AGRO-FORESTRY FOR IMPROVEMENTS
OF DEFORESTED MOUNTAIN LANDS IN COSTA RICA
-A PILOT STUDY-

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SUMMARY

Investigations on agro-forestry have been carried out at Centro Agronómico Tropical de Investigación y Enseñanza, (CATIE), Turrialba, Costa Rica, during the last two decades (4, 5, 6). In 1980 a collaboration program was started with the German Agency for Technical Cooperation (GTZ). The objective, in the first phase of this collaboration, is to study existing agro-forestry practices in regard to their ecological and socio-economic relevance. The CATIE GTZ Agro-forestry Collaboration Program is realized in three regions, two in Costa Rica and one in Nicaragua. Preliminary results from one region, the Cantón of Puriscal, Costa Rica, are reported here in.

INTRODUCTION

Population density increases in Costa Rica with a yearly birthrate at 3.37% for 1950-80 (1), price-cost relations are changing, and forest protected lands decrease rapidly, (with a rate of about 3.5% per year) (10). Out of the total territory of Costa Rica land clearing for wood extraction and crop cultivation has decreased the forest area from 75% in 1950 to 35% in 1979. The regions which are most heavily affected by a shortage of wood and soil depletion are the densely populated mountain areas.

For many generations the small farmers in Costa Rica have applied a great variety of mixed cropping systems (5), preserving soil fertility and harvesting sustained yields of cash and subsistence crops. A number of different tree species are used or known for shading coffee plantations or pasture lands. Live fences are quite common and occur in a large number of different species combinations, utilization and management forms. Knowledge and experiences of agro-forestry land use practices are widely spread.

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In 1979 the Cantón Puriscal was declared a priority area by the Ministry of Agriculture because of the severe deforestation (13). Most recent estimates show, that only 10 to 15% of the total 690 square kilometers covering mountain lands are still under small forest patches (9), the rest is mainly crop and pasture land. According to the site classification map (11), only 18% of the land is adequate for agriculture and pasture. The remaining 82% should be under forest cover but alternatives to traditional practices are needed. However, in order to introduce new production techniques or improve existing techniques the effective requirements and conditions have to be well studied and understood.

PROBLEMS

About 30 years ago the Cantón Puriscal became easily accessible, after paving the old 40 km road connecting the small city Santiago de Puriscal (2,500 inhabitants) with the capital San José (13). The farmers gained access to the central market but lost their independences, and lands to invaders and speculators (3). New areas became occupied for cultivation of coffee, beans and corn, thus accelerating deforestation. At the same time the costs for labour and fertilizers began to increase and young people to abandon the country side which often leaves the farmers with the necessity to change towards extensive cattle farming (2).

This tendency is indeed amplified due to the receptive international beef market providing increasing prices, and to the national credit policies, which almost exclusively support beef production for export. Regarding topography and soils, the Puriscal cantón is suitable for pastures on less than 5% of the total area (12) when in reality more than 70% of the lands are used for cattle grazing. Steep slopes (40-60° inclinations) on erodable latosolic soils (7), indicate the vulnerability of these lands.

There is a periodicity in rainfall distribution (8) with a dry period of 3 to 4 months between December and April. During the rest of the year precipitation amounts to 1500 - 2500 mm depending on altitude and aspect. Santiago de Puriscal, situated at approximately 1 100 m above sea level, receives a mean annual rainfall of 2 300 mm in a 8-month period. Erosion control or watershed management do not exist and rotation systems for grazing are quite rare (12). Beyond Santiago de Puriscal infrastructural components, social and educational aspects are severely neglected.

Deforestation is a well-known problem in tropical zones which has frequently been described (e.g. by FAO). Also the ecological and socio-economic consequences of devastated forest areas are well analyzed, in broader sense as well as in small scale detailed studies, at least since the beginning of this century. Reforestation, especially in denuded mountain regions is necessary and sometimes even promoted to meet increasing demands not only for wood but also to prevent site depletion and uncontrolled floods. Quite often soil conservation by means of reforestation is biased against the actual basic needs of the local population: today's food must have priority over tomorrow's improvement.
OBJECTIVES

The long term objectives of the Agro-forestry Collaboration Program are a profound analysis of traditional agro-forestry land use techniques considering socio-economic and ecological aspects, and a systems oriented investigation on the alternative ways of establishing and managing trees in combinations with crops and pastures. Because of the complexity of these studies, an interdisciplinary approach is required. Thus, the program is carried out in collaboration with the United Nations University (UNU) agro-forestry project, the CATIE-GTZ project "Farming Systems in Centroamerica", and other established CATIE projects as well as with appropriate national institutions.

