TROPICAL RESOURCES

The Bulletin of the Yale Tropical Resources Institute

Volume 31, 2012

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Assessing Rainforestation: The Social and Ecological Effects of Smallholder-based Native Species Reforestation in the Philippines

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ABSTRACT

Commercial logging and conversion of degraded forests to agriculture reduced forest cover in the Philippines from 70% to under 3% over the course of the 20th century. Many of these areas were planted with coconut palms and colonized by *Imperata cylindrica* grass, impeding natural regeneration to secondary forest. Consequently, large-scale reforestation efforts since the 1960s have primarily used fast-growing exotic trees to reclaim this forest cover. However, many of these efforts failed due to high tree mortality, low financial returns, and poor understanding of local socio-economic dynamics. In response, Visayas State University and GTZ developed the concept of Rainforestation Farming, a more holistic reforestation method that plants native tree species with crops to combine ecological restoration with improvement of livelihoods and food security. This method was piloted on 28 smallholder sites in the Visayas region between 1995 and 2000. However, no overall assessment has been conducted to date. Our study addresses this gap by assessing Rainforestation through two parameters: performance of planted species, and socio-economic benefits to local community members. Through tree growth measurements and interviews with landowners and project staff we gathered site history data that helped explain the performance of species across sites. Interviews were also conducted in two sites where establishment of Rainforestation demonstration farms was accompanied by formation of Farmers Association. Our study identified several high-performing native tree species, confirming that native tree species can be planted successfully in degraded lands. Long-term socio-economic benefits were realized through pathways different than the one envisioned, such as through formation of social networks rather than through seedling and food production. Community members also highly valued the environmental services provided by Rainforestation, such as watershed protection and disaster risk reduction.

Introduction

In the tropics, reforestation, agro-forestry and forest plantation projects are often dominated by the use of fast-growing exotics at the expense of using native species (Garen et al. 2009: 220). While exotic species can provide high-value timber, they have been found to support lower levels of biodiversity, contribute to

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soil erosion, and provide limited goods and services to landholders (Lamb et al. 2005: 1628). The use of exotic species can also alter ecosystem processes, which poses risks to long-term sustainability because they differ from native species in how they affect watershed systems and processes, fire regimes, and soil respiration (Lamb et al. 2005: 1629).

In the Philippines, the Rainforestation method for reforestation was developed specifically to use indigenous species for the rehabilitation of degraded landscapes while at the same time delivering socio-economic benefits (Milan and Margraf 1994: 10, Milan and Göltenboth 2005: 7). It was first developed in 1992 by Visayas State University (VSU) and the German Agency for Technical Cooperation (GTZ), based on the assumption that farming systems in the humid tropics can be made more sustainable, by approximating the structure and function of humid lowland and upland rainforest. In addition to providing environmental services such as increasing habitat for native plants and animals, restoring site productivity, and protecting watersheds, Rainforestation sought to provide timber, food products, spices, and medicinal plants in order to improve food security and local livelihoods (Milan and Göltenboth 2005: 26). In the pilot phase, native tree species produced in the VSU nursery were planted in 28 Rainforestation sites on the island of Leyte between 1995 and 2000.

Rainforestation addresses a recognized need for more holistic reforestation projects, incorporating plantations, agro-forestry, and native species components. Lamb et al. (2000) investigated the trade-offs between commercial timber production and species richness, and argued that what is needed in the future is a more diverse range of alternatives including plantation systems that yield financial returns plus a degree of biodiversity (Lamb 2000: 217).

