrong. In all contexts I found good, informed people with an overflowing desire to make lives better, to help the environment, to improve the world we share. I would like to conclude by urging all academics, all environmentalists, all concerned citizens and members of this global commons to try to see what I learned this summer: behind every publication, every criticized action, every difficult choice there are people who are probably friends, colleagues and teachers of your friends, colleagues and teachers. It could never hurt to question your assumptions about who they are and what they are trying to achieve.

Acknowledgments

For their incredible and generous support of this research, the author would like to thank TRI, the Charles K. Kao Fund Summer Research Grant at Yale, and the Southeast Asia Studies Department at Yale. She would also like to send a heartfelt thank you to everyone who took the time to participate in this research, as well as all of the people instrumental in helping to organize this project, including Dr. Michael Dove, Indriyo Sukmono, Siti Nissa Mardiah, Dr. J. David Neidel, and others.

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Fostering Resilient Communities in Disaster-Prone and Climate-Change Threatened Tropical Coastal Areas:

Views from West Sumatra, Indonesia

Kasey R. Jacobs, MESc 2010

Introduction

"Alam takambang jadi guru." This was a response I received from a high-level official in the Social Department of the West Sumatran provincial government of Indonesia to a question about climate change and risk management. Nature is our teacher. This proverb is not widespread throughout Indonesia. It is unique to the Minangkabau ethnic group that resides in West Sumatra; an ethnic group famous for their matrilineal social system, adherence to local *adat* (customs), and dedication to Islam. My field research in the summer of 2009 in three coastal districts of West Sumatra (Fig. 1), introduced me to the culture, governmental institutions, and their ways of coping with frequent disasters. This region is prone to earthquakes, harmful wave abrasion, landslides, floods, typhoons, and tsunamis. I went to learn how they have responded to such risks as well as how they are dealing with a new risk on the horizon – climate change. West Sumatra is plentiful with coastal resources from the mangrove forests, small islands, and coral reefs. The resources are used as food for subsistence and export, building materials, livelihoods, and, to a lesser extent, tourism. Many of these ecosystems are showing serious signs of degradation. The rapid- and slow-onset hazards that put pressure on these socio-ecological systems can be vast and extremely detrimental to quality of life. As I learned, efforts to reduce risks extend far beyond "Nature is Our Teacher" and raise questions about what researchers and practitioners should consider "climate adaptation".

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On September 30th, 2009 a 7.6-scale earthquake that triggered massive landslides in West Sumatra killed over 1,100 people and displaced thousands more. This event revealed that communities living in areas historically bombarded by natural hazards are not necessarily hazard-resilient as of yet – a somewhat counterintuitive concept. I collected data using structured interviews with government officials in three West Sumatran areas surrounding themes of coastal governance, climate change adaptation (CCA), and disaster risk reduction (DRR). Adaptation to increased climate change and variability will require policy interventions, yet detailed discussions of how to redesign policies and institutions are rare at the scales of national and sub-national policy and planning (Dovers and Hezri 2010). The revelations from this sub-national study have implications for practitioners and researchers that should be kept in mind for disaster-prone or climate change-threatened coastal regions:

- Some programs and policies are already in place across many government agencies and institutions, though only one agency is defining their work explicitly as "climate adaptation";
- Local, traditional ways and cultural institutions exist to cope with hazards;
- There is overlap in existing strategies and implementing agencies for coastal governance, CCA, and DRR;
- Points of entry into these communities may not be the environmental departments despite the strong possibility that they are where most discussions about climate change exist. Rather the social departments, planning boards, disaster management agencies, fisheries/maritime affairs agencies, and public works departments have existing programs and regulations that arguably could be considered "adaptation".

Study Site and Methodology

Padang is the capital city of West Sumatra, and with almost one million inhabitants is the third largest

Figure 1. The Island of Sumatra. Three research sites are shown by the dots and the line indicates the end of the EEZ zone for Indonesia. Courtesy of the Australian Center for International Agricultural Research.

city in Indonesia. It is positioned directly on the coast and partially positioned beneath sea level, and thus, is located in a zone of extreme risk to severe earthquakes, potentially triggered tsunamis, landslides, and floods as well as sea level rise from global warming. Much of the tectonic hazards are due to the Sunda Arc, an active convergent plate boundary, located off the coast of Padang (Taubenböck et al. 2009). These conditions combined with the fact that the province has 185,580 km^2 of marine territory including the Exclusive Economic Zone with 375 km shore line from Pasaman Barat to Pesisir Selatan Regency and up to 2,420 km when including the District of the Mentawai Islands, make West Sumatra an ideal study site for researching the themes of CCA, DRR, and coastal governance. Additionally, I combined my summer research with an internship at Mercy Corps Indonesia learning first-hand how community-based DRR works on-the-ground.

