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Farmers' perception and use of planted *Calliandra calothyrsus* fallow in southern Cameroon

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Abstract
The leguminous tree *Calliandra calothyrsus* was introduced to farmers in southern Cameroon for soil fertility and crop yield improvement in shortened fallow phases in 1989. On-farm trials by ICRAF and IITA used the alley cropping concept, and various spatial patterns and tree densities. Initially 2 year old fallow was cropped after slash and burn land preparation. This study reports farmers' perception of the effects of *C. calothyrsus* fallow in four areas and verifies if farmers used the system without researchers' involvement.
After the initial 2 years fallow, 95% of farmers cropped, after the second and third fallow 47% and 13% cropped, respectively. Labor requirement to clear and prepare land after *C. calothyrsus* was perceived as being larger than after natural fallow by 86% of farmers after the first fallow; and by 24% and 13% after the second and third fallow. Perceived and recorded labor requirements were closely correlated. Across all crops, 61% of farmers perceived yields being higher after *C. calothyrsus* than natural fallow; 17% did not report any difference. Perceived yield advantages after *C. calothyrsus* increased from 57% after the first fallow to 77% after the third fallow. Yield perception varied with location: in the south 45% of farmers believed *C. calothyrsus* produced higher crop yields, compared with 70% north of Yaounde. Maize was believed by 78% of farmers to produce higher yields in *C. calothyrsus.* Groundnut was believed to not respond positively to *C. calothyrsus* with 45% of farmers reporting higher yields in *C. calothyrsus.* Cassava yields were perceived by 62% of farmers as higher in *C. calothyrsus.* For sites where yields were measured by researchers, farmers either incorrectly perceived a yield advantage or overestimated the yield advantage of *C. calothyrsus* by a wide margin. The decline in the use of *C. calothyrsus* fallow indicates, that increased labor requirements for clearing and land preparation outweighed perceived and real yield advantages. Consequently, *C. calothyrsus* is virtually only used in the high population density area north of Yaounde. The species can neither be recommended for large areas nor for all crops.

Introduction
Increasing population densities demand increasing food production in West and Central Africa. The traditional long-fallow shifting cultivation can no longer meet the food requirements in most of humid sub-Saharan Africa. Farmers' major response to higher food demands has been either an increase in cultivated area, where possible, or a reduction of fallow length. Both responses pose a serious threat to the natural resource base. Planted fallow, specifically tree fallow has been proposed and tested as an alternative land management system. Various arrangements of trees, in hedgerows, block planting border planting and as clusters in fields were evaluated for their suitability in improving crop yields. On-station research on Alfisols (Kang et al 1995) produced

promising data, yet results from Ultisols and Oxisols were not convincing. Because most of the research on planted tree fallow was done with only a few species, *Leucaena leucocephala, Gliricidia sepium* and *Senna siamea*, testing more species held promise to find species performing on West and Central African Ultisols and Oxisols. The leguminous tree *Calliandra calothyrsus* was introduced to farmers in southern Cameroon for soil fertility and crop yield improvement in shortened fallow phases in 1989. Initially the system was based on annual cropping yet was quickly changed to an real fallow system (Kanmegne & Degrande 2002). On-station and on-farm trials by ICRAF and IITA used the alley cropping concept, and various spatial patterns and tree densities (Nolte et al 2003). Also Calliandra produced remarkable amounts of biomass no positive yield responses compared with natural fallow were found (Nolte et al 2005, Hauser et al submitted). As a consequence, IITA phased out planted tree fallow as a means to improve crop yields on Ultisols and Oxisols in West and Central Africa. Between 16 and 9 years after establishment of on-farm trials and about 6 years after the withdrawal of researchers from this type of intervention, a survey was conducted to determine farmers' perception of the effects on labour requirements, and crop yields in *C. calothyrsus* fallow in four areas of different land use intensity and to verify if farmers used the system without researchers' involvement. Because a considerable number of former participating farmers started complaining about the spread of Calliandra volunteers which, according to the farmers were a difficult to control weed, an assessment of Calliandra spread from former trial sites during fallow phases was conducted.

Materials and methods

A survey was conducted amongst 61 farmers who had participated in establishing Calliandra fallow. The sample was stratified by region into:

Surroundings of Monatélé, 60 km north of Yaounde (17 farmers in 5 villages)

Surroundings of Yaoundé (19 farmers in 4 villages)

Surroundings of Mbalmayo (16 farmers in 6 villages)

Surroundings of Ebolowa, 110 km south of Mbalmayo (9 farmers in 5 villages).

The survey was started 9 years after the last introduction of the trees to farmers to ensure that all had sufficient time to undergo three fallow cycles (2 years each) and 3 cropping cycles (1 year each). Farmers were asked to evaluate labour requirements for land preparation after Calliandra versus natural fallow, to list the crops they planted and to assess the yield by crop after Calliandra versus natural fallow.

