THE TROPICAL MIXED GARDEN: AN AGROFORESTRY COMPONENT OF THE SMALL FARM

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INTRODUCTION: APPROPRIATE AGROECOSYSTEM FOR THE TROPICS

The tropical environment, with its year-round plentiful sunshine, and consequently, relatively unvarying day to day temperatures, is theoretically, a plant cultivators dream come true - a place where growth is possible 365.25 days per year. Of course, we are all aware that there are other limitations besides sun-light and temperature to plant growth. However, no small number of plant species may be found which are adapted to most limiting factors that one cares to mention. Here in lies one of the dilemas of plant cultivation in the tropics, where one species would grow, a host of other species are ready and prepared to "do battle" for the same square inch of space. As a result, natural tropical environments are inhabited by a deversity of plant life that is often startling to the recently arrived from the more northern or southern latitudes.

Agricultural and forestry practices which contest this natural pattern would appear, both logically and intuitively, to be asking for trouble. The strong dependence of current agricultural and forestry cropping systems on expensive outside inputs of fertilizers, pesticides and herbicides would seem to indicate that it has found it.

An alternative to the current mode in agriculture (forestry is generally included too when refering to agriculture) might be to try and copy nature. Such a suggestion has been made either in general or direct terms by various authors (Trenbath 1975; Holdridge 1959; Hart 1980). Hart (1980) formalized the suggestion with his paper, "A Natural Ecosytem Analog Approach to the Design of a Successional Crop System for Tropical Forest Environment". In this paper Hart argues that a successional crop system has agronomic potential which is closely tied to characteristics of the crop system which reduce weed competition and the energy required to manage the system.

Hart's arguments were mainly based upon a review of the literature and his conclusions were necessarily conditional. However, they were, in part, responsible for the development of a large, long-term ecological study of natural succession as a model for designing new tropical agroecosystems. This study, based at CATIE and directed by John Ewel of the University of Florida, seeks to study productivity, herbivory, nutrient retention and ecosystem design in natural succession and a variety of investigator manipulated treatments. The goal of this and similar research (Jordan et al 1980 ; Harcombe 1977; Uhl 1980) is to establish basis for

designing alternative and productive tropical agroecosystems.

Of course, the idea of copying nature, at least intuitively, is not new nor only the domain of researchers with Ph.Ds, as any student of subsistence agriculture knows. Traditional forms of tropical agriculture often bear obvious resemblances to the local natural vegetation and at times have actually been mistaken and studied under this impression (Anderson 1954).

The variety of cultural responses to adapting agriculture to environment is the subject of a body of literature in anthropology and travel memoirs which extends back to the 19th century. Extensive bibliographies encompassing this literature are to be found in Spencer (1966) and Conklin (1961).

More recently, interest in traditional agriculture, and one can say also traditional "agroforestry", as trees more often than not play an important role in these systems, has been re-newed. (Gliessman, Garcia E., Amador A. 1978, 1981; Sommers 1978; Anderson 1979; Bompard et al. 1980).

The principal advantages that natural systems and their "mimics" seem to have are briefly summarized in graphic form in Figure 1. Shown in the Figure are two successional sequences, one a natural succession indicating three possible phases of regrowth from a natural or man-induced disturbance. The second sequence is a progression in complexity of form, structure and diversity of currently practiced cultivation systems.

Productivity, as one moves towards the right in Figure 1, appears to be on the average higher than for monocultures due to better use of nutrients, water and light (Allen et al. 1976; Parrish & Bazzaz 1976). Stratification of canopies through species diversity with attendant ranges in responses to light intensity permits fuller utilization of incoming radiation (Allen et al. 1976), while a similar arrangement below-ground of variable rooting depths and abilities to capture given elements argues for more efficient nutrient retention (Parrish & Bazzaz 1976; Nair 1981). Litter-fall and the partial harvests (i.e. generally, in perennial dominated mixtures only certain parts of plants are removed-leaves, fruits or branches) characteristic of tropical polycultures tend to favor maintenance of good soil-organic matter relations, which in turn favors infiltration of moisture and recycling of nutrients. Gliessman and colleagues (1981) working on cropping systems in Mexico based upon traditional designs are finding that biomass input in the perennial systems, in relation to output, is very similar to that reported for natural ecosystems of similar structure. This suggests that outside

inputs into the system are reduced and more stability in obtainable yield is gained (Gliessman et al 1981).

The literature on the relationship between plant diversity and insect problems is extensive and complex. However, there appears to be some consensus that diverse plant communities may be better adapted (Figure 2) to resist serious problems (Pimental 1977; Attsat & Dowd 1976; Harris 1974).

Unwanted plants in tropical polycultures are often controlled by the use of shade from overstorey crops or through the filling of niches occupied by serious weeds with cultivated or semi-cultivated substitutes as well as the occasional judicious use of machete.

THE TROPICAL MIXED GARDEN

Definition: The term "tropical mixed garden" refers to the complex of cultivated or semi-cultivated plants, mainly perennial or semi-perennial, that are found on the farm, often around the farmhouse. The late Edgar Anderson (1950), a botanist who spent some of his time getting to know the Guatemalan species of mixed garden, described it as follows:

> "By European standards the garden was desorderly, but productive; helter-skelter in general aspect but intelligent in its basic patterns. It was simultaneously an orchard, a vegetable garden, a medicinal garden, a flower garden, a bee yard, a garbage disposal unit and a compost heap. It was a continuous performance, constantly in use, continually being replanted. ... Every week in the year would find the garden in actual production."

The impression of disorder and lack of management is typical for the uninitiated, but this feeling changes to one of respect once a person appreciates how the garden functions. The roles ennumerated by Anderson in the preceeding quotation are by no means the only ones, for these gardens also serve to ameliorate household climatic conditions, serve as genetic banks for a wide variety of domesticated and semi-domesticated plants, and as an area for experimentation with new species or varieties, to mention some other functions of merit.

Spatial Organization, Structure and Diversity: As mentioned earlier, the mixed garden because of its structure and diversity, has on occasion been mistaken for its "counterpart" , the natural forest. Some of the diversity may be appreciated from Table 1 and from the mixed garden species lists(Appendices 1-4) which are appended as part of the written presentation. The number of species in Costa Rica, depending upon the ecological zone, appears to range from 20 to 60 species (without taking into consideration varietal variation) with an average of 16 species found per garden. It is interesting to note that the division between the

number of tree species to non-tree species found per garden is more or less equally divided, with an average of eight each (see Appendix 1 for species list) appearing in the average garden.

The spatial organization of the mixed garden is shown for a few examples in Figures 2-5, and in Figures 6-8 some impression of the vertical structure of these systems is also given. From these it is not hard to imagine how early observers, culturally oriented towards the ordered and neat European models of cropping, could become bewildered and disdainful of tropical mixed gardens.

The size of the mixed garden is an important but variable factor. In the farms surveyed by Sommers (1978) in the Philippines the gardens ranged from less than 150 sq. m. to over 1,500 sq. m. Garden size in Costa Rica ranges from a similar low to 4.5 ha. (Maffioli & Holle, n.d.). However, the number of farms so far surveyed in Costa Rica is too low to as yet calculate an average size, but it should be noted that the gardens studied by Maffioli and Holle (n.d.) in the Alajuela area from where the upper figure for size comes from have a strong commercial character. This situation appears to reflect the location of farmers in an important fruit growing area near to a large urban center (i.e. Alajuela).

The Primary Function of the Mixed Garden: The range of vegetables and fruits as well as other products from a well established mixed garden are an indispensable part of Man's upkeep in subsistence economies. However, as farmers tie themselves more and more into the cash economy traditional systems of subsistence are displaced in favor of money earning activities. The result of this trend is a growing dependence by small farmers upon forces beyond their control, and seemingly, beyond the control of the governments which pretend to manage them. In a world where economic stability seems to be only within the domain of economic theory the loss of a traditional buffer against hard-times, such as is the mixed garden, in a loss to be regretted.

This is the primary function of the mixed garden, to act as a buffer to cushion the impact during periods of scarcity. As an example, in West Java during the period November to Febuary, prior to the rice harvest, 25.5% of the income of the average rural family is derived from the mixed garden (Ahmad et al. 1980). This figure drops to 6.4% during the rice harvest when more of the garden products are consumed by the family. Analogous situations have been described for Mexico (Romero 1981), Haiti (Anonymous 1978) and the Philippines (Sommers 1978).

SERVICES PROVIDED BY THE MIXED GARDENS

The different products that the tropical mixed garden supplies to the farm household have been mentioned in passing previously. These functions are briefly reviewed again below.

1. Nutritional Support

The mixed garden may provide all or a significant percentage of the recomended dietary intake of minerals and vitamins. Sommers (1978) in his survey of Philippine households found that the family had the potential resources in their garden to meet their recommended daily allowance (R.D.A.) for vitamin A, vitamin C, iron and calcium. Over half could make a sizeable contrubution to the R.D.A. for thiamin, and niacin. He also found that nearly one out of every four households could meet their energy and protein needs.

2. Medicinals

With the introduction and acceptance of modern medicines and medical practices the culture and use of traditional curative methods tends to disappear. However it is still quite possible to encounter medicinal plants in the mixed gardens of Asia and Latin America. In Costa Rica much of the traditional medicinal knowledge still remains, particularly amongst the rural families who do not have as ready access to the services of pharmacies and doctors. Although there is a trend for this knowledge, which includes the recongnition of appropriate species, their cultivation and their preparation in curatives, to be lost to the current generation there is some indication by way of the opening of a number of herbal medicine shops in centers like San Jose that the trend may be reversing itself. This phenomenom is undoubtedly linked to the present economic crisis in Costa Rica and the increasingly high cost of imported medicines.

