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Agroforestry in the Humid Tropics of Latin America: Dynamics and Possibilities for Agricultural Development and Conservation in Amazonia

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AGROFLORESTRY IN THE HUMID TROPICS OF LATIN AMÉRICA: Dynamics and Possibilities for Agricultural Development and Conservation in the Amazon.

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Summary

Agroforestry is often touted as one of the most "sustainable" ways to develop rural areas in the humid tropics. The planting of trees and shrubs alongside other crops helps to protect the soil, improves water retention, and diminishes pest and disease pressure, among other environmental benefits. The experience with agroforestry in the Neotropics is reviewed here, with particular attention on the Amazon Basin. Amazonia contains the largest remaining stretch of tropical forest, and in order to help conserve this largely untapped biodiversity, it will be necessary to intensify agricultural production in ways that do not damage the environment. The diversity of agroforestry systems is briefly reviewed, some of the products from agroforestry systems with commercial potential are explored, and constraints to further development of mixed perennial cropping systems are identified.

Introduction

The forests of the humid tropics of Latin America provide multiple goods, values and environmentals services. They help maintain local and global climate patterns and biological diversity, they supply products and commodities, soil protection, stabilization of hydrological systems, and they maintain water availability and quality and mitigate storm impacts.

It is estimated that about 600 million ha out of the estimated 1.5 billion ha of original tropical rain forest in the world have been cleared and convertd (Ehrlich & Wilson 1991), Africa having lost the greatest proportion of its original forest (about 52%), followed by ASIS (42%) and Latin America (37%) (Lean et al. 1990).

Rates of deforestation have been highest during the past two decades. In the 1980s, the annual rate was highest in Africa (1.7%), followed by Asia (1.4%) and Latin America (0.9%). The absolute rate of deforestation per anum, however, was highest in Latin America (7.3 million ha) followed by Africa (4.8 million ha) and Asis (4.7 million ha) (FAO 1991). In the past two decades, deforestation was highest in the Brazilian Amazon where about 35 million ha (Brazilian Institute of Space Research 1990) have been cleared for different development purposes.

Behind the increasing rate of forest conversion in Latin America, there are a variety of direct and indirect causes, usually acting in combination (Repetto & Gillis 1988; Hecht & Cockburn 1989). Leading direct and immediate causes include large-scale commercial logging forest conversion to pastures, clearing by subsistence farmers, and implementation of large-scale government colonisation projects. Undoubtedly, agricultural development has been the most important direct cause of deforestation in Latin America.

The track record of agricultural development in the humid tropics of Latin America is checkered. Pastures overtaken with weeds, extensive plantations that have become white elephants, and extensive deforestation characteristic of some slash-and-burn farming systems can give the impression that much of the agriculture in the forest regions of the Neotropics is "unsustainable". This paper will argue that intensification and proper management of agriculture in Amazonia can lead to more sustainable systems.

The paper will attempt to shed some light on the sustainability issue of agricultural development in rain forest regions, with particular emphasis on Amazonia, by exploring the history, current practices, and future of one of the most appropriate land uses for the humid tropics: **agroforestry**. The Amazon Basin embraces the world's largest continuous stretch of rainforest and contains a diverse array of land use systems, including agroforestry. It is thus a particularly propitious setting to explore issues surrounding the question of sustainability.

Agroforestry is a type of land use that incorporates trees or shrubs in crop and/or livestrock production systems (Torquebiau, 1990). Under ideal conditions, these systems offer multiple agronomic, environmental and socioeconomic benefits for resource-poor small-scale farmers, including enhancing nutrient cycling, fixing of atmospheric nitrogen through the use of perennial legumes, efficient allocation of water and light, conservation of soils, natural suppression of weeds, and diversification of farm products. It requires market access for widespread use (NRC 1993:9) Many different agroforestry systems have evolved, particularly in the humid tropics, which are tailored to a wide variety of ecological and cultural conditions. Agroforestry systems range from species-rich assemblages with various storeys that mimic tropical rainforests to more simple arrangements, such as windbreaks planted around fields planted to an annual crop (Nair, 1991).

The contribution that agroforestry can make to sustainable agriculture is well recognized. Agroforestry helps conserve the natural resource base for agriculture by helping to check soil erosion, improving nutrient recycling, providing an equitable microclimate for soil microorganisms, and helping to retain moisture for crops and downstream water users (NRC, 1993:92). In addition, agroforestry can improve the livelihoods of farmers by providing staggered agricultural production, reduce the reliance on a single crop that may be vulnerable to wide fluctuations in market value, and reduce the need for purchased supplies and inputs. Agroforestry provides farmers with a wide variety of products for domestic needs, ranging from firewood to construction materials and medicinal plants, in addition to food. Furthermore, agroforestry reduces pest and disease pressure, thereby reducing or even eliminating the need to purchase pesticides, and the shade created by perennial crops suppresses weeds, thereby reducing the cost of controlling unwanted plants.