To determine the spread of Calliandra in to the surrounding of former trial sites seedlings were counted in 2x2 m squares at 0 to 45 m distance from the former trial border. Counting was done after the surrounding had been cleared for cropping, yet the spread happened in the previous fallow phase.

Results

After the initial 2 years fallow, 59 farmers (95%) cropped, 29 farmers (47%) cropped after the second and 8 farmers 13% cropped after the third fallow. However, 30 farmers (50% of those who cropped) used the fallow only once. The two farmers, who did not crop after the first fallow phase, never cropped the land (Figure 1). The establishment of the Calliandra fallow was either done solely by technicians of IITA or ICRAF, by the farmers alone or in cooperation. At Monatele all trials were established in collaboration, while at Mbalamyo a majority of trials was established without farmers' contribution (Figure 2).

At the first fallow clearing, farmers perceived the labour requirement to clear Calliandra and prepare the land for cropping as larger (2.93 weeks) than that to clear the same area of natural fallow of the same age (2.29 weeks $p = 0.01$). Apart from the time requirement the difficulty to clear was ranked, with Calliandra being perceived by most farmers as more difficult to clear than

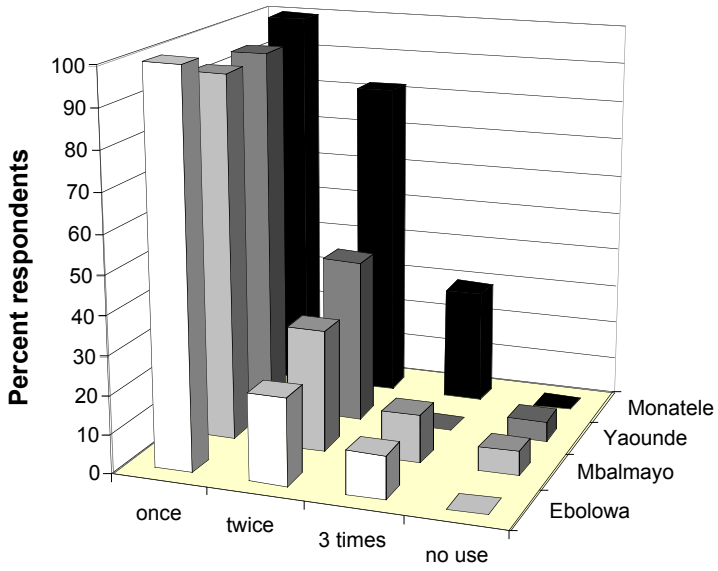

Figure 1: Distribution of use frequency of Calliandra fallow in 4 sites in southern Cameroon.

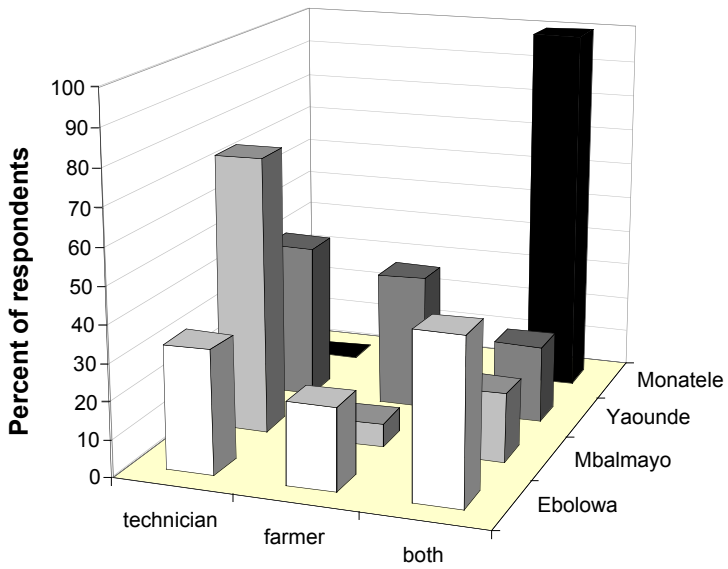

Figure 2: Distribution of technician and farmer involvement in Calliandra establishment in 4 sites in southern Cameroon.

natural fallow. Of the 30 farmers, who cropped only once, 26 ranked Calliandra clearing as more difficult than natural fallow. Of the 21 farmers who used the Calliandra fallow 2 times, 16 ranked it at both clearings as more difficult than natural fallow, 4 found it at least once more difficult than the natural fallow and only one farmer had ranked it at both clearings as easier to clear than natural bush. Only 8 farmers cropped three times, yet three of them ranked Calliandra clearing on all three clearings as more difficult than natural fallow. Overall in the total of 96 cropping events 75 times (78%) Calliandra was ranked as more difficult to clear than natural fallow. To verify the perception, it was compared to the time requirement given by farmers, although the two parameters are not the same it would be expected that greater difficulty results in a higher time requirement. In most cases farmers who considered Calliandra more difficult to clear had as well recorded longer time to clear.