3. Materials

Lumber taken from fruit trees (see Appendix 5 for characteristics of some common fruit trees) which have ceased to produce satisfactory harvests will often find its way into the construction of fences, sheds and possibly of the farm house itself. The prunings from the trees find themselves occupied in forming shelters against farm animals for other plants and also, more often than not are consumed by the farm household as firewood. Species which offer hardness, strength and durability are to be found in the repair of broken tools, such as shovels or yokes for oxen.

Some indication, for Costa Rica at least, of the potential utilization by farmers of products from fruit trees may be had from tables 2 and 3. These tables offer an idea with respect to the number of fruit trees and species of fruit trees

farmers in Costa Rica have on their farms. These trees may be found mixed with other crops (eg. coffee, pasture, etc.) as well as within the mixed garden.

The range and nature of the mixed materials is both wide and diverse and depends upon the kind of plants a farmer can and wants to grow in his garden. It may be in the form of lumber or firewood as indicated above or it may be very different, such as leaves for wrapping tamales for cooking, twine for tying tamales, gummy sap for use as a glue, or something like the rotted husk of loufa or the half husk of a coconut which serve as household scrubbers - examples are almost limitless.-

4. Aesthetics and Household Climate

As indicated in the definition of the mixed garden the farm house is often located in its midst. In situations where trees dominate the garden and shade the house, the garden has the effect of ameliorating the temperature in and around the household. The house is also sheltered against strong winds and driving rains by this same buffer. The overall impact of such effects, where they are present, is to produce a more moderate and comfortable climate for the farm family.

Ornamental plants are an intrinsic part of every rural family's garden, be it in Asia or Latin America. These will be found hanging from verandas or trees, sitting on window sills or planted along the walk way into the house. It seems to be almost a rule that, although the mixed garden as a whole may be almost non-existent, there will be some ornamental plants without fail.

5. Supplemental Income

In Latin America the role of the mixed garden, both from a subsistence perspective and from an economic point of view, remains to be quantified. Some indication that this gap in our knowledge merits attention is given by the figures for the contribution to total family income by garden products from other parts of the world, most notably Asia. Though the income from the garden varies enormously - Ambar and Karyono (1976) quote various figures between 10% to 20% of total income.- it appears undoubtedly to play a significant role in the farm economy. Regionally in West Java, as quoted from Soemarwoto (1975) by Ambar and Karyono (1976) the mixed garden products which were sold for the years 1969-1973 had a value about 60% that of rice or U.S.$163 million. This is an average for the region of U.S. $32.6 million/year, a not insignificant sum.

For a number of reasons, mainly cultural and demographic, there is reason to beleive that the mixed garden in Latin America does not play as strong an economic role, as in Asia. Though the gardens from the region of Alajuela, Costa Rica (Table 1; Figure 3) have an obvious, but at present unquantified economic character.

And so, the questions still remain for most of Latin America "exactly what does the mixed garden contribute, if anything to the farm income?" and "what, if any, are the possibilities for improving this?"

6. Area for Experimentation

Experimentation, though not necessarily with a random-block design with the different levels of stratification, is a common practice amongst farmers all around the world. In the tropics often it is in a patch of the mixed garden that this experimentation takes place, be it with a new variety of corn or beans, or a new fruit species. This is an important practice as it provides the farmer with knowledge obtained at low risk which may serve him in making his farm more productive.

THE TROPICAL MIXED GARDEN: ITS ROLE AS AGROFORESTRY

By the definition of agroforestry that we have been following, that is

> "The combination of trees in space or in time with crops or animals - or both - with the goal of obtaining a stable system of production for the benefit of rural populations."

the tropical mixed garden classifies as an agroforestry system. However, its function is not agro- in the sense of producing commercial crops nor forestry in the sense of producing trees but a little of both. The mixed garden is a subsistence system, whose function, as has already been mentioned, is to act as a buffer for when the results of other farm activities have a lag in producing themselves or should external market conditions be adverse. The role is an important one and one which should be guarded and fostered. This must be regarded as its primary role as a system of agroforestry.

However, I believe that the mixed garden may be used as a focal point for small-scale agroforestry development. I would like to suggest three possible approaches to taking advantage of the mixed garden component of the small farm.

1. Introduction and Testing of New Crops and Varieties

The traditional approach to introducing new crops and varieties to farmers is to first previously test on the research station the crop or variety before approaching the farmer. The rationale for this is to avoid the risk of failure on the farm. The disadvantage of this is that because of the logistics of field research, these plants can only be tested over a small range of ecological conditions. However, it would be relatively inexpensive to distribute small lots

of seed of promising new plant varieties or new crops through agricultural extention agents to farmers and asking them to try them out in their gardens. This would permit testing the reaction of the plants not only to a wide variety of environmental conditions but also its reactions to traditional methods of cultivation. In this way there would be no risk to the farmer. This would be an approach complementary to field station research.

2. Development of Multiple-use Fruit Tree Species

Many species of fruit trees are used for other purposes, such as lumber, firewood or animal forage. However, there has been little research carried out with the expressed purpose of developing multi-use fruit trees. This is a possible development which may be tackled from both directions, that is through observation of farm practices (eg. pruning, age of replacement, etc.) as well as through directed research on specific species. An example of a potential multiple-use tree from Asia is the jack fruit (Artocarpus communis). This large, densely foliated tree produces large fruits weighing 12 kg. or more. From these fruits may be taken for human consumption the nutritious seeds and the fleshing seed caseins, the remainder or the fruit may be fed to pigs. The foliage also edible by livestock and wood is a highly respected construction material in Asia. A potential multiple-use fruit tree, common to Central America and parts of South America, is Chrysophyllum cainito. Other possibilities are included in Appendices 5-7, lists of some common trees and their characteristics.

3. Micro-scale Plantings of Precious Timbers

One of the main constraints to the development of precious timbers is the amount of care and maintenance required. If however, such timbers were planted in and/or around the mixed garden in low densities they would not necessarily increase greatly the work of the farmer as it would be possible to utilize other members of the family, such as the wife and children, who are often the ones who watch over the garden anyway, in the care of these trees. Though, because of the low densities these precious woods may not be a major economic cash crop on the farm, they may well represent "standing cash" for emergencies, such as has been the case with the laurel (Cordia alliodora) tree overstorey in the Atlantic cocoa plantations of Costa Rica. Another possibility, once shown that such a system as described above was practical, is thet the precious timber

planted in this manner might be used as collateral against the obtaining of bank credit.

These three ideas are admittedly tentative and poorly developed at present. However, my objective throughout this presentation has been mainly to stimulate interest in the mixed garden. If I have managed to do this, then there is promise that more thought and observation will be given to these interesting and valuable systems and they may become better understood.

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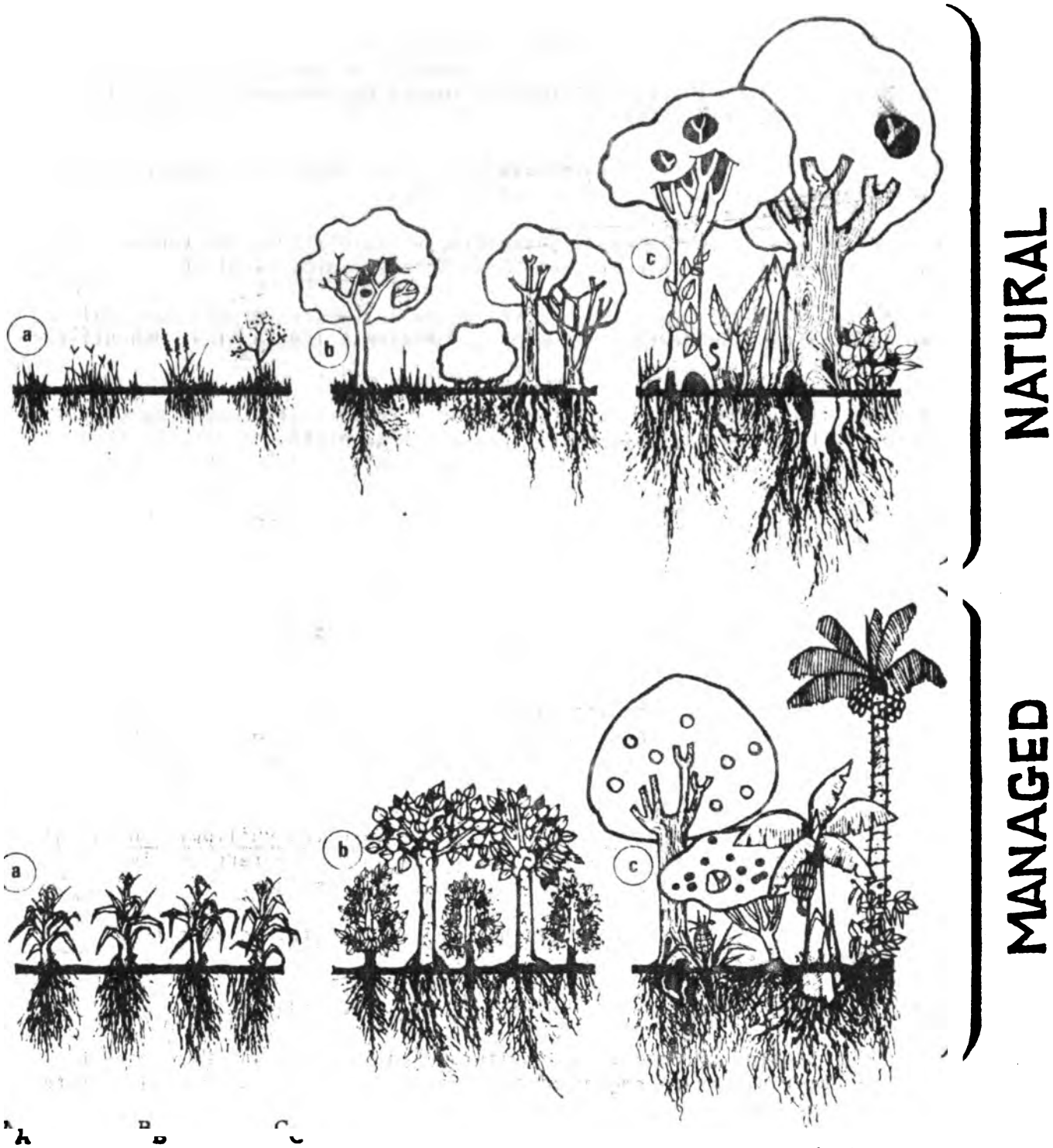
FIGURE 1



A B C

increasingly more efficient use of light
increasingly more retention of nutrients
increased addition of oryanic matter to soil
(some mono-crops or systems of management
may be exceptional)
on average, increasing productivity
decreasing incidence of major insect and
disease problems
decreasing competition from "weeds"
increasing self-maintenance

FIGURE 2 - Diverse agroecosystems may have reduced problems with insects pest build-ups by making desired food difficult to locate.

