PROMOTING AGROFORESTRY PRACTICES AMONG SMALL PRODUCERS: THE CASE OF THE COCA AGROFORESTRY FARM DEMONSTRATIONS IN AMAZONIAN ECUADOR

ROBERT B. PECK

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R.B.PECK

Silvicultural Advisor to the Ecuadorian National Forestry Directorate.

SUMMARY

After oil was discovered and commercially exploited in the early 1970's, construction of roads in the lowlands converted Eastern Ecuador into one of the most active centers of colonization in the upper Amazon Basin. Land distribution by IERAC (Ecuadorian Institute of Agrarian Reform and Colonization) is limited to a maximum of 50 Ha per farm. Farming systems research, including trees as a basic component of pastures, was started by INIAP (National Institute of Agriculture Research) at the field station in Limoncocha in the mid. 70's. By 1984 two commercial farming systems, coffee and pastures, had evolved from what had been only 10 years before subsistence agriculture.

In an effort to make more sustainable the existing farming systems, a reforestation project funded by USAID was designed in 1984 within the institutional framework of the Provincial Ministry of Agriculture to demonstrate the contribution of agroforestry techniques in improving commercial production

while bringing greater sustainability to the systems. By strengthening the Ministry, the project has been able to provide selected germ plasm and management techniques for farmers in the predominant production systems, subsistence agriculture (Chacra), robusta coffee and pastures, with most emphasis in the later two systems.

Rather than build an extension service to attend to 15.000 colonists and 15.000 indigenous families living in the lowland forest, the design called for the establishment of on-farm agroforestry demonstrations developed within the existing production systems, establishing up to one hundred trees of commercial value per Ha.

Planting material and technical assistance are initially provided by the Agroforestry Project. Generally for sites that are not overly degraded, natural regeneration provides the trees for future cropping associations. Billboards have been erected along the principal roads identifying commercial tree species such as Jacaranda copaia for red clay soils, that can easily be associated both with coffee and pastures.

Monitoring the adoption of the agroforestry practices in on-farm demonstrations provides the opportunity to correct establishment errors and introduce new germ plasm as it becomes identified. Successful practices that are strategically located along roads or rivers speak for themselves. On-farm demonstrations are a means of communicating to the community at

large and have the agricultural production systems promote reforestation. Presently, twenty seven native tree species having commercial value are being promoted in mixed associations on more than 200 farm demonstrations ranging from 1 to 12 Ha. in size.

On the basis of field trials established earlier, the project is expanding its ecological and geographical sphere of influence, as new roads are being built after the 1987 earthquake.

INTRODUCTION

Three perennial production systems (chacra-the tropical forest agricultural system, robusta coffee and pastures) all traditionally associated with trees have been developed by the residents of the lowland tropical forest of Eastern Ecuador in the area of confluence of the Coca and Payamino Rivers with the Napo River, and provided guidelines for designing a reforestation project.

An understanding of the ecological issues related to land use in the humid tropics is demonstrated by the lowland Napo Quichuas in their development of the "Chacra", a perennial production system that has sustained low density settlements since before the first western contact made in the mid 1500's (Muratorio 1987), Hudelson 1987 and Irvine 1987). A similar system is described for the Bora located further to the east by

Denevan et al (1984) which highlights the accumulated knowledge of indigenous populations regarding their environment and socio-economic conditions of the time.

By understanding the individual components of these three traditional agroforestry systems (chacra, robusta coffee and pastures) all traditionally associated with trees, opportunities for improvement based on improved germ plasm and improved management techniques abound.

The Coca Agroforestry Farm Demonstrations Project implemented by the Ecuadorian Ministry of Agriculture and the National Forestry Directorate with financial and technical support of the United States Agency for International Development (USAID) address's the sustainability of small-holder production system in the lowland humid tropics by promoting agroforestry practices and demonstrates the acceptance and adaptability of the proposed technology with on-farm demonstrations, monitored semi-annually for adoption and expansion of the practices. Feed back from the farmers practical experience provides management guidelines for individual components that are not available from experimental station research.

Geographically the project is in the Napo Province, located in the Napo River Valley, east of the Andes and south of the Equator, between the altitudes of 600 m above sea level at its highest point and 200 m above sea level at the eastern most

point (see map 1). Rainfall is reported to be 3.100 mm annually by Costales et al (1987) (see map 2). There is no pronounced dry season with precipitation always exceeding the potential evapotranspiration (Canadas, 1983). Forest vegetation for the eastern lowland forest in the Yasuni National Park is reported by Balsler et al (1987), while the vegetation at a higher elevation near Tena was described by Grubb et al (1963). Because there is no distinct dry season in this part of the Ecuadorian lowlands, cut vegetation is not burned, but allowed to remain as mulch for cultivated crops (Hiraoka and Yamamoto 1980).

