SOCIAL CARBON
Adding value to sustainable development
Divaldo Rezende
Stefano Merlin

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Adding value to sustainable development

Organization Andrea Sarmento
Acknowledgements

So many people have, directly or indirectly, contributed to and supported the production of this book that we cannot even begin to mention all of them here.

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We would also like to thank our families, who have been a constant source of support and encouragement in this process of discoveries and innovations.

Finally, and most importantly, our heartfelt thanks go out to each one of the inhabitants of the settlements in the Bananal Island region who provided the motivation for this book, and in particular to the residents of the União II, Barranco do Mundo and Pericatu settlements.
Preface

It may be easy to give an account of events when one is an observer, but to do so when one was an integral part of the facts is rather more complicated. This book will hopefully show that it is possible to do something for the community and for our society as a whole, without fear and without prejudice.

I am an agronomist, trained at the Escola Superior de Agricultura in Lavras, Minas Gerais state, Brazil. A Chevening scholarship awarded by the British Council enabled me to take my Masters degree at the University of London in 1995-1996, after which I returned to Brazil and set up a consultancy – Ecológica, Planejamento e Desenvolvimento Ambiental – focused on activities promoting sustainable development in the state of Tocantins and in the Brazilian Amazon in general. The name ‘Ecológica’ was suggested, in the course of a long inter-continental phone conversation, by my friend and colleague, Dominic Harbinson, in England.

In November of that same year, I was in Brasília when, out of the blue, I got a phone call from Natural Resources International (NRI), an organization based in the United Kingdom, asking me if I knew of any carbon sequestration projects. They had a client who was looking to fund a project of this sort and they were soliciting tenders from organizations around the world to try to find the most suitable scheme.

“Yes, of course,” I replied, adding that, although we did not yet have any project of that sort underway, we would be extremely honoured to take part in the tender process. When I got off the phone, I quickly began to look for information on carbon sequestration and mustered the people we had available to put together a project which fitted the bill.

The terms of reference called for a project which could offset, in part or in full, the carbon dioxide emissions expected from a thermoelectric power station, AES Barry, which was being built in the town of Barry,
in south Wales, UK. The project was to be paid for with resources made available under AES Barry’s social responsibility fund and should ideally benefit the local community in some way. Working in close conjunction with my friend, Dominic Harbinson, in England, and with the help of the engineer, Maria Ângela de Araújo, we drew up the proposal for the Bananal Island Carbon Sequestration Project. The proposal was structured around three main components, integrated in a mutually supportive way: Environmental Education, Forest Management and Scientific Research.

A total of 12 proposals were presented, 5 were short-listed and, early in 1998, during the Brazilian Carnival holiday season, I was called to Wales to personally present our proposal to the staff of AES Barry.

Subsequently, AES Barry’s representatives visited Brazil. At the time, the 1998 soccer World Cup was being held in France, and their arrival in Tocantins coincided with the match between Wales and Brazil. Brazil won, fortunately, but the atmosphere was very intense and positive.

In August 1998, we signed the contract with AES Barry and started working. A week later, our office was burgled and we lost our computers, laptops and several other equipment, none of which has ever been found.

In July 1999, the economist, Stefano Merlin, co-author of this book, arrived in Tocantins and quickly became a key player in the project’s development and in the process of creating and refining the ‘Social Carbon’ concept, contributing significantly to the growth of the organization and the development of the Social Carbon Methodology.

In December 2001, we published the book “Seqüestro de Carbono: Uma Experiência Concreta” (Carbon Sequestration: A Practical Experience), which documented the results achieved in the first years of the Bananal Island Carbon Sequestration Project – the prototype project for the Social Carbon concept. Copies of the book sold out soon after its launch. From about that time, we began using the term ‘Social Carbon’ to differentiate carbon projects which featured a high degree of community participation. Eventually, we felt that the time was ripe for another book, focusing on the methodology behind the Social Carbon concept and the forest/community relationship.
With five chapters of the new book already written, we decided to put everything on hold and, acting on Dr. Michael Keller’s advice, to adopt a completely different approach, writing a book which had more of the feel and the perspective of people from the communities who have benefited from the Social Carbon approach. We invited the journalist, Andréa Sarmento, to be the bridge between what we, the authors, had to say about Social Carbon and the views of the communities targeted by the project. We wanted someone independent for this task, so as to ensure that people in the communities felt free to express their opinions, their worries and their hopes. These views are reproduced through Chapters 1-4, which describe the background and the main elements of the Social Carbon approach.

Chapters 5 and 6 deal more closely with the Social Carbon concept, its theoretical underpinnings and methodology. In the interests of clarity, we have adopted a more concise and scientific style for these chapters, since Social Carbon is an innovative idea and few institutions are undertaking projects of this sort.

Chapter 7 outlines the future perspectives for projects of this kind, including the possibility of combining Social Carbon with another innovative concept, that of Biodiversity Corridors. It concludes with a sample of the views and aspirations voiced by local inhabitants for whom the Social Carbon concept was devised.

Over the years, several people and organizations have greatly helped us. I will not try to mention them by name because I would hate to be rude by missing anyone, but I am deeply grateful to all the people who have been our partners and collaborators. Everything that we have built and achieved together so far is a dream transformed into reality.

Divaldo Rezende
This issue is right up to date and it affects us all: the month of May 2003 was the second hottest since records began, back in 1880.

“The months of May and June 2003 saw a record number of extreme climatic phenomena.”

“In France, temperatures in June reached levels not seen in decades, with averages 9-12°F above normal, and peaks of more than 104°F.”

“In Switzerland, the month of June was the hottest on record for the last 250 years.”

“In India, temperatures of 113-120°F were recorded in the period leading to the monsoon season, with weekly averages being 3-9°F higher than those previously recorded for the same period.”

“In the United States, the month of May saw the highest number of tornadoes ever recorded in the country: 562.”

“Extreme meteorological phenomena (excessive cold or heat, floods, tornadoes, storms, torrential rains and droughts) have gradually increased in frequency over the past century, but their intensity has never been greater than in recent years.”

And more:

“The fact that, in the Amazon region, an area of 6,301,162 acres was deforested between August 2001 and August 2002 provides alarming evidence of the second greatest forest loss in history.”

“The possibility that, in 2003, logging concessions covering 25 million hectares of Amazonia could be issued to private companies and communities is a real problem for environmentalists and government decision makers.”

“Government policy has as yet no guidelines for the rational use of forest resources in the Amazon region. Policies for the region are limited to emergency responses, without any government project that might enable sustainable development on the long term.”

“Agricultural activities and demands for transport infrastructure for cereals grown in the states located along the Amazonian Deforestation Frontier (Mato Grosso, Pará, Rondônia, Tocantins and Maranhão) are creating very significant pressure on the remaining areas of Amazon rain forest and Brazilian savannah (cerrado).”
When I first arrived in Brazil, I wasn’t aware of all these newspaper reports, and knew very little about the importance of the problems now being highlighted by the press. Significant issues for the future not just of Brazil, but of the whole planet.

I first set foot in Brazil towards the end of 1998, soon after completing a long motorcycle journey across the Middle East and down through Africa. On arrival, I went straight to the town of Formoso do Araguaia, just south of Bananal Island, where my cousin, Lorenzo, was working as a volunteer on a number of ecclesiastical initiatives to help the inhabitants of deprived rural settlements.

Lorenzo introduced me to Divaldo, who in turn invited me to take part in a project which was just then getting off the ground. Money was very short and I would basically be working as a volunteer.

I accepted the invitation anyway and when I started work in 1999, I went straight out to the Canguçu Research Centre, in the middle of the rain forest. It was quite a shock, in cultural, climatic, linguistic and social terms. I had left my job as an executive who travelled and did business all over Europe and who lived in an ancient little town in northern Italy, on the mountains near the Austrian border, to come and manage a research facility which was still under construction in the middle of the jungle, complete with mosquitoes and alligators, in the south-western corner of a state that I’d never heard of before: Tocantins.

And it was with this sense of being a pioneer, together with a desire to do something practical for the environment and to feel truly useful to society, with great dedication and total commitment to environmental and social issues, that I finally got involved in the project and in the other activities of Instituto Ecológica.

In the years that followed, we began to build the organization on all fronts: in the generation of knowledge, in the professionalization of our staff and in the establishment of a genuine civil society organization. It was a process often punctuated by events which were not always favourable, when I had to look hard for solutions to find a way through – but the important thing is what we managed to accomplish in spite of that. And we have accomplished a lot.
We had to deal with much envy, and always keep looking far ahead to foresee possible obstacles, but we had help from many friends, from people who supported our work and, most importantly, from the communities we were working with.

Perhaps we could have done more, or better, maybe some decisions we made were wrong, but there is no doubt that our work is a benchmark for all those were involved in the projects, for the Amazon region, and also, incredible though it may seem, for the planet.

As time passed and our work and our capabilities evolved, we were able to refine our methodologies to the point where we saw that it was time to publicize the ‘Social Carbon’ concept, developed in our great laboratory of activities in Tocantins.

Other organizations are probably using similar methodologies, with a dual focus on the environment and rural communities, and I hope that this book with our contributions will help to reassure them that they are on the right track. Of course, whatever one does is never really enough: never enough for the community, that has so many needs, nor for the environment, that is suffering huge pressures and significant losses of biodiversity and of conservation areas, and never enough for our atmosphere, as the benefits in terms of climate change mitigation are very limited when compared to the rate at which the modern world can pump out pollution.

But even so, this ‘never enough’ is still a lot, a lot compared to doing nothing, or simply accepting the situation that is developing, and closing one’s eyes to reality.

The greatest lesson I have learned in these years is that it is possible to make the world a better place; all depends on us.

Stefano Merlin
## Summary

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CHAPTER 1

The Local Reality – Communities in the Bananal Island Region
Rural Settlements in the Bananal Island Region

Milton Souza and his wife Regina have been living in the União II settlement in Caseara municipality, Tocantins state, for eight years now and they are happy with their new life. With the support from Instituto Ecológica, the couple established an agroforestry system on their property two years ago.

Milton and Regina have moved to Tocantins from the state of Minas Gerais and lived in Caseara for sixteen months before moving to the União II settlement in December 1995. Milton has driven trucks and tractors and worked as a rural labourer and a ranch hand. He and his wife were among the first inhabitants of the settlement, and Milton was president of the residents’ association for two years. In the agroforestry system on their small-holding, the couple grow rice, beans, corn, and coffee, interspersed with fruit trees and local timber species such as aroeira and pau-ferro, and some trial species such as teak (a hardwood of Asian origin).

Since July 2001, Regina has been running a cottage industry in the União II settlement – a sweet factory known as “Delícias do Cerrado” (Cerrado Delights). It produces liqueurs, preserves, jams, and dried and crystallized fruit made from pineapple, guava, cashew, papaya, and star fruit, and from local cerrado species such as acerola and pequi. The production unit had been set up a year earlier, but administrative problems meant that it never entered operation. Regina, whose parents and grandparents ran similar enterprises, took over the management of the business and now works alongside seven other women from the settlement.
Regina set up a workshop in which she trained the women to prepare the sweets. She also handled all the formalities required to establish the business and founded an association, of which she is vice-president.

People like Milton and Regina are typical inhabitants of the region around Bananal Island, the world’s largest river island, which is located in the south-western Tocantins state, in the Brazilian Amazonia region. The island covers an area of some 4.9 million acres, extending 217 miles from north to south and approximately 37 miles from east to west.

Many of the region’s inhabitants had previously lived on the island itself but, following the federal government’s establishment of the Araguaia National Park and the Araguaia Indian Reservation there, they have been re-settled in neighbouring municipalities. Five of these municipalities – Pium, Cristalândia, Cascaira, Lagoa da Confusão and Duéré – were selected to take part in the Bananal Island Carbon Sequestration Project.

The Social Carbon concept was developed out of Instituto Ecológica’s practical experience with this and other carbon sequestration projects.
stretches back over the past five years. The concept has been applied in the field for almost three years now, becoming a concrete reality for people like Milton and Regina. Under the Social Carbon principle, local communities obtain benefits from a series of activities which help to reduce carbon emissions into the atmosphere.

The social and environmental benefits generated by the Social Carbon concept include the establishment of agroforestry systems, a reduction in the use of fire to clear land (queimadas) and the generation of income and employment from the sustainable exploitation of the region’s natural resources. When the economic value of such resources is shown the local inhabitants stop destroying them by burning off the land and cutting down trees.

Activities such as these, implemented and refined in those five municipalities in the Bananal Island region over the past five years, lie at the heart of the Social Carbon methodology. This methodology is described in Chapter 5, which unpacks the various elements and indicators that are inherent in the Social Carbon idea.

While there are still some squatter communities that have not been officially sanctioned, many of the region’s inhabitants are beneficiaries of agrarian reform initiatives designed to move them off land in the National Park and the Indian Reservation on Bananal Island and re-settle them east of the island.

The communities are marginalized in terms of their social standing, and receive little technical, financial or credit support, except for some limited intervention by the Ministry for Agrarian Development under its National Agrarian Reform Programme (Pronaf).

It is against this background that the work which has been transforming the lives of the inhabitants of the island’s periphery is set. This work had two main goals. The first one is to involve the communities in programmes and projects which reduce deforestation rates and help preserve the region’s forests and conservation areas. The second is to work with the communities to prevent environmental degradation and to identify sustainable production alternatives.
This is an “ecotone” region where a number of different ecosystems – Amazon rain forest, Pantanal (swampland) and cerrado (Brazilian savannah) – meet and interact amidst a scenery of striking beauty, rich in wildlife. Until the founding of Tocantins state in 1989 and the establishment of these rural settlements, large parts of that extensive region were virtually untouched.

Within this context, a number of settlements were analyzed and a total of five were targeted by Instituto Ecológica on a more intensive basis.

For the purposes of this book, we have focused on just three of those communities: União II, in Caseara municipality, and Barranco do Mundo and Pericatu in the municipality of Pium.

The União II Settlement

A sapling nursery has been set up in the União II settlement next to the residents’ association building, which also serves as a schoolhouse. The settlement is located 20 miles from the town of Caseara, to which it is linked by the state highway TO-080.

The area was occupied by squatters in 1992-1993 and the resulting community was subsequently recognized by the National Institute for Colonization and Agrarian Reform (INCRA) in 1994 and formally established as a settlement for 25 families in 1995. On average, each family was granted 118 acres of land. For water supply, the community depends on just one small stream and some holdings only have access to well water.

Rural settlements such as União II should not be thought of as closely-knit groups of people working together. In fact, the dwellings are located at some distance from each other, hindering the development of any sense of a unified community. União II is a very fragmented population grouping. Its inhabitants, who come from different places, with different backgrounds and skills, were all given land by the government but they don’t form a coherent social entity. Following the land allocations, the settlers got together because they had to, in order to receive funding from the National Agrarian Reform Programme (Pronaf) but, in fact, their interests are not really aligned.
The community is highly politicized and has a number of inhabitants who have been involved in sociopolitical movements such as trades unions. Seeing the scattering of small half-finished houses, remote from each other, and the land without any clear definition in terms of usage or cultivation methods, one has the impression of a collection of men and women who have been grouped more or less by chance, without any guidance or planning to help them use the area’s natural resources.

When Instituto Ecológica began its intervention there, the community was enthusiastic, ready to discuss what needed to be done, and keen to see a sapling nursery established there. In terms of income, the settlement’s situation was precarious, with most earnings being generated by men working in agricultural production. The establishment and start-up of the sweets’ factory under the Bananal Island project was a real step forward for the community, with the women working together under Regina’s coordination.
The Barranco do Mundo Settlement

The Barranco do Mundo community, located 74 miles from the town of Pium, was created in 1996 by the National Institute for Colonization and Agrarian Reform (INCRA) and formally established in 1998. It extends over an area of 12,000 acres, and is accessed from Pium via the TO-354 state highway and then along further 54 miles of unpaved road.

Instituto Ecológica has been working with this community since its establishment. The settlement has achieved some significant improvements though the process has been very slow. The inhabitants are now better organized and feel grateful for the project’s assistance.

One frequently heard comment in the settlement is that, “People from the government agencies pass by, but Ecológica is always here for us.” They are very aware of the ground-breaking nature of the work that is being conducted in their community.

Inhabitants of the Barranco do Mundo settlement reckon that the presence of technical staff from Instituto Ecológica is crucial for the community. A series of training courses have been held there for women and for members of the residents’ association, and several agroforestry systems have been established.

The Pericatu Settlement

Created by INCRA in 1996, the rural settlement of Pericatu, situated 26 miles from the town of Pium, was established near a water-hole which is barely adequate for the needs of its population. Access to the settlement is made by the TO-354 state highway, known as the Transjavaés, and then by some 6 miles minor road.

The small-holder, Lucas Alves Cantuário, has been living in the settlement for more than five years, growing rice, beans, corn, cassava, pumpkin and fruit such as watermelon, cashew and buriti (a regional palm species). “Our biggest problem is the water shortage. What we really need is an irrigation system.” Lucas already has an agroforestry system established on his small-holding. “What I’d like to do is to set up another agroforestry
system just with fruit-bearing species, to make our woods more diverse and help restore degraded areas.”

The first training course given in the settlement by staff from Ecológica was on cooperatives and other forms of community organization and was held two years ago. Although government financial institutions offer credit schemes for low-income rural populations, the inhabitants didn’t know how to draw up a project proposal.

Now, with Ecológica’s help, the president of the Pericatu residents’ association, Sebastiana Martins Oliveira, has submitted a proposal for
government credit to build a small flour mill in the settlement. “The course helped us to see the importance of working as a group and of everyone pulling together. Life has got much better since Ecológica began working with us. We had already set up our residents’ association, but we didn’t know how to assert our rights.” Sebastiana envisages the unit being used to process the cassava grown in Pericatu, yielding flour and other products.