"Weeds" to one farmer can be an spontaneous asset, or even a crop, to another farmer who practices agroforestry.

The Question of Sustainability in Latin America and the Amazon

Sustainable development and sustainable agriculture are terms often banded around with the assumption that the audience has a clear idea of the meaning of such phrases. Without dwelling excessively on the history of such terminology and exploring its many variants, it would be useful to highlight the main facets behind the ideas of sustainability, criticality, and resilience as they apply to land use in the humid tropics.

Environmental sustainability prevails when ecological and socioeconomic conditions are capable of supporting the continuation of the current range of land use systems in a given area (Kasperson et al., 1995). A land use system is therefore sustainable when its productivity is not declining, the land management practices are culturally acceptable, and agricultural and other practices do not undercut the natural resource base nor create social disharmony (NRC 1993:141).

Sustainability cannot be understood without reference to **environmental criticality**, a state in which the degradation of the natural resouce base has passed the threshold beyond which current land use systems or levels of social welfare can be supported. A related notion is **environmental endangerment**, a less urgent condition, but no less worrisome because environmental degradation has reached the point where current land use systems and the human populations they support are in peril.

These three measures taken together provide a scale of environmental impact applicable to regional ecosystems. In this regard, the Amazonian situation is worth considering. Presently available knowledge suggests that an impoverishment process is underway, but that economic/ecological threats to residents stemming from resource degradation are unlikely in the short to mid-term. This is in large part due to the abundance and inaccessibility of the resource base. A great deal of forest remains in place, and infrastructural development of the region is minimal. In addition, certain land use systems have shown unexpected stability over the short run. Residence times of slash-and-burn agriculturalists, for example, may be much longer than popular imagens of this farming activity suggest (Walker et al 1993; Walker et al 1994). On the other hand, localized instances of endangerment and criticality are frequent. The most notable instances occurring in the Amazon basin are not linked to agricultural and forest land uses, and derive from mining activities and thereats to local water supplies and fish populations through mercury contamination.

That Amazonia presently is not endangered due to resource abundace offers little solace, given current land use and demographic conditions, that together contain the seeds of future endangerment. Just what this endangerment represents, and how soon it will be manifested, remain empirical questions, although current rates of land use system expansion and deforestation suggest generational time frames in the unfolding of degradation processes in the Amazon basin. Part of this knowledge-base uncertainty stems from lack of information on *resilience*, the ability of ecosystems to maintain basic structure and function during perturbations, and to recover from them (Kasperson et al. 1995). With respect to current concerns about Amazonia, a key question relates to resilience of the region's ecosystems in the face of human encroachment. A number of indications exist that the Amazonian upland forest ecosystem is fairly resilient to current uses (Uhl et al 1998, Vieira et al in press, Nepstad et al in press, Serrão et al 1993, Serrão and Nepstad in press).

In the Amazonian context, neither itinerant agriculture as carried out by small farmers nor the periodic abandonment of pasture by small and larger operators alike is consistent with the goal of promoting sustainable agriculture. A distinction needs to be drawn between the slash-and-burn acitivies of small producers, often colonists in the region, and indigenous people who typicall practice a more itensive form of swidden farming with managed fallows. Indigenous swidden systems are ecologically sound and are capable of supporing moderate population densities since they require less cutting of the forest and the fields remain in production longer. In effect, slash-and-burn fields rapidly evolve into agroforestry systems since they involve a mixture of crops, many of which produce harvests over a protracted period.

In general, the more tree cover and thus better protection of the soil and biodiversity, the greater will be the sustainability of land use in tropical rain forest areas (Figure 1). The number of species of plants and animals increases from highly disturbed environments, such as a cattle pasture, to forest environments, particularly those with little if any human disturbance. Two land use systems mimic at least some of the complexity of forest ecosystems: agroforestry and extraction of non-timber products. Although extraction of non-timber forest products is a significant supplement to the diet and incomes of rural people in some parts of Amazonia it is not viable from the socioeconomic viewpoint because it is not possible to obtain a suitable standard of living for extraction of non-forest products alone. Agroforestry, on the other hand, can be a major source of income for many of the small and medium-scale farmers in the Amazon Basin.

In summary, new alternative technologies for agricultural and forestry development in the Amazon have to take into account the need for sustainability, the concern with criticality and take advantage of resilience. Surely, agroforestry alternatives, as land use systems, fit well in this context.

Sustainability and the Mosaic of Land Use Systems

Agroforestry is one of the most sustainable of land uses in the Amazon and other parts of the humid tropics in Latin America but it alone is no insurance against environmental criticality or endangerment will not surface. Agroforestry should be viewed as part of a mosaic of land use systems that includes timber extraction, plantations, livestock production, root crop agriculture, and intensive cereal production in favored environments such as the Amazon floodplain (Figure 2). Each land use system has differential impacts on nutrient cycling, soil moisture conservation, and biodiversity, among other attributes (Table 1).

