

Farm Profiles and Ideas for Improved Conservation Management for Farms within the Buffer Zone of Cocobolo Nature Reserve (CNR), Panama

Preface

Cocobolo Nature Reserve and its surrounding Buffer Zone are located within the Mamoni Valley (see map 1 below), found in the interior of eastern Panama. The Mamoni Valley suffers from ever increasing human impact such as logging, cattle ranching and clearance through slash and burn agriculture¹ by non-indigenous rural poor (campesinos) otherwise known as shifting cultivation. One of the most noticeable impacts resulting from such activities is deforestation and degradation of large areas and the concomitant loss of biodiversity.



Map 1. Protected areas in Panama, central region. Chagres National Park (green), Narganá Wilderness Area (orange) and the Mamoni Valley. Inset is CNR.



Facing north, Cocobolo Nature Reserve, roughly outlined in black, extends from the continental divide in the background to the Mamoni River in the foreground.

For the purpose of this assessment we focussed on two farmer groups that are prevalent in this area:

1. Shifting subsistence agriculturalists that use slash and burn methods;
2. Cattle farmers who use permanent pasturelands in rotation usually over large areas.

These farming practices, both of which have a profoundly negative impact on the wider environment, arise from a lack of economic security combined with a lack of knowledge of sustainable farming techniques. Our aim, therefore, is to aid local farmers engaged in CREA's sustainable land use project (IUCN EGP project) and who are operating in the buffer

¹ Slash and burn agriculture is a technique which includes the cutting of primary or secondary forests, burning it to reduce biomass to ash that serves as fertilizer, and the planting of crops in a haphazard way amongst the woody debris and ash that lay on the bare soil. Initial production from this method is good but soil nutrients are quickly exhausted through direct uptake by crops, but mostly by erosion from heavy persistent rain falling directly on the bare soils.

zone of CNR to become more sustainable in the way they manage their farms (fincas), both environmentally and economically, on a long-term basis. This document will provide a land management ideas that will improve onsite as well and landscape context conservation for each of the farms of the 8² agriculturalists and 3 cattle ranchers working within the project.

General Description of Area

Several contributing factors have been taken into account whilst drawing up this assessment such as physical (climate, topography), ecological (vegetation, soil, water sources etc) and socio-economic characteristics (market access, transport facilitation) of the area and the communities living within it. Whilst specific characteristics of each individual farm are described below, it is first of all necessary to describe some overall characteristics of the general area itself in which the project is located.

Due to its central location within Panama, the Mamóní valley is influenced by both Pacific and Atlantic weather regimes. Panama is a humid tropical country that attracts high rainfall, an optimal environment for the growth of tropical rainforests. Panama experiences a strong dry season from January to April when the Inter-Tropical Convergence Zone moves below the equator. The effect is experienced mostly on the Pacific coast and in general the Atlantic coast receives much higher precipitation than the Pacific all year round. The Mamóní Valley lies on the Pacific side of the central divide but is strongly influenced by Caribbean weather regimes. For this reason the area does not have a marked dry season. In fact, the Mamóní Valley has a particularly wet climate for the majority of the year with total rainfall between 2.5-3.5 m per year, with the intensity and duration of the rains increasing between May and November. This climate regime, therefore, has a large impact on how the farmers manage their farms, what crops they grow and when. From a topographical perspective, the Rio Mamóní runs west to east through the Mamóní valley and is fed by various small and large tributaries flowing from western, southern and northern hills that form the valley's upper watershed basin.

The vegetation of the area mainly consists of a mixture of evergreen and semi-deciduous lowland tropical rainforest. The biodiversity value of CNR is heightened since it is one of the last remaining areas of the Mamóní watershed with significant biodiversity and that conserves forest from the top of the central divide range to the valley floor. Due to the nature of rainforest systems, the oxisol soil in the area, which has a clay and sand texture and pH between 4.25-4.85, does not contain a high percentage of available nutrients, as most nutrients available to plants in a tropical forest exist in its biomass. The practice of slash and burn agriculture therefore aims to quickly make the biomass nutrients available to crops by reducing them to ash, however it is a very inefficient method that requires large areas and long fallow periods for it to be successful. Soils, stripped of vegetation are highly susceptible to erosion and micro and macro nutrient depletion from the high rainfall and strong sunlight.

