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# NATIONAL, BILATERAL AND MULTILATERAL AGROFORESTRY PROJECTS IN CENTRAL AND SOUTH AMERICA*

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A paper delivered at the International Conference on "International Cooperation in Agroforestry", from 15th till 23rd July, 1979 in Nairobi, Kenya.

# NATIONAL, BILATERAL AND MULTILATERAL AGROFORESTRY PROJECTS IN CENTRAL AND SOUTH AMERICA

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## Introduction

The title of this paper suggested by the organizers and received only 3 weeks ago, pretends to give a broad picture of who is doing what at present in the field of agroforestry in Central and South America. Ideally it should be the task of a person or a group who has been in contact with relevant institutions or key people in the region for a relatively long time. This is definitely not the case since, with a few exceptions agroforestry is relatively new in Central and South America, at least when viewed from the present scientific community. Its scope is not yet clearly defined.

Moreover the author is not familiar with various types of information or activities that would have provided a better evaluation notably: a) a survey commissioned by ICRAF in late 1978 and a meeting held that year by a team of Latin American specialists; the results have not been circulated and are unknown to CATIE. b) A more careful perusal of literature on the subject a task that is only beginning at this stage and c) information from certain countries where no contact has yet been established.

On the positive side CATIE can claim the following advantages: a) a programme on agroforestry initiated in 1961 and described since .... 1976 (see Appendix 1) including the offering of a graduate course since .... 1976 (see Appendix 2); b) a group of scientists dedicated to agroforestry at CATIE, presently involving 5 full time professionals and two more for part time, plus a varying number of graduate students working on a dissertation on this subject (an average of 1 1/2 a year since 1976) in close and direct contact with other professionals at CATIE -over 60- connected with annual crops, perennial crops, animal production and natural renewable resources (mostly forestry, wildland and watershed management) supported by a good library and documentation services (see for example Villegas and Coto, 1979); c) a certain contact with international groups dealing with agroforestry, notably ICRAF, IUFRO, FAO, UNU, IDRC and to a lesser degree other institutions, for instance the International Research Center on Environment and Development (CIRED) (Paris) and UNEP; and d) the realization at CATIE on 26-30 March 1979 of an international workshop on agroforestry systems in Latin America, attended by 37 invited participants and observers plus 14 scientists and 20 graduate students stationed at CATIE (Taller, 1979). This meeting produced 36 papers from the following countries: Brazil (2), Colombia (1), Costa Rica (14), Ecuador (5), Honduras (1), México (2), Nicaragua (1), Perú (2), Surinam (1), Venezuela (1), Zaire (1), South East Asia (1) and worldwide (4).

The present study should therefore not be considered complete, much less exhaustive. It represents an attempt to describe present

programmes and future needs as a basis for discussion.

What agroforestry include

Using basically ICRAF's definition*, agroforestry as here described includes such aspects as agrisilviculture (including taungya system), multiple strata management involving trees, sequential cropping including trees, management of secondary forests following abandonment from cultivation or pastures, certain types of shelterbelts, live fence posts, trees associated with grass (for cattle) for biological (soil improvement) and/or economic benefits, fodder trees, bordering ponds, etc.).

Most of the experiences here described are derived from relatively wet areas. An unavoidable bias will become apparent when the work carried out at CATIE is described. It is not because it is of greater importance but it is simply much better known.

*KING, K.F.S. and CHANDLER, M.T. 1978. The wasted lands; the programme of work of ICRAF. Nairobi, 36 p. (Definition on page 2).

Historical

Undoubtedly agroforestry was used by indigenous populations for centuries as has been described by Romanini (1976) for a wide area Wilken (1977) for Central America and Eden (1978) and Goodland et al (1977) in South America and more particularly in Mexico by Nations and Nigh (1978). A good worldwide literature revision was made by Romanini (1976) in Spanish with many examples from Latin America. All authors agree that native knowledge needs to be much better quantified and could often become the basis for improved stable systems.

