Sustainable Woodfuel Production in Latin America
The role of Government and Society

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List of translated acronyms

ABC - Brazilian International Cooperating Agency
ABRAF - Brazilian Association of Forest Plantations Producers
ABC - Brazilian International Cooperating Agency
ABRAF - Brazilian Association of Forest Plantations Producers
ALBA - Bolivarian Alternative for the People of Our Latin America
APROPRES - Forest Replacement Association of San Rafael del Sur
ARCE SAN BENITO - Forest Replacement Association and Commercialization of Forest Products San Benito
ARFLOR - Regional Forest Replacement Association of São Sebastião do Caí, Rio Grande do Sul (Brazil)
ASEROFOR - Forest Replacement Association and Commercialization of Tiles and Bricks of La Paz Centro
ASIFLOR - Steel Industry Association for Forest Promotion
BNDES - National Bank for Social Development (Brazil)
CDM - Clean Development Mechanism
CNE - National Energy Commission
CORFOP - Peoples Forest Corporation (Nicaragua)
DEPRN - State Service for Natural Renewable Resources Protection
ECO-CARBON - Forest Replacement Association and Commercialization of Charcoal of Nagarote Municipality
EMATER - State Institute of Technical Assistance and Extension
EMBRAPA - Brazilian Agricultural Research Institute
FARERGS - Confederation of Forest Replacement Associations of Rio Grande do Sul State
FARESP - Confederation of Forest Replacement Associations of São Paulo State
FEHIDRO - National Funds for Hydro Resources
FRA - Forest Replacement Associations
FUNDENIC - Nicaraguan Foundation for Sustainable Development
HDI - Human Development Index
IAP - Environmental Institute of Paraná State
IBAMA - Brazilian Institute of Environment and Natural Resources
IEF - State Forestry Institute (Minas Gerais)
INAFOR - National Forest Institute (Nicaragua)
IPEF - Forest Research Institute (São Paulo University)
MAGFOR - Ministry of Agriculture and Forest (Nicaragua)
MCA - Millennium Challenge Account (US Government program)
MEM - Ministry of Energy and Mines (Nicaragua)

NFCP - The New Frontiers of Cooperative Program
PRONAF - Family Farming National Program
RS - Rio Grande do Sul State
SP - São Paulo State
SEAB - Food Supply State Secretariat
SERFLOR -Compulsory Forest Replacement System
SFM - Sustainable Forest Management
SMA - State Secretariat of Environment of São Paulo
TEP- Tons equivalent petroleum
TFP - Tree Farming Program
TWP - Trees, Water and People
USP - São Paulo State University

I. Preface

Across the globe, of every 100 hectares of forest lost between the years 2000 and 2005, nearly 65 were in Latin America and the Caribbean. During this period, the proportion of total land surface covered by natural forests in the Mesoamerica region (southern Mexico and Central America) fell from 36.9 to 35.8 percent and in South America from 48.4 to 47.2 percent (Ceballos 2009). Two of the primary causes of similar trends were described earlier by Myers (1984) and Ceccon and Miramontes (1999) as changes in demographic and related cultivation patterns which converted tropical forest to pasture (particularly in Brazil) and the increasing demand for forest products, especially for exportation. In recent years, substantive measures designed to reverse deforestation have been introduced in several Latin American countries, largely motivated by increasing bottom-up pressure from environmental and other social groups, and growing urgency around climate change. Protection of forest resources has risen to be among the top priorities for all regional stakeholders, from political parties to civil society organizations and private companies (Rodriguez 1998, Reed 2001).

At the same time, consumption of forest products, especially woodfuels, is an important part of the economy in Latin America. Woodfuels are widely used as a primary energy source by small businesses and residences, especially in rural areas. In Brazil, woodfuels represented 13% of all energy produced in 2004 (42% as charcoal; MEM 2005), while in Nicaragua woodfuels represented 42% of domestic energy in 2005 (1.2% as charcoal; MEM 2009).

The challenges of balancing between preservation of natural resources and economic imperatives which require the use of forest resources are not new. As environmental protection rises in importance, the region must find sustainable methods of using forest resources, including the production of woodfuel for existing and future consumers. In Brazil, a variety of forms of sustainable forest management (SFM) have been implemented. For example, forest replacement programs located on small and medium farms have been supported by governments, the private sector and civil society (Miranda 1998, Miranda 2000, Miranda et al. 2003, Ceccon and Miramontes 2008).

A particularly interesting regional trend is the proliferation of woodfuel consumer associations, created in Brazil at the end of the 1980s and subsequently copied in Nicaragua. These groups, which bring together small-scale wood consumers and producers, are known as Forest Replacement Associations (FRA). The region's FRAs are active and some have been in operation for years, but they have encountered varying degrees of success due to differences in state-level regulation, enforcement and other local issues.

The FRA model merits an in-depth analysis to explore the potential of such organizations as an important method of sustainable forest use. This paper reviews existing

practices, as well as the potential for improvement and replication. The book provides analysis and detailed studies on several FRAs in Brazil and Nicaragua, and concludes with recommendation on how to strengthen existing organizations so that they better serve local consumers while protecting local resources, and so that they may act as a model for other countries within the region. Other models of sustanable woodfuel production promoted by the government and private enterprises are also evaluated in Parana and Minas Gerais States, in Brazil.

The main objectives of this study are: i) to extensively review the experiences of FRAs in selected cases within Brazil and Nicaragua, including existing literature and field visits; ii) to extract the lessons learned and challenges in the application and implementation of FRAs and others government-based sustainable forestry strategies; and iii) to identify the principles for successful replication of these strategies elsewhere.

II. Methodology of the study

An extensive literature review on the current state of FRAs was carried out, focusing specifically on Brazil and Nicaragua. Key actors in both countries were identified and contacted. Preliminary phone interviews were conducted, and some interviews with government officials were conducted via email.

Site visits were made in both countries to analyze current operations and management practices at both operational and non-operational FRAs. Semi-structured personal interviews were conducted during site visits with staff of FRAs, participating farmers, and end consumers of wood. Government officials and local NGOs were also included in interviews (mainly to evaluate the cases in Paraná and Minas Gerais states).

Details of site visits, including the particulars of management, operations and production of each FRA, are included in Annex 1. Several photos of individual FRA operations are also included. A list of stakeholders interviewed in both countries appears in Annex 2, and the contact information of FRAs associated within the Federation of FRAs in São Paulo state (FARESP) appears in Annex 3. Some of the information published here is based on a previously published ESMAP-World Bank report[1].

[1]R.C. de Miranda, S. Sepp, E. Ceccon, S. Mann & B. Singh. Sustainable Production of Commercial Woodfuel: Lessons and Guidance from Two Strategies. The World Bank Group, Washington D.C. 2010.

III. Brazil

Background

Woodfuel has been a primary source of energy in Brazil for centuries (the administrative division of Brazil in Regions and States is shown in Figure 1). A 1941 analysis of energy use found that 75% of the energy consumed within the country was generated by burning woodfuel (Suffert et al. 2007). Although between 1970 and 1990 the relative proportion of wood fuel in domestic energy consumption declined, in 2007 the woodfuel consumption was 16.672 million tons equivalent in petroleum [TEP] and 1.6% more than 2006. Nowadays, 8.3% of energy consumed in this country came from woodfuel (Balanço Energetico Nacional 2008). Until the 20th century, wood was traditionally harvested for energy without significant regard for protection of the forest or replacement of the resource.

Protection and conservation of natural resources became a focus of public policy for the first time in Brazil during the period of military governments in the 1960s. During this time, several important new laws were introduced, including the Statute of the Land (Law No. 4504 of 1964), the new Forest Code (Law No. 4771 of 1965), the Law for the Protection of Fauna (Law No. 5197 of 1967), the Fisheries Code (Decree-Law No. 221), and the Mining Code (Decree-Law No 227). In addition, the Brazilian Institute for Forestry Development (IBDF) was established in 1967, with explicit responsibility to enforce both the Forest Code and the Law for the Protection of Fauna. Indigenous reservations were established and National Parks and Biological Reserves were also created in 1967 (Oliveira 2009)[2].

In 1965, forest tax incentive policies were introduced in Brazil, designed to encourage investments in forest plantations by private companies that consumed forest products and that were also obligated to undertake forest replacement (4.771/65 law; Antonângelo and Bacha 1998). These policies made it possible for larger investors to deduct up to 50% of their tax liability for investments in reforestation, after the application of capital.

In 1970 tax policies were expanded to allow even more generous deductions. The FISET (Fundo de Investimento Setorial - Sectoral Investment Fund) was created in 1974, which made it possible for companies to establish large-scale forest plantations and take advantage of the ability to drastically lower their taxes by deducting expenses that were

[2]As 2012 the new Forest Code remains a controvertial matter for environmentalists and agriculturalists as it is beign under discussion at the Brazilian legislative house. The farm lobby campaigned for changes to the forest code, including amnesty for farmers who had cleared land illegally. Environmental groups are not happy with the Senate proposal, which would weaken protections for streams and hillsides. The discussion is not finished yet.

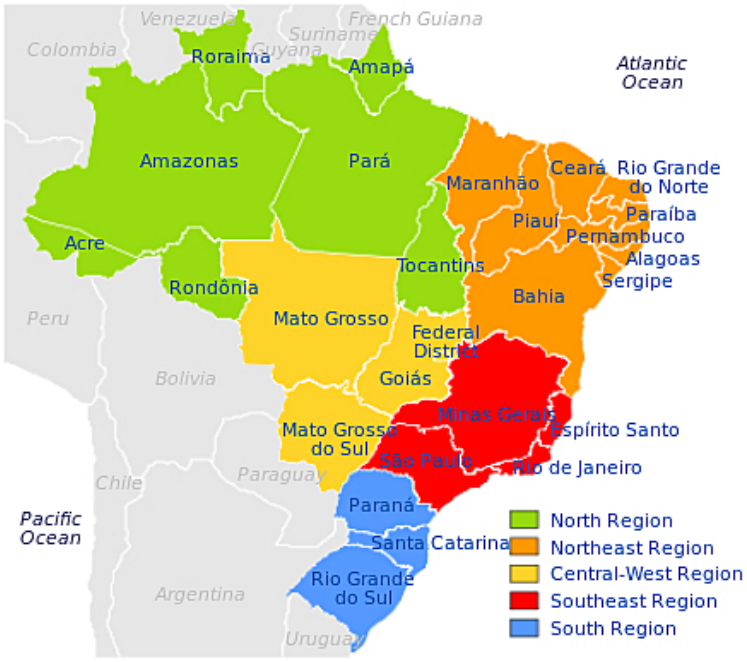

Figure 1: Political map of Brazil showing states and regions. Source: Wikimedia, 2009

used for reforestation (Juvenal and Mattos 2002). These policies were in force between 1965 and 1988, and had the effect of stimulating a significant increase in reforested areas, from 470,000 ha in 1965 to 6 million ha in 1987 (Antonângelo and Bacha 1998).

Institutions that Support the Forestry Sector in Brazil

Beginning decades ago, Brazilian federal and state governments initiated the promotion of forest sciences and technology by creating key institutions. In 1960, the first National College of Forestry was established in Minas Gerais. In 1973, the first M.S. degree program in forest engineering was created; in 1982 the first PhD program appeared. Today, there are 48 forest engineering colleges in Brazil (Lima, 2008). Also, in the late 1960s, the three most important forest engineering colleges established their respective forest research institutes, which are IPEF- Institute of Forestry Research and Studies, founded in 1968 by Luis de Queiróz Agriculture College (ESALQ) in São Paulo, FUPEF - Foundation for Forest Research of Paraná, founded in 1971 by Paraná Federal University (UFPR) in Paraná and SIF- Forestry Research Society, founded in 1974 by Viçosa Federal University (UFV) in Minas Gerais. These forest research institutes are nonprofit civil associations that have partnership with and are partially supported by forest product companies.

In addition, the federal government established the first National Program of Forest Research (PNPF) in the EMBRAPA (Brazilian Agricultural Research Corporation) in 1978. The PNPF was established in agreement with the IBDF (Brazilian Institute of Forest Development) and with the support of SBS (Brazilian Society of Silviculture; EMBRAPA-FLORESTAS, 2009).

Along with the increase in planted forest areas, technology was also advancing thanks to the forest research institutes that received financial support from the steel, and pulp and paper industries. One example is the significant increase in productivity of *Eucalyptus* plantations (Figure 2), the result of investments in genetic improvements, tree nurseries, silviculture techniques, and more recently to cloning of high productive trees. These advancements greatly contributed to Brazil's current leadership in forest technology as applied to *Eucalyptus* genus.

However, the tax incentives ended in 1988, while wood demand increased and the expansion of planted forests stagnated during the 1990s. In 2000, a new National Forest Program (NFP) was created, designed to stimulate the sustainable use of native forests and plantations, and to promote new reforestation activities. Among the objectives of NFP were i) the establishment of low-interest credit that farmers could use to finance the planting of trees on their land; ii) support for the development of sustainable forest-based

industries through technical assistance to and training of small farmers; iii) dissemination of information and research on forest plantations; and iv) monitoring and control of forest programs (Programa Nacional de Florestas 2009).

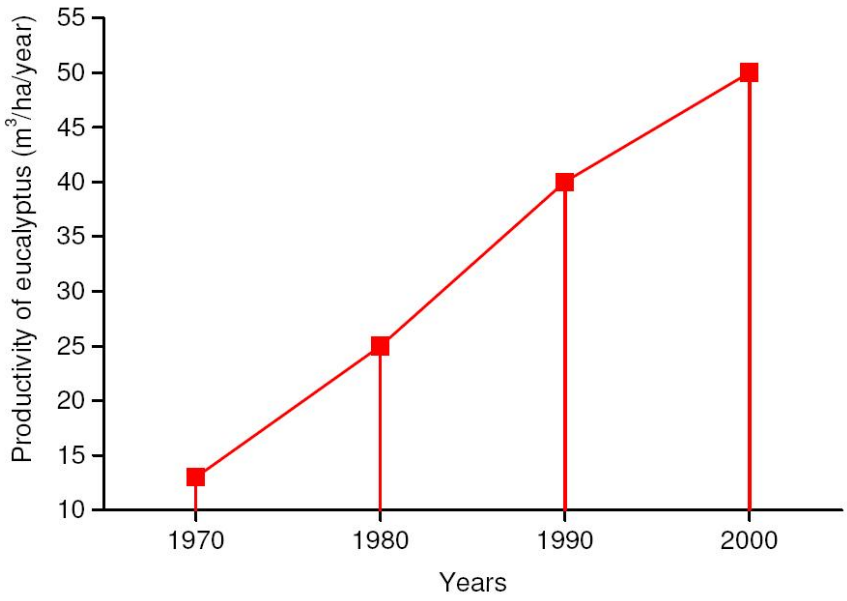

Figure 2: Productivity in *Eucalyptus* plantations in Brazil between 1970–2000. Data source: SBS 2004.

In the opinion of the Brazilian Association of Forest Plantations Producers (ABRAF), Brazil is recently experiencing a new expansion cycle of forestry-based projects. The main factors driving this expansion are the increase in demand for forest products, more attractive prices of some forest products, and the competitive and comparative advantages of the forest sector. The latter are primarily the result of intensive research and development in forestry science and the resulting improvement in forest productivity, advances that mainly benefit the pulp and paper and charcoal industries (ABRAF 2008).

Despite this progress, recent data projects the current overall demand for wood in Brazil to be 350 million m^3/year, and that the country's planted forests are able to supply only about 90 million m^3/year. Clearly, without a more aggressive reforestation program and sustainable forest management, pressure on remaining native forests will be strong (Portal REMADE 2009).

Brazil's Tree Farming Programs

One of the main pillars of sustainable forest management in Brazil is the Tree Farming Program (Fomento Florestal in Portuguese), developed by NGOs, industries and government. Tree Farming Programs (TFP) promote tree planting on small and medium size farms, and are designed to increase the supply of sustainable wood for local and regional industries (avoiding the high cost of transport and land acquisition that industries must pay), and as well for self-supply of the farmers (Ladeira 1992, Sungsumarn 1993). Minas Gerais was the first state in Brazil to implement TFP. According to Neves (1997) it was in 1958 in the city of Paraopeba where the very first partnership program was initiated, integrating institutions of the state, municipalities and unions in forest replacement efforts with local small farmers.

On a global scale, the TFP program is expected to increase carbon sequestration associated with tree plantations. For this reason, TFP was designated a priority program by ABRAF [3] in 2006.

Large wood consumers and TFP

Larger industrial consumers of *Eucalyptus* wood, primarily the pulp and paper and steel and pig iron industries (use charcoal[4]), are obligated by law to guarantee their own sustainable supply of wood. The industries usually fulfill this obligation by managing their own wood plantations and sometimes, by negotiating to buy their supply from a third party that can certify sustainable growing practices. However, in the past 20 years these industries have come under increasing pressure from environmental organizations over the industries tendency to grow large, single-species *Eucalyptus* plantations for their wood supply. Environmentalists call such plantations green deserts, claiming they are detrimental to the country's biodiversity. For this reason, and also to reduce the costs of wood supply, many of the industries have embraced TFP (Ceccon 1999, Ceccon and Miramontes 2008).

Under the TFP, private companies that are consumers of wood form partnerships with small farms located near their business operations. Farmers provide the land and the workforce, while the companies provide key inputs such as high quality tree seedlings, fertilizers and technical assistance. After five to seven years of growth, approximately one-third of the harvested wood goes to the partner company as repayment

[3] ABRAF represents, promotes and defends the collective interests of associated companies, and publishes an annual Statistical Year Book about the country's forest sector.

