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 diversity 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 referring 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 Ecosystem 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 disorderly, 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 enumerated by Anderson in the preceding 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 February, 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 recommended 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 contribution 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 pharmacied and doctors. Although there is a trend for this knowledge, which includes the recognition 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 phenomenon 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 (e.g. 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 believe 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 extension 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 (e.g. 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 that 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.
BIBLIOGRAPHY


GLIEMMAN, R., R. GARCIA ESPINOZA and M. AMADOR ALARCON. 1978. Ñubulo de Produccion Diversificada, un Agroecosistema de Produccion Sostenida para el Trópico Cálido, Húmedo de Mexico. SARH/CSAT/P/PPDR, Mexico


Increasingly more efficient use of light
Increasingly more retention of nutrients
Increased addition of organic 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>
<thead>
<tr>
<th>Location</th>
<th>Total Species</th>
<th>Ratio of Tree to non-tree species (mean/warden)</th>
<th>Mean No. Species/warden</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chupajales**</td>
<td>58</td>
<td>8 : 12</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Alajuela²</td>
<td>47</td>
<td>9 : 7</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>Porto Viejo¹</td>
<td>23</td>
<td>7 : 6</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Monte Verde³</td>
<td>31</td>
<td>8 : 12</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Santa Rosa⁴</td>
<td>25</td>
<td>10 : 7</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Wayabo⁵/Limon⁶</td>
<td>56</td>
<td>5 : 6</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.8 : 8.3</td>
<td>16</td>
<td>39</td>
</tr>
</tbody>
</table>

* Unpublished survey data from Helinda 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.*

* Anatable Mafiioli, unpublished data.
Gaia vol. 1:97-103
FIGURE 5 - Schematic Representation of a Garden in Haiti*

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

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

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

*Anabelle Maffioli. Unpublished data.*
FIGURE 10 - A Schematic Aspect of the Vegetation in a Home Garden, West Java*  

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

<table>
<thead>
<tr>
<th>No. of Trees</th>
<th>Percent of farmers with fruit trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>2</td>
</tr>
<tr>
<td>1 - 4</td>
<td>3</td>
</tr>
<tr>
<td>5 - 19</td>
<td>28</td>
</tr>
<tr>
<td>20 - 49</td>
<td>31</td>
</tr>
<tr>
<td>50+</td>
<td>36</td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th>No. of Species</th>
<th>Percent Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1 - 4</td>
<td>34</td>
</tr>
<tr>
<td>5 - 9</td>
<td>52</td>
</tr>
<tr>
<td>10+</td>
<td>12</td>
</tr>
</tbody>
</table>

