Amazonia at the Crossroads

The Challenge of Sustainable Development

edited by

Anthony Hall

Institute of Latin American Studies
31 Tavistock Square, London WC1H 9HA
http://www.sas.ac.uk/ilas/publicat.htm

Institute of Latin American Studies
School of Advanced Study
University of London

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available
from the British Library

ISBN 1 900039 31 1

CHAPTER NINE

Agroforestry Development and Prospects in the Brazilian Amazon

Nigel J.H. Smith

Introduction

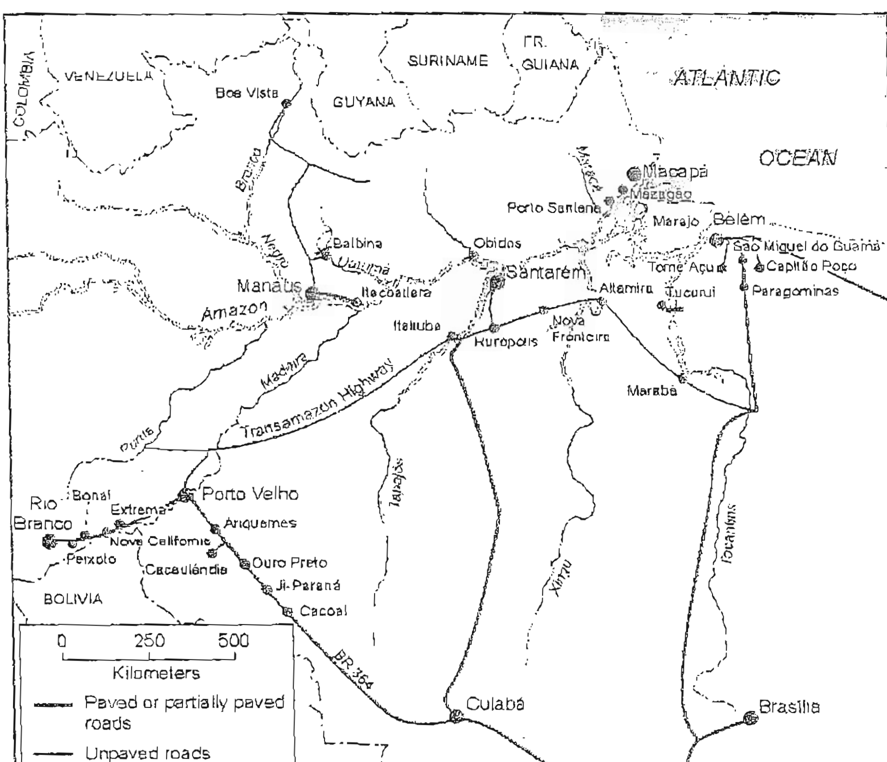
Agroforestry is often touted as one of the more 'desirable' forms of land use in the Amazon and other tropical forest regions because of its many perceived ecological and social virtues. Agroforestry involves the growing together of at least two crops, one of which is a perennial. The cultivation of tree or bush crops alongside other perennials or annuals is thought to replicate the forest — albeit on a simplified scale — reduce soil erosion and help farmers to diversify their incomes and sources of food. Agroforestry is also deemed to be a more 'stable' agricultural production system than monocultural fields, which tend to be more prone to disease and pest attack. In the case of the Amazon, agroforestry is also envisaged as one way to help arrest deforestation, an issue that has again surfaced at the international level with dramatic forest fires sweeping across parts of the Amazon, especially in Roraima, and on Kalimantan in Indonesia.

Some of the perceived virtues of agroforestry may have been oversold, but it is certainly less damaging to the environment than some other land uses, particularly cattle ranching. Yet for all its perceived benefits, agroforestry in field settings occupies a relatively small portion of cleared areas in the Brazilian Amazon. Cattle ranching, second growth, annual crops and root crops — particularly manioc — dominate deforested areas. Before examining why agroforestry is largely hemmed in by other land uses, agroforestry systems in the Brazilian Amazon are described to point out their diversity and long history. Finally, suggestions for promoting agroforestry are offered so that land use patterns might be more balanced. The purpose should not be to foster agroforestry at the expense of other cropping patterns, but to level the playing field.

Agroforestry in a land-use perspective

Agroforestry is largely in the hands of small farmers and generally occupies relatively small portions of their operations. Polyculture with perennials is virtually absent on ranches, even for living fences, mainly because of the frequent use of fire to check growth of weeds. Small operators, rather than large-scale ranchers, are trying out innovative combinations of pasture and tree crops. A farmer living in the community of Murumuru in the Municipality of Santarém, for example, has planted yellow mombim (*Spondias mombim*) trees to support a fence around his small pasture. Yellow mombim, known locally as *taperebá* and as *cajá* in other parts of tropical Brazil, sprouts readily from cuttings and produces a much-appreciated fruit. In Rondônia and near Tomé-Açu in Pará (see Figure 9.1), a few farmers graze livestock in small groves of rubber trees.

Figure 9.1 The Brazilian Amazon



Rather than intercrop with perennials, many small farmers are pursuing other land-use options, such as raising small herds of cattle, growing monocultures of robusta coffee or cacao or cultivating vegetables intensively on small plots for urban markets. While some farmers specialise in such activities, more often they combine a range of land uses to spread risks. A large proportion of farmers still rely primarily on slash-and-burn agriculture for subsistence and income generation. Apart from home gardens, agroforestry remains a minor component of the varied tapestry of land uses in most areas of the Brazilian Amazon.