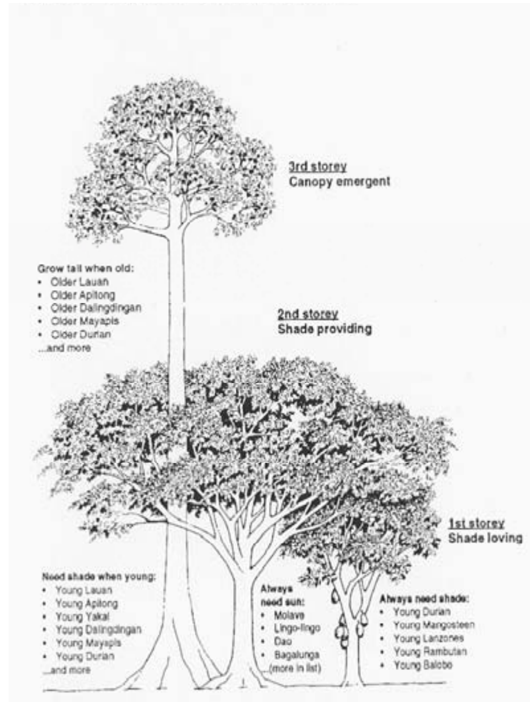

Figure 1. Rainforestation advises inter-planting shade intolerant pioneer tree species at high stocking rates (2 m x 2 m) with shade tolerant tall-growing species (mainly Dipterocarpaceae) as well as economically important fruit trees. Over time, a multi-story structure is created.

Lessons from Rainforestation are relevant given recent developments in the forestry sector of the Philippines. In February 2011, Philippine President Benigno Aquino III issued two new executive orders that banned all logging in natural forests in the Philippines, and mandated that 1.5 million hectares of the country's land area be reforested by 2016 via the establishment of a National Greening Program. Similar declarations have been made in the past in the wake of large natural disasters, yielding disappointing results and mistakes that would be disastrous to see repeated. Large-scale reforestation efforts in the Philippines began in the 1960s, initially through establishment of large-scale monoculture plantations of fast-growing exotic timber species such as *Gmelina arborea* and *Swietenia macrophylla* (Lasco and Pulhin 2006: 49). Between 1960 and 2002, about 1.7 million hectares of land were planted with trees. However, it has been estimated that only 30% of trees planted through these programs survived