[4] Brazil is the only country in the world that has a large steel industry that uses wood charcoal in addition to carbon coke (ABRAF, 2006).

for the inputs, while the farmer can sell the remaining wood in the local market (after granting first refusal rights to the company), or keep it for himself (Ceccon, 1999). In Brazil, TFP has had a remarkable effect on the production of exotic tree species (mostly *Eucalyptus* and *Pinus* genus). In 2002, small and medium farmers owned only 7% of all reforested areas that contained exotic species, while in 2005 the figure jumped to about 23%, for a total of 5.5 million hectares (Almeida 2006),

There are many advantages of the private TFPs for farmers, according to Scherr et al. (2004) and Ceccon and Miramontes (2008):

- A new source of income through diversified farming activities
- High quality seedlings
- Quality control by the partner company throughout the planting and growing cycles
- Possibility of using part of the wood produced for self-consumption
- Technical assistance and knowledge gain
- Guaranteed market for the wood produced
- Possibility to intercrop the forest plantations with food crops

The main advantages of the TFPs for private companies are (Capitani et al. 1992, Ceccon and Miramontes, 2008):

- Reduction in wood production costs
- Reduction of budgets for land acquisition, infrastructure and staff
- Compliance with environmental and forest regulations by consuming sustainable wood
- Positive image among environmental NGOs and public opinion by promoting smaller *Eucalyptus* plantations and supplementing the incomes of local farmers

Federal Government and TFP. There are more than 4 million small farms scattered across Brazil, and family farms are quite productive, contributing 40% of the country's gross value of agricultural production (Rosseto 2009). The federal government currently supports two types of TFP which provide low-interest loans to farmers to encourage forest activities: PRONAF-Forest and PROPFLORA. Both programs are primarily attractive to

farmers who have no other active TFP in their area, since other TFPs (those run by FRAs, the private sector or even state governments) usually provide the incentives (seedlings and technical assistance) for free or only with the requirement of partial payment of harvested wood.

Brazilian Forest Production Credits

PRONAF-Forest (Family Farm Credit; established in 2003). PRONAF financing ranges from US$430 (exchange rate of R$2.286 per US$) to US$43,000 per farm and is divided into two types. The cost type PRONAF-Forest loan can be used for annual farm activities in the forest, agriculture and livestock areas, with interest from 1.5% to 5.5% per year. The investment type PRONAF-Forest loan aimed at improving farm infrastructure, with interest from 1% to 5% per year (Rosseto 2009). Almost all of the small farmers interviewed during this study have this kind of financing for agriculture activities.

PROPFLORA (Commercial Plantation Program and Restoration of Forests; established in 2003) focuses on the development of silvi-pastoral (trees associated with livestock) and agroforestry (trees associated with other crops) practices and the ecological restoration of conservation areas (mainly riparian zones) and legal reserves (Brazil's Forest Code of 1965 requires that a minimum of 20% of the country's land surface be protected as legal reserves). PROPFLORA loans range as high as US$87,355 per client (a person, a cooperative or association; Banco Central 2009) and carry an annual interest rate of 6.75%. Interest rates in both programs are very low when compared with those applied to personal loans in Brazil (ranging from 20% to 92% per year; BNDES 2009).

Small consumers of wood and the Forest Replacement Associations

Forest Replacement Associations (FRA) were originally created in the mid-1980s in the state of São Paulo by small industrial and commercial consumers of woodfuel to en-

gage in TFP. At that time, small consumers[5] were not required to undertake reforestation themselves, but instead could pay a forest replacement tax (a varying amount based on wood consumed) to the Brazilian Institute of Environment and Natural Resources (IBAMA), the Federal agency designated as responsible for forest replacement activities. However, forest replacement (TFP) was slowly or only minimally implemented by IBAMA, while woodfuel for consumers became ever more scarce and expensive. Unhappy with the situation, in 1985 a group of brick and tile producers initiated a movement to replace IBAMA as the collector of the Forest Replacement Tax. The group created a woodfuel consumers association and began collecting the taxes from its associates - although they had no legal authority to do so - and used the money to run a TFP. The FRA movement was born.

From 1985 to 1995 other associations of woodfuel consumers copied the FRA model, all rejecting the official mandate of IBAMA. During that time, thirteen FRAs were created and more than 20,000 ha of woodfuel plantations were established, involving more than 3000 farmers and supplying wood to thousands of small industries throughout the State of São Paulo (Miranda, 1998).

However, the state's Environmental Secretary (SMA) and the IBAMA held conflicting views about the future and role of FRAs, and disagreed over the legal right of FRAs to operate within the state. In 1990, the IBAMA held the view that FRA operations violated federal law, and began an investigation which temporarily halted FRA activities for four years until the São Paulo State Department for the Protection of Natural Resources (DPRN) officially recognized the associations. It was not until 2001 that the state government established Law 10.780 that made forest replacement compulsory for wood consumers and enabled FRA operations. Regulations were not issued until seven years after that (December 2008).

In 1997, after observing the scope of reforestation achieved by FRAs in São Paulo, especially among small farmers, the Ministry of Agriculture's New Frontiers of Cooperative Program (PNFC) joined with the United Nations Development Program to promote and stimulate the creation of FRAs throughout Brazil. In addition to organizing conferences and workshops promoting the potential of FRAs, the PNFC distributed kits with information on how to create an association and how to build a nursery for seedlings The success of the expansion efforts was impressive: by 2000, there were a total of 17 FRAs in São Paulo, 21 FRAs in Rio Grande do Sul, four in Bahia, three in Mato Grosso and seven in other states (Lima and Bajay 2000).

[5]Companies that consume less than 20.000 stereo per year of wood (one stereo is a stack of round wood with 1 meter high, 1 meter length and 1 meter width, which is approximately 2/3 of a cubic meter) or 8.000 mdc (meters of charcoal) per year.

FRA Structure and Activities (Figure 3). All FRAs in Brazil are organized in a similar manner. For each cubic meter of stacked wood consumed by industry, the consuming entity must pay for the replanting of five trees. The average cost is about US$0.75 per tree, paid to local FRAs who do the actual reforesting (raising the seedlings and providing technical assistance to farmers). The farmers receive free high quality seedlings and technical assistance for a period of five years. During plantation start-up, farmers receive approximately four initial visits by an FRA forester; after that, farmers are visited once per year. FRA contracts require farmers to follow explicit technical guidance on issues such as plant spacing, tillage, the use of fertilizers and pesticides, and maintenance of the plantation. Sales revenue from harvesting the timber belongs exclusively to the farmer, without any obligation or royalties owed to the FRA. However, in case of violation of the contract terms (such as failure to follow technical guidance, negligence or dishonesty) the farmer must repay the value of the investment made by the FRA in technical assistance, administration and seedling production (State Secretary of Environment of São Paulo Ordinance; SMA 2008).

FRAs often maintain significant relationships with other organizations and institutions, such as municipalities, labor unions, farmers associations, and other NGOs. Many FRAs participate in local Watershed Committees, which manage land use and preservation within river basins across Brazil. Some FRAs also participate in restoration projects in riparian areas, providing seedlings of native species or implementing restoration projects themselves as service providers.

Impact. The positive results of the FRAs are numerous. Wood harvested from FRA-related forest plantations supply local woodfuel markets, avoiding additional destruction of native forests. In addition, since FRA plantations are scattered among many small farms and not concentrated in large areas, the potential negative consequences of large-scale monocultures are avoided or reduced (Ceccon and Martínez-Ramos, 1999. The technical assistance supplied by the FRAs fills a gap left by the government, since in Brazil government-supplied technical assistance is often exclusively available for agriculture and livestock activities.

Reforestation activities also create jobs and additional income for small farmers. The fact that the seedlings are distributed for free makes the longer-term investment of time and effort (five to seven years until timber matures) attractive to farmers who might otherwise be unable to invest heavily up front. FRAs are promoting inclusion of small farmers into forest industry production, and the idea that forestry can be part of farming operations is growing in acceptance. FRAs also serve to disseminate the idea that small and medium farmers can be good stewards of forest resources, in contrast to past practices where the government and private corporations have been the sole actors in forestry management (Ceccon and Miramontes 2008).

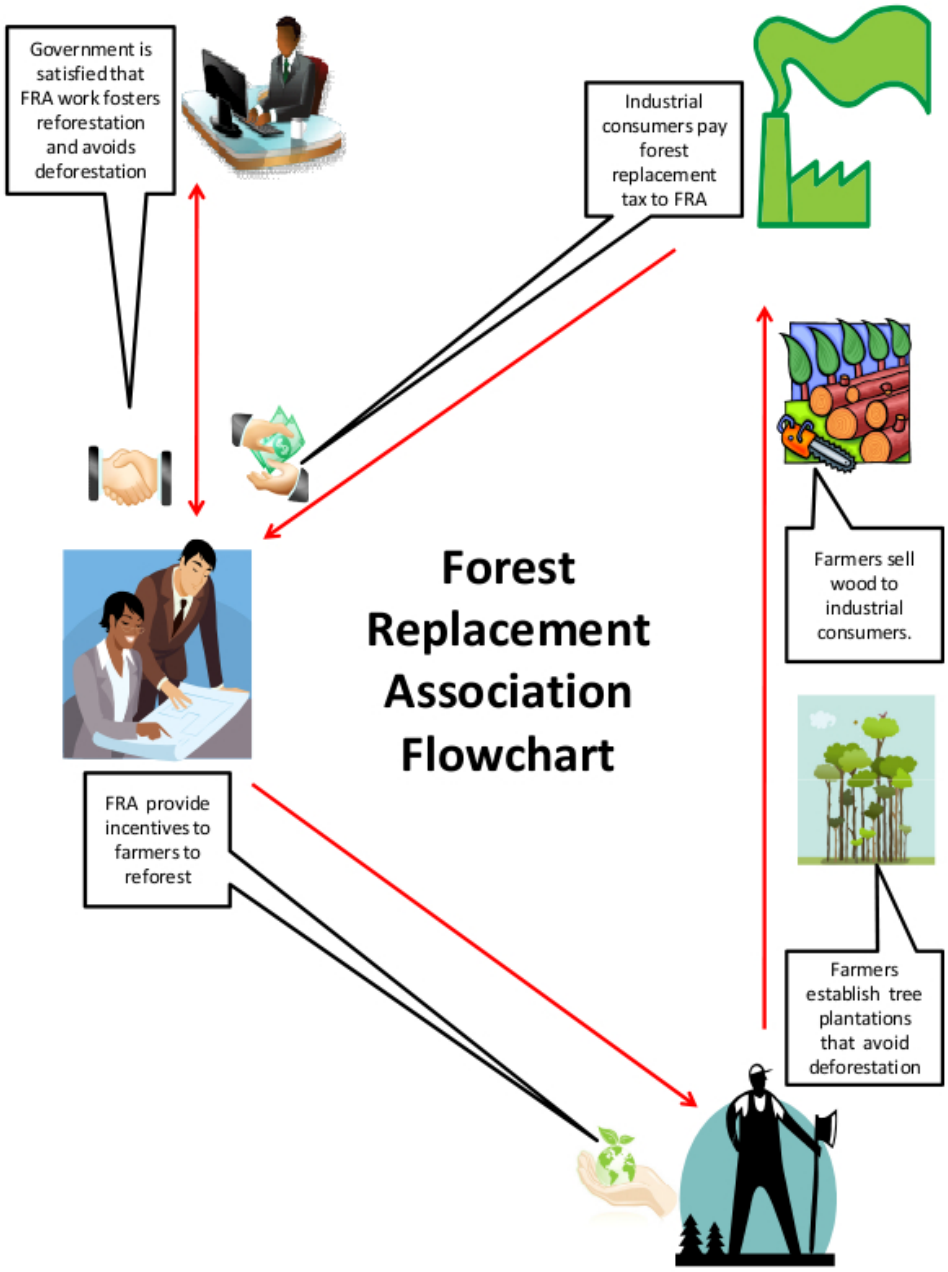

Figure 3: Scheme of FRA operations.

Comparing FRA and other TFP in Four States

The present study analyzed FRA and other TFP in four Brazilian states. FRAs are dominant in one state, were previously dominant in another, while other interesting models (including a tree-stock exchange and a public-private partnership) appear in other locations. The present study examined activity in each state to review how incentives for forest replacement have functioned in different locations, how activities have been disseminated throughout the area, how the institutions are meeting the local needs for woodfuel and to identify practices that have proven successful. The study also discusses the interaction between federal and state law regarding FRAs, such as Federal Ordinance Number 5.975 of 2006 which exempted all wood consumers from the requirement of forest replacement if the timber came from planted forests linked with TFP programs (the states, however, were left free to implement the ordinance according to local needs).

Below is a summary of FRA history and other activities in São Paulo, Rio Grande do Sul, Paraná and Minas Gerais states. Detailed notes on site visits, as well as multiple photographs of FRA operations, appear in Annex 1.

São Paulo

São Paulo state is located in the Southwest part of Brazil, and is the industrial and economic powerhouse of the Brazilian economy. The state's most recent HDI was 0.833, the third highest in the country (São Paulo State official website, 2009). São Paulo has the second largest area of planted forest in Brazil, over 950,000 ha, of which 30,000 ha are on small and medium farms (ABRAF 2008).

The first FRA was established in São Paulo in 1985. In 1989, when model had begun to spread, the Confederation of Replacement Associations of São Paulo (FARESP) was created. FARESP's mission is to promote the integration, organizational structure and the institutional representation of the state's FRAs (FARESP 2007).

Organization of the FRAs. Currently in São Paulo there are 16 operating FRAs; 14 of them are associated with FARESP (Figure 7, Annex 3). In spite of the fact that the working territories of some of the FRA are in close proximity, there is no competition among them thanks to a gentlemen's agreement on territorial cooperation. State law covering FRAs requires that consumers pay the replacement taxes to the FRA located nearest to their industrial facilities. When a dispute arises, it is discussed and resolved by the FARESP.

Each FRA in São Paulo must be accredited by the State Service for Natural Renewable Resources Protection (DPRN). To obtain accreditation, each FRA must meet several requirements; including proof that at least 2/3 of the board of directors are wood con-

Figure 4: Example of a nursery and facilities of a FRA in São Paulo state (ACIFLORA in Bauru Municipality).

sumers. Under state law, FRAs are required to produce only 1 to 5% of the seedlings of native species, depending on local demand in the region where the FRA operates.

FRA Activities. The São Paulo FRAs have expanded activities beyond reforestation, with some groups undertaking additional for-profit and non-profit activities such as:

- Production and sales of seeds for many species of regional flora, including the selection and marking of mother trees, seed collection and selection, and testing and grading;
- Nursery design and construction;
- Development of reforestation, ecological restoration, agroforestry and urban arborization projects; and
- Environmental education.

Successes and Challenges. In spite of legal challenges, São Paulo's registered FRAs planted nearly 92 million trees between 1993 and 2007. Approximately 80 million of these were exotic species (mainly *Eucalyptus* genus) and the rest were native species (Figure 8). FRA efforts beyond reforestation also gained recognition: São Paulo's Forest

Figure 5: Pasture with 1 year old *Eucalyptus* in Bauru, owned by a beneficiary of Aciflora FRA

Figure 6: *Eucalyptus* plantations (4 years old) in a small farm in Penapolis, Flora Tiete

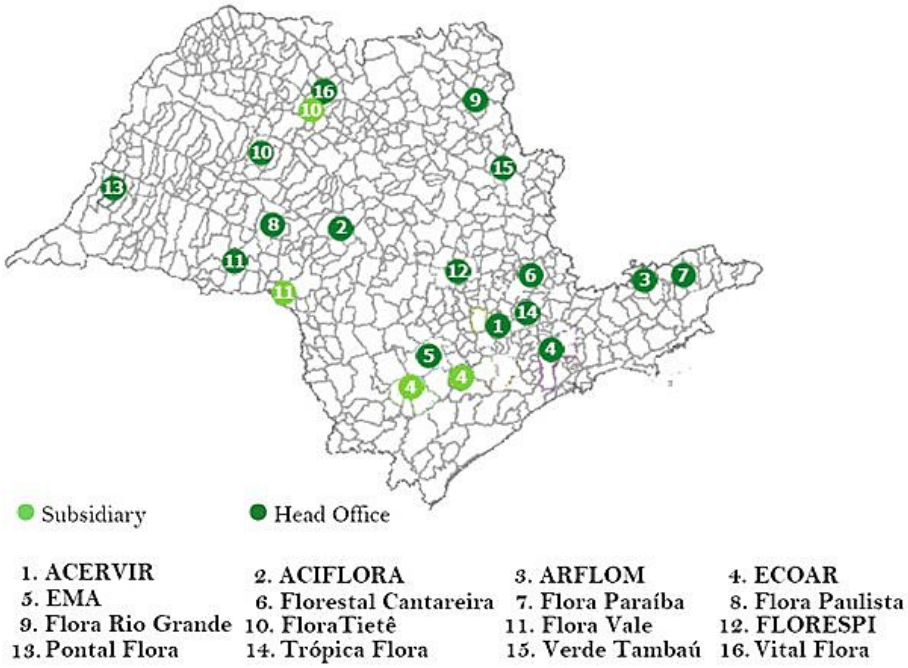

Figure 7: Locations of FRAs in São Paulo State. Data source: FARESP, 2009

Replacement Program won the 2007 national prize for Innovative Experiences of Management in Public Administration (FARESP, 2009).