Ten years of germplasm collection and evaluation by the INIAP-NAPO Research Stations at San Carlos, Payamino and initial Limoncocha (Kirby 1976) for improved grasses (Muñoz, et al 1981), legumes (Imrie et al 1983), tropical hair sheep (Bishop 1983) and platain varieties provided promising new species that could be introduced into existing smallholder production systems for greater stability both ecologically as well as economically.

By focusing the project design on stratifying soil types, identifying crop production systems and working with improved germ plasm and its management, improvements that increase small-holder productivity and sustainability could be recommended while trying to optimize the number of trees per Ha. associated with any one or all of the existing production systems.

Using a farming system framework (Zandstra 1982, Jones and

Price 1985) for designing and implementing the Coca Agroforestry Demonstration Project and having three 2-yr phases (1984-85, 1986-87, 1988-89), has allowed for administrative as well as technical redisign of the project based on feed back from the farmers of their appreciation of the new germ plasm being introduced and management practices recommended, as well as a revaluation of their needs for solving their problems. Multiplier effects of successful demonstrations are increased using billboards to call attention to agroforestry tree species, especially Jacaranda copaia.

TRADITIONAL AGROFORESTRY

The Chacra and its Lessons.

The chacra might best be understood using Lathrap's (1970) term of being "The Tropical Forest Agricultural System". In the Napo Quichua system of "Slash-and-Mulch", valued trees and palm species are left standing when the forest is first cut (Muratorio 1987). Sources of regeneration include residual saplings, sprouts from cut trees, germination of buried and wind born seeds and intentionally planted seeds or seedlings (Irvine 1987). People alter the proportions of those four sources of regeneration by selecting desirable species, through protection or transplanting, by eliminating undesirable plants, and by cutting or weeding. The choice to cut or protect individual plants occurs during different agriculture practices.

A chacra belongs to the person who establishes it, never being abandoned in the figurative sense (Posey 1983). They continue to be productive until they are reworked, being the continual source of fruits, medicinal plants, fire wood and timber. See table 1 for a list of some of the more frequent Chacra species.

Just learning how the forest cover of the chacra is re-established by the Napo Quechuas has provided the silvicultural bases for the Agroforestry practices recommended by the project design, a model that already has been proven in the chacra (Peck 1983).

Commercial Production Systems.

After oil was discovered and commercially exploited in the early 1970's, construction of roads in the lowlands converted Eastern Ecuador into one of the most active centers of colonization in the Amazon Basin (Uquillas 1984). An early base study conducted in 1976 by CICAME (Centro de Investigaciones Culturales de la Amazonía) (González, A and J.S. Ortíz de Villalba, 1977) indicated that the colonists first preocupation was that of establishing subsistance agriculture for auto consumption, adapting the indigenous slash-and-mulch production system to their own food preferences (Hiraoka and Yamamoto 1980). The early tendency for the colonists was to develop pastures for cattle reaching, though several pasture diseases

presented problems, in particular spittle bug and lack of knowledge of pasture management. Half of the average area in cultivation on each farm was dedicated to pastures, with a tendency to expand pastures as they are accustomed to planting corn on recently cleared land followed by more pastures (Mag-Orstom 1978 from Uquillas 1984).

But landuse patterns were destined to change. Killing frost destroyed coffee plantations in Brazil and Robusta coffee was introduced into Eastern Ecuador or "Oriente" as it is locally known, from coastal plantations established during the 50's by Rockefeller in Hacienda Café Robusta.

By 1976 frontier colonization had greatly expanded. In the Napo Province alone 12.500 homesteads had been granted by IERAC occupying 464.000 Ha. of lowland tropical forest with a population of 74.000 persons, an average of thirty seven Ha. per agricultural unit, of which less than one-third was in production, averaging only 11.8 Ha. per unit (MAG-ORSTEM 1978 from Uquillas 1984).

By 1984 when the Coca Agroforestry Project was designed, two commercial market-oriented farming systems, coffee and pastures, had evolved from what had only 10 years before been subsistence agriculture. The National Coffee Censes (1983) showed that the Napo Province competed for second place in coffee production with 7.748 metric tons from 28.430 Ha. of robusta coffee.

By 1986 (Estrada et al 1988) the Cantón Francisco de Orellana which is the center of project activities, IERAC had allocated 145.500 Ha. of a total 845.000 Ha. in the Cantón to approximately 3.300 families. Average farm size of farms located along road side is 46 Ha. After 15 years of colonization in the Cantón only an average of 16 Ha. per farm of forest has been converted to cropping systems. See Table 2 for distribution of cropping systems within the farm homesteads stratified by soil type and Tables 3 and 4 for the number of trees traditionally associated with each production system.

PROJECT DESIGN PHASE 1 (1984-85)

For the center of project activities, Coca (Cantón of Francisco de Orellana) located on the Napo river and a commercial center having a population of some 10.000 people, was chosen for its strategic location in the lowland humid tropics. Also conveniently located in Coca is a Ministry of Agriculture field office and nearby are the two Napo Agriculture Research Stations.