Any land use system has its limits, both in terms of market viability and cultural acceptance. It is the combination of land use systems that is largely the key to sustainability in the region, and agroforestry has an important role to play in promoting long-term agricultural development. Furthermore, agroforestry overlaps parts of several other land use systems, such as annual crop production.

Agroforestry Systems in Latin America and the Amazon

The Antiquity and Diversity of Agroforestry Systems

Agroforestry is arguably the oldest form of agriculture. Contrary to the popular myth that agriculture started with the cultivation of cereals in the fertile crescent of the Tigris and Euphrates basins, the earliest agriculture surely involved tree gardens around campsites in the humid tropics tens of thousands of years ago. Farmers in the warmer and wetter parts of Asia, Africa, and Latin America have learned that continuous cropping with cereals is often not feasible due to poor soils, soil erosion, and weed invasion. Even in areas where continuous cropping with cereals is possible, such as in paddy rice systems, agroforestry is still practiced around homes.

In many parts of the humid tropics, landscapes have been virtually transformed into cultural forests through enrichment of natural vegetation with economic species. Examples of this transformation include the African oil palm belt in parts of West Africa, forest islands in the Yucatán Peninsula, and sections of upland and floodplain forest in Amazonia (Anderson, 1988, 1990; Gomez-Pompa et al. 1987; Smith, 1995). Indeed, in many cases it is meaningless to use terms such as "pristine" or "virgin" tropical forests in Latin America. People have been farming forests or otherwise altering them for millennia.

Agroforestry in Relation to Other Land Use Systems in Latin America

Whereas agroforestry in Latin America is an ancient practice, such systems are on the decline in many areas, mainly as a result of the expansion of cattle ranching, unsustainable forms of slash-and-burn agriculture, and intensive cereal production. In the case of the Brazilian Amazon, for example, many agroforestry systems once practiced by indigenous peoples have diseappeared as their cultures have come into contact with national society. Even agroforestry systems employed by peasant communities have often been replaced by cattle ranching. A similar process is underway in the Yucatán Peninsula where rich agroforestry systems developed by the ancient Maya are gradually being replaced by cattle pasture.

Cattle ranching is the most important cause of deforestation in the Latin American tropics and development agencies are seeking alternative land uses to combat this widespread wave of habitat destruction. In the Brazilian Amazon, for example, cattle raising is thought to account for at least half of the annual retreat of forest cover (Serrão et al., in press). Agroforestry is one of the most promising options to help stem the tide of deforestation. Indeed, agroforestry intersects other land use systems, including cattle ranching and annual and perennial crops (Figure 3). In cases where cattle are raised alongside tree crops, such as coconut or rubber trees, they can be considered a type of agroforestry, typically referred to as agrisilvopastoral or silvopastoral systems (NRC, 1993:329).

Agroforestry is certainly no panacea, however. Cattle production, intensive cereal and vegetable production, and forest extraction, among other land uses, all have their place in most rural landscapes in Latin America (Figure 2). Cattle have their place in many agricultural settings in Amazonia because they provide ready cash for smallholders to cover emergencies, provide fertilizer for cash crops, they do not impose a seasonal demand for labor, and can they can be easily sold at any time of the year.

It is the balance of land uses in a region that is at issue. Agroforestry is one of the most biodiverse agricultural production systems, and one that promises to help rehabilitate degraded environments and relieve pressure on remaining habitats for wildlife and native flora. For this reason, it is worth exploring the potential for restoring the contribution of agrforestry systems to agricultural production in areas where it is on the decline and examining the possibilities of expanding agroforestry in areas where more "environmentally-aggressive" land uses currently predominate.

Agroforestry Developments in the Brazilian Amazon

Agroforestry in the Brazilian Amazon is oriented strongly to markets, rather than for subsistence food production as in traditional slash-and-burn shifting agriculture (Smith et al. 1995). The rural poor are not necessarily best served by focusing exclusively on food crops such as cassava, corn, beans and rice; income generation allows famers to purchase foodstuffs and other supplies. In the vicinity of Ouro Preto in the State of Rondônia, for example, farmers who cultivate perennials have generally fared better than those who rely on annual crops (Southworth, et al. 1991).

Another characteristic of agroforestry in the Brazilian Amazon is that farmers are not particularly interested in trees that enrich the soil with nitrogen, provide fodder for livestock, or serve as living fences. Multipurpose leguminous trees that fix nitrogen through symbiotic bacteria in their roots have been a major focus of international programs to promote agroforestry, but such technologies have had negligible impact in Amazonia. Farmers are interested in trees that will make money, not restore soil nutrients. Farmers have found that planting trees such as *Gliricida* compete for space, water, and nutrients with other crops, such as black pepper. Ranchers are dubious that living fences can make a contribution to their operations because of the frequent use of fire to control weeds in pastures, and because of labor requirements to trim branches. In general, farmers are planting a mixture of "single-purpose" trees rather than a miracle tree that attempts to cover many perceived needs.