### Appendix 1.

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

#### Trees and Palms

<table>
<thead>
<tr>
<th>Common Names</th>
<th>Latin Binomial**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Itabo</td>
<td>Yucca elephantipes</td>
</tr>
<tr>
<td>2. Mandarina</td>
<td>Citrus nobilis</td>
</tr>
<tr>
<td>3. Pejibaye</td>
<td>Guilielma utilis</td>
</tr>
<tr>
<td>4. Coco</td>
<td>Cocos nucifera</td>
</tr>
<tr>
<td>5. Limon</td>
<td>Citrus aurantiifoium</td>
</tr>
<tr>
<td>6. Guava</td>
<td>Inga edulis</td>
</tr>
<tr>
<td>7. Guavo, Machete</td>
<td>Inga spectabilis</td>
</tr>
<tr>
<td>8. Almendro</td>
<td>Terminalia catappa</td>
</tr>
<tr>
<td>9. Aguacate</td>
<td>Persea americana</td>
</tr>
<tr>
<td>10. Naranjo</td>
<td>Citrus aurantium</td>
</tr>
<tr>
<td>11. Naranjo dulce</td>
<td>Citrus sinensis</td>
</tr>
<tr>
<td>12. Toronja</td>
<td>Citrus grandis</td>
</tr>
<tr>
<td>13. Jocote</td>
<td>Spondias purpurea</td>
</tr>
<tr>
<td>14. Jobo</td>
<td>Spondias mombin</td>
</tr>
<tr>
<td>15. Mango</td>
<td>Mangifera indica</td>
</tr>
<tr>
<td>16. Guanabana</td>
<td>Annona muricata</td>
</tr>
<tr>
<td>17. Nispero</td>
<td>Achras sapota</td>
</tr>
<tr>
<td>18. Guayaba</td>
<td>Psidium guajava</td>
</tr>
<tr>
<td>19. Café</td>
<td>Coffea arabica</td>
</tr>
<tr>
<td>20. Cacao</td>
<td>Theobroma cacao</td>
</tr>
<tr>
<td>21. Zapote</td>
<td>Calocarpum mammosum</td>
</tr>
<tr>
<td>22. Mamón</td>
<td>Lucuma obovata</td>
</tr>
<tr>
<td>23. Mamón chino</td>
<td>Meliocca bijuga</td>
</tr>
<tr>
<td>24. Marañón</td>
<td>Anacardium occidentale</td>
</tr>
<tr>
<td>25. Coyol</td>
<td>Acrocomia vinifera</td>
</tr>
<tr>
<td>26. Calabacero</td>
<td>Crescentia cujete</td>
</tr>
<tr>
<td>27. Tamarindo</td>
<td>Tamarindus indica</td>
</tr>
<tr>
<td>28. Caš</td>
<td>Psidium friedrichsthalianum</td>
</tr>
<tr>
<td>29. Manzana de agua</td>
<td>Eugenia malaccensis</td>
</tr>
<tr>
<td>30. Pochote</td>
<td>Bombacopsis fendleri</td>
</tr>
<tr>
<td>31. Cedro amargo</td>
<td>Cedrela mexicana</td>
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<tr>
<td>32. Cedro dulce</td>
<td>Cedrela salvadorensis</td>
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<td>33. Caoba</td>
<td>Swietenia humilis</td>
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<td>34. Durazno</td>
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<td>35. Annona</td>
<td>Annona reticulata</td>
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<td>36. Ciprés</td>
<td>Cupressus lusitanica</td>
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<tr>
<td>37. Manzana rosa</td>
<td>Eugenia jambos</td>
</tr>
<tr>
<td>38. Yuplón</td>
<td>Spondias dulcis</td>
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** Incomplete as many identifications were made in the field or were based upon the common name used by farmer.
<table>
<thead>
<tr>
<th>Common Names</th>
<th>Latin Binomial</th>
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<tr>
<td>39. Platano</td>
<td>Musa paradisiaca</td>
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<td>40. Chayote</td>
<td>Sechium edule</td>
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<td>41. Achiote</td>
<td>Bixa orellana</td>
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<tr>
<td>42. Caña de Indio</td>
<td>Taetsia fruticosa</td>
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<tr>
<td>43. Heleño</td>
<td></td>
</tr>
<tr>
<td>44. Verenjena</td>
<td>Solanum melongena</td>
</tr>
<tr>
<td>45. Bombú</td>
<td>Bambusa sp.</td>
</tr>
<tr>
<td>46. Malanga</td>
<td>Xanthosoma sagittifolium</td>
</tr>
<tr>
<td>47. Chuperno</td>
<td>Lonchocarpus sp.</td>
</tr>
<tr>
<td>48. Ayote</td>
<td>Cucurbita pepo</td>
</tr>
<tr>
<td>49. Amapola</td>
<td>Hibiscus sp. /Malvaviscus spp.</td>
</tr>
<tr>
<td>50. Sandía</td>
<td>Citrullus vulgaris</td>
</tr>
<tr>
<td>51. Maní</td>
<td>Arachis hypogaca</td>
</tr>
<tr>
<td>52. Zacate de Limón</td>
<td>Cympopogon citratus</td>
</tr>
<tr>
<td>53. Frailecillo</td>
<td>Jatropha gossypifolia</td>
</tr>
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<td>54. Culantto coyote</td>
<td>Eryngium foetidum</td>
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<td>73. Piña</td>
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<td>86. Piper</td>
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<td>Menta sp.</td>
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<td>94. Camomile</td>
<td>Anthemis sp.</td>
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<td>Tagetes sp.</td>
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<td>96. Frijoles</td>
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<td>97. Icaco</td>
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<td>102. Yerba buena</td>
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<td>106. Tacaco</td>
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<td>107. Frijol de palo</td>
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### Appendix 2

**List of species found in Haitian Mixed Gardens (Jardin Devant Port Kaye)**

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APPENDIX 3.

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

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<th>Days to maturity</th>
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<th>Scientific Names</th>
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*P-Perennial
Floristic composition of home-garden by 25 samples at Ciwaringin, Karawang. Samples criteria: plain and sawah areas, far from the city.*