The taungya system was used in Trinidad as early as 50 years ago and later in Belize, mostly with teak and a series of papers appeared in the "Caribbean Forester" in the fourties on the subject. In Mexico, some research was carried out in El Tormento, close to Escarcega, Campeche, in a warm, monsoonal climate, using mostly taungya with a variety of species (Verduzco 1978). In his book on plantations in Latin America, Flinta (1960) makes abundant reference to taungya. At CATIE, a graduate student thesis using Cordia alliodora planted with corn was turned in by Aguirre in 1963 followed by a series of thesis combining various tree crops with corn alone or corn and beans, varying planting distances, fertilization and different types of crop rotation (Aguirre 1977; Fernández 1978; Magne, 1979; Muñoz 1975). Various bibliographical treatises for Latin America made various references to agroforestry in the region (for example Villegas, 1978, Villegas, 1979); agroforestry, in a way, is also linked with shade trees (that also yield fruits, firewood and other products) on coffee, cacao or with live fence posts. Amazonian economic plants, including many trees of interest to agroforestry were the object of a symposium in 1972 (Villegas, 1976).

Interest by FAO became evident in a series of international meetings (for instance Haufe, 1979; Dourojeanni, 1979). IDRC organized a small meeting in Bogotá in 1978 to consider possible projects for financing and IDRC began activities that year with surveys in some countries. In 1978 too, the United Nations University initiated a cooperative programme with CATIE funding research activities in a pilot area in Costa Rica (Beer, 1979) and co-sponsoring the already mentioned international workshop at CATIE (Taller, 1979). A number of papers from the workshop are quoted in the literature cited. A meeting on management of ecological systems and alternatives of agroforestry production in the Equatorian Amazon, was held in Limonococha on 14-17 November 1978.

The following is a country by country description from which published data were available or some observations were made.

Argentina: Trees combined with crops are mentioned in the literature, notably by Cozzo (1976) and Flinta (1960).

Brazil: Dubois (1979) of the Inter American Institute of Agricultural Sciences has produced a chart showing what could be done in multistrata systems (see appendix 3). Cavalcante (1976) has produced a book on fruit and nut trees often associated with crops. A paper by Briscoe (1979) shows work done at Jari Florestal, a private enterprise where agroforestry is practiced on a grand scale within the *Pinus caribaea* and *Gmelina arborea* plantations. Devallos and Alvim (1967) have shown the benefits of leguminous shade trees on the physical and chemical properties of cacao soils.

Chile: Intercropping with corn has been observed by the author in Populus plantations at the early stages of development and grazing in radiata stands was investigated by Cortes (1979).

Colombia: Most of the work was carried out in South East Colombia and has been described by Peck (1976 a, b and c, and 1977) and Leguizamo (1979).

Peck describes practices involving Cordia alliodora and Cedrela mexicana. He also provides data on inputs and outputs. Taungya is practiced in the Bajo Calima by community groups, individual farmers who own land or forest workers on Government land. CONIF, a Colombian research organization is the organization that undertakes most research. Several fruit and timber trees are used together with food plants. One of the projects is carried out jointly by FAO and Inderena, the latter being the equivalent of a forest service (Leguizamo 1979).

Ecuador: The published work comes from Bishop (1978, 1979a, 1979b, 1979c); Prentice (1979) and Lojan (1979). Bishop (1979a) mentions the sequence of establishing legumes (Mucuna pruriens) followed by Brachiaria humidicola and stumps of Cordia alliodora, a timber tree. In another study the multistrata system is described with a diagram of the sequence used for several food and tree crops, including hogs as the main animal ingredient. The work is carried out by a missionaire group, the Instituto Linguístico, in Amazonian Ecuator.

Prentice (1979 considered particularly the worn out pasture lands in the Eastern slopes of the Andes with very high rainfall (4500 mm a year) at 950 m elevation. Corn, chicken and fruit trees are the main ingredients of multistrata systems including fruit trees. The work is carried by a training center in East Ecuator.

Loján (1979) for the University of Loja, describes several combinations in the relatively dry southern part of the country, as witnessed by small farmers at different elevations. Much of it refers to shifting agriculture that follows a pattern towards stability. In grazing areas some fodder trees are browsed and these are protected by local people. In the highlands Eucalyptus globulus is often associated with grasslands.

Eucalyptus with alfalfa and cattle or sheep grazing was also observed by the author in Central Ecuator. In fact Eucalyptus in the inter Andean valleys plays a dominant role in various agro-forestry combinations in Ecuador, Peru, Bolivia and some areas in Colombia.

In the lower humid areas, Cordia alliodora was often associated as a high canopy tree over coffee or cacao, with usually a middle stratum of smaller shade tree.