Farmers in many parts of the Brazilian Amazon are planting an impressive array of crop mixtures involving perennials. The experience of these farmers is a valuable resource for development planners and policymakers involved in establishing priorieties for agricultural research (Fearnside, 1995). Most of the agroforestry systems deployed in the Brazilian Amazon have been implanted by "grass-roots" initiative rather than top-down technology transfer. Another interesting feature of experiences with agroforestry in Amazonia is that they have evolved in response to market demand, rather than fiscal incentives. They are thus relatively robust, since they do not hinge on further price or other supports from government agencies.

Space does not permit a comprehensive review of all agroforestry systems in Amazonia. Rather some of the variation is sampled here to give a flavor of the innovative spirit of small farmers as they search for new ways to generate revenue from their land.

A total of 111 different agroforestry configurations were observed recently in a survey of 142 polycultural fields in the 1 to 10 hectare range across the Brazilian Amazon (Smith et al., in press). Farmers are tapping a large pool of crops in their agroforestry systems since over 80 species of perennials and annuals were noted in the sampled fields. Farmers are clearly experimenting with a wide array of crop combinations, some of which might be tested for more widespread adoption. Although most of the agroforestry associations involved only a handful of crops, some farmers interplant as many as 20 perennials. Such "agrobiodiversity" undoubtedly helps provide niches for wildlife, including birds, that would otherwise be excluded from agricultural landscapes devoted to monocultures.

Land use systems in Amazonia and other parts of Latin America can be viewed along a spectrum from highly-disturbed environments, such as planted pasture, to primary forest (Figure 1). The greater the tree-cover, particularly when several species are involved, the biodiversity index is correspondingly higher. Thus although agroforestry is an "artificial" habitat, it nevertheless provides a more equitable environment for at least some of the indigenous wild animals and plants (Figure 4).

Another noteworthy dimension to agroforestry systems in Amazonia is the mixture of indigenous and exotic species. The most common crop associations in the sample of agroforestry plots in the Brazilian Amazon were black pepper and sweet orange; manioc and sweet orange; coconut and sweet orange; cacao and rubber; and manioc and banana. Cacao and rubber are native to Amazonia, while manioc was domesticated in tropical America. Two points are worth emphasizing here: the continued exchange of crops and genetic materials is vital for agroforestry throughout the tropics; and the conservation of tropical forests is essential for the sustainability of agroforestry. Many crops used in agroforestry still have wild populations in forests; if the latter are wantonly destroyed, then valuable genes for crop improvement could be lost.

Market Opportunities and Trends

Interest in novel crops, especially tropical fruits and essential oils, is growing both at the international and regional levels. Many ingredients in "tropical forest" products are actually grown in polycultural fields. Many exciting possibilities exist to domesticate indigenous forest species in Amazonia for food, cosmetics, and industrial purposes.

A number of formerly little-known fruits of the American tropics have recently penetrated markets in Europe and North America (NRC, 1993:183). Examples include guaraná, domesticated by the Maué Indians of the middle Amazon to provide a stimulating drink, and cupuaçu, a relative of cacao and native to the forests of eastern Amazonia, the pulp of which is used to make a savory juice, ice cream, and puddings. Annatto, native to western Amazonia, and grown in backyards and other agroforestry systems throughout the tropics, is used extensively as a "natural" food colorant and even as a safe ingredient in some lipsticks (Table 2). Essential oils are in demand by the cosmetic and herbal medicine trade. For example, pataua, a water-loving palm found throughout Amazonia provides a high-quality oil that has been used in the past as a substitute for olive oil. Demand is increasing in Latin America for pataua oil as a hair tonic, among other medicinal uses. All the above crops are, and can be, grown in agroforestry systems and they represent the tip of an iceberg.

Aquaculture is up-and-coming enterprise in Amazonia. At present, aquaculture is concentrating mainly on an important fruit-eating fish in the region: tambaqui. All of the commercially aquaculture operations in the Brazilian Amazon are concentrated in upland areas, and are being undertaken by both small and large holders. Typically, a stream is dammed to create a pond, and young tambaqui are released into the ponds to grow to market size. A variety of feeds are being tried out, and aquaculture operators are particularly interested in fruits that can be added to the diet shortly before the fish are sent to market to improve the flavor. Farmers on the Amazon floodplain often keep a stock of trees that produce fish bait in their home gardens and some of these could be tried out in more extensive agroforestry fields geared to the fish culture business.