Historical dimensions

Agroforestry has been practised in Amazonia for millennia. Traditional agroforestry encompasses three main land uses: forest enrichment; managed fallows between periods of cultivation with short-cycle crops; and home gardens. International donors often see forest enrichment as the more 'desirable' form of agroforestry because forest disturbance is minimal. Forest enrichment involves planting crops, usually perennials, in light gaps in the forest. The light wells or narrow corridors can be natural, caused by tree falls, or artificial. In practice, very few examples of such forest enrichment can be identified, at least on a commercial scale. Enrichment planting generally works better in second growth where light is more generous. 'Enriched' forests exploited by rural communities in the Amazon today are generally 'managed' fallows, areas that have been completely deforested, farmed and then reconstituted using perennial species of subsistence and commercial value.

Managed fallows can be found in various parts of the Amazon basin, such as in Peru where *umarí* (*Poraqueiba sericea*) and Brazil nut (*Bertholletia excelsa*) are often important components of such systems in their mature stages. Except in the case of ancient Brazil nut groves, enriched forest only attains significant economic importance close to major cities and towns. The *açaí* palm-rich forests of the Amazon estuary are the culmination of centuries of enrichment planting (see Photo 1) following slash-and-burn farming.[2] Extraction of fruits and nuts from cultural forests also provides appreciable income for farmers in other parts of the Amazon floodplain, such as in the backswamp forests near Santarém (see Photo 2) and in the Peruvian Amazon near Iquitos.[3]

---

[1] Denevan and Padoch (1987); Padoch and de Jong (1995).

[2] Anderson (1988, 1990); Anderson and Ioris (1992).

[3] Hiraoka (1989); Padoch (1988); Padoch et al. (1985).

Photo 1 A farmer tending his nursery of *açaí* palm seedlings. These seedlings will be planted in a field on the floodplain of the lower Maracá, an affluent of the lower Amazon, after the maize is harvested. Comunidade São João, Maracá River, Amapá, 4 May 1996.

Home gardens are another traditional form of agroforestry, often overlooked by development planners. Rural people throughout the Amazon, both in upland and floodplain areas, typically cultivate a wide assortment of perennial and herbaceous plants around their houses.[4] Home gardens are a greatly under-utilised source of promising new plants for widespread commercial production for several reasons. Farmers often recruit wild plants from the forest or test exotic plants in their home gardens before risking a larger investment by planting them in fields.[5]

[4] Leeuwen and Gomes (1995).

[5] Noda et al. (1997); Smith (1996).

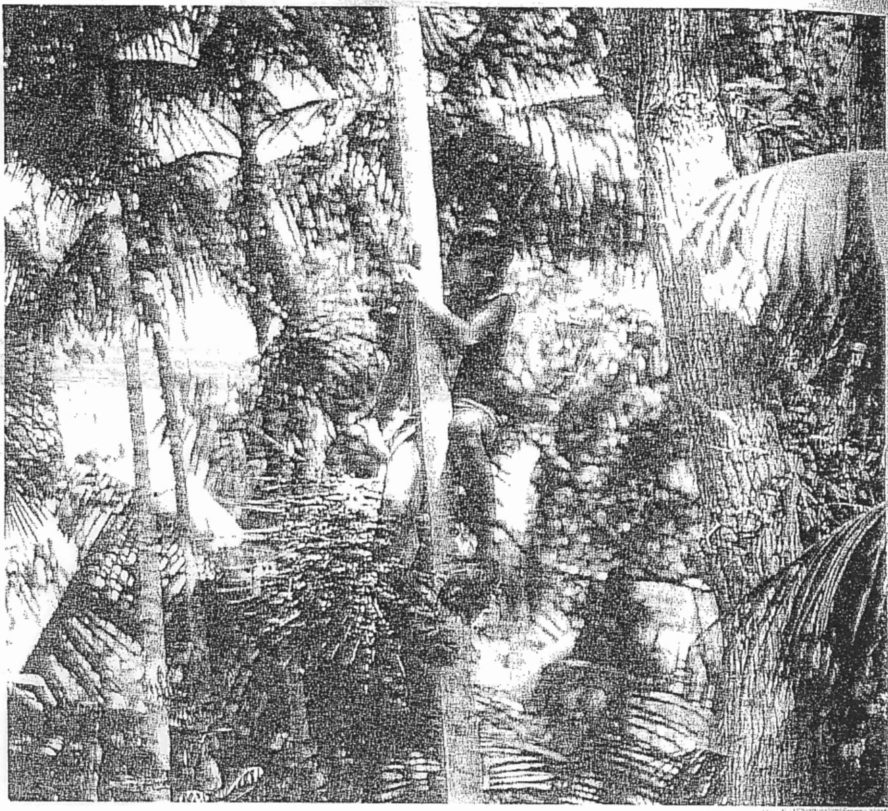


Photo 2 Harvesting fruits of *açaí* palm from a backswamp forest of the Amazon floodplain. The boy has a footsling fashioned from polypropylene sacking to facilitate his climb up the palms, which can reach twenty metres. The fruits will be sold in Santarém to make juice and ice cream. Murumuru, municipality of Santarém, Pará, 19 July 1996.

Japanese-Brazilian farmers in Tomé-Açu in Pará State have been among the vanguard of commercial agroforestry in the Brazilian Amazon. Dozens of Japanese families immigrated to Tomé-Açu in the late 1920s and early 1930s and, after a series of disappointing rice harvests, they settled on black pepper as their main cash crop in the 1950s. The close-knit community soon formed the Cooperativa Agropecuária Mixta de Tomé-Açu (CAMTA) to market black pepper, much of which is exported through the port of Belém.