There are many levels of government in West Sumatra and 32 structured interviews were conducted in all of them from the Cities of Padang, Padang Pariaman (90 km north of Padang) and Painan (76 km south of Padang – see Fig. 2).

Field Interviews

It was not long after my second interview that I realized asking about "climate change adaptation" would not provide the detailed data I was hoping to collect. Through my translator it became clear that *adaptasi perubahan iklim* (climate change adaptation) was not an understood concept by most officials. The only two agencies that understood this terminology were the Health Department and to a lesser extent the Fisheries Department. The Health Department has partnered with the World Health Organization to begin a formal CCA to reduce the risks of vector borne and water borne diseases like malaria, dengue, diarrhea, and cholera. The Fisheries Department sent many representatives to the May 2009 World Ocean Conference in Manado, Indonesia just one month prior to my field research and for most this was the first time they had encountered adaptation. In response to this realization I modified my interview questions and instead asked about existing policies, strategies, and institutions (formal and informal) for dealing with specific climate impacts. Despite the lack of exposure to the international climate regime's terminology for coping with climate change, government officials at all levels were able to provide me with examples of ways they were dealing with impacts like wave abrasion, sea level rise, coral reef bleaching and degradation, fish migration, and increased storm surges.

Government-led Strategies

This new interview strategy uncovered surprises. For instance, the Social Departments were very active in reducing climate risks while the Environmental Departments were very inactive. A myriad of strategies exist in West Sumatra for dealing with these impacts and for preparing as impacts worsen in the future (see

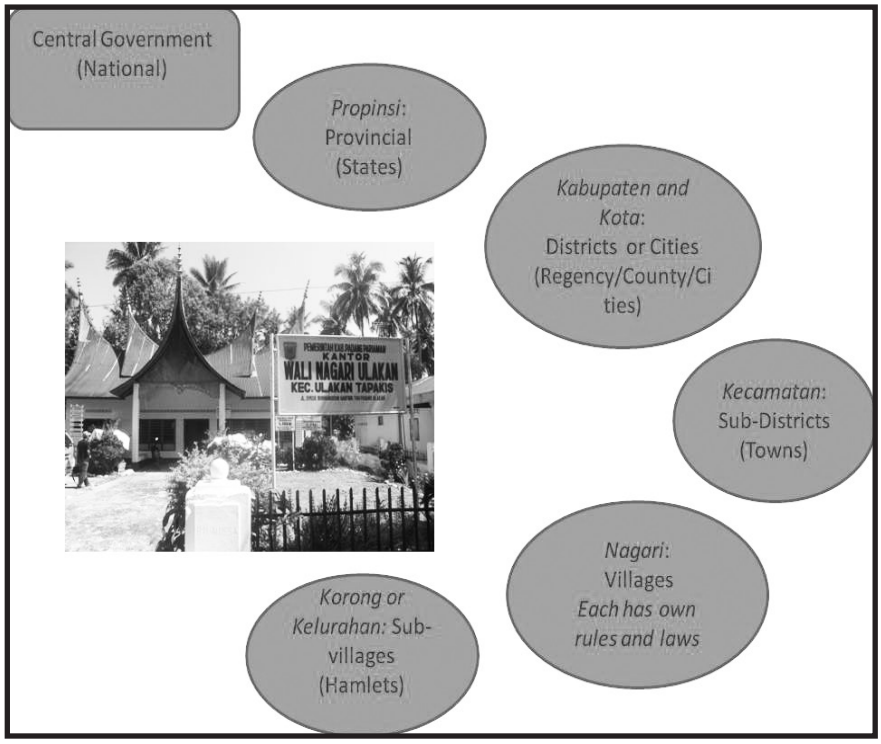

Figure 2. Government structure of West Sumatra and photo of Wali Nagari office for Ulakan (Leader of Village).