Consumers are increasingly concerned about the safety of their food and the impact of their consumption habits on the environment. In other words, people in both industrial and developing countries want to consume wholesome food that is not contaminated with agricultural chemicals. Also, they want to be reassured that the food and other agricultural products they consume do not trigger massive environmental damage. Agroforestry is well-suited for rehabilitating areas degraded by overgrazing or inappropriate agricultural practices. Agroforestry can thus provide a "green label" to fruits, nuts, essential oils, and medicinal plants.

Policy Implications

In order to spur the further development of agroforestry in Amazonia and other parts of Latin America, a number of interlinked steps need to be taken. First, market studies are needed to assess demand for products. Feedback from such studies will orient research efforts. Once the demand for a range of products that can be grown in agroforestry associations is assessed, a number of issues need to be addressed to realize the potential. Among the issues requiring attention by policymakers are:

- Incentives for agroindustry at all scales for value-added processing and to prevent spoilage
- Incentives for producers to deliver high quality products via a rating system. This is particularly important for the fresh-fruit trade
- Incentives for the establishment of nurseries to provide high quality planting material of crops in demand by agroforestry growers
- Encourage the formation of growers´ associations so that technologies can be diffused more rapidly and adequate supplies of given products can be gauranted to buyers and operators of agroindustrial plants
- Increased recognition of the links between the conservation of biodiversity and agricultural development. Conservation plans should incorporate a concern for plants of actual or potential economic value, and agricultural development projects need to be aware of their potential impact on biodiveristy, especially "agrobiodiversity"
- Importance of "agrobiodiversity" surveys to assess the richness of agroforestry systems already developed by farmers as a prelude to further development efforts.
- Involvement of local or "indigenous knowledge" in agroforestry development. Local people often have profound knowledge about the plant resources in their environments, and such information is often ignored by development planners.

The private sector is clearly heavily involved in the ultimate success of agroforestry. A large passion-fruit processing plant owned by a multinational company near Belém is largely responsible for the widespread planting of that crop in the Bragantina zone of eastern Amazonia. Similarly, a fruit pulp processing plant installed near Tomé-Açu in Pará State in 1991 has greatly facilitated the diversification of agroforesry products by Japanese-Brazilian farmers in that region. The pulp-processing plant near Tomé-Açu, which is operated efficiently by a business-like cooperative, has increased the value of fruit products from agroforestry systems by a factor of four (Homma et al., 1995). More such enterprises are needed to spur socially and environmentally beneficial land use systems such as agroforestry.

Concluding Remarks

Agroforestry clearly enhances the environment, helps generate income, and contributes to sustainability because it allows farmers to obtain products throughout the year, rather than during a concentrated period when inclement weather or shortages of labor may impair the harvest. The sustainability of agroforestry thus makes it not only a sustainable option for agricultural development in Amazonia, but also throughout Latin America.

Some interesting lessons can be drawn from the Amazonian experience with agroforestry. First conservation of biodiversity and agroforestry development are linked. Biodiversity provides genetic resources for crop improvement and the domestication of new crop plants. Second, Japanese-Brazilians were among the pioneers in developing commercial agroforestry systems in the Brazilian Amazon. Now their vision and technological fine-tuning is being emulated by other farmers in the region. Exchange of ideas and information, both at the local, national, and international level is thus essential for continued progress in agricultural development, including agroforestry.

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Table 1. Present[1] and potential[2] biophysical and socioeconomic attributes of the most important land use systems utilizing or converting the forest ecosystem in the Brazilian Amazon. Adapted from NRC (1993) and Serrão and Homma (1993).

Land Use System	Biophysical Attributes					Social Attributes			Economic Attributes		
	Nutrient cycling capacity	Soil and water conser-vation capacity	Stability tow-ards pests and diseases	Biodiver-sity level	Carbon storage	Health and nutri-tional be-nefits	Cultural and commu-nal viability	Political accepta-bility	Required external inputs	Employment per land unit	Income
Forest reserves	H	H	H	H	H	L	L	M	L	L	L
Extraction of non-timber products	H	H	H	M	M(H)	L(M)	M(H)	M(H)	L	L	L(M)
Extraction of timber products	H	H	H	M(H)	M(H)	L	L	M	H	M	M(H)
Secondary forest management	H	M(H)	M	M(H)	M	L	M	M	L	L	L
Shifting agriculture	L(M)	L(M)	L(M)	L	L(M)	M(H)	M	M	L-M	M-H	L(M)
Pasture-based cattle ranching	M	L(M)	M	L	L(M)	L(M)	L	M-H	M	L	M
Agroforestry systems	***M***	***M(H)***	***M***	***L(M)***	***M***	***M***	***L(M)***	***H***	***M***	***L(M)***	***L-M***
Perennial crop plantation	M-H	M	L(M)	L	M	L	M	H	H	M	M(H)
Plantation forestry	M-H	M(H)	L(M)	L	M(H)	L	M	H	M-H	M	M(H)
Social forestry	M-H	M-H	M	L-M	M	M	M	H	L-M	M	L-M