TABLE 1 - Summary of Number of Plant Species Recorded from Mixed Gardens in Costa Rica*

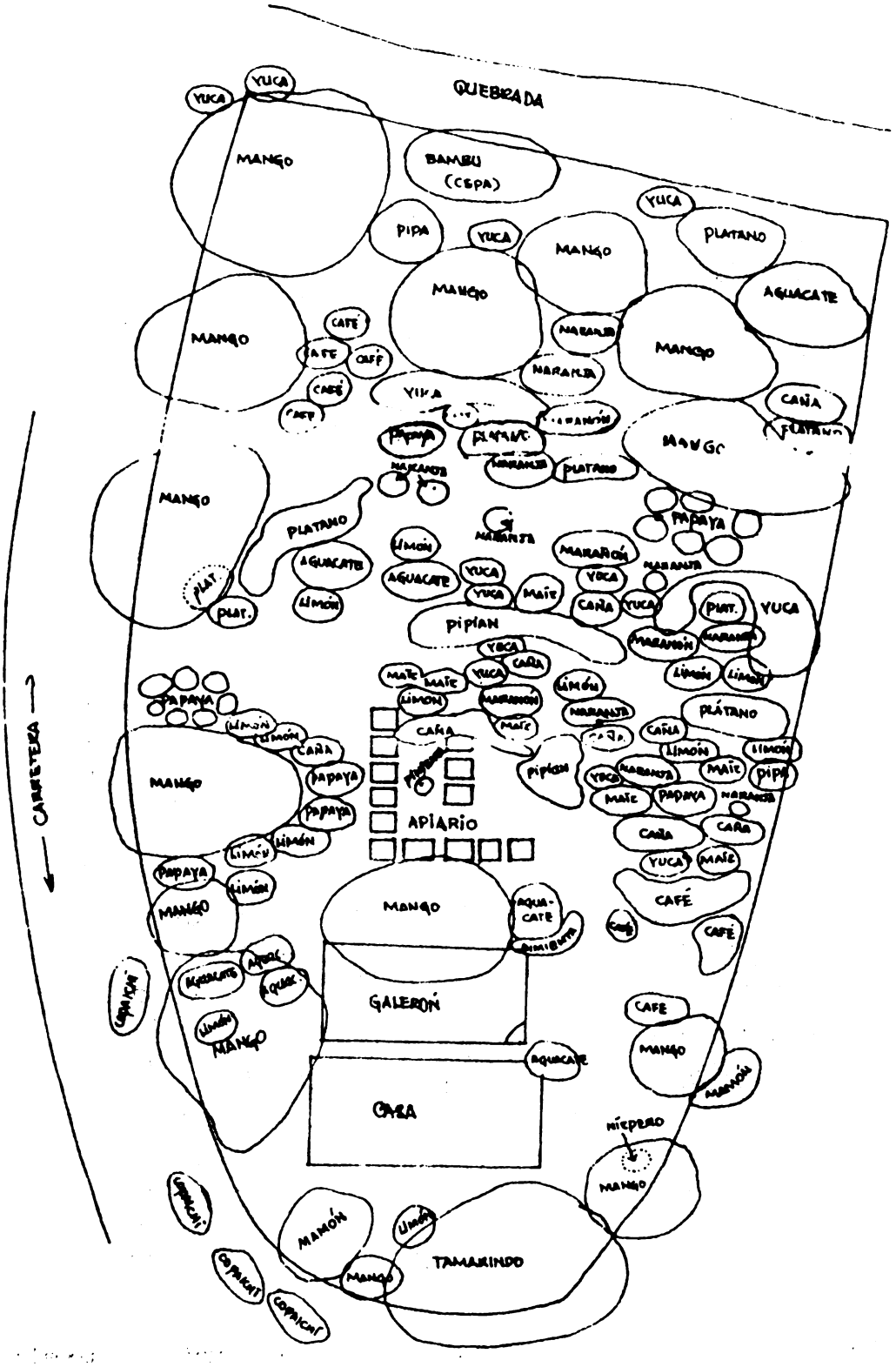
Location	Total Species	Ratio of Tree to non-tree species (mean/garden)	Mean No. Species/Garden	n
Guapiles[1]**	58	8 : 12	20	5
Alajuela[2]	47	9 : 7	16	6
Porto Viejo[1]	23	7 : 6	16	2
Monte Verde[3]	31	8 : 12	19	2
Santa Rosa[4]	25	10 : 7	16	2
Guayabo[5]/Limon[6]	56	5 : 6	10	22
		7.8 : 8.3	16	39

* Unpublished survey data from Melinda Troutner, Linda Newstrom, Anabelle Maffioli, Miguel Holle and Norman Price

** ecological Zones (Holdridge)

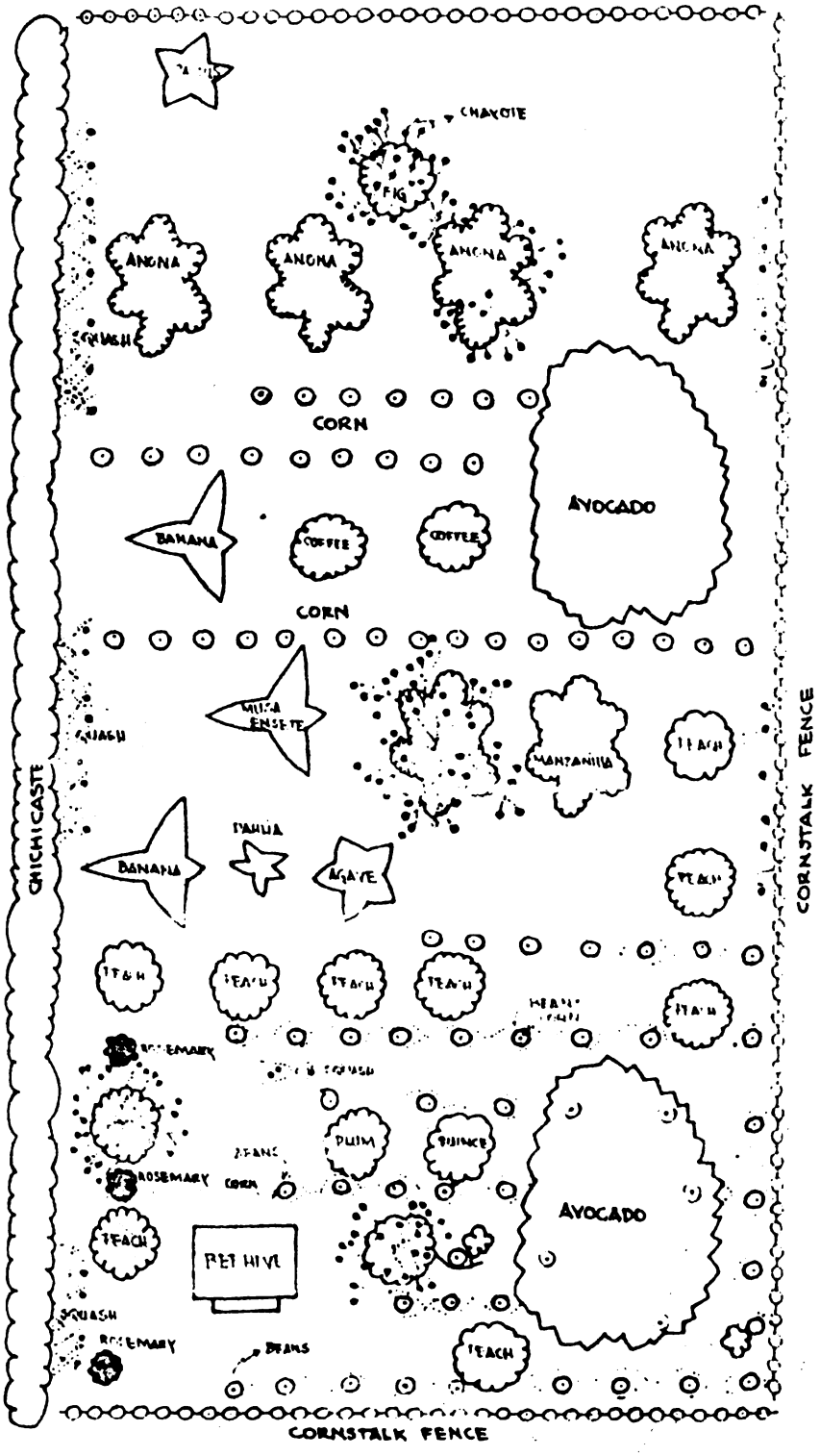
1 Tropical Wet Forest
2 Premontane Moist Forest
3 Premontane Rainforest
4 Premontane Moist Forest, Basal Belt Transition
5 Premontane Rain Forest
6 Premontane Wet Forest, Basal Belt Transition