Initial project design included four specific objectives:

1. Promotion of agroforestry practices.

a. Establishment of on-farm demonstrations using agro-silvicultural practices within existing traditional perennial production systems (robusta coffee) by introducing commercial timber species and legume cover crops.

b. Establish on-farm field trails using silvo-pastoral practices for associating grasses and legume forrages with timber tree species.

2. Nursery production of agroforestry germ plasm making promising species available to the general public.

a. Nursery production of commercial tree species having known silviculture: Laurel (Cordia alliodora), Pachaco (Schizolobium parahyba), Jacaranda (Jacaranda copaia) Puma maqui (Didymopamax morototoni), Cedro (Cedrela odorata) and Ahauno (Swietenia macrophylla).

b. Multiplication plots of perennial food crops for commercial production and auto consumption, plantain varieties, SABAD (ABB), red stemed plantain (AAB) and Xanthosoma sp.(papa mandi).

c. Multiplication plots of living fence post material for vegetative propagation, particularly: Mataraton (Gliricidia sepium), Pinon (Jathopha carcas) and Red Leafed Lechero (Euphorbia cotinifolia).

d. Multiplication plots for vegetative propagation of grasses and legumes for well and poorly drained sites: Brachiaria himidicola (Kikuyo Amazónico) and Desmodium ovalifulium (Trébol Tropical) for well drained sites and Echinochloa polistachya (Pasto Alemán), Echinochloa pyrimidales (Antelope) and D. heterophylum for poorly drained sites.

3. Training of technical staff; includes professional foresters and agronomists, agricultural technicians and nursery personnel.

4. Support of basic agroforestry research with INIAP.

a. Training project personnel in management practices and selection of improved varieties of robusta coffee.

b. Support of silvo-pastoral research, in particular with tropical hair sheep as an alternative production system for smallholders.

c. Establish an arboretum of leguminous tree species for evaluation of their contribution in the restauration of degraded soils and of promising timber species.

METHODOLOGY

1. Promotion of Agroforestry Practices.

The classification of "farm demonstration" is given to those practices that have demonstrated results, such as the planting of tree species having known silviculture in coffee plantations.

The classification of "field trials" is given to those practices that must still be proven such as the establishment of multiplication plots of improved grasses, legumes, plantains and living fence post material until these multiplication plots are expanded by the farmer they are not classified as demonstrations.

Demonstrations are established on farms located along the seven principal roads radiating out from Coca in the Cantón of Francisco de Orellana, with farmers expressing voluntary

interest in receiving technical assistance for increasing the number of commercial trees associated with their existing production system, giving particular emphasis to commercial coffee and pasture production systems. The objective being to validate on farm, the different components (improved germ plasm from INIAP station trials) of the agroforestry practice being promoted.

Demonstrations are initially planted by the farmer with the help of a project agronomist to assure that the plot fits into the existing farming system and proper cropping sequence to assure successful establishment. Before establishing a field trial, or demonstration, the project agronomist makes a farm plan, walking through the farm with the farmer, identifying soil types, farming systems and subsystems, sounding out the farmer for his reasons and needs for different agroforestry practices.

This farm plan is recorded in a folder established for each farm, where these observations are recorded. Each subsequent visit and recommendations are recorded as points of reference for evaluating results and for allowing project coordinators to evaluate the quality and effectiveness of field work each semester. Areas in each production system are skechted to scale and up dated as required.

As of December 1987, more than 200 demonstrations have been established on individual farms of which 109 are in extensions greater that 1 Ha. stratified by agroforestry practices. Seventy

five demonstrations greater than 1 Ha in size have been established associating commercial timber tree species with robusta coffee, while 34 demonstrations greater that 1 Ha. have been established associating commercial timber trees species within improved germplasm of grass-legumen pastures (B. humidicola y D. ovalifolium). It should be pointed out that all the silvopastoril demonstrations are initially established with vegetative planting material as small multiplication plots (as small as 10 x 10 meters), which are progressively multiplied as the farmer recognizes the merits of the particular grass or legume. As of December 1987, 188 farms have established grass/legumes multiplication plots of improved germ plasm. Stratified by soil type 74% of the demonstrations are located on red clay soils, 15% on alluvial soils and 11% on river alluvial soils.

2. Nursery Production.

Tree species are produced in prepared beds for bare root planting as stripling or root stumps. The nursery site was selected for having a reliable water supply and having sufficient area of secondary forest with undisturbed alluvial top soil (6 Ha.) so that nursery beds could be rotated each year, planting between beds a legume cover crop with perennial peanut (Araachis sp.) to control weeds and erosion. As beds are being abandoned after 2-3 productions of plants, D. ovalifolium and Inga edulis are established to form a persistent legume cover crop for restoring soil fertility during the fallow or

restauration period of 2-3 years.

One Ha. of improved varieties of plantain are planted along the stream crossing the nursery, as well as several Ha of legume ground cover planted to D. ovalifolium and D. heterophylum. Living fence posts consisting of distinct species surrounds the 12 Ha. nursery serving as a multiplication plot and source of material for farm demonstrations.