Socio-economically, communities living within the Mamóní Valley have little developmental security due to decades of marginalization by state authorities. This has limited their access to education, health, and infrastructure including roads and in turn has severely restricted their ability to access markets and to take advantage of economic and development opportunities. One of the key objectives of CREA's sustainable agriculture project therefore is to enhance the food and economic security of the farmers by facilitating improved market access of sustainably farmed organic produce. More specifically in early 2009, CREA initiated a pilot organic box scheme called "campesino a cliente" (farmer to client) which enables the farmers to sell their organic produce from their plots on a two week basis to approximately 10 clients based in Panama City, with transport facilitated by CREA. As the farmers begin to diversify and increase production on their farms, CREA hopes to engage more clients into the project with the intention of providing a greater economic incentive for the farmers to farm more sustainably.

² Originally the project consisted of 10 agriculturalists defined as vegetable producing farmers that have traditionally practiced slash and burn, but due to personal reasons, two no longer actively participate.

Farm Assessments and Conservation Recommendations for Individual Farms

1. Alejandro Morales

a) *Introduction to the Farmer*

Alejandro Morales came to the La Zahina community in 1963. He has been participating in conventional farming all his life, cultivating crops such as yucca, corn and plantain, as well as cattle ranching. However, Alejandro is interested in starting to farm more sustainably as he is aware that he can sell organic produce for better prices than the crops he farms conventionally, which would enable him to modernise his lifestyle as well send his grandchildren to school. His organic agriculture pilot plot (see photo 1 in the appendix) which is approximately one hectare in size, is a converted corner of his cow pasture, which is approximately 25 ha in size and is situated close to the community of Las Zahinas. Alejandro is growing spring onion, sweet red pepper, yucca, plantains and some other experimental crops (including tomatoes but so far these have failed due to a fungus disease). He currently attends to this CREA plot twice a week.

b) *Specific Farm Characteristics*

⇒ *Physical*

Alejandro's cattle farm lies on the north bank of the Mamoni River. The area adjacent to the river is flat while the remaining area to the north has an incline of approximately 10-20%. The area where the plot is situated is flat and has minimal erosion problems. The plot itself is well drained but the cattle pasture surrounding it is flat and boggy. The soil is clay oxisol with a low pH. A slow moving stream/wetland is located immediately to the northern side of the plot, which is sometimes used by cattle as a drinking source.

⇒ *Ecological*

The plot contains several crops, which are arranged in blocks with some sparse areas where crops are yet to be cultivated. There is little natural vegetation or ground cover within the plot itself. The plot is closed in by barbed wire to keep cattle out. To the west of plot is secondary forest of approximately 20 years, belonging to a neighbour. Otherwise the plot is surrounded by cattle pasture. The cattle pasture is fenced by live fencing but few trees remain within the property. Several small seasonal streams run through the property to the Mamoni River to the south.

⇒ *Socio Economic*

Alejandro is one of CREA's stronger producers for the organic agriculture project contributing to the organic box scheme on a regular basis with his produce (mainly with spring onion, sweet pepper and plantain). Alejandro also farms cattle and earns income through the sale of individual cattle rather than dairy products, which are not utilised. He also has 4 pigs and earns money through the sale of piglets.

c) *Identified Issues*

- Within the test plot, although agrodiversity is high, intercropping has been minimally utilised, potentially increasing pest damage and exhaustion of micro nutrients in the soil;
- A lack of ground cover does not enhance biodiversity richness nor protect soil microorganisms;
- The border of the plot is currently fenced by barbed wire;
- A slow moving stream runs north of the plot but is often invaded by cattle;
- Several streams run through the entire property but no native vegetation exists on their banks leading to severe degradation and erosion;
- Cows must use available natural water sources and hence degrade stream banks and contaminate streams with faeces;
- A pig sty is located next to a stream running directly into the Rio Mamoni there are no effluent controls and faeces runs directly into it;
- Compaction and lack of shade trees cause great concern for the soil and erosion.