Characters

Maria das Graças Bezerra Leite has lived in Barranco do Mundo since August 13, 1998. She moved there from the town of Rosalândia, in Tocantins, where she had enrolled in the INCRA land allocation programme. Her family stayed for a while in the settlement, before going back to the town, and it was only in late 2002 that they set up home in the settlement for good.
“We really wanted to have a small plot of land, but we couldn’t afford to buy one,” Maria explains. In 1999, once the summer was over, she and her husband moved back to Rosalândia. Squatters had moved into the Barranco do Mundo settlement before the land demarcation process, causing problems. They tried to prevent Maria’s family from growing crops, to discourage them from settling in the area. “We came from the town to take up a small-holding here, to grow food for us to live on. But we weren’t able to work, we didn’t have anywhere to grow any crops, so we decided to go back to Rosalândia once again.”
Late in 2002, her husband asked her to agree to return to the settlement. They talked things over with the staff from the agrarian reform agency, INCRA. A meeting was held at the settlement, and Maria’s family decided that they would only return to the settlement if all the community’s inhabitants voted in favour of the move. “There wasn’t a single vote against us, everyone voted in favour, so we came back. And now here we are with our small-holding.”

The settlement has a communal tractor which the residents use to cultivate their land. Maria grows rice, beans, corn and cassava on her plot. Her family consists of her, her husband Antônio, and their son, José Wilson, with his wife and their two children – a daughter, Sara, aged 5, and a newborn baby.

The teacher, Marinalva Souza Carvalho, is one of the community leaders in Barranco do Mundo. Her time is taken up with looking after her three young children and teaching at the little school which has been improvised in the settlement. Her husband works on the land.

Marinalva is 32 and has lived in Barranco do Mundo for the past six years. Before that, she lived in Pium, the municipal centre. She came to live in the settlement in 1998, with her husband and the first of their three children. When the family arrived there were already a few people living there. There was no electricity. Water supplies came from a stand pipe, placed on the outskirts of the settlement.

Two years ago, staff from Ecológica began visiting the settlement. They offered training courses, such as the one on community organizations. “I like the people from Ecológica. I can see that they’re trying to bring us good things to make our life better.”

At the school, Marinalva gives classes for 18 students, aged between 7 and 14, and she teaches them about the importance and the need for environmental conservation. She uses the environmental education handbook Aprendendo com a Natureza (Learning with Nature). The handbook was drafted with the full participation of primary and secondary school teachers in the region who took part in an intensive series of meetings coordinated by Ecológica and another local non-governmental organization (NGO), Gaia. Marinalva explains the risks involved in using fire to clear land. “The
Kids say that you shouldn’t cut down trees, and that you have to take care of the forests.”

She and her husband grow rice, beans, corn, and pumpkin. In the harvest season, the family enjoys an abundance of these crops, and thereafter they use the stores they have set aside for their own consumption and to feed the pigs, chickens and cattle they keep.

In their early days at the settlement, the couple received help from the National Agrarian Reform Programme (Pronaf) which handed out “cestas básicas” – “baskets” of staple food for each household. Nowadays they are
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able to sell cassava flour, corn, pigs, pumpkins and other products. But in order to survive, they also have to work on nearby farms, and this work’s income allows them to buy household supplies. Marinalva has attended courses on women’s health and the use of medicinal plants organized by Instituto Ecológica, and has received saplings of fruit tree species from Ecológica’s nursery in Pium.

This year she is hoping to plant some species which have medicinal properties, like eucalyptus, malva do rei (a kind of mallow) and mint. She uses home-grown remedies such as bathing with eucalyptus leaves “to clear the kids’ catarrh.” Her medicine for sinusitis or runny nose is simple: “You just boil the eucalyptus leaves, then leave the water out in the dew and bathe the children with it the following morning. It works really well,” she says. For worms, she makes a tea of garlic and mint. For digestive problems, she uses herbs like boldo, sete dores and crista de galo. If the inhabitants are seriously ill, they go to the healthcare centre in Pium. Once a month, a doctor visits the settlement, but no dentist has ever been there. Marinalva plans to establish a small rubber plantation on her land, and she also wants to plant fruit trees so that she has other sources of income for her family.

The Origins of Brazil’s First Carbon Project

In 1999, Ecológica teamed up with the local NGO, Gaia, to undertake environmental education activities at state and municipal schools in the five municipalities targeted by the Bananal Island Carbon Sequestration Project which was underway at the time.

The first step was to conduct a diagnostic survey in order to fully understand the reality facing local communities in the project’s area, and to help with the planning of future activities. The survey encompassed all five municipalities, taking in both rural and urban areas. Five communities were selected for more intensive engagement, serving as focal points for initiatives geared towards income generation and socioeconomic development.

The environmental education component of the project covered all five municipalities with the full participation of teachers in the region’s municipal and state schools.
At the project’s outset, a working group was established to oversee activities. This consisted of the state environment agency, Naturatins, the federal environment agency, IBAMA, the NGO, Gaia, and Ecológica. In time, however, political changes in the environment agencies’ leadership disrupted the continuity and effectiveness of the working group, so Ecológica assumed sole responsibility for project activities. A UK charity, AES Barry Foundation, provided core funding for the first years of the project, and Ecológica was subsequently able to use this to leverage additional resources from other sponsors.

Selection Process

The selection of the Bananal Island project, which aimed to provide social benefits while securing carbon sequestration objectives, involved an international tender in which 12 organizations participated, with five being short-listed by the British charitable foundation behind the scheme.

Invitations to tender were sent out late in 1997, with bids due back in January 1998. In February 1998 – carnival time in Brazil – one of Ecológica’s directors flew to the UK to take part in the finalization of the tender process.

The choice of the winner from the five short-listed organizations was made in an unusual way. The selection process involved members of the community in the Welsh town where the gas-fired power station which would sponsor the project is located. This group of ordinary citizens opted for the Bananal Island project proposed by Instituto Ecológica, because it had a very strong social component couched within the unique environmental context provided by an ecotone region (involving cerrado, rainforest and swamp ecosystems), and also because activities were to take place in the vicinity of the world’s largest river island, in a remote area barely known to the rest of the world.

From the outset, the carbon sequestration objectives of Ecológica’s project were firmly placed within the social context of the Bananal Island region. The project served in effect as the prototype for the Social Carbon idea, which was developed and refined as activities with local communities progressed. Thus, Ecológica was able to base its Social Carbon methodology
on the practical experiences acquired while implementing the Bananal Island Carbon Sequestration Project.

Rapid Rural Appraisal

The Rapid Rural Appraisal conducted at the project’s outset provided a ‘snapshot’ of the situation in the project area prior to the implementation of project activities. A similar evaluation was carried out two years later, in 2000, and a further stage will be completed this year. These appraisals enable Ecológica’s staff to keep a close eye on progress and the changes their activities are generating in the project area.

The first appraisal served as a benchmark of conditions in each settlement and subsequent ‘snapshots’ enable an ongoing evaluation of whether communities are benefiting from project activities, and in what way. Comparing the results of the second appraisal with those of the first one, both positive and negative changes occurring within the communities can be detected. Ecológica’s experience with these community appraisals has demonstrated the need for regular monitoring and quantification of social benefits as an essential part of the Social Carbon methodology.

The indicators which are inherent to the Social Carbon methodology were also developed from these appraisal exercises. These indicators, which are described in Chapter 5, allow the construction of a matrix encompassing various aspects of the community’s reality, the natural resources to which it has access, local biodiversity, and the type of project being proposed – whether geared towards carbon sequestration, carbon substitution or carbon conservation.

Faced Challenges

The first challenge faced by Ecológica and its team was the involvement of the different partners in the working group that coordinated project activities. The discontinuity in the government agencies’ leadership and their lack of interaction with the other members of the working group led to delays in the project timetable and the achievement of results. Often,
The Local Reality – Communities in the Bananal Island Region

a certain course of action would be agreed upon and, thereafter, changes in the presidency of the government agencies would occur, meaning that everything would have to be renegotiated and adjusted.

In 1998, the term ‘carbon sequestration’ was virtually unheard of. People in Tocantins didn’t know anything about the Kyoto Protocol and the terms ‘climate change’ and ‘greenhouse effect’ meant nothing to them.

The novelty of the carbon sequestration concept was a major challenge. When working with local communities, concepts such as these have to be translated into simpler, more accessible language. The project’s environmental education component, founded on the participation and involvement of local teachers, was crucial in this respect. By working closely with the teachers, project staff were able to discover the most effective vocabulary and the most suitable terms to convey the concepts underlying the project. This then allowed the teachers, such as Marinalva, in the Barranco do Mundo settlement, to pass on this new understanding to their pupils.

It was also challenging for a NGO to undertake such an ambitious project in Tocantins – a recently formed and as yet under-developed state where government structures, in the form of agencies and their procedures, had not been fully consolidated.

Civil society organizations were very few and far between, and the idea of citizens’ rights was not well-established. The only strong organization in the region was the Catholic church. The Cristalândia diocese is very active in local communities, and Ecológica has formed an effective partnership with the bishop, which has been very helpful in the field, facilitating the work of Instituto Ecológica staff.

The project was multi-faceted, and consequently it required very strong logistical support. This support had to be delivered over a very large area in the Bananal Island region which has only rudimentary transport and communications infrastructure. In the rainy season (November-March), for example, many of the region’s settlements maybe cut off by floods, and so all project planning had to be based on the fact that access to these communities would only be possible in the drier months of the year.

The final big challenge was the need to work for the environment and for development in an integrated fashion. The local reality was one of great
natural riches but very poor communities, so the development vector had to be prioritized within the context of sustainability.

It was clear that, for the project to achieve any success, the social component would have to be emphasized, as the poverty of regional communities was undermining their development’s sustainability. The project’s environmental focus was thus guided and conditioned by the perceived importance of socioeconomic development, being a key element of this focus the way in which communities interacted with their environment.
CHAPTER 2

Communities & forests: A learning process
The Communities’ Relationship with the Forest

The relationship between the inhabitants of settlements and municipalities in the Bananal Island region and the forest is not a harmonious one. The prevailing cultural attitude is based on deforestation and land clearance to make way for agriculture. They do not see the forest as something with which they can coexist and from which they can derive environmental benefits, but as a challenge to be overcome to enable the use of the land for crops and pasture.

This attitude is strongly reinforced by the Brazilian government’s agrarian reform policies, under which only deforested land is considered potentially productive. As forested areas have no value in the agrarian reform context, the beneficiaries of reform programmes naturally assume that, if they clear forest and plant crops, the land’s market value increases.

One of the fundamental challenges faced by Instituto Ecológica when it launched its first Social Carbon project was the need to transform this deeply-rooted perception and to demonstrate to local communities that a different sort of relationship with the forest was possible – that forests could be a resource, providing a whole range of services and products, including seeds which the inhabitants of rural settlements can now sell for use in project nurseries.

The first effective step in the project’s implementation was to show local people that, through the use of agroforestry and extractive techniques, forests could be seen as partners rather than rivals to be overcome or obstacles to be removed.
Project workers found that the region’s inhabitants tended to view the forest as an obstruction, hindering the expansion of pastoral and agricultural lands. Instead of this perception, they seek to foster an attitude which sees the forest as an ally that can support household incomes and living standards. This process of transforming perceptions and raising awareness is central to the activities undertaken as part of the project’s forestry component.

Hitherto fragmented and disparate communities have begun to unite, forming associations and cooperatives. Alternative methods of income generation have been put into practice, for instance the “Delícias do Cerrado” enterprise established in one of the settlements. The participation of local residents in the various training and environmental education courses held under the aegis of the Social Carbon project is further evidence of the project’s success in mobilizing and empowering communities in the Bananal Island region.

A number of other organizations and government agencies provide skills-building and training courses in these same communities, but few of them return later to check on the results. As part of its monitoring activities, staff from Instituto Ecológica return to the communities to check on progress and outcomes, provide guidelines on planting procedures, and maintain interaction with community members.

Ecológica’s engagement with the target communities is ongoing. Staff visits to the settlements are scheduled at least once a month and as a result the organization has developed a presence in the communities. “It’s been a new experience for us. We’d heard about agroforestry before, from the television, but now we’ve seen it for real and have been able to experience it for ourselves. It’s been very good,” the farmer, José Wilson Bezerra Leite, comments.

José Wilson, who lives in the Barranco do Mundo settlement, is a typical person the Social Carbon project seeks to benefit. “Talking to the people from Ecológica, I grew aware of the need for conservation. I want to do more work with them and I’ve asked them for more saplings to plant.”

Nowadays, people in the settlements are very open to alternative technologies and new production methods, whereas at the beginning there was a certain resistance. This was especially the case of people such as
Antônio Bezerra, who had been farming in the area for some time and whose normal practice was to clear forest to open up land for crops and pasture. Along with the rest of his family, he now intends to combine crops with conservation, with help from Instituto Ecológica. “We fell trees when we have to, but we’ve learned that it’s best to replace what we cut down.”

Given the poverty of regional communities, the demand for Ecológica’s services is high. However, the organization has to tread a fine line, maintaining a presence in the communities and responding to their needs without becoming a substitute for government action. Ecológica does not have the resources for this and anyway there are some government agencies active in the same areas. In its work on the Social Carbon project, Ecológica’s policy has always been to concentrate its efforts on certain priority initiatives requested by the communities themselves.

Seed Collection

The collection of seeds for use in the sapling nurseries established as part of the project begins in the forests, with the identification and selection of healthy, mature and fertile specimens of regional species which will serve as sources of seed stocks. People in the settlements can make quite good money selling seeds to the nurseries. Though it may seem a very simple procedure, seed collection is in fact quite complex, and it has become a key contributor to the effectiveness of the Social Carbon idea and the preservation of existing forested areas.

To perform their function, project nurseries require a lot of seeds. Initially, Ecológica’s technicians sourced their seed stock from commercial suppliers and from other nurseries. However, these supplies often remained unused for long periods with the result that their germination rates deteriorated and the nursery’s operational costs increased.

In response to this, Ecológica decided to turn to the communities themselves, training people who lived closest to suitable areas of cerrado (savannah) and forest to recognize the best trees to use as seed sources, and to collect and process the seeds. The collectors then take the seeds to their local nursery, or project staff travel out to the settlements to meet
them and purchase their supplies. In the process, community members come to view the forest and cerrado trees as a resource which can be used to supplement their household income.

Certain inhabitants of the target settlements in the Bananal Island region have now become regular suppliers to Ecológica’s nurseries. The main period for seed collection runs from August to October, with a second phase, involving other species, in January and February. “Seed collection provides an extra bit of income for the community. Obviously it depends on how much a person collects, but the money can be enough to pay for a ‘basket’ of staple food (cesta básica) for the household. Even though several people have been trained in this activity levels of interest are still quite low. But although the uptake in percentage terms is not very high, it’s clear that those who are prepared to try it are very satisfied,” explains Clóvis José Maria, the technician who heads Ecológica’s forestry activities.

Project staff pay collectors in cash or with saplings from the nursery. People often ask for fruit-bearing species such as cupuaçu, cashew, or pitanga, and for exotic species such as teak or neem in exchange for the seeds they have collected.

The community seed collection idea has only been going for about two years. At the beginning of the project, all the attention was focused on establishing the nursery’s infrastructure, and it was only later that the potential for community seed collection to reinforce project objectives, and to strengthen the links between Ecológica and the local community, was recognized. A win-win situation has developed, with the nurseries managing to reduce their operational costs, and local community members learning to appreciate and to derive value each year from a previously underrated and overlooked resource.

Another aspect that deserves note is the bartering process which occurs at the interface between the seed collectors and the staff responsible for running project nurseries. Local residents are highly effective negotiators, skilled at bartering and with a keen eye for a bargain.

Seed collection activities are something which can involve the whole family, learning new skills and developing existing abilities. It may be a
very simple set-up, but it has some quite far-reaching results in terms of both environmental conservation and community empowerment.

Agroforestry Systems

Forestry activities under the first Social Carbon project began in the rural settlements. Subsequently, once the project nurseries were well established, activities were expanded to include neighbouring towns and villages.

The initial proposal for the Bananal Island Carbon Sequestration project called for the introduction of agroforestry systems in the target municipalities. Following the establishment of the first project nurseries, there was an unsuccessful attempt to set up an agroforestry demonstration unit on an area of 3.7 acres in the União II settlement in Caseara, north of Bananal Island.

This community-based scheme was effected in a partnership with the settlement’s residents’ association. However, most of the saplings died because the soil at the chosen site was very acid, a number of errors were made at the design and planting phases, and the settlers who participated did not all share the same degree of dedication towards the scheme.

After this experience, Ecológica had to rethink its strategy, and new forms of agroforestry system were designed and implemented using a different and better targeted approach. Only those small-holders who had a real interest in working within an agro-ecological model were involved. The distribution of saplings and other inputs and the provision of extension services were targeted at these people.

This was how the first of the agroforestry systems that are operational today came about. Initial plans called for the establishment of eight systems, but to date a total of 15 have been installed. These systems have different designs; some combine annual and perennial crops, others focus on medicinal species, and there are still others which are specifically designed for use in cerrado (savannah) areas.

The agroforestry work underway as part of the Social Carbon project in the Bananal Island region has benefited from another initiative run by
Social carbon: Adding value to sustainable development

Ecológica, in the Taquarussu district near the state capital, Palmas, in central Tocantins. Here, Ecológica has set up an organic farm (Fazenda Ecológica) whose main purpose is to serve as a pilot scheme, demonstrating the viability of organic agriculture in the cerrado region. In addition to organic fruit production, activities at Fazenda Ecológica have included agroforestry experiments to identify the most suitable species for use in regional systems, and trials involving the use of green manures as a means of enhancing soil fertility. The findings from these experiences have been used to inform and refine Ecológica’s work in rural settlements in the Bananal Island region.

The response of local communities to the introduction of agroforestry techniques has generally been positive. The inhabitants have begun to understand and appreciate the principles behind the techniques, but for this new perception to take root and flourish, the systems have to be profitable.