3. Project field staff

Project field staff are recruited from the local Agricultural High Schools, whom had been raised locally on farms or comunas (Communal lands belonging to the lowland Napo Quichuas), all having had practical farming experience, knowing the local species of trees, coffee, pastures and their management problems. Formal training focused on learning the merits of agroforestry practices of selected germ plasm available from initial research results from INIAP, and spacing requirements for the trees to be associated with the existing agricultural production systems. Field training included their interviewing on an informal bases farmers living in the sector assigned to them, and consisted of determining what the farming system were and detecting interest in receiving technical assistance for planting trees and acquiring improved grass and legume species for pasture production, and were the first steps in establishing contact with the farmer and the community.

Interviews were later recorded and farmers interested in participating with the project were located on sector maps made by the agronomist using IERAC base maps for posterior contact.

Agronomists receive in-service training in preparation of planting materials and in the establishment of on-farm demonstrations.

4. Support of Basic Agroforestry Research

a. Consists of establishing on-farm demonstrations focusing on distinct management practices for Robusta coffee, in particular establishing a ground cover of Desmodium for reducing cleaning costs and hopefully reducing fertilizer requirements.

b. Technical support in attaining an elite flock of 200 ewes of Tropical Hair Sheep for providing breeding stock in a cross-breeding program with small producers working with the project. To date 12 modules have been established on farms.

c. With the help of the "Flora del Ecuador" project staffed by technical personal from Missouri Botanical Gardens and the New York Botanical Garden. Two floristic reserves were established on the two major soil types within the INIAP stations for purposes of identifying and quantifying species composition and structure.

PROJECT EVALUATION (1986-1987) PHASE II

During this period it became apparent that the initial project objectives were being achieved and even surpassed. The demonstrations speak for themselves.

Disemination of improved germ plasm has entered into expanding production systems, helping meet the farmers needs. Management constrains have been identified and in some cases alleviated.

Farmers recognizing the compatibility of maintaining up to a maximum of 100 trees per Ha. within their production systems have identified more tree species with silvicultural characteristics that are now being recommended to others. (See table 5).

But, what about answers to more searching questions? What is the economic impact of the project to the farmer accepting the agroforestry practices, is it worth while? What are the multiplier effects and how will these practices if really successful reach others?

Fortunately the project has not developed in a vacum, it has been visited by 176 visitors from 49 institutions and 14 countries. These visitors have been another source of feed back other than the farmers themselves. One result was a cooperative baseline study conducted with the help of six institutions

recently published by CIAT entitled "Characterization of the production systems in the lowland tropical forest on the Napo Province, Ecuador" (Estrada et al, 1988). Another was the training of the two project coordinaters at CIAT during 1987, in the use of utilizing IBM - PC computers for evaluating project progress with the PANESEA program developed by PAN Livestock Services (1986).

PROJECT OUTREACH (1988-89) Phase III

In formulating the phase III work plan, initial objectives were strenghtened to build on the experience gained to date.

1. Maintain the existing on-farm demonstrations for long term validation.

2. Initiate a social economic study monitoring 20 farms for flow of inputs and outputs, evaluating agroforestry practices for their contribution in sustaining the systems both ecologically and economically. This study will be conducted with technical support from CIAT and FUNDAGRO.

3. Promotion of Agroforestry Practices with rural schools using didactic material already developed, that is an introductory slide show, bulletins for school children, parents and teacher groups and poster programs, in addition to the establishment of school yard demonstrations for providing improved germ plasm to each community.

4. Training--- make available in-service training to other national programs having similar ecological situations and potential for agroforestry practices.

5. Continue supporting basic research, particularly work related to the Floristic Reserves and utilization of promising agroforestry species.

DISCUSSION OF TECHNICAL CONTRIBUTIONS

The baseline study conducted in 1986 by the project in conjunction with other institutions (Estrada et al 1988), confirms Collins (1986) has conclusions about smallholder production systems that labor is not unlimited, in fact it is a major constraint. Recommendations for improved technology must take this into account. Labor intensive practices means hiring more labor or sacrificing some other activity.

Introduction a legume cover crop into the farming system.

D. ovalifolium is slow to establish, requiring several cleanings before forming a ground cover. Broadcast seeding where there exists weed competition is not feasible. Planting at close spacing vegetatively at the time of planting the grass is very time consuming and is resisted initially by farmers who have not seen the benefits.

But at the moment trees are introduced into the system as

root stumps or striplings (a practice limited to the rainy season only), Desmodium seed can be sprinkeled around the plant on bare ground and cleaned to reduce weed competition. One hundred small patches of Desmodium per ha. can be thus established successfully with a minimum of labor. During subsequent cleaning of the trees when the farmer cleans his other associated crops, he cleans the Desmodium as well. The stoloniferous growth habit allows for gradual extension of the Desmodium, and if introduced in pastures, will further be propagated when cattle consume the seed and like wise distributing them, scarified and fertilized.