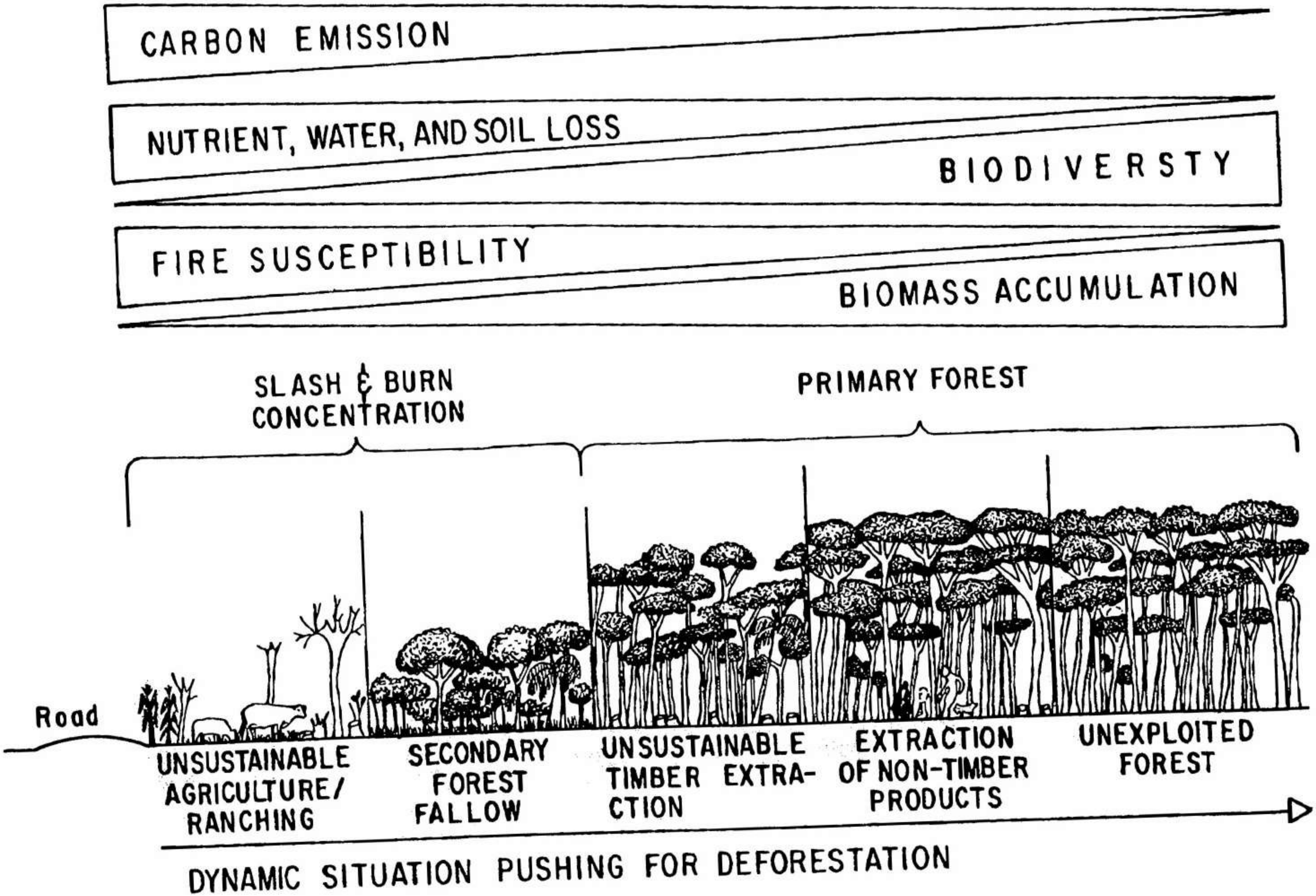
[1] Average levels of attributes of sustainability at present stage of regional development
L = Low; M = Medium; H = High

[2] Potential levels of attributes of sustainability if best available and potential scientific knowledge and appropriate tecnologies are applied.
(L) = Low; (M) - Medium; (H) = High

