Authors: Armin Schnatmann, Herbert R. Wilkes, Dr. Noemi Stadler-Kaulich, August 2007

Successional agroforestry with cocoa – a locally adapted and profitable land use strategy for small-scale farmers in Bolivia

The Yungas region on the eastern descent of the Bolivian Andes is widely known for its unique biodiversity. During the last 30 years, because of the Bolivian government's colonization programme which, between 1960 and 1980 has brought families of former miners and highland farmers to the zone has been one of the focus points of international development aid. The donation of land and technical support in agriculture were the main incentives for thousands of people to settle in the area.

The need of a constant food supply and the agricultural traditions of the highlands led to the practice of slash and burn techniques and the cultivation of annual crops like rice and corn. Monocultures of cocoa, coffee and citrus served as cash crops to reduce poverty. Particularly, cocoa production is currently a great success in the area of Alto Beni River.

The inadequate cultivation of the fragile tropical soil through monocultures caused a significant decline of soil fertility, generating a loss of productivity. Cocoa and citrus trees suffered from the loss of soil nutrients and periods of drought. Successful experiments with agroforestry in the mid 1990s and the requirements of the organic production of cocoa for the Northern markets led to the installation of a highly diversified agroforestry system: Successional Agroforestry or Analog Forestry.

In 2006 the team of international and local experts of DED[1] working in agroforestry defined Successional Agroforestry as follows:
"Successional Agroforestry is similar to natural regeneration, following the natural process of succession and dynamic in the local ecosystem. The plantation of an agroforestry parcel consists of pioneer, secondary (I, II, III) and primary[2] species with a certain density and highest possibility of diversity which, at the same time, satisfies the needs of the small-scale farmers a possible."

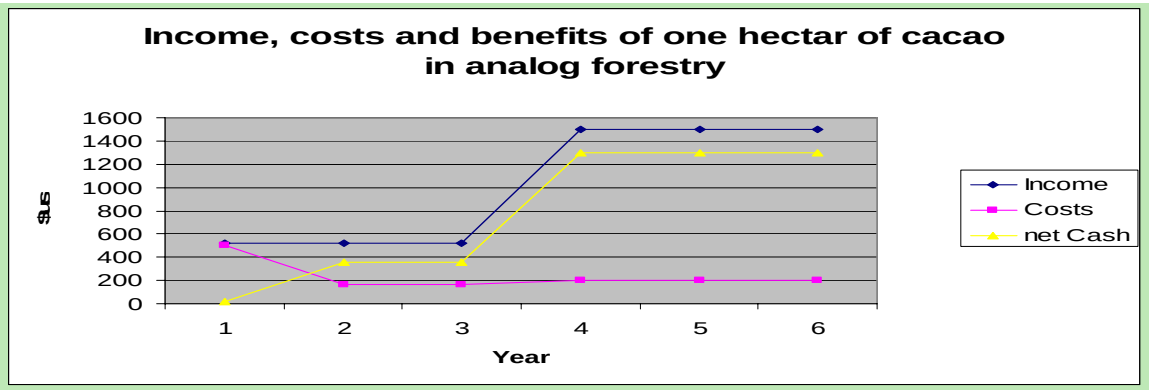
Implementation of a parcel of Successional Agroforestry focuses on:

- Preservation of local biodiversity by optimizing small farmers income
- Combination of long-term cash crops (cacao, coffee, citrus) with short term (rice, corn, yucca), mid term (banana, pineapple, papaya) cash crops and timber
- Selective cutting of shadow trees and hashing the organic material, which is later used on the ground as mulch to protect the soil recycle plant nutrients and upgrade soil structure to improve its humidity capacity
- Leguminous trees are fixing nitrogen to ameliorate soil fertility

The integrated production of cocoa or coffee as permanent cash crops with annual species like corn or rice in the first years and mid term crops like bananas and other varieties of fruit and long term timber producing trees provides constant income and food supply for small-scale farmers. Based on observations of the natural succession and the utilization of a wide variety of indigenous species, the agroforestry concept has proved to be ecologically sustainable and economically rentable at the same time. An economical and technical survey in cooperation with selected farmers focused on the first six years after implantation shows the competitive ability for successional agroforestry management:

Price-earning ratio from one hectar of cacao, successional agroforestry in Alto Beni

Year	Income	Costs	Net Cash
1	520	500	20
2	520	168	352
3	520	168	352
4	1500	200	1300
5	1500	200	1300
6	1500	200	1300