Black pepper was cultivated in Tomé-Açu as a monocrop and became susceptible to a virulent disease, *Fusarium wilt*. The ravages of *Fusarium wilt* forced the Japanese-Brazilian farmers to diversify their farming operations towards agroforestry. Black pepper once accounted for virtually all of the value of crop production in Tomé-Açu but, by 1992, the crop accounted for only about one-fifth of the total value of agricultural production. Papaya came on the scene as a commercial option in the late 1970s, but within a few years its importance had also plummeted, the victim of disease build-up, particularly that of ringspot, and competition from other producers, especially in the north-east of Brazil. Many farmers in Tomé-Açu have now adopted agroforestry as a means to reduce vulnerability to diseases and pests as well as the vagaries of the market.

Although black pepper is no longer the most important commercial crop for members of the CAMTA cooperative in the vicinity of Tomé-Açu, it helped generate sufficient wealth that farmers were in a better position to experiment with alternative crops. Even though black pepper plantations only remain productive for about eight years, they help support families while intercropped perennials come on line.

It might be argued that the Tomé-Açu experience is unique and cannot be replicated. In addition to capital generated by Japanese-Brazilians travelling to Japan for short-term employment, the government of Japan has subsidised the cooperative at Tomé-Açu. However, other farmers in the vicinity of Tomé-Açu have also adopted a diverse array of agroforestry systems in old black pepper fields. The incomes of the latter do not appear to be as high as those of the Japanese-Brazilian farms, but the trend is similar. Many small-scale farmers from diverse parts of Brazil who have settled in pioneer zones in Amazonia have adopted commercial agroforestry, and so have numerous farmers who were born in the region.

Commercial field agroforestry

Although some agroforestry fields contain over two dozen perennial species, most commercial polycultural plots besides those in home gardens contain from two to six tree or shrub species. Species diversity in agroforestry fields generally dips considerably compared to home gardens as market forces streamline the number of commercially viable crop candidates. Agroforestry fields are generally in the 0.5 to ten-hectare range, but one to three hectares is typical of commercial agroforestry fields.

Farmers in both upland and floodplain areas of the Amazon are experimenting with a rich array of perennial crops and crop combinations, mostly on their own initiative. Farmers have deployed well over 100 agroforestry configurations in the Brazilian Amazon, involving over 80 perennial crops.[6]

---

[6] Smith et al. (1995a, 1996).

This diversity is a resource still largely ignored by agricultural research a development organisations.

The origins of field agroforestry are also diverse. Many of them can traced to:

- The evolution of black pepper plantations that are succumbing to *F sarium wilt* or have already been destroyed by the disease. Instead abandoning disease-ridden black pepper plantations, many farmers o to interplant perennial crops, such as *cupuaçu* (*Theobroma grandifl rum*), oil palm (*Elaeis guineensis*) or citrus, so that the field remains i production as the black pepper harvests diminish after about eigh years. Some farmers intercrop fine hardwoods as well so that incom can be generated later in the field's life cycle.
- The planting of perennials, such as Barbados cherry (*Malpighia glabra* or citrus, in groves of passion fruit (*Passiflora edulis*) so that other fruit come on line as passion fruit ceases producing after about three years.
- Spontaneous enrichment of cacao and, to a lesser extent, robusta coffee with valuable timber trees.
- The planting of timber trees in cacao and robusta coffee groves to provide shade and future income.
- The planting of fruit and timber trees among manioc that would otherwise represent the terminal stage in slash-and-burn fields.
- The protection of timber species in pastures.
- The introduction of pasture grasses and/or forage legumes in rubber groves that are either no longer tapped or have never been tapped because of low prices.
- The establishment of living fences around pastures.
- The planting of fruit trees around fish culture ponds, or encouraging the natural regeneration of trees that produce fruit or nuts that are consumed by *tambaqui* and other fish raised in artificial water bodies.

In areas where cacao is an important cash crop, such as on the better soils (alfisols) of the Transamazon, farmers sometimes 'start' their agroforestry fields with manioc as an intercrop to feed workers. Manioc is then phased out within a year or two as the main cash crops — robusta coffee or cacao — become established. Short-cycle crops are sometimes incorporated in polycultural systems involving perennials because landowners are reluctant to allow resident workers to grow their own food in separate plots. If they did, workers might lay claim to the land. If, on the other hand, food crops are planted among perennials that are getting established, the landowner has less to worry about with respect to labour disputes.

Another departure point for agroforestry is found among vegetable growers in the vicinity of Agrovila Nova Fronteira along the Transamazon Highway. Several growers there are planting perennials, such as robusta coffee, *cupuaçu* or soursop (*Annona muricata*), among tomatoes and bell peppers because vegetable plots are itinerant in order to stay ahead of nematodes and other pests. The perennial crops benefit from the irrigation and fertiliser for the one to two years the vegetable plots are kept in production.

Major constraints

Constraints to the more widespread adoption of commercial agroforestry can be separated roughly into three main categories: socioeconomic infrastructure, credit and research capacity and technology delivery. These are not hard-and-fast groupings and issues often overlap. Overall, the major constraints are socioeconomic and political in nature, rather than a lack of adequate crop candidates for agroforestry development.[7]

Socioeconomic infrastructure

Markets

Market access is a problem for many agroforestry products.[8] The issue is not what will grow well in Amazonia, but rather who is willing to buy the product at a price and in sufficient quantities to make it a worthwhile proposition for all parties involved. In many cases development agencies and non-government organisations (NGOs) simply assume there will be a market for whatever they produce and are disappointed when that market does not materialise.

Some 'green' markets may help alleviate marketing problems for growers adopting agroforestry systems in Amazonia. The Pobreza e Meio Ambiente na Amazônia (POEMA) project in eastern Pará has been able to sell headrest cushions made from coconut fibre and rubber to the Daimler-Benz company of Germany, which uses them in automobile production. Although these types of markets may be limited, they provide some income-generating opportunities.