Nevertheless many significant challenges still remain. In general, the state's wood consumers are not widely aware of the potential of FRAs to benefit their business, such as increasing local supplies of woodfuel. More critically, the collection of the forest replacement tax has been dropping (Figure 9). The main reason for the decline, according to those interviewed for this study, is that only a small number of the woodfuel consumers actually pay the forest replacement tax. The majority do not feel obligated to pay and do not fear reprisal, since regulations were only issued recently in December 2008, and has not yet been fully enforced. Compounding the problem, the state only loosely monitors the amount of tax payments, since the amount due is based only on the consumer's declaration of consumption. FRAs staff point to a lack of interest in more robust collection on the part of the government, because the majority of the forest replacement tax goes to the FRA and not to government coffers. The government has justified the situation by citing lack of tax collection personnel. Due to this situation, around half of the seedlings produced by the state's FRAs are for sale to the general public, and some FRAs have resorted to undertaking restoration projects for the government in order to obtain additional funds to continue operating. By state law FRAs are required to pay

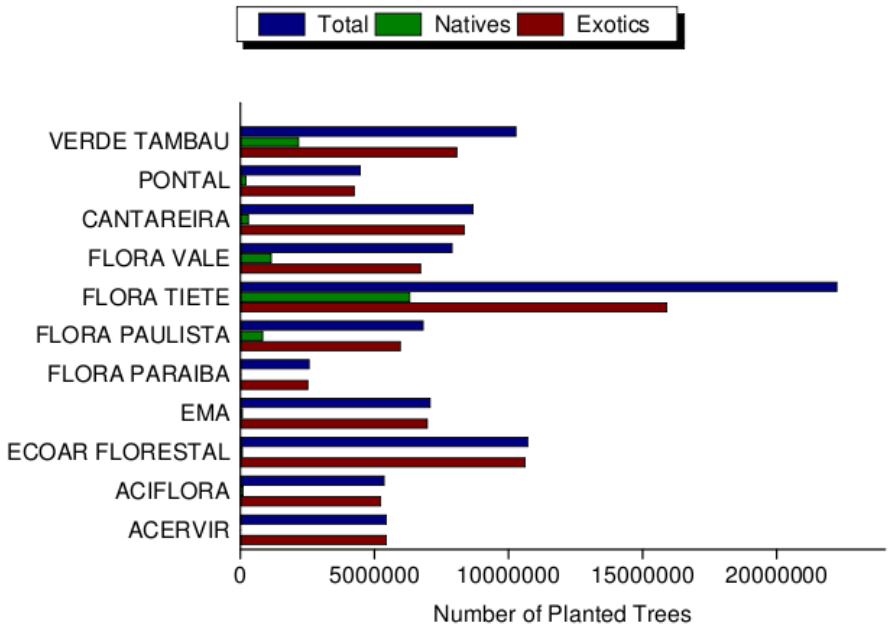

Figure 8: Total number of trees (natives and exotics) planted by São Paulo FRAs between 1993 and 2007. Data source: FARESP, 2009

a tax to the government in order to contract a consultant, who in turn will supervise their work and certify them as compliant (State Secretary of Environment of São Paulo ordinance; SMA 2008).

Up to now the new regulations (2008) reinforcing the role of FRA on the state, and a call for renew registration of all wood consumers by the State Secretary for the Environment were recently issued in November 2008, and it currently in progress and online[6] with more than 3,200 renewed registrations up to August 2009. The expectation is to have a revamp of payment of forest replacement tax.

Rio Grande so Sul

Rio Grande do Sul is the southernmost state of Brazil, and has the fourth highest HDI and GDP in the country (Rio Grande do Sul official website, 2009). It is the sixth largest state in Brazil with planted forests occupying over 400,000 hectares. In the last year, there was a 24% increase in forest plantations on lands owned by ABRAF member companies

[6]http://www.sigam.ambiente.sp.gov.br/Sigam2/Default.aspx?idPagina=5161

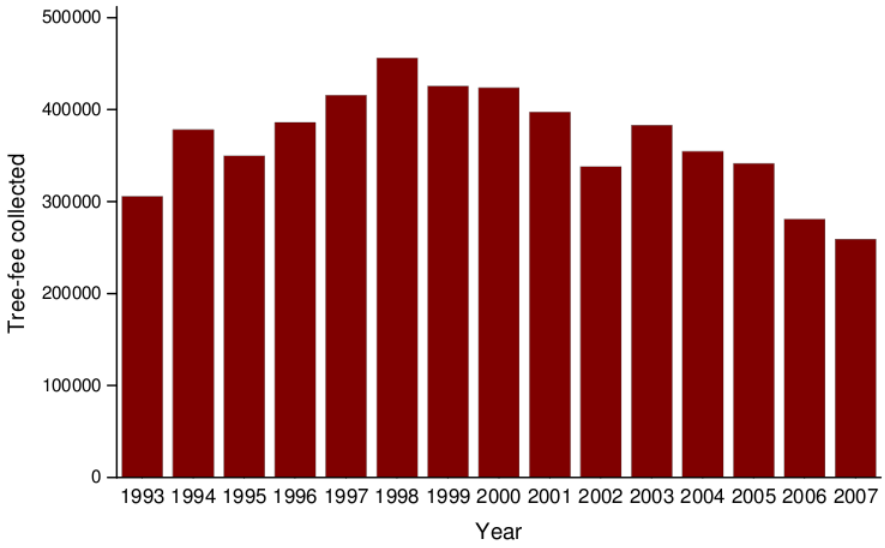

Figure 9: Annual tree-fees collected by eight São Paulo FRAs from 1993 to 2007. Data source: FARESP, 2009

(ABRAF 2008).

The first FRA in Rio Grande do Sul was created in 1987. In 1992, the state ratified the federal Forest Law, which required all consumers of wood products to establish reforestation plantations or to participate in enterprises for forest replacement. In 1994, the law was amended to authorize six specific forms of forest replacement, including paying replacement taxes to a regional or municipal FRA. The state's consumers were required to pay six tree-fees per m^3 consumed of wood (1 tree fee = US$0.15). The Confederation of Replacement Associations of Rio Grande do Sul (FARERGS) was created in 1996, and in 1998 the state had 21 FRAs, reforested around 10,000 ha and had involved 8500 farmers in forest replacement activities (Brose 2000).

FRA activity in the state flourished until 2000 when a change in state law drastically altered incentives for forest replacement, causing nearly all the state's FRAs to collapse. A new law was issued that placed a moratorium (for five years or until a new forest inventory was conducted) on requiring wood consumers to replace forest resources. The reasons for this change in the law are still disputed. Stakeholders of the one remaining and several shuttered FRAs interviewed for this study believe that powerful wood-consuming businesses pressured the State Legislative Assembly to make the change. The state government argues, however, that the results of a 2000 forest inventory found that the native forest coverage had significantly increased (rising from 5.62% in 1983 to 17.53%

Figure 10: Example of a *Eucalyptus* plantations (7 years old) in a small farm promoted by ARFLOR in Tupandi, Rio Grande do Sul.

in 2000[7]) thus making forest replacement unnecessary. However, those interviewed from the state's FRAs argue that the coverage of planted forests actually increased only from 0.62% in 1983 to 0.97% in 20013, leaving a gap when compared to wood consumption data, and leading to the assumption that native forests were still being used for woodfuels. Adding to the issue´s complexity, FRA stakeholders believe that the increase in forest coverage was concentrated in the southern parts of the state, which, if those areas were the ones surveyed, created a biased view that wood supply was plentiful and available throughout the state.

At the time the present study was undertaken, the state´s moratorium was still in place, given that the "new forest inventory" recommended by the 2000 law had not yet been conducted (the government argues budgetary shortfall). A majority of the stakeholders interviewed in Rio Grande do Sul (including the director of the state Forest and Protected Areas Department) believe that the northern part of the state is facing a serious risk of a forest "blackout" (a term used in Brazil to mean a shortage of wood supply from sustainable sources) in the near future. A new contributing factor to this risk is the fact that one of three large companies that has recently relocated to the area, a significant consumer of forest products, has decided not to create its own forest plantations but

[7]Inventario Florestal Continuo 2001

instead to buy wood from the local market since they no longer have a legal obligation to grow their own supply. Today, there is only one FRA operating in Rio Grande do Sul (see Annex 1 for details of site visit).

Paraná

The state of Paraná is located in the southern part of Brazil, bordering the states of São Paulo, Santa Catarina, Mato Grosso do Sul, and the nations of Paraguay and Argentina. Paraná has one of the highest living standards in Brazil with an HDI of 0.820, the 5th highest in Brazil (Paraná State official website 2009). The forest sector is very important in Paraná's economy, as timber is the second most important agribusiness export (EMATER 2002), while the forest sector generates 8.5% of the state's GDP. According to SEAB (2006), 40% of Brazilian timber exports come from this state, and Paraná's timber industry generates 9000 direct jobs. In 2007, Paraná had the third largest area of planted forests (more than 950,000 ha) among all Brazilian states (ABRAF 2008).

Paraná does not have FRAs operating within the state. However, pressures exerted by environmental movements in the early 1990s increased the supervision of the state's forest resource use. During that period, the IAP (Environmental Institute of Paraná) was restructured and four departments were created: Administrative, Biodiversity and Protected Areas, Control and Environmental Resources and Forest Development (Santos and Nogueira 2007). In 1992, following federal regulation, Paraná added mandatory forest replacement to its State Law (Number 10.155).

Paraná's SERFLOR (Compulsory Reforestation System) established that the forest replacement requirements for all consumers of forest products should be consistent regarding quantity consumed, with the objective of achieving a sustainable balance between the volume of wood consumed and the number of trees planted in the state. SERFLOR designated three acceptable methods for forest replacement:

i) Wood consumer establishes a forest plantation on his/her own land;

ii) Consumer pays a tree-fee to the IAP to produce seedlings and promotion of forest replacement (US$0.45 per tree consumed[8]); or

iii) Consumer acquires a tree-credit (similar to a tree-fee) in a tree-stock exchange with the State Institute of Technical Assistance and Extension (EMATER) at a cost of US$0.22 per tree consumed (SERFLOR 2006).

[8]The tree-credit equivalence was: eight trees-equivalent paid per m^3 of native timber consumed and four trees-equivalent per each m^3 of exotic timber consumed.

The tree-credits function as follows: a farmer registers his recently established tree plantation in a tree-stock exchange managed by EMATER. The plantation's tree-credits can be sold to a consumer for a fixed price before the trees mature, and the farmer receives the equivalent value in cash. With this money, the farmer is able to expand or establish new plantations without waiting years for the original trees to mature and be sold. Once they are ready for harvesting, the trees will be cut, sold and delivered to the holder of the tree-credits. Before receiving the timber, consumers must deposit equivalent tree-credits corresponding to consumption amounts in the exchange, where they are then issued bar-coded transport stamps. The state road police supervise the transport and verify the transport stamps on timber (SERFLOR 2006).

Using part of the tree-fees paid by consumers, the IAP, in association with local municipalities participated in the production and distribution of seedlings (70 million at the end of the 1990s; Santos and Nogueira 2007) while EMATER provided technical assistance. In 2006, the management of productive forests was transferred from the State of the Environment Secretary to the Agriculture and Supply Secretary.

In 2007, a new state law relieved consumers of the forest replacement requirement when forest products consumed were of non-native species grown on plantations. At that time, the SERFLOR program was halted and the wood market was considered self-sustainable by the state government. This viewpoint, however, conflicts with the analysis made by Freitas (2005), cited by Santos and Nogueira (2007), that reflected a deficit of wood supply in the local Paraná market of 8.3 million tons/year during 2003-2004. Santos and Nogueira (2007), in fact projected that the demand for forest biomass to be used for energy generation will continue to growing in Paraná. Due to the increased price of logwood, the forest residues, which once fulfilled part of the demand for energy, began to be used by companies that produced reconstituted wood panels.

Minas Gerais

The state of Minas Gerais is located in the southeastern part of Brazil. It has an HDI of 8.0, the 8th highest in the country, while its per capita GDP is the 10th highest (Minas Gerais official website 2009). Minas Gerais is Brazil's largest producer of steel and pig-iron and also among the largest producers in the world. Production of a ton of pig-iron requires about $4m^3$ of charcoal (Padua 2006). Consequently, to sustain a supply of inputs, Minas Gerais' pig-iron producers, together with the state's steel companies, maintain the largest forest plantation area in among all Brazilian states (more than 1.2 million ha). The state's steel and pig-iron industries consume 65% of the country's charcoal and nearly 20% of world charcoal supply (ABRAF 2008).

Reforestation requirements in Minas Gerais for timber, pulp and paper and wood-

fuels apply only when native forests are consumed or when the forest consumed was planted with resources of a TFP. A 2002 state law sets out three acceptable schemes for forest replacement:

i) Consumer pays replacement tax into a State Government bank account;

ii) Consumer plants his/her own forests or does so through partnerships with small farmers (TFP); or

iii) Consumer participates in a forest replacement association or similar entity.

Small and medium-sized farmers in Minas Gerais also participate in TFP through the three methods of forest replacement listed above, as follows:

i) The TFP run by the State Forest Institute (IEF) through many of its regional three nurseries that are distributed throughout the state. The TFP is financed by the replacement tax paid by small and medium-size consumers of woodfuels and timber (for furniture);

ii) The TFP run by the forestry units of the larger pulp and paper companies and largest steel companies, who obtain 20% to 30% of their wood supply from small farmers (as a strategy to lower costs, engage the surrounding community and avoid large monoculture plantations); and

iii) The TFP run by the only FRA in the state ASIFLOR (Association of small and medium-size pig-iron companies) in partnership with IEF.

Minas Gerais' replacement tax requirement on consumers is US$3.20 per mdc (cubic meter of charcoal) consumed or US$0.34 per tree consumed. A portion of these taxes is collected and designated for forest replacement through the IEF (State Forest Institute). These taxes are used to promote native forests plantations in small and medium-sized farms by offering seedlings, fertilizers, technical assistance and pesticides. These services and inputs are provided free to participating farmers, who do not have any obligation for repayment or sharing of revenue when the wood is sold. However, the actual size of new areas planted through IEF programs in recent years is much lower than that achieved by TFP by private companies under the second method (point ii) described above (Figure 11).

The state's third method of forest replacement (point iii above) involves the partnership between IEF and ASIFLOR (Steel Industry Association for Forest Promotion). ASIFLOR began operations in 1997 with 27 steel companies, and has as its objective the promotion of forest replacement activities. ASIFLOR collaborates with IEF to promote

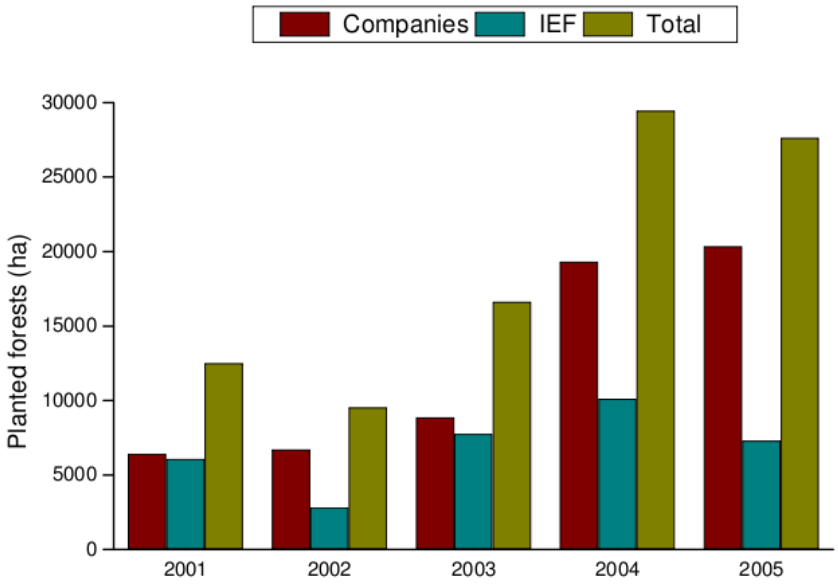

Figure 11: Planted areas resulting from TFP promoted by IEF alone and those of private companies, including IEF/ASIFLOR. Data source: Mapeamento e Inventário da Flora Nativa e dos reflorestamentos de Minas Gerais, 2006

TFP. Currently, ASIFLOR members include today 16 steel companies that are responsible for the forest replacement of approximately 40% of their charcoal consumption that originates from Minas Gerais native forests. Of the 14 state administrative regions in which IEF run tree nurseries, six regions include the IEF/ASIFLOR program (Center-west, Center-south, Center-north, Alto Paranaíba [West], Zona da Mata [Southeast] and Rio Doce [Southeast]).

In the contracts between farmers and IEF/ASIFLOR, the obligations and capabilities of each partner are clearly defined. The farmer agrees that he/she has received all necessary technical information regarding the plantation to be established and that the resources have been delivered and will be used for the *Eucalyptus* plantation. The contract also establishes that all forest production from plantations belongs to the farmer. The cost of implementation of the plantation is divided equally between IEF and ASIFLOR. Each partner has to fulfill the following obligations stated in the contract (Table 1; Padua 2006)

Create standby nurseries[9] Fertilize with proper preparations (First and second year

[9]Standby nurseries do not have infrastructure to produce seedlings. These are facilities near

Table 1: Partner obligations in IEF/ASIFLOR/FARMER agreements

IEF	ASIFLOR	FARMERS
Technical assistance	Nursery infrastructure	Land to establish the plantation
Inputs (fertilizer, pesticides for ant control and seedlings)	Acquire seeds and substrate	Protect against forest fires
Land for nursery	Acquire vehicles and seedlings transportation	Follow the technical instructions of IEF including plans for planting and management
Produce seedlings	Recruit nursery workforce	Prepare the soil and plant seedlings
Perform farmer cadastre register	Recruit engineers or technicians for project implantations	Control ants, other pests, diseases and weeds

in the savanna zone)

The Brazilian Carbon Market and its Potential for the FRA

In recent decades, the international community has become galvanized over the issue of climate change and has coordinated global efforts to address the threat. The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 with the primary objective of stabilizing the concentrations of greenhouse gases in the atmosphere through the reduction of negative anthropogenic effects in the climate balance of the earth (United Nations 1992). To mitigate the negative economic impact resulting from emissions reduction efforts, the Kyoto Protocol established three mechanisms to help developed countries meet the requirements: Carbon Emission Trade, Joint Implementation and the Clean Development Mechanisms (CDM; Campbell 2009). Unfortunately in 2011, Canada, Japan and Russia stated that they would not take on further Kyoto targets.The Canadian government invoked Canada's legal right to formally withdraw from the Kyoto Protocol on 12 December 2011. However Canada was committed to

plantation sites dedicated only to store the seedlings while carrying out the land preparation ahead of the plantation establishment.

cutting its greenhouse emissions to 6% below 1990 levels by 2012, but in 2009 emissions were 17% higher than in 1990.