The systems that have been established to date are testing the hypothesis that agroforestry provides a sustainable production alternative for the region’s farmers. The key to this sustainability lies in the systems’ ability to generate economically viable returns through the use of forest species alongside more conventional crops, and by ‘enriching’ existing forests through the introduction of high-value species.

Community Nurseries

The Bananal Island region, selected as the site of the first Social Carbon project, contains extensive areas of cerrado (Brazilian savannah) and of Amazon rain forest. Local farmers burn off cerrado areas every year to clear the land for use as pasture for cattle. There is no awareness of the cerrado’s potential to supply fruit and other products which could contribute to the economies of regional communities.

This is the context in which Instituto Ecológica began its work of establishing sapling nurseries in several of the region’s communities. At first, only native regional species were grown at the nurseries, but in response to requests from the local communities, the range was later
extended to include saplings of fruit-bearing species such as açaí and cupuaçu, and other exotic trees such as teak, eucalyptus and neem. The saplings raised in the project nurseries have been incorporated into agroforestry systems, planted out along field boundaries to help prevent fires from spreading, and used as a means of regenerating, extending and enriching the existing forest.

The first nursery was established on community land next to the residents’ association headquarters in the Caseara settlement. The site was selected with the community’s full participation during a series of meetings between members of the association and technicians from Instituto Ecológica.

The federal environment agency, IBAMA, donated the timber used in the construction of the facility, which was inaugurated on August 5, 1999. The event was marked by the planting of a rosewood tree. The mayor and other local dignitaries were present, as well as representatives of the British foundation that was providing core funding for the project.
The nursery was staffed by a manager and two assistants whose salaries were initially paid by the Caseara town council and subsequently by Instituto Ecológica itself. At the outset, a large number of species endemic to the cerrado region were grown, but afterward this has changed as local people wanted fruit trees and exotic species such as neem and eucalyptus.

The first sapling batches were donated to rural settlements in the area and distributed to schools and community members during environmental education events held throughout the region. Some of those saplings were planted in school grounds and others were taken away by pupils, to be planted at home.

A second nursery was established in 2000, in the town of Cristalândia, near the cattle market, on land donated by the town council. Cristalândia has some reputation as a progressive place, whose schools and colleges are always ready to try out new ideas and educational techniques. On learning of Ecológica’s proposal for a nursery in the area, the local teachers suggested that the best site would be near the town centre where it could be easily accessed for use in environmental education and other activities organized by the town’s schools.

This idea was accepted by the town council and the nursery was duly established, achieving reasonable production rates thanks to the assistance of agricultural extension staff working under the coordination of Instituto Ecológica. Unfortunately however, in practical terms, the chosen site was not approved. Operations were affected by a series of problems, ranging from disease infections to access difficulties during the rainy season. Consequently, the nursery was never able to achieve its target output of 60,000 saplings/year.

Following this, with support from the Brazilian natural cosmetics firm, Natura Cosméticos, and other sponsors, Ecológica set up another nursery in the town of Lagoa da Confusão. The main objective of this nursery was to supply saplings for rural settlements in the Bananal Island region. The town council also supported the project, donating land for the nursery to Instituto Ecológica. The nursery is now fully operational and its production includes a significant number of teak and palm tree saplings.
Communities & forests: A learning process

The Pium nursery was the fourth one established under the Social Carbon banner, and its main focus is on the production of medicinal species. This nursery is equipped with a germination unit, where seeds are processed and the initial growth phases can be closely monitored. The Pium facility supplies saplings to all the other nurseries. It employs women from the local community who have been fully trained to conduct the various activities required for its successful operation.

Clóvis José Maria, who has been in charge of operations at the Pium nursery for the last two years, has a good relationship with local settlers. “The community is very supportive. The nursery is very important for the inhabitants, because it helps with conservation. We get the saplings ready for distribution, but it’s the community itself who actually plants them in the ground.” The technician keeps a record of the saplings that are distributed to the local settlements. “The register helps us to monitor production and to know which communities have received what. In parallel with our sapling distribution events, we also have an ‘open door’ policy which enables people from the community to come and collect saplings when they need them.”

Nursery operations involve everything, from seed collection to the germination and growing of saplings in the nursery and their subsequent distribution to local communities, particularly rural settlements, for use in agroforestry schemes where native, exotic and fruit-bearing species are interspersed with cereal crops. “The community members themselves are responsible for the actual planting. The first yields from saplings which are planted now should begin in perhaps two or three years’ time.”

A fifth nursery was recently opened near the state capital, Palmas, in the town of Taquarussu. This was set up with resources provided by the Italian province of Bolzano, in a partnership with the Palmas city council and the local Amigos do Meio Ambiente (Friends of the Environment) project. With the city council’s support, the nursery is used to train young people and teenagers in practical skills which will help them later on, when they will be looking for work.

Instituto Ecológica has tried on two occasions to hand over its nurseries ownership to the local community. On the first occasion, it was agreed
at meetings with the residents’ association that a group from the community would carry on operations at the nursery, as it represented an important source of income generation, but the new arrangement did not work out. The people who were left in charge of the saplings did not follow the correct procedures and, eventually, a large number of saplings were lost and staff from Ecológica had to return and re-assume the nursery’s management.

On the second occasion, the transfer occurred just before the rainy season, when the nursery was fully stocked with saplings. However, since they lacked the require administrative skills, the inhabitants have been unable to manage the operations successfully. Currently, Ecológica is discussing with a group of women from the community to see if they could take over the facility’s management.

**Agro-ecology**

As a part of its Social Carbon activities, Instituto Ecológica has been trying to introduce local communities to the concepts of agro-ecology. The idea is to inculcate the vision of a symbiotic relationship with the forest, making use of ecology, the various elements of the forest, and the community and their social characteristics as factors of production, taking into account aspects of nature such as the phases of the moon, the collection of seeds and even local bird species.

Examples include the introduction of organic agricultural practices, avoiding the need for chemical fertilizers and the aggressive exploitation of the soil, using ‘green manures’ as a means of increasing the amount of organic matter in the soil and enhancing its fertility. This is done by growing a type of bean which is then ploughed back into the soil instead of being harvested. Because it is a leguminous plant, the bean absorbs nitrogen from the atmosphere, enriching the soil without the need for chemical fertilizers.

There have been strong criticisms voiced in local communities about conventional technical assistance packages which require the use of chemical fertilizers. No information or assistance is provided on alternative means of enhancing soil fertility. However, the high cost of conventional
fertilizers means that small-holders in the region are very keen to try out alternative methods.

Instituto Ecológica is providing assistance with the training programmes and extension work undertaken as part of the National Agrarian Reform Programme (Pronaf-). Ecológica’s focus is on agro-ecology and, in addition to its work in the Bananal Island region, its activities for Pronaf have been extended to settlements in eastern Tocantins focused on soya bean production, such as in the town of Lizarda near the state of Maranhão. Ecológica has published an illustrated handbook on agro-ecological techniques which is being used in these training courses. Agro-ecology is gaining recognition as a result of the Instituto Ecológica’s work with agroforestry systems and, in recent years, the region has seen a significant increase in the adoption of agro-ecological techniques.

A Community-Centred Approach

Carbon sequestration projects usually involve the acquisition of an area of deforested land, which is then cleared of scrub and grasses in preparation for the establishment of single-species tree plantations. Saplings are supplied from a large purposely-built nursery, and the whole scheme requires significant levels of investment.

Instituto Ecológica has adopted a different approach which does not function through the acquisition of land for project plantations. Instead, forestry activities are directly undertaken with local communities. Project nurseries are established in partnership with local settlements whose inhabitants are also engaged in seed collection and in the establishment of agroforestry systems. Records kept at Ecológica’s nurseries show that, to date, almost 300,000 saplings have been produced and distributed to the local population.

From Project to Programme and Beyond

Most carbon sequestration projects revolve around the generation and sale of carbon credits. This was not the case with the Bananal Island project
which was financed by resources made available through a social responsibility fund. Nonetheless, the project has served as a pilot scheme to test the application of Social Carbon principles and methodology ‘live in the field,’ allowing for the subsequent formulation and refinement of the concept.

The Social Carbon concept has now been sufficiently developed to enable its application in a commercial project aimed at generating carbon credits. However, the experiences and the innovations which are the subject of this book had no commercial basis. Thus, when people ask how many carbon credits Ecológica has sold as a result of its work in the Bananal Island region, the answer is none, since the work is not geared towards this end.

The Bananal Island project originated as a carbon sequestration scheme from which the Social Carbon concept evolved. Over time, as new sponsors were brought on board, so many other features and elements have been added that today it is somewhat misleading to think of it as a project. It is perhaps better described as a programme, or alternatively it may be thought of as a large-scale laboratory in which innovative scientific and social initiatives are put to the test.

Looking to the future, Instituto Ecológica is proposing to link the Social Carbon concept with the concept of ‘Biodiversity Corridors’ developed by Conservation International. The expectation is that this will generate a range of other advantages in both environmental and social terms, reinforcing and building on the Social Carbon idea.

For the forestry technician, Clóvis, who dedicates most of his time to ensuring the success of the Social Carbon initiative in Tocantins, the programme’s expansion is crucial for the concept’s survival. Last year, he took part in sapling distribution activities and environmental education initiatives throughout the Bananal Island region, in the municipalities of Pium, Caseara, Cristalândia and Dueré. “We are now starting to extend activities to include the mining prospectors who work in the region so that they can help regenerate areas they impact. The Social Carbon idea has also been publicized at science exhibitions organized by government schools in the region.”
CHAPTER 3

Social carbon: The community benefits
The Origins of the Social Carbon Concept

The Social Carbon concept was formulated two or three years after the start of the Bananal Island project. From the outset, when the Rapid Rural Appraisal was underway, allowing local communities the opportunity to express their priorities and basic needs, Instituto Ecológica felt that it was on the right track.

The term ‘Social Carbon’ was first coined in 2000. Ecológica was harshly criticized at the time, with its critics claiming that, “There is only one kind of carbon; there aren't different types, no blue, yellow, black or red. You are making up a concept that doesn't exist.” Yet today, in 2003, these same people who criticized the concept in the first conferences and meetings addressing the carbon issue, now argue along these very lines, stressing the importance of the social context and of involving local communities in the project.

The Kyoto Protocol was signed in 1997 and these discussions on carbon concepts occurred in 1999 and 2000, after the publication of the first book presenting the initial results of Ecológica’s work in the Bananal Island region. A series of presentations were held in different Brazilian cities and on these occasions a number of criticisms were voiced by people who today are among the main proponents of the Social Carbon idea.

In fact, in starting its work on what has now become the prototype Social Carbon project, Ecológica’s key perception was that benefits for the community had to be included in the criteria for project sustainability and for sustainable development in general.
However, one thing is to say that a project is socially appropriate and just, and quite another to have a means of measuring whether or not it actually delivers social benefits. This was the challenge addressed in formulating the Social Carbon methodology, which adopts the ‘Sustainable Livelihood Approach’ as a tool to verify and measure the benefits generated by the project and to evaluate them qualitatively and quantitatively.

With the definition of methodological procedures to evaluate and quantify the project’s social benefits, and the application of this methodology in the field, Ecológica has been able to effectively consolidate the Social Carbon concept.

Another aspect of note is that this assessment of social benefits relies on methodologies and approaches which involve the participation of the affected community, working with women, children and adults.

The Bananal Island project can be seen as a pilot application of the Social Carbon concept. This concept did not arise by chance. In fact, the environmentalists at Ecológica had been working on it for some time, without bothering with definitions or labels. They only began to refer to it as a Social Carbon project in the third year of operations, once the theoretical and methodological foundations for the concept had been solidified.

The Social Carbon idea is now being proposed for projects focused on low-impact logging, investments for co-generation using sugar cane, urban carbon sequestration programmes and a carbon project involving tropical fruit production.

Learning by Doing

When the pilot project began, a great deal of effort was placed on environmental education activities to ensure that local communities were aware of, and involved in, the project’s process. During these initial activities, it became clear that the region’s inhabitants had no conception of environmental problems. In their eyes, the region held abundant natural resources, large areas of forest, and a great diversity of animals and fish.
At the same time, the reality and the depth of the poverty in which the communities lived was quite striking. Most of the inhabitants were extremely poor, their diets were deficient in protein, and their educational standards, social cohesion and motivation were all very low.

The form and direction of project activities were designed in response to these perceptions. Environmental awareness was fostered through a series of training programmes and community education initiatives which also sought to identify alternative means of income generation in order to reduce poverty among the region’s inhabitants, and to forge links between the community, the forest and conservation.

Environmental Education – Learning with Nature

The project’s environmental education component gave rise to the publication of the handbook Aprendendo com a Natureza (Learning with Nature), in which more than 300 local teachers participated.

The production of this handbook was done in a participatory manner and it is now being used as a tool for environmental education in the region’s schools. The teachers themselves provided input regarding the contents and drafting of the handbook, and as co-authors they feel a certain pride when using it in classroom activities.

The main themes of the handbook were discussed with teachers in state and municipal schools in the five municipalities targeted by the Bananal Island project. The selected themes, the comments made by teachers and the conclusions of these discussions were all incorporated into the drafting process. The text was edited by the teachers to ensure that the language was simple, accessible and relevant to the regional context, with an environmental perspective which took full account of the situation in which the communities live.

Income Generation & Women’s Health

Several income generation initiatives are underway in the project area. When the project first began, the initial focus of its social component was
on formal environmental education involving teachers and pupils in regional schools. Once Ecológica’s activities moved on to take in more isolated rural communities and settlements, the priorities changed and, in response, the focus of activities had to shift towards income generation and health issues.

This shift really began in 2000, when a new sponsor, Natura Cosméticos, was brought onboard. The project’s social component was re-aligned to strengthen the inhabitants’ productive capacities via a series of training courses directed to this end, and also to improve family health through courses that trained local women in the use of herbal remedies.

A number of different training courses were held. Project nurseries produce medicinal plants which are then distributed among the target communities. Community members have been taught how to plant and to make use of these medicinal species, with the help of an educational handbook specifically designed for this purpose. Given the precarious nature of the health assistance services provided for isolated rural settlements, the use of these home-grown remedies makes an important contribution to the well-being of their inhabitants.

This work with medicinal plants is part of the social component of the Social Carbon project which aims to improve the health standards in target communities by making use of the resources naturally occurring in the vegetation of the cerrado (Brazilian savannah) region. In addition to general guidelines and specific advice on family health matters, project staff have organized training courses instructing local inhabitants in the cultivation and preparation of herbal remedies. People with experience in the field have been brought in to pass on their knowledge, teaching local residents about the uses of various plant species and distributing seedlings of herbs, bushes and trees which have medicinal properties.

A second phase of this community health work featured training courses in five rural settlements and in the associated municipal centres. These courses were organized with the support of the mayors’ wives and involved the women who worked in daycare center, those who prepared lunch for the local schools, and community health workers. The courses were delivered by Pro-Vida, a state government agency connected with the Health Secretariat, which works to improve nutrition among local
communities and indigenous groups. Pro-Vida has been promoting the medicinal use of plants for many years and has lent its experience to the “Care for the Children” initiative launched by the Catholic church.

Women from local communities were shown how to prepare herbal remedies that can help in the treatment of a number of common diseases such as worms and flu. These included a syrup made from the flower of a species of papaya, and a pill made from the babosa plant which may be used to treat worms, as well as a syrup made from three regional tree species which is used to treat flu, bronchitis and sore throat.

As yet, there is no commercial production of these herbal remedies; they are made exclusively for use within the community concerned. However, Ecológica is hoping to set up a mini-laboratory at its Training and Community Centre in Pium and to work with neighbouring communities producing herbal remedies for commercialization on a limited scale. People in rural communities will collect the raw materials and urban residents will process and package the herbal products. To support this proposal, a partnership agreement is currently being negotiated with Pro-Vida and the Tropical Medicine Foundation of Araguaína (in north-western Tocantins).

Although local women produce home-made syrups for use in their own households, especially for flu and other respiratory conditions, there isn’t currently a systematic production process. To encourage this, the idea is to establish a community garden with a section specifically devoted to medicinal plants.

The environmentalist, Juliete Oliveira, is a specialist in environmental education and community development and is one of the people responsible for monitoring the work on herbal remedies and for delivering the training courses in the rural settlements. “Working with local communities is not easy,” she says. “Even when you have identified an idea or an activity which has considerable potential, finding a way for it to work successfully within the community is very difficult and time-consuming.”

Flu, bronchitis, digestive and renal problems, headaches and other illnesses are treated initially by the community members themselves. Only if the symptoms deteriorate they will seek assistance from one of the local
health centres. The first attempts at curing disease tend to rely on local resources, making use of locally grown herbs and endemic trees and shrubs. It is estimated that up to 30% of the diseases affecting a given community may be treated by these means, without recourse to external health services.

Sebastiana, a housewife in Pericatu, wants to see the installation of a health centre nearer to her settlement. “We don’t have access to any health service, so almost all diseases – everything from fevers to worms, and even snake bites – are treated right here in the settlement using herbal remedies from the local vegetation.”

“Although a lot of attention has been given to species in the Amazon rain forest, I reckon that the cerrado (Brazilian savannah) is really blessed for having such a tremendous plant diversity, and the remarkable thing is that almost all of the species here have some sort of medicinal property,” Juliete comments.

Funding from a sponsor in Italy has been secured to pay for the installation of the Training and Community Centre in Pium and also for one in the town of Taquarussu, near Palmas. This latter centre is already operational and focuses on the production of handicrafts. Taquarussu has a tradition of handicraft production, but the artisans were very poor, and produced very little, just a few items which they would sell once a week in the local market.

Six months after the inauguration of the Taquarussu centre, the situation has improved quite noticeably. The artisans have united to form an association which is responsible for the running and maintenance of the centre, their production has increased and they are now running a handicraft fair which is open every day. Moreover, the income generated from their activities has tripled, and as a group they are far more coherent and proactive.