Establishing trees in pastures ?

This can be a very frustrating experience, but over 100 field trials indicate that there are ways to successfully establish trees in pastures.

Survival is greatly increased when trees are planted next to natural barriers, such as stumps and fallen tree trunks. In the absence of these natural barriers or associated with them, plant a natural barrier--- yes, plant vegetatively 4-6 of red leafed lechero (Euphorbia cotinifolia) around the planted tree, preferable during the rainy season when red leafed lechero sprouts best, forming a protective barrier of leaves offensive to most cattle. Around the base of each tree needless to say should be established Desmodium.

Living fence posts - a labor saving practice.

Pasture subdivisions is a basic element for the management of rotational grazing which is reduced to continuous grazing if fencing failures due to rotten posts previal. The labor requirements for acquiring (more labor or purchase), transporting and replacement of fence posts is a labor intensive activity that is a serious problem expressed by the farmers participating with the project.

From an initial list of three living post species (Mata ratón, Pinon and Red leafed lechero), 5 more species based on the experience of participating farmers have been added to the list of species available (see table 6) for living fences.

Renovation of Degraded Pastures.

Degradation of pastures can be caused by any one of a series of causes or a combination of them including: declining soil fertility, increasing weed competition, spittel bug, overgrazing, soil compaction, undergrazing and planting off-site among other causes (STANDLEY 1977).

Multiplication plots and small expansions of these are generally accomplished by cleaning the site down to bare soil with a machete, and planting the grass vegetatively at spacings

ranging from 50 to 90 cm. Two or three initial cleanings are generally required before the grass is well established ready for grazing or further multiplication. This process is very labor consuming, often to the point that farmers are discouraged about planting B. humidicola, and even more so about D. ovalifolim which is even slower in establishment.

Two distinct renovation methods have developed by farmers trying to reduce labor costs of establishing new pastures. One method consists of using herbicides a practice that farmers learned for controlling weeds in the coffee plantations. By planting vegetatively B. humidicola in degraded pastures two or three days after applying a combination of contact and post-emergent herbicides, the grass has time to establish itself, set seed, and be grazed before requiring the first cleaning.

A second method for renovating a degraded pasture is to temporally abandon the pasture, allowing it to grow up into a fallow or secondary forest for a year or two. Then the undergrowth is slashed, and grass planted under the overstory of secondary tree species. Within several days the overstory is cut, leaving only the valued species - most frequently Laurel and or Jacaranda.

CONCLUSIONS

Conclusions include the following points that are not necessarily apparent from reading this paper:

1. Formation of a multidisciplinary team for project design and implementation, and using the farming systems approach helps keep project objectives from being dominated by one field of specialization.

2. Build on former project experience---INIAP had worked on germ plasm collection and evaluation under the guidance of one of the project team members.

3. Recruitment of local resident personnel that tend to be more stable than those brought in from other regions. It is easier to establish confidence with smallholders when project field staff are locals.

4. Build into the project a continuing self - evaluation process that incorporates project personnel into the evaluations of the on-farm demonstrations so that they hear directly from the farmer the pros and the cons of practices they are recommending.

5. Build into the project design linkages with national and international research centers for additional backup support for technical problems.

6. Introduction of germ plasm and transfer of technology is site specific and must be adjusted for each individual farmer; incorporate the farmer into the decision making process--- they are often very curious, having already made

many of their own introductions of new germ plasm that they received from neighbours. Each farm should have it's own work plan.

7. Design and develop projects within national organizations that will have continuity of project trained personnel, even if there is no continued financing when a project ends.

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TABLE 1

THE CHACRA THE TROPICAL FOREST AGRICULTURAL SYSTEM

A listing of some of the more frecuently cultivated or protected plant species by the lowland Napo Quichua 250-600m above sea level

SCIENTIFIC NAME	COMMON QUICHUA NAME	COMMON SPANISH NAME
Fruit trees		
Inga edulas	Pacai suni pacai	Guaba
Inga spectabilis	Muchetuna pacai	Muchatona
Inga densiflora	Ilta pacai	ilta
Theobroma bicolor	Patas yura	cacao blanco
Caryodendron orinocense	Inchi huachansu	Maní de árbol
Pourouma cecropiifolia	Uvillia	Uvillia
Pouteria caimeto	Abiyu	Abiyu
Persea americana	Palta	Aguacate
Rheedia macrophylla	Pungara Muyu	Madroño
Palms		
Bactris gasipaes	Chunda ruru	Chonta dura
Iriatea carneto	Patihua	Pambil
Jessenia polycarpa	Ungurahua	Mil pesos
Carludovica palmata	Lisan	Paja toquilla
Astrocaryum chambira	Chambira	Macora
Palandra aequatorialis	Yarina	Tagua
Small trees or shrubs		
Bixa orellana	Manduru	Achiote
Ilex guayusa	Guayusa	Guayusa
Crescentia cujete	Pilchi	Maté
Lonchocarpus sp.	Ambi	Barbasco
Brownea spp.	Cruz caspi	Palo de cruz
Cultivated plants		
Musa spp.	Palanda	Plátano
Carica papaya	Papaya	Papaya
Manihot esculenta	Lumu	Yuca
Arachis hypognea	Inchi	Mani
Zea mays	Sinchi sara	Maíz duro
Grossypium burbadense	Algudun	Algodon perennial
Xanthosoma saguttifolium	Papa mandi	Papa mandi
Renealmia alpinea	Shihuango muyu	Platanillo morado
Commercial Timber Trees		
Cordia alliodora	Araña caspi	Laurel
Cedrela odorata	Cidra	Cedro
Jacaranda copaia	Copa	Jacaranda
Poilalesta karstenii	Pigui	Pigue