Forest plantations play an important role in mitigating the effects of climate change since slash-and-burn deforestation is responsible for 35% of emissions in developing countries. It has been estimated that one hectare of *Pinus* or *Eucalyptus* plantations is able to fix about 30 tons/CO2/year, generating an additional income of about US$200/ha/year for the owner of the plantation in carbon credits (ABRAF 2008). Indeed, Fearnside (1999) considers that when forest plantations can be used for coal substitution, as in the case of plantations for charcoal production, such plantations remove substantial amounts of carbon from the atmosphere. However, the participation of small farmers in the carbon market has been limited by the current rules that complicate the implementation of small projects, given their burdensome processes and high implementation costs. One FRA director interviewed for this report asserted that the costs of a carbon sequestration project are very high for an FRA and only would be feasible if a single plantation was larger than 3000 ha. Currently, only 14 Brazilian forest-plantation projects are larger than 3000 ha and have been certified by the CDM Executive Committee of the United Nations (ABRAF 2008).

IV. Nicaragua

Background

Figure 12: Political map of Nicaragua showing the locations of the FRA mentioned in the present study.

Nicaragua has the second largest forest cover in Central America (nearly 3.3 million hectares or 25% of the national territory; FAO 2005). Most of this forest area is located on the Atlantic plains, a region sparsely inhabited by the Misquito, Sumo and Rama indigenous communities (Castilleja 1993). However, between 1990 and 2005, Nicaragua lost more than 20% of its forest cover, or about 1,349,000 hectares. Nicaragua, like other developing countries in the tropics, depends a great deal on woodfuels, or wood energy, as an energy source. According to Nicaragua's 2005 National Energy Balance, 42% of all energy produced in the country came from woodfuels, including 1.2% from charcoal. The main consumer of charcoal is the residential sector, the remaining volume is absorbed by restaurants and humble eateries, tobacco and brick industries(MEM 2009).

This demand for wood to be used as an energy source was estimated at nearly 6 million cubic meters in 2005. When this figure is compared to the annual production of

wood for uses other than energy (such as sawed wood or whole logs), which was approximately 250,000m^3 in 2005, the data reflect that the demand for wood to be used as energy was about 24 times higher than the demand for wood to be used in sawmills and construction (CRM 2008). As such, woodfuels represent the most important forest product in Nicaragua. In 2007, the National Survey of Biomass Consumption (carried out by the consulting company Multiconsult) concluded that while current legislation ably regulates large-scale timber extractions, the country's many small forest extraction activities for energy purposes actually translate into large volumes of timber being harvested without regulation (Multiconsult 2008).

Firewood is used primarily for domestic food cooking in Nicaragua. According to the Nicaraguan Institute of Energy (INE), in 1996, 90% of Nicaragua's domestic energy consumption was in the form of woodfuels. Ten years later, the National Woodfuel Survey (2006) found that approximately 75.3% of all Nicaraguan households used woodfuels for cooking; 52% of households used woodfuels as the sole fuel for all purposes; 7.2% as a primary fuel and 16.1% as a secondary fuel. Over 90% of households consuming firewood had not changed their consumption patterns over the previous five years, and about 80% of these did not expect to do so in the future primarily because they considered woodfuels a cheap and available fuel. On the other hand, in 2006 industrial consumption was equivalent to 247,192 tons of woodfuel or 96,409 TEP. Industrial consumption comprises primarily street restaurants, tortilla manufacturers and brick manufacturers (Figure 13).

The production chain of woodfuel is similar for a number of Nicaraguan cities that were analyzed for this report. Is important to remark that a big share of woodfuel comes from land clearing activities for agriculture crops. Woodfuel production begins with the extraction of trees by the forest owner, who cuts the wood into different sizes and who may also consume part of the wood. Forest owners commonly sell the portion they will not use to intermediaries, who often own trucks that can be used to transport the wood. These intermediaries, in turn, distribute the woodfuel by selling it to the owners of urban stores as well as to small industries in each municipality, according to the National Woodfuel Survey (FUNDENIC 2008). In the view of Multiconsult (2007), the typical profile of a woodfuel producer is an individual that does not have a job in the formal economy, but instead uses his ax or machete to cut trees from his own farm or nearby farms. This activity represents his sole source of income. Such a producer splits the wood into different sizes and brings it to a central market to sell it, or he might place it on display at the side of a road hoping to attract a buyer or trader who will subsequently take it to market.

The domestic firewood market involves a large number of people in Nicaragua. Approximately 230,000 people are involved in the extraction of woodfuel, of which about

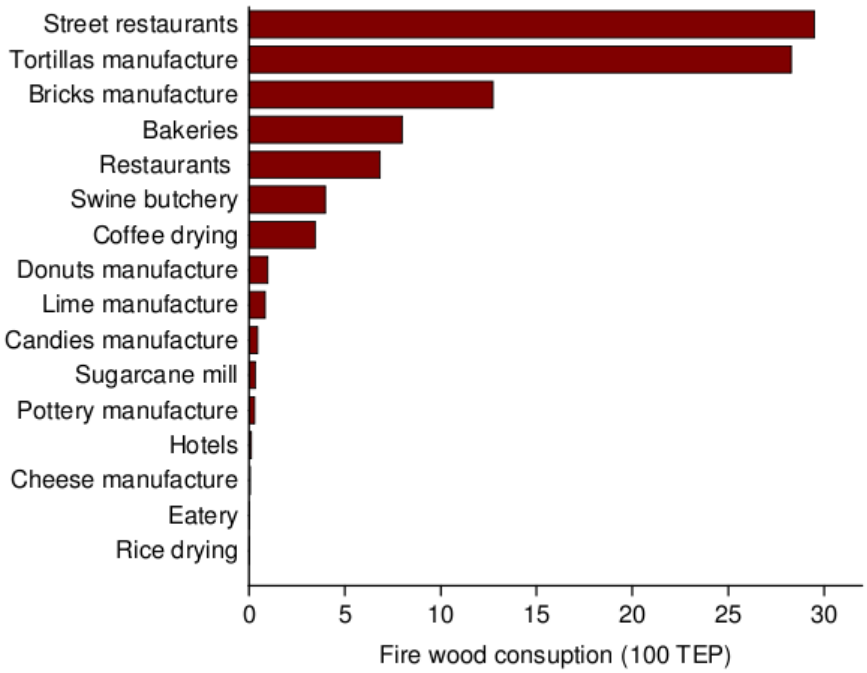

Figure 13: Woodfuel consumption of small industrial/commercial consumers in Nicaragua in 100 TEP of energy. Data source: Multiconsult 2008

75% are micro- and small producers with an average production of 25 metric tons of woodfuel per year (Multiconsult 2007). A large part of this production (69%) is transported in non-motorized transportation and uses alternate routes to main roads in order to reach urban zones, making this trade difficult for government institutions to control or regulate (Multiconsult 2007). The production of woodfuel for large urban markets such as Managua, Leon, Chinandega, Masaya, Rivas and Diriamba -Jinotepe was estimated, based on demand, to be approximately 321,000 metric tons per year in 2006-2007, while for the same period INAFOR granted permission for only 9,653 tons to be harvested, a figure that represents only a small fraction of the actual annual volume traded (Multiconsult 2007).

The 1999 EMOLEP[10] study concluded that the absence of coherent policies regarding the regulation of woodfuel production was perplexing, given the reality that a majority of Nicaraguans used it as domestic fuel, EMOLEP further recommended that the govern-

[10]Encuesta de Oferta de Leña para el Pacifico de Nicaragua (Survey of Woodfuel Supply in the Pacific Region of Nicaragua)

Figure 14: Brick yard with woodfuel to be used for brick production in La Paz Centro, Nicaragua.

ment institutions dealing with bioenergy issues (such as MAGFOR, INAFOR, CNE[11] and MARENA) should join forces with municipalities and community organizations to define more coherent plans and strategies for wood energy matters, including establishing Forest Replacement Associations among industrial and commercial consumers of wood energy.

Forest Replacement Associations (FRA) in Nicaragua are non-profit organizations which associate small and medium size wood consuming industries with the objective to replace on nature the wood consumed for its commercial and/or industrial operation, as usually required by legislation. The FRAs must receive monthly capital contributions from each associated consumer, which are equivalent in number of trees that need to be reforested, in order to replace trees in the same amount of wood consumed (tons or m^3). FRAs then produce the tree seedlings and together with technical assistance provide them freely to small and medium farmers located near the consumers. The

[11] In 2007, the Energy and Mines Ministry was created which took over the attributions of the National Commission of Energy. In this new Ministry there is a Renewable Resources and Energy Conservation Directorate with a Department addressing aeolian, biomass and solar energy issues.

Figure 15: Meeting in INAFOR office in Managua (From left to right: María Eugenia Rosales Caballero – Forest Incentives Department, INAFOR; Franz E. Arnold – Advisor of German Forest Cooperation, INAFOR; Augusto García – World Bank Nicaragua; Oscar Valdivia- Municipal Operating Department, INAFOR; Esperanza Siria – MEM; and Rogerio C. de Miranda – PROLEÑA President.

seedlings serve as an incentive for reforesting to the farmers, who are now the owners of the planted trees, and might sell this sustainably produced wood to the FRA members, to any other buyers, or keep it for himself.

Forest Replacement Associations in Nicaragua

The first FRA began operations in Nicaragua in 2000, when a local NGO (PROLEÑA Association of Woodfuel Energy Development) took the initiative to establish three FRAs in Nicaragua among important woodfuel-consuming industries such as brick and tile producers, lime producers and the woodfuel traders for the metropolitan Managua market (Miranda et al. 2003). The main motivation behind PROLEÑA's initiative was a feasibility study made by Miranda (2000) following the recommendations of EMOLEP.

One of the main conclusions of the Miranda study was that the high demand for woodfuel by the brick and tile industries of La Paz Centro region and the lime industries

of San Rafael del Sur[12] was the leading factor in forest degradation and deforestation surrounding these municipalities. At the time, woodfuel was becoming scarcer and more expensive every year, and there was a clear opportunity to create FRA among the industry leaders. For example, in La Paz Centro there were about 51 formal brick and tile companies that together consumed nearly 19,000,500 tons of woodfuel per year, most of which originated 40 to 80 km away, including from within the Momotombo Volcano natural reserve. In San Rafael del Sur, about 35 lime companies consumed nearly 21,000 tons of woodfuel per year, which originated 60 to 120 km away. In addition, the 1998 ESMAP-PROLEÑA woodfuel market study found that Nicaragua's capital city, Managua, consumed nearly 100,000 tons of woodfuel per year alone. Therefore, these three regions were identified as the top priorities for the establishment of forest replacement programs.

To further support the new FRA initiative, PROLEÑA started to engage both the Nicaraguan and Brazilian governments through the National Energy Commission -CNE (later renamed the Ministry of Energy and Mines - MEM) and the Brazilian Cooperating Agency -ABC, respectively, in a technical and financial cooperation project called National Program for Wood Energy Modernization that fostered several technologies and technical training. Project activities included training of Nicaraguan technical personnel (INAFOR, MAGFOR, CNE and PROLEÑA) on wood energy in Brazil and the introduction of modern charcoal kilns, a feasibility study for the generation of electricity from biomass, and in exchange, Ecostove technology transfer from Nicaragua to Brazil. The FRA model was one of the main components of this program, which included strengthening the FRAs that were in the process of creation by implementing several activities:

- Technical assistance from ABC, with consultants from Brazil assisting FRAs in Nicaragua, and a field tour to Brazilian FRAs by Nicaraguan woodfuel consumers and CNE;
- Financial support from CNE to set up three modern tree nursery facilities; and
- FRA management assistance from PROLEÑA.

Other partners of the project included Trees, Water & People (TWP), a US-based NGO that supports reforestation initiatives in Central America (Miranda et al. 2007), USAID and the World Bank (PROFOR Project). Each group of participating woodfuel consumers (brick manufacturers, lime manufacturers and woodfuel traders) provided land for establishing the nurseries, while the Nicaraguan government provided the infrastructure,

[12]These two industries were selected due to their concentration in a very small area, which create a greater demand of woodfuel locally.

and the Brazilian government, PROLEÑA and TWP provided the expertise for implementing *in situ* the Brazilian FRA methodology and tree nursery techniques (Miranda et al. 2007). Today, there are four FRAs in Nicaragua, including ECO CARBON which is the most recent association created (2003) and is composed of charcoal producers and traders from the region of Nagarote.

FRAs fit well into the Nicaraguan rural context, given that projects that promote sustainable woodfuel supply usually require a long-term time horizon, which does not match the primary short-term economic needs of small farmers. According to Miranda (2003), Nicaraguan farmers have some expectation that participating in forest replacement activities will provide a certain measure of economic security, since the region suffers intermittent agricultural crop losses due to natural disasters such as the drought caused by El Niño (the periodic meteorological phenomenon from the Pacific Ocean) and floods such as those caused by Hurricane Mitch in 1998. After such disasters, small farmers who have forest plantations will have the option of cutting the trees and selling them as woodfuel to local industries and urban domestic consumers, generating immediate income when other crops may be destroyed. In this context, FRAs function almost as a form of disaster insurance, and provide an attractive option for small farmers.

Government planning and policy issues regarding Nicaragua's wood fuels have tended to fall into a gap between the country's Forestry and Energy ministries. The country's Ministry of Energy and Mines (MEM) traditionally did not have an important role in forest biomass production. However, due to the minimal participation of INAFOR in this matter, the MEM has been filling some of the resulting institutional gaps and has been an important institution supporting FRAs. Recently, however, woodfuels matters have been assigned to special units within both MEM and INAFOR[13] that have very little political clout despite the key role played by biomass fuels in both forest and energy sectors.

In spite of nearly 10 years of promotion of FRAs, the four existing Nicaraguan FRAs still require consistent financial support from the Ministry of Energy and some NGOs (mainly FUNDENIC and PROLEÑA) just to maintain operations. The FRAs have not even succeeded in meeting the primary objectives that inspired their founding (donation of seedlings and technical assistance), since the current proportion of donated seedlings versus those sold to the public is very low. Only about 78,000 FRA seedlings (representing approximately 4% of the total number produced) have been donated to farmers, and in some years (2001, 2002, 2006 and 2009) no seedlings were donated at all due to the FRAs limited budgets (Table 2, Figure 16). In nine years of operation, the four FRAs were responsible for producing over 1.9 million seedlings which represent roughly

[13] At the MEM there is a small unit for biomass, wind and solar within the General Directory for Electricity and Renewable Resources, while at the INAFOR woodfuels fall within the Directory of Forest Promotion

961 hectares (assuming spacing of 2.5 x 2.5 m and a mortality rate of 20%; PROLEÑA database).

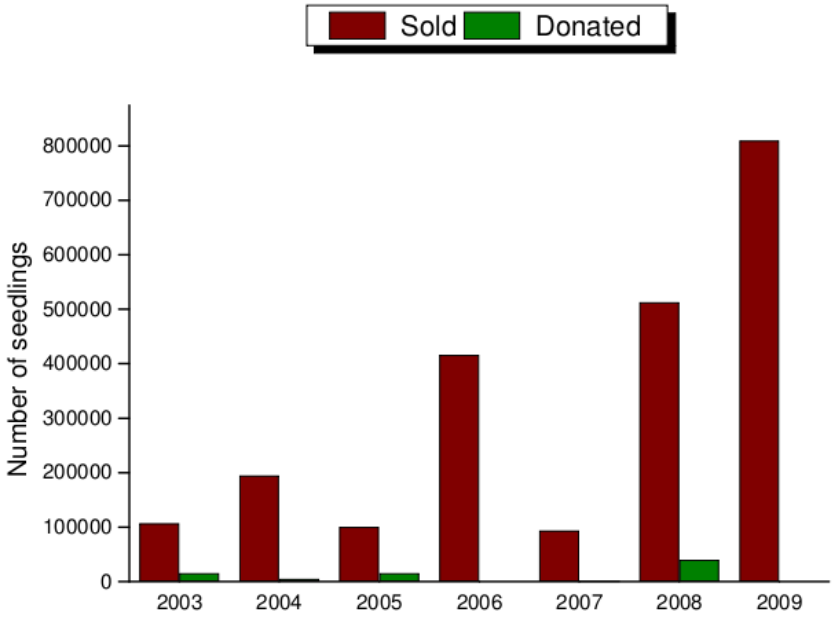

Figure 16: Sold and donated seedlings produced by three FRAs (ASEROFOR, ARCE SAN BENITO and APRORES) in Nicaragua. Data source: PROLEÑA database.

Table 2: Tree seedling production by the FRAs per year in Nicaragua

		Year									
FRA	Status	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
ASEROFOR	S	99348	39986	48251	71457	31201	41633	232758	105880	180000	850514
	D				300			700			1000
ARCE SB[1]	S	39986	15459	59200	42220	69472		154750	147850	130000	658937
	D			1429	2240	15908			39950		59527
APRORES	S	20110	20110		81500			54030	78964	80000	334714
	D			14432	2800						17232
Total		159444	75555	123312	200517	116581	41633	442238	372644	390000	**1921924**

[1]ARCE SAN BENITO. S=Sold, D=Donated.

The primary bottleneck of Nicaragua's system for free distribution of tree seedlings is the fact that the government has not yet passed legislation that makes forest replacement compulsory. Therefore, the FRA model has not yet moved beyond the initial pilot phase after nine years in operation. In spite of that fact, Nicaragua's FRAs have survived and even thrived during this long pilot phase by adopting a more commercial approach and producing tree seedlings under contract for other parties. The Ministry of Forestry, which is the responsible authority for forest policies and regulations, appears to underestimate the potential of FRAs to help modernize wood energy in Nicaragua. This is true even though three of the four existing FRAs have been established and strengthened by strong local and international efforts, and have been active for several years now.