FIGURE 3 - Finca Maffioli (0.5 ha.), Alajuela, Costa Rica.*



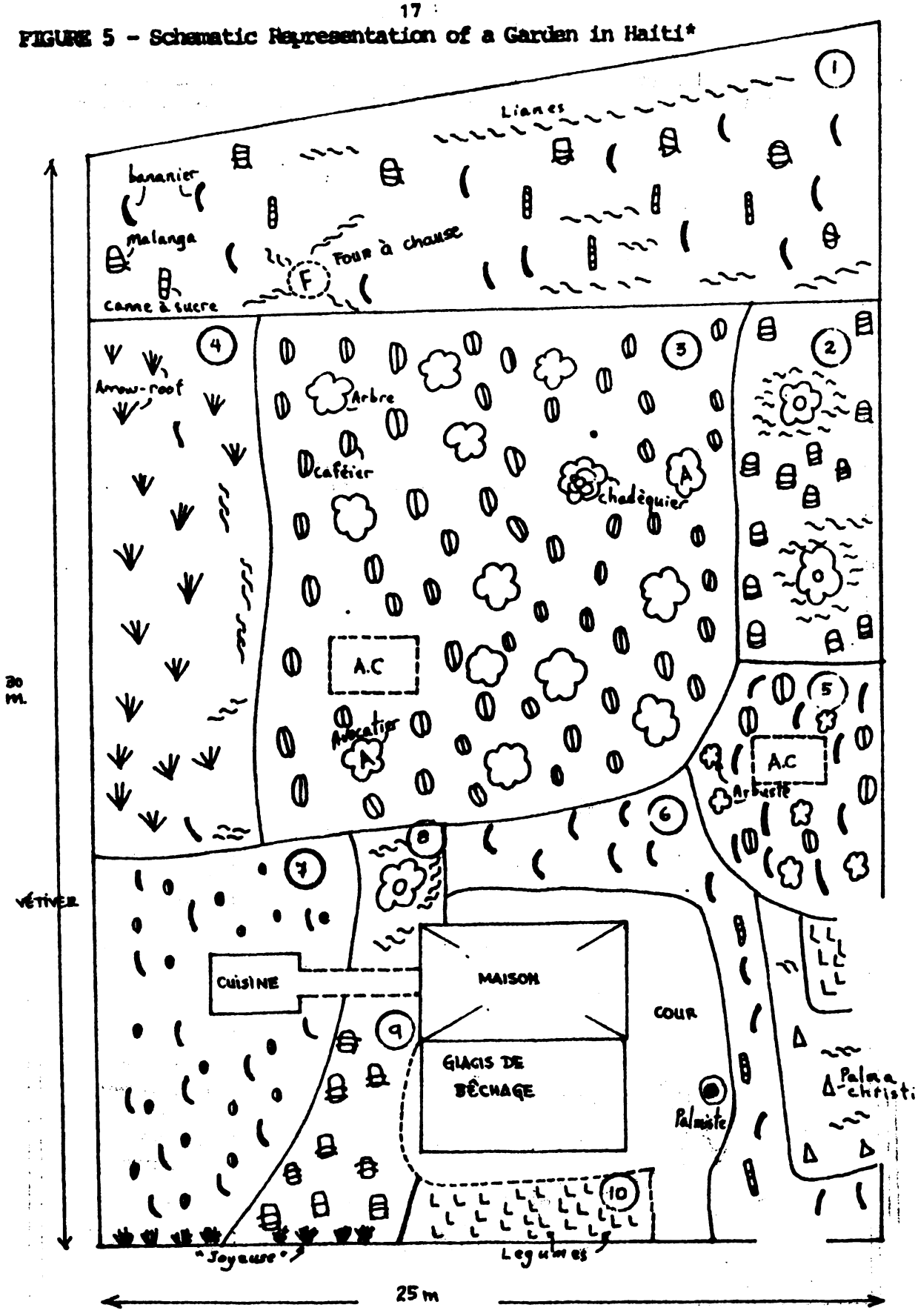
* Anabelle Mafioli, unpublished data.

FIGURE 4 - An Indian Garden at Santa Lucia, Guatemala*



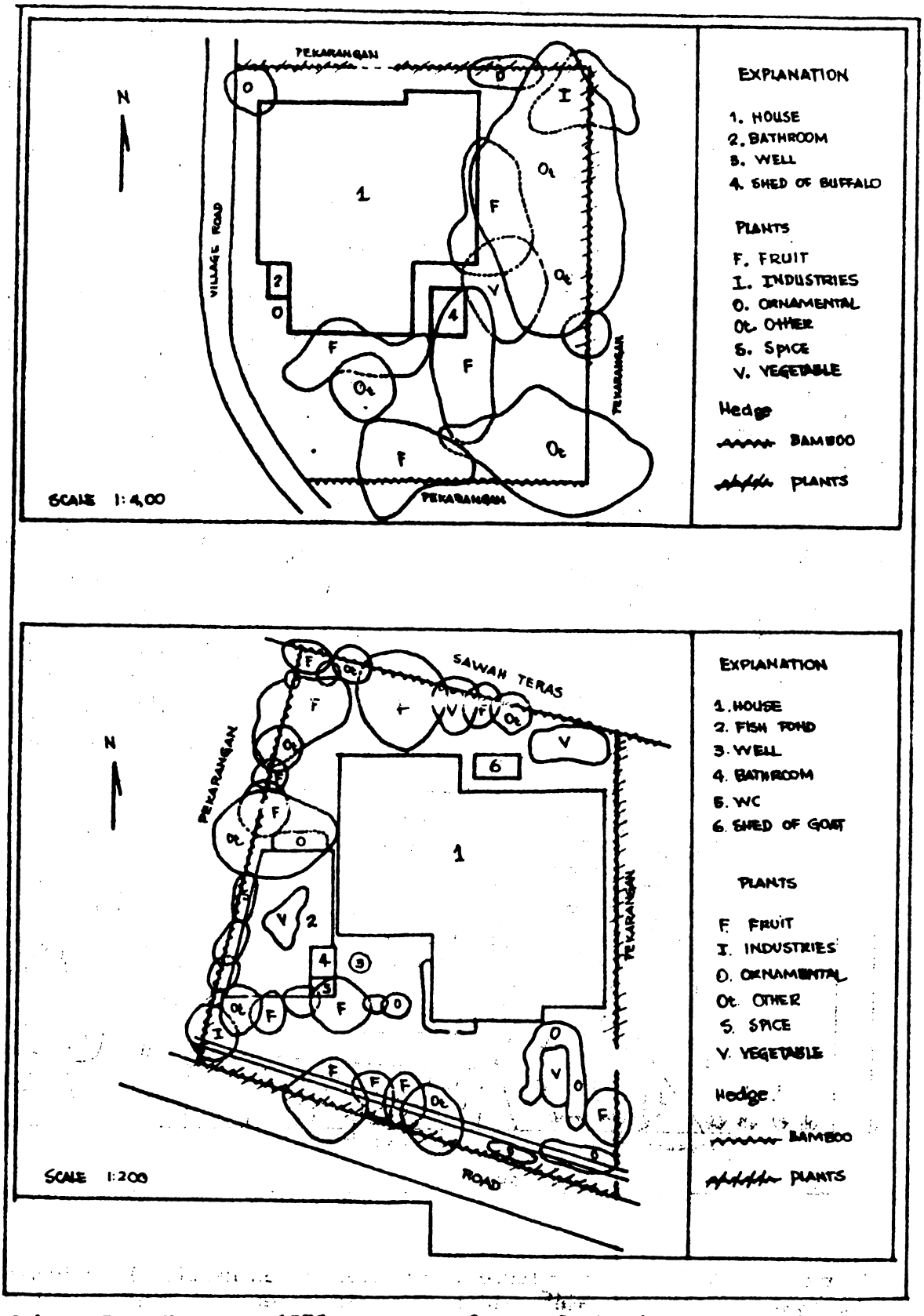
* Anderson, E. 1950. An Indian Garden at Santa Lucia, Guatemala. Ceiba vol. 1:97-103

FIGURE 5 - Schematic Representation of a Garden in Haiti*



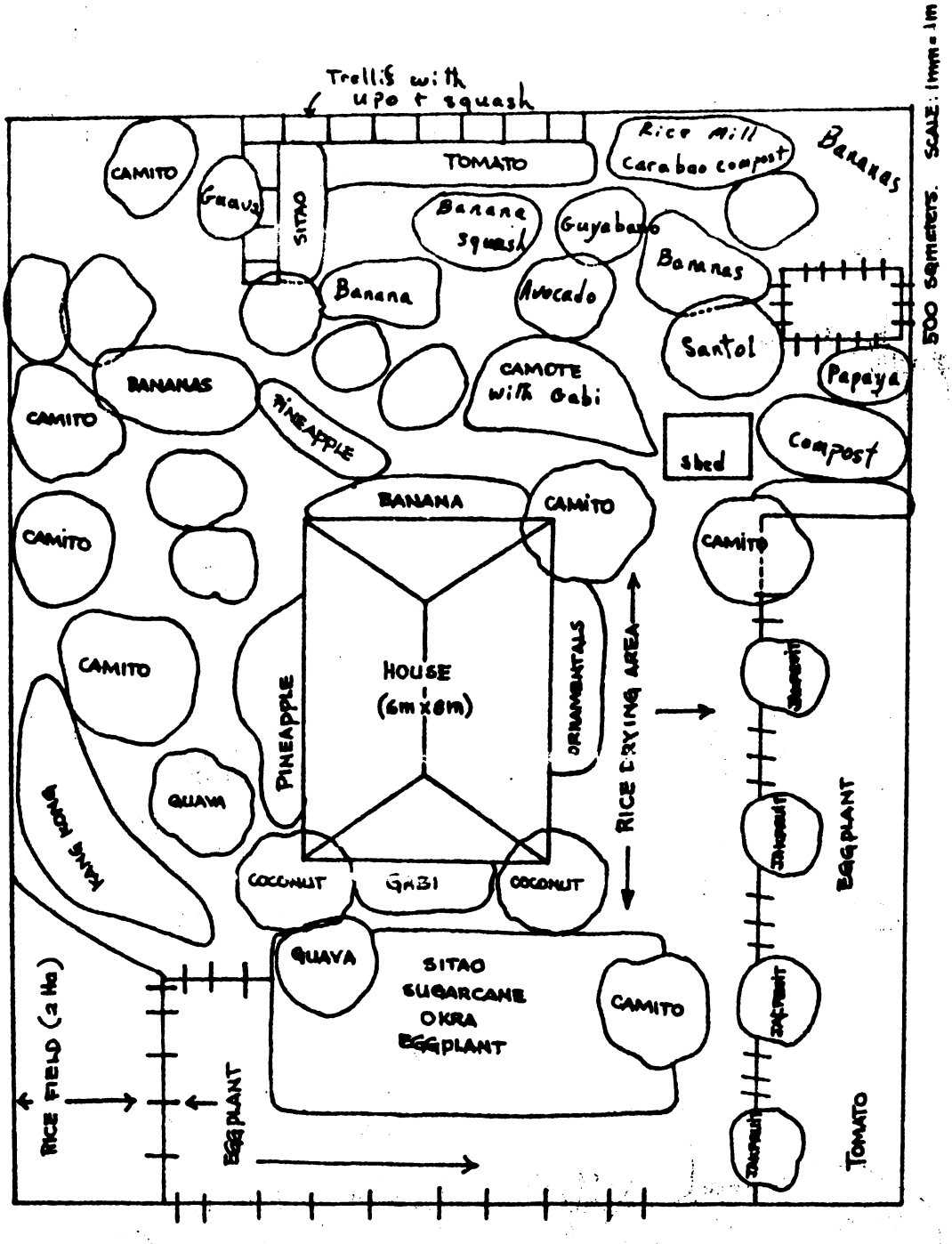
* Anonymous, 1978. L'Agriculture Traditionnelle en Haiti. Fonctionnement des Systemes De Culture et Valorisation Du Milieu. Le Centre de Madian-Salagnac - La Faculté d'Agronomie F.A.M.V. - SERA.