d) **Recommended Mitigation Actions**

- Plant ground cover between rows of crops and between the different crops themselves;
- Construct live fences in order to increase soil nutrition, attract pollinators, provide a corridor for wildlife, and provide extra long term income from the sustainable harvest of timber. This action should be extended to the entire farm not only the pilot plot;
- Restore stream banks with native vegetation;
- Provide alternative watering facilities for cattle;
- Prevent pig manure from entering stream;
- Increased use of organic fertiliser to boost organic production.

e) **Inputs**

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ Fruit trees to be planted within the plot to respond to the lack of intercropping. Amongst the plantains, fruit trees such as avocado and papaya will be planted as these tree species grow taller than the plantains themselves, but will not block out the light;
- ⇒ Leguminous, fruit and hard wood trees to be used to increase live fencing around the plot and a new live fence should be planted in the middle of the plot, again to enhance intercropping and connectivity between the plot itself and the entire finca as a whole;
- ⇒ Leguminous ground cover seeds to be sown (such as orrachi, beans etc) which will improve the nitrogen fixation in the soil;
- ⇒ A small hut to be built where organic fertiliser will be made on a regular basis;
- ⇒ The construction of 20 more beds to plant more spring onion and onion and to utilise the unused areas of the plot;
- ⇒ Provision of water troughs for cattle negating the need for the cattle to drink from the streams which would therefore reduce erosion;
- ⇒ Re-location of the pigs away from the main water sources in the finca, perhaps to a larger area of the finca where they would have more space;
- ⇒ Transportation of saplings to pilot plot.

2) **Orlando Navarro**

a) **Introduction to the Farmer**

Orlando Navarro has lived and farmed in the area of La Zahina for most of his life (he is now 50 years old). His plot is situated a short walk from La Zahina. Before his relationship with CREA, he farmed only subsistence crops, i.e. rice, yucca, maize and other vegetables. His main motivation for farming for profit is to assist in supporting his daughters through their 6 years of high school (one is supported by the CREA scholarship). His motivations for farming sustainably may also be partly motivated by his wife, Maria, who noticed the increase in skin rashes with the use of chemicals. Motivations are probably also financial. Orlando mainly grows parsley, culantro³, and spring onion for selling – crops he has used to diversify his plot since his relationship with CREA. Interspersed with these, he is growing crops for his family (plantain, bananas, vegetables etc). Orlando also intends to start cultivating peppers (the seeds of which will be provided by CREA) for sale and own consumption. Orlando has a good working relationship with CREA and seems engaged in the project and is keen to develop new ideas for his plot. However since his ownership of the village shop, farming has become less of a priority and his plot has not received the attention it needs to be fully productive (visiting his plot once a week).

³ Culantro is culturally an important herb throughout Central America, widely used in regional cuisines and even used by small rural and indigenous populations medicinally as a mild local anaesthetic.

b) **Specific Farm Characteristics**

⇒ **Physical**

The plot is situated in an area with little incline so persistent erosion from runoff is not a huge problem. His plot is square in shape and is bordered by secondary forest on two sides and two streams on the others.

⇒ **Ecological**

Intercropping and crop diversity have been utilised well within this plot, which enhances not only the biodiversity of the plot itself but also helps to improve the overall biodiversity of the whole finca by enabling the plot to blend into the surrounding forest. There is pioneer natural vegetation within the plot, which serves to enhance its integration into the landscape. Some live fences have been planted along the borders.

⇒ **Socio Economic**

Orlando participates in the organic box scheme on an irregular basis. If he is to make the most out of the scheme, then he could cultivate his plot in a way that would provide him with more organic produce. Orlando also looks after the village store and hence tends to his farm with less regularity than the other farmers who are dedicated to farming alone.

c) **Identified Issues**

- Removal of vegetation next to the stream has resulted in the banks of the stream to become eroded;
- The plot is susceptible to inundation by the streams during floods;
- The plot suffers from landscape integration into the finca itself;

d) **Recommended Mitigation Actions**

- Plant native vegetation along stream banks to prevent erosion and to mitigate susceptibility to floods;
- Construct greater density of live fencing to improve the connection between the plot and the surrounding landscape as well as enhance wildlife corridors;

e) **Inputs**

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ Leguminous and hardwood trees to be used to restore the live fencing to improve landscape integration and connection between the plots and the finca;
- ⇒ Fruit trees to be planted to restore the stream area;
- ⇒ The construction of 20 – 30 crop beds within the plot to increase its overall production;
- ⇒ More labour need to ensure the plot is well maintained and productive;
- ⇒ Transportation of saplings to pilot plot.