An interesting combination of Salix chilensis planted in single rows and associated with corn and sugar cane has also been observed close to Cuenca.

Costa Rica: Work is mostly carried out by CATIE (see below). However, one important paper on alder (Alnus acuminata) a nitrogen fixing timber tree used above coffee, has been produced by Fournier (1979),

a staff member of the School of Biology of the University of Costa Rica. The Ministry of Agriculture (1971) has produced a popular brochure to promote alder planting.

CATIE has undertaken systematic research on taungya though a series of thesis initiated in 1963 (Aguirre, 1963) (see under historical above). CATIE also maintains a pilot watershed nearby its headquarters, a programme sponsored by the U.N. University, where different agroforestry research is being undertaken. A book with all forestry trials carried out in the last 30 years is about to be published (Combe and Gewald, 1979). It includes a large section on agroforestry.

Recent and present research deals with the following topics:

a) Alnus acuminata (= A. jorullensis) with grass for grazing or cutting in humid highlands (1500-2500 m) where the main dairy region is located (Programa de Recursos Naturales Renovables, 1979a). A master's thesis has been produced in 1956 on the trees but the relationship with pasture and management systems is not well understood. There are conflicting beliefs (and reports) as to the real benefit of this N producing tree and its merits. However the area planted is increasing annually and present estimates range between 2000 - 3000 hectares.

b) Cordia alliodora as a third canopy in coffee at middle elevations (600 - 900 m) with Erythrina poeppigiana a legume that fixes N, at the middle stratum. Erythrina is heavily pruned twice a year. Two M.S. thesis are about to be concluded.

c) Cordia alliodora either on cacao in the humid lowlands, often with Inga spp. (a legume, fixing N) at the intermediate stratum, or in combination with pastures (Programa de Recursos Naturales Renovables, 1979c). Cordia seems to be an ideal tree to use in agroforestry in the wet lowland areas because of its self pruning quality, straight form, fast growth, small crown and very valuable timber (Johnson and Morales, 1972).

d) Taungya using Cordia alliodora, Eucalyptus deglupta, Gmelina arborea and Terminalia ivorensis associated with corn alone or corn and beans (Aguirre Castillo, 1977; Fernández, 1978; Magne, 1979). Different spacings, planting stocks, use of fertilizers and sequence of food crops have been the main variables investigated.

e) Live fence posts that not only serve as enclosures but also produce more fence posts from cuttings (combined with pruning) fodder for rabbits, food from flowers, fruits for human consumption, firewood, poles as well as posts, and medicinal products. Over 50 species are used in Central America alone.

f) Use of Cupressus lusitanica as a windbreak that is also cropped for timber in the moist dairy highlands (Programa de Recursos Naturales Renovables, 1979d).

g) Use of Cedrela odorata in coffee plantations (Ford, 1979). The fast growth seems to make the attack of Hypsipyla less damaging.

h) Control of erosion in pastures or crops by various trees planted inside, some of which are also lopped for fodder or planted to improve the soils (Alberty, 1977; Apolo 1979; Bermúdez 1979; Rocha 1977). Research currently in progress will compare - plots with and without trees and measure run off, sedimentation, organic matter, compactation and grass production.

i) The importance of trees in grasslands and cattle farms, their influence on soil and grass growth (Avila et al., 1979; Decarrett, 1976). Several small farmers are actively planting but reliable data are still scarce.

j) Sequential cropping involving trees, observed under carefully controlled conditions since its initiation (Enríquez, 1979) two years ago. Corn, beans, bananas, cacao, Erythrina poeppigiana trees and Cordia alliodora trees are involved.

k) Management of secondary forest following cultivation or pasture (Becerra, 1971; Programa de Recursos Naturales Renovables, 1979b).

l) The choice of case studies in a selected watershed: "La Suiza" close to Turrialba (Beer 1979; Programa de Recursos Naturales Renovables, 1979e). This programme involves a series of trials with the farmers with careful monitoring of their own appreciation of agroforestry practices.

Honduras: Work is just beginning through a joint mission between FAO and COHDEFOR the local semi-official forest promotion institution (Bauer and Sanchez 1979) on the following traditional practices: a) live fence posts, b) *Cordia alliodora* in pastures; and c) a high canopy with timber and shade trees on coffee.