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**FOOD PLANTS**

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<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3.</td>
<td>Bridelia monoica</td>
<td>Kayu albisiah</td>
</tr>
<tr>
<td>4.</td>
<td>Caesalpinia sp.</td>
<td>Johor</td>
</tr>
<tr>
<td>5.</td>
<td>Cassia siameae</td>
<td>Daun ampelas</td>
</tr>
<tr>
<td>6.</td>
<td>Ficus ampelas</td>
<td>Bisoro</td>
</tr>
<tr>
<td>7.</td>
<td>Ficus sp.</td>
<td>Bambu tali</td>
</tr>
<tr>
<td>8.</td>
<td>Gigantochloa apus</td>
<td>Bambu gomgong</td>
</tr>
<tr>
<td>9.</td>
<td>Gigantochloa</td>
<td>Gamal</td>
</tr>
<tr>
<td>10.</td>
<td>Glyricidia maculata</td>
<td>Waru</td>
</tr>
<tr>
<td>11.</td>
<td>Hibiscus macrophillus</td>
<td>Kareumbi</td>
</tr>
<tr>
<td>12.</td>
<td>Hibiscus similis</td>
<td>Jati wandal</td>
</tr>
<tr>
<td>13.</td>
<td>Homalanthus tanareus</td>
<td>Kendal</td>
</tr>
<tr>
<td>14.</td>
<td>Jati wandal</td>
<td>Kihapit</td>
</tr>
<tr>
<td>15.</td>
<td>&quot;Kendal&quot;</td>
<td>Kilalayu</td>
</tr>
<tr>
<td>16.</td>
<td>&quot;Kihapit&quot;</td>
<td>Binatinu</td>
</tr>
<tr>
<td>17.</td>
<td>&quot;Kilalayu&quot;</td>
<td>Sulangkar</td>
</tr>
<tr>
<td>19.</td>
<td>Kleinovia hospita</td>
<td>Hindi</td>
</tr>
<tr>
<td>20.</td>
<td>Leca indica</td>
<td>Pandan</td>
</tr>
<tr>
<td>21.</td>
<td>Melia azedarach</td>
<td>Angsana</td>
</tr>
<tr>
<td>22.</td>
<td>Pandanus sp.</td>
<td>Bayur</td>
</tr>
<tr>
<td>23.</td>
<td>Pterocarpus indicis</td>
<td>Bauur</td>
</tr>
<tr>
<td>24.</td>
<td>Pterospermum diversifolium</td>
<td>Kihujan</td>
</tr>
<tr>
<td>25.</td>
<td>Pterospermum javanicum</td>
<td>Kesambi</td>
</tr>
<tr>
<td>28.</td>
<td>ScHBania grandiflora</td>
<td>Turi</td>
</tr>
<tr>
<td>29.</td>
<td>Vitex trifoliatus</td>
<td>Laban</td>
</tr>
</tbody>
</table>
## Appendix 5

### SOME USES OF WOOD FROM COMMON FRUIT TREES*

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


**Costa Rican common names used.
<table>
<thead>
<tr>
<th>Tree</th>
<th>Scientific Name</th>
<th>Characteristics &amp; uses</th>
<th>Vaule Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango</td>
<td>Mangifera indica</td>
<td>White to chestnut colored wood, hard, durable, medium density; furniture, construction</td>
<td>4</td>
</tr>
<tr>
<td>Marañon</td>
<td>Anacardium occidentale</td>
<td>White, reddish or chestnut, low density (0.5), susceptible to termites; small wooden objects.</td>
<td>3</td>
</tr>
<tr>
<td>Naranja</td>
<td>Citrus sinensis</td>
<td>Yellowish wood, hard, strong, susceptible to termites; small wooden object</td>
<td>2</td>
</tr>
<tr>
<td>Naranja agria</td>
<td>Citrus aurantiunm</td>
<td>Whitish to yellowish wood, hard, fine texture; baseball bats.</td>
<td>1</td>
</tr>
<tr>
<td>Níspero</td>
<td>Manilkara zapota</td>
<td>Red, very strong, very dense, durable; strong construction material, tough tool handles, fine furniture.</td>
<td>5</td>
</tr>
<tr>
<td>Panapén</td>
<td>Artocarpus altilis</td>
<td>Yellowish to chestnut, soft, very light (0.27), susceptible to termites; boxes, panels.</td>
<td>2</td>
</tr>
<tr>
<td>Mamón Chino</td>
<td>Melicocca bijuga</td>
<td>Coffee colored, medium density, medium hardness, susceptible to termites; construction.</td>
<td>2</td>
</tr>
<tr>
<td>Tamarindo</td>
<td>Tamarindus indica</td>
<td>Yellowish wood, soft, heart wood very strong, very dense (0.9), durable, susceptible to termites; construction.</td>
<td>3</td>
</tr>
<tr>
<td>Toronja</td>
<td>Citrus paradisi</td>
<td>Whitish, hard; firewood.</td>
<td>2</td>
</tr>
</tbody>
</table>
### Appendix 6

**TIMBER TREES AS SOURCES OF FRUITS, NUTS OR LEAVES**

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

**Appendix 7.**

**SPECIAL USES OF LIVING FENCES**

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