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METHODOLOGICAL ASPECTS OF ON-FARM AGROFORESTRY EXPERIMENTATION

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Abstract: In Brazil's Central and West Amazon, agroforestry research started in the seventies with the test of agroforestry systems in experimental stations. Farmers did not adopt these systems. As alternative, the Agroforestry Unit of the National Institute of Research for the Amazon (INPA) started a program of on-farm agroforestry trials, attributing a decisive role to the farmer. Together with the farm's family a tree planting proposal was developed. Farmers furnished land and labor and were to manage the trees their way. Research offered planting stock, accompaniment and advice. Resulting agroforestry plantings differed substantially. The obtained experience is reviewed to come to suggestions for this type of research. Attention is given to the selection of farms for participation; field staff preparation; trial design, installation and maintenance.

Key words: on-farm trials, participatory research, agroforestry adoption

ASPETOS METODOLÓGICOS DA EXPERIMENTAÇÂO AGROFLORESTAL NA PROPRIEDADE

Resumo: Na Amazônia Central e Ocidental do Brasil, a pesquisa agroflorestal iniciou nos anos setenta com o teste de sistemas agroflorestais em estações experimentais. Os agricultores não adotaram esses sistemas. Como alternativo, o Núcleo Agroflorestal do Instituto Nacional de Pesquisas da Amazônia começou um programa de ensaios agroflorestais em propriedades agrícolas, atribuindo um papel decisivo ao agricultor. Junto com a família do estabelecimento agrícola foi desenvolvida uma proposta para a instalação de árvores. Os agricultores forneciam terra e mão-de-obra e iriam manejar as árvores de seu jeito. A pesquisa ofereceu mudas, acompanhamento e assessoria. Os plantios agroflorestais resultantes diferiam substancialmente. A experiência obtida é revista para chegar a sugestões para este tipo de pesquisa. Atenção é dada à seleção dos estabelecimentos para participar, à preparação dos técnicos e ao planejamento, instalação e manutenção dos ensaios.

Palavras chave: ensaios no estabelecimento agrícola, pesquisa participativa, adoção agroflorestal

1. Introduction

In the seventies, agroforestry research for Brazil's Central and West Amazon started with the experimentation of agroforestry systems in field research stations. As these systems were not adopted, the Agroforestry Unit of the National Institute of Research for the Amazon (INPA) started a program of on-farm experimentation, attributing a decisive role to farmers (Anónimo 1999; van Leeuwen et al. 1994; van Leeuwen 2002).

Participatory on-farm experimentation can be central to the adoptability of agroforestry proposals. It can be done in very different ways. To contribute to the debate on this approach, aspects of the experience of INPA's Agroforestry Unit are reviewed.

2. Methodology

The proposed program of on-farm experimentation with trees was discussed in meetings of local communities (*comunidades*). Land use of farms of volunteers was analyzed to detect possibilities for

the inclusion of more trees. The farm family chose the species and the quantities per species to be planted. In principle, species needing expensive inputs were avoided, as these were already promoted by financial schemes (e.g.: citrus, *Citrus spp.*; coconut, *Cocos nucifera*). Final decisions were entirely with the farmer. The program offered free planting material and technical advice (the type of support that can be supposed to occur in schemes promoting agroforestry). The farmer furnished land, labor and sometimes part of the planting material; he/she was to manage the plot his/her way. This level of farmer participation was considered necessary to observe what can function under "real" conditions. Experiments were visited to observe and measure the plot, discuss its management with the farmer and note eventual changes of farm and family.

Following the trend of these days, we originally aimed at completely new plantings, combining tree species for two or three different canopy strata, forming a rectangular plot (the so-called *SAF*: *Sistema Agroflorestal*). These plantings were mostly installed in fields already prepared for cassava (*Manihot esculenta*) or pineapple (*Ananas comosus*), as this eliminates costs for field preparation and early maintenance. Later, the integration of trees in actual land use was interpreted in a broader way and any interesting proposal to introduce more trees on the farm was considered.

In the Manaus' region, the first experiments were installed in the rainy season 1992/1993; more followed later. In 1995/1996, work was expanded to Rondônia state. Agriculture in these areas is described by van Leeuwen et al. (1994) and Anônimo (1999). Trials varied in size from little more than a hectare to just one tree. A farm could have more than one experiment. Intensity of the work varied with the availability of funds. This paper reviews part of the obtained experience and presents suggestions for the design and execution of this form of participatory research.

3. Results and discussion

3.1. Selection of participating farms

The community's didn´t show to be the well-functioning united rural organizations, as sometimes suggested. Not everybody comes to meetings, or is even member of the community. For contacting farmers, community channels have to be used, but it can be recommendable to combine this with other means. Important differences in wealth between the families are the rule. The best-of families hire labor, while the most destitute sell most of their labor. On-farm testing needs to occur with families of different economic levels, as relevant agroforestry options can vary accordingly.

As the aim was to find new land-use options, only those proposals were followed-up which could give new information. It has therefore to be clear from the start, that only certain farms will be selected for on-farm experimentation. Excluded farms can be thanked with planting material and can be asked to participate in the testing of new species and varieties (van Leeuwen et al., 2009).

As trees have a long economic cycle, their performance depends on the continuity of the farm's management. Therefore we selected families which lived on their farm and had agriculture as their main occupation. Especially in recently settled areas, mobility can be a menace to continuity. Farmers may plan to move closer to educational opportunities for their children, but may not tell so. On the contrary, they may reason that a new tree plantation will be an asset when offering their farm for sale. Working with several farmers per community allows a more efficient use of field trips.