3) **Amado Navarro**

a) **Introduction to the Farmer**

Amado Navarro is the brother of Orlando Navarro (see above) and came to La Zahina with his family when he was a child (currently age 60). He has not been a farmer for his entire adult life as he was based in Panama City for many years. His plot is located in a valley with steep slope and is approximately one hectare in size (see photo 2 in the appendix). He is keen to farm for profit so that he can improve his standard of living and is motivated by the idea of organic farming so that he can protect the surrounding forest and eat healthier produce that has not been sprayed with chemicals. Traditionally Armado only grew and sold culantro as a cash crop, but since entering into the CREA project he now grows plantain, yucca, banana, sweet pepper and pineapple. He is also starting to cultivate okra and spring onion. He attends to his plot three times a week.

b) *Specific Farm Characteristics*

⇒ *Physical*

The finca is situated in a valley with steep slopes surrounding the plot and so is susceptible to erosion, which is particularly visible. Most of the plot is in use and there is a stream that runs through the middle.

⇒ *Ecological*

Secondary forest over some 30 years old, surrounds the majority of the plot, and even though intercropping has been used, the plot blends poorly into the surrounding forest mainly due to the topography of the area and the erosion that is taking place. Few live fences have been used to connect the plot with the surrounding landscape.

⇒ *Socio Economic*

Amado has until now been mostly involved in culantro production which he sells to a supermarket chain in Panama City. As stated in the business plan, culantro production is not a sustainable form of farming as it is grown in monocultures in wide, open spaces, which do not contribute to the improvement of the general biodiversity of the area. His participation in the sale of organic produce is now a priority of CREA and its staff will encourage him to maintain his high level of involvement in this project.

c) *Identified Issues*

- Soil erosion, actual and potential, is a particular issue with this plot, particularly on the southern side of the stream. Next to this, a monoculture of corn has been planted by a neighbour which has exacerbated erosion in this area;
- Stream banks stripped of vegetation has caused the stream to erode several areas of the plot;
- Initial terracing attempts need improvement (see photo 3 in appendix);
- Mediocre integration between the plot and the surrounding landscape.

d) *Recommended Mitigation Actions*

- Attention needs to be paid to the erosion in the plot, particularly on the slopes as well as by the stream. In order to grow crops successfully here, the area needs to be terraced;
- Attention also needs to be paid to the terracing on southern slope. There are some logs present for the terracing along with a strip of pineapples (which have a good root structure and are a useful living barrier for terraces);
- Existing terraces need better construction;
- Plant trees within the plot as well as around the plot as part of a live fence which will not only prevent erosion but also improve landscape connectivity;
- The stream needs more plants planting near to its banks to prevent erosion.

e) *Inputs*

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ Labour for terracing all slopes within the plot;
- ⇒ Leguminous and hardwood trees to be used to establish a live fence around the plot and fruit trees to be planted within the plot to improve intercropping as well as landscape connection and integration. The fruit trees can also be used to restore the area around the stream;
- ⇒ Transportation of saplings to pilot plot.

4) *Cristino Arcia*

a) *Introduction to the Farmer*

Cristino Arcia is one of three Arcia brothers that are engaged in CREA's organic agriculture project. Alonso and Nelson Arcia plots are discussed in section 5 below. All of the brothers have lived in the La Zahina community for thirty-two years and farmed their entire lives.

Cristino's plot is a 30-minute walk from the road between CNR and Las Zahinas. Before engaging with CREA, Cristino mainly grew culantro on his plot as well as rice and yucca for subsistence. Now he grows in addition to these crops, sweet pepper, bananas, tomatoes and mustard greens. His main motivation for organic farming is so that his land can become more sustainable from an environmental and economic perspective. He is also keen to start experimenting with new crops, as well as incorporate terracing into his land. He attends to his plot twice a week.

b) Specific Farm Characteristics

⇒ Physical

This plot is situated at the base of a small hill that is bordered by a river at the bottom. The plot forms part of a larger cow pasture on one side and a rice plantation on the other side. All crops within the pilot plot have been planted on the flat land at the bottom of the hill whilst the hill itself is covered in natural vegetation. The plot is not susceptible to erosion and no terracing is currently necessary (unless he decides to have crops on this slope).

