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Ecosystem Approach for landscape rehabilitation-review and perspectives of the „Rainforestation Farming“ technology in the Philippines

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Abstract

The Convention on Biological Diversity adopted the ecosystem approach for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable fashion.
An innovative ecosystem approach, combining the necessities of rural development, biodiversity conservation and rehabilitation and a sound resource management was developed on the island of Leyte in the Philippines. This approach, under the acronym of "Rainforestation Farming" is based on the assumption that a farming system in the humid tropics is increasingly more sustainable the closer it is in its species composition to the original local rainforest (Milan&Margraf, 1994).
This recommended subsistence farming technology includes indigenous forest and fruit trees, as well as shade-demanding crop plants like the fibre-banana (*Musa textilis* Nee).
First year sun-demanding pioneer trees are planted at close distances of 2×2 m to reach a closed canopy for shading out grasses, like *Imperata cylindrica*. In the second year hard wood-timber trees and fruit trees are planted in the shade of the pioneers. Seeds and seedlings come from mother trees in the remaining natural forests. Identification, protection and collection of the seeds and seedlings are part of the village-based community activities. Economically this technology is the best and most sustainable option, compared to systems like *Abaca* + coconuts or *Abaca* + *Acacia* sp. farms, a susbistence farmer on Leyte can adopt (Ahrens et al., 2004)
After already 4 years a forest with about 20-25 different rainforest and fruit tree species is usually established in the former *Imperata cylindrica* grassland.
The reforested close canopy subsistence farming area is also a newly created habitat even for such endangered species like the insectivorous nocturnal ape *Tarsius syrichta*, the herbivorous flying lemure, *Gynocephalus volans*, as well as numerous pollinators like bats, amphibians and insects.

INTRODUCTION

When the Convention on Biological Diversity approved the motion that the necessities of biodiversity conservation and rehabilitation should be combined with rural development and a sound resource management, the so-called ecosystem approach for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable fashion was born.

The Philippines as part of South East Asia is one of the hotspots concerning biodiversity. This fact has not prevented that during the last three decades of the last century the original amount of about 17 million hectare of tropical forest, mainly Lowland Dipterocarp-Rainforest, has been decreased to a mere 5.5 million ha in the year 2000 (Schulte, 2002). With the forest, the unique fauna and flora is under a steadily increasing threat particularly by land use systems like ecologically-unsafe logging practices, expansion of monocultures like coconut, sugarcane or Abaca (Manila hemp), poverty driven shifting cultivation and other demands for land for a growing population with an annually growth rate of 2.3%.

Realizing the destructive effects of deforestation of entire landscapes the Philippine Government imposed a total logging ban in 1990. In a sometimes frantic search for remedies and alternatives the community-based forest management as suitable and effective strategy towards forest conservation and sustainable rural development was rediscovered.

In 1990 the Philippine-German Applied Tropical Ecology Project started with the objective to look into possibilities to rehabilitate former forested areas to get back the ecological functions of the degraded areas needed for poverty alleviation through sustainable rural development on the island of Leyte.Three major necessities needed to be combined: Sustainable rural development, conservation of remaining primary forests and natural resources and biodiversity rehabilitation.

The replacement of the wide-spread slash-and-burn practices was a main objective in the development of a "Closed Canopy and High Diversity Forest Farming System, called "Rainforestation Farming" (Milan & Margraf 1994,Göltenboth & Hutter 2004).The biodiversity is protected by using indigenous trees only. The ecological functions of a given ecosystem are re-established while subsistence farmers are provide with a stable and long-term income (Margraf & Milan 1996, Göltenboth 1999,2004, Schulte 2002). In 1994 the hypothesis was formulated that" a farming system in the humid tropics is increasingly more sustainable the closer it is in its species composition to the original local rainforest" (Milan & Margraf 1994). Neglect of the existing coconut monocultures, covering 35% of the land area of Leyte of 571 000 ha, added to the problems encountered. Almost 50% of the presently existing coconut plantations are approaching the end of their economic productivity, because they are older than 50 years.