FIGURE 6 - Spatial Distribution of Plant Canopy in the Home Garden in an Alluvial Plain Area (above) and a Mountainous Area (below)*



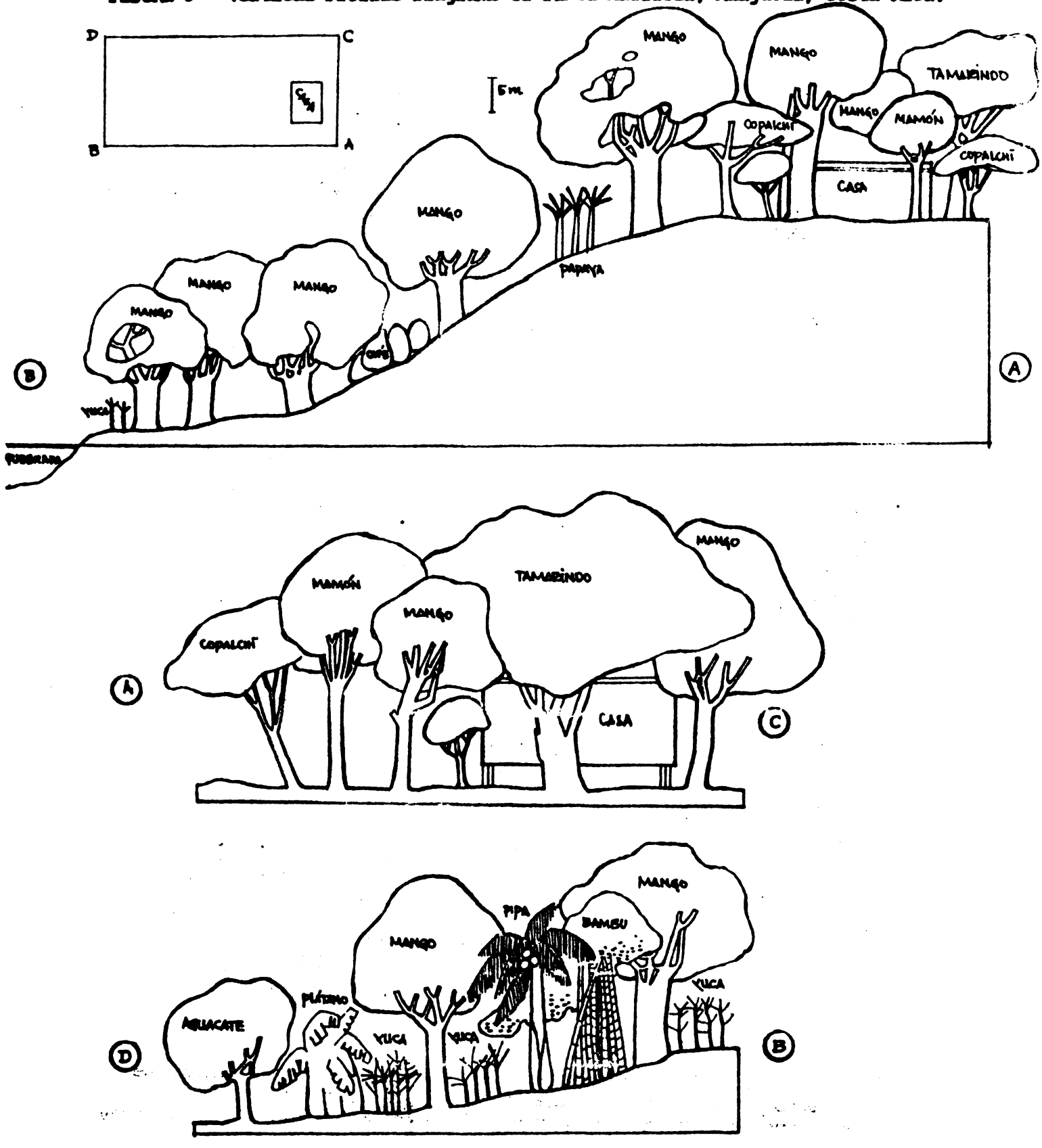
* Ambar, S. & Karyono, 1976. Home Garden Study in the Citarum River Basin, West Java. A/D/C Workshop on Household Studies, Singapore, August 3-7.

FIGURE 8 - Home Garden (400 sq. m.) in Oriental Mindoro, Philippines*



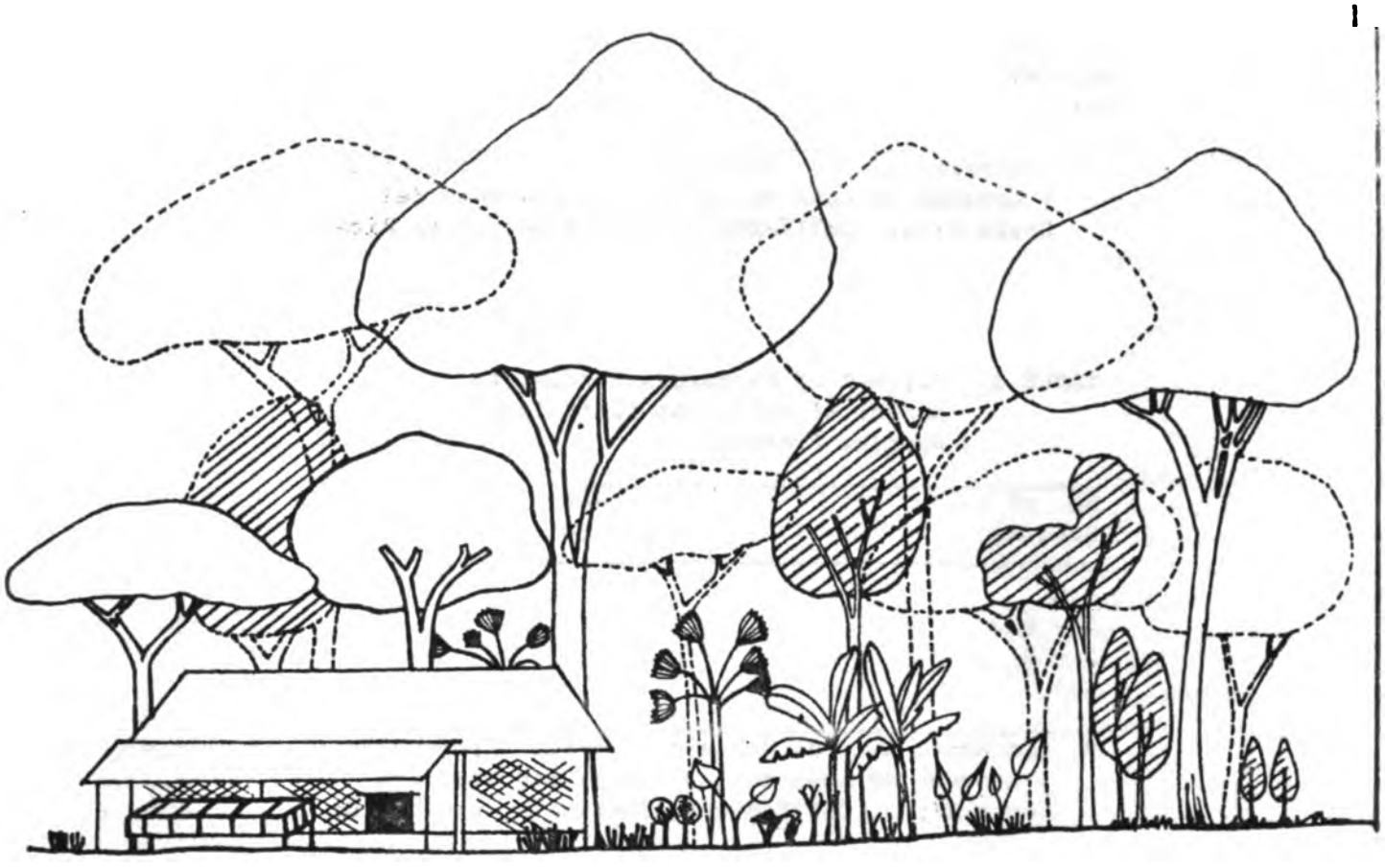
* Sommers, P. 1978. Traditional Home Gardens of Selected Philippine Households and their Potential for Improving Human Nutrition. M.S. Thesis. University of the Philippines at Los Baños, Philippines.