Mexico: Recent work includes appraisals of *Brosimum alicastrum* as a fodder tree (Yerena *et al*., 1978) and various combinations of trees and food crops described by Nations and Nigh (1978) and Romanini (1976). For the coffee region a series of trees can be advantageously used (Fuentes Flores 1979). Taungya and multistrata systems are also investigated in the South East (Chavelas, 1979) and sequential cropping (including trees) in the wet Tabasco region (Gliessman and Amador, 1979).

Nicaragua: Agroforestry is being considered as a promising tool for wet lowland colonization schemes by governmental institutions (Araquistain, 1979).

Peru: *Prosopis juliflora* is being planted and managed to produce food for cattle and systematic measurements on yields have been made by the Forest Service (Valdivia 1979). Honey is an important additional product. Irrigation is used at least in the initial stages and eventually sheep will be introduced. At the early stage, beans have been associated.

For the humid tropics a series of papers by the Head of the Forest Service, Dr. M. Dourojeanni (1976, 1978, 1979) indicate that agroforestry is, or could become an important tool for better land occupation and to promote appropriate forest management techniques in the humid Eastern region. Conceptual considerations are also advanced by Ríos (1979) of the Agrarian University in the Tingo-María subcenter. The subject now needs to be buttressed by data collection in support of what people are already practicing.

Surinam: Work on taungya has been initiated by the Forest Service since over 10 years. Trees used presently are *Cordia alliodora*, *Eucalyptus deglupta* and *Cedrela angustifolia*. The results have been carefully analyzed as to costs and yields (Vega, 1979).

Venezuela: There are some reports on taungya in the Southwestern lowlands with teak and other species.

Systematic multistrata systems were undertaken by staff of the School of Agriculture of the Central University (Escalante *et al.*, 1979) in the lowlands in North Central Venezuela (Barlovento), where various annual and perennial food crops were associated with fruit trees. Fertilizers are being tried.

Work of regional interest

In 1977 an outline for a programme of work concerning agroforestry for the humid tropics was prepared at CATIE (Budowski, 1979). In 1978, Combe and Budowski produced an essay in French on

classification for agroforestry techniques, soon to be translated into Spanish and English (1979) and in 1979 Combe designed a punch card system to record bibliographical data on agro-forestry (Combe, 1979b).

Future needs

Undoubtedly agro-forestry has made an imposing start in the region and will undoubtedly move ahead particularly in wet areas were trees seem to be particularly indispensable ingredients.

However at this stage, it appears that scientists and administrators are more moved by wishful thinking than hard evidence.

The task of designing appropriate technologies for specific ecological, social and economic conditions still remains to be done.

A fitting conclusion could be copied from exceerps of what the participants of the international workshop (Taller, 1979) perceived as most promising lines of research for the future:

"Priorities for research actions

The participants of the international workshop on agroforestry techniques, Turrialba, 1979, recognized the importance of establishing in distinct ecological regions, experimental trials and pilot projects for the investigation and future transfer of agro-forestry techniques that mainly benefit rural populations.

In the initial phase priority should be given to actions designed to evaluate and utilize successful traditional agro-forestry techniques already practiced by local farmers and indigenous communities. With this in mind case studies, and the consequent dissemination of the results, are particularly appropriate in order to obtain the maximum multiplying effect and to be able to cause the greatest impact.

Socio-economic-cultural evaluations should also be included because of the direct influence of these factors upon the existing and proposed techniques. Especially worthy of emphasis are the following aspects: the inherent difficulties in transferring knowledge of techniques and their application to different types of farms.

Information and communication

The paucity of information about the subject, and likewise the lack of communication between people working in related fields, became obvious. There is a need to create a means for the interchange of information, adapted to the desiderata of investigators, educators, promoters and producers interested in agro-forestry techniques.

An appropriately coordinated network should be especially concerned with the propagation of information related to the following themes: persons and institutions interested in agro-forestry techniques, details of present and future projects on this subject, location of germplasm banks, training centres, possibilities for grants and study tours, announcements and reports on national and international meetings dealing with the subject, international sources of financial support, new or impeding publications and the possibilities of using documentation services.

Education and training

The study and development of agro-forestry production systems requires the participation of inter-disciplinary groups and that the output of trained personnel, capable of adapting to this type of work

should be a permanent goal of the appropriate training centres.