The exploitation pressure on the remaining productive ecosystem is clearly connected with the poverty in rural areas and therefore the ecosystem approach is inevitable to alleviate the poverty, prevent further large-scale soil erosion, landslides, floods, sedimentation and biodiversity losses. The "Rainforestation Farming" Technology is certainly such an approach.

MATERIAL AND METHODS

Basic Studies: Due to the fact that only very limited information was available on the ecological functions of the given environments on Leyte Island extensive research and empirical studies were needed concerning the existing biodiversity, the land-use systems and socio-economic baseline data (see respective literature in the references).

The Research and Demonstration Site: Between 1991 and 1993 a demonstration farm was established in a degraded former coffee and banana experimental plantation of about 17 ha at about 45-90 m a.s.l. with 5-10% slope. Annual rainfall was about 2600 mm and average monthly temperature 27^{o}C. The drainage of the Haplic Alisol was good and the area was mainly occupied by *Imperata cylindrica*, and some banana plants. The total project area included the rainforestation demonstration farm subdivided into 4 plots, arboretrum or gen bank, nursery and expansion area, an area set aside for enrichment planting activities in an existing teak and Gmelina-Stand.

Origin of seeds and seedlings: At the beginning only seedlings risen in the established nursery under already existing trees like the indigenous *Melia dubia or the exotic Gmelina arborea* were used as pioneer or sun-demanding tree species. Further the tropical cosmopolite *Swietenia mahagoni* and the local *Samanea saman* were planted. Based on research in the surrounding rainforest areas, mothertrees were identified and have ever since been used as source for seeds and wildlings.

Planting scheme and management: The original trial planted with more than 5000 trees/ha composed of about 46 species of pioneers or sun-demanding trees, about 18 shade-loving tree species and about 12 fruit tree species, was actually in place at the end of 1993 on 2.6 ha. The spacing was about 1 x 1 m only, because the pioneer tree species were planted in the first year with a spacing of 2 x 2 m, while in the following second year in the shade of the one –year –old stand of pioneers the shade-demanding tree seedlings were planted with a space of 2 x 1 m. Impacts of typhoons and torrential rainfall in 1993 showed that on average the indigenous tree species lasted while the exotics, mainly coming from South America, were significantly more damaged. Therefore only indigenous trees were further used like:

1. Dominating pioneer species : *Samanea saman, Artocarpus blancoi, Melia dubia, Casuarina nodosa* and a compromise *Swietenia mahagoni*
2. Dominating shade loving trees-at least as seedlings- are *Dipterocarpus validus, Shorea contorta* and *Litsea leytensis* to mention three major species.
3. Dominating fruit trees used were *Artocarpus heterophylla, Nephelium lappaceum, Garcinia mangosteen,Durio zibethinus* and *Sandoricum koetjape*, to mention just a few.

The shade-out effect of *Imperata cylindrical* by the pioneer species started to be effective after about 10-12 month.
The most important activity during the first month is ring-weeding and cutting of vines.
The third year slow-growing shade-demanding trees, mainly belonging to the family of Dipterocarpaceae, can be added with a space of 3x 3 m. Seedlings of different species were added, at random arrangement in a way that each neighbouring tree was of a different species to build up a maximum diversity (Kolb, 2003).

Other methods applied: The perusal methods to run a tree nursery, to record weather data, to do soil analysis and to identify plant species were applied.

RESULTS

Since 1994 the rainforestation farming technology spread via individual and cooperative farmers to more than 1200 ha on the island of Leyte, Palawan, Bohol and Mindanao. Since 2000 EURONATUR supports the dissemination of the rainforestation concept. In 2004 the technology was adopted by the Philippine-wide operating HARIBON foundation for all of their reforestation and agro-forestry projects. The Department of Natural Resources and Environment of the Philippine Government issued in June 2004 a memorandum for all their offices to use the rainforestation technology for their reforestation activities.
In 2004 the Rainforestation Farming approach became part of an integrated project to use one of the major commodities of the Philippines, Abaca or *Musa textilis Nee,* in the automotive industry as replacement for glass fibers in composites.
The Rainforestation Farming technology can be described as a system of fading in and out:

- Fading out of a cropping system with sun-demanding crops into a shade-tolerating cropping system.
- Fading out of the slash-and –burn approach into the ecosystem approach by putting the individual farmer into the position to generate his income without shifting necessities and by bringing together annual and perennial crops with long-term income from lumber. Due

to the high diversity approach various growth successions are initiated and therefore also a succession of income without embarking on a clear-fell economy.