Ecológica continues to seek out new sources of funding for other initiatives focused on income generation and improved living standards. The promotion of such activities is seen as a fundamental component of its work with local communities under the Social Carbon banner.
Work in Progress

Courses on nutrition and on the preparation of foodstuffs and dietary supplements from edible cerrado fruits and plants were also held for the benefit of immigrant settlers who had little idea of the potential uses of the region’s natural resources. These courses also highlighted specific examples of regional cooking and culminated in the publication of a handbook of regional recipes.

These activities were also geared to increase the self-esteem of the housewives who participated, their awareness of family health and personal hygiene, and their knowledge of naturally occurring foodstuffs which were easily accessible and simple to prepare.

This work on family health with women in local communities is an ongoing part of the Social Carbon project’s social component and will be continued along the same lines, seeking to extend the range of natural alternatives available to local populations by working with local healers (benzedeiras), midwives, and herbalists (mesinheiras). There are loose networks of these professions operating throughout the cerrado region, facilitating the exchange of information between different groups. Ecológica’s work on environmental conservation, especially with regard to regional flora, will be greatly enhanced by linkages and interaction with those networks.

Preparations for the establishment of the Pium Training and Community Centre are currently underway. As mentioned earlier, the idea here is to focus on the production of herbal remedies with the installation of a small-scale production unit employing local women and making use of the medicinal plants produced at Ecológica’s Pium nursery, along with other material gathered by rural residents.

A series of courses have been held instructing local cooperatives and organizations in the drafting and submission of project proposals so that they can apply for funding from various sponsor agencies for initiatives that will benefit their communities. Ecológica is careful not to engender amongst the region’s inhabitants any sense of dependence on its intervention, but instead to enable them to seek out and promote their own solutions for sustainability in the medium and long term.
Ecológica has also highlighted the potential contribution, in terms of employment and income generation, that tourism could make to local communities, given the outstanding natural beauty of areas such as Taquarussu, near the state capital Palmas, and the Bananal Island region in general. The Canguçu Research Centre, near Bananal Island, and the Visitors Centre at the Fazenda Ecológica near Taquarussu are already functioning as ecotourism lodges, providing employment for local people.

A range of contacts has been initiated aiming to develop community-friendly ecotourism, involving indigenous communities, social projects and the inhabitants of rural settlements in the Bananal Island region. Implementation of this strategy will result in a significant increase in the self-esteem of the communities involved and provide abundant opportunities for their inhabitants to earn extra income, as well as fostering inter-cultural learning and exchange between the communities and visiting tourists.
CHAPTER 4

The Canguçu research centre:
Environmental science & technology
The Canguçu Research Centre

The Canguçu Research Centre was inaugurated by the Brazilian Environment Minister, José Sarney Filho, and the Governor of Tocantins State, José Siqueira Campos, on August 5, 1999. Representatives from the AES Barry Foundation, the lead sponsor of the first Social Carbon project, were also present to celebrate the event.

Only a few Brazilian research centres are owned by NGO’s, and Canguçu is currently one of the largest centres of its kind in the country. Initial research conducted at the centre focused on carbon sequestration and involved the quantification of the carbon held in the various regional ecosystems (carbon ‘stocks’). A total of 43 sample plots were established for the measurements. On 13 of these plots, sampling involved the removal and measurement of all biomass, while on the other 30 plots, an indirect sampling method was adopted, which involved making an inventory of the existing vegetation. In selecting the locations of these sample plots, the researchers ensured that their surveys included representatives of each of the region’s main ecosystems: cerrado (savannah), rain forest and pantanal (swampland).

Canguçu (an Indian word meaning ‘fierce jaguar’) was established to promote inter-disciplinary research and methodology development, and to increase scientific and technological understanding. The research station is located in an area of seasonally flooded rain forest on the right bank of the Javaés river north of Bananal Island in Pium municipality, south-western Tocantins. Scientific and technological research studies such as those conducted at Canguçu are needed to provide the foundations for
Social Carbon projects, and to promote sustainable development and improvements in the regional communities’ living standards, as well as to enhance the understanding and conservation of regional biodiversity.

The Canguçu facility is located on one of the few privately owned properties lying between the Araguaia National Park and the Cantão State Park. The site, extending over an area of 160 acres, was donated to Ecológica by a regional landowner. The construction of the Centre’s first stage was financed by AES Barry Foundation, a charity based in Wales (UK), as part of a social responsibility initiative launched by its parent organization. The construction of a centre the size of Canguçu was important as it provided a focal point that could draw attention to research opportunities in Tocantins, strengthening local scientific capabilities through partnerships with universities and research institutions from elsewhere in Brazil and from abroad. The Centre’s location in an area of outstanding natural beauty makes it ideally suited as a base for ecotourism activities, generating resources to help ensure its self-sufficiency in the longer term.

Research Activities

The Canguçu Research Centre can currently accommodate 20 researchers and visitors. Its facilities include three research rooms equipped with computers, a Visitors’ Centre, accommodation suites, a restaurant and bar, an observation tower overlooking the Javács river and the rain forest, and a climate monitoring station, along with staff quarters, kitchen, storeroom, laundry, and generator.

The Bananal Island Social Carbon project contains a strong research component which is geared towards the development of methodologies to calculate carbon stocks and carbon fluxes in the region’s different ecosystems, and the definition of procedures by which the Social Carbon methodology can be implemented in ways that generate carbon credits. Surveys of the regional environment and its biodiversity are an integral part of this work, and aim to characterize the various ecosystems present, as well as generating inventories of fauna and flora.
In addition to the ongoing research into carbon cycle dynamics, work at the Canguçu Research Centre encompasses the development and application of technologies to facilitate the sustainable use of the region’s natural resources and studies in the field of Conservation Biology. These studies – currently focused on the freshwater turtle species prevalent in the region – are conducted in conjunction with post-graduate students and lecturers at the Araguaína campus of the University of Tocantins (Unitins), and the Brazilian federal environment agency, IBAMA.

In the area near the research centre, there are a relatively large number of river beaches which only become apparent when river levels decrease the dry season. The turtles use these beaches as nesting sites. The nesting season runs from July through September, and the eggs hatch in October-December. Among the aspects investigated by researchers are the identification of parasite species, and the influence of temperature on the sex of turtle hatchlings. Ecológica Institute has teamed up with the Earthwatch organization which sends volunteers from abroad to assist the researchers in their field work. Part of the money these volunteers pay Earthwatch for arranging their field placements is passed on to Ecológica, and this helps cover the costs of the facilities, equipment and logistical support required for the continuation of research activities at Canguçu.

Brief summaries of the main research projects currently underway at Canguçu are given below.

**Social Carbon** – Aims to develop and implement an innovative, equitable and sustainable system to offset emissions of greenhouse effect gases by means of carbon sequestration, in a manner which is compatible with social and environmental realities in the Bananal Island region, generating methodologies, technical know-how and scientific understanding, and enhancing the capabilities of local researchers.

**Evaluation of Social Benefits from Social Carbon Projects** – Aims to quantitatively evaluate social benefits using measurable parameters based on the indicators defined by the Social Carbon methodology.
The Sustainable Management of Ecotones in the Bananal Island Region –
Aims to highlight strategies which are environmentally compatible with the sustainable management of the Bananal Island region. This region is home to a number of different ethnic and cultural groups which have different and often conflicting goals. The research makes particular reference to the region’s indigenous peoples who have their own distinctive patterns of land use.

The Large-Scale Biosphere-Atmosphere (LBA) Programme in Amazônia – The LBA research programme is based on international technical and scientific cooperation led by Brazilian institutions. It aims to enhance scientific understanding of the dynamics and influences of the Amazon ecosystem. Research is focused on biological, chemical and physical processes in the Amazon region, the sustainability of these processes and their influence on the global climate.

The Bananal Island Turtle Project – Focuses on the conservation of freshwater turtle species (Podocnemis expansa and Podocnemis unifilis) whose populations have suffered a dramatic decline in numbers, largely due to human impacts. Nesting sites of these turtles are marked and monitored during incubation and hatching. Volunteers from the Earthwatch organization assist the research work in the field. The research work is conducted by post-graduate students and lecturers from local universities investigating a number of issues as summarized below:

- The influence of sedimentological and geomorphological processes on the choice of nesting sites by Podocnemis expansa (the Amazonian turtle) and P. unifilis (the tracajá turtle) in the Araguaia River Basin – Aims to establish the geological conditions that determine the choice of nesting sites by the Amazonian turtle and the tracajá turtle in areas managed by the federal environment agency, IBAMA.

- Studies of salmonella contamination of the eggs of Podocnemis expansa and P. unifilis in the Araguaia National Park, Tocantins – Aims to detect
the presence of pathogenic bacteria of the salmonella genus and other organisms in the eggs and the nests of these turtle species, by means of microbiological analysis. The research will help to determine the origin of this contamination, thereby generating important information for turtle farming projects, minimizing human contamination and economic losses.

- The reproductive biology of Podocnemis expansa and P. unifilis in the Javaés river – Aims to ensure the conservation of populations of these turtle species in the Javaés river, Araguaia National Park, Tocantins. The process involves activities such as the identification and marking of nesting sites, the protection of turtle eggs and hatchlings from predators, ensuring the reproductive success of the species, and the verification of environmental factors that influence the biological cycle of these animals, including temperature-dependent sex determination and mortality rates of turtle hatchlings.

Carbon Measurements

Researchers working at the Canguçu Research Centre are familiar with advanced practices and techniques associated with carbon measurement. One of the technicians engaged in carbon measurement is Dariusz Kurzatkowski. Using equipment which measures the height and the diameter of the trees in an experimental plot near Canguçu, he keeps a close eye on growth rates of different tree species, and thus on the carbon stocks they contain.

In studies which began in 1998, plots measuring 100 meter² (1.076 foot²) and containing different vegetation types were surveyed and cleared and the gross weight of the trunk, branch, leaf, bark and litter components recorded. The dry weights of these same components were subsequently measured and recorded in terms of kg/100 meter², enabling estimates of biomass and carbon content per hectare to be generated for areas of similar vegetative composition.

A further part of these studies involved non-destructive sampling of 30 plots measuring 1,000 m² (10,760 foot²). On these areas, vegetation
inventories were taken to assist in the estimation of biomass and carbon content based on the data derived from the direct sampling measurements.

The area studied by Dariusz is flooded every two or three years, and is reckoned to contain a particularly large amount of biomass – around 200 tonnes in each hectare (2.47 acres). “This means that each hectare in this area contains something like 100 tonnes of carbon. If it was deforested and transformed into pasture, all this carbon would be released back into the atmosphere,” warns the researcher.

After two years measuring carbon sequestration in the Canguçu area, Dariusz notes that the tree species which have colonized the deforested plots are different from those in mature forest areas. They tend to be more aggressive species which grow at faster rates. “These pioneers grow fast, occupy the space that has been cleared and, in the process, they bring shade and the conditions which allow the more mature forest species to develop. However, it’s a very long process.” The initial pioneer species may be fast-growing, but they are also relatively short-lived.

Investigations of the sample plots around the Canguçu Research Centre have shown that each hectare in the area typically contains some 100 tonnes of carbon above ground. Moreover, in the cerrado (savannah) areas, there could be around 100 tonnes of carbon per hectare below ground level, accumulated in the soil. Consequently, the Canguçu researchers reckon that the ongoing clearance of large areas of cerrado in the Bananal Island region results in the release into the atmosphere of very considerable amounts of carbon, provoking changes in the micro-climate and making a significant contribution to climate change on a larger scale.

What interests the North American Space Agency (NASA), which is one of the institutions participating in the LBA programme, is whether environmental degradation in the Brazilian Amazon region has repercussions in the Caribbean and other regions in the form of hurricanes and other storm events. LBA research in the Bananal Island region involves the monitoring of an area of 7.5 hectares, spread over some 30 plots measuring 50m x 50m (164 ft x 164 ft).

“We are looking at the quantification of biomass and of carbon uptake. This research will also enable us to develop our understanding of carbon
cycles in regional ecosystems. We lay out mesh to collect all the material that falls to the ground in the forests, and this helps us to measure the amount of carbon that is liberated or lost from the ‘stock’ held in the forest,” Dariusz explains. Other techniques are used to assess the amount of wood produced and tree mortality rates, and to measure the respiration rates in the soil, the leaf litter and of the trees themselves.

**Institutional Partnerships**

The first results of the research into the biomass and carbon content of regional ecosystems were released in 2000, with the publication of the first edition of the book, “Seqüestro de Carbono: Uma Experiência Concreta” (Carbon Sequestration: A Practical Experience). The dissemination of these results caught the attention of scientific circles, and attracted interest to the Canguçu Research Centre and its activities in the carbon sequestration field. Until then, all the research work at Canguçu had been conducted independently, without any technical or financial assistance from scientific institutions.

At about the same time, the LBA programme was setting up an experiment in different parts of the Brazilian Amazon with two main objectives: to investigate gaseous exchanges (of carbon dioxide, methane, etc.) between terrestrial ecosystems and the atmosphere in the Amazon rain forest, and to increase the understanding of interactions between the forest and the atmosphere from a meteorological point of view, in terms of their effects on rainfall and other factors in a global context.

In 2000, Canguçu was included in this ambitious research project, a move which greatly strengthened Ecológica’s ability to draw in additional funding to sustain its activities at the research station. Scientists of some renown, such as Dr. Humberto Rocha, from the Astronomy, Geophysics and Atmospheric Sciences Institute at the University of São Paulo, began the Canguçu facility.

Several research projects were drawn up and applications for funding were submitted to a number of sponsor organizations, but it was not until 2003 that the first instalments were received, enabling work on these
Social carbon: Adding value to sustainable development

projects to begin. A total of eight research scholarships were awarded by the National Research Council (CNPq), and Canguçu was recognized by the Ministry for Science and Technology as an emerging research centre in the Amazon region. A major Brazilian cosmetics company, Natura Cosméticos, also supported the continuation of research activities at Canguçu, providing funding for researchers and equipment over a two-year period.

As part of Canguçu’s involvement in the LBA programme, research agreements were also signed with the University of Tocantins (Unitins), the University of Brasília (UnB), the University of São Paulo (USP), the Federal University of Goiás (UFG) and the Lutheran University of Brasil (Ulbra).

Activities in 2003 will include the construction of a tower, 130 feet high, which will be fitted with equipment to monitor fluctuations in carbon dioxide (CO2) concentrations over an area of 2,470 acres. The tower will be located in an area of seasonally flooded forest and, in addition to CO2 measurements, it will monitor hydrological parameters, including floods in the rainy seasons, and the duration and intensity of the dry seasons. There are estimates that the establishment of the monitoring tower will increase the attraction of the Canguçu facility and draw more researchers there.

Although environmental research stations were operating in Brasília, Belém, Santarém and Manaus, prior to the inauguration of the Canguçu Research Centre, there was no facility for advanced environmental research in the central part of Brazil. The establishment of Canguçu in this region of the country was a considerable achievement and a significant advance for the scientific community, at both national and international levels.

The Bio-Architecture of Canguçu

During the rainy season, the water level of the Javaés river rises 22or 26 feet, and the Canguçu area is therefore subject to flooding – sometimes to depths of 3.3 feet or more. For this reason, the Centre was built on stilts, which keep it above the high water-mark and which also allow local wildlife to roam freely through the site. Often, the tracks of animals such
as jaguars and tapirs can be discerned beneath the accommodations and, when the area is flooded, alligators feed below the kitchen.

The facility's structure is made of wood with roofs of palm-leaf thatch set on high ceilings, allowing air to circulate freely and ensuring that temperatures remain relatively cool even on the hottest days. The sewage system is completely sealed and based on charcoal filtration. The whole construction was made from local materials – the palms used for the roofs, for example, are abundant in the region and the thatch was woven by people living nearby.

The Canguçu Research Centre stands at the heart of a unique and virtually untouched natural environment, featuring tropical forest, cerrado (savannah) and swampland components interspersed with rivers, lagoons and beaches. It is a remote location which can be accessed by a single-track dirt road during the dry season (May-November). From December to April, depending on river levels, it can only be reached by boat. The Centre's innovative architectural design and the local materials used in its construction ensure that the building fits harmoniously into its natural setting.

The facility is comprised of four modules interlinked by elevated walkways. The first module contains the research rooms, the meteorological monitoring facility, the restaurant, kitchen, storeroom and generator. The second module, houses the ancillary services – laundry, bathrooms, and service quarters. The en-suite accommodation units are located in a third module and then there are two bungalows which provide lodging for researchers and support staff.

Facilities at Canguçu are being gradually extended, and as part of this process a Turtle Nursery and Aquarium have been installed in the Centre's grounds. The purpose of this unit, which is currently nearing completion, is to facilitate studies of turtles kept in captivity. This research will help provide guidelines for the establishment of turtle-rearing enterprises which would help to draw off pressure on wild populations and also provide a much-needed source of employment and income generation in this economically deprived region of the country.

The Turtle Nursery and Aquarium will also serve to support and illustrate environmental education activities held at the Centre. The idea
is for school groups to visit Canguçu to learn more about the importance of regional ecosystems, forests and biodiversity and the need for conservation in face of the threats to these precious resources.

**Illustrious Visitors**

The Turtle Nursery and Aquarium were inaugurated on March 5, 2002 by Prince Charles, the Prince of Wales, on a visit to Brazil. Former Environment Minister, José Sarney Filho, has also visited Canguçu to preside over the opening ceremony. Leading scientists in the field of climate change, and government officials involved in policy-making on this issue, have also visited the Centre, as have representatives from the National Research Council (CNPq), and the Ministry of the Environment, Science and Technology.

In August 2001, a major event on renewable energy for the Amazon region was held at Canguçu. The meeting focused on alternative sources of energy for isolated communities and was attended by World Bank representatives, Brazilian government ministries and staff from organizations working in both the public and private sectors.