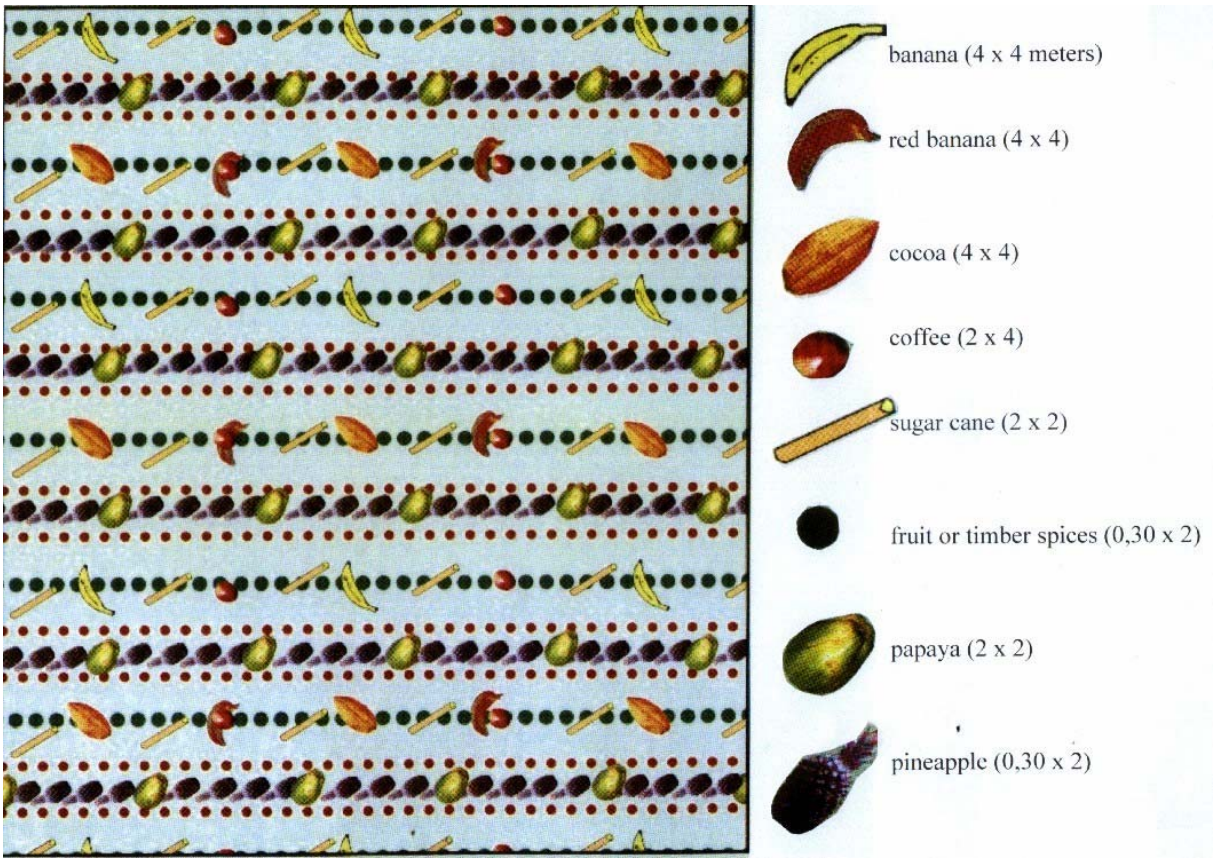
Parcel of Bernabé Coaquira / Sapecho / Alto Beni / Bolivia

[1] DED: Deutscher Entwicklungsdienst = German Development Service
[2] Species differ in time of life cycle: Pioneer until 6 month (Corn *Zea mais*, rice *Oryza sativa*), Secondary I from 6 month until 2 years (Papaya *Carica papaya*, yucca *Manihot esculenta*) Secondary II from 2 years until 15 years (banana *Musa sp.*, pineapple *Ananas comosus*, Pacay *Inga sp.*)Secondary III from 15 years until 80 years (*Citrus sp*, mango *Mangifera indica*, avocado *Persea americana*), Primary above 80 years (Cocoa *Theobroma cacao*, coffee *Coffea arabica*, timber trees: *Swietenia macrophylla*, *Amburana cearensis*, *Spondias mombin L.*)

Space for agriculture in Alto Beni is limited. For this reason the farmers are interested in conservation or even melioration of the soil. Permanent soil coverage and the integration of green-mulching techniques ensure even the regeneration of degraded farmland and the ability to retain humidity. Therefore, successional agroforestry is very well accepted in the Alto Beni region of Bolivia.