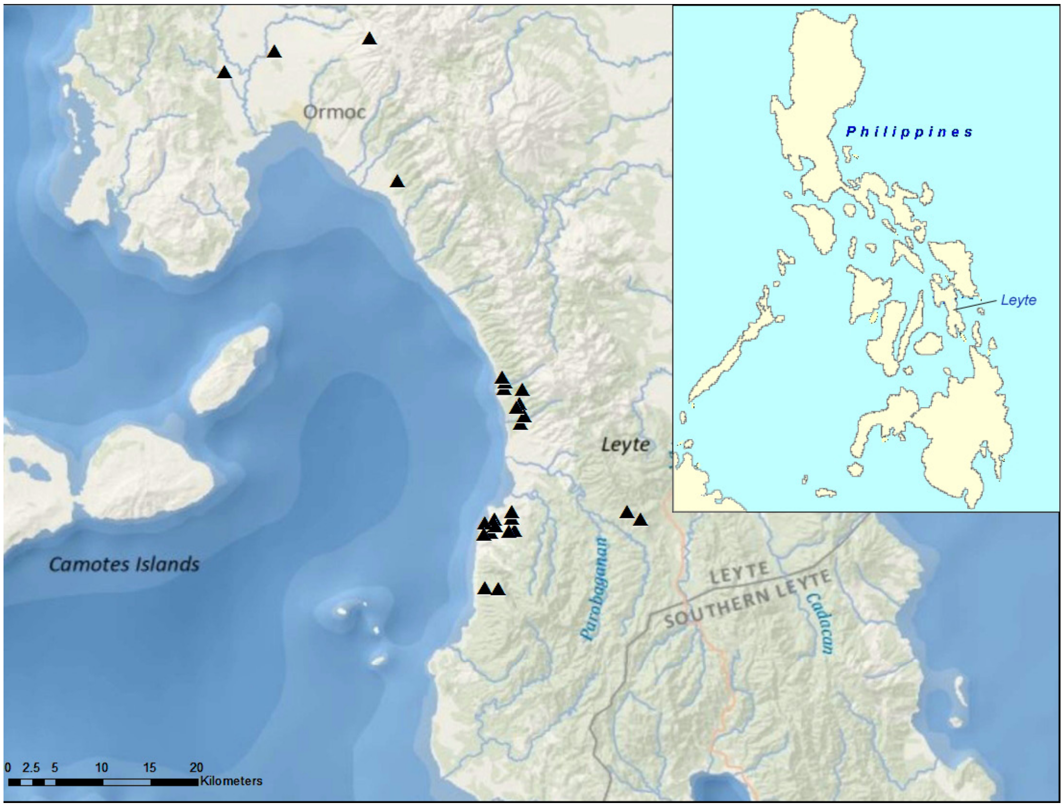

Figure 2. Map of Rainforestation sites, Leyte. The triangles represent study sites where height and diameter measurements were taken on planted trees.

(Lasco and Pulhin 2006: 50), even though more than USD 570 million has been spent on reforestation since the 1970s (Chokkalingam et al. 2006:6). Most efforts failed due to poor site adaptation of exotic species, low financial returns for landowners, failure to monitor or maintain sites over the long-term, and poor understanding of local socio-economic dynamics (Chokkalingam et al. 2006: 3, 43, 115).

Rainforestation can provide a model for alternative forms of reforestation to those employed by large-scale initiatives such as the National Greening Program. Although recent studies have examined various ecophysiological aspects of planted sites (Dierick and Hölscher 2009: 1317; Sales-Come and Hölscher 2010: 846; Navarrete et al. 2010: 289), none evaluating overall plantation success and growth performance have been conducted to date. This study assessed Rainforestation through two parameters: (1) performance of planted species; and (2) socio-economic benefits to local farmers. It fills several gaps in the literature, such as the need for data to address claims that native species grow too slowly or are prohibitively difficult to propagate in nurseries (Garen et al. 2009: 233). Furthermore, in SE Asia, the habitat ranges of native tree species in lowland dipterocarp forests are poorly understood in many locations, and more work is needed to determine species-site interactions and site requirements for long-term sustainability of reforestation efforts (Langenberger 2006: 155, Kettle 2010: 1144). This study endeavors to shed light on these issues and provide recommendations to aid the scaling up of Rainforestation in the future.

Background: Site description

Introduction to Leyte

The island of Leyte is the eighth largest island in the Philippine archipelago, with a population of approximately 1.72 million as of (NSO 2007). In 1972, 87% of the island was

Table 1. Comparison Between Two Case-Study Communities

	Community 1	Community 2
Forest Area	2,236 ha	582 ha
Tenure Status	Community-based Forest Management Agreement	Watershed Reserve Forest (Government Ownership)
Level of Organization	High. Active since 1997	Low. Re-organized in 2008
Total Members	113	63
Active Members	43	21
Threats motivating organization	Illegal logging, mining	Loss of water rights
Receiving outside funding for projects?	Yes	No
Alternative income sources	Seedling production and project activities	Employment outside community

covered by lowland dipterocarp forest. As of 1990, forest cover had declined to 12.1% due to industrial logging operations, illegal logging, and conversion of forest land to agriculture, and coconut and abaca (*Musa textilis*) plantations (Groetschel et al. 2001: 10). Most of the population are subsistence farmers, and the major crops grown are coconut, rice, abaca, sugarcane, banana, sweet potato, and maize, with coconut oil as the main commodity export.

Rainforestation site descriptions

Management regimes of the early Rainforestation sites fell into three categories easily typified according to the identity of the landowner: smallholders (n=22), experts with high education levels (n=2), and communities (n=2). The smallholder group included 11 sites with very low survival rates of planted trees, due to escaped fires, flooding, trampling by livestock, or neglect due to emigration or death of the landowner. Management intensity varied across all sites, with some sites weeded and monitored frequently. Two communities received technical assistance and financial support to develop native species nurseries and demonstration farms. Privately owned sites were leased to the community Farmers Association with divided revenues (owner-25%, association-75%).