Likewise, according to the circumstances, it is worthwhile promoting the creation of various arrangements that would permit the incorporation of agro-forestry considerations into teaching and training schemes. For example, the following should be developed or included in existing curricula; standard courses in faculties or postgraduate schools, intensive short courses, in-service training, seminars, courses for continued education of executives and officials, study tours, institutional interchanges, and general training programmes adapted to different needs and levels of education. Moreover, practical training schemes should be established for rural populations that utilize agro-forestry systems, or who live in areas where these techniques show promise.

The training and education methods should be continously revised in accordance with the characteristics of the countries, taking into account their respective ecological zones and the inhabitants who are involved.

Dissemination of germplasm

In order to encourage greater diversification of the components in agroforestry systems and to maximize their yields, the activation on a regional, national and international level of mechanisms to promote the registration, interchange and introduction of germplasm, together with its judicious transference into the rural environment, should be urgently considered.

It would also be worthwhile to develop a parallel study of known species of potential interest, particularly shade tolerant plants which could form a productive subordinate strata and which are well adapted to the different local conditions.

Importance of the animal component

The use of agroforestry systems for the production of meat, hides, honey and other benefits could become one of the most important resources of the rural people.

Therefore, it is worthwhile considering fish, domestic and wild animal species as components of appropriate agroforestry combinations.

Establishment of an international network

There is a need to establish a research and promotion network that will bring together the national, regional and international organizations that work in the field of agroforestry.

Priority tasks for such a network should be to propose mechanisms for improving research cooperation and coordination, to harmonize methodologies so that results are readily comparable, and to explore the possibilities for transferring technologies that are already in use or are known from previous historical periods.

Future meetings

Future meetings about this theme should be orientated towards evaluations of specific case studies from regions, such as some wet tropical zones, which by reason of their ecological and socio-cultural characteristics are critical and thus merit priority attention.

Likewise, a major effort should be made to look at the problems resulting from the perception of the environment by the respective rural populations that live in affected areas. This is especially true when dealing with the transfer of technology.

Role of the international organizations

International organizations are requested to take note of the priorities recommended by this workshop and to consider the corresponding countries and institutions in their aid programmes.

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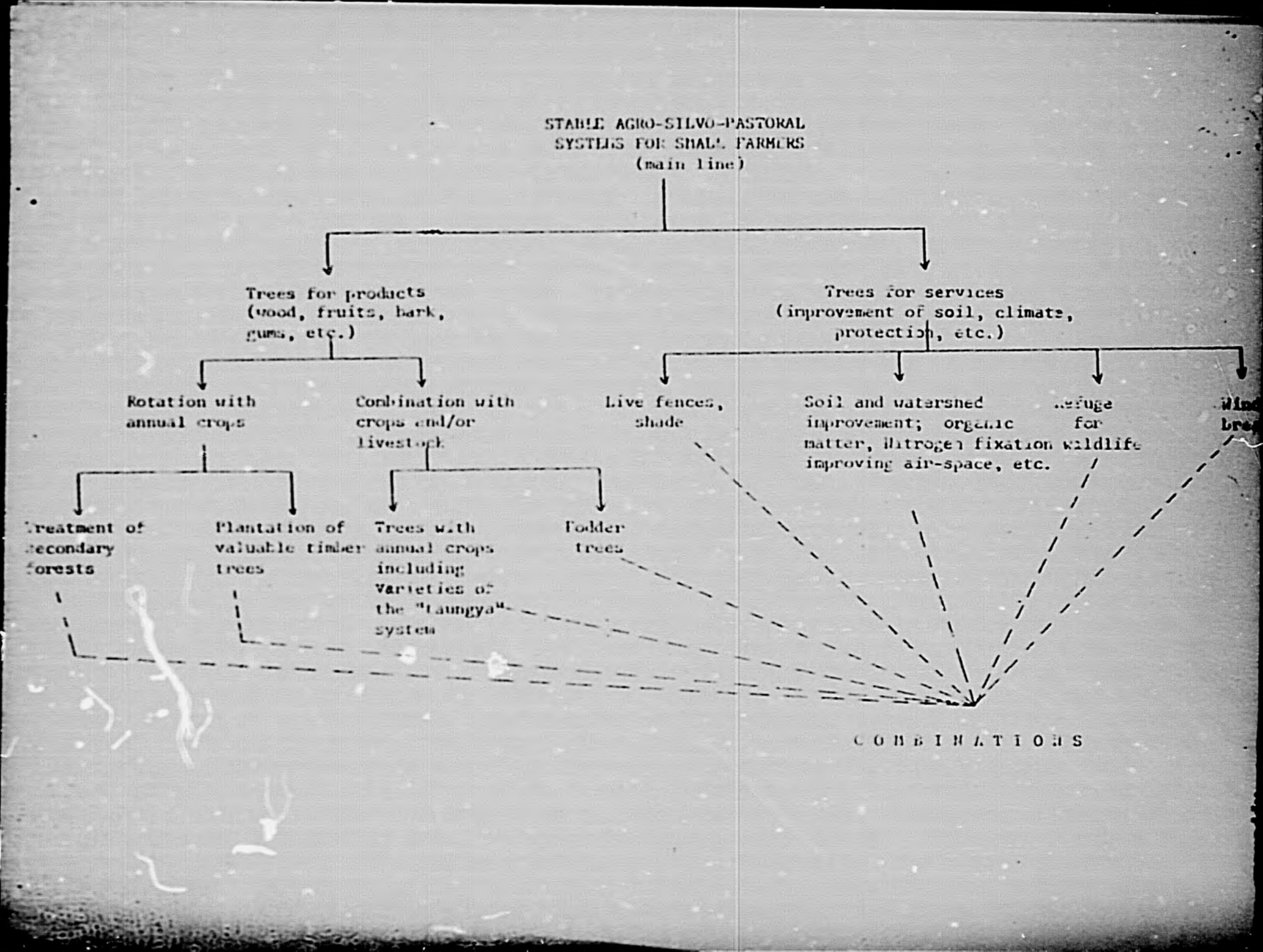
# APPENDIXES