From an environmental point of view the near-to nature reforestation scheme using only indigenous trees, whether as pioneers , fruit trees or local natural forest trees revitalises degraded tropical areas. All the essential ecological functions like improvement of water retention capacity, prevention of soil erosion, re-establishment of soil fertility and provision of habitats for the biocoenosis are returning into an anthropogenic "green desert".

Biodiversity conservation and protection can be achieved through three major paths:

1. Passively through the creation of suitable habitat and microclimatic conditions to which species migrate from adjacent secondary growth areas.
2. Actively through the propagation and planting of indigenous tree species in a near –to-nature planting scheme.
3. Directly by efforts to protect the remaining mother-trees, which are the source for seeds and seedlings for the local farmers.

The Rainforestation farming technology was gradually developed and any significant new finding by the numerous different environmental and social fields of research was considered and the working hypothesis readapted until the final working hypothesis was formulated with "A farming system in the humid tropics is increasingly more sustainable the closer it is in its species composition to the original local rainforest" (Milan&Margraf, 1994). Whether the introduction of "rainforestation farming" on large scale will be successful depends to a high degree on its profitability for the subsistence farmer and his family.

In an extensive study in form of a cost benefit analysis (Ahrens et al., 2004) concerning three different systems of land-use on the island of Leyte, it was found that"… the alternative of rainforestation is by far the most profitable land-use system." (Ahrens et al.,2004).

DISCUSSION

The "rainforestation farming technology" allows for the reforestation of degraded areas and worn-out plantations with a highly diverse and economically future-oriented, sustainable tree farm (Goeltenboth &Hutter, 2004).Pioneer species were used to provide the needed shade for those tree species forming the climax canopy. By following this approach the following two main components are combined:

1. Establishment of community-based "close canopy and high diversity farming system" in former degraded areas and old coconut stands.

The fist farms were started in 1994. On average most farms have an increased income of about 8-10% by now. Due to economical investigations a main income can be expected from the 12-15th year onward because than some of the hard-wood and highly valuable Dipterocarpaceae species can be harvested (Waibel et al., 1997).

Enrichment planting with annual crops like pineapples and anthurium flowers, perennial crops like ginger and abaca is giving the farmers an income from the first year onward. Starting in the fifth year the first fruit trees are bearing fruits, e.g. rambutan and durian, but even mangosteen produced fruits already in the 6th year after being planted. The pioneer trees can be sold as posts and firewood.

To adjust the respective socio-economic effects in the right way further research and investigations have to be paralleled to the on-going process.

2. Protection and rehabilitation of the environment and biodiversity.

The ecological functions are clearly measurable in form of a total reduction of any significant soil erosion in the "Rainforestation Farming" areas. The improvement of the soil is clearly demonstrated by the mulch layer and the humus serving the growth of the annual and perennial crops (Daub, 2002, Bande, 2004).First users of the area are birds and small hymenopterans, followed by reptilian and mammals. The droppings of birds and bats do even contribute to an

enrichment of the area, because seeds are coming into the region together with the droppings. Flying Lemures *(Cyanocephalus volans*) have been recorded as visitors during their night time activities in search for the foliage of Jack fruits. The nocturnal , insectivorous *Tarsius syrichta* migrated into the Rainforestation Farming site on the campus of the Leyte State University. The birds, the bats, the insects are all very valuable pollinators and needed for the near future to secure fruits and seeds. Only after 5 years some of the *Dipterocarpus validus* trees produced their first batch of winged seeds. Further research on the production of seeds, the composition of trees, the thinning, pruning and the interactions between trees and crops is needed to optimize the technology.

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