The Role of Proleña in FRA Operations

The main goals of the NGO PROLEÑA are the promotion and the modernization of the biomass energy sector in Nicaragua. PROLEÑA plans to achieve these goals through research, development, the validation and promotion of modern biomass energy technologies and methods for wood burning and production, and policy reform. The group's activities include addressing both the industrial and domestic sectors, promoting the sustainability of forestry resources for energy through tree farming plantations and natural forest management (PROLEÑA 2009).

PROLEÑA initiated the process of evaluating the opportunities for introducing and adapting FRAs in Nicaragua following a study done in 2000 by Miranda and funded by USAID's PRO-ARCA project. The Miranda study assessed woodfuel consumption by the brick and tile industries of La Paz Centro, and also of the lime industries of San Rafael del Sur, and recommended that in order to meet these industries' woodfuel demand in a sustainable manner, FRAs should be created. The establishment of FRAs in both municipalities (La Paz Centro and San Rafael del Sur) would be a mechanism that could mitigate the social and environmental costs of the deforestation caused by these industries and their woodfuel consumption. FRAs would transfer to these private enterprises the responsibility and costs of reforestation to meet their future woodfuel needs, and avoid further deforestation in their respective municipalities as well as neighboring ones.

Since then, PROLEÑA successfully engaged many important stakeholders in the creation of FRAs (including the MEM, ABC, TWP, PROFOR, USAID and local municipalities). PROLEÑA also played a critical role in creating a FRA for Managua's woodfuel traders. PROLEÑA has been the primary promoter of FRAs in Nicaragua, advocating for the concept with policymakers, engaging stakeholders and other supporting agencies, raising initial seed funds, and providing key advice and financial and operational

support to the FRAs.

Currently PROLEÑA provides technical assistance and funds for seedling production for existing FRAs. The organization also helps to identify clients for the purchase of the FRA seedlings. PROLEÑA receives financial support from TWP, whose funds are used to pay the salary of a nursery manager for each of the three FRAs, and to support the technical supervision of some forest plantations promoted by the FRAs.

In the view of PROLEÑA, there are two main obstacles to sustainable production of woodfuels in Nicaragua: 1) the lack of incentives for farmers to replant after harvesting trees; and 2) lack of adequate regulation that controls consumption and encourages sustainability. Under its current structure, another problem is the woodfuel market structure itself, which does not provide adequate economic incentive for farmers to engage in forest plantations on their farmland. For example, farmers sell standing woodfuel for around US$8 per ton while the urban domestic consumer can pay up to US$100 per ton for cut woodfuel at the peak of the rainy season. This leaves the farmer with only a small percentage of the final consumer price while middlemen receive most of the profits. Meanwhile, the responsibility (and costs) of sustainable management of forest resources fall on farmers, but not on woodfuel consumers. Thus, farmers have little or no incentive to engage in natural forest management and or establish forest plantations, even if middlemen assume most of the processing costs like cutting, splitting and transporting woodfuel, and paying fees (legal or illegal; FUNDENIC 2008). At the same time, PROLEÑA believes that there is too much bureaucracy surrounding the legal processes for selling woodfuel, which raises costs both due to the length of the processes as well as required fees. Furthermore, at times it is impossible to obtain required permits due to the lack of proper documents by the woodland owner, such as registered land titles or proof of tax payments.

PROLEÑA also believes that it is unfortunate that INAFOR, as the main coordinator of Nicaragua's wood energy sector, does not share PROLEÑA's vision of the potential role that FRAs could play in the country. INAFOR is thought to lack robust knowledge of the ways in which FRAs could help to address the main problems related to a sustainable supply of woodfuels for Nicaragua.

The Role of FUNDENIC in FRA Operations

The Nicaraguan Foundation for Sustainable Development (FUNDENIC) is an NGO that operates in coordination with the Ministry of Energy and Mines. FUNDENIC collaborates on a project that is working on the development and commercialization of woodfuels consumption (firewood and charcoal) in five municipalities (San Rafael del Sur, San Francisco Libre, Tipitapa, Nagarote, La Paz Centro), as well as sustainable forest man-

agement practices that support those products. One of the components of the project focuses on the institutional strengthening of the four existing FRAs. FUNDENIC considers that the FRAs experience to date in Nicaragua has been an important one, given that good basic infrastructure for seedling production (three nurseries) has been established and participating stakeholders have gained experience in management of forest projects. However, FUNDENIC considers that the FRAs have not developed enough experience in successful commercialization of forest products, and should redefine their business vision and build management capacity in order to transform FRAs into successful and sustainable businesses. The FRAs should receive financial support for three years (2007-2009) for nursery operation costs. Beginning in 2010, FUNDENIC will cease funding operations and expects that all nurseries should be financially sustainable. In addition to supplying each FRA with a computer, FUNDENIC pays the salary of an accountant and one employee for two years. The project also intends to work towards the formulation and passage of a municipal ordinance in each city regarding sustainable extraction, production and commercialization of firewood and charcoal.

Ms. Rosario Saenz, FUNDENIC's Executive Director, was interviewed for this study. She spoke of the importance of encouraging forest culture among Nicaragua's farmers. In her view, Nicaraguan farmers consider it quite natural to plant agricultural crops for consumption or sale, while the forest is seen as a completely separate realm, and something that must be removed if land is to be used for agriculture. The concept of deliberately planting trees on farmland, even though they could provide a good income, is a completely foreign one. Nicaraguan farmers tend to believe that the forest "takes care of itself".

One of the main obstacles to strengthening and expanding the FRA model is the lack of demand for tree seedlings from farmers, who often see the country's natural forests as an obstacle to agricultural activities. Farmers have so little value for the harvested wood that many consider it almost a favor when the middleman (trader) takes away the woodfuel. Ms. Saenz believes that forest plantations need more than the mere incentive of free seedlings to create a forest culture and that in addition to existing incentives, the government should also pay farmers an incentive for forest preservation. Ms. Saenz cited as an example of the farmers' lack of interest the fact that approximately 60% of the seedlings donated by the Millennium Challenge Account (along with fertilizers and herbicides) were lost due to farmer neglect.

The Role of the Millennium Challenge Account in FRA Operations

In 2005, Nicaragua signed a five-year, $175 million compact with the U.S. government's Millennium Challenge Corporation for Millennium Challenge Account (MCA) funding.

The MCA funding aimed to increase incomes and reduce poverty in the departments of Leon and Chinandega through promoting economic growth. However, bilateral political issues have caused the MCA to close out the Nicaragua compact in 2009, one year before its planned completion. While the MCA has pulled funding from other projects, its reforestation program will continue with purchasing and donating seedlings through 2010, and provide technical support to farmers in subsequent years.

One of the compact´s three components was Rural Business Development. Under that component, the MCA program contracted with nurseries in Leon and Chinandega to produce high-quality seedlings for timber, woodfuel and fruit species. The seedlings were donated to farmers, along with fertilizers and herbicides, to establish forest plantations. The goal for 2009 was to establish 2113 hectares of forest plantations in medium and small farms. At the time this report was prepared, MCA funding was the main income source of the FRAs in Leon and Chinandega.

Forest Replacement Associations Visited

Association of Producers of Reforestation and Commercialization of Tiles and Bricks of the Municipality of La Paz Centro (ASEROFOR).

In the La Paz Centro municipality (12° 20′ N and 86° 40′ W) the predominant industry is the fabrication of bricks and tiles. Currently there are about 100 brick and tile companies legally registered within the municipality, many of which use woodfuel as the energy source for their business. Woodfuel is supplied to these companies by ox cart owners who live in rural areas and by truck owners in the urban zones. However, market control by authorities is quite weak. For example, in 2006 there were only two permits granted for woodfuel harvest equivalent to about 86 tons of woodfuel (Multiconsult 2008).

ASEROFOR began operations in 2000 and currently has three full-time employees and another three seasonal employees that work during seedling production. ASEROFOR has 30 members and the board of directors is composed of seven members. The ASEROFOR nursery has capacity for 100,000 seedlings grown in plastic tubes and 115,000 grown in plastic bags.

In interviews conducted for this study, ASEROFOR members and board of directors expressed their belief that local demand for woodfuel is much higher than the sustainable supply, and that existing woodfuel quality is low because the best species are now scarce. The members are in agreement that the FRA finances are precarious; in the recent past, a staff reduction was necessary. ASEROFOR receives no support from the municipal or national governments, but does receive funding from PROLEÑA and MCA, and formerly

Figure 17: PROLEÑA was the initiator of FRAs in Nicaragua including the CNE (MEM), ABC, TWP, USDA, the municipality of La Paz Centro and the World Bank (PROBOSQUE was the original name of ASEROFOR).

FUNDENIC. The new mayor of La Paz Centro, Mrs. Lesbia Abarca, was interviewed for this study and demonstrated no knowledge of the role played by ASEROFOR. However, she was interested in the potential of ASEROFOR to contribute to reforestation around the municipality and the creation of future business opportunities for a sustainable forest industry.

Since its foundation, ASEROFOR has been one of the most active FRAs in terms of seedling production, producing nearly 851,000 seedlings from 2001 to 2009. However given that the funds available for forest replacement have always been quite limited, ASEROFOR has been able to distribute only 1,000 seedlings for free (PROLEÑA, database). Most of the seedlings produced were sold to clients, including USDA, private buyers, FUNDENIC and MCA. As an example, in 2008 ASEROFOR produced around 106,000 seedlings. Most of these were acquired by the MCA program (about 75,000) and FUNDENIC (30,000), while the few remaining were sold directly to farmers. The main support that ASEROFOR would need in order to expand its free seedling distribution to farmers (tree farming program) is to have compulsory forest replacement legislation for

Figure 18: Launching of the CNE's Wood Energy Modernization Program with the inauguration of ASEROFOR's modern tree nursery in 2001

industrial consumers passed within the municipality.

The most commonly planted species by ASEROFOR has been *Eucalyptus camaldulensis*. The seeds are usually purchased from INAFOR (US$ 5/kg) and the native species seeds come from local farmers. The FRA bought the land for the tree nursery within the first year of operations with its own profits. Later, ASEROFOR expanded its property with the support of the NGO TWP. This FRA also engages in environmental education, promoting forest plantations in the schools and distributing pamphlets about the role of FRAs in the region. Currently, ASEROFOR is working with FUNDENIC and INAFOR to create an arboretum for production of high-quality seeds.

Two beneficiary farmers of ASEROFOR were interviewed for this study. One farmer has four hectares of forest plantations and considers forest plantation a good business option. In 2006 he spent around US$253 in planting costs (he bought the seedlings from the FRA at US$0.05 each) for 1.4 ha of *Eucalyptus camaldulensis*. Five years later, the farmer sold the wood (for typical rural construction or "ranchos") for approximately US$2000. For the second harvest (natural re-growth after cutting) there were no additional costs at all. Another farmer planted around 14 hectares of *Eucalyptus camaldulensis* in 2008 and

Figure 19: Tree nursery facilities of the FRA ASEROFOR in La Paz Centro with root trained seedling plastic tube technology provided by ABC

received subsidies from the MCA program (fertilizer, herbicide and seedlings), so that his only cost was for the clearing of weeds (US$182 in total). Nevertheless, this farmer thinks that land clearing should be subsidized because local farmers are so poor, and if money must be borrowed for start-up costs, the commercial banks charge such high interest rates (around 20% annually) that forest plantations are not feasible.

Forest Replacement Association and Commercialization of Forest Products San Benito (ARCE SAN BENITO)

ARCE San Benito is an FRA composed of the entrepreneurs who own trucks, and transport and sell woodfuel within the capital city of Managua. The FRA is located in Tipitapa municipality, (12° 11′ N and 86° 05′ W) about 22 km from Managua. In Tipitapa farmers are mostly devoted to the cultivation of basic grains for their own consumption. Farmers of the nearby coastal zone of Lake Managua cultivate horticultural crops. In the higher elevations of San Benito municipality, located to the north, the main crops cultivated are beans and livestock, albeit with low yields, while the communities supplying woodfuel

Figure 20: Two years *Eucalyptus* plantations by a small farmer in La Paz Centro, promoted by ASEROFOR.

are located in the lower elevations of the municipality (FUNDENIC 2008). According to the National Woodfuel Survey , the annual consumption of woodfuel in Tipitapa municipality can reach more than 29,500 tons; however, INAFOR granted legal permission for harvesting less than 394 tons in 2006 (1.3% of the total woodfuel sold; FUNDENIC, 2008). According to FRA members, the low level of compliance by woodfuel producers and traders is primarily due to the bureaucracy and costs required to obtain legal permits. Most of the woodfuel bought by the wood traders is from municipalities surrounding Tipitapa, such as San Francisco Libre, Ciudad Dario, Matagalpa, Camoapa and Comalapa. The traders of wood are located in the communities of Las Banderas, Las Maderas and San Benito and operate with approximately 55 trucks (FUNDENIC 2008).

When the FRA concept was introduced in the area, the woodfuel-trading truck owners thought that joining the FRA might contribute to better regulations and an improvement in their relationship with INAFOR, and they supported the concept. ARCE-San Benito began operations in 2001 with 133 associates who paid approximately US$5 per month to the FRA. In the beginning, most truck owners were optimistic about the FRA and the benefit it could bring to their business. However, due to INAFOR's lack of

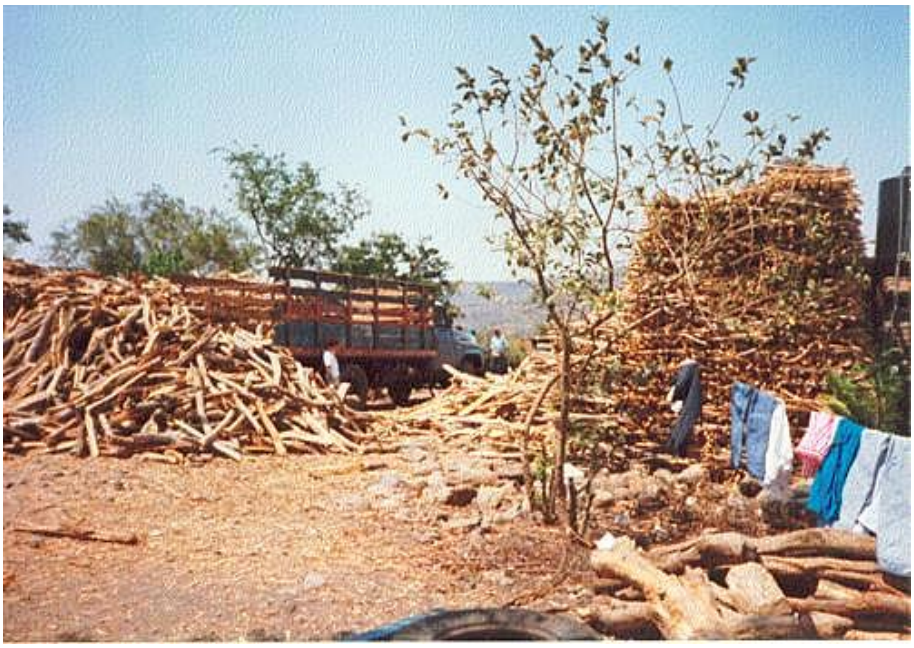

Figure 21: Truck traders woodfuel deposit on Las Calabazas, near San Benito.

support for the FRA concept, most members failed to see the expected benefit of participation, and today only 24 members remain.

Typically, woodfuel is bought as standing trees from farmers by the truck owners. According to the FRA members, in order to extract the woodfuel legally the farmer must possess all required documents, including deed to the farm. Within one month of requesting a permit at INAFOR and the local municipality, an environmental expert from INAFOR and another from the municipality must visit the site of the harvest and estimate the amount of woodfuel that can be extracted, as well define the silvicultural treatments that must be performed on the site to make the harvest sustainable. Although there is no legal requirement to do so, the farmers are expected to pay gasoline and lunch expenses for these officials when they visit the extraction site. In reality, due to the low price of the woodfuel sold, the farmers usually negotiate with the truck traders who agree to assume these costs. The truckers must also pay a tax of US$25 to the local municipality as well as a transportation license fee to INAFOR equivalent to US$2.5 per ton (usually four tons are transported per truckload). By law, if extracting native vegetation, the farmers must replant the area with seedlings of native species, which are often provided by the truck traders who obtain seedlings from their FRA. According to a 2008 supply chain evaluation made by Multiconsult, truck traders earn the highest

Figure 22: Tree nursery facilities of ARCE FRA with its board members in San Benito municipality.

percentage of profit (estimated at 35%) in the woodfuel supply chain, since the price of woodfuel paid by end consumers is on average at least ten times higher than the cost at the production sites.

ARCE San Benito has donated a higher proportion (8.3%) of seedlings compared to the other two FRAs, producing nearly 718,500,000 seedlings since 2001 and donating almost 60,000 of those. There was no production in 2006 (PROLEÑA database). Most of the seedlings produced are of *Eucalyptus* species, Neem (*Melia azadirachta* L.) and other native species, and the sales are mostly through third party contracts with the help of both FUNDENIC and PROLEÑA. Seedlings are sold to members for US$0.09 each, while for non-members the price is around US$0.15. The MCA program bought seedlings at US$0.06.

Today the FRA survives by producing and selling seedlings to customers who pay for the services under contract. Contracts are usually negotiated with the help of either FUNDENIC or PROLEÑA. Like ASEROFOR, ARCE San Benito would also welcome a compulsory forest replacement regulation for Nicaragua's commercial and industrial consumers of woodfuel, which would generate funds for FRA operations.

Figure 23: ARCE-San Benito also has a modern tree nursery infrastructure based on root trained seedling plastic tube technology.

Forest Replacement Association of San Rafael del Sur (APRORES)

This FRA is located in the San Rafael del Sur municipality (11° 50′ N and 86° 26′ W). The main crops in the region are corn, beans, rice, sorghum, citrus, sugar cane and coffee. Important lime companies that collectively consume around 21,000 tons of woodfuel per year are located in this region; however most of the woodfuel consumed by the lime industry is supplied by other municipalities (Miranda 2000).