3.2. Staff – farmer relations

Efficient cooperation between smallholder farmers and professional staff of a prestigious government institution does not always come naturally in a society with a strong authoritarian tradition. As the common top-down approach of agricultural extension is counterproductive in participatory approaches, staff needs special training and accompaniment. It is recommended to agree on certain rules: no use of field visits for commercial activities (e.g.: buying produce for resell, acquiring land); gifts from farmers are better avoided; when some farm produce is taken home, payment should be the rule.

The contact of the farm with the program easily leads to not-intended advantages (gifts for members the family, advice unrelated to the trial), normal consequences of good human relations. Completely avoiding this is unnatural and thus undesired. But, it should be realized that too many "side benefits",

or a too strong personal relation, can lead to a biased (too positive) attitude of the farmer towards the technology being tested.

3.3. Species composition, system performance

Farmers showed interest in many species. At the start, our species list for the upland around Manaus contained 31 different species, today it contains more than 60. Resulting agroforestry plantings differed substantially in size, species composition and management. Most consisted of a mixture of minor fruit species. The majority of the plots developed reasonably well, but farmers showed limited interest in those mixtures of species of minor economic interest. Consequently these agroforestry plots didn't have much influence on the major farm activities. More successful systems were designed around economically important perennial crops, such as *cupuaçu* (*Theobroma grandiflorum*) and citrus. It became clear that agroforestry systems meant for production need a main tree crop as economical backbone. Positive impact also resulted from the integration of trees into existing land uses. A list of options hereto was developed during the program (van Leeuwen, 2008). Deforested creek (*igarapé*) borders were recovered with trees (Gomes et al., 2009); coffee and floodplain fruit plantations were enriched with timber species. Special trials were used for the small-scale introduction of species not planted before (van Leeuwen et al., 2009).

Soil fertility proved to be very important. It is important to know, if the area to be planted will be fertilized, or has been so in the past. On the upland nutrient-poor soils, horticultural crops and semi-perennials, such as passion fruit (*Passiflora edulis*) and papaya (*Carica papaya*), are always fertilized. Local species, such as Brazil nut (*Bertholletia excelsa*), *sorvinha* (*Couma utilis*), *bacaba* (*Oenocarpus mapora*) and ice cream bean (*Inga edulis*), developed well on non-fertilized, nutrient-poor soils. Most non-local species showed to be more demanding. *Gliricida sepium* only developed well in places, fertilized in the past.

Farmers didn´t generally know about the use of (nitrogen-fixing) plants for soil improvement and weren´t really motivated to try it. This obliged to change the approach. We asked farmers to allow us to demonstrate the use of these species in the already installed agroforestry plot on their land. Some agreed. The research program guaranteed installation and the first two years of maintenance, after which the farmers took over. One farmer made interesting, unforeseen adaptations.

3.4. Execution and maintenance

The strategy of planting trees in crop fields proved to be a good one. After the installation of the trees, the crop needs to stay present for at least two years. Once the crop is harvested for the last time, maintenance is strongly reduced. If this occurs less than two years after tree planting, the appearing bush vegetation (*capoeira*) will out-compete the treelings all too easily, as occurred several times. For fields obtained by clearing primary forest, this won´t necessarily be a problem, as such fields will normally be cropped for two or three consecutive years. But fields obtained by clearing secondary vegetation will often be cropped for just one year.

Once the initial, annual or semi-perennial crop is no longer present, the maintenance of the young tree planting turns problematic. This "critical period" ends, when the harvest of tree products motivates the farmer to do sufficient maintenance. Several interesting species initiate production late and need large spacing; both aspects worsen the maintenance problem. In these cases, precocious, "filler" species are needed, which start producing soon after the last harvest of the initial crop. A spacing of 5 x 5 or 6 x 6 m should be considered the widest acceptable; a larger spacing will need too much maintenance during the "critical period" before the trees start producing.

Loss of trees by fire, entering from neighboring areas, occurred several times. Possibly, the placement and layout of the plantation can help to diminish this risk, for instance, by fitting the planting within natural boundaries, instead of laying out a strictly rectangular plot.

How to plant the treelings needs demonstration. Farmers won't necessarily realize that plastic bags have to be removed (causing sudden tree fall, years later), or apply mulch around the young plant. The treelets should be marked with large durable sticks, to avoid that they are wounded or destroyed during maintenance, often done by hired labor. It is better to install all trees in the same season. Promises of adding trees later were mostly not held.

As already mentioned, once the initial, annual or semi-perennial crop is harvested for the last time, the "automatic" maintenance stops and the spontaneous bush vegetation will appear. Eliminating all spontaneous vegetation is a lot of work and stimulates re-growth around the trees. It is often better to cut back/eliminate plants which compete for light with the young trees and only suppres all vegetation within a circle around the trees (*coroar*). Material resulting from pruning and weeding should be used to mulch the trees.

To develop straight boles, many timber species need shade management and/or pruning. Farmers normally don't have experience herewith. Rectification of bifurcations and elimination of too heavy branches have to occur early.

4. Conclusions

Participatory on-farm trials showed to be a useful tool in developing agroforestry options. Agroforestry promotion should not only ad trees to a farm, but also try to interfere with major farm activities by developing agroforestry systems for the principal crops. This requires intensive interaction over a longer period, but can have an important influence on the way of farming.

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