The installation of a successional agroforestry parcel in sum is as follows:

- Clean the space from weeds, chop and leave the organic material on the floor, existing timber trees and those which offer shadow will remain
- Plant banana subspecies, yucca, sugar cane, pineapple, cocoa, coffee, citrus
- Seed corn, rice, fabaceous, annatto, papaya, hibiscus, fruit and timber trees as available
- Cut all the remaining trees as low as possible, chopping the organic material for mulch

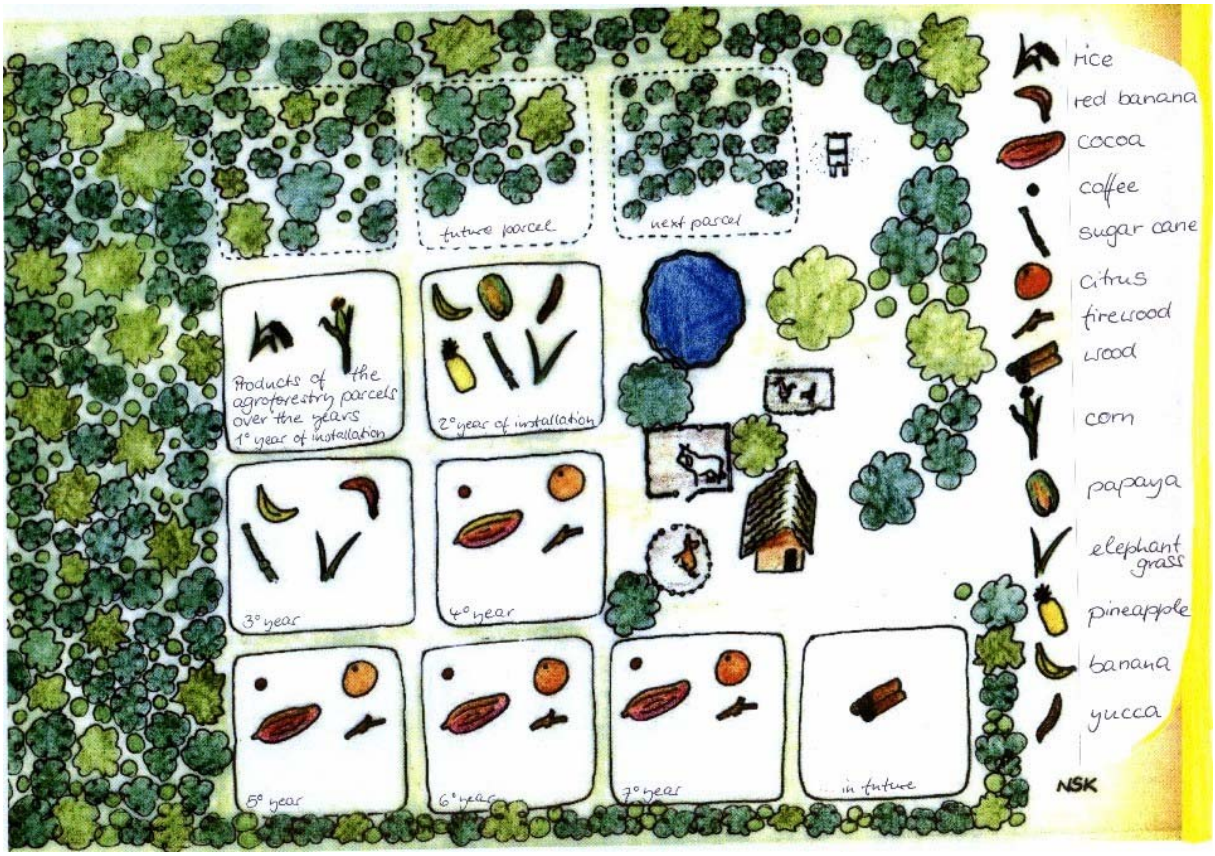


The management of a successional agroforestry parcel is of high importance:

- Selective weeding, respecting the natural regeneration of timber trees; in the first tree years this will be necessary more often than in later years
- Selective cutting back of the shadow trees, letting the sunshine come in to induce the blossoming of cocoa and citrus
- Periodical tree-cutting in order to regulate the intensity of sunshine, to generate mulch which protects soil and through decomposition assure fertility and humidity retention of soil

The daily nutrition of the farmers and their families depends mostly of food items rich in carbohydrates like rice and corn. These crops require a certain intensity of the sun. Thus, in the

humid tropics, one or two years after having installed the parcel of successional agroforestry, it becomes impossible to continue with the cultivation of corn and rice crops. Therefore, in a certain period of time the farmer must install a completely new parcel of successional agroforestry:



Successional Agroforestry in the last five years has become very popular in the region of Alto Beni/Bolivia. Agroforestry is also gaining in importance in other regions of the country because of the increasing interest in sustainable agricultural production. Particularly in the regions of new colonization in rainforest areas and buffer zones, successional agroforestry is one solution for sustainable and integrated development in sensitive districts.

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Drawings: Herbert R. Wilkes, Eliza Kaulich, Dr. Noemi Stadler-Kaulich

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