APRORES was co-founded and initially directed by a former Vice-mayor of San Rafael, now deceased. The municipality donated an abandoned slaughterhouse and the MEM together with Nicalet Foundation (private foundation supported by a local cement factory) provided the infrastructure for the tree nursery. APRORES currently has 16 members and three volunteer workers that are also members. Seeds of native species are collected wherever there are nearby trees with seeds available, with no other selection criteria, and FUNDENIC provided APRORES with *Eucalyptus* seeds. Between 2001 and 2009, APRORES produced nearly 352,000 seedlings and donated about 5% of this total to

Figure 24: ARCE-San Benito has received important support from NGOs such as FUNDENIC and PROLEÑA and the European Commission.

farmers. There was no production in 2005 nor 2006 due to organizational turmoil in the wake of the death of the FRA's founder. In the last five years, no seedlings were donated (PROLEÑA, data base). In interviews conducted for this study, APRORES members commented that local farmers think that the price of woodfuel is very low in the region (farmers receive around US$8 per ton for standing wood) and so forest plantations are not an attractive option without incentives that the FRA should provide. Most of the beneficiaries of this FRA planted native species in live fences.

Forest Replacement Association and Commercialization of Charcoal of Nagarote Municipality (ECO CARBON)

The ECO CARBON FRA is located in San Pablo Nagarote (12º 15' N and 86º33 W). San Pablo Nagarote is the most deforested municipality in the Pacific region of Nicaragua, with only 8.4% of its territory still covered with native forests. The economically active population raises cattle and cultivates basic grains and other staples like corn, beans, soybeans, watermelon, sesame, sorghum, and cassava. The municipality is well-known

Figure 25: Tree nursery facilities of FRA APRORES in San Rafael del Sur.

for its many charcoal producers, who buy woodfuel from farmers to produce charcoal. The charcoal is usually sold to middlemen who buy it in order to sell it to the tobacco industries in the northern part of the country, for urban markets like Managua and Leon and even for export to foreign consumers in El Salvador. The annual consumption of woodfuel in this municipality was just over 39,000 tons in 2007 (FUNDENIC 2008).

ECO CARBON began operations in 1999 but was only formally organized and legally registered in 2003. ECO CARBON is primarily an association of charcoal producers and traders. The producers employ traditional technology for charcoal production; most use the "Parva kiln", which is basically a hole in the ground filled with woodfuel and covered by leaves and dirt. Charcoal producers sell to traders for about US$0.09/kg, and the traders sell to retailers for US$0.13/kg. Retailers can sell the charcoal for US$0.23/kg to final consumers in Managua or Leon.

ECO CARBON does not produce seedlings as the FRA does not have a tree nursery, given that they were not part of the initial group of FRAs established by PROLEÑA and MEM with the support of ABC. However, ECO CARBON does promote forest plantations by obtaining free seedling from other sources (usually donors) and distributed them freely among local farmers. For example, in 2007 the FRA promoted the plantation of 107,000 seedlings (primarily *Eucalyptus* species) received from FUNDENIC along with technical assistance, and in 2008 ECO CARBON promoted the plantation of 124,000

Figure 26: FUNDENIC has supported the strengthening of the existing FRA with funding from European Union.

seedlings (56,000 from FUNDENIC, 56,000 from MCA and 12,000 from ALBANIZA[14]) ECO CARBON's goal is to plant at least 80 hectares of forest plantations per year.

According to the FRA Director, current regional demand for charcoal is increasing and regional producers are exporting some charcoal to El Salvador. The Director also commented that other modern techniques for charcoal production (kilns) are supported by MEM with technical assistance from ESMAP and ABC. These new kilns are more efficient than the traditional "parva" kilns, but yet have to be widely disseminated and adopted among charcoal producers.

[14]ALBANIZA is a joint stock company between Nicaragua and Venezuela for the development of energy projects, The name comes from ALBA, the major Venezuelan development initiative to promote cooperation aimed to promote cooperation in Latin America and it stands for "Bolivarian Alternative for the People of Our Latin America".

Figure 27: Test of high efficiency kiln for charcoal production in the ECO CARBON FRA facility in Nagarote Municipality, provided by MEM with support from ESMAP.

V. Conclusions

In spite of various obstacles encountered over the last two decades, FRAs have proven in general to be effective mechanisms to foster tree plantations among small and medium-size farmers in Brazil and Nicaragua, thus reducing deforestation.

Small and medium-sized farmers have embraced the FRA model in many locations. Farmers welcome the free incentives provided by the FRA, and generally see the benefits of having small lots of planted trees on their property. The trees are seen as a strategic product that fetches a good price, and that can be sold whenever he/she wants or used themselves for their own needs. Many farmers interviewed for this report considered that forest plantations offer the best income when compared with traditional agriculture crops or pure livestock, since they offer (as a long term investment) a counter-cyclical relationship with the volatility of agriculture crop prices. Farmers also reported inter-cropping *Eucalyptus* trees with food crops in the first year and/or livestock after the second year of the plantation, increasing the economic value of the forest plantations (agroforestry). The technical assistance and the high quality of the seedlings offered had a key role in the satisfaction and success of small forest plantations according to all the farmers interviewed.

Many commercial wood consumers have also found participation in an FRA to be a smart economic move. However from the point of view of commercial wood consumers, participation in an FRA is a viable option when forest replacement is required by law, and at the same time, if the nearest FRAs can run a TFP less costly than the forest replacement programs (TFP) run by the government.

The FRA model could play a larger role as a partner to government. FRAs can be an effective partner of the government in efforts to convince commercial wood consumers of the importance of mitigating the impact of their industries on deforesting natural forests. However, not all state governments in Brazil are completely supportive of FRAs, seeing the model as competition to government-run TFPs. In Nicaragua, FRAs could play an even more important role in helping the government to prevent deforestation, especially given that the lack of government support is perceived to originate in a lack of understanding from the government of the benefits of the FRA model..

FRA and similar models have had significant impact. In Brazil there are other models of TFP beyond FRA, many of which are run by the state governments and large industrial wood consumers'. Together, all of these programs have had a significant impact on encouraging small farmers to participate in forest activities. In 2002 the participation of small and medium-size farms in the country's forest plantations was only 8%; by 2006 this figure rose to 25% of all domestic reforestations. This latter figure represents nearly 40% of all reforestations when only new reforested areas are considered and the reform of existing plantations is not counted (Servico Florestal Brasileiro, 2007).

Supporting legal and regulatory environments are lacking in many places, forcing FRAs into secondary activities or making their operations impossible. The lack of mandatory forest replacement regulations that would support FRAs as is the case in Nicaragua and Brazil (both Federal law and in many states), and the lack of enforcement of existing regulations as is the case in São Paulo state (at least until February 2009, prior to the regulations issued in December 2008) force many FRAs into other income-generating activities. These activities are primarily the production of seedlings of exotic and natives tree species for sale (as it is the case in both São Paulo state and Nicaragua) and also the offering of services for environmental restoration and the sale of quality seeds (as it is the case in São Paulo).

FRAs in São Paulo engage in non-profit activities of social importance, such as environmental education within their communities, vocational training for teenagers from low-income families, establishing arboretums and ecological restoration at small farms.

The carbon market is not yet an option for FRAs since all stakeholders interviewed in Brazil agreed that the process is too bureaucratic and expensive to be established in small farms.

In Nicaragua there are long-standing differences among environmental organizations, the private sector, rural farmers and the government regarding appropriate sustainability measures that could be adopted by woodfuel consumers. In addition to the fact that each of these groups has very different objectives, the conflicts over sustainability are primarily due to the lack of communication and coordination among the stakeholders, lack of robust understanding of the problem, a dearth of good international examples to follow, and scarcity of funding.

The issues themselves are also quite complex. The management of Nicaragua's woodfuel production is affected by property rights, price distortions, layers of bureaucracy and the absence of regulations that could support an effective sustainable woodfuel market. Nevertheless, there have been recent important interactions among civil society organizations regarding sustainable production of woodfuel. PROLEÑA and MEM were fundamental in the creation of Nicaragua's FRAs, FUNDENIC has supported the FRAs for three years and today, together with MCA the three institutions continue to offer fundamental support for FRA operations. However, the country lacks specific legislation regulating the wood energy sector (especially smaller industrial and commercial consumers) which could create an expanded role for the FRA, and most importantly enable the FRAs to collect a woodfuel tax from industrial consumers, with governmental enforcement of compliance by municipal authorities. In the interviews conducted for this study, small farmers and woodfuel consumers alike complained about the many restrictions caused by what they saw as excessive taxes charged by INAFOR and municipalities. In the view of these stakeholders, the costs of the complex bureaucracy involved in obtaining legal permission to cut trees not only cost them time and money, but resulted in a very low rate of compliance with legal requirements. Furthermore, even when consumers take the initiative to mitigate the impact of their woodfuel demand, such as creating or participating in FRAs, INAFOR does not respond to, recognize or support their actions.

Similarly to INAFOR, municipality support for FRAs is practically non-existent. Municipalities provide no financial support nor have any municipalities established regulations which could support FRA operations. The municipalities apparently do not recognize the opportunity inherent in strong demand for woodfuel, which, if properly regulated, could become a primary incentive for reforestation. Increased reforestation could generate significant opportunities for a local, diversified forest products industry based completely on planted forests.

Support among farmers is also weak. There appear to be several key reasons why farmers in Nicaragua show little interest in establishing woodfuel plantations without institutional support. The most important factors are numerous: the low selling price of woodfuel; the scarcity of resources for investment including the lack of financial incentives; the absence of a forest plantation tradition; low level of forest technology (low

yields); and a lack of available technical expertise. The role of FRAs in Nicaragua was designed precisely to overcome these barriers, as was done in Sao Paulo state in Brazil, where FRAs compensate farmers for the low price of woodfuel by providing free high quality seedlings and technical assistance. Nevertheless farmers in areas surrounding FRA are slowly gaining confidence in reforestation, and those who long ago planted trees with incentives from FRAs, are already benefiting by selling their standing trees to premium markets.

Productivity is an issue as well. Although Nicaraguan FRA personnel do have some basic knowledge about tree nurseries, there is insufficient technical training in more modern techniques of forest plantation management. This lack of technical knowledge has resulted in low survival and growth rates on existing plantations. For example, the average estimated yield for Nicaraguan forest plantations today is only 10-15 m^3/ha/year (INAFOR, 2008) while in Brazil, according to FARESP (2008), the average yield is 40.5 m^3/ha/year. The higher Brazilian yield is due to consistent work on genetic improvement of the country's tree species, better techniques at the tree nursery level and better management in the field (silviculture). If Nicaragua can increase its forest plantation productivity in the near term, it certainly would encourage more farmers to establish forest plantations and create new investment opportunities in forest industries.

In spite of these multiple obstacles, Nicaragua's existing FRAs have done a remarkable job in promoting reforestation, given the challenging legal, regulatory and economic environment in which they must operate today. Institutional support has been vital to the FRA model, however. Without the support from PROLEÑA, MEM, FUNDENIC and MCA, it is likely that Nicaragua's FRAs would not be in existence today. Even more could have been achieved if both INAFOR and the municipalities had become engaged and supported the existence of the country's FRAs.

The key roles played by FRAs in both countries can be summarized as follows:

- Function as win-win partnerships between consumers and producers, and even for government environmental and forestry regulating agencies;
- Encourage consumers to assume responsibility for the environmental impact of their commercial wood demand by assuming the costs of its replacement;
- Engage small farmers in forestry activities and encourage the practice of tree intercropping with traditional agricultural crops and livestock, creating new income opportunities for small and medium-sized farms, with wood products as strategic less risk commodity as well as wood for self consumption;
- Increase the sustainable supply of commercial woodfuels and other wood prod-

ucts, moving toward an equilibrium between sustainable supply and industrial/-commercial demand;

- Reduce pressure on remaining native forests;
- Reduce the distance required to transport wood from forest to industry;
- Disperse forest plantations among small farm holdings, which is ecologically more sustainable than larger concentrated plantations; and
- Develop projects related to ecological restoration, environmental education, social projects, and urban tree planting.

VI. Recommendations

Brazil

The most important recommendation for the existing FRA in São Paulo State is to improve the supervision of woodfuel consumption in order to increase the amount of forest replacement taxes collected. Since the state government claims they do not have sufficient staff to increase supervision, an alternative may be to incorporate the control of forest replacement tax into the control of the production or product sales made by the wood consumers, since it is possible to elaborate correlation models between wood consumption at the factory and the production of many of the products which use wood as energy source. The control of the forest replacement taxes to be paid to FRAs could then follow the same methods used to pay local sales and other taxes to the state government.

In Rio Grande do Sul, it is urgent to that the new state forest inventory stipulated in the 2000 law be conducted. The inventory will provide detailed information on regional data, which will highlight the regional differences in forest resources availability and its implication on the sustainable supply of forest products. The state must find new ways to involve small and medium-sized farms in forest production, and institutional policies that can to re-establish FRA operations or similar TFP.

There is a general perception that the state governments in Brazil would like to transfer the forest management responsibility to the municipalities. This may be a positive alternative, but only if the state improves the capacity of the municipalities, such as training of staff, recruitment of new trained staff and infrastructure (transportation, equipment, nurseries, etc). Currently, only a few municipalities have the ability to take on this responsibility.

Nicaragua

In Nicaragua, it is necessary to improve the information-gathering process and to establish a robust database covering all biomass issues throughout the country, such as market dynamics, pricing, transportation, and supply and demand.

Improved institutional capacity (in terms of planning, regulation, research, extension services and training) is needed. Governmental institutions directly related to wood energy, such as MAGFOR, INAFOR and MEM, should coordinate a joint program to modernize the wood energy sector and its technological and regulatory framework. Such a program should include the participation of leading NGOs such as PROLEÑA and FUNDENIC, as well as representatives of the FRAs, producers, consumers and merchants of

wood energy.

Municipalities could play a key role. While INAFOR provides valuable services, INAFOR extension workers and those from other agencies are already overloaded with responsibilities, and do not have capacity to take on the task of advancing the concept of forest plantations across the country. The development of local solutions for forest promotion (such as FRAs) would be a more effective way to encourage reforestation in municipalities where it is most needed. Local solutions must engage municipalities in the creation of a municipal agenda that places a priority on forests and the environment. Such strategies should take into account the economic potential of sustainable use of local forest resources for each municipality – potential that could be realized by using the existing capital and entrepreneurial human resources available among local woodfuel-consuming industries.

Partnerships between the government and FRAs may also be a good model for Nicaragua, given the limited resources available to both government and private sector. In Brazil for example, the partnership between ASIFLOR (an FRA) and IEF (the state agency that regulates forests) in Minas Gerais has been successful in addressing unsustainable woodfuel production and expanding the production of quality wood that supports the sustainable development of the state's forest industry. In Nicaragua, similarly INAFOR could enhance and scale up its incipient tree farming program by leveraging the infrastructure, human and financial resources already existing within the three FRAs. In the same way, municipal governments in Nicaragua could be more active and visionary in forestry planning by supporting local FRAs, and using their existing infrastructure, capital and human resources as leverage to create a strategic forest development agenda, which should diversify and create new local economic opportunities.

The regulatory environment should be improved. The Nicaraguan government should move towards the establishment of a compulsory forest replacement law with related user fees, so that consumers assume the cost of sustainability of their energy needs. Alternatively, such an initiative could originate from local municipal governments in areas of high woodfuel consumption.

New technologies should be promoted. Modern silviculture should be pursued in order to explore the most of the forest resources in Nicaragua, with better tree nursery techniques, tree planting and management, and as well genetic improvement. Furthermore energy-efficient cook stoves reduce the consumption of firewood. Initiating a program of credit for the acquisition of such stoves in the domestic and commercial food sectors in Nicaragua may be an effective way to support sustainable woodfuel use by reducing demand.

Education is also important. Developing an environmental and forest education pro-

gram in primary and secondary schools in areas where commercial woodfuel consumption is high could promote awareness of issues surrounding the environment and use of forest resources.

Better data is required. An ecological zoning of commercial tree species and a mapping of land use throughout the country is needed. Increased genetic improvement of seeds for commercial species is also needed. Forest inventories are important tools to identify where reforestation is needed, and where major deforestation is identified, FRAs could be an effective model to promote tree planting among small farmers.

Examples from Brazil provide Nicaragua with many ideas that could generate income for the rural poor and also improve sustainable forest use. Research and development for charcoal production is urgently needed in order to improve Nicaragua's technology efficiency and reduce consumption as well as related deforestation. Educating farmers about the economic benefits of intercropping seedlings and agricultural crops in the first years of forest plantations may encourage participation. Honey production and livestock can be integrated into forest plantations in the second year after planting. Adding tree species that take longer to mature but fetch better prices as timber after 15 years could be an additional way to increase farmer incomes.

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Annex 1 | Brazil: Site Visit Reports

Seven site visits were made to Forest Replacement Associations in Brazil; four in the state of São Paulo and three in Rio Grande do Sul. Two of the FRAs in Rio Grande do Sul were no longer operating.

Figure 28: Interview with José Catarino (ex-Chairman of FARESP and recently appointed as Executive Director of Pontal Flora Forest Replacement Association)[far left]; Eliane Ceccon; Ricardo Viegas (Director of Forest Development Department of São Paulo State Environmental Secretary and Carlos Eduardo Beduschi (Forest Management Department)) [far right] .

FLORA TIETÊ Forest Replacement Association, São Paulo

Operations and Activities. The Flora Tietê FRA was established in 1986 in the city of Penápolis. In 2009, the FRA had a permanent staff of 28 people, and two administrative staffs that work in a subsidiary office in the city of José do Rio Prêto. In addition to technical staff (nursery workers, seed collectors, forest technicians), the FRA employs a forest engineer, a business officer and an environmental educator. The land occupied by the FRA was donated by the municipality. Since income from the forest replacement

tax is not enough to cover all costs of operations and infrastructure, the FRA performs several other income-generating activities:

- Sale of seedlings and seeds;
- Technical assistance (for a fee) to farmers who are not part of the FRA program;
- Seeking of national and international grant support to improve site facilities and
- Implementation of forest restoration projects for NGOs such as SOS Mata Atlântica.