TABLE 2

Distribution of production systems within Homestead by soil type*

	SOIL TYPE			
	Aluvial	Volcanic	Red Clay Hills	Total
Number of Homesteads	27	33	47	107
Size of Homestead (Ha)	45.6	49.1	44.7	46.0
Area cleared (Ha)	17.4	23.3	9.6	15.8
Area in crops (Ha)	6.0	8.5	5.1	6.5
Area in pastures* (Ha)	7.0	10.0	4.1	6.6
Area in fallow (Ha)	4.4	4.8	0.4	2.7

Source: Estrada, R. et al 1988

* Based on animal inventories, the stocking rate is 0.95 animal units per hectare.

TABLE 3

Distribution of trees by species, associated with distinct cropping systems according to their relative presence at the time of the base line study*

		Laurel		Jacaranda	
crop	No. of farms producing this crop	No. of farms associating tree/crop	No. of trees per Ha	No. of farms associating tree/crop	No. of trees per Ha
Coffee	104	95	19.1	7	6.7
Cacao	16	12	19.3	1	5.0
Corn	23	14	18.3		
Elefant grass	47	36	11.9	1	1.3
Saboya grass	9	8	8.6		
Dellis grass	48	36	14.7	2	4.5
Kikuyo grass	11	9	23.1	1	10.0
Alemán grass	9	5	7.8		
Fallow	38	38	27.9	4	56.2

Source: Estrada et al 1988

* A total of 107 farms were sampled, of which 20 farmers participated in the MAG Agroforestry Project

T A B L E 4

DISTRIBUTION OF LAUREL (Cordia alliodora) BY SOIL TYPE AND CROP PRODUCTION SYSTEM

SOIL TYPE	ALLUVIAL		VOLCANIC		RED CLAY HILLS		TOTAL	
AREA IN HA.	149375		200625		401875			
	17.7		23.7		47.5			
CROP								
FARMS SAMPLED	27		33		47		107	
	No.Farms	Trees per Ha.	No.Farms	Trees per Ha.	No.Farms	Trees per Ha.	No.Farms	Trees per Ha.
Coffee	23	31.9	33	12.2	39	17.4	95	19.1
Cacao	4	12.1	5	8.8	3	46.6	12	19.3
Corn	6	18.6	6	11.6	2	37.5	14	19.3
Elefant grass	15	12.5	15	9.8	6	16.8	36	11.9
Saboya grass	1	15.0	6	8.6	1	2.0	8	8.6
Dallis grass	11	20.4	14	6.4	11	19.6	36	14.7
Kikuyo grass	2	11.2	3	9.1	4	39.6	9	23.1
Aleman grass	4	7.2	-		1	10.0	5	9.8
Fallow	14	13.1	14	28.9	10	48.3	38	27.9

