

**Protocol of the Ecotop training course
in dynamic agroforestry systems,
Sapecho, Bolivia (6-23 October 2014)**



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Facilitators:

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Day 1

We started the training with an Andean ritual (Chaya) in which we offered and chewed Coca leaves while Bastian played the pan flute. Coca is considered a holy plant in the region where it has been cultivated for thousands of years. After the welcome by the Ecotop crew, we were also welcomed by three representatives of the Bolivian Soil Association, an umbrella organization that unites initiatives for the promotion of sustainable agriculture from various part of the country.

In order to sensitize us for learning about and working with agroforestry systems, we went on a blindfolded sensitization walk in Joachim's system. Accompanied by an Ecotop guide, in silence, and part of the walk barefoot, we slowly moved forward. The reason for this exercise is that in agroforestry, not only technical skills, knowledge and creativity play important roles, but also feelings. While usually, we behave very confidently and purpose driven and tend to lose touch with our surroundings, on this walk we felt vulnerable and paid much more attention to the sounds, smells, soil and temperature changes. In agriculture, when we feel lost, quite often technical and economic advisers offer to be our guides. However, if we open our minds in the forest, our guides can also be those who are often called our "enemies": pests, weeds and diseases. They show us when something in our system isn't working. It's a bad idea to kill these guides. On the other hand, farmers cannot afford great losses due to pests, weeds and diseases. In this course, the objective is to learn to interpret the system and see how the elements in it are related. We will also learn about the requirements of crops and tool-species in agroforestry. Beside theoretical lessons, much of the course will be taught in a practical way.

In the afternoon of the first day, we visited two very different orange production systems.



The first one is an example of a monoculture typical of the Alto Beni region. The orange trees did not look very healthy, we observed fungal infections and a lot of parasitical mistletoe weeds. The second orange production system (Joachim's) offered a very different impression. It is characterized by a high biodiversity, production on various strata and rich soils covered with a layer of organic matter.



The oranges looked much healthier here and we did not see any mistletoes. Joachim told us that when he started working here in 1996, he converted an orange monoculture in crisis into the agroforestry system that still flourishes today. At that time most people believed that oranges could only be produced in the plain sun. He therefore had to develop an orange agroforestry system himself. He cut the lower branches of the orange trees to create space for other crops like cocoa and coffee. Moreover, he introduced species that could provide biomass to improve the soil. So-called weeds were one of his most valuable tools in starting his agroforestry system. Species and individuals being the tools, the higher the diversity is, the greater his toolbox. In the meantime, he has shown that oranges produce very well under the shade of higher trees.

With regard to cocoa production, Joachim's observation is that all producing regions are in crisis (which expresses itself in diseases and pest attacks). Attempts to solve this crisis with the help of chemicals only make matters worse. The basis for finding lasting solutions is an understanding of the natural habitat and growing conditions of cocoa.

Day 2

Early in the morning we left for the research station at Sara Ana. The spectacular drive there involves a river crossing. After a heavy rain after our arrival at Sara Ana, we visited the research site of the experiment coordinated by the Swiss Research Institute for Organic Agriculture. Five cocoa production systems are compared in a 20-year-trial: conventional monoculture, organic monoculture, low diversity agroforestry systems under conventional and organic management and the high diversity Successional Agroforestry System (SAFS).







In the afternoon, Walter Yana explained the principle of natural succession using a model that shows the development from barren rock through various stages of vegetation development towards primary forest.



Back at the research station, we planned the layout of the field that we would install the following day considering in particular the different crops' lifecycles and their sun- and shade requirements.

In the evening, Joachim showed slides of cocoa production in Ivory Coast.

Day 3

In each of the last two years, Ecotop had installed a SAFS demonstration plot at Sara Ana. The plot we installed was to be the third in this series, which is intended as a living illustration of the development of SAFS over the years.

The undergrowth had already been cleared the day before and the ground was covered with organic matters.



Only some bigger trees were still standing. These provided shade for our work which proceeded as follows:

1. Planting bananas and plantains
2. Sowing seeds of maize, pigeon pea, beans, hibiscus and papaya
3. Planting cuttings of cassava and elephant grass
4. Felling the bigger trees cutting up stems and branches
5. Planting cocoa trees and protecting them from direct sun with palm leaves (an alternative would be to plant the trees when the maize and pigeon peas are high enough to provide some shade)



Next, we visited the neighbouring 2- and 1-year-old SAFS plots. We learned about the vital importance of management, e.g. in order to obtain a good stratification of the plants. Moreover, we observed leaf-cutter ants (who Joachim called his “forest workers”) in action.

In the evening, Joachim showed slides from a SAFS project with peasant farmers in Nicaragua.

Day 4

In the early morning, we returned from Sara Ana and visited farmers' plots installed using slash-without-burn techniques. These plots showed vigorous crop growth on a thick layer of biomass. In one of the plots, the very productive papayas had not been sown by the farmer but appeared otherwise, maybe introduced by birds.



In the afternoon, we went to a fallow plot on Joachim's farm, where we intended to install a rice plot the following day.

Day 5

In installing this rice plot, we proceeded as follows:

1. Weeding and slashing understorey vegetation
2. Sowing rice with the planter tool (the rice grains were mixed with bixa seeds at a ratio of 10:1)
3. Sowing pigeon pea and planting ginger around the rice plot
4. Felling and chopping up of bigger trees





Later, Fortunato gave a presentation on his research comparing slash-and-burn and slash-without-burn agriculture. In the second system, the energy does not go up in smoke but stays on and contributes to a strong and healthy system.

In Fortunato's study, the installation of a plot without burning is approximately 15% cheaper compared to traditional slash-and-burn practices while the yields tend to be higher.

The steps in installing a slash-without-burn system are:

1. Cutting undergrowth
2. Sowing seeds, planting tubers/bananas/plantains
3. Felling higher trees, chopping up the material
4. Planting trees/cassava and other plant seedlings

Ecotop also produced a video on rice cultivation using slash-without-burn techniques, which we watched in the following.

Day 6

In the morning, we visited the cocoa farmers' cooperative El Ceibo, pioneers in the production of certified organic cocoa. The fact that El Ceibo is a cooperative means that it is owned by the cocoa farmers themselves.

First, we went to the tree nursery, where 100 000 grafted cocoa trees are produced. Each year, beside cocoa trees, 1000 grafted mango and avocado trees each are also sold.

El Ceibo also has a seed bank where the seeds of various shade trees for cocoa (mostly timber trees) are processed, stored and sold.

El Ceibo consists of 50 local cooperatives, each of which unites 20-30 farmers. These bring their harvested cocoa to their local cooperative office from where it is then picked up and brought to the central El Ceibo storage facility in Sapecho. Here, the quality of the cocoa beans is checked. El Ceibo has a fermentation facility, in which a cascade system is used to ferment fresh cocoa during 8 days. El Ceibo buys both fresh and dry beans from the farmers. The price for dry beans is about 4 US\$ per kg. El Ceibo also process cocoa to produce chocolate in their factory near La Paz. About half of this chocolate is for the local market and the other half is exported. Only a very small percentage of the cocoa is sold as dry beans.



In the afternoon, we went for a walk in Joachim's system. Looking at the different levels of vegetation, we focused in particular on the cocoa trees. We saw a variety of crops including washnut, vanilla, rambutan, different timber trees etc.



In the evening Joachim gave a presentation of problems of the conventional agricultural approach followed by theory and practical examples of SAFS.

Afterwards, we discussed possible designs for palmoil/rubber agroforestry systems. One of the requirements of such systems are that oil palms and rubber trees have to be planted in lower densities than in monocultures.

Day 7

In today's walk in Joachim's system, we compared an area that had not been managed for a longer time with a neighbouring area where shortly before, 90% of the shade trees – including all secondary forest trees¹ – had been felled. Joachim told us that after this intervention, there had been a great increase in cocoa production. The felling of the large trees had been possible without much damage to the cocoa trees below. One of the techniques for doing this had been to direct trees to fall into other high trees in order to stop them in their fall and then be able to cut them into smaller pieces without falling on cocoa trees below. There are several criteria in selecting trees for felling, including the completion of their function for the system, for making space for other trees, diseases, etc. but also personal preferences (leaving trees that you like).

We proceeded with cocoa tree pruning. Beginning from the top of a tree, we worked our way around and downwards cutting off dead and diseased branches, branches that cross, watershoots (chupones), new crowns. The aim is a well-balanced tree in which the branches are not too dense so that light and air can enter and that has a good height (high enough to walk underneath it but not too high for harvesting).

Day 8

Grafting day. Before we could get started with grafting, we got an introduction into the materials that are needed for this technique:

1. Grafting knife. It should be very sharp and clean. To be sharpened with fine sandpaper.
2. Plastic band. Can be prepared from plastic sheets that are cut in stripes of 3 cm.
3. Pruning scissors to cut the branches for drafting.
4. Grafts from cocoa trees

What are the criteria to select the trees that will be propagated by drafting?

- They should be productive over several years and healthy
- They should have other positive characteristics, such as resistency to diseases/good variety of cocoa/good fruit/...
- They should be self-pollinating (this means that the male parts of the blossoms and the female parts of the same blossoms are fertile and can make fruit). If this is not observed, we might select a tree that is only productive in combination with its neighbouring trees.

¹ Secondary forest trees that are reached or surpassed by primary forest trees have fulfilled their function for the system and should leave.

Sonia explained that every cocoa blossom is only fresh for one day and then showed us how to test for self-pollination (or auto-pollination). First, we learned how the male and the female parts of the cocoa blossom look. Then, we brought the male parts in contact with the female parts. Returning to the same tree a few days later, one can check whether the pollination has worked and there are many small fruit.





The grafts should be prepared from healthy branches from higher parts of selected cocoa trees. The buds that grow above each leaf should not have developed into branches yet. The grafting

sticks should be approximately 10 cm long and have a diameter of 0.5 cm. If kept in a wet cloth or paper or in a cut banana trunk, they can be kept for up to 7 days.

Sonia told us about cocoa varieties of which there is a great number.

After this theoretical introduction, we went on to graft our first trees. We used different grafting techniques: bud grafting (or budding), side grafting, top grafting and crown grafting.

Day 9

We spent the morning with some more grafting practice under the supervision of Sonia.

In the afternoon, we made a plan for the rehabilitation of a degraded cocoa system in a part of Joachim's land. The cocoa trees there were in a rather bad condition with a lot of watershoots, dense branches, lots of witches' broom disease. In this state they will produce little or no cocoa. the ground was covered densely with weeds. One area was shaded by high trees. Here, we found tree seedlings resulting from natural regeneration that we decided to keep. All the other ground cover should be removed and the cocoa trees restored and grafted. The priority for us was to restore the cocoa production of this area.

After a lengthy planning for this plot on Joachim's land, we went on to discuss possible agroforestry systems for Ghana.

Day 10

On a hot day, we started early with our work in the neglected cocoa plot. We proceeded as follows:

1. Selective weeding in the shady part: we cut all the lianas, grasses and other plants with a short life cycle leaving small trees and plants with a longer life cycle (more than a few months) that can be pruned to provide biomass. In the meantime, Alfredo cut the weeds in the other parts with a brushcutter.
2. Sowing/planting of
 - a. rice and bixa with the planting machines and in a mix of 10:1
 - b. pidgeon pea
 - c. Inga
 - d. Banana
 - e. Plantain
 - f. Ginger
 - g. Papaya
 - h. Breadfruit
 - i. Coconut
 - j. Sugarcane
3. Pruning of cocoa
4. Pruning of shade trees

In the afternoon, we discussed the work and got to know Sandra with whom we would work the following day.

Day 11

We spent the day with Sandra, Joachim's wife, in her enterprise Mapajo. Mapajo's products include dried fruit and vegetables, marmelades, spices, herbal teas, sirup, vinegar and seeds, mostly from agroforestry systems. We learned that the production of dried fruit always follows the same steps:

1. Harvesting of fruit
2. Selection of good fruit for drying
3. Washing of fruit
4. Peeling of fruit
5. Cutting of fruit
6. Drying of fruit
7. Selection of good dry fruit
8. Packaging
9. Storage

Sandra showed us the driers, which work mostly with heat from the sun and some firewood. Small ventilators are used to blow the humid air out of the drier. Most fruit require a drying time of around 1 day in which they lose 90% of their weight (in the case of tomatos even more).



After this introduction, we went on to prepare bananas and tomatos for drying.





The morning session ended with a short presentation by Sandra about healthy food.

In the evening, we produced chocolate. For this, we first roasted cocoa beans. The next step (which took most time) was to de-husk the beans. In Sandra's opinion, good results can also be

obtained without this, leaving the husks on the beans and grind them directly. The grinding was done with a hand-powered grinder. Afterwards, the chocolate mass was filled in small plastic containers.



Day 12

With the help of Sandra, Jamaica (hibiscus) sirup was produced. After this, our dried bananas, tomatos and the chocolate were packaged and labelled.

Day 13

The first topic of the day was stratification management. In a plot with a high density of shade trees, we discussed which trees should play a role in the future and which trees should be pruned back or leave the system. The approximate aim is to have a cover of 10-15% in the highest level of trees (the 4th layer), a cover of 30-40% in the high level trees (3rd layer), 50-60% in the intermediate level (2nd layer) and 80-90% in the lower level (1st layer). As we had discussed in previous days, there is a range of other reasons for keeping or cutting down trees depending on our main crops, our personal preferences, etc.

After this, we went on with a practical exercise on managing bananas. In order to channel all the plant's energy into the development of good-quality fruit, Ecotop only leave one banana stem of each generation (one mother, one child and one grandchild) and cut the others. Stems that have delivered fruit will not grow again after being cut while other stems should be cut down to the roots in order to prevent re-sprouting which would cost a lot of energy. If a bunch of bananas is already big, the flower and the last row of fruit are removed leaving only one single banana in the lowest row. That way, the remaining fruit become big.

The morning session ended with a visit of a neighboring plot with high Elephant grass. Ecotop have rented this land in order to rehabilitate and diversify a degraded orange plantation. As the last management intervention already dated back one year, the Elephant grass was very high (6 m) and the trees in its shade could not develop well.



We started by cutting back the Elephant grass. In order to prevent that the cuttings resprout, we put the leafy top parts on the ground first and the lower parts of the stems (which can produce roots when they touch the soil) on top.

In the afternoon we learned about the seeds of plants for different successional stages.

Later, Cathy and Brigitte went to Palos Blancos to buy tools.

Day 14

Early morning, we went back to Sara Ana. There, we first visited the 2-year-old SAFS plot in which an intervention had been carried out a few days before. The plot appeared very open now that the Elephant grass and many bananas had been cut back.



In the 1-year-old SAFS plot, we went to work on a selective weeding. As there weren't many weeds, the main things to do were to prune the pigeon peas and other shrubs, take out lianas and cut back some plants on the ground to give more space for the Elephant grass to grow.

Next, Joachim took us on a tour of the experimental plots and down to some newer plots where the local cocoa variety Cacao Nacional Boliviano was planted. In that experiment, managed and unmanaged systems of cocoa trees are compared. The area had been flooded some time before and the ground was covered in a layer of river sediment. While this had killed many other plants, the young cocoa trees had survived the flooding well.

As Joachim would leave for La Paz in the afternoon, we sat down for a feedback session in which everybody gave their impressions about the SAFS training course.

After this, we discussed with Monika Schneider from the Swiss Institute for Organic Agriculture (FiBL). She told us about first results from the research in Sara Ana and we talked about differences in cocoa production in Ghana and Bolivia.

The last visit in Sara Ana took us to the plot we had installed in the first week of our training. Many of the plants we had sown were sprouting, including the maize, the beans, the pigeon peas and the hibiscus.



After our return to Sapecho, Bastian asked Enoch and Peter to assist him in planting seedling of some African trees to strengthen the African-Bolivian ties.



Then, we learned how to get the delicious palm heart out of a palm tree.



In the last light of the day, we planted Elephant grass in the cocoa plot that we had last worked in. An extremely fast-growing grass, it can serve to control weeds and to create biomass for the other

plants. It is very important however to manage it well because if left to itself, Elephant grass will take over the whole system and delay other crops in their growth.

Day 15

Bastian introduced us into the art of shade-tree pruning. We started by learning the most important knots.



He also told us about the tools needed for tree climbing and pruning. Beside two ropes (one to secure the climber and one for material, branches etc.), a harness and further climbing equipment, arguably the most important tools are the saws. Different blades exist for cutting fresh and dry wood. Then, Bastian climbed into an older Inga tree where he pruned some big branches. He lowered them down with a rope in order to not damage the cocoa trees underneath. This is an important technique for multilayer agroforestry systems.



In the afternoon, we went to El Ceibo to buy tree seeds for Ghana. Later we went to check on some of our work: first, we had a look at the grafts. Most grafts were still green while some were already dead. It was too early to tell which ones will finally succeed. For this, the Ecotop crew will

send us pictures after a 25-day period. After learning how to select and dig out suitable banana shooters, we proceeded to the rice plot that we had installed. Rice shoots were already showing between the branches and leaves of the trees we had felled.

After dinner, the training certificates were handed out to the proud participants of the Dynamic Agroforestry course.



Day 16

We got an introduction into the use of a chainsaw. We started by sharpening the blades and then proceeded to cut some trees that had already been felled.



The next step was to learn an easy construction to fell a tree in a controlled way by using a rope and a neighbouring tree. For this technique, only a rope and a saw is needed.



The last action of the course was to get some last seeds. and prepare the tools for the travel.

The three weeks with Ecotop were inspiring and fun. Thank you all very much!