FIGURE 9 - Vertical Profile Diagrams of Finca Maffioli, Alajuela, Costa Rica.



* Anabella Maffioli. Unpublished data.

FIGURE 10 - A Schematic Aspect of the Vegetation in a Home Garden, West Java*



* Michon, G. 1980. Village - Forest - Gardens in West Java. Institute de Botanique, Montpellier, France.

TABLE 2 - Percent of Farmers according to the Number of Fruit Trees Present*

No. of Trees	Percent of farmers with fruit trees
none	2
1 - 4	3
5 - 19	28
20 - 49	31
50+	36

* Lemckert, A. & J. Joaquin C. 1981. Producción y Consumo de Leña en las fincas pequeñas del Costa Rica. CATIE-ROCAP, Turrialba, Costa Rica.

TABLE 3 - Percent of Farmers According to Number of Different Fruit Tree Species Present*

No. of Species	Percent Farmers
0	2
1 - 4	34
5 - 9	52
10+	12

* Lemckert, A. & J. Joaquin C. 1981. Producción y Consumo de Leña en las fincas pequeñas del Costa Rica. CATIE-ROCAP, Turrialba, Costa Rica.

Appendix 1.

List of species found in Mixed Gardens from different regiones of Costa Rica

Trees and Palms

Common Names	Latin Bionmial**
1. Itabo	Yucca elephantipes
2. Mandarina	Citrus nobilis
3. Pejibaye	Guilielma utilis
4. Coco	Cocos nucifera
5. Limon	Citrus aurantiifoium
6. Guava	Inga edulis
7. Guavo, Machete	Inga spectabilis
8. Almendro	Terminalia catappa
9. Aguacate	Persea americana
10. Naranjo	Citrus aurantium
11. Naranjo dulce	Citrus sinensis
12. Toronja	Citrus grandis
13. Jocote	Spondias purpurea
14. Jobo	Spondias mombin
15. Mango	Mangifera indica
16. Guanabana	Annona muricata
17. Nispero	Achras sapota
18. Guayaba	Psidium guajava
19. Café	Coffea arabica
20. Cacao	Theobroma cacao
21. Zapote	Calocarpum mammosum
22. Mamón	Lucuma obovata
23. Mamón chino	Meliocca bijuga
24. Marañón	Anacardium occidentale
25. Coyol	Acrocomia vinifera
26. Calabacero	Crescentia cujete
27. Tamarindo	Tamarindus indica
28. Cas	Psidium friedrichsthalianum
29. Manzana de agua	Eugenia malaccensis
30. Pochote	Bombacopsis fendleri
31. Cedro amargo	Cedrela mexicana
32. Cedro dulce	Cedrela salvadorensis
33. Caoba	Swietenia humilis
34. Durazno	Prunnus persica
35. Annona	Annona reticulata
36. Ciprés	Cupressus lusitanica
37. Manzana rosa	Eugenia jambos
38. Yuplón	Spondias dulcis

* Unpublished survey results of Melinda Troutner, Linda Newstrom and Dirk Rhode, Annabelle Maffioli, and Norman Price and Miguel Holle.

** Incomplete as many identifications were made in the field or were based upon the common name used by farmer.

Non-Trees

Common Names	Latin Binomial
39. Platano	Musa paradisiaca
40. Chayote	Sechium edule
41. Achiote	Bixa orellana
42. Caña de Indio	Taetsia fruticosa
43. Helecho	?
44. Verenjena	Solanum melongena
45. Bambú	Bambusa sp.
46. Malanga	Xanthosoma sagittifolium
47. Chaperno	Lonchocarpus sp
48. Ayote	Cucurbita pepo
49. Amapola	Hibiscus sp. /Malvaviscus spp.
50. Sandia	Citrullus vulgaris
51. Maní	Arachis bypogaca
52. Zacate de Limón	Cympopogan citratus
53. Frailecillo	Jatropha gossypiifolia
54. Culantto coyote	Eryngium foetidum
55. Oregano	Lippia berlandieri
56. Rosa	Rosa sp.
57. Hortensia	Hydrangea opuloides
58. Gloxinias	Gloxinia sp.
59. Begonias	Begonia sp.
60. Malva	Malva parviflora
61. Platanillo	Calathea lutea
62. Chicasquil	Jatropha aconitifolia/J. multifida
63. Nance	Byrsonima crassifolia
64. Florcilla	?
65. Carambola	Averrhoa carambola
66. Tiquisque	Xamthosoma violaceum
67. Name	Dioscorea sp.
68. Banano	Musa sp.
69. Higuerilla	Ricinus communis
70. Chile	Capsicum sp.
71. Vainilla	Vanilla fragrans
72. Chan	Hyptis suaveolans
73. Piña	Ananas comosus
74. Albahaca	Ocimum basilicum
75. Caimito	Chrysophyllum cainito
76. Arroz	Oryza sativa
77. Yuca	Manihot esculenta
78. Mate	Ilex paraguayensis
79. Saragundi	Cassia reticulata
80. Caña de azúcar	Saccharum officinarum
81. Colpachi	Croton niveus
82. Nance dulce	?
83. Cuadrado	?
84. Pimienta	Piper nigrum
85. Pepino	Cucumis sativa
86. Piper	Piper sp.
87. Zanahoria	Daucus carota
88. Repollo	Brassica oleracea

Common Names		Latin Binomial
89.	Camote	Ipomoea batatas
90.	Lechuga	Lactuca sativa
91.	Parsley	Petroselinum petroselinum
92.	Espinaca	Spinacia oleracea
93.	Menta	Menta sp.
94.	Camomile	Anthemis sp.
95.	?	Tagetes sp.
96.	Frijoles	Phaseolus sp.
97.	Icaco	Chrysobalanus icaco
98.	Mimbro	Crescentia sp.
99.	Tomate	Lycopersicum esculentum
100.	Calabaza	Cucurbita sp.
101.	Rábano	Raphanus sativus
102.	Yerba buena	Menta citrata
103.	Naranjilla	Solanum sp.
104.	Maíz	Zea mays
105.	Cebolla	Allium cepa
106.	Tacaco	Polakowskia tacaco
107.	Frijol de palo	Cajanus cajan

Appendix 2

List of species fouds in Haitian Mixed Gardens (Jardín Devant Port Kaye)*

Abricotier	Hypéricacées	Mammea américana
Acjeu	Méliacées	Swietenia mahogani
Afio	Cyperacées	Cyperus rotundus
Amandier	Combrétacées	Terminalia catappa
Armoise	Compowpees	Artémisia vulgaris
Arrow-root	Marantacées	Maranta arundinacea
Avocatier	Lauracées	Persea américana
Bambou	Graminées	Bambusa vulgaris
Bananier	Musacées	Musa paradisiaca
Bayahonde	Léguminosées	Prospis juliflora
Bois dine	Myrtacées	Eugénia frayans
Bois rouge	Méliacées	Guarea trichiliodes
Bois savane	Léguminosées	Pithecolobium bertériorum
Cachiman cannelle	Annonacées	Annona squamosa
Calebassier	Cucurbitacées	Lagenaria leucantha
Canne á sucre	Poacées	Saccharum officinarum
Caféier	Rubiacées	Coffea arabica
Campechier	Léguminosées	Haematosil campechianum
Cédre	Tamaricacées	Tamarix gallica
Chadéquier	Rutacées	Citrus maxima
Citronelle	Graminées (Poacées)	Cymbopogan citratus
Citronier	Rutacées	Cetrus aurantifolia
Cive	Liliacées	Alliums choonoprassum
Cou pays	Brassiacacées	Brassica spécies
Cocotier	Phoenicacées	Cocos nucifera
Ceressol	Annonacées	Annona muricata
Coton	Malvacées	Gossypium barbadense
Epinard	Chémopodiacées	Spinacca oleracea
Gingembre	Zingibéracées	Zingiber officinale
Giraumon	Cucurbitacées	Cucurbita moshata
Gommier	Burseracées	Bursera simaruba
Geyavier	Myrtacées	Psidium guajava
Ignamo	Dioscoreacées	Dioscorea vulgaris

* Source: L'Agriculture Traditionale en Haiti. Fonctionnement des sytemes de Culture et valorisation du Milieu. Centre de Madian-Salagnac Faculté d'Agronomie. F.A.M.V./SERA, 1978. 44 pp.

Giraumon	Cucurbitacées	Cucurbita moshata
Gommier	Burseracées	Bursera simaruba
Geyavier	Myrtacées	Psidium guajava
Ignamo	Dioscoreacées	Dioscorea vulgaris
Laurier	Lauracées	Octea leucoxylon
Loup garou	Crassulacées	Bryophillum pinnatum
Lian'n panié	Amaranthacées	Chamisson altissima
Malanga	Aracées	Muthogana sp.
Malanga deux palles	Aracées	Colocasia esculenta
Malanga noir	Aracées	Xanthosoma violaceum
Malanga thiste	Aracées	Xanthosoma sagittifolium
Mazombelle	Aracées	Colocasia
Manioc amer	Euphobiacée	Manihot utilissima
Manioc doux	Euphobiacée	Manihot dulcis
Manguier	Anacordiacées	Mangifera indica
Médecinier	Euphorbiacées	Jatropha Sp.
Mirliton	Cucurbitacées	Sycios Edulis
Mombin (franc)	Anacardiacées	Spondias mombin
Orange sur	Rutacées	Citrus aurantium
Oranger amer	Rutacées	Citrus bigaradia
Oseille	Polygonacées	Rumox patientia
Palma christi	Euphorbiacées	Ricinus communis
Palmiste	Phoenicacées	Roystonea regia
Papayer	Caricacées	Papaya vulgaris
Paresseux	Araliacées	Polyscias pinnata
Persil	Ombelliféres	Petrosetunum satyum
Piment	Solenacées	Capricum anucum
Poireu	Alliacées	Allium parrum
Pois congo	Léguminosées	Cajanus cajan
Pois de souche	Léguminosées	Phaseolus lunatus
Pomme rosa	Myrtacées	Eugenia jambos
Quénépier	Sapindacées	Melicoccus bijugatus
Sablier	Euphorbiacées	Hura crepitans
Tabac	Solenacées	Nicotiana tabacum

Thym	Labiées	Thymus vulgaris
Tomate	Solanacées	Lycopersicum esculentum
Trompette	Moracées	Cecropia pelata
Véritable	Artocarpées	Artocarpus incisa
Vétiver	Graminacées	Anathenum zizanoides
Succrin	Léguminosées	Inga vera

APPENDIX 3.