⇒ Ecological

Intercropping has been used in the plot, although there are some patchy areas, where more groundcover is needed to make the plots more integrated into the general surrounding landscape. The plot is surrounded by live fencing, which helps landscape integration and connectivity.

⇒ Socio Economic

Whilst the plot belongs to Cristino, both his brothers help him to farm so that when it comes to selling the produce, they share the benefits. As Cristino's plot is fairly productive, he contributes a lot to the organic box scheme.

c) Identified Issues

- The presence of empty patches within the plots which deters maximum landscape integration and does not contribute towards enhanced biodiversity;
- Poorly positioned seedbeds that allow the runoff from the slope to wash away the seeds;
- The brothers recently slashed and burned a fallow forest next to the pilot plot for rice cultivation. This is likely to have a negative effect on biodiversity and sustainability of the pilot plot;
- Above the sustainable agriculture plot, to the north, is a fallow plot, which makes up part of the Arcia's shifting cultivation land. This fallow borders directly onto CNR and is of critical concern for CREA particularly as it forms part of the buffer zone around CNR. It is likely that this area will be slashed and burned within 2 years under a business as usual regime.

d) Recommended Mitigation Actions

- More crops or groundcover to be planted in empty areas of plots as well as the integration of more fruit trees to encourage intercropping and increased agrobiodiversity within the plot;
- Change the positioning of the beds;
- Encourage Cristino as well as his two other brothers to invest more time and energy in their organic agriculture plots and steer them away from slash and burn⁴;
- Establish reforestation area in fallowed land to not only enhance the CNR buffer zone but to ensure the protection of CNR itself.

⁴ It would be useful to organise a workshop or focus group (video following by a discussion for example) with ALL farmers to demonstrate to them impacts of slash and burn and the impacts of deforestation in general.

e) **Inputs**

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ Leguminous ground cover seeds needed to cover patchy areas;
- ⇒ A selection of different hardwood trees and fruit trees (approximately 400 in total) for a reforestation project. The hardwood trees will be planted in lines in the reforestation plot and some will be used to reinforce the live fencing in their organic plot below. The fruit trees will also be integrated into the organic plot itself below the reforestation plot;
- ⇒ Labour required to change the position of the existing beds and then construct 30 more beds;
- ⇒ Transportation of saplings to pilot plot;

5) **Alonso and Nelson Arcia**

a) **Introduction to the Farmers**

Alonso and Nelson Arcia have their plots situated next to each other in an isolated location in the middle of the forest about a one hours walk from the road to Las Zahinas. Due to their proximity, the plots share very similar characteristics and factors that influence them. Their main motivation for converting to sustainable agriculture is similar to their brother Cristino in that both Alonso and Nelson are concerned about the environment and are keen to learn other farming techniques that are more sustainable where they may be able to sell their organic produce for a higher value than produce that is conventionally farmed. Alonso grows culantro, plantains, yuca, sugar cane and sweet pepper. Nelson grows culantro, sweet peppers and tomatoes.

b) **Specific Farm Characteristics**

⇒ **Physical**

Both plots face each other on opposite slopes. Both of these slopes have gentle inclines so there is no need for terracing. There is lots of ground cover on both plots so this helps with preventing erosion from taking place. Both of the plots are surrounded by primary forest and a small stream runs along the border.

⇒ **Ecological**

Mixed cropping has been used which helps the plots become well integrated into the forest and the surrounding landscape. As both plots are situated in the middle of the forest, there is no need for live fencing.