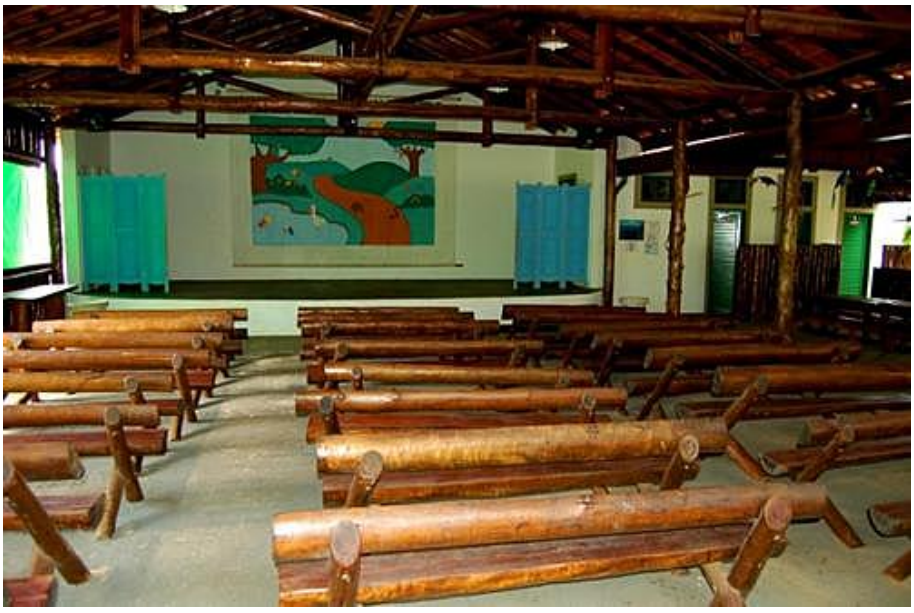

Figure 29: Environmental Education Center in the FLORA TIETE FRA

In 2003 Flora Tietê established an Environmental Education Park in Penápolis with the objective of creating environmental and civic awareness. Since that time, the park has received over 35,000 visitors from schools, civic associations and the general public. Flora Tietê also participates as full member of the region's Watershed Committee. At the time this study was conducted, the FRA was developing an Experimental Station (15 ha) that will result in an arboretum of 200 native species (many of them under extinction risk) and 15,000 trees of high genetic quality. The trees will be used for seed production and research by regional universities.

Forest Replacement Statistics. The main species of *Eucalyptus* seedlings produced by Flora Tietê are *citriodora, camaldulensis, toreliana, urophylla* and *urograndis*. The FRA also produces seedlings from around 120 native species, since São Paulo state legislation requires the plantation of at least 80 different species for restoration purposes. Most of the high-quality seeds used for forest activities are purchased from the Institute of Forest Research and Studies of Luiz de Queiróz Agriculture College (IPEF).

In its 15 years of operations, Flora Tietê has planted a total of nearly 16 million trees and has collected 9.2 million tree-fees. Thus, the FRA has planted 42% more trees than were covered by the fees collected. However, the number of tree-fees collected by this FRA varies widely each year. For example, in 1993 Flora Tietê collected nearly 831,000 tree-fees while in 2007 the number was reduced to 348,000. However, at the time of the site visit the FRA members were optimistic because of the 2008 regulation which is expected to increase government supervision of wood consumers and thus tax collection.

The Woodfuel Market and FRA Farmers. The price of woodfuel in the region of Flora Tietê is set by the market. The price at the time of the site visit was around US\$20/m^3. Average income for FRA-associated farmers when wood is harvested (five years after planting seedlings) is approximately US\$6000 per hectare. The yield of a well-managed plantation can reach 70m^3/ha/year. About 70% of the woodfuel is sold to middlemen that come to the farm and negotiate the price directly with the farmer. In turn, the middlemen log the timber and transport the woodfuel to the final consumers (bakeries, potteries, butchers, etc). According to the farmers, the demand for woodfuel is high; the income generated is excellent and is higher than other traditional rural activities in the region such as livestock or sugar cane. Most importantly, the price does not vary much throughout the year and has shown a general tendency to increase. In addition, a single *Eucalyptus* tree may coppice (re-grow) two times after it is cut, reducing new planting costs. *Eucalyptus* plantations were the main activities on the lands of two farmers interviewed, who also raise cattle inside the plantations.

ACIFLORA Forest Replacement Association, São Paulo

Operations and Activities. The ACIFLORA FRA was established in 1989 in the Bauru municipality. At the site visit, the FRA reported a staff of 15 people and expanded operations into 31 additional municipalities. FRA staff includes an agriculturist engineer, a production manager, two administrative officers and 11 technical personnel. The land occupied by the FRA is rented from the municipality. Currently, in addition to environmental education activities (which do not generate profit) the FRA performs other activities:

- Sale of seedlings;
- Implementation of restoration projects for the National Fund for Water Resources (FEHIDRO), which generates additional income that is important for improving the FRA's infrastructure.

Figure 30: ACIFLORA nursery and facilities at Bauru Municipality (SP).

Forest Replacement Statistics. The main species of *Eucalyptus* produced are *citriodora*[15], *saligna*, *urophylla* and *urograndis*. Most of the high quality seeds used by the FRA are bought from the Institute of Forest Research and Studies (IPEF) and other certified seed producers. The production of native species seedlings is low, with only about 130,000 trees of 60 native species planted. Staff of the FRA report that, the demand for native species is very low in the region.

In 15 years of operation, the FRA collected the equivalent of 4.7 million tree-fees. This revenue was used for administrative expenses and for planting 13% more trees than those for which they collected fees (5.4 million trees). Despite the FRA's generally good management, the association also reported recent deep reductions in annual forest

[15]This species was reclassified as *Corymbia citriodora* in 1995, by Ken Hill and Dr Laurie Johnson and published in "A revision of the bloodwoods, genus *Corymbia* (Myrtaceae)" in Telopea, 6(2-3), a journal of plant systematic published by the National Herbarium of the New South Wales Royal Botanic Gardens (source Australian plants on line; http://asgap.org.au/APOL2/jun96-5.html).

replacement tax receipts. In 1993 ACIFLORA collected nearly 450,000 tree-fees while in 2007 they collected less than 180,000.

The Woodfuel Market and FRA Farmers. Two farmers were interviewed during the site visit and reported their perspective on the FRA program. The price of woodfuel in the region of ACIFLORA is set by the market. At the time of the site visit, the price was around US\$15/m^3 and the net income for FRA-associated farmers was approximately US\$4500/hectare. The farmers interviewed were satisfied with the price of woodfuel and considered that the income from forest plantations is better than what they could make from raising livestock or growing rice (traditional rural activities in the region). In addition, farmers are happy with existing arrangements of selling the standing wood to middlemen, a similar arrangement as reported above with Flora Tiete FRA. ACIFLORA began donating seedlings for woodfuel production, however, the current greatest interest of local farmers is to produce wood log for timber, since there is an increasing demand for this forest product and the profit is much higher. Sawmills buy the timber that is at least 15 years old for US \$533/m^3 and the remainder is sold for woodfuel. *Corymbia citriodora* is considered the best species for wood log and the demand for its seedlings is the highest in ACIFLOR. The association members are also optimistic with the recent 2008 regulation.

PARDO GRANDE-VERDE TAMBAÚ Forest Replacement Association, São Paulo

Operations and Activities. This FRA began operating in 1990 in the Tambaú municipality and now includes 60 other municipalities in its reforestation activities. A section of the area occupied by the FRA (0.77 ha) was loaned by the municipality for 99 years, and an additional 2.4 ha was loaned for five years by a woodfuel consumer (Atlas Ceramics). At the time of the site visit, only 48% of FRA income came from forest replacement taxes, while 52% of its budget came from private services which cover the FRA's administrative expenses, such as:

- Sale of seedlings;
- Fee-based technical assistance offered to farmers, municipalities (urban arborization) and private companies.

This FRA is collaborating with São Paulo State University (USP) and the Tambaú municipality in a project to establish an arboretum of 45 native species which will be used to perform research on genetic improvement for seed production. Motivated by

this program, USP created the Center of Studies and Forest Development. The FRA also participates in the regional watershed committees.

Figure 31: Tree nursery facilities of VERDE TAMBAÚ FRA

Forest Replacement Statistics. In 15 years this FRA collected the equivalent of 7.6 million tree-fees and planted 10.3 million trees (26% more than collected). Of the *Eucalyptus* species produced, 90% of seedlings are from *E. urograndis*, 5% *E. urophylla* and other 5% of *C. citriodora*. Around 21% of seedlings produced are native species. The high quality seeds are purchased from the IPEF.

The nursery has current capacity for 1.2 million seedlings; however in 2008 the FRA collected replacement taxes to cover production of only 420,000 seedlings. For comparison, in 1993 the FRA collected the equivalent of nearly 700,000 tree-fees.

The Woodfuel Market and FRA Farmers. Two farmers were interviewed during the site visit. The cost of forest implantation for the farmers is US$1100/ha with FRA support (seedlings and technical assistance for 5 years). Farmers receive around US$19/$m^3$ of wood produced. The net income from one hectare after seven years is approximately US$4500 when the standing timber is sold to middlemen, in a process similar to that used by other FRAs. The farmers interviewed would like to receive more seedlings for planting because *Eucalyptus* has proven to be one of the most profitable activities available. Some of the farmers introduced cattle in the second year of the forest plantation to increase their earnings. According to the Executive and Technical directors of the FRA,

demand exceeds supply in the regional market for woodfuel. Recently, some supply has been provided by wood coming from orange plantations destroyed by species-specific plagues; the owners are cutting the trees and selling them for woodfuel.

FLORA VALE Forest Replacement Association, São Paulo

Operations and Activities. Flora Vale started operations in 1993 in the Assis municipality located in the Paranapanema river watershed. About 26 people work in this FRA, including one executive coordinator, two productive technicians and 17 workers (nursery and office), two educators and one coordinator. Flora Vale has established a joint program with the Assis municipality and Duke Energy Company called "Broto Verde" (Green Bud), which has been in operation since 1994. Broto Verde is an environmental education program for low-income teenagers from Assis, offering a small scholarship to study technical issues such as nursery operations and environmental education. The grant offers the teens other services like psychological counseling and dental services. At the time of the site visit, the program enrolled 100 male teenagers between 14 and 16 years old, who receive four hours of education after school. Participants must be registered in a regular school and show an interest in tree nursery activities. Today, a great part of the nurserymen that work in the FRA are graduates of this program.

Forest Replacement Statistics. In 15 years of operation, this FRA planted nearly 8 million trees, compared to 6.6 million tree-fees collected (fees covered 84% of trees planted). In 2000, Flora Vale collected its highest amount of replacement taxes (691,641 tree-fees) but by 2007 was collecting only half this number (320,000 tree-fees). At the time of the site visit, most of the seedlings produced by the FRA were sold to the local municipality (300,000 seedlings of *Eucalyptus* and native species) for further donating to local farmer associations. An additional 600,000 seedlings of native species were sold to Duke Energy Company (a private hydroelectric energy generator) for riparian forest restoration, since the restoration of native species in reservoir areas is required of hydroelectric companies in Brazil.

In the forest replacement program Flora Vale produced E. urophylla (50%), *E. urograndis* (30%), *E. grandis* (10) and *C. citriodora* (10%). The native species represent 14% of the total production. Most of the seeds (high quality) are bought from the IPEF and a small portion from certified private companies.

The Woodfuel Market and FRA Farmers. The total productivity of plantations is around $300 m^3/ha$ after five years and the price of woodfuel is around US\$16/m^3 when standing trees are sold. When the timber is delivered already cut to the consumer, the price may reach US\$23/m^3. Farmers sell primarily to a middleman, providing a net

Figure 32: Nursery facilities of FLORA VALE in the city of Assis (SP).

income of approximately US$5000 per hectare. Many farmers plant beans or cassava together with the seedlings during the first year. The woodfuel in the region is considered easy to sell due to a lack of local supply. The forest plantation is the most important economic activity for the one farmer interviewed during the site visit because he has found it to be a profitable activity that demands less time to manage, which allows him to run the store he owns in the nearby town.

ARFOM Municipal Forest Replacement Association of Santo Angelo, Rio Grande do Sul

Operations and Activities. ARFOM is the only FRA currently in operation in the state of Rio Grande do Sul. It was founded in 1990 and was, at the time, the third FRA created in the state. The board of directors is made up of 50% farmers and 50% consumers, compared to most FRAs where the board is composed of consumers only. ARFOM has no direct employees; the nursery operates with six employees paid by a contracting company. Today the FRA operates with the support of the local municipality, one agricultural cooperative, one manufacturer of vegetable oils and four consumers that pay an annual fee of just over US$200. The total annual income of the FRA is just US$14,000.

Forest Replacement Statistics. The FRA has distributed 6.3 million seedlings in 18 years

Figure 33: Tree nursery in Flora Vale in Assis, Sao Paulo.

Figure 34: Tree nursery facilities of ARFOM Santo Angelo

and reforested more than 2,500 hectares, benefiting 4,132 farmers. The species of *Eu-*

calyptus produced are *saligna* and *grandis* and 10% are native species. The high quality seeds are bought from EMBRAPA (Brazilian Agricultural Research Institute) and are pelletized[16]. Prior to 2001, when the FRA received forest replacement taxes, it offered the farmers from 18 other municipalities, seedlings, fertilizers, ant pesticide and technical assistance. Today the farmers receive only seedlings and they must pay 10% of the cost and 90% of the seedlings are destined for the Santo Angelo municipality only. Despite these changes, the number of seedlings distributed and the number of farmers supported has not varied much since 1995 (Figure 35), but the quality of the services offered to farmers dropped significantly with reduced technical assistance. According the Executive Director of the FRA, the low figures of planted trees and forest replacement tax collected since 1995 are due to the fact that the government never adequately enforced relevant laws, so that woodfuel consumers were not obligated to pay the full amount of forest replacement taxes due.

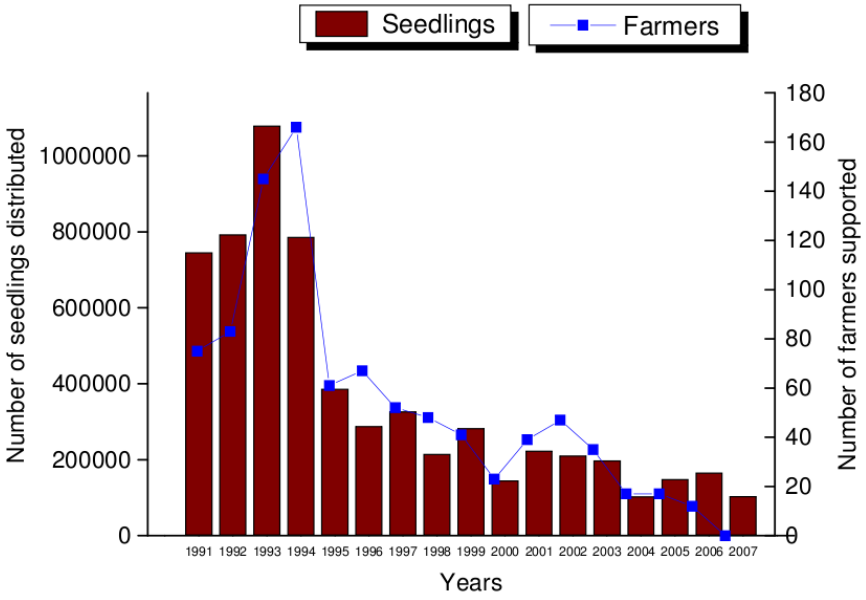

Figure 35: Seedlings distributed and farmers supported by ARFOM of Santo Angelo 1991-2007.

The Woodfuel Market and FRA Farmers. The consumers that support the FRA with an annual fee are companies that are concerned about lack of local woodfuel supply. Some have to travel more than 300 km to buy woodfuel. The average size of farms associated

[16]Seeds that have been coated with an inert material to facilitate handling.

with the FRA is 16 ha (small farms) and the beneficiary farmers associate the first year forest plantation with other agricultural crops such as corn and soybeans. During the second year many farmers allow livestock to graze among the trees. Farmers receive around US\$22.50/m^3 for the woodfuel harvested and delivered to local consumers and US\$7.60/m^3 when standing. In the latter case, a middleman would receive three times more than the farmer who grew the trees. The yield of a plantation after seven years was 350m^3/ha, and the net income for the farmer was US\$2200/ha for woodfuel sold standing, which is the most common method of sale. The main activities in the farms are agriculture crops (soybeans, corn and wheat) and the farmers considered forest plantations a welcome extra income stream.

The FRA executive coordinator, Mr. Nelson Almeida, believes that the one of the problems related to the forest production system, given that there is only one FRA operating in the state, is the quality of seedlings offered by the state TFP and its lack of technical assistance. The government only participates in licensing and supervision of farmers that want to include forest plantations on their farms, and does not offer technical assistance. Mr. Almeida also perceives an emerging trend to transfer forest management issues from the state to the municipality; however he considers that most municipalities do not have the capacity to carry out such activities. Mr. Almeida also reported his view that the current dominant thinking in the government and legislative assembly regarding "forest sustainability" is that the free market should be in control, while the NGOs are only worried about the defense of the environment in a general sense (defense of specific kinds of ecosystems, transgenic products, lost of diversity, etc.). The result is that no significant stakeholder is committed to real forest sustainability.

ARFLOR Regional Forest Replacement Association of São Sebastião do Caí, Rio Grande do Sul (Inactive)

Operations and Activities. This former FRA was founded in 1994 and was active until 2007. Beginning in 2003 - two years after the exemption of reforestation requirements was introduced - the FRA's collection of replacement taxes fell drastically (see Figure 36). The FRA continued to operate for four more years but eventually had to cease operations.