These two communities have been involved with over two decades of forest rehabilitation activities, beginning in the late 1980s. The time that has passed has allowed ample opportunities to observe the relative success of the projects and their cumulative impacts on the individuals and communities involved (Table 1).

Methods

Performance of planted species

Planted trees and relevant site characteristics (elevation, slope, and aspect) were measured across 25 sites. Total height, and diameter at 1.4 m (diameter at breast height - DBH) of the trees were recorded, and height and straightness of the trunk were visually estimated.

Socio-economic benefits to local farmers

Sixty-two farmers were interviewed, as well as 12 individual landowners and 10 key informants from academia, national NGOs, and local government. The community interviews targeted members of the local farmers associations that were first established by the Rainforestation and the GTZ project. The sample consisted of men, women, youth, senior citizens, and both active and inactive members. Interviews focused on: (1) involvement with reforestation, (2) historical forest management, (3) livelihoods and property rights, and (4) household demographics.

Data was also gathered through active participant observation related to the two communities' efforts to get involved with the national government's National Greening Program. The local farmers engaged in activities every day, in the form of voluntary work known as *pintakasi*,

Table 2. Growth rates across the 25 rainforestation sites assessed.

Site	Size (ha)	Soil Type	Mean DBH (cm)	MAI DBH (cm/yr)	Mean Height (m)	MAI Height (m/yr)
1	0.25	Limestone	14.31	0.95	11.54	0.77
2	1	Volcanic	8.8	0.59	11.61	0.77
3	0.97	Volcanic	5.95	0.4	8.17	0.54
4	1	Volcanic	14.91	1.15	14.86	1.14
5	0.41	Limestone	22.93	1.53	17.77	1.18
6	0.38	Limestone	17.58	1.26	10.82	0.77
7	0.95	Limestone	11.81	0.79	11.71	0.78
8	0.43	Limestone	26.61	1.77	18.48	1.23
9	0.61	Volcanic	15.2	1	12.16	0.76
10	0.34	Volcanic	7.79	0.52	9.38	0.63
11	0.9	Limestone	11.11	0.74	11.6	0.77
12	0.87	Limestone	11.54	0.77	9.38	0.63
13	1.33	Volcanic	12.28	0.82	9.16	0.61
14	0.8	Volcanic	17.38	1.34	11.34	0.87
15	0.99	Limestone	22.61	1.51	16.45	1.1
16	3.37	Volcanic	7.49	0.47	9.53	0.6
17	0.59	Volcanic	16.37	1.09	14.32	0.95
18	0.7	Limestone	14.89	1.35	12.99	1.18
19	0.47	Limestone	20.41	1.36	15.58	1.04
20	0.48	Limestone	15.99	1.07	13.82	0.92
21	3.1	Limestone	5.83	0.73	10.56	1.32
22	1.8	Limestone	17.79	1.19	16.24	1.08
23	0.44	Volcanic	17	1.06	13.61	0.85
24	3.22	Volcanic	10.67	0.67	11.43	0.71
25	1	Volcanic	9.36	0.72	12.44	0.96

during which they constructed new nurseries, repaired structures, and collected and bagged seedlings. Data was also collected while observing regular stakeholder meetings, board meetings, and training events on dendrology and environmental advocacy.

Growth Rate Findings

We measured 2,858 live trees from 93 different species across 25 of the 28 sites established between 1995 and 2000. For each site, the mean annual increment (MAI) in DBH and height for all trees was calculated, with MAI for DBH ranging from 0.4 cm/year for site 3, to 1.77 cm/year for site 8, and MAI for height ranging from 0.54 m/year for site 3, to 1.32 m/year for site 21 (Table 2). For the 2,282 individuals of the 30 most frequently planted species (of which more than 20 individuals were measured across all 25 sites), MAI for DBH ranged from 1.89 cm/year for *Melia dubia*, to 0.27 cm/year for *Garcinia mangostana*. MAI for height ranged from 1.31 m/year for *Melia dubia*, to 0.33 m/year for *Garcinia mangostana*.