---

[7] Smith et al. (1998).

[8] Fearnside (1998).

Table 9.1: Some Intercropping Configurations in Cacao Orchards in the Brazi Amazon, 1996 (timber species in italics)

Location	Species Intercropped with Cacao	Area (hectares)	Age of C (year
10 km W of Ouro Preto, Rondônia	***Bandarra***	5	1
Km 95 Altamira-Itaituba, Pará	Taperebá*, *ipê**, tauari*, Brazil nut*, *paricá**, babaçu*, *kapok**	20	1[illegible]
S. travessão Km 80 Altamira-Itaituba, Pará	Rubber, ingá*, gmelina, *tatajuba**	6	1[illegible]
Km 107 Altamira-Itaituba, Pará	*Mahogany*, babaçu*, Brazil nut*, taperebá*, *cedar**, *paricá**, canafista, gameleira*,	35	1[illegible]
Km 107 Altamira-Itaituba, Pará	*Freijó**, *ipê**, *tatajuba**, taperebá*	20	12
Km 107 Altamira-Itaituba, Pará	Banana, manioc, papaya*, *cedar*	5	1
Travessão Km 165 Altamira-Itaituba, Pará	*Mahogany*, jackfruit, mango, avocado, taperebá*, palheteira, *ipê**, jarana*, *tatajuba**, Malay apple	24	12
Km 75 Altamira-Itaituba, Pará	*Jarana**, *ipê roxo**, *ipê amarelo**, *tatajuba*, *freijó**, *melancieira**, taperebá*, ingá*, ingá do metro, *cedar**, *mahogany*, figueira*, mororo*, pindaíba*, gmelina, palheteira, *itaúba**, banana	10	20
Km 79 Altamira-Itaituba, Pará	*Tatajuba**, mango, taperebá*, angico*, *ipê roxo**, babaçu*	8	12
Km 77 Altamira-Itaituba, Pará	Palheteira, ingá*, taperebá*, *tatajuba**, *ipê**	1	24
Ramal João Leãoquinho, R. Xingu, 7 km upstream from Altamira, Pará	Cumaru*, faveira*, ingá*, banana	1	10
Murumuru, near Santarém, Pará	Passion fruit, tangerine, murici, pineapple, avocado, cupuaçu, peach palm, sweetsop, açaí, lime, tamarind, guava*, breadfruit, banana, soursop, Barbados cherry	0.9	8

* Spontaneous

Source: Author's field notes.

The growing market for timber has enticed a significant number of farmers to incorporate timber species in their agroforestry fields. Timber species are deliberately planted and spared when they arise spontaneously in orchards. This trend is widespread and is particularly noticeable among cacao and coffee growers in Rondônia and along the Transamazon Highway between Altamira and Rurópolis. Floodplain farmers are also increasingly aware of the value of spontaneous timber species in their agroforestry fields, such as those along the Maracá river in Amapá and near Urucurituba on the middle Amazon floodplain.

Farmers are planting or encouraging two types of timber species: quick growing 'softwoods' to be used as filler material in plywood, and hardwoods with high market value. In the former category, three species are commonly being planted or protected: *paricá* (*Schizolobium amazonicum*), also known as *bandarra*; *pinho cuiabano* (*Parkia multijuga*); and *kapok* (*Ceiba pentandra*). The softwoods can be harvested within ten to 12 years. Precious hardwoods, such as *ipê* (*Tabebuia* spp.), mahogany (*Swietenia macrophylla*), cedar (*Cedrela odorata*) and *freijó* (*Cordia* spp.), are also being planted or protected if they sprout spontaneously, but farmers have to wait 20 to 30 years before they are ready for market. The intercropping of timber trees is especially evident in cacao groves in upland areas of the Brazilian Amazon (see Table 9.1).

Some farmers have recognised the value of saving tracts of forest on their properties as the source of seeds of timber species arising spontaneously in their orchards. Furthermore, several farmers in Rondônia are allowing seed collectors, for a fee, to comb their forest patches for valuable timber species. The Arara Indians are selling to several colonists mahogany seeds collected on their reserve in the vicinity of kilometre 100 of the Altamira–Rurópolis stretch of the Transamazon Highway. In such cases, farmers have spared trees in their forest tracts from the chainsaws of logging crews. Moreover, the Arara are understandably incensed that loggers have illegally penetrated their reserve.

Agroforestry farmers generally have greater difficulties in selling fruit crops. The local markets for fresh fruit may become quickly saturated in season, and if no facilities for processing and freezing pulp are available, much production spoils. If more agroindustries were operational, less fruit would be wasted and farmers would be more likely to adopt agroforestry. In this manner, fruit products could be better stored and sold during the off-season or transported to more distant markets.

Agroindustrial development

Although several large and small agroindustries have been established in the Brazilian Amazon to process fruits, a number of constraints have prevented expansion of their activities or have led to plants closing in several cases. Among the most common complaints is unreliable electricity supply. Rural electrification is either non-existent or often precarious, leading to black and deterioration of pulp in cold storage. Back-up generators are ex sive. One farmer remarked that if you have to depend on refrigeration your products, you are going to have problems.

Another factor affecting product quality is hygiene. For the most part, s dards of cleanliness in the fruit-processing plants in the Amazon leave muc be desired, particularly for the export market. Few agroindustries can affor set up in-house laboratories to systematically monitor product quality systen cally. Fruit-Ron in Ji-Paraná, Rondônia, which became operational in 199 an exception. Fruit-Ron is one of the largest fruit pulp processing plant Amazonia with an annual capacity of 15,000 tons of pulp. It currently sends zen fruit pulp, particularly of Barbados cherry, to Germany, Puerto Rico the United States via the port of Santos in São Paulo.