⇒ **Socio Economic**

Both Nelson and Alonso were subsistence farmers with the occasional sale of culantro. Today Nelson and Alonso sell to CREA's organic box scheme in addition to their traditional form of production. It is hoped that the brother's relinquish unsustainable farming altogether through the proficiency of sustainable production.

c) **Identified Issues**

- Few trees on the plot;
- Potential for erosion should the brother's intend to farm on the adjacent hillside;
- Potential for high impact should the brother's decide to slash and burn the fallow adjacent to CNR.

d) **Recommended Mitigation Actions**

- More intercropping as well as tree planting is needed in the area next to forest so that the plots are able blend in more with the landscape;
- Construction of terraces to prevent soil erosion from surface runoff from rainwater;
- The farmers could plant some rows of pineapples where there are steeper slopes to make sure no soil erosion takes place

- Provide value to the fallow adjacent to CNR.

e) **Inputs**

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ A combination of hardwood and fruit trees to improve landscape connectivity and to help prevent erosion within the plot;
- ⇒ Enrichment planting with timber trees within the fallow adjacent to CNR will provide value to the area and make it less likely that this area will suffer slash and burn;
- ⇒ Intercropping with more seeds for different vegetables;
- ⇒ Labour for terracing;
- ⇒ Transportation of saplings to pilot plots.

6) **Isidoro Vasquez**

a) **Introduction to the Farmer**

Isidoro Vasquez has been living in La Zahina community since 1972 (currently he is in his late 60s) and has been farming all his life. His plot is a 10 minute walk from the road to Las Zahinas and is situated right next to a large cattle pasture. Before Isidoro's relationship with CREA, he mainly grew maize in this plot. His motivation in converting to sustainable agriculture is to experiment with new crops and to gain a higher income. Now Isidoro grows spring onion, yucca, plantains, bananas and spinach. He attends to his plot 3 times a week.

b) **Specific Farm Characteristics**

⇒ **Physical**

The plot is situated on top of a gently sloping hill and backs directly onto a forest on one side and sits next to a large cow pasture on the other. There is small stream, which borders to the west of the plot. Gentle terracing has been incorporated into the plot to prevent erosion and retain water.

⇒ **Ecological**

Intercropping has been used to some extent in this plot, but there could be more. There are plenty of trees scattered in and around the plot including live fences, which improves the plot as habitat for wildlife and provides connectivity to the surrounding forest.

⇒ **Socio Economic**

Isidoro is the most active in the organic box scheme as he has sold his produce in the last 9 deliveries. He is therefore very engaged in the CREA alternative and eager to benefit from the market access, which the organisation provides.

c) **Identified Issues**

- Some beds badly maintained and under utilisation of some areas with vegetables or ground cover;
- More ground cover needed under plantains;
- Live fencing lacking or widely spaced in some parts undermining attempts to provide connectivity between the plot and the surrounding landscape;
- Under usage organic fertiliser production.

d) **Mitigation Actions**

- More groundcover needs to be provided between the crops as well as fruit trees for intercropping purposes;
- Restoration of live fence;
- Increase production and use of organic fertiliser.

e) **Inputs**

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ Leguminous ground cover seeds needed to cover patchy areas;
- ⇒ A selection of leguminous, fruit trees and hardwoods to be planted in and around the plot;
- ⇒ Labour for bed maintenance;
- ⇒ Transportation of saplings to pilot plots.

7) **Arquimedes Vasquez**

a) **Introduction to the Farmer**

Arquimedes Vasquez was born in La Zahina (currently 24 years old) and, like his father Isidoro, has been farming all his life. His plot is situated next to his father's but is slightly more elevated (see photo 4 in the appendix). Before engaging with CREA, Arquimedes was mainly growing culantro, rice and plantains. He became interested in converting to sustainable agriculture to see if he could sell his produce at a higher price than his conventionally farmed produce. Now, along with plantains and some culantro, he is cultivating spring onion, arugula⁵ (*Eruca Vesicaria*) and lemons. Arquimedes attends to his plot twice a week.

b) **Specific Farm Characteristics**

⇒ **Physical**

The plot is situated next to Isidoro's plot, but sits slightly more elevated. It too also backs directly onto a forest ecosystem. Currently it consists of four beds only for production.

⇒ **Ecological**

The plot is surrounded by forest except for one of the boundaries, which provides access between his plot and Isidoro's plot.