Several training workshops related to the delivery of ecotourism services have been held at the Centre, including courses on bird-watching. A series of meetings involving more than 250 local teachers were also held to draft the Learning with Nature handbook and to train the teachers in the classroom application of the materials it contain.

All the results of the various research initiatives at the Centre are collected in a database that can be accessed on the Internet. Construction of the Canguçu database was funded by a number of Brazilian institutions. The database contains maps and information enabling all the knowledge generated at the Centre to be shared with scientists in local, national and international universities, research institutions and members of the general public.

Instituto Ecológica has no permanent sponsor and, in consequence, research activities at Canguçu are sometimes interrupted because of funds’
shortage. To its great credit, however, Ecológica perceived the region’s potential and relevance for environmental research and has succeeded in attracting a range of partners to build the existing knowledge base. By bringing sponsors, researchers, universities and collaborative initiatives such as the LBA programme to the Canguçu Research Centre, Ecológica has been able to consolidate the Centre’s reputation and to gain international recognition for the work undertaken there. In 2004, the research facility will celebrate five years of activity contributing to environmental research, skills building and scientific development.
CHAPTER 5

Social Carbon
Introduction

Social carbon is carbon preserved or absorbed in terrestrial ecosystems as a result of actions that improve the livelihoods of local communities who live and interact with emissions-reduction/climate-change projects in ways that strengthen the communities’ well-being and citizenship—without degrading their resource base.

The Social Carbon concept arose from the need to ensure that projects designed to reduce or mitigate emissions of greenhouse-effect gases could make a genuine contribution to sustainable development, incorporating a transparent method of assessing and measuring the benefits obtained by communities involved in the projects and making sure that the environmental services provided by those communities are properly valued. Carbon sequestration and climate-change mitigation projects have time horizons which stretch at least 25 years into the future. The involvement of the affected communities through participation in the project’s process and in the benefits it generates is the only guarantee of the project’s achievement on the long term.

The concept was built on five years’ experience in the implementation and management of the two phases of the Bananal Island Carbon Sequestration Project. Project activities in the first phase were focused on five municipalities located east of the Island, and were subsequently extended to include indigenous communities on Bananal Island itself.

The Social Carbon concept was developed in close conjunction with local communities, analyzing their problems, and proposing feasible solutions associated with projects focused on sustainable development and climate
change. Another feature of the concept is that it maintains or increases the strengths and capabilities of local communities, without eroding or otherwise damaging the resources (social, environmental, etc.) they have at their disposal.

Methodology Development

The Social Carbon approach has been monitored, evaluated and perfected over the past five years. During this period, a series of socio-environmental and poverty-reduction projects have been designed and implemented with local communities, with a view to create a standard participatory approach to emissions-reduction projects which may be eligible for inclusion under the Clean Development Mechanism (CDM). Although the first Social Carbon project was not designed having in mind the CDM, the development of such a standard approach has provided useful indicators to ensure the eligibility of future projects under the criteria defined by CDM’s Executive Board.

The major challenge was to define a methodology which was capable of detecting and monitoring, in a transparent and participatory manner, the changes occurring in a given community. We examined several existing methodologies, but none was deemed suitable to our purposes. We realized that, if we were to have an appropriate tool for analyzing reality and for providing guidance for sustainable-development initiatives addressing climate-change issues, we would have to generate our own methodology – the Social Carbon methodology. This methodology ensures the participation of the community at different levels, and at the same time registers changes that occur over time.

Qualitative assessments of communities targeted under the Bananal Island project using this methodology are set out in the following chapter.

The Social Carbon methodology takes as its framework the sustainable livelihood approach, which is defined as “a way of thinking about the objectives, scope and priorities for development, in order to enhance progress in poverty elimination” (Ashley & Carney, 1999, p. 1). As this approach is directly connected with the concepts of ‘development’ and
‘poverty,’ it may be used in understanding the complex reality of the less fortunate. It is a conceptual system that provides a framework to assist any external support to be consistent with the priorities of the target group.

The Social Carbon methodology incorporates two new parameters into the sustainable livelihoods approach. The first one is biodiversity and the second one relates to carbon resources and carbon management practices (conservation, substitution and sequestration). The addition of these two parameters endows the methodology with a truly holistic vision, and one which is capable of identifying and strengthening activities that assist in the achievement of sustainable livelihoods.

This methodology is already being successfully used in projects accomplished by Instituto Ecológica in Tocantins state, and it is fully applicable to other emissions-reduction/climate-change projects which incorporate community development initiatives.

The methodology may be applied to different processes, including: survey design, monitoring and evaluation of development projects, guidance for the formulation of government policies aimed climate change and communities, analysis of environmental services provided by traditional communities, and analysis of social benefits derived from climate-change projects.

An example of the practical application of the Social Carbon methodology can be found in the Barranco do Mundo settlement near Bananal Island, in south-western Tocantins. There, the small-holder, José Wilson Bezerra Leite, has seen real change in his family’s life since the adoption of the Social Carbon project. “I have allocated part of my land for agroforestry. Before that, we used to clear the land completely, whereas now we are planting native species with the crops. Now we take care of the local forests, which we didn’t bother about before, and we carefully think about what we plant. I have even given a few saplings of native species to a colleague of mine and he says they’re starting to look really good.”

In José Wilson’s world, deforestation was the only way to turn land productive, whether for pasture or for subsistence crops, such as rice, beans, maize, cassava and pumpkin, which provide the basic foodstuffs for his family. Now, however, he and his family are beginning to
discover new possibilities that are more tuned with the ecosystem where they live.

“Our agroforestry system was set up to deliver yields in the long term, but Ecológica is being very innovative here and should carry on and do more. It’s a pity their resources are limited. If Ecológica doesn’t keep working here with us, the other settlers who aren’t very aware yet, will destroy all of this. It’s very beautiful here. The settlement is 1.5 mile wide and about 2.5 to 3 miles long. I’ve been talking with some other settlers about establishing a wildlife corridor here at the entrance. There’s no point in protecting a certain area if my neighbor doesn’t do the same. The wildlife would have no way of getting to or from it. If this gets cut down, in a short while from now we won’t see any deer any more, and there’ll be no more armadillos.”

The Social Carbon Methodology

The methodology consists of:

1. Basic guidelines for initiatives undertaken with local communities.

2. A conceptual framework which generates a panorama of the situation encompassing various elements:
   - Perspectives, resources, strategies, challengers and opportunities, political organizations and social relations.
BASIC GUIDELINES

1. Community-centred.
2. Values people’s potential and resources.
3. Participatory, holistic, dynamic and flexible.
4. Deals with local and global issues.
5. Geared towards analysis of local ecosystems and their biodiversity potential.
7. Strives for social inclusion and recognizes gender issues and the forms of social difference.
8. Takes account of existing power relations and the political context.

The methodology’s perspective is community-centred, it respects people’s opinions and tries to support the community in its search for ways to achieve its goals and aspirations.

It values people’s potential and resources, looking not just at what is lacking, but recognizing and valuing what people have, what they know and their skills, awaking the potential in each person.

It is participatory, holistic, dynamic and flexible, using different methods to promote participation, ensuring that people can provide input at all stages of projects and programmes, encouraging the community to assume ownership of project assets and activities, with specific interventions being grounded in a holistic analysis of the local situation.

It identifies the impacts of global changes on the local scenario, encourages analysis of local actions in a wider context, and considers the influence of institutions and government policies in ways that highlight political and social tendencies which may be strengthened or weakened through partnerships.

It analyzes local ecosystems and their biodiversity potential, identifying areas of possible ecological tension, giving value to and promoting the use
of traditional knowledge, and enabling the continuous monitoring of flora and fauna.

It is geared towards problem-solving and the search for sustainability, is not unduly influenced by immediate short-term pressures, but proceeds in a way to ensure that sustainability for one does not imply vulnerability for others.

It strives for social inclusion and recognizes gender issues, promoting improved living standards among the less well-off by reducing social inequalities based on gender, race, class, age, sexual orientation, religion, geographic location and other factors.

It takes into account existing power relations and the political context, seeking equality and promoting citizens’ rights and consideration of the political context in the discussion process.

**Conceptual Framework**

The following items are considered as elements of the methodology:

- Perspectives, resources, strategies, challenges and opportunities, political organizations and social relations

The consideration of perspectives throws light on what the communities want, their dreams and aspirations, and attempts to fulfil their visions of the past, present and future.

The parameters of sustainable development considered under the Social Carbon methodology make use of the definition of sustainable livelihoods originally developed by Robert Chambers and Gordon Conway (Chambers & Conway, 1992) and slightly modified by Scoones:

“A livelihood comprises the capabilities (a term created by Amartya Sen), assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base” (Carney, 1998; p. 4).
Chambers and Conway define sustainable livelihoods as an integrating concept that links equity, capability and sustainability. Equity can be defined as incorporating relative income distribution, a more equal distribution of assets and less discrimination, especially against women and the less educated. Capability, as defined by Amartya Sen (Sen, 1984, cited in Chambers & Conway, 1992), refers to the ability to possess certain basic qualities, including what a person is objectively capable of doing, how able they are to cope with stress and shocks, and how they make use of opportunities for survival.

The authors define shocks as sudden, unpredictable and traumatic events, for example, fires, floods and epidemics. Stresses are pressures which are continuous and cumulative, and are generally predictable, such as, for example, seasonal shortages. Capability can include access to food and income, and to assets which may be tangible or intangible. Examples of tangible assets include financial resources and stocks, while intangible assets include the ability to gain access to different areas. The definition of ‘sustainability’ has given rise to innumerable variables and versions since the classic formulation put forward by Lester Brown in the 1980’s, extolling the quality of actions which, in satisfying the needs and aspirations of present generations, do not harm the ability of future generations to meet their own needs and aspirations.

Scoones was responsible for the development of a framework for investigating the degree of sustainability of a given livelihood. He states that this framework can be applied at a range of scales, at the level of an individual, a household, a community, a town, a region or even a nation (Scoones, 1998; p. 5). The author, arguing that the ability to pursue different livelihood strategies is dependent on the basic material and social assets that people have in their possession, identifies five different types of assets which have been defined as ‘resources’ or ‘capitals.’ They are: natural, economic or financial, human, social and other. The Social Carbon methodology has adopted the first four resources defined by Scoones and incorporated two additional resources: biodiversity and carbon.
Biodiversity resources: the species, ecosystems and genes which make up the biological diversity of a given region. Relevant aspects of this component are: the integrity of natural communities, the way humans use and interact with biodiversity, the degree of conservation, the pressures and threats imposed on native species and the existence of high-priority conservation areas or conservation ‘hotspots.’

Natural resources: the natural resource stocks (soil, water, air, etc.) and environmental services (soil protection, maintenance of hydrological cycles, pollution sinks, pollination, etc.) from which resources for livelihoods are derived.

Financial resources: the basic capital (cash, credit/debt, savings and other economic assets) which is available to people and which provides them with different livelihood options.

Human resources: the skills, knowledge, ability to work and good health that people have. Taken together, these become fundamental for the successful pursuit of different livelihood strategies.

Social resources: the social resources (networks, social duties, social relations, relationships of trust, affiliations, community associations, etc.) upon which people draw when pursuing different livelihood strategies.

Carbon resources: refer to the type of carbon management being practised, which may be categorised as sequestration, substitution, or conservation.

In conceptualizing the Social Carbon methodology, a visual representation in hexagonal form was drawn up, showing the assets which people possess. The sustainability of a livelihood can be verified by measuring, for example, increases in quality of life or in monthly income, or a reduction in risks and vulnerability, improved food security and more sustainable use of the natural resource base. However, such outcomes maybe subject to various forms of interference. For instance, if people’s aim is to accumulate a large
amount of financial resources, it may end up diminishing the resources held by others, or lead to an unsustainable use of natural resources. The interaction with biodiversity and the type of carbon management adopted may also have a significant influence on the dynamics of sustainability.

In the figure 1, the centre of the hexagon represents zero access to assets or resources, while the external border represents maximum access. Each axis of the hexagon can be scaled from 0 to 6 in order to reflect the levels of access to each of the six resources. It is also important to attempt to take account of the level of access to the different resources enjoyed by each member of a group. This is because it is easy to overlook gender problems and social issues, due to the difficulty of measuring intangible assets. The figure below illustrates how the access to a given resource or asset is constantly changing, and consequently the shape of the hexagon will also be constantly shifting.

A Social Carbon project must do more than focus on a single resource, therefore Social Carbon methodology requires a more holistic approach. For this reason, it is important to realize that, in a given intervention in
a community, the objective may be to help people to develop the capabilities and the flexibility required to alter their survival strategies over time. Survival strategies can be defined as the combination of activities and choices that people make to achieve their livelihood objectives.

The resource hexagon illustrated above is a useful tool to help identify the reality of a given community. What is problematic is evaluating the interaction between the various resources and identifying the best way to change the shape of the hexagon for the better. In other words, it is difficult to define what might be the ideal level for one resource in relation to another. Despite this, the Social Carbon methodology can contribute to a better analysis of the communities’ access to different resources. The understanding of this reality may help resolve the problem of lack of connection between government policies and the real needs of target communities, ensuring that development is harmonious and truly sustainable.

**Social Carbon Methodology Indicators**

**Carbon resources**: the types of carbon management practices adopted – reforestation, agroforestry systems, conservation, etc. – regardless of whether these practices are eligible for inclusion under the Clean Development Mechanism or not. At present, only practices which promote the substitution and sequestration of carbon are eligible; carbon conservation is not eligible under the mechanisms established by the Kyoto Protocol.

**Biodiversity resources**: the project is located within a ‘hotspot’ area, or in areas of importance for conservation and/or biodiversity, harbouring a number of threatened species or ecosystems of economic importance that experience a strong anthropogenic impact.

**Natural resources**: the project results in lower rates of deforestation, a stabilization or increase in fish and wild game stocks, and improvements in the quality of soils and water resources.
**Financial resources:** the project results in increased ability to obtain credit, increased participation in goods and service markets, and higher levels of household income and savings.

**Human resources:** the project results in improvements in family health, increased adult literacy, an increase or improvement in the professional skills of a household, especially with regard to agricultural, livestock and extractivist technologies.

**Social resources:** the project results in increased participation in civil organizations, an increase in the number of people capable of taking collective decisions for the benefit of the community, increased adherence to and actions by institutions representing the local community, resulting in a reduced dependency on government intervention.

These indicators should be set out and used to detail the benefits and impacts arising from a project included under the Clean Development Mechanism (CDM), and/or other climate-change mechanisms. It is of fundamental importance to understand local aspirations, evaluate the level of interference by policies, institutions and processes, verify the survival strategies used by the community, define the results to be achieved and contextualize the vulnerabilities to which the community is subject, so that one can identify the specific contributions of the CDM project to the community, be these positive or negative.

The flow chart below shows how the Social Carbon analysis includes interactions on a number of different levels, and the various influences and effects that may be generated by a given project.
The flowchart shows that livelihoods depend on the community’s aspirations, the survival strategies adopted, the vulnerabilities to which population is exposed, and the many and varied influences generated by projects, policies, institutions and processes.

**Carbon Management Strategies**

In the conceptualization of Social Carbon for forestry or land-use change projects, three general strategies of carbon management are considered: sequestration, conservation and substitution.
The main activities associated with each kind of carbon management are detailed in the table below.

<table>
<thead>
<tr>
<th>Social carbon management</th>
<th>Carbon sequestration</th>
<th>Carbon substitution</th>
<th>Carbon conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of land use and activities which may be implemented.</td>
<td>Reforestation; Silviculture; Fruit production; Agroforestry systems; Restoration and regeneration of degraded areas.</td>
<td>Deforestation for energy purposes; Use of biodiesel; Use of biomass as a fossil fuel substitute; Use of agricultural and forestry by-products and residues.</td>
<td>Establishment of private nature reserves; Use of low-impact forest management practices in place of conventional forestry; Protecting forested areas from damage by fire.</td>
</tr>
</tbody>
</table>

For a better understanding of the kinds of activities associated with each carbon management category, the table below shows the types of forestry and rural-development project which could be considered under each category.

It should be noted that the Social Carbon concept is not restricted to forestry projects, and may be suited to renewable energy schemes, landfill projects, etc. The key distinguishing feature of the concept is the centrality of community participation and social benefits in the Social Carbon methodology.
Social carbon management | Project types
---|---
CARBON CONSERVATION | Conservation and preservation
| Intensive agriculture
| Crop rotation
| Community-based fire prevention measures
| Urban nature reserves
| Non-timber forest products
| Ecotourism in conservation areas

CARBON SEQUESTRATION | Restoration and regeneration of degraded areas
| Silviculture, fruit production, reforestation
| Agroforestry systems

CARBON SUBSTITUTION | Community-based forestry for fuel wood
| Use of biomass from crop and forestry residues
| Charcoal production
| Use of biodiesel for transportation purposes

Applications of the Social Carbon Methodology

Use of the Social Carbon methodology has clearly shown that the survival strategies of communities in the Bananal Island region are precarious, mainly because they are based on fragile social resources and the degradation of the natural resource base. Small- and medium-scale producers account for only a small part of the regional land area and, even though they cause environmental degradation, their impact is minimal compared to that resulting from the agricultural and ranching activities of large landowners. The problem, however, is that the degradation caused by small-and medium-scale farmers has a direct impact on the environment’s capacity to support the livelihoods of the most needy rural communities.

Even though, over the last decade, the federal government has changed its policies towards the rural poor, its initiatives are still insufficient to meet demand which has been repressed for years. The staff of government
institutions need better skills and more experience to serve this public, who has not previously had access to credit facilities, and the rural poor themselves also need to know how to get what is theirs by right.

As discussed in an earlier publication\(^1\), it is clear that Social Carbon projects provide a great opportunity of working with local communities to reinforce and extend their ability to achieve sustainable livelihoods. To this end, community organizations need to be strengthened so that they can respond better to local needs. Otherwise, environmental degradation will jeopardize the community’s survival and will also have a negative impact on projects that aim to preserve the carbon-dioxide absorption capacities of local ecosystems.