CHOCAM, a Manaus-based company, produced a powdered chocolate using *cupuaçu* beans before it went out of business due to problems with pro uniformity. Farmers did not always take care to ferment the beans properly batches of *cupuaçu* powder varied noticeably in taste. Inadequate infrastructure agroindustry and marketing is a major reason why Amazonia is losing out to o regions of Brazil in tropical fruit production. This process has been underway several decades and appears to be accelerating. For example, Bahia has bee more significant producer of *guaraná* (*Prancea Duckeana*) than northern Brazi over a decade, even though the crop is native to the Maués area of the Braz Amazon. Growers in the drier parts of north-eastern Brazil are competing succ fully with Amazonian producers to supply southern markets with Barbados che and the Brazilian north-east has recently emerged as a significant exporter of fi mangoes to the United States.[9]

Camu-camu (*Myrciaria dubia*), a recently domesticated fruit that is nativ certain floodplain areas of central and western Amazonia, seems destined the same fate. *Camu-camu* is one of the up-and-coming fruits of Amazonia si it makes an enticing juice and is exceptionally rich in vitamin C, much more than the juice of orange or Barbados cherry. Fink, a Manaus-based comp specialising in pharmaceutical supplies, has established a nursery for *ca camu* that contains a million seedlings at km 100 of the Manaus–Itacoati highway. The company has contracted around 30 nearby farmers to grow crop. But most of the *camu-camu* seedlings are being dispatched in plastic b by overnight mail to establish a 500-hectare plantation of the crop near Paulo. Fink has chosen São Paulo as the mainstay of the *camu-camu* operat because yields are expected to be much higher there on better soils using c irrigation. Furthermore, bank loans are much easier to obtain in São Paulo tl

[9] Caviedes and Muller (1994).

in Manaus, and São Paulo has a huge urban market, with a growing demand for 'natural' vitamin C pills.

The credit bottleneck

The availability of credit on reasonable terms is a major constraint for farmers and agroindustry alike. High interest rates in Brazil are a barrier to investment in agroindustries, particularly small to medium-sized operations, precisely those mostly likely to work with 'exotic' fruits from agroforestry systems. Only large corporations in Brazil are able to tap international sources of financing, which carry lower rates of interest. While large orange juice processors in São Paulo are likely to qualify for loans from major banks in the United States, Japan or Europe, a relatively small plant working with a variety of regional fruits in Amazonia would have to pay exorbitant interest rates. High interest rates in Amazonia are thus a barrier to agricultural diversification.[10] The bias of fiscal incentives towards cattle production that prevailed in the 1960s, 1970s and, to a limited extent, in the 1980s, has been significantly reduced, but little credit is currently available for agroforestry crops.[11]

In parts of Pará, some farmers have applied for a special line of financing from the Fundo Constitucional de Financiamento do Norte (FNO) for an agroforestry package that includes ten head of cattle. This particular line of credit (FNO Especial) became available in 1992, and the mix of perennials available for financing has varied according to local conditions. The favoured crops have been coconut (*Cocos nucifera*), *cupuaçu*, sweet orange, peach palm and robusta coffee.

Farmers in the Altamira region of the Transamazon appear to have received a disproportionate share of FNO–Especial financing thanks to political pressure from an umbrella group called the Movement for Survival on the Transamazon (Movimento pela Sobrevivência na Transamazônica — MPST). But even there, fewer than ten per cent of the farmers have presented proposals for financing from FNO–Especial. In Santarém municipality in 1995, only about 300 of the 2,000 applicants for agroforestry/cattle financing from FNO–Especial had their loans approved and processed.

In practice, the cattle and agroforestry credit line from FNO–Especial has been largely ineffective. To be eligible, farmers have to belong to an association. Associations have, therefore, been arranged quickly with no real commitment to working together. Their sole purpose is to capture bank credit.[12] To simplify administration, the Bank of Amazonia decided in 1995 to only release disbursements to the presidents of the associations. Some presidents of associations, it turned out, were not even farmers, and even farmer-presidents allegedly absconded with the funds in

[10] Nobre et al. (1994).

[11] Smith et al. (1995b).

[12] Castellanet et al. (1996).

some cases. As of 1996, the Bank of Amazonia has changed its policy and will only release funds to the individual loan applicants. Those relatively few farm who have applied for funding are interested mostly in the cattle, not the agrofo try part of the deal. In some cases, a token plot of coconut and *cupuaçu* is es lished and then essentially abandoned.

Agribusiness may ultimately prove the most efficient source of financing farmers interested in planting perennial crops. Agromazon, a new compan Porto Velho, is one such option for farmers in the vicinity of Nova Califó and Extrema in Acre. The company signs agreements with farmers to prod fruit crops, especially pineapple. The farmer provides land and labour, w the company prepares the field and provides planting material, technical as tance, financing, processing and marketing services. Profits are divided, with per cent going to the farmer, while Agromazon keeps the remainder. Dur the growing season, the farmer is paid a salary, which is deducted from share of the profits at harvest. To qualify, farmers must agree to work with company for at least ten years.

Research and extension

For the most part, research institutions in the region are not geared to needs of farmers adopting agroforestry. The main reason is that research is largely a top-down affair. Even so-called 'on-farm' agroforestry trials are signed mostly by scientists with little farmer contact, and the trials are m replications of research station models. Little wonder that such trials rai serve as catalysts for agroforestry development in the surrounding communi

To improve the performance of on-farm trials, farmers should be invol in the design and implementation of research. Too often, small farmers in Amazon are seen as passive recipients of technology, rather than as active perimenters in their own right. The prevailing research culture tends to v small farmers as people in need of modernisation, rather than as individu with useful local knowledge.