Source: Estrada et al 1988

TABLE 5

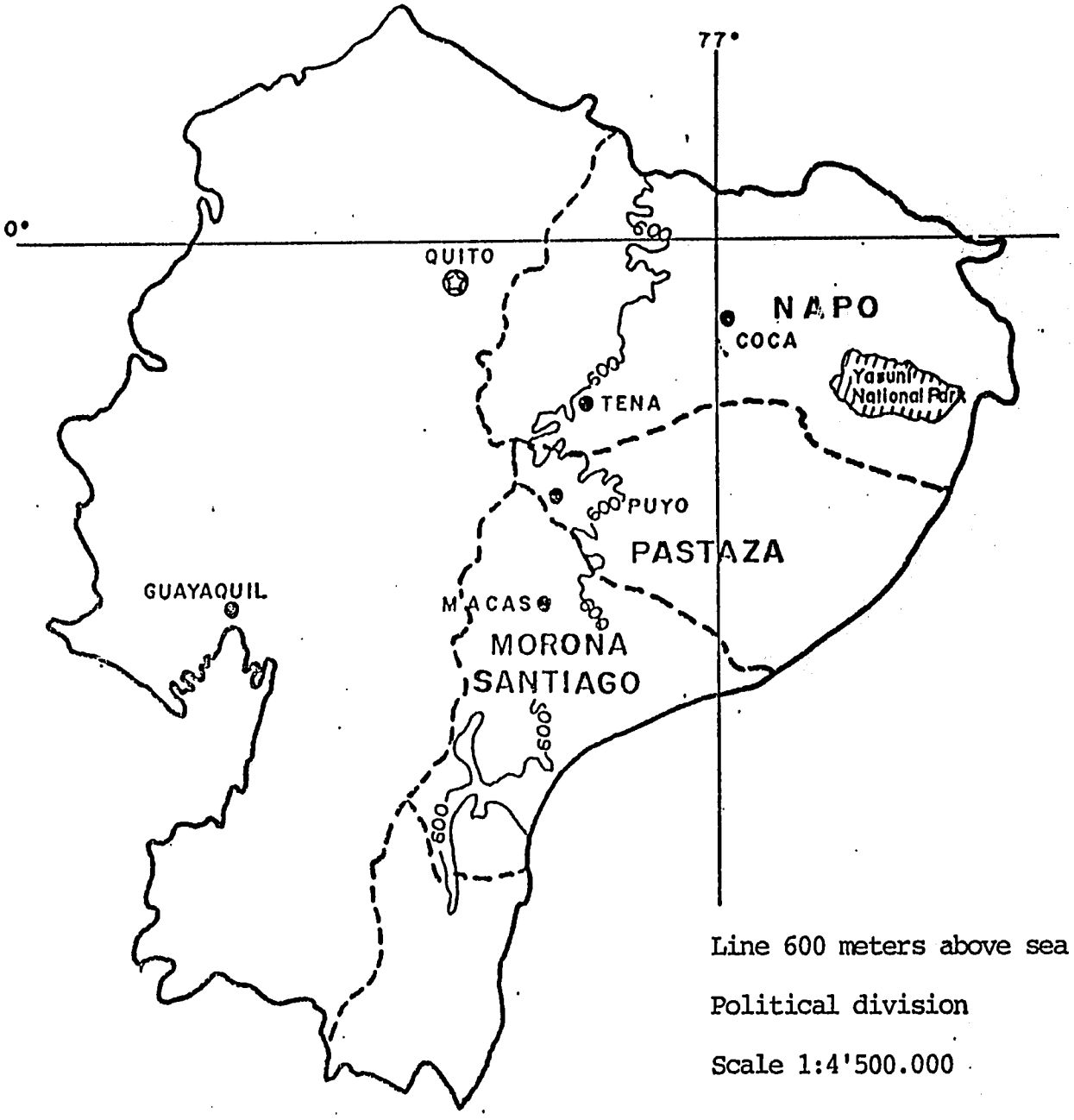
List of commercial timber species identified by farmers and included in Agroforestry Demonstrations in lowland and humid Tropics of Eastern Ecuador

SCIENTIFIC NAME	FAMILY	COMMON SPANISH NAME	QUICHUA NAME
Didymopanax morototoni	Araliaceae	Fósforo	Puma maqui
Pollalesta karstenii	Asteraceae	Pigue	Pigui
Jacaranda copaia	Bignoniaceae	Jacaranda	Copa
Tabebuia chrysantha	Bignoniaceae	Guayacan	Guayanchi
Cordia alliodora	Boraginaceae	Laurel	Araña caspi
Hyeronima chocoensis	Euphorbiaceae	Mascarey	Huapa
Schizolobium parahybum	Fabaceae-Caes.	Pachaco	Masachi
Myroxylum balsamum	Fabaceae-Fab.	Balsamo	Balsamu
Platymiscium stipulare	Fabaceae-Fab.	Caoba veteada	-
Cedrelinga catenaeformis	Fabaceae-Mim.	Chuncho	Chunchu
Parkia multijuga	Fabaceae-Mim.	Cutanga	Cutanga
Parkia nitida	Fabaceae-Mim.	Guarango	Guarangu
Cabralea canjerana	Meliaceae	Batea caspi	Batia caspi
Cedrela odorata	Meliacea	Cedro	Cedru yura
Guarea kinthiana	Meliaceae	Tocota	Tucuta
Swietenia macrophylla	Meliaceae	Ahuano	Ahuanu
Brosimum utile	Moraceae	Sande	Sandi yura
Clarisia racemosa	Moraceae	Moral bobo	Moral
Otoba parvifolia	Myristicaceae	Sangre de de gallina	Huapa
Virola spp.	Myristicaceae	Huapa	Huapa
Calycophyllum spruceanum	Rubiaceae	Capirona	Capiruna
Chimarrhis glabriflora	Rubiaceae	Mecha	Intachi
Zanthoxylum spp.	Rutaceae	Tachuelo	Casha caspi
Huerta glandulosa	Staphyleaceae	Bajaya	Bajuya
Apeiba aspera	Tiliaceae	Prene mono	Naccha caspi
Vitex cymosa	Verbenaceae	Guayacan pechiche	Pucuna caspi
Vochysia bracelineae	Vochysiaceae	Tamboro	Tamburu