The Social Carbon methodology provides a useful tool to evaluate the social benefits generated by climate-change projects. Firstly, because it offers the chance to use participatory techniques, and secondly because natural and social resources or ‘capitals’ may be analyzed in association with other resources, or in isolation. The methodology may also be used to evaluate government policies, which are fundamental for the successful management of natural resources. Finally, the methodology works with the survival strategies of local populations, which are clearly important in terms of natural resource conservation.

The small-holder, Milton Barbosa, has learned a lot in the eight years that he and his wife have lived in the União II settlement, near Caseara, especially in the last five years when Instituto Ecológica has been working in the community. “The ideas that Ecológica have brought here have been a great help, and things are going to be better in the future for my children and grandchildren, who are going to benefit from the results of the work we are doing. I’m starting something which they will see bear fruit. We learn things, and become more aware, and pass this understanding on to our children.”

Evidence of the success of the Social Carbon concept can be observed in the degree of awareness of people, especially those who have lived longer

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in the settlements, and which is gradually spreading amongst the target populations. “We often do the wrong thing because we don’t know better. Before, for example, I used to burn off everything on my land in the belief that I was improving it, whereas now I can see that I was actually making it worse. Nowadays, I don’t even burn the rubbish, because I use it to make organic compost. I hardly ever buy artificial fertilizers any more,” Milton comments.
CHAPTER 6:

Qualitative community analysis using the social carbon methodology
Introduction

The Social Carbon concept has been described in the preceding chapter. The objective of this chapter is to show how the Social Carbon methodology has been used to provide a qualitative analysis of the benefits generated by the first Social Carbon project (the Bananal Island Carbon Sequestration Project), and how it may be applied to other projects geared towards community development and the mitigation of climate change.

Research Methods

The first phase of the qualitative analysis performed was conducted in Palmas, with the collection of statistical data from State Secretariats, and the Brazilian Institute for Geography and Statistics (IBGE).

In the second phase, participatory methods were used to gather information from the inhabitants of rural communities. The research methods used included: tendency analysis, individual interviews and drawings expressing respondents’ perceptions of the possible future. The field work was conducted in December 2000, following an initial survey carried out in June 1999 in the municipalities of Caseara and Pium, with one rural settlement (União II) being targeted in the former municipality, and two settlements (Barranco do Mundo and Pericatu) in the latter. A total of 201 people were interviewed; their gender and age profiles are summarized in the table below.
Tendency analysis: 160 adults were asked to discuss changes which had occurred in different aspects of their lives from the time they first arrived in the community to the present day. They were also asked to discuss their perceptions of how those same aspects may develop in the future over a 10-year horizon.

Drawing possible futures: 41 children, aged up to 14 years old, were asked to draw pictures of what their community might look like in 10 years’ time.

b) Interviews

Semi-structured interviews were conducted with certain key informants in order to indirectly obtain information on the six resource types established by the Social Carbon methodology (discussed in the previous chapter).

The purpose behind the application of the Social Carbon Methodology was to support activities conducted as a part of the social component of the Bananal Island Carbon Sequestration Project. Activities under this component have been sponsored by a number of institutions, chief among them the AES Barry Foundation and the Brazilian cosmetics firm, Natura Cosméticos. Through partnerships such as these, Instituto Ecológica has been working to improve living standards amongst local communities by means of training courses on health issues, environmental education, and
sustainable production alternatives, involving the populations of the rural settlements described in this chapter.

Building the Community Resource Hexagon

On completion of the field work, the next phase involved the systematization of the information gathered. During this phase, apart from relating the experiences in the field and the observations made from them, efforts focused on putting together a picture of the resources and services available to the inhabitants of the surveyed communities.

One of the main challenges in the methodology’s conception and in its application was related to the valuing of resources which required to establish the indexes used to build the resource hexagon. In order to facilitate this process, an index of 1-6 was chosen, with 1 representing the lowest level of availability and/or access to resources, and 6 signifying maximum access or availability. Various aspects of the resources analyzed under the methodology’s holistic framework (biodiversity, carbon, human, social, financial and natural) were considered in discussions held by the field work team, taking into account the reality perceived by the community concerned.

For the natural resource index, factors analyzed included the degree of fragmentation in local ecosystems, the amount of protection they are afforded, and the kind of management to which they are subject.

With regard to the social resource, factors taken into account included the degree of community organization (as indicated by the existence or absence of formal associations or community groups) and the presence of support agencies (especially those of a religious character), family networks, and the existence or absence of internal conflicts and whether those conflicts were provoked by agents external to the community itself.

For the human resource index, the factors analyzed included the level of formal education, disease incidence, attitudes towards work, the leisure options available, professional skills and technical competence, taking into account access to technical extension services.

For biodiversity, the aspects considered related to the integrity of natural communities, the use made of them by local residents, and the
occurrence of species of conservational interest (endemic, rare, threatened, migratory, and keystone species).

Under the carbon resource, the elements considered included transaction costs, project types and eligibility under the terms of the Clean Development Mechanism (CDM), the community’s involvement and participation and the social and economic returns of CDM projects.

Finally, to assess a community’s financial resource, the factors considered included access to credit, ease of commercialization for agricultural produce and for the products of extractive activities such as fishing, hunting, logging, and also for non-timber goods, monthly income, the state of the local labour market and the indebtedness level.

The following tables set out the criteria used to establish the indexes that, taken together, make up the hexagon of the Social Carbon methodology.
## Biodiversity

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biodiversity</strong></td>
<td>Natural communities are totally degraded with non-native species predominating.</td>
<td>Natural communities are strongly degraded; common species of little conservation interest predominate.</td>
<td>Natural communities are reasonably well preserved but exhibit visible signs of disturbance (absence of indicator species).</td>
<td>Natural communities are well preserved in legally mandated conservation areas.</td>
<td>Natural communities have been subject to little disturbance and exhibit high levels of diversity in legally mandated conservation areas.</td>
<td>Natural communities are undisturbed or almost intact in legally mandated conservation areas.</td>
</tr>
<tr>
<td>Biodiversity is either not available or is not used by the local human population.</td>
<td>The local population make very little use of available biodiversity.</td>
<td>Biodiversity is reasonably well used by the local population.</td>
<td>Significant use is made of biodiversity, which provides a considerable proportion of the nutritional and medicinal needs of the local population.</td>
<td>Biodiversity is widely used by the local population which is heavily dependent on native species.</td>
<td>Biodiversity is heavily used by the local population which has an intrinsic dependence on native species.</td>
<td></td>
</tr>
<tr>
<td>Complete absence of species of conservation interest.</td>
<td>Species of conservation interest are rare, or their populations are declining rapidly.</td>
<td>Species of conservation interest occur sporadically and their populations show moderate rates of decline.</td>
<td>Occurrence of a small number of species of conservation interest, exhibiting slight population decline.</td>
<td>Occurrence of a reasonable number of species of conservation interest, whose populations are stabilizing.</td>
<td>Occurrence of several species of conservation interest, whose populations are stable or increasing.</td>
<td></td>
</tr>
</tbody>
</table>
### Monitoring biodiversity indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Method of evaluation</th>
<th>Responsibility</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural communities</td>
<td>Field surveys</td>
<td>Multidisciplinary team</td>
<td>Biannual</td>
</tr>
<tr>
<td>Use of biodiversity</td>
<td>Interviews with local inhabitants</td>
<td>Any professional</td>
<td>Biannual</td>
</tr>
<tr>
<td>Species of conservation interest</td>
<td>Interviews with local inhabitants</td>
<td>Multidisciplinary team</td>
<td>Annual</td>
</tr>
<tr>
<td></td>
<td>field surveys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>-------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Native ecosystems account for less than 1% of the regional area and are highly fragmented.</td>
<td>Native ecosystems enjoy minimal legal protection.</td>
<td>Native ecosystems enjoy a reasonable level of legal protection.</td>
<td>Native ecosystems are afforded the minimum level of protection provided for under the law.</td>
</tr>
<tr>
<td>Socioeconomic activities have a high level of impact on native ecosystems.</td>
<td>Socioeconomic activities cause a moderate impact on native ecosystems.</td>
<td>Socioeconomic activities result in minimal impact on native ecosystems.</td>
<td>Socioeconomic activities are undertaken in a sustainable manner.</td>
</tr>
<tr>
<td>Water resources are not available for use by local communities.</td>
<td>Water resources are available for use by local communities at a high cost.</td>
<td>Water resources are available at low cost but are used in an unsustainable manner.</td>
<td>Water resources are readily available at low cost, are of good quality and are used in a sustainable way by local communities.</td>
</tr>
</tbody>
</table>
## Monitoring natural resource indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Method of evaluation</th>
<th>Responsibility</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation cover</td>
<td>Analysis of satellite imagery</td>
<td>Geoprocessing specialist</td>
<td>Annual</td>
</tr>
<tr>
<td>Legal protection</td>
<td>Surveys conducted in conjunction with government agencies at federal, state and municipal levels</td>
<td>Any professional</td>
<td>Biannual</td>
</tr>
<tr>
<td>Impact of human activities</td>
<td>Surveys of vegetation structure and species composition in affected areas</td>
<td>Multidisciplinary team</td>
<td>Biannual</td>
</tr>
<tr>
<td>Water resources</td>
<td>Collection of physical and chemical data on water resources</td>
<td>Specialist in limnology</td>
<td>Biannual</td>
</tr>
</tbody>
</table>
## Social Resources

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Resources</td>
<td>Absence of formal community associations; individualism predominates, in other words, it's every one for him/herself.</td>
<td>Community organizations exist but they lack structure and are riven by internal conflict.</td>
<td>Community organizations exist and those in charge are keen to strengthen the group.</td>
<td>Community organizations exist and are headed by people who are recognized as leaders by the community.</td>
<td>Leaders of community organizations are motivated and relatively experienced.</td>
<td>Organizations which internalize the sense of community exist and are headed by capable and experienced leaders.</td>
</tr>
<tr>
<td>Family networks are non-existent or highly fragmented.</td>
<td>The community is very vulnerable to external influences, especially from local politicians.</td>
<td>Few intractable internal conflicts.</td>
<td>Internal conflicts are amenable to resolution.</td>
<td>Few internal conflicts.</td>
<td>No internal conflicts, or none which the group is unable to tolerate or resolve.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate vulnerability to external influences.</td>
<td>People have an interest in the collective and in teaming up with other community members.</td>
<td>Little vulnerability to external influences.</td>
<td>Minimal vulnerability to external influences.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Monitoring social resource indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Method of evaluation</th>
<th>Responsibility</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social relations</td>
<td>Participatory methods and interviews</td>
<td>Social scientist</td>
<td>Annual</td>
</tr>
<tr>
<td>Community organizations</td>
<td>Participatory methods and semi-structured interviews</td>
<td>Social scientist</td>
<td>Annual</td>
</tr>
</tbody>
</table>
### Human Resources

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most people have had only 2-3 years’ schooling.</td>
<td>Young people have had 4 years in school.</td>
<td>Young people have spent 6 years or more in school.</td>
<td>Young people have more than 6 years’ schooling and have access to school.</td>
<td>Young people have access to school and, though many of them have completed their primary education (to age 16), they are not interested in continuing their studies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High incidence of disease, especially tropical diseases, and almost no access to hospitals or doctors.</td>
<td>Disease incidence mainly confined to children and the elderly, but there is little access to hospitals or doctors.</td>
<td>Diseases occur and there is quite some difficulty in accessing hospitals and doctors.</td>
<td>Few diseases but some difficulty in accessing doctors and hospitals.</td>
<td>Low disease incidence and little difficulty accessing doctors and hospitals.</td>
<td>Very low disease incidence and easy access to hospitals and doctors.</td>
<td></td>
</tr>
<tr>
<td>Little access to extension services.</td>
<td>Little access to extension services, but awareness of their existence.</td>
<td>Some technical assistance available in planning agricultural projects but without any ongoing extension service.</td>
<td>Access to extension services on a fairly regular basis.</td>
<td>Regular access to extension services.</td>
<td>Access to extension services is a routine part of production activities.</td>
<td></td>
</tr>
<tr>
<td>People have no incentive to work.</td>
<td>People have little incentive to work.</td>
<td>People have some incentive to work.</td>
<td>People want to work, but find it hard to know what to do.</td>
<td>People ready and willing to work.</td>
<td>People are very keen and eager to work.</td>
<td></td>
</tr>
<tr>
<td>Near absence of professional skills.</td>
<td>Few people have professional skills.</td>
<td>Some people have professional skills.</td>
<td>People have professional skills but these need upgrading.</td>
<td>Presence of skilled professionals.</td>
<td>Presence of skilled professionals of various types.</td>
<td></td>
</tr>
<tr>
<td>No leisure.</td>
<td>Leisure activities consist of visiting other family members.</td>
<td>Leisure activities consist of short journeys and sport.</td>
<td>Leisure activities consist of excursions and sport.</td>
<td>Leisure activities consist of sporting competitions, religious festivals, excursions and bathing in local rivers, water-holes etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Qualitative community analysis using the social carbon methodology**
### Monitoring human resources indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Method of evaluation</th>
<th>Responsibility</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Site visits, interviews, and group discussions with community members</td>
<td>Social scientist familiar with the local reality and with participatory techniques</td>
<td>Annual</td>
</tr>
<tr>
<td>Health</td>
<td>Site visits, interviews, and group discussions with community members</td>
<td>Social scientist familiar with the local reality and with participatory techniques</td>
<td>Annual</td>
</tr>
<tr>
<td>Technical assistance</td>
<td>Site visits, interviews, and group discussions with community members</td>
<td>Social scientist familiar with the local reality and with participatory techniques</td>
<td>Annual</td>
</tr>
<tr>
<td>Professional skills</td>
<td>Site visits, interviews, and group discussions with community members</td>
<td>Social scientist familiar with the local reality and with participatory techniques</td>
<td>Annual</td>
</tr>
<tr>
<td>Leisure options</td>
<td>Site visits, interviews, and group discussions with community members</td>
<td>Social scientist familiar with the local reality and with participatory techniques</td>
<td>Annual</td>
</tr>
<tr>
<td>Carbon Resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Carbon Resources</td>
<td>High project transaction costs.</td>
<td>High project transaction costs but with matching funds from communities concerned.</td>
<td>Transaction costs paid up front by the financial agents (to be recouped later).</td>
</tr>
<tr>
<td>Projects geared towards carbon conservation, ineligible under the CDM.</td>
<td>Projects with very few activities eligible under the CDM.</td>
<td>Projects with 30% of the activities eligible under the CDM.</td>
<td>Projects with 50% of the activities eligible under the CDM.</td>
</tr>
<tr>
<td>No community involvement in the conception or development of the project.</td>
<td>Little community involvement.</td>
<td>Moderate level of community participation.</td>
<td>Considerable community participation</td>
</tr>
<tr>
<td>The project provides negligible social and economic returns for the community.</td>
<td>Low social returns.</td>
<td>Social and economic returns are adequate, based on the level of community participation.</td>
<td>Satisfactory social and economic returns.</td>
</tr>
</tbody>
</table>

N.B. This consideration of Carbon Resources includes all three types of carbon management practice (conservation, sequestration and substitution) and their eligibility under the Clean Development Mechanism (CDM).
### Monitoring carbon resources indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Method of evaluation</th>
<th>Responsibility</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction costs</td>
<td>Analysis of costs at each phase</td>
<td>Specialist</td>
<td>At start of project</td>
</tr>
<tr>
<td>Eligibility for CDM</td>
<td>Analysis of criteria of Kyoto Protocol, CDM/Baseline/ Project Design Document</td>
<td>Multidisciplinary team</td>
<td>At start of project</td>
</tr>
<tr>
<td>Community involvement</td>
<td>Participatory process</td>
<td>Multidisciplinary team</td>
<td>At start of project and annually thereafter</td>
</tr>
<tr>
<td>Economic and social returns</td>
<td>Semi-structured participatory meetings Information on community income</td>
<td>Multidisciplinary team</td>
<td>Annual</td>
</tr>
<tr>
<td>Financial Resources</td>
<td>People are aware of the existence of credit schemes but have no access to them.</td>
<td>People are unaware of the existence of credit schemes.</td>
<td>People have paid off almost all of their debt and are applying for new loans.</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Commercialization of produce from extractivist activities is virtually non-existent.</td>
<td>Very little production from farming and cattle-raising activities.</td>
<td>Yields from farming and cattle-raising activities are low and there is little commercialization of produce.</td>
<td>People work exclusively on their own land.</td>
</tr>
<tr>
<td>People work mostly as day labourers on neighbouring farms.</td>
<td>People work as day labourers on their own land and also as day labourers on neighbouring farms.</td>
<td>People work on their own land and almost exclusively as day labourers on the household.</td>
<td>People work on their own land and almost exclusively as day labourers on the household.</td>
</tr>
<tr>
<td>Livestock and agricultural production is sufficient for the household and there is a surplus for sale.</td>
<td>Production and sale of produce from agricultural and cattle-raising activities.</td>
<td>Livestock and agricultural production is sufficient for the household and there is a surplus for sale.</td>
<td>Access to consumer markets.</td>
</tr>
<tr>
<td>Food security is guaranteed.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Monitoring financial resource indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Method of evaluation</th>
<th>Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to credit</td>
<td>Interviews with community and financial institutions which provide credit.</td>
<td>Annual</td>
<td>Economist or social scientist with knowledge of existing credit and market systems</td>
</tr>
<tr>
<td>Ease of commercialization</td>
<td>Interviews and market analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour market</td>
<td>Participatory meetings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural and livestock production</td>
<td>Field surveys and interviews</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Settlements Analyzed Using
the Social Carbon Methodology

The União II Settlement

a) Location

The União II settlement is located in the central-western region of Tocantins state, in the Caseara municipality. It lies 20 miles from Caseara itself, and has a total area of 3,207 acres. Access to the settlement from Caseara is via the TO-080 state highway, and then along 5 miles of unpaved road.

b) Brief history

The formal creation of the União II settlement, on January 13, 1995 by the National Institute for Colonization and Agrarian Reform (INCRA) was just another stage in a process that began back in 1992 with the arrival of a landless labourer, Joaquim Onofre da Silva, on the old Cabeceiras dos Porcos Farm. This ranch was owned by Walter Ribeiro and the estate of Ribeiro Bessa, from the town of Bom Jesus in the state of Goiás. Mr. da Silva built a hut near the old ranch house, in which a man named Azarias and his mother, Maria Pereira Dionísio, were living. Azarias was acting as a caretaker of the property and, at first, he did not want da Silva to stay there. However, he was eventually persuaded to let him remain on the strength of da Silva’s promise that, if the land was subsequently expropriated and turned into an INCRA settlement, he would make sure that Azarias also had the ownership of a plot there. When this news got around, other landless labourers began to arrive at the ranch, including Joaquim Alves da Silva, Raimundinho, Emivaldo and Salomão.