It should be noted that all trees were planted together in degraded areas after site preparation in the same year. Survival rates for the Rainforestation sites were high for both pioneer and dipterocarp species, which indicates that the widely held belief that dipterocarp seedlings cannot be planted in open areas should be reexamined.

The 25 sites visited showed a very high diversity in species composition, with only few sites overlapping in species composition, making robust statistical comparison of growth rates across sites difficult. However, the extensive ranges among sites and species suggest that factors such as soil quality and management through weeding and monitoring affected species performance across sites.

Socio-economic Findings

The second component of this study sought to explore the complex social context influencing the relationship between two local communities and Rainforestation by examining whether the advertised socio-economic benefits had materialized for community members. This is especially important in the Philippines, where an estimated 20 million people live in the uplands, half of whom are believed to be solely dependent on forest resources for their livelihood (FMB 2009). Many reforestation projects have failed due to improper alignment with local socio-economic conditions, and several scholars have argued that new opportunities and insights emerge when initial steps are taken to understand farmers' needs and interests when designing reforestation programs (Dove 1992: 13).

Our study found that the direct economic benefits of the Rainforestation site and nursery seedling revenues were minimal to farmers' association members. No revenues from timber in the demonstration farms have been realized; and after 16 years none of the fruit trees were producing fruit. Although one community averaged $2015/yr in seedling sales between 1998 and 2010 (CSVFA 2011), distribution of this income did not follow the benefit sharing arrangement dictated by the Rainforestation methodology. According to the Rainforestation manual, farmers association members would record the number of hours spent working on association activities, and receive a portion of seedling revenues directly proportional to their labor. However, farmers' association members in both communities could recall few instances in which income from seedling sales was directly distributed to association members.

However, the single most influential impact of Rainforestation was its catalytic role in organizing farmers associations that were able to receive official accreditation as Peoples' Organizations (PO). In the Philippines, POs can receive external funding from the government, NGOs, and other funders to implement local development projects. For example, the PO in one community was able to secure tenure over their 2,236 ha forest by applying for a Community-based Forest Management Agreement. With this official tenure, they have attracted a number of forest restoration, conservation, and agro-forestry projects over the past decade. These projects created several pathways to realize economic benefits; among them:

(1) Project budgets financed daily wage labor for nursery activities, which benefited both association members and relatives with certain skills (carpentry) or assets (vehicles).

(2) When projects included tree-planting components including funding for fruit trees and commercially valuable native timber species, association members were able to advocate for these project activities to be located on their own 'areas,' informally claimed individual parcels of land within the CBFMA area.

(3) Project implementation contributed to the cohesion of the farmers associations in both communities, maintaining a network that helped to distribute resources amongst farmers.

Analysis

Although Rainforestation has not yet significantly scaled-up throughout the Philippines, the method's ideology of native species-based reforestation has had a lasting legacy. After 16 years, Rainforestation had only been used to reforest a total area of 183 ha across the Philippines; on Leyte, the total area barely exceeds 20 ha (Milan 2010: 27). This is partially because Rainforestation was originally designed for smallholders, to rehabilitate swiddens only a few hectares in size. However, it has evolved beyond this original smallholder-based model to the point where it has been adopted by prominent Filipino environmental NGOs to restore habitat in large-scale biodiversity conservation projects. In 2004, the Department of Environment and Natural Resources (DENR) adopted it as one of the official reforestation strategies of the Philippines and issued guidelines for its use in an official memorandum (DENR MC 2004-06). Rainforestation has thus successfully challenged the entrenched government paradigm that it is impossible to raise native dipterocarp seedlings or reforest using native species. Our data support this, in providing evidence of long-term survival and growth rates of planted dipterocarps and other native species. It also falls in line with the observations of one community leader, who stated, "Any species will not survive if you don't plant it."