A major advantage of the participatory research approach with farmers is t extension is essentially 'built-in'. Formal extension services in the Amazon, as many parts of the world, are inefficient and reach only a small percentage growers. Extension agents have generally abandoned working with individ farmers due to time and resource constraints. Even when still operational, ext sion services prefer to work with growers' associations or cooperatives. NGOs a tend to work with 'community-based' organisations, or with rural syndicates.

The wisdom of a small but important segment of Amazonia's populati is essentially totally ignored by the agricultural research and developm system, namely, that of indigenous people. There are several reasons this neglect of a significant resource for agricultural development. First, f indigenous groups in the Brazilian Amazon are growing crops for markets and their experiences are therefore thought to have little relevance for 'development'. Second, access to indigenous groups is often difficult for researchers because of restrictions imposed by the Indian protection agency, Fundação Nacional do Índio (FUNAI). Such restrictions are designed to minimise exposure to introduced diseases and prevent exploitation of natural resources in indigenous reserves. Third, the language barrier discourages many researchers — particularly those working in the agricultural sciences — from visiting indigenous groups.

Only a few of the crops of interest to agroforestry farmers in the Amazon are being worked on by scientists. The long lead-time for research funding and the inherent lethargy in realigning research programmes means that scientific institutions often lag behind farmers at the frontiers of agroforestry. Moreover, social scientists and economists are under-represented at research institutions in the region. Fieldwork designed to canvass local knowledge of farmers is often considered 'soft' and lacking in analytical rigour. A blend of science and local knowledge is required to jump-start agroforestry and sustain it over the long term.

NGOs are often seen by donors as the way to promote 'sustainable' development, including agroforestry, because they are considered grass-roots efforts. NGOs are a mixed bunch, so it is hard to generalise about their operations with regard to agroforestry. But overall, NGOs are having a minimal impact on agroforestry development in the Brazilian Amazon. There are several reasons for this. Donors that are bankrolling NGOs pay insufficient attention to market realities when setting up agroforestry programmes. Many NGO-inspired agroforestry projects have tried to circumvent traditional trade networks involving middlemen. Most NGOs lack research capacity and therefore are rarely in a position to tackle crop disease problems and other challenges to agricultural productivity.

Moreover, NGOs have adopted a small-scale approach in the hope that they will produce a ripple effect over a wider area. Although some NGOs are doing promising work with agroforestry, so far at least, such projects have not produced a tidal wave of agroforestry adoption. Most of those adopting agroforestry are working on their own initiative. Finally, NGOs tend to focus on 'communities', assuming that they are relatively homogeneous. Most 'communities' in the Brazilian Amazon embrace a range of players with different income levels and agendas.

In practice, most agroforestry adopters in the Brazilian Amazon are garnering expertise and technology from the private sector, from other farmers and entrepreneurs, including itinerant nurseries, and fruits purchased in markets. Some farmers specialise in nursery production and derive appreciable income from such sales to farmers planting perennials in monocultural stands or in agrofor try fields. Miguel das Freiras, whose property is located at kilometre 16 of t Santarém–Ruropólis Highway, is one such entrepreneur. Raised by nuns (hen his name), Miguel has been selling seedlings and grafted material of numero perennial crops for several decades. Growers within a radius of dozens of ki metres come to his farm to purchase planting material.

Lessons learned from two case studies: ASPRUVE and COAPEX

The pitfalls and problems associated with the much-touted agroforestry a proach of the Projeto de Reflorestamento Consorciado e Adensado (RECA), l cated 155 kilometres east of Rio Branco in Acre, are examined elsewhere Here the experiences of two nearby agroforestry projects are reviewed brief the Associação dos Produtores Rurais Vencedores (ASPRUVE) and the Coo erativa Agrícola de Produtores Extratavistas (COAPEX), both located at V Extrema, 180 kilometres east of Rio Branco, along the BR 364 Highway th extends from Rio Branco to Porto Velho and then heads south-east to Cuia in Mato Grosso. ASPRUVE broke away from RECA because of policy disput and is a virtual carbon copy of the agroforestry model adopted at Proje RECA. COAPEX, in turn, split from ASPRUVE for similar reasons. ASPRUV soon ran into difficulties, whereas COAPEX is in much better shape because opted for different crops and extractive products than ASPRUVE.

Before preliminary results were in from Projeto RECA, external dono promoted the same agroforestry configuration — Brazil nut (*Bertholletia e celsa*), peach palm and *cupuaçu* — among farmers belonging to ASPRUV Consequently, the growers' association suffers from problems similar to those Projeto RECA, only worse. ASPRUVE has only five small freezers to store *c puaçu* pulp and they quickly fill up during the harvest, which spans the rai season. Accordingly, in May 1996, ASPRUVE was no longer buying *cupua* from its members and growers were forced to let most of the fruit rot on t ground. The number of active members in ASPRUVE has thus dwindled fro a high of over 100 to a few dozen. Meanwhile, some dissatisfied growers split c from ASPRUVE to form a new cooperative, COAPEX.

With 33 active members as of 1996, COAPEX is rapidly outgrowi ASPRUVE and has been able to obtain a bank loan for a Brazil nut factory, whi is currently processing nuts collected in the surrounding forest. COAPEX is se ing processed Brazil nuts significantly more cheaply than Cooperativa Agr Extrativista de Xapuri (CAEX), a cooperative based in Xapuri, Acre, that has r ceived considerable external support from donors for close to a decade because is in an extractive reserve. Wisely, COAPEX has avoided imposing a single agr

[13] Smith et al. (1998).

forestry model and instead growers are free to tailor their own cropping patterns. One of the leaders of COAPEX is experimenting with a novel agroforestry system, comprising teak (*Tectona grandis*), an exotic timber tree, interplanted initially with manioc and later with pineapple. The strengths of COAPEX lie in its flexibility, a relatively large mix of product lines including extractive products, avoidance of fruits that require refrigeration and its attention to market signals.