Crops grown in the 40 households surveyed, estimated yield per plant (kg) and days to maturity (Quisumbing et al, 1974).*

Local Name	Scientific Name	Yield/plant (kg.)	Days to maturity
Ampalaya	Momordica Charantia	1.5	120
Batao	Dolichos	1.0	180
Garlic	Allium sativum	.03	120-150
Kadios	Cajanus cajan	1.25	180
Calabasa	Cucurbita maxima	3.0	180
Kamatis	Lycopersicum esculentium	.6	100
Camote (tuber)	Ipomea batatas	.6	100
Camote (leaves)	"		45
Cassava (tuber)	Manihot esculen	1.0	240
Kangdokng	Ipomoea squatila	.5	45
Condol	Benincasa hispida	10.0	180
Gabi	Colocasia esculentum	1.25	120
Lubi-lubi	Solanum nigrum	.30	60
Ginger	Zingiber officinale	.5	270
Malunggay	Moringa oleifera	1.25	180
Mani	Arachis hypogaea	.01	100
Munggo	Phaseolus aureus	.01	75
Okra	Hibiscus esculentus	.30	180
Patani	Phaseolus lunatus	1.0	180
Patola	Luffa cylindrica	5.5	180
Petsay	Brassica chinensis	.30	35
Roselle	Hibiscus sabdariffa	.5	180
Saluyot	Corchorus oliterius	.3	180
Onion	Allium cepa	.1	100
Sweet pepper	Capsicum annum	.5	120
Chili pepper	Capsicum frutescens	.5	180
Sitao	Vigna sinensis	1.0	90
Ubi	Dioscorea alata	1.0	180
Upo	Lagenaria siceraria	1.0	180
Talong	Solanum melongena	1.0	180
Mais	Zea mays	.2	90
Alugbati	Basella rubra	1.25	90
Winged bean	Phophecarpus tetragonolobus	1.00	180
Singdamas	Pachyrhizus erosus	1.0	180
Radish	Raphanus sativus	.1	90

* Source: Sommers, Paul. 1978. Traditional Home Gardens of Selected Philippine Households and their prtential for Improving Human Nutrition. M.Sc. Thesis. University of the Philippines at Los Baños. Philippines. 131 pp.

Local Names	Scientific Names	Yield/plant (kg.)	Days to maturity
Fruits			
Avocado	Persea americana	41	P*
Atis	Caneona aquamosa	10	P
Belimbing	Averrhea carambola	10	P
Guava	Psidium guajava	20	P
Caimito	Chrysophyllum cainito	32	P
Calamansi	Citrus microcarpa	29	P
Camatsili	Pithecolobium dulce	20	P
Cashew	Aracardium occidental	10	P
Naranghita	Citrus nobus	30	P
Duhat	Sizygium cumini	30	P
Guyabano	Annona muricata	16	P
Jackfruit	Jetsrophullus artocarpus	66	P
Lanzones	Lanzium domesticum	30	P
Mablo	Diespryres discolor	30	P
Mango (carabao yellow)	Mangifera indica	100	P
Mango (carabao green)	Mangifera indica	100	P
Papaya	Carica papaya	18	1 yr
Pineapple	Ananas comosus	1.5	1.5 yrs
Banana	Musa	30	1 yr
Banana	Sapientum	30	1 yr
Banana	Sapientum	30	1 yr
Banana Saba	Sapientum compresca	30	1 yr
Banana Tuldoc	Sapientum	30	1 yr
Tamarind	Tamarindus indica	15	P
Santol	Sandoricum koetsape	35	P
Pomelo	Citrus grandis	56	P
Chico	Achras zapota	26	P
Grape	Vitis vinifera	1.5	P
Pili	Canarium duatum	25	P
Cacao	Theobroma cacao	-	P
Bettle nut	Areca catheli	-	P
Sugar cane	Saccharum officinarum	1.5	1.5 yrs
Breadfruit	Artocarpus altilis	20	P
Coffee	Coffea arabica	5	P
Chesa	---	-	P
Coconut	Cocos nucifera	-	-
Coconut young		20 kg	-
Coconut old		20 kg	
Lime	Citrus	15	P
Lemon	Citrus limonia	30	P
Litchi	Litchi chinensis	10	P
Kamias	Averrhea biumi	10	P
Tiesa	Lucuma nervosa	20	P
Anonas	Annona reticulata	20	P

*P-Perennial

APPENDIX 4

Floristic composition of home-garden by 25 samples
at Ciwaringin, Karawang.
Samples criteria: plain and sawah areas, far from the city.*

Plant species (1)	Local Names (2)	Family (3)
ORNAMENTAL PLANTS		
1. Acalypha wilkesiana	Dawolong	Euphorbiaceae
2. Bambusa vulgaris	Bambu kuning	Bambusaceae
3. Basella rubra	Gandola	Basellaceae
4. Canna hybrida	Bunga tasbih	Cannaceae
5. Codiaeum variegatum	Puring	Euphorbiaceae
6. Coleus artopurpureus	Jawerkotok	Lardiaceae
7. Cordyline fruticosa	Hanjuang	Agavaceae
8. Cressentia cujette	Berenuk	Bignonicaeae
9. Duranta repens	Sianak nakal	Verbenaceae
10. Euphorbia barnhartii	Susuru	Euphorbiaceae
11. Gardenia augusta	Kacapiring	Rubiaceae
12. Hibiscus schizopetalus	Kembang sepatu	Malvaceae
13. Impomea cressicaulis	Dnagkungan	Convolvulaceae
14. Ixora javanica	Soka	Rubiaceae
15. Jatropha curcas	Jarak pagar	Euphorbiaceae
16. Nothopanax fruticosa	Kedondong pagar	Araliaceae
17. Nothopanax scutelaria	Mangkokkan	Araliaceae
18. Pandanus amaryllifeliu folius.	Pandan wangi	Pandanaceae
19. Pedilanthus bracteatus		Euphorbiaceae
20. Pleomele elliptica	Daun suji	Agavaceae
21. Pluchea indica	Beluntes	Asteraceae
22. Premma corymbosa	Cincau kebo	Verbenaceae
23. Thevetia peruviana	Burahol	Apocacynaceae
FOOD PLANTS		
1. Amorphophalus campanulatus	Suweg	Araceae
2. Canna edulis	Ganyong	Cannaceae
3. Coyx lacrema-jobi	Hanjeli	Poaceae
4. Colacosia esculenta	Keladi/talas	Araceae
5. Dioscorea alata	Gadung	Dioscoreaceae
6. Manihot utilissima	Ketela pohon	Euphorbiaceae
7. Maranta arundinaceae	Sagu/maranta	Marantaceae

*Source: Supriyo Ambar and Karyono. 1976. Home Garden Study in the Citarum River Basin. A/D/C Workshop on Household Studies, Singapore, Aug. 3-7. 12 pp.

(1)	(2)	(3)
8. Pachyrrhizus erosus	Bengkuang	Papilionaceae
FRUIT PLANTS		
1. Anacardium occidentale	Jambu monyet	Anacardiaceae
2. Ananas comosus	Nenas	Bromelliaceae
3. Annona muricata	Sirsak	Annonaceae
4. Annona reticulata	Buah nona	Annonaceae
5. Artocarpus integra	Nangka	Moraceae
6. Averrhoa carambola	Belimbing	Oxalidaceae
7. Carica papaya	Pepaya	Caricaceae
8. Citrus maxima	Jeruk bali	Rutaceae
9. Eugenia argua	Jambu air	Myrtaceae
10. Eugenia cumini	Jamblang	Myrtaceae
11. Mangifera foerida	Embacang	Sapindaceae
12. Mangigera indica	Mangga	Sapindaceae
13. Musa paradisiaca	Pisang	Musaceae
14. Nephlium lappaceum	Rambutan	Sapindaceae
15. Persea americana	Adpokat	Lauraceae
16. Phyllanthus acidus	Cereme	Euphorbiaceae
17. Psidium guajava	Jambu klutuk	Myrtaceae
18. Sandoricum koetjape	Sentul	Meliaceae
VEGETABLE PLANTS		
1. Alocasia indica	Lompong	Araceae
2. Artocarpus communis	Keluwih	Moraceae
3. Cajanus cajan	Hiris	Papilionaceae
4. Capsicum frutescens	Caberawit	Solanaceae
5. Cucurbita pepo	Labu besar	Cucurbitaceae
6. Dolichos lablab	Roay	Papilionaceae
7. Ipomoea aquatica	Kangkung	Convolvulaceae
8. Leucaena glauca	Kamlandingan	Mimosaceae
9. Momordia charantia	Paria	Cucurbitaceae
10. Moringa oleifera	Kelor	Moringaceae
11. Ocimum bacilicum	Serawung	Labiateae
12. Parkia speciosa	Pete	Mimosaceae
13. Solanum melongena	Terong	Solanaceae
14. Tamarindus indica	Asam jawa	Papilionaceae
MEDICINAL PLANTS		
1. Areca catechu	Pinang	Palmae
2. Erythrina variegata	Dadap	Papilionaceae
3. Moringa citrifolia	Mengkudu	Rubiaceae
4. Peristrophe pantajarensis	Kalingsir	Acanthaceae
5. Piper betele	Sirih	Piperaceae
6. Piper retrofactum	Lada ekor	Piperaceae
7. Strobillantus crispus	Kecibeling	Acanthaceae
8. Zingiber amarum	Lempuyang	Zingeberaceae
9. Zingiber officinale	Jahe	Zingiberaceae