Conclusion

In response to increasing awareness of the importance of undertaking reforestation efforts using native species and involving local communities in planting and stewardship, Rainforestation aims to improve local livelihoods, as well as restore forest cover in the Philippines. Our research confirms that dipterocarps and other shade-tolerant species can successfully be used to restore degraded lands in the Philippines. Dipterocarp species showed high growth rates even when planted in open areas. While more analysis is needed to compare species of interest across different soil types, future reforestation efforts should not solely focus on fast-growing pioneer species, such as *Melia dubia*, which often are characterized by light wood that is less valuable in lumber markets. Also, trunk straightness in several of the fast-growing species was often poor, and trunk form could be improved through higher intensity silvicultural prescriptions, such as thinning and pruning. However, the additional permits required by the logging ban for harvesting timber may be a disincentive for smallholder reforestation projects.

Our assessment of this method shows that while economic motivation remains a strong driving force for smallholder reforestation and communities, timber and fruit harvests and seedling sales did not prove to be a significant source of earned income for farmers' association members. However, other forms of economic benefits were realized through paid labor for planting projects. Several smallholders have also begun extracting timber from their sites for house construction or have harvested pole-sized trees for their own use. In contrast, landowners and community members assigned high importance to the non-economic benefits, including environmental services (watershed protection and reducing the risk from natural disasters, e.g. landslides and floods). Rainforestation sites also symbolized the community's accomplishments, providing a sense of achievement and a rallying point for community cohesion and engagement in conservation activities.

ACKNOWLEDGMENTS

This research would not have been possible without support from Dr. Paciencia Milan at Visayas State University, VSU's Institute for Tropical Ecology, the Cienda-San Vicente Farmers Association, the Patag-Gabas-Guadalupe Farmers Association, and Dr. David Neidel and Ms. Hazel Consunji of the Environmental Leadership and Training Initiative (ELTI). We would like to thank our advisors, Dr. Florencia Montagnini, Dr. Mark Ashton, and Dr. Amity Doolittle, and our funding sources: the Tropical Resources Institute, the Council on Southeast Asia Studies, the Program on Agrarian Studies, and the Charles Kao Fund.

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Announcing the 2012 Fellows

TRI Endowment Fellowships are designed to support Masters and Doctoral students who conduct independent research in tropical countries. This year 30 students received TRI Fellowships for summer research. The 2011 recipients and the countries where they conducted research are:

Ellen Arnstein	Bolivia
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Jorge Barbosa	Ecuador/Brazil
Jeffrey Chow	El Salvador
Luisa Cortesi	India
Liliana Dávila Stern	Vanuatu/Nauru
Guilherme DePaula	Brazil
Julia Fogerite	Indonesia
Ankur Garg	Kenya
Jessica Gordon	China
Anobha Gurung	Nepal
Angel Hertslet	Haiti
Daniel Hoshizaki	Japan
Jasmine Hyman	Cambodia/Laos/Vietnam
Thomas James	Mongolia
Ambika Khadka	China
Bassem Khalifa	Kenya
Andrew Lerer	Argentina
Vrinda Manglik	Peru
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Adina Matisoff	Peru
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Jennifer Miller	India
Thomas Owens	Brazil
Pablo Peña	Costa Rica/Peru
Erin Raboin	Panama
Alark Saxena	India
Sumana Serchan	Nepal
Chris Shughrue	India
Jeffrey Stoike	Brazil
Angela Whitney	Philippines

The Andrew Sabin International Environmental Fellowships support the education and training of international students from less-developed countries, who intend to return to their home region or country to work in the field of conservation and development. This year's recipients and their home countries are:

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Bunyod Holmatov	Uzbekistan
Vijeta Jangra	India
Ambika Khadka	Nepal
Aparna Mani	India
José Medina Mora de León	Mexico
Pablo Peña	Peru
Lucia Ruíz Bustos	Mexico
Sumana Serchan	Nepal
Wen Wang	China