Crop responses

A total of 9 different crops were reported to be grown after Calliandra fallow. Across all crops, 64% of farmers perceived yields being higher after Calliandra than natural fallow; 17% did not report any difference (Table 1). In the south 45% of farmers believed Calliandra produced higher crop yields, compared with 70% north of Yaounde. Positive response to Calliandra was more frequent in maize (80%) than cassava (58%) and groundnut (46%). For the less frequently grown crops, with the exception of sweet potato, farmers had dominantly the impression of positive effects on yields by Calliandra.

Table 1: Farmers perception of crop yield responses to Calliandra versus natural fallow by crop.

	Total number of cropping	no difference (%)	higher in Calliandra (%)	higher in natural fallow (%)
Maize	71	12.7	80.3	7.0
Groundnut	71	11.3	46.5	42.3
Cassava	69	27.5	58.0	14.5
Plantain	14	28.6	71.4	0.0
Tomato	7	0.0	85.7	14.3
Cocoyam	4	0.0	100.0	0.0
Okra	5	20.0	80.0	0.0
Sweet potato	2	50.0	50.0	0.0
Yam	1	0.0	100.0	0.0
Total	244	17.2	63.9	18.9

For sites where yields were measured by researchers (Nolte et al 2005), yield responses were either negative or there was no difference. Apparently farmers either incorrectly perceived a yield advantage or overestimated the yield advantage after Calliandra by a wide margin.

Spread of Calliandra

The invasive character of Calliandra is a concern to many farmers who have abandoned this fallow. While the initial establishment was problematic, requiring scarifying seed and raising trees in nurseries, the species is capable to spread and establish in the surrounding fallows and crops (Figure 3). Strong superficial roots impede tools and Calliandra is perceived by many farmers as a weed. Calliandra can be controlled by herbicides such as glyphosate yet, under the usual manual control regime of farmers it re-sprouts rather quickly. Due to its early flowering seed production sets in after less than one year of growing.

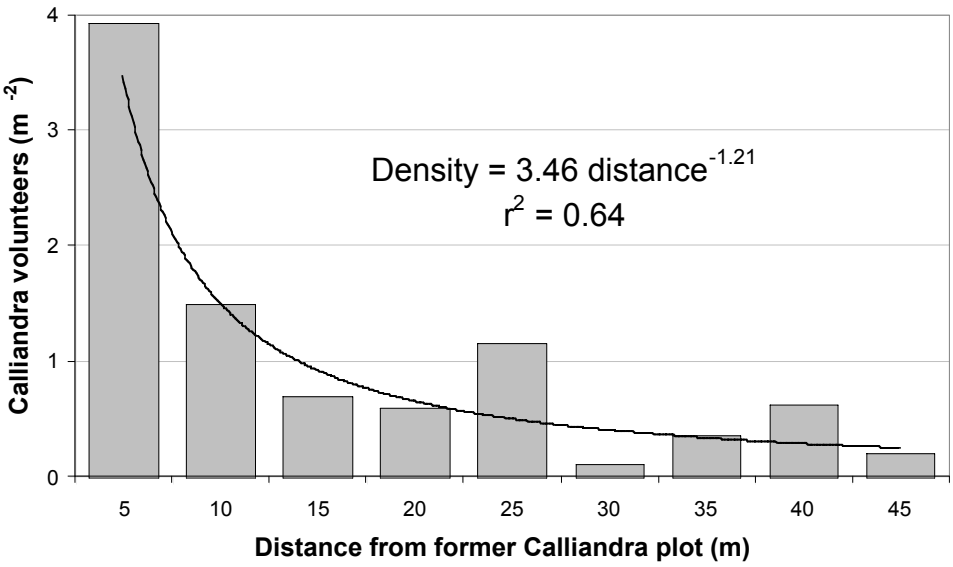

Figure 3: Calliandra volunteer density as a function of the distance from a former Calliandra trial.

Discussion

The main feature of planted Calliandra fallow is a significantly higher labour requirement for clearing and land preparation than in natural fallow. It appears that this disadvantage outweighed perceived yield advantages leading to a decline in use. However around Monatele a high proportion of farmers cropped 2 or even three times, much more than in the other sites. At Monatele all trials were established in collaboration and it may well be that the farmers' labour investment at establishment is important to create an incentive to take the trial seriously and not abandon after just one cycle. Although most farmers were convinced that Calliandra fallow produced higher yields, the use of the system declined. The contradicting farmer perceptions versus researcher results would need verification, however, as farmers largely abandoned Calliandra this is being rendered irrelevant. The fact that farmers rather accurately estimated the labour demand and the difficulty of clearing may as well show which aspect of technology intervention is the most important one for them – labour!

Currently Calliandra is only used in the high population density area north of Yaounde. Some farmers who abandoned after one crop have converted to using Calliandra as a basis for bee-keeping, using the trees' almost all-year round flowering as a source of nectar. However, unless the use of Calliandra is newly defined and clearly indicated to farmers, the species can neither be recommended for larger areas nor for all crops.

Acknowledgement

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