The Tupandi municipality cooperated with the FRA in the selection of farmers, in the transportation of seedlings from the nurseries to the farms and in the promotion of native species plantation. ARFLOR was also involved in the promotion of *Eucalyptus* plantations for honey production, which could subsequently be logged for timber after 15 years. Together with the Tobacco Association Producers, ARFLOR offered farmers a group of seedlings of *Eucalyptus* species that produced flowers in different seasons,

allowing honey collection throughout the year. In this case, contracts between the FRA and farmers included specific language which described the special management tasks required on such a plantation, including the actions required of the farmer during the different stages of planting, growing and management.

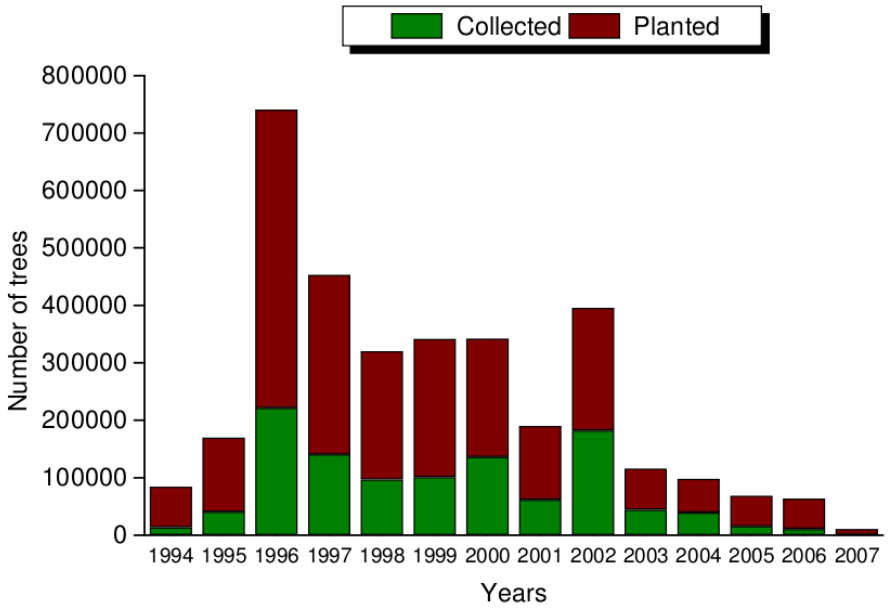

Figure 36: Tree-fees collected and trees planted by ARFLOR of São Sebastião do Caí from 1994 to 2007. Data source: Annual reports from ARFOR São Sebastião do Caí

Forest Replacement Statistics. In 14 years of operation, ARFLOR had planted 2.3 million trees with only 1.1 million tree-fees collected (48%), and operated in more than 100 nearby municipalities. In 2007, 89.5% of the produced seedlings of this FRA were from *Eucalyptus* (*dunnii* and *saligna*), 10% of black wattle (*Acacia mearnsii* de Wild[17]) and 0.5% of native species. After five years, the yield of black wattle was around 140m^3/hectare, and that of *Eucalyptus* was approximately 210 m^3/hectare.

The Woodfuel Market and FRA Farmers. Most regional enterprises that are consumers of woodfuel are pickle industries, potteries, ceramics companies and farms for swine

[17]Native species of Southeast Australia (Victoria to New South Wales and southern Queensland) and Tasmania. Its main use in Rio Grande do Sul is for tanning of soft-leather, which places Brazil as the second leading world tannin exporter. Ranging from 30-54 percent tannin in dried bark (NAS, 1980). This species is also used for pulp, woodfuel and timber production (Assis et al. 1993)

Figure 37: Ricardo Litwinski Sufert, founder of ARFLOR of São Sebastião do Caí beside the *Acacia mearnsii* plantation in the Harmonia Municipality (RS).

and poultry. The price of the wood was around US\$20/m^3 of harvested wood and the farmer received around US\$2800 and US\$4200 per hectare for the sale of *Acacia* and *Eucalyptus* respectively. In the farm visited, *Eucalyptus* silviculture was the second most important economic activity, surpassed only by tobacco, and the farmer received PRONAF credit for the crops cultivated. On his two-year-old tree plantation, the farmer also grew tobacco, corn and beans. He felt it would be very easy to sell the wood when it was ready to harvest. In this region, farmers cut the timber themselves and then stack it next to the road to signal that it is for sale. Usually such timber is purchased by middlemen who sell it onwards to final consumers.

ARFOM Municipal Forest Replacement of Santiago, Rio Grande do Sul (Inactive)

Operations and Activities. This FRA was relatively very small. It began operations in 1995 in eight municipalities around the Santiago municipality. ARFOM ceased operations in 2003, because beginning in both the taxes collected and the number of trees

Figure 38: *Eucalyptus* plantations in the small farm of Lídio Aluisio Kochhann, farmer and ex-partner of ARFLOR of São Sebastião Do Caí, in the Tupandí Municipality (RS).

planted fell drastically (from 39,500 trees planted in 1996 to only 12,600 in 2000; Figure 39). The main reason for this decline was the exemption of the requirement of forest replacement established by the 2001 moratorium. ARFOM never had a nursery of its own; its main role was to manage the replacement taxes, to buy high quality seedlings from commercial tree nurseries and pesticides, to select farmers and to prepare contracts. The FRA worked with the Santiago municipality, which was responsible for transporting seedlings to the farms. ARFOM also collaborated with EMATER to offer technical assistance (the FRA executive coordinator was a forest technician of EMATER).

Forest Replacement Statistics. In eight years of operation, the FRA planted 196,300 trees and supported 163 farmers with seedlings, ant pesticides and technical assistance. The seedlings, mainly of *E. grandis* and *saligna*, came from the Cruz Alta University Foundation (located at the nearby Ijuí municipality). The FRA encouraged farmers to graze livestock in the *Eucalyptus* plantations after the second year.

Farmers that were under contract with ARFOM committed, to maintaining a survival rate of at least 70% of the seedlings and to keeping the plantation free of weeds during the two first years. The partners were small farmers (around 30 ha), producing many items (milk, meat, brooms, sugarcane spirits, peanuts, beans, etc.) and were associated in cooperatives.

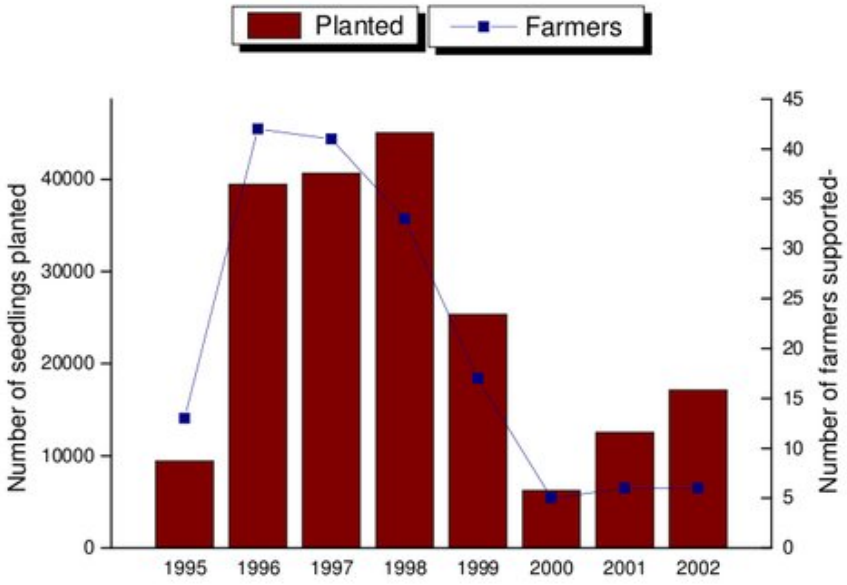

Figure 39: Trees planted and farmers supported by ARFOM of Santiago 1995-2003. Data source: ARFOM of Santiago annual reports

The Woodfuel Market and FRA Farmers. The forest production was marginal in the farms and the price of woodfuel was low compared with other regions. Farmers received around US$11.26 per ms (around 0.70 of m^3) or US$3400 per ha after seven years. Most of the farmers preferred to use or sell the wood for logs after 15 years when they could get around US$7200 per hectare.

Annex 2 | List of people interviewed in Brazil and Nicaragua

Brazil

Institutional

São Paulo

- Carlos Eduardo Beduschi - Forest Management Department, São Paulo State Environmental Secretary.
- Ricardo Viegas, Director of Forest Development Department São Paulo State Environmental Secretary.
- Dr. Ézio Spera - Municipal Mayor of Assis Municipality.

Paraná

- Emanuele Jankowski Saboia- Forest Department Chief, IAP.

Rio Grande do Sul

- Rafael Ferreira, Department of Forest and Protected Areas Director of Rio Grande do Sul State Environmental Secretary

Minas Gerais

- João Câncio de Andrade Araújo - Forestry Superintendent, ASIFLOR, Belo Horizonte Municipality (interview by internet).
- Julio Cadaval Bedê - Consultant Environment Area of the Minas Gerais State Legislative Assembly, Belo Horizonte Municipality (interview by internet).

Forest Replacement Associations Members

São Paulo

- João Seiki Nagamura, Chairman of FARESP and member of ECOAR Forest Replacement Association.

- José Catarino, Ex - Chairman of FARESP and recently appointed as Executive Director of Pontal Flora Forest Replacement Association
- Claudio José Silvestre, Institutional Director, VERDE TAMBAÚ, Tambaú Municipality
- Antonio Carlos Rosa, Technical Director, VERDE TAMBAÚ, Tambaú Municipality
- Paulo Henrique Arruda, Nursery Production Manager, FLORA VALE, Assis Municipality
- Isaura Aparecida Toloy, Executive Coordinator, ACIFLORA, Bauru Municipality.
- Fernado Alberto Buzeto - Nursery Production Manager, FLORA TIETÊ, Penápolis Municipality
- José Borges Campos Neto, Executive Coordinator, FLORA TIETÊ, Penápolis Municipality

Rio Grande do Sul

- Gilmar Deponti, Founder, ARFOM Nova Esperança
- Nelson Lopes de Almeida - Technical Coordinator, ARFOM Santo Angelo
- Ricardo Litwinski Suffert, Founder, ARFLOR São Sebastião do Caí
- Leida Werlang Kochhann, Environmental Fiscal of Tupandi Municipality, ARFLOR São Sebastião do Caí support.
- Ricardo Roberto Mossmann, Forest extension of Tupandi Municipality , ARFLOR São Sebastião do Caí support.

Farmers and Consumers

São Paulo

- José Marcio Salatiel, Farmer, VERDE TAMBAÚ, Tambaú
- Duílio A. Salamoni de Campos, Farmer, VERDE TAMBAÚ, Santa Rita do Passa Quatro Municipality
- Helio Rosa Sussel - Farmer, FLORA VALE, Assis Municipality.

- Shozo Sakai - Farmer, ACIFLORA. Bauru Municipality
- Flavio Faidega, Consumer and farmer, ACIFLORA, Bauru Municipality

Rio Grande do Sul

- Ulisses Cogo, Farmer, ARFOM Nova Esperança Municipality
- José Paulo Viero - Farmer, ARFOM Nova Esperança Municipality
- Vilmar Cargnelutti, Farmer, ARFOM Santo Ângelo Municipality
- Egidio Angeri - Farmer, ARFOM Santo Ângelo Municipality
- Lídio Aluisio Kochhann, Farmer, ARFLOR São Sebastião do Caí, Tupandí Municipality

Figure 40: Interview with José Paulo Viero, farmer and ex-partner of ARFOM Santiago (RS)

Nicaragua

Institucional

- Dr. Fernando Sanchez - General Director of Policy and Planning, MEM

- Rosario Saenz - Executive Director, FUNDENIC
- Jacinto Cedeño - Forest Project Coordinator, FUNDENIC
- Marlyng Buitrago - Manager, PROLEÑA
- Leonardo Majorca - Board Member, PROLEÑA
- Rosario Sotelo - Founding Member, PROLEÑA
- María Eugenia Rosales Caballero - Forest Incentives Department, INAFOR
- Franz E. Arnold - Advisor of German Forest Cooperation, INAFOR
- Augusto García - WB, INAFOR
- Oscar Valdivia - Municipal Operating Department, INAFOR
- Maria Esperanza Siria - Biomass Energy Specialist, MEM.

Forest Replacement Associations Members

ARCE

- Karen Mejia - Accountancy
- Alfredo Arroliga - Paymaster
- Pedro C. Muñoz Tejada - Member-Partner
- Angel A. S. Muñoz - Member-Partner
- Martin I. Membrino - Fiscal Management
- Francisco Lopez - Chairman

ASEROFOR

- Francisco Oscar Berillo Ocampo - Founding Partner
- James F. Dolmus Sandoval - Executive Secretary
- Juan T. Morelales Vargas - Paymaster
- Maria de Los Angeles Morales - Manager of Nursery Production and Tax Board

- Aristoteles Mendonza - Accountant

ECO CARBON

- Maria Sanchez - Charmain - Partner

APROPRES

- Arsenio de Jesus Gutierrez - Nurserymen-Partner
- Jose Benicio Hernandez Garcia - Partner
- Juan Emilio Vargas - Chairman of Board

Farmers and Consumers

- Eriberto Antoni Toruño - Farmer, San Juan District. La Paz Centro Municipality
- Ycidro Jesus Morales vargas - Farmer, El Jardin District. La Paz Centro Municipality
- Ramon Reyes - Consumer, Manager of San Pablo Manufacture of Bricks and Tiles, La Paz Centro Municipality

Annex 3 | List of Forest Replacement Associations that are members of the Confederation of Replacement Associations of São Paulo (FARESP)

ACERVIR
Associação das Cerâmicas Vermelhas de Itu e Região
Av. Corporação Musical União dos Artistas, 110 - Caixa postal 564, Vila Lucinda, 13300-000, Itu
(11)4024-3294/ 4305 / 4421
acervir@acervir.com.br
www.acervir.com.br

ACIFLORA
Associação Florestal e Ecológica da Região de Bauru
Av.Rodrigues Alves, 4.615, Vila Coralina 17030-000 Bauru
(14).3203-5975
aciflora@terra.com.br
www.aciflora.com.br

ARFLOM
Associação de Reflorestamento da Serra da Mantiqueira
Av. Pedro Paulo s/ nº, Horto Florestal 12460-000 Caixa Postal nº 264, Campos do Jordão
(12)3663-3762, (12)3663-1977 pecjordao@if.sp.gov.br

ECOAR
Associação Ecoar Florestal
Rua Dr. Augusto de Miranda, nº 1.186, Vila Pompéia, 05026-001, São Paulo
(11) 2574-1626
florestal@ecoar.org.br
www.ecoarflorestal.org.br

EMA
Associação de Reposição Florestal EMA
Rua Venâncio Ayres, 556 Conj. A, Centro, 18200-660, Itapetininga
(15)3271-2246
ema@ebras.com.br
www.ebras.com.br/ema

FLORA CANTAREIRA
Associação de Recuperação Florestal da Bacia dos Rios Jaguari, Atibaia,Camanducaia e Sistema Cantareira
Rua São José, 133, Centro, 13920-000, Pedreira
(19)3893-3468, (19)3893-2961
florestalcantareira@uol.com.br

FLORA PARAÍBA
Associação de Recuperação Florestal do Vale do Paraíba e Litoral Norte
Rua Nossa Senhora da Piedade, 185 sala 5 Centro 12600-190, Lorena
(12)3152-4155
gabrieljrnunes@pop.com.br

FLORA PAULISTA
Associação Paulista de Recuperação e Preservação da Ecologia
Rodovia do contorno s/nº Jardim Bandeirantes, 17505-200, Marília
(14)3413-3463 flora@coopemar.com.br

FLORA RIO GRANDE
Associação de Recuperação Florestal do Vale do Rio Grande
Av.Wilson Sábio de Mello, 3.100 Distrito Industrial 14406-052, Franca
(16)3720-0993, (16)3711-6243
compras.fertilizantes@cocapec.com.br

FLORA TIÊTE
Associação de Recuperação Florestal Flora Tiête
Av. Presidente Getúlio Vargas, 151-A Parque Industrial, 16300-000, Penapólis
(18)3652-2348
floratiete@floratiete.org.br
www.floratiete.org.br

FLORA VALE
Associação de Recuperação Florestal do Médio Paranapanema
Av. Nove de Julho, nº 520 - 3º Andar Conj 31 Centro, 9800-020, Assis
(18)3322-2996, (18)3324-7003
floravale@femanet.com.br
www.floravale.com.br

FLORESPI
Associação de Recuperação Florestal da Bacia do Rio Piracicaba e região
R. Tiradentes, 1139, Centro 13400-765, Piracicaba
(19) 3434-2328
florespi@florespi.org.br
www.florespi.org.br

PONTAL FLORA
Associação de Recuperação Florestal do Pontal do Paranapanema
Rodovia Raposo Tavares, Km 622 Aeroporto, 19400-000, São Paulo
(18)3271-8085, (18)3271-3633
pontalflora@itelefonica.com.br
www.pontalflora.com.br

TRÓPICA FLORA
Associação de Reposição Florestal Trópica Flora Rua Quinze de Novembro, 195 Centro, 13920-000, Pedreira
(11)4815-5777
chadania@uol.com.br / adm@mataciliar.org.br
www.mataciliar.org.br

VERDE TAMBAÚ
Associação de Recuperação Florestal do Pardo Grande
Rua Santo Antônio, 73 Sobre Loja Sala 3 Centro, 13710-000, Tambaú (19)3673-1179/ 2469
verdetambau@verdetambau.com.br
www.verdetambau.com.br

VITAL FLORA
Associação de Reflorestamento do Noroeste do Estado de São Paulo
Rua Alceu Lemos de Medeiros, 161 Jardim Veneza(Viveiro), CP 15082-018, São José do Rio Preto.
(17)3808-1764, (17)3242-9716
vital.flora@ig.com.br