Untapped potential of the Amazon floodplain

Thus far, much of the activity in agroforestry has taken place on the uplands and the Amazon estuary. Agroforestry has diminished considerably along much of the middle and lower Amazon floodplain during this century, but could be revived, especially if floating fruit processing plants were available. Some of the fish processing plants are on barges and a similar model could be used for processing fruits and nuts from floodplain orchards.

One of the common misconceptions about the Amazon floodplain is that seasonal inundations preclude the viability of perennial cropping.[14] It is commonly assumed that alluvial soils are best used for annual crops or pasture. However, the formerly extensive floodplain forests are testimony to the fact that many woody species are adapted to varying degrees of flooding dictated by the complex topography of the floodplain. Furthermore, residents of the Amazon floodplain have long cultivated a blend of indigenous and exotic crops in their home gardens, some of which have provided significant income.[15]

Agroforestry could provide an economically viable alternative to the 'grass rush' underway on the Amazon floodplain, triggered by the expansion of cattle and water buffalo. Mixed cropping with perennials will not completely stem the onslaught of cattle and water buffalo ranching, but it might provide a choice for small and large holders alike. The Amazon floodplain is ecologically heterogeneous with many subtle changes in soil texture and elevation. Consequently, numerous niches are available for perennial crops that can withstand varying degrees of flooding. Some promising avenues for agroforestry development include the cultivation of:

- Fish bait fruits to supply fish farming operations employing *tambaqui* (*Colossoma macropomum*).
- Select cultivars of well-known fruits with a high market value that are suited for higher portions of the Amazon floodplain, such as varieties of mango, guava, cashew, banana and *cupuaçu*.

---

[14] Hammond et al. (1995).

[15] Smith (1998).

- Some lesser-known, but up-and-coming, indigenous fruits, suc *camu-camu*.
- Certain high value hardwood species that have been largely logge the Amazon floodplain (see Photo 3).
- Fast growing, light woods for the plywood industry.
- Essential oils with growing markets, particularly in homeopathic n cine, such as *andiroba* (*Carapa guianensis*).

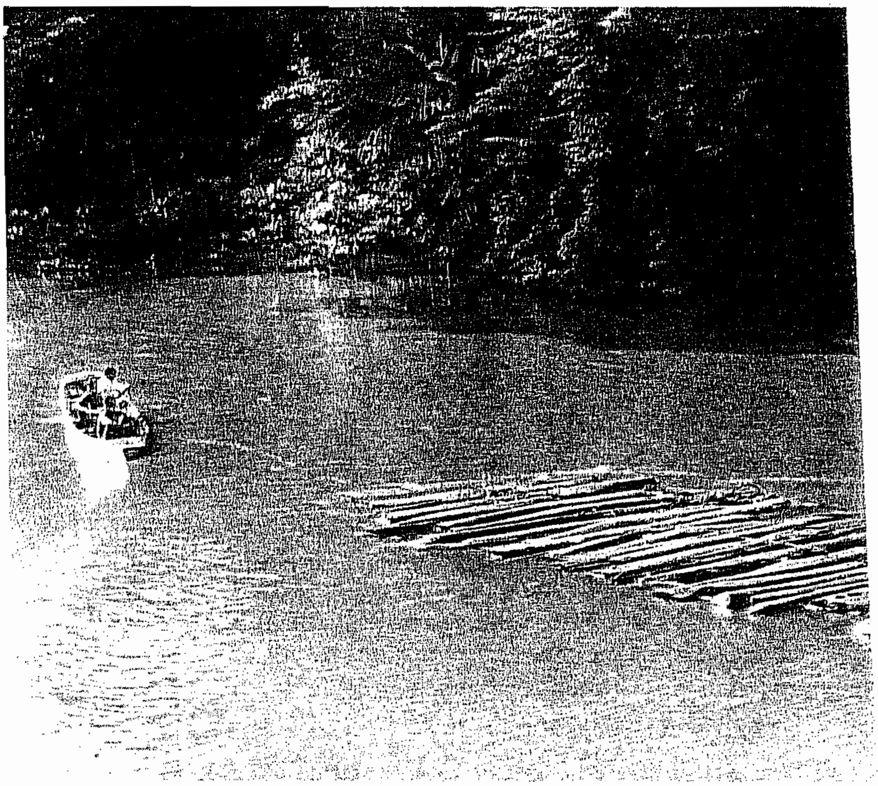


Photo 3 Many of the valuable trees have already been logged off the Ama: floodplain. At current logging rates, the remaining stands of valuable timbe1 the estuary will also be largely gone within a few decades. Furo de Breves, Pa 5 November 1995

The recent emergence of aquaculture of *tambaqui*, a native frugivore, many upland parts of the Brazilian Amazon underscores the importance conserving floodplain forests. At the moment, pond-raised *tambaqui* are mostly sold after about two years, when the fish weigh between one and two kilograms. However, the flavour of pond-raised *tambaqui* is inferior to wild caught specimens because they are fed manioc, maize or, in some cases, commercial fish food. The really lucrative market for this fish is with its ribs, which fetch a high price in urban markets. *Tambaqui* must be at least four years old for sizeable ribs, and will need a diet of native fruits to mimic the taste of wild-caught *tambaqui*, which are under tremendous pressure. Numerous fruits of the Amazon floodplain that are currently used as fish bait could be grown in agroforestry plots to supply fish farms (see Photo 4).