With the land occupied, the squatters and INCRA began to negotiate with the ranch owners and, after a series of meetings, a survey and a valuation, the land was expropriated. When this happened, more settlers
arrived, including Chico, Tomé, Valdeci, Daniel, Paulo, Zezinho, Zacarias, Tertuliano, Alaor, Milton, Pedro, José Raimundo, and Augusto.

The expropriation decree called for the settlement of 22 families, but during the demarcation process it was agreed that three additional plots of land would be allocated, making a total of 25 individual plots, plus one plot of community land. These three additional plots were eventually allocated to João de Deus (a resident of Marianópolis), and to Joaquim and Neilton (who worked on the Rincão Farm).

Now, six years since its establishment, União II is considered by INCRA and by rural social movements in the region, to be a successful example of the settlement of landless people on expropriated land.

c) Natural resources

The predominant vegetation in the settlement area is Brazilian savannah (cerrado), merging into a zone of secondary scrub and a small area of forest at the far end of the settlement. With the settlers’ arrival, the cerrado and the scrub began to be cleared to make room for house building, and to open land for pastures and crops. Even so, the settlement still has a number of native vegetation species, including jatobá, carvoeiro, ipê-roxo, ipê-amarello, sucupira, pau-d’óleo, barbatimão, pequi, puçá, araçá, mutamba, macatuba, tucum, buriti, bacaba, and piacava.

The area also has a wildlife reserve, containing animals such as deer, tapir, wild boar, jaguar, foxes, anteaters, and armadillos, birds such as toucans, parakeets and parrots, ducks, macaws, rheas and seriemas, as well as several species of snake. Most of the settlers will not admit to hunting there, but they acknowledge that it does happen, and know of other settlers who would hunt.

d) Production system

The production system that has emerged in the União II settlement relies on family labour, and features areas set aside for crops and cattle raising. The settlers also keep other livestock such as chickens and pigs,
usually on a ‘free range’ basis – for consumption within the household. They feed on rice, maize, cassava and the scraps left over from family meals.

The agricultural plots tend to be planted with rice, maize and beans, grown on their own or interspersed with each other. The area is mainly savannah (cerrado), and crop production there occasionally requires machinery which the settlers usually borrow from the municipal council or from neighbouring ranchers. Produce is harvested and transported by hand and tends to be kept in a partitioned storage area in people’s dwellings.

Dairy cattle are reared on extensive pastures consisting of kikuyo and braquiaria grasses. There are presently an estimated 150 head of cattle in the settlement.

Most of the production activities and the management of production/commercialization are undertaken by men. Women take care of domestic activities and, at certain times of the year, help out with production activities.

e) Infrastructure and services

**Health**

When the settlement was established, there was a high incidence of endemic diseases such as malaria, and dengue fever as well as flu, chickenpox, mumps, pneumonia, and cardio-vascular disease, and there was no health service available in the area. With the implementation of the Community Health Worker Programme (PACS), União II began to benefit from the services of a community health worker, who resides in the settlement and whose responsibility is to effect regular home visits to the various households and to dispatch sick people for treatment at the regional health service.

The residents consider that the health services available in the settlement, and those available in the municipal centre, Casaréa, are inadequate, and often they look for treatment in other towns such as Barreira de Campo or Santana do Araguaia (in Pará state), or Araguaína, Barrolândia, Paraíso and Palmas (in Tocantins) or even Goiânia (in Goiás state).
Education

União II has a municipal school – Escola Santa Bárbara – which teaches infants and juniors together in the same classroom in the mornings. The school has its own building, built in 1998 on communal land. It has 40 pupils, two teachers, and a woman who prepares the school lunch, all of whom are settlement residents.

Dwellings

When they first arrived, settlers worked together to build wooden huts. In 1999, they received government funding for infrastructure, and as a result 22 houses were built on individual plots. These residences consist of two bedrooms, a kitchen, living room, and a bathroom, plus a verandah. Because of the lack of water supply, and also for cultural reasons, some settlers never finished building their bathrooms, or use them only for bathing.

Transportation

The school bus provides a daily service for the settlement and is the most frequently used means of transportation. Apart from this, some people own cars and will give others lifts into town, or even lend them the car in emergencies.

Projects

Since 1999, União II has been targeted by a series of activities initiated under the social and forestry components of the Bananal Island Carbon Sequestration Project (the pilot project for the Social Carbon concept). These include the establishment of a sapling nursery (inaugurated in August 1999), a pilot agroforestry system (established in March 2001) and a production unit making sweets and liqueurs from the fruit of cerrado species (inaugurated in June 2001). These activities are now incorporated into the community life and are helping to promote an agro-ecological approach amongst settlers.
f) Social Organization

The Associação dos Miniprodutores do Projeto de Assentamento União II was established in 1996, headed by Milton Barbosa de Souza. This was the community’s first formal organization and its roots can be traced back to the negotiations which led to the land expropriation and the formation of the settlement.

Through this association, União II secured funding for a number of activities under various agrarian reform programmes, including demarcation (1997), food (1996), and dwellings (1999), as well as assistance from the Procera initiative (which promotes agrarian reform in the cerrado region), delivered in two instalments in 1998 and 2000.

In 2000, during the electoral process which led to the re-election of Salomão Avelino do Nascimento Filho as president of the association, a number of complaints were registered which, in conjunction with allegations of political interference in the elections, resulted in the creation of a women’s association, known as the Associação das Produtoras Rurais de União II, with 13 associate members and a leadership composed of Gercy Alves de Matos (president), Maria Regina Lima de Souza (vice) and Eva Pinto da Silva (treasurer). The aim of this association is to empower the settlement women, through money-making activities such as sowing, knitting, sweet production, etc.

After a process involving some changes and upheaval, the original association has just entered into a new phase, with the selection of a new leadership composed of Paulo Dias (president), Pedro Resende Simões (vice-president), Mariano Pinto da Silva (treasurer) and Jorcelino Alves Santos (secretary). The advent of this new leadership is healing the settlement’s political wounds, and setting a new rhythm for the community, that is now considering to consolidate into a single association.

The land struggle and the experience of united action has fostered a sense of cohesion amongst the settlers, who are managing to resolve their differences and make progress in establishing themselves on the land.
Respondents’ comments on livehoods in União II

<table>
<thead>
<tr>
<th>Resource</th>
<th>Comments</th>
<th>Views in the future</th>
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</table>
| Natural & biodiversity          | **Wildlife:** there used to be a lot of animals such as deer, tapir, paca, armadillos, wild boar, peccary, foxes, anteaters and jaguar and many birds. Now the numbers of some animals – like tapir, deer and wild boar – have decreased a little.  
**Forest/cerrado/pasture:** there used to be forest and cerrado, with vegetation species such as jatobá, carvoeiro, pequi, puçá, aracá, ipê-roxo, ipê-amarelo, sucupira, pau-d’óleo, barbatimão, mutamba, macaúba, tucum, buriti, bacaba and piaçava. There are fewer of these now because land has been cleared and timber felled for crops, houses and boundary fences. | **Wildlife:** if the forests are preserved, the animals will still be there.  
**Forest/cerrado/pasture:** respondents believe there will be more forests, because they are planting a lot of trees, including species which weren’t there before such as teak and aroeira. They hope to have access to technologies which will help them conserve the environment and still enable them to make a living. |
| Financial                        | **Cash/credit:** when they first arrived, money was very tight and what they had came from the sale of their assets and their labour. In 1996, they received financial support which they invested in their small-holdings. Between 1998 and 2000, they received funding instalments from the cerrado agrarian reform programme (Procera). Now, there is an abundance of food, but financial resources are scarce. There are three retired people in the settlement, and three people who work for the municipal council.  
**Agriculture:** at first, they grew rice, maize and cassava in sufficient quantities to meet their families’ needs. They also planted fruit-bearing species such as banana, orange, lime, lemon, mango, cashew, acerola, jaca, jambo, and guava. Nowadays their yields have increased and they harvest, on average, 3,000 sacks of rice, maize and cassava (1 sack = 50 kg). They have diversified production introducing a wider range of fruits including star fruit, plums, cupuaçu, juçaça, cocoa, ata, mangaba, bacaba, buriti, ingá, pitomba, jambo, etc. They have also planted timber species such as mahogany, teak, mamona, aroeira, goçalo-alves and baru.  
**Livestock/cattle:** initially few livestock were kept but most households had | **Cash/credit:** they hope to have access to new credit schemes to invest in crops, pastures, fences, dairy cattle, fish-farming, bee-keeping and orchards.  
**Agriculture:** they hope to have good fruit yields, especially banana, coconuts and cupuaçu. They are also going to invest in increasing their rice production.  
**Livestock/cattle:** they hope to have permanent pastures and high-yielding dairy cattle. They also hope to increase the numbers of other livestock and to purchase horses as well.  
**Labour:** they hope that the young people will take over production activities and will have access to more technology.  
**Markets for produce:** they hope to increase the range of produce offered in existing markets and to gain access to new markets such as Goiânia, Brasília, etc. |
Qualitative community analysis using the social carbon methodology

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<th>Human</th>
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<tr>
<td>chickens, and pigs; some also kept turkeys, ducks and a few head of cattle. Nowadays, most settlers have more chickens (50 on average) and there are around 150 cattle in the settlement. Pigs are the only livestock which have reduced in number.</td>
<td><strong>Labour:</strong> all cultivation and harvest activities are still entirely dependent on family labour.</td>
<td><strong>Markets for produce:</strong> at first, there was no surplus production; everything was needed for subsistence. Now, the settlers sell rice, cassava flour, fruit and eggs in towns such as Caseara, Marianópolis, Paraíso and Palmas.</td>
<td><strong>Health:</strong> there were a lot of diseases such as malaria, flu, chicken pox, mumps, pneumonia, hypertension and dengue fever. Nowadays, diseases such as malaria are under control but there are still no medical services available in the settlement.</td>
<td><strong>Education:</strong> at first there was no school so the children had to stay in Caseara if they were to attend lessons. There is now a school in the settlement but it only provides education up to the fourth year of the junior level. There is only one classroom so all the pupils have to study together.</td>
<td><strong>Technical assistance:</strong> at first no technical assistance was available. It took a long time for the state extension agency, Ruraltins, to come to the settlement but it has provided some help. It does not provide any close support, it only gives training courses in the settlement. In 2000, the government support agency for small and medium-sized businesses, SEBRAE, gave a course in rural administration.</td>
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| Health: they hope that the settlement will have a health centre with a nurse, a doctor, medicines and an ambulance. | **Education:** they hope that the school can have more and better trained teachers so that pupils are able to complete their primary education (to age 16). | **Technical assistance:** they hope to have training courses from a number of entities (Ruraltins, Coopter, SEBRAE and the Instituto Ecológica) teaching them about alternative production methods, rural administration and marketing. | **Leisure:** they hope to maintain the tradition of festivals marking Mothers’ Day and Fathers’ Day and to have more leisure options generally. |
Social carbon: Adding value to sustainable development

Organisation: the community’s first formal association was established in 1996 and its membership currently consists of 22 families. This association achieved a lot for the settlement. In 2000, another association was formed to empower the womenfolk of the community. It has thirteen associate members. The first association needs to be restructured and the women's association is only just getting started. Some 80% of the settlers are members of the Caseara branch of the Rural Workers Union.

Carbon: Reforestation and agroforestry activities are eligible under the Clean Development Mechanism (CDM). Economic returns are generated from sapling production and from social activities and training courses.

Organization: some want the existing associations to continue while others want them to combine into a single larger and stronger association.

Carbon: To have large areas dedicated to agroforestry, plantations for timber and fuel wood, and forests. Self-sufficiency in fuel wood.

Schematic representation of livelihoods in the União II settlement
Qualitative community analysis using the social carbon methodology

**PA União II – Gender of respondents in União II**

- 52% Men
- 48% Women

**PA União II – Age distribution of respondents in União II**

- 50% 0-14 years
- 22% 15-25 years
- 16% 26-40 years
- 8% 41-59 years
- 4% Over 60
The Barranco do Mundo Settlement

a) Location

The Barranco do Mundo settlement is located in the central-western region of Tocantins state, in the Pium municipality. It lies 74 miles from Pium, and access is via the TO-354 state highway (Transjavaês), and then along further 13 miles of unpaved road inside the Ponderosa Farm.

b) Brief History

The Barranco do Mundo settlement was created by INCRA in 1996 and established in 1998 on an area of the old Capituva Farm, owned by Mário Shizuo Sugahara. It has a total area of 11,947 acres.

Initially, the settlement comprised 97 families from municipalities in other parts of Tocantins (Cristalândia, Lagoa da Confusão, Rosalândia, Nova Rosalândia and Palmas), who were selected from a census carried out by INCRA. Due to a lack of technical assistance and the difficult working conditions, many of those families gave up the land soon after receiving their first credits.

The area demarcation was carried out in 2001. Individual plots of 36 hectares were marked out, plus a communal area of 11 acres of seasonally flooded land for each of the individual plots. A legal reserve was also established, covering 35% of the total settlement area, and a further 33.3 acres set aside for the construction of dwellings. During this demarcation work, the number of plots was reduced to 70, and this could be reduced still further as there are roughly 20 small-holdings which are not suited for production purposes, either because they are flooded in the rainy season, or because a large proportion of the land is bare rock.

It should be noted that, while INCRA was performing the demarcation, the residents’ association proposed that the nature reserve should be expanded from 35% to 50% of the settlement area, and that the number of small-holdings should be limited to 39, but the government agency staff rejected these proposals.
c) Natural resources

The predominant vegetation in the settlement is that of Brazilian savannah (cerrado), with areas of secondary scrub and gallery forest. Native vegetation species present in the area include mirindiba, cajueiro, nativo, landi, camaçari, ipê-roxo, aroeira, pequizeiro, buritizeiro, bacaba, jatobá, bacuri, angico, faveiro, sucupira, pau-d’arco, piaçava and many graminaceous species typical of the cerrado region.

As with the flora, the region’s fauna is quite diverse, with the presence of wild animals such as anteaters, deer, tapir, paca, armadillos, wild boar, peccary, foxes, and jaguar, birds such as toucans, parakeets, macaws, rheas and seriemas, as well as various species of snake. Hunting is also practiced, not just in the settlement but also on neighbouring ranches, which has given rise to conflicts with these properties’ owners. The area of the Barranco do Mundo settlement has no stream or river.

d) Production System

Some of the settlers had previously lived only in urban areas, but for others who had not farmed for a long time, the arrival in the settlement in mid 1998 meant the beginning of a new cycle.

In the first year, following advice from INCRA, a communal rice crop was grown on a 66 acre area, involving all 97 families who were present then. The harvest was good, even though all the rice planted in the seasonally flooded area was lost. Apart from this, the settlers planted rice, maize, cassava, beans, sesame, cucumber and pumpkin on their small-holdings as well as fruit-bearing species such as banana and watermelon.

In subsequent years, this communal farming gave way to small areas of crops grown on the individual holdings, where species such as coconut, coffee and orange were also planted.

Livestock such as chickens and pigs are kept unconfined and reared solely for consumption within households. Cattle are also raised under an extensive system on natural pastures and pastures sown with grasses
such as kikuyo and braquiaria. On some areas of the settlement, natural pastures are rented out for a very low monthly rate per cattle.

The soils in Barranco do Mundo are poor, being acid and very stony. Agricultural activity in the settlement tends not to result in high yields, nor does there appear to be any standard agricultural schedule. At the time when this survey was undertaken, in small-holdings which contained areas of forest there was intense activity focused on opening up land (felling trees and burning off scrub) for crops, while on other plots, where preparation for sowing depended on machinery and soil-correction techniques, work was only just beginning.

With the help of a rural credit scheme, the residents’ association acquired a range of machinery and equipment including two tractors, a Ford F4000 truck, a generator, a welding machine, a machine for cleaning rice, a lime spreader, a seed drill, and two harrows. These were all bought second-hand, and as a result of this fact, combined with a certain lack of adequate management, they have begun to develop faults and need maintenance.

e) Infrastructure and Services

Health

The settlement has a high incidence of diseases such as malaria, pneumonia and dengue fever. In 2000 alone, 36 cases of these were registered in the settlement. In 2001, further 36 cases were recorded, and the National Health Foundation (FUNASA) subsequently established a laboratory at the Javaés Farm to carry out diagnostic tests for such diseases.

The settlers’ diet is generally deficient consisting in most cases of rice, cassava and beans, with some occasional meat, usually fish or game.

As yet the settlement has no health centre, though it is served by a community health worker whose household visits are, according to the inhabitants, less than regular.

In cases which require the services of a doctor or a hospital, the inhabitants tend to rely on getting a lift from a neighbour, otherwise they have to hire a vehicle, which is very expensive.
Education

Barranco do Mundo has a school – the Escola Municipal Ana Francisca – which teaches infants and juniors. The school has two classrooms, built in 1999 as annexes to the old ranch house. There are two teachers, and a woman who prepares the school lunches; all three employees are resident in the settlement. Lunches and textbooks are provided by the Pium Municipal Secretariat for Education.