STABLE AGRO-SILVO-PASTORAL
SYSTEMS FOR SMALL FARMERS
(main line)
Trees for products
(wood, fruits, bark,
gums, etc.)
Trees for services
(improvement of soil, climate,
protection, etc.)
Rotation with
annual crops
Combination with
crops and/or
livestock
Live fences,
shade
Soil and watershed
improvement; organic
matter, nitrogen fixation
improving air-space, etc.
Refuge
for
wildlife
Wind
Brea
Treatment of
secondary
forests
Plantation of
valuable timber
trees
Trees with
annual crops
including
varieties of
the "taungya"
system
Fodder
trees
COMBINATIONS

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Appendix 2

STABLE AGROFORESTRY SYSTEMS IN THE TROPICS

Graduate Course N° SP. 6309

Prof. Gerardo Budowski, Ph.D.
Prof. Jean Combe, Ing. For.

1 hour a week
several field trips
1 term paper (10-15 pages)

1. Definition and concepts. Emphasis on trees associated with crops (including pastures). Present terminologies: agrisilviculture, agro-forestry; the concept of system, of stability. General discussion on advantages and drawbacks of associating trees with crops and pastures in the light of biological social, economic and other factors. Revision of available literature.

2. A classification of agro-forestry systems.

3. The possibility of obtaining many products from trees in relatively short periods (props, posts, poles, firewood, charcoal, different types of timber, chips, etc.).

4. Taungya system and other annual crops associated with valuable tree species.

5. The management of a secondary forest (following annual cropping) in a small farm.

6. Coffee and cacao with a third canopy of laurel (Cordia alliodora). The experiment in "La Montaña" (collaboration by Prof. Gustavo Enríquez, Ph.D.)

7. Pastures and trees (including palms) in lowlands tropical areas.

8. Alder (Alnus jorullensis) and other combinations of trees and pastures in dairy farms at higher elevation. The case of Cupressus lusitanica; Eucalyptus globulus in Ecuador and other combinations.