Photo 4 *Louro*, an unidentified species of *Nectandra* or Ocotea, gathered in floodplain forest for fish bait. The floodplain forests of the Amazon and its tributaries contain numerous trees bearing fruits eaten by fish, some of which could be cultivated to supply feed to fish farms. Paraná Cachoeri, near Oriximiná, Pará, 20 June 1994.

If the floodplain forests continue to shrink, options for domesticatin; commercial crops, including fruits for fish food, will be foregone. P gather fruits and nuts from floodplain forest for domestic consumptioı for nearby markets (see Photo 5). Some of these wild plants could al: grown in agroforestry systems on the Amazon floodplain to cater to grc urban markets. One reason why forests are falling so fast in many tropic: gions is that there is a widespread lack of understanding of how they cor ute to human welfare.[16] Forests in the Amazon are an important source of crops for agroforestry, particularly in home gardens. Forest trees are b recruited for a wide variety of purposes, ranging from fish baits to lives feed. The survival of forests is, therefore, critical for the long-term growth sustainability of agroforestry in the region.

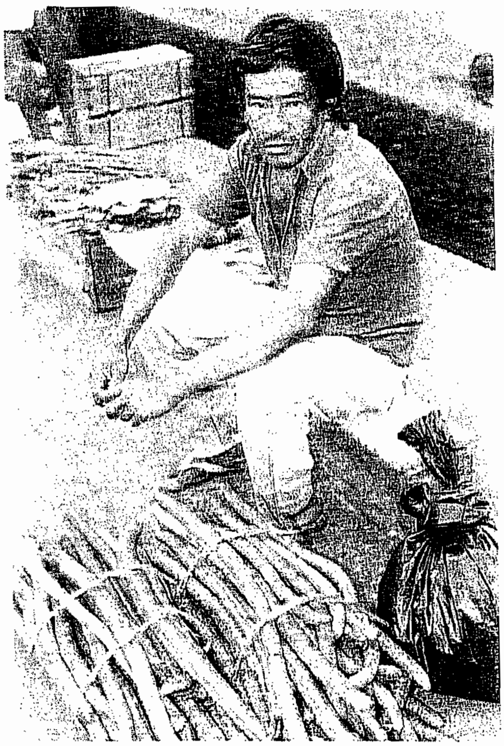


Photo 5 *Marimari* fruits (*Cassia leiandra*) for sale in Santarém, Pará, 17 June 1994. *Marimari* fruits are gathered wild in the floodplain forests of the middle and lower Amazon. Locals relish the sweet, white pulp surrounding the seeds encased in the long pods.

---

[16] Myers (1996).

Scouting a way forward

For the most part, cooperatives are too weak and ineffectual to offer much hope for promoting agroforestry in the Brazilian Amazon, at least in the near future. Local farmer groups do not usually have sufficient capital or managerial experience to launch and maintain a resilient growers' association or cooperative. In such cases, the formation of partnerships with agribusiness is a viable option.[17] Sometimes referred to as social enterprises, NGOs could gainfully redirect their efforts to engage more fully in market operations and generate profits to sustain operations, rather than ignore the market.[18]

Another promising avenue is that of large, well-organised fruit processing plants entering into contractual relationships with individual farmers. Large agribusiness operations are vertically integrated since they are involved in the production, transportation, processing and marketing of products. Once farmers become more prosperous, strong cooperatives are likely to emerge, as occurred in Tomé-Açu.

Development planners should resist the temptation to produce a single agroforestry blueprint. Given the highly heterogeneous nature of cultural experiences, soils, climatic conditions and distances to markets, such an approach would be likely to fail. Farmers are adept at designing a wide variety of configurations to suit their particular needs. Furthermore, there is little point in trying to identify 'winners' in the crop sweepstakes that characterises agroforestry in Amazonia and many other regions. Today's 'hot' crop could be tomorrow's loser. Conversely, a 'minor' crop today can rapidly emerge as a major income earner for hundreds of thousands of farmers. Farmers should be free to pick from a basket of crops to suit their particular needs.[19] Such an approach is more likely to succeed than a complete 'package' devised in a research station and then handed over to extension agents for delivery to farmers.

In spite of the many impediments to agroforestry, polyculture with perennials is likely to increase. Burgeoning urban centres, particularly Belém with 1.7 million inhabitants and Manaus with some 1.3 million residents, will draw ever-increasing numbers of farmers into their market orbit. The swelling ranks of the middle and upper-income households in such cities bode well for farmers and agribusinesses that cater to quality fruits and juices, among other agroforestry products. It is in regional and national markets, rather than the export trade, that growth for agroforestry products is likely to be strongest, at least in the short term.

---

[17] Clay (1996).

[18] Bebbington (1997a, 1997b).

[19] See Leeuwen (1994).

Acknowledgements

This chapter is based largely on a report entitled *Agroforestry Experienc the Brazilian Amazon: Constraints and Opportunities* (Nigel Smith, Jean bois, Dean Current, Ernst Lutz and Charles Clement), which was publishe the Pilot Programme to Conserve the Brazilian Rain Forest, World B Brasília, in 1998. The Pilot Programme is administered by the Secretaria the Coordination of Amazon Affairs in Brazil's Ministry of Environment anc World Bank. The author wishes to acknowledge the valuable contributio Jean Dubois, Dean Current, Ernst Lutz and Charles Clement to some of ideas and analysis contained in this paper. The author is also grateful to th lot Programme for supporting fieldwork related to the agroforestry publicat The opinions and findings in this paper are those of the author, however, do not necessarily reflect those of any other individuals or institutions, incluc the Government of Brazil and the World Bank.