Table 1). This revelation has led me to question when strategies or plans for dealing with environmental changes can be considered "adaptation" and when they cannot. Is it only adaptation if an explicitly defined program with the goal of *adaptasi* is laid out or can traditional and old "coping mechanisms" (or ways to reduce risk) be considered adaptation?

Another surprise in my research was the clear linkage between institutions, policies and strategies for coastal governance, climate adaptation, and disaster management. International discourse would suggest that this has not been happening on-the-ground yet but in West Sumatra many of the departments working on coastal governance and adaptation are also in charge of a facet of disaster management. A comparative study would be needed to determine if this was unique to West Sumatra and/or Indonesia. In all my interviews I only asked about climate impacts like the ones listed above with the anticipation I would learn about disaster management in detail through my internship, yet in most cases the informant would eventually discuss disaster management plans as a response to dealing with those impacts. For some this could have been the result of the informant knowing my status as an intern with Mercy Corps Indonesia but in most cases, the reasons can be attributed to the overlap in strategies.

Traditional Strategies

Not all the institutions I researched were government-led. For instance, a local traditional institution that merges *adat* (or customary law) and religion (Islam), KAN/LKAAM, teaches community members to learn from nature, such as learning from storm clouds, rain, stars, etc. This is even taught in schools for secondary students. These institutions keep the memory of the traditional nature quote mentioned earlier for the Minangkabau culture, *Alam takambag jadi guru*, which is also linked to Islamic values. Two interviews stand out for how traditional institutions respond to climate change along the lines of this proverb. The head of a hamlet in Padang Pariaman, a fisherman by trade, told me the ways they use the stars to anticipate when a tropical storm or cyclone is coming and how to deal with changing fish populations. He said that their predictions tend to be more accurate than BMG, the Meteorological and Geophysics Agency, as the fishers observe the environment directly (though later the informants did admit that some recent events in 2007 caught them off guard and they were not prepared). Five types of stars let the communities know if a storm is coming and if it will be good fishing or not. The Hamlet leader seemed confidant their traditional ways would be sufficient for the future.

Alternative livelihoods are a strategy-type that crossed the boundaries between traditional coping strategies and formal programs by agencies. The government constructs artificial ponds for aquaculture to be used by fishermen when the population of fish decreases (due to climate variability or reef degradation) and gives the resources and knowledge necessary to cultivate fish and seaweed in the ponds. Traditionally fishermen are also rice paddy farmers to augment incomes when fish populations in the ocean are low. They call it *tani layan* when a person does both fishing and farming. This method is used seasonally as they have learned from nature the fishing seasons by month and by currents. For instance, the "South Season" is when water flows south giving the Bungkulu Province a small fish catch. In "West Season" when water flows from east to west, the fish catch by the Mentawai Islands is less, and in the "East Season" fishing ten miles from the beach has a decreased fish catch. Fishermen can anticipate these seasons and when necessary augment their incomes with rice farming. Alternative livelihoods are a coping strategy by government and they are anticipating having to provide more options for citizens as time goes on.

One informant told me that in 1998 a new fish population swarmed the areas within 10 miles of the coast of West Sumatra and remained there for one and a half years. This fish had never before been seen here. This alien fish was dubbed the "crisis fish" because it came during the Asian Financial Crisis. As I could not find this odd occurrence in the literature the only description I have of the fish is "looks like sardine but different in terms of the scales". When I asked the hamlet leader if other climate conditions were off that year he said everything was the same

Table 1. Strategies identified in government institutions and traditional institutions for coastal governance, climate change adaptation, and disaster management.