The specific objectives are:
- classification of existing agro-forestry systems
- evaluation of information on management, utilization and marketing of tree species used by the farmers
- identification of problem areas and evaluation of improvement techniques
- investigations on, and experiments with different native and exotic tree species for multiple use

METHODS

The classification is realized according to COMBE and BUDOWSKI (5). However, simultaneous combinations of forestry with crops and grazing is neglected out of two reasons: this combination hardly exists in the surveyed area and the system itself is far too complicated to be analyzed within the limits of available financial and human resources at the present stage of the project. As pisciculture is not observed in the area, the two remaining agro-forestry systems, I: combined agro-silvicultural and II: combined forestry and grazing, are subdivided as follows:

I
1) Agri-silviculture (Taungya method or system)
2) Commercial trees among crops
3) Fruit trees among crops
4) Shade trees among crops and/or for improving soil fertility
5) Live fence post
6) Shelterbreaks and erosion control

II
1) Pasture (or fodder production) in forest plantations
2) Pasture (or fodder production) in secondary forests
3) Commercial trees in pastures
4) Trees in pastures for producing shade and/or improving fertility (e.g. by nitrogen fixation)
5) Fodder producing trees
6) Fruit trees in pastures
7) Live fence posts
8) Shelterbreaks and erosion control

A preliminary questionnaire has been distributed to 108 farms. These farms were randomly selected by the CATIE-GTZ Farming-Systems-Project. By aerial photo interpretation in combination with a terrestrial survey, total area and distribution of forests, tree species and stand structures have been investigated in order to obtain data on native forest vegetation for selection of species for experimental plantings. In collaboration with local farmers and the Ministry of Agriculture two nurseries have been established to produce these species together with some exotic species for comparison within a species trial. Most of them are leguminous species with multiple purposes such as erosion control, soil improvement and production of fire wood, timber and fodder.

**FINDINGS**

Preliminary evaluation of the studies showed that among the 108 small farms, 42% of the total are farms with less than 4 ha and 26% with less than 2 ha. The majority (70%) of the farms have both crops and pastures. 30% have crops only, and 6% have only pastures. Most commonly produced food crops are corn (86% of all farms) and beans (74%) (13). Coffee is considered by the farmers to be the most important cash crop followed by tobacco and sugar cane. Almost all farms have trees, either planted (20%) or natural regeneration. In 86% of all farms, trees are used as live fences and 72% of the farms are using trees in combinations with coffee. However, combinations of trees with pastures are relatively rare and almost exclusively found in some bigger farms. Among these farms Cedrela odorata (Spanish cedar) is the most common timber species. These farms also show a distinct reduction in shade trees in their coffee plantations, compensating by application of fertilizers and pesticides. On the contrary small farmers have a large number of species, such as different fruit trees in their coffee plantations.

In some exceptional cases, coffee is grown even under a dense crown cover of fruit trees. Although coffee yield in these cases is lower, a better soil protection is obtained as well as an additional production of fruits and fire wood for domestic use and eventually also for sale. Especially in the smaller farms total net income has now decreased to a critical level due to the inflation rate. Thus, these farmers are becoming dependent on extra income which is hardly possible to find in the area. Also the coffee harvest period forms a labour peak during almost the same time for all coffee farms. Consequently labour or cost intensive small farming production systems are either badly managed or have to be abandoned. Realizing this, the small farmers seem quite receptive to improvement trials in their traditional mixed cropping systems while the majority of the cattle farmers are still rather negative to the development of silvo-pastoral practices.
CONCLUSIONS

As remaining forests still form a main source for fire wood, and since erosion in pastures all over the area is a severe problem, the reintroduction of tree species, in short rotation, for multiple purposes is being strengthened by the Ministry of Agriculture and other institutions in Puriscal. The CATIE-GIZ Agro-forestry Program participates within the frame of these activities on the techniques and practices of combining trees with crops and pasture lands as one possibility to improve ecological and socio-economic situations under the described conditions. Special emphasis will be given to species trials and demonstration plots.

LITERATURE

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