The schooling provided only runs until the fourth year of the junior level and, as no school transport is available, pupils wanting to study beyond this level have to go live in the town of Pium.

Water Supplies

Water supplies for the settlement are delivered through a standpipe and six wells near the old ranch house; there are also a few wells sunk on individual plots.

Dwellings

When they arrived in the settlement, in 1998, settlers were advised to build temporary houses with materials such as tarpaulin and palm leaf, as proper construction materials would be available within 90 days. Materials never came, but, in 2001, on completing the settlement demarcation, INCRA staff promised once again that the material would be ready by the end of the year. They advised the settlers to opt for an “agrovila” system, with dwellings grouped in a relatively small area, as this would simplify house building and the delivery of electricity and water supplies.

Now, almost three years later, construction material has still not been delivered, and most of the temporary houses are in a precarious condition, with some of them apparently in danger of falling on the heads of their inhabitants.

Access Problems

One of the major problems for the settlers’ families and one that has been there since the establishment of the settlement, is the existence of a check-point 13 miles from the settlement at the entrance to Ponderosa
Farm. The purpose of this check-point is to control the access of fishermen and hunters to the property which is rich in fish and game.

The residents complain that the check-point hampers access to the settlement during the day, and that after 10 o’clock at night, by order of Adão de Jesus da Mata (manager of Ponderosa Farm), they are forbidden to pass beyond it and have to spend the night at the check-point.

f) Social Organization

The settlement has one formal organization that has currently 38 members. It is called Associação dos Pequenos Agricultores do Projeto de Assentamento Barranco do Mundo (APABM). Its current leadership is comprised of José Raimundo (president), Manuel Silva (vice-president), Messias (secretary), and Rosa (treasurer). The fiscal council consists of Cícera, Manuel Costa, Luiz, Herculano, Walter, and Cássio.

Despite the difficulties in motivating its members and the absence of a tradition of concerted action, the association’s president, with the help of the local priest, has been campaigning on issues such as demarcation, and funding for housing and community infrastructure. In addition to these issues, José Raimundo has been questioning INCRA about the criteria they used to evaluate the land which, according to him, is “the worst land for agrarian reform purposes in the whole of the Pium municipality” because of the lack of water during the dry season and the flooding of almost 50% of the area during the rainy season.
Qualitative community analysis using the social carbon methodology

Respondents’ comments on livehoods in Barranco do Mundo

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<tr>
<th>Resources</th>
<th>Comments</th>
<th>Views on the future</th>
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<tbody>
<tr>
<td>Natural &amp; biodiversity</td>
<td>There are several areas of forest with an abundance of wildlife and flora. The vegetation is characteristic of ecotone areas between Brazilian savannah (cerrado) and tropical rainforest.</td>
<td>Agro-extractivist activities and maintenance of conservation areas.</td>
</tr>
<tr>
<td>Financial</td>
<td><strong>Cash/credit:</strong> only three people arrived at the settlement with any money from previous employment, social security benefits or the sale of assets. In 1998, each settler received assistance worth R$ 1,025.00 (roughly US$ 360) and ‘baskets’ of basic foodstuffs (cestas básicas) worth R$ 400.00 (approximately US$ 140). Current, average monthly income in the settlement is around R$ 50.00 (US$ 18). <strong>Agriculture:</strong> to start off with, they grew a communal crop of rice and also their own crops of maize, cassava and beans. Part of the communal rice crop was lost due to flooding. Nowadays, there is no communal crop, but rice, cassava, maize, coconuts, coffee, bananas, and oranges are grown on family small-holdings. They have found that the soil is not good for beans. <strong>Livestock/cattle:</strong> most settlers brought no livestock with them. Nowadays, they have chickens, pigs, cattle, and pack animals.</td>
<td><strong>Cash/credit:</strong> they hope to get credit to invest in cassava, orchards and cattle.  <strong>Agriculture:</strong> they hope to grow rice, maize, and cassava and to have a productive orchard. <strong>Livestock/cattle:</strong> they hope to increase the number of chickens and pigs and to get funding to work with dairy cattle.</td>
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<tr>
<td>Human</td>
<td><strong>Education:</strong> a school began functioning at the settlement in 1999. It has two teachers and takes pupils up to the fourth grade of the junior level. Pupils wanting to study beyond this level have to go live in the town of Pium. <strong>Health:</strong> at first, there was a lot of malaria and no health assistance in the settlement, so the settlers had to go into Pium for advice, tests, and treatment. This is still very much the case now, although in 2001 the settlement was assigned a community health worker, and a doctor has visited three times. <strong>Technical assistance:</strong> the settlers have never had any access to technical assistance.</td>
<td><strong>Education:</strong> they hope that the school will be better organized and will enable pupils to complete their primary education (to age 16), or perhaps offer training in agricultural techniques. They want projects that will improve access to education for both young people and adults. <strong>Health:</strong> they hope to see a health centre established with a full-time nurse, a doctor, a dentist, and an adequate supply of medicines.</td>
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**Social carbon: Adding value to sustainable development**

<table>
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<tr>
<th>Social</th>
<th>Organization: the residents’ association was established in November 1998. It currently has 38 members and has improved since the early days as the president is very active in his duties.</th>
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<tr>
<td>Carbon</td>
<td>Carbon: establishment of pilot agroforestry systems on individual plots. Training courses in agroforestry techniques and in strengthening community organization.</td>
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**Gender of respondents in Barranco do Mundo**

- **Men**: 45%
- **Women**: 55%

**Technical assistance:** they hope to see their children fully trained and able to provide extension services themselves. They want assistance in activities such as vegetable production, bee-keeping, growing pineapples and watermelons, etc.

**Organization:** they hope that the organization of the community association will improve and that it can open a bank account and have financial resources to ensure that they can all work.

**Carbon:** An increase in the number of agroforestry systems, along with fruit production schemes and the enrichment and regeneration of forested areas.
Qualitative community analysis using the social carbon methodology

Schematic representation of livelihoods in the Barranco do Mundo settlement

Age distribution of respondents in Barranco do Mundo
The Pericatu Settlement

a) Location

The Pericatu settlement is located in the central-western region of Tocantins state, in the Pium municipality. It lies 27 miles from Pium, and access is via the TO-354 state highway (Transjavaés), and then along further 6 miles of unpaved road. It has a total area of 16,328 acres and is currently home to 39 families.

b) Brief History

The Pericatu settlement was created by INCRA on November 25, 1996 by means of directive 038/98, and established in 1998 on an area of the Pericatu Farm, owned by Vicente Osmar Sérgio.

The settlers either purchased their plots or, in the case of those registered under INCRA’s agrarian reform programme, were allocated them by the agency. If settlers decide to give up their land and move elsewhere, new families are chosen from INCRA’s register and, following an interview with staff from the agency, are allowed to take up the small-holdings that have been vacated.

The settlement demarcation was effected in 2001, establishing the boundaries of a legal reserve, rural small-holdings and the settlement’s agrovila in which the dwellings are concentrated.

c) Natural Resources

Pericatu has an ecosystem which is typical of the Brazilian savannah region, containing several native vegetation species, including ipê, aroeira, pequi, sucupira, pau-terra, jatobá, camaçari, landi, candeia, and piranheira.

The fauna is fairly diverse, with the presence of deer, anteaters, tapir, paca, peccary, foxes, capybara, several species of feline and a great variety of birds.
d) Production System

Agricultural production in Pericatu is not prolific but, scattered amongst the various small-holdings, one finds subsistence farming systems growing rice, cassava, beans, pumpkin, and a wide range of fruit-bearing species including acerola, avocado, banana, guava, passion fruit, orange, lime, papaya, and jaca.

Agricultural activities are assisted by tractors that prepare the land for sowing, with the rest of the work – land clearance, burning, construction of fire breaks, planting, weeding and harvesting – being done by the various members of each household.

Responsibility for the rearing of livestock other than cattle – most commonly chickens and turkeys – is generally undertaken by women.

e) Infrastructure and Services

Health

Most health problems in Pericatu are related to the contamination of water supplies and to inadequate nutrition, with diets consisting basically of carbohydrates, sugars and proteins. The settlement has a community health worker who lives in the community and who carries out home visits and sends sick people off for treatment by the doctor in Pium.

Education

Pericatu has one school – the Escola Municipal Sebastião Moura – that teaches infants and juniors up to the fourth grade of the junior level. It has 31 pupils and, in addition to these, there are another 23 pupils who are taking their studies up to the eighth grade of junior level at the municipal school in Pium.

The Pericatu school has two teachers, one of whom lives outside the settlement, and a woman who prepares the school lunch. Lunches and textbooks are provided by the Pium Municipal Secretariat for Education.
Transportation

The only regular transportation service available in Pericatu is the bus that takes the older pupils from the settlement to school in Pium.

f) Social Organization

The residents’ association – known as Associação dos Pequenos Produtores do PA Pericatu (APPPP) – has had trouble with the level of participation in its activities. Consequently, power has become centralized, with decisions being made by just a few people. Currently the association has 65 members and their monthly contribution is fixed at R$ 2.00 each (less than US$1). Until the year 2000, this contribution was covered by the rental of communal land for pasture but, following the settlement demarcation, e residents decided to stop this practice.

Respondents’ comments on livelihoods in Pericatu

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<tr>
<td><strong>Natural &amp; biodiversity</strong></td>
<td>Rivers: water-holes in the area used to be clean and full of fish. One water-hole in particular was always very full in the rainy season. Nowadays, the water-holes and springs are contaminated and are not as abundant as they were before. There are only three water-holes that do not dry up in the dry season. There are not many fish.</td>
<td>Rivers: they hope that there will still be water-holes and streams with fish in them.</td>
</tr>
<tr>
<td></td>
<td><strong>Forest/cerrado/seasonally flooded areas (varjão)</strong>: almost all of the settlement area consists of Brazilian savannah (cerrado) vegetation. Forested areas have been greatly reduced as a result of logging activities and also the use of fires to clear land (queimadas), which has proved particularly destructive. The cerrado has been harrowed and the seasonally flooded areas are used for crops. There are many native vegetation species present including jatobá, camaçari, aroeira, landi, sucupira, candeia, piranheira, pau-d’arco and casca-da-anta.</td>
<td><strong>Forest/cerrado/seasonally flooded areas (varjão)</strong>: the women hope that deforested areas will be reforested with other species, especially fruit-bearing trees.</td>
</tr>
<tr>
<td></td>
<td><strong>Wildlife</strong>: there used to be a lot of animals such as jaguar, deer, tapir, foxes, peccary,</td>
<td><strong>Wildlife</strong>: they think that there will be fewer animals in future as, with activity in the settlement increasing, wildlife will tend to avoid the area.</td>
</tr>
</tbody>
</table>
Qualitative community analysis using the social carbon methodology

| **Financial** | **Cash/credit**: most people arrived without any money, though some brought cash from assets they had sold, social security benefits, redundancy payments, etc. They subsequently received assistance to help buying basic food staples but this money was all channelled through the residents’ association. Any money that people brought with them has since run out and although there are a lot of promises, nothing concrete happens. Some settlers work as day labourers for which they are paid a wage of R$ 8.00 plus lunch. Average household income is around R$30.00 per month (roughly US$ 10).

**Agriculture**: rice has been grown on communal land, as have cassava, beans, sesame, cashew, passion fruit, lime, açaí, oranges, jaca, guava, banana, and avocados. Nowadays the settlers all grow rice on their small-holdings, along with cassava, beans, watermelon, pumpkin, sugar cane, banana, papaya, yam, sweet potato, pineapple, cashew, peanuts and sesame. They have found that maize does not grow well there.

**Livestock/cattle**: at first, few people had chickens or turkeys. Gradually, the number of cattle and other livestock in the settlement has grown. Now, nine small-holders keep chickens, turkeys and cattle.

| **Human** | **Education**: the school began functioning 90 days after the settlement was established, taking pupils up to the fourth grade of the junior level. It was very disorganized so the children did not really learn much. Nowadays, the pupils are separated into two groups, but at the time of the survey one of these groups had no teacher.

| **Cash/credit**: they hope to be able to earn more money and get more financial assistance, but above all not to suffer hunger any more.

**Agriculture**: they want to invest in traditional crops such as rice, cassava, and maize, as well as trying out less familiar things such as rubber trees, coconuts, açai, cupuaçu, pupunha, cashew, passion fruit, coffee, sugar cane and bananas.

**Livestock/cattle**: they hope that all families will rear chickens, pigs, turkeys and goats, as well as many beef and dairy cattle.

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- opossum, paca, and capybara, birds such as partridges, quail, curassow, and seriema, as well as several types of snake. Animals such as rheas and deer have become much less common over the years. The federal environment agency, IBAMA, allows hunting in the settlement, with the exception of rhea, deer, seriema and paca.

- **opossum, paca, and capybara**, birds such as partridges, quail, curassow, and seriema, as well as several types of snake. Animals such as rheas and deer have become much less common over the years. The federal environment agency, IBAMA, allows hunting in the settlement, with the exception of rhea, deer, seriema and paca.
Health: there used to be a high incidence of diseases such as flu, malaria, pneumonia, dysentery and fungal infections. Nowadays, there are fewer diseases but the health services available are very inadequate.

Technical assistance: so far they have had no technical assistance apart from vaccinations from the government livestock agency, Adapex. The government support agency for small and medium-sized businesses, SEBRAE, has given courses on rural credit schemes and community cooperatives, as part of the national Rural Entrepreneur programme.

Health: they hope to have a health centre with a doctor, medicines and equipment.

Technical assistance: they hope to get assistance from the state extension agency, Ruraltins, and other government agencies in the form of information and training courses relating to agro-industry, sweet production, cassava flour milling, dairy products, bee-keeping, chicken farming, orchards and rice production.

Organization: the residents' association was established six months after the start of the settlement. Its first president was Bento Batista. Although it had a lot of money, it was badly organized and few people participated. There are also allegations of drunkenness and abuses of power. Nowadays, things have improved but there is still very little participation and little sense of unity amongst its members.

Organization: they hope the association can be more organized and can generate its own resources so that it can function better.

Carbon: establishment of pilot agroforestry systems on individual plots. Training courses in agroforestry techniques and in strengthening community organizations.

Carbon: An increase in the number of agroforestry systems, along with fruit production schemes and the enrichment and regeneration of forested areas.

Gender of respondents in Pericatu

- Men: 36%
- Women: 64%
Qualitative community analysis using the social carbon methodology

Schematic representation of livelihoods in the Pericatu settlement

Age distribution of respondents in Pericatu

- 0-14 years
- 15-25 years
- 26-40 years
- 41-59 years
- Over 60
CHAPTER 7

Future perspectives
Social Carbon and Biodiversity Corridors

The future that we envisage involves the integration of two innovative concepts – Social Carbon and Biodiversity Corridors – to be effected by a partnership between Instituto Ecológica and Conservation International, so that we can, above all, show that it is possible to integrate conservation and sustainable development in a way which makes an effective contribution to issues related to climate change.

The conservation of biodiversity will only be possible if practical steps are taken to protect areas that remain untouched and to restore degraded areas so as to re-establish physical connections which enable the maintenance of natural ecological processes. Such steps should be taken as an immediate priority in areas that are heavily impacted by human action, and especially in conservation ‘hotspots.’ In those areas, the establishment of biodiversity corridors will allow conservation to be effected on a scale that is sufficiently extensive and wide-reaching for natural processes to be encompassed in their totality.

We believe that the adoption of a strategy that links carbon sequestration to the environmental restoration measures needed to prevent the collapse of biodiversity represents a very significant step forward, uniting current global efforts associated with two major issues: biodiversity conservation and the attenuation of climate change.

The conservation model implicit in this new concept requires the application of financial resources for research, monitoring, environmental education and other activities. The possibility of linking these two concepts – Biodiversity Corridors and Social Carbon – must surely rank as one of
the most significant advances made in recent years relating to actions designed to minimize climate change and protect biodiversity.

Local People Look Forward

Antônio Bezerra’s family, his wife Maria and his son José Wilson, and the married couple Milton and Regina, live in rural settlements which have benefited from Instituto Ecológica’s Social Carbon project. Their lives have changed a lot in recent years due to the initiatives launched in their communities, and it is expected that Ecológica’s work will yield even more benefits in the future.

The work to empower and raise the awareness of these communities has only just begun. With regard to two fundamental aspects, much remains to be done: contributions to the environment through the implantation of agroforestry systems, and improving living standards amongst local populations who live their lives in degrading poverty.

It is not only the practical results noted during Ecológica’s ongoing monitoring of conditions in these settlements that motivate and inspire those who participate in the project. There is also the rich and diverse culture which these communities maintain and which they pass on to succeeding generations. This is the case of 5 year old Sara, who accompanies her grandparents, Antônio and Maria, when they are planting crops and working on their agroforestry system in the Barranco do Mundo settlement near the town of Pium.

Although this girl is poor and lives in a settlement where living conditions may be described as precarious, she has a promising future. As well as benefiting from the work her parents and grandparents are doing on their land, she is beginning to appreciate the need for environmental conservation as a result of the practical experience of her family, supported by the Social Carbon project.

As she sets off to look for seeds of the cachamorra tree to sell to the Instituto Ecológica’s nursery, Sara’s grandmother, Maria das Graças, is satisfied with her new life and with the hopes she holds for the future. “I was really happy with the saplings of jatobá, graviola, pitomba and
passion fruit that Ecológica’s staff brought here.” Technicians like Juliete pay frequent visits to the settlement, eat with the local people and sometimes, when there is a training course lasting a couple of days or more, stay as guests in their houses.

“I want to plant eucalyptus along both sides of the road to make the place look prettier,” Maria says. Though she lives in a simple little house, everything is kept clean and in good order. “When these fruit tree saplings which Ecológica gave us start to yield, we can sell whatever we don’t need. I’ve already planted 45 coffee