Agency/Institution	Strategy/Policy	Coastal Ecosystem Management	Climate Change Adaptation	Disaster Management
Fisheries and Maritime Affairs Department	CORE Map (coral reef restoration and protection program)	√	√	√
Fisheries and Social Departments	Alternative Livelihoods (aquaculture)	√	√	√
Fisheries, Infrastructure, and Public Works Departments	Home Construction (earthquake resistant, homes on stilts *rumah panggung*)		√	√
Fisheries and Environmental Protection Agency	Mangrove Planting	√	√	√
Fisheries and Meteorological Agencies	Climate Variability Information (Forecasting)	√	√	√
Fisheries	Turtle Conservation on offshore islands	√	√	
Fisheries	Fisher Education about Hazards	√	√	√
Fisheries	Coral Reef transplanting	√	√	√ (reduces wave abrasion and tsunami impacts)
Parliament, Fisheries, Public Works, District Offices, Planning Department, Water Source Department	Hard Structures (jetties, groins, sea walls)	√	√	√
Fisheries, Environmental Department, Forestry, Social Department	Cemara Laut (Pine species) Planting on the Beach	√	√	√

(**Table 1**. continued)

Agency/Institution	Strategy/Policy	Coastal Ecosystem Management	Climate Change Adaptation	Disaster Management
Forestry	Highland Forest Conservation	√ (reduces sediment impacts to reefs from the slopes)		√
Social Department	Post-Storm Assistance (Money, Food and primary needs, Boats, nets)	√		√
District Government, Social Department, NGOs	Hazard Mapping and Risk Analysis	√	√	√
Village and District level government, LKAAM (Minangkabau Council of Traditional Laws), KAN (state Islamic culture institution)	Nature is your teacher – education in schools and culturally through the community	√	√	√
SATKORLAK (dissolved in August 2009 for new disaster prevention board, BPD)	Intergovernmental coordination			√
Fisheries and Maritime Affairs	Creation of Pok Maswas, Fisheries Society to collect and distribute information and after an event liaise between fishers and government	√		√
Fisheries with assistance of Pok Maswas (Local Fisher Network created by Fisheries Department)	Limit use of small netting or the *bagan* fish capture method use by restricting net distribution to government	√		
Forestry and Agriculture Department	Terracing for shifting cultivation to prevent landslides and soil erosion (makes way via rivers to the sea smothering coral reefs). Pilot programs and public awareness campaign.	√	√	√

except the water was muddy, not the usually blue-green color. November 1997 was marked by a very strong upwelling event that extended from south Java to the equator around mid West Sumatra and lasted until mid 1998 (Hendiarti et al. 2004). This upwelling event was linked to the El Niño/Southern Oscillation (ENSO) and could be the cause of a new fish being found abundantly in the area. Abnormal upwelling events increase the pelagic fish abundance in upwelling regions. Some researchers suggest that with climate change there will be more frequent and perhaps intense ENSO events in the future. Indonesia typically experiences droughts during El Niño events and the one in 1997-1998 caused massive crop failures suggesting that if the predicted trend continues *tani layan* would switch to fishing instead of farming.

My data on existing customary institutions from the coastal Minangkabau does bring into question whether traditional coping mechanisms alone would be sufficient for dealing with more intense climate impacts like sustained sea level rise, stronger storm surges, and fish migrations. However, these strategies could be investigated further using modern science and combined with policy interventions and strategies like those in Table 1 for assisting with future adaptations to anthropogenic climate change.

Conclusions

This research revealed that West Sumatra is responding to climate change even though the terminology "adaptation" is not used by most agencies or government officials. Furthermore, the same institutions responding to climate change are also those working closely on coastal governance and disaster management, affirming the international call for linking these fields and expanding it to also use coastal governance as a possible point of entry. Because formal government institutions and traditional institutions were found to be responding, practitioners and governments working on efforts

Photo 1. Bungus Bay in West Sumatra. Fishermen pulling in nets at sunset for ikan tri. Photo by Kasey Jacobs.

to build coastal resilience might first find out what coping strategies and policies are already in place in a target area before beginning an adaptation program. Resources could be put towards enhancing or expanding current policies and programs instead of creating new "adaptation" programs that could overlap with existing efforts or conflict with traditional practices.

Acknowledgements

This study was made possible by grants from the Tropical Resources Institute at Yale, The Charles K. Kao Fund, Yale Council on Southeast Asian Studies, and the F&ES Globalization Internships and Research Fund. I would like to thank my advisor, Dr. Benjamin Cashore, for his excitement, curiosity, and great advice on my research design. Data collection and informant contact would not have been possible without the assistance of Redian Fikri, Endang Trisna, and Iqual Rama Dipayana. I would like to acknowledge the institutional support from Mercy Corps Indonesia and editorial support from Nathaniel Delafield, Dr. Michael Dove, and Heidi Jump.

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