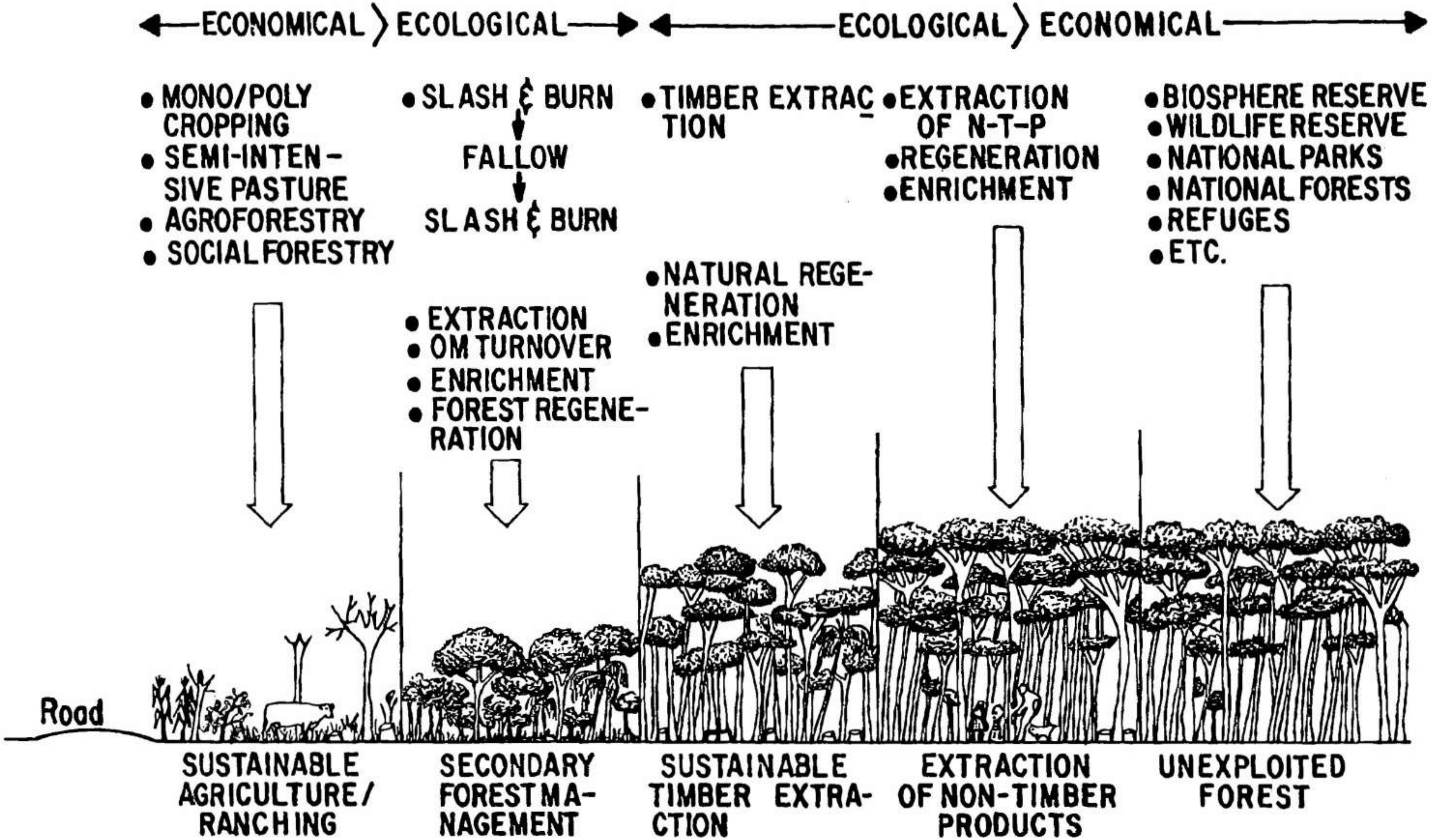
Table 2. Some plants used in products marketed by companies in North America and Europe that are suitable for commercial agroforestry in Amazonia. Source: Smith et al (in press).

Plant(s)	How used	Product name	Company
COSMETICS			
Various essential oil of Amazonian trees	Perfume	Amazone	Hermès, Paris
Annatto	Shampoo	Emerald Forest	Natural Nectar Corporation, Santa Monica, California
Avocado	Body lotion	Avocado Body Lotion	Crabtree & Evelyn, Uk (specific product made in Switzerland)
Passionfruit	Cleansing gel, bath beads	Passion Fruit Cleansing Gel; Passionfruit Bath Beads	The Body Shop (main HQ in UK)
Brazil nut	Hair conditioner	Brazil Nut Conditioner	The Body Shop (main HQ in UK)
Papaya	Shampoo	Papaya Miracle Shampoo	Freeman Cosmetic Co., Beverly Hills, California.
BEVERAGES			
Cupuaçu	Fruit juice	Tropical Rain Forest Cupuassu	Knudsen & Sons, Chico, California
Soursop	Fruit juice	Guanabana Nectar	Goya, Bayamon, Puerto Rico
Soursop	Fruit juice	Guanabana	Libby's Brand. Nestlé Beverage Co., San Francisco, California
Mango	Fruit juice	Mango Nectar	Libby's Brand. Nestlé. Foods Corporation, Purchase, New York
Annatto	Colorant for orange soda	Sunkist	Coca-Cola & Schweppes Beverages Ltd., Uxbridge. England (Sunkist is a registered trademark of Sunkist Growers, Sherman Oaks, CA 91423)
PRESERVES/JAMS/JELLIES			
Guava	Jelly	Pure Guava Jelly	Palmito Brand, Palmetto Canning Co., Palmetto, Flórida
Mango	Jam	Mango Jam	Goya Foods, Inc., Secaucus, New York
DESSERTS			
Annatto	Food colorant	Rhubarb Custard;Style Yogurt	Safeway. U.K.(main HQ in USA)
Mango	Sherbet	Mango Sorbet	Sharon's Sorbet, Old Chelsea Station. New York
Brazil nut	Ice cream	Rainforest Crunch	Ben & Jerry's, Waterbury Vermont
CEREALS/SNACKS			
Brazil nut	Breakfast cereal	Rainforest Crisp	Rainforest Products, Inc., Berkeley, California
Brazil nut	Cocktail snack	Rainforest Tropical Mix	From the Rain Forest, Inc., New York-NY