(1)	(2)	(3)
SPICE PLANTS		
1. Alpinia galanga	Lengkuas	Zingiberaceae
2. Cucurma domestica	Kunir	Zingiberaceae
3. Eugenia aromatica	Cingkeh	Myrtaceae
4. Eugenia polyantha	Salam	Myrtaceae
5. Phaeomeria atropurpurea	Kecombrang	Zingiberaceae
INDUSTRIAL PLANTS		
1. Cocos nucifera	Kelapa	Palmae
2. Ceiba pentandra	Kapok	Bombacaceae
3. Hevea brasiliensis	Karet	Euphorbiaceae
4. Saccharum officinarum	Tebu	Poaceae
WEEDS		
1. Ageratum conyzoides	Babadotan	Asteraceae
2. Alternanthera sessilis		Amaranthaceae
3, Amaranthus spinosus	Bayam duri	Amaranthaceae
4. Andropogon aciculatus	Domdoman	Poaceae
5. Axonopus compressus		Poaceae
6. Borreria latifolia		Poaceae
7. Centella asiatica	Pegagan	Apiaceae
8. Cleome gynandra		Capparidaceae
9. Cynondon dactylon	Rumput kawala	Poaceae
10. Cyperus cyperoides	Teki	Cyperaceae
11. Cyperus rotundus	Teki	Cyperaceae
12. Eclypta alba	Urang aring	Asteraceae
13. Elephantopus scaber	Tapak liman	Asteraceae
14. Eragrostis unioloides		Poaceae
15. Eleusine indica	Jampang	Poaceae
16. Euphorbia hirta	Nangkaan	Euphorbiaceae
17. Hymnenachne sp.		Poaceae
18. Hyptis brevipos	Jarong	Labiaceae
19. Impereta cylindrica	Alang-alang	Poaceae
20. Kyllinga brevifolia	Teki	Cyperaceae
21. Kyllinga monocephala	Teki	Cyperaceae
22. Mimosa invisa		Mimosacceae
23. Mimosa nigra	Jukut garut	Mimosaccaeae
24. Mimosa pudic	Putri malu	Mimosacceae
25. Panicum coloneum		Poaceae
26. Panicum reptum		Poaceae
27. Phillanthus urinaria	Meniran	Euphorbiaceae
28. Portulaca oleacea	Gelang	Portulacaceae
29. Sida acuta	Sidagori	Malvaceae
30. Syneddella nodiflora		Asteraceae
31. Urera lobata	Pangpurutan	Malvaceae
32. Veronia cinerea		Asteraceae
OTHERS		
1. Albizzia falcata	Kayu albisiah	Mimosacoreae
2. Bambusa spinosa	Haur duri	Bambusaceae

(1)	(2)	(3)
3. Bridelia monoica	Kayu albisiah	Euphorbiaceae
4. Caesalpinia sp.		Caesalpiniaceae
5. Cassia siameae	Johor	Caesalpiniaceae
6. Ficus ampelas	Daun ampelas	Moraceae
7. Ficus sp.	Bisoro	Moraceae
8. Gigantochloa apus	Bambu tali	Bambusaceae
9. Gigantochloa	Bambu gomgong	Bambusaceae
10. Glyricidia maculata	Gamal	Papilionaceae
11. Hibiscus macrophillus		Malvaceae
12. Hibiscus similis	Waru	Malvaceae
13, Homalanthus tanareus	Kareumbi	Euphorbiaceae
14. Jati walanda	Jati walanda	
15. "Kendal"	Kendal	
16. "Kihapit"	Kihapit	
17. "Kilalayu"	Kilalayu	
19. Kleinhovia hospita	Binatinu	Sterculicaceae
20. Leca indica	Sulangkar	Ampededaceae
21. Melia azedarach	Mindi	Meliaceae
22. Pandanus sp.	Pandan	Pandanaceae
23. Pterocarpus indicas	Angsana	Papilionaceae
24. Pterospermum diversifolium	Bayur	Sterculiaceae
25. Pterospermum javanicum	Bauur	Sterculiaceae
26. Samanea saman	Kihujan	Mimosaceae
27. Schleisera oleracea	Kesambi	Sapindaceae
28. Scsbania grandiflora	Turi	Papilionaceae
29. Vitex trifoliatus	Laban	Verbenaceae

Appendix 5

SOME USES OF WOOD FROM COMMON FRUIT TREES*

Tree**	Scientific Name	Characteristics & Uses	Value Rating
Aguacate	Persea americana	Medium soft wood, medium density (0.6), for soft wood boxes.	1
Almendro	Terminalia catappa	Reddish to chestnut colored wood, medium density (0.59), hard and strong, susceptible to termites; construction.	3
Cacao	Theobroma cacao	Beige colored wood, medium strength; small objects.	2
Café	Coffea arabica	White colored wood, hard, durable; construction of animal pens, fireward.	2
Caimito	Chrysophyllum cainito	Reddish wood, hard, dense (0.7), strong and durable; construction.	4
Camistel	Pouteria campechiana	Chestnut-reddish chestnut colored wood, very hard, dense (0.74), strong, suceptible to termites; versatile, specially wood-working.	3
Coco	Cocos nucifera	Durable; large postes and construction.	2
Guabo	Inga vera	Witish wood, medium hard, density (0.59), suceptible to termites, construction, charcoal.	3
Guamá	Inga laurina	White wood, medium hard, medium density (0.62), very susceptible to fungus and termites; firewood, construction	2
Guayabo	Psidium guajava L.	From beige to reddish wood, hard, strong, very dense (0.8); Tool handles, firewood, charcoal.	3
Guaitil	Genipa americana	Creamy yellow wood, dense,(0.66), strong, durable, susceptible to termites, fine texture; construction,	2
Mamey	Mammea americana	Chestnut solored wood, hard, medium density(0.62), strong susceptible to termites; construction, furniture	3

*Source. F.Martin. 1980. Curso Corto sobre "Técnicas Agroforestales Para el Trópico Húmedo. Turrialba, Costa Rica. 8-16 Diciembre CATIE-DSE

**Costa Rican common names used.

Tree	Scientific Name	Characteristics & uses	Vaule Rating
Mango	Mangifera indica	White to chestnut colored wood, hard, durable, medium density; furniture, construction	4
Marañon	Anacardium occidentale	White, reddish or chestnut, low density (0.5), susceptible to termites; small wooden objects.	3
Naranja	Citrus sinensis	Yellowish wood, hard, strong, susceptible to termites; small wooden objects	2
Naranja agria	Citrus aurantium	Whitish to yellowish wood, hard, fine texture; baseball bats.	1
Níspero	Manilkara zapota	Red, very strong, very dense, durable; strong construction material, tough tool handles, fine furniture.	5
Panapén	Artocarpus altilis	Yellowish to chstnut, soft, very light (0.27), susceptible to termites; boxes, panels.	2
Mamón Chino	Melicocca bijuga	Coffee colored, medium density, medium hardness, susceptible to termites; construction.	2
Tamarindo	Tamarindus indica	Yellowish wood, soft, heart wood very strong, very dense (0.9), durable, susceptible to termites; construction.	3
Toronja	Citrus paradisi	Whitish, hard; firewood.	2

Appendix 6

TIMBER TREES AS SOURCES OF FRUITS, NUTS OR LEAVES*

Genus or specie	Use	Place	Relative importance
Albizia spp.	Seek	S.E.Asia	2
A. falcata	Leaf	S.E.Asia	3
A. procera	Leaf	S.E.Asia	2
Aleurites moluccana	Nut	Oceáno Indico	2
Bombax spp.	Leaf	Trópics	2
Brosimum spp.	Fruit	Mexico, Central América	3
Cassia spp.	Leaf	Tropics	2
Ceiba spp.	Leaf	Tropics	2
Cordia alliodora	Fruit	Tropics	1
Ficus spp.	Leaf	Tropics	2-3
Gmelina arborea	Fruit	India	2
Guarea trichilioides	Fruit	Caribean	2
Inga spp.	Fruit, seed	Western Hemisphere	4
Khaya ivorensis	Nut	Tropical African	3
Parkia spp.	Seed	Africa	4
Pithecolobium spp.	Fruit	Tropics	2
Prosopis spp.	Fruit	Tropics	2
Sambucus spp.	Fruit	Tropics	3

*Source. F.Martin. 1980. Curso Corto sobre "Técnicas Agroforestales Para el Trópico Húmedo. Turrialba, Costa Rica. 8-16 Diciembre CATIE-DSE.

Appendix 7.

SPECIAL USES OF LIVING FENCES*

Specie	Human consumption	Animal consumption
Bursera simaruba	Infusion (tea)	Fruit
Castilla elastica	Fruit	Root
Cordyline terminalia	Root	Root
Crescentia cujete	Leaves, seeds	Young fruits,foliage.
Diospyros spp.	Fruits	Fruits
Erythrina berteroana	Flowers	Foliage
Ficus citrifolia	Fruits, leaves	Foliage, fruits
Gliricidia sepium	Flowers	Foliage
Guazuma ulmifolia	Fruits	Foliage
Lippia torresii	Infusion (tea)	--
Psidium guajava	Fruits	Fruits
Spondias purpurea	Fruits	Fruits
Yucca elephantipes	Heart of stem, flower	--
Erythrina spp.	Leaves, flowers	leaves

*Source. F. Martin. 1980. Curso Corto sobre "Técnicas Agroforestales Para el Trópico Húmedo. Turrialba, Costa Rica. 8-16 Diciembre CATIE-DSE