TABLE 6

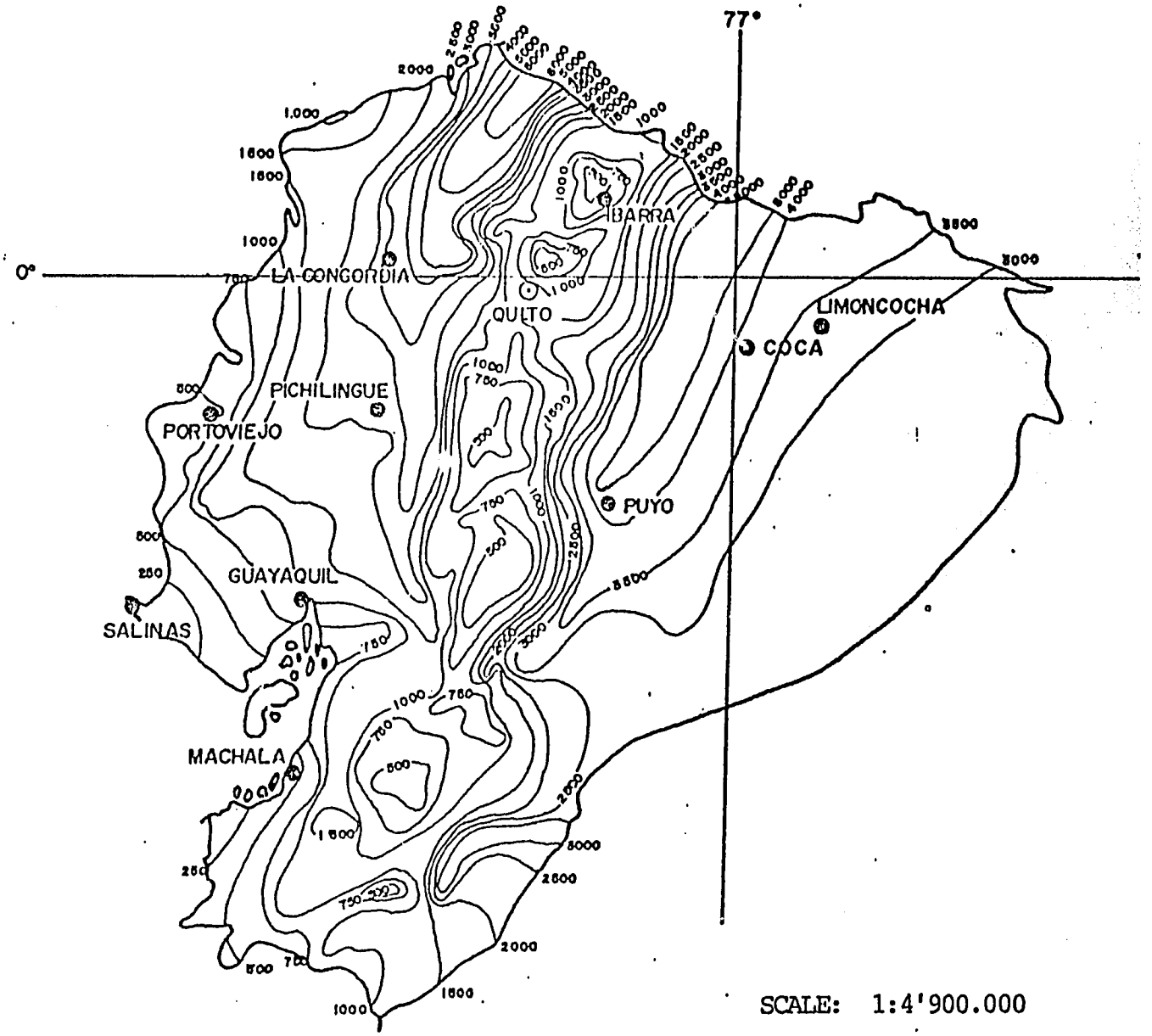
Table of species used as living fence post
by small-holders in the lowland tropics of Ecuador

SCIENTIFIC NAME	LOCAL NAME IN SPANISH	LOCAL NAME IN QUECHUA
1. Gliricida sepium	Mata ratón	---
2. Euphorbia cotinifolia	Lechero	Puca panga
3. Jatropha curcas	Pinon	---
4. Cithrarexylum sp.	Nacadero	Pilche caspi
5. Erythrina ulei	Porotillo	chucu
6. Spondis sp.	Hobos	---
7. Spondis luthea	Ciruelo	Ciruelo muyu
8. Lonchocarpus sp.	Barbasco	Ambi



SOURCE: MAG-PRONAREG-ORSTOM (1982)

MAP 1. Location in Amazonian Ecuador



SOURCE: CEDIG (1983)

MAP 2. Annual Precipitation of Ecuador and the Ecuadorian Amazon 1965-1978