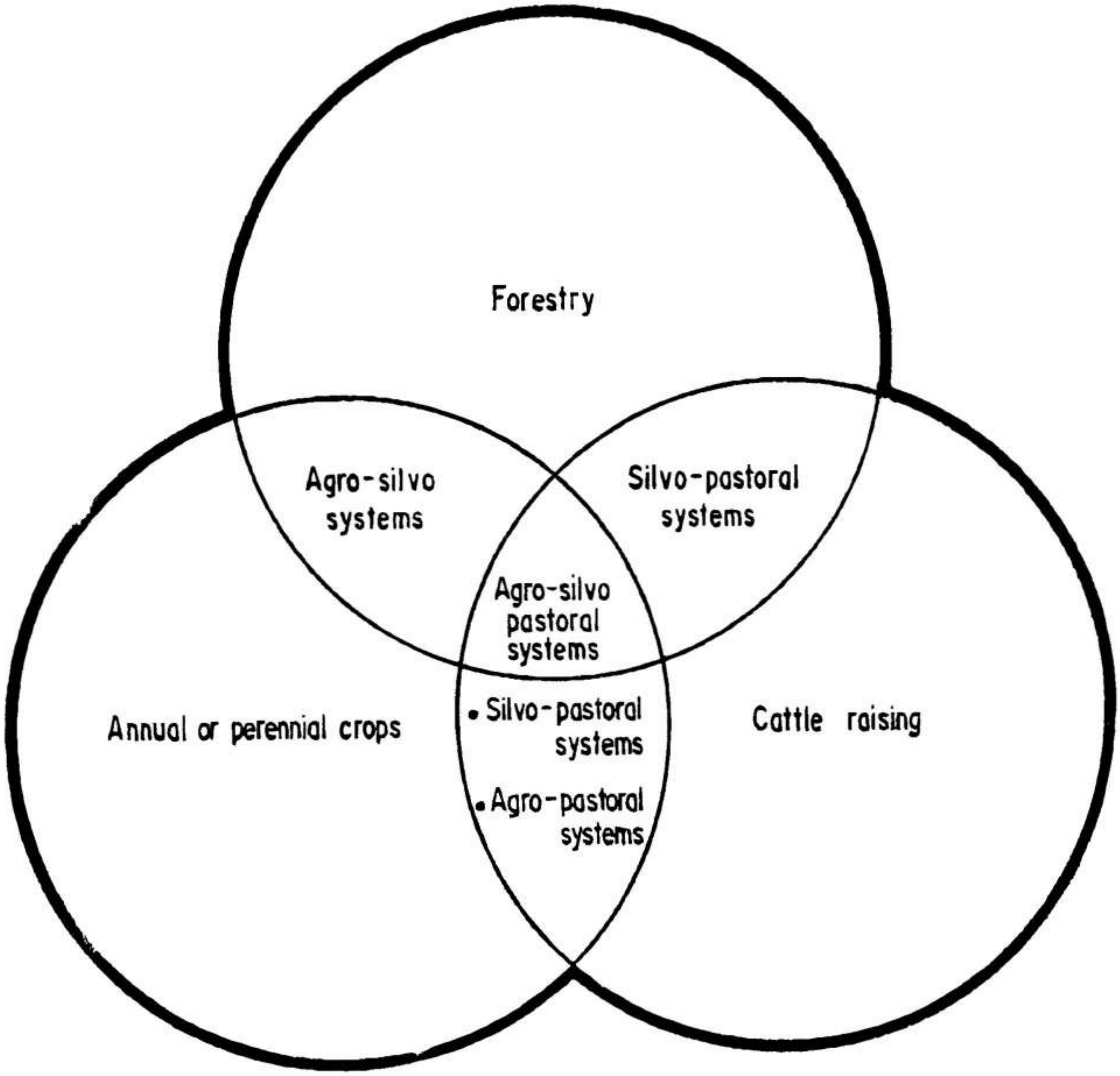
Serrão & Smith FIG 1



Serrão & Smith FIG. 2



Serrão & Smith FIG. 3



Serrão & Smith FIG. 4