9. Multiple purpose fodder trees (lopping and browsing) in dry areas.

10. Hydrolisis of wood; other food sources from leaves.

11. Live fence posts.

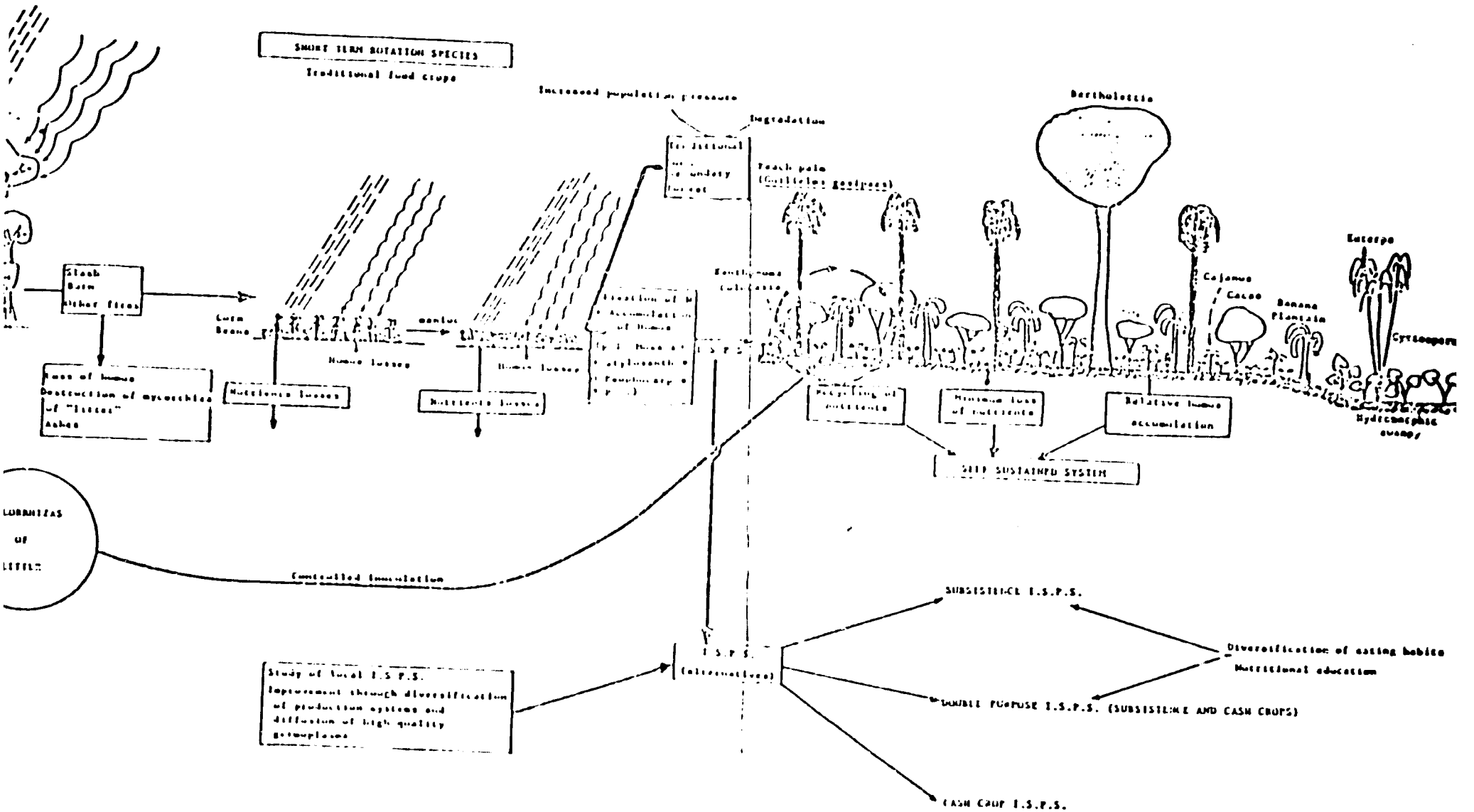
El CATIE es un Centro Internacional, establecido como una Asociación Civil de Carácter científico y educacional, constituida entre el Instituto Interamericano de Ciencias Agrícolas de la O E A y el Gobierno de Costa Rica. Su objetivo es realizar, promover y estimular la investigación y la enseñanza, en el campo agrícola en toda su amplitud.

12. Windbreaks and other tree crops to improve climatic conditions for crops and grazing areas.

13. Trees to improve soil conditions, to serve as "nurse crops" or other purposes. The case of Leucaena leucocephala.

14. Other agro-forestry combinations. Fishing ponds and trees.

15. Current international programs: ICRAF, FAO, UNU, PNUMA, etc. and potential funding sources for research and action programs.

16. The future of agro-forestry systems, particularly for the low income rural inhabitant. How much can marginal lands contribute?

# INTEGRATED STRATIFIED PERMANENT SYSTEMS
# I.S.P.S.