⇒ **Socio economic**

Arquimedes contributes to the organic box scheme but not as much as his father. Presently he is mainly contributing lemons.

c) **Problems**

- Beds positioned in wrong direction so that when it rains, water from surface runoff can easily wash away topsoil etc;
- Lack of diversification of crops.

d) **Mitigation Actions**

- Change position of bed and ensure general bed maintenance. To ensure from rainwater has less of an impact on the plot, bamboo can be placed on the border of the beds to make sure all the soil is kept in one place;
- Construct more beds in the plot so that more seeds can be sown;
- There needs to be increased use of organic fertiliser.

e) **Inputs**

For the purpose of improved conservation on this plot, the main inputs that are needed are:

- ⇒ Seeds for more crops e.g. arugula, spring onion, sweet pepper, cucumber etc;
- ⇒ A selection of leguminous, fruit trees and hardwoods to be planted in and around the plot;
- ⇒ Re-positioning of beds and construction of news beds;
- ⇒ Transportation of saplings to pilot plots.

⁵ A leafy green used in salads which has a bitter or peppery flavour. In Europe and the US arugula is also know as rocket.

8) **Cattle Ranchers - Joel Gonzalez, Javier Solis, Euklides 'Kilito' Diaz**

CREA has engaged three cattle ranchers into the EGP project who have cattle pastures bordering CNR in order to encourage them to reforest some of their land. Cattle farming is particularly detrimental to the environment and in some cases more so than shifting cultivation as the cattle need a large surface area for grazing and so farmers slash and burn large sections of forest. CREA's intention is to collaborate with these three farmers and encourage them to reinforce their live fences with a mixture of hardwood trees and fruit trees in and around their pastures so that the pastures are better integrated into the surrounding landscape and contribute towards reducing general habitat fragmentation. In particular, there will be more of a focus on Sr. Gonzalez' farm, and south of CNR, in order to strengthen the buffer zone between his cattle pasture and the river (which is located approximately 10 metres from the border of his pasture).

Between the reforestation project with the cattle ranchers as well as with the Arcia brothers, 750 trees (400 trees will be planted by the Arcias, 150 by Joel and 100 each by Javier and 100 Euklides) will be planted with a mixture of hardwood trees (70%) and fruit trees (30%). The rest of the trees will be planted between the plots of Isidoro, Arquimedes Alejandro, Orlando and Amado. All 1000 trees will be purchased from a women's cooperative on the outskirts of Panama City, a project that is funded by USAID.

Conclusions

Having assessed the conservation status of all the pilot plots involved in the project, it would seem that attention still needs to be paid towards their overall environmental management and their integration into the surrounding landscape as a whole. One of the most common inputs for all plots in order to improve their conservation status is the planting of more trees in and around the plots, not only to restore the live fencing on the borders but also to encourage intercropping and diversification and restore habitat. In some farms, trees also need to be planted along streams and water sources and courses to ensure the control of erosion. The incorporation of more trees in the plots will create habitat for insects and birds as well as reduce fragmentation of forests in the area through the provision of corridors. Another important mitigation activity is the need to ensure that bare areas within the plots are covered with low lying plants to prevent erosion – particularly leguminous ground cover to enhance the nitrogen fixation in the soil. Along with increased and improved planting, some plots need some improvement in relation to their layout and organisation. For example, a few plots need terraces to be constructed on areas where there is an incline to prevent soil erosion from surface runoff. Many plots also need more seedbeds to be constructed to obtain greater productivity. An overall observation is that all farmers need to use more organic fertilisers (e.g. Bocashi, a Japanese fertiliser) and natural insecticides (e.g. tabasco, ginger and garlic soaked in water for a 2 of days and then used in a spray) in order to increase their productivity in an organic manner and allow them to become accustomed to such techniques so that they stop becoming so dependent on chemical products.

Already some of these mitigation activities have already started to take place and the conservation status of many plots has improved since the beginning of the project. These activities, along with CREA's help and support, will continue to be implemented. A practical guide to conservation techniques is also being prepared by the CREA team which when ready will be distributed to all farmers working in the EGP project. CREA intends to initiate the use of this guide at a workshop or open day at Cocobolo.

Appendix

Photo 1



Photo 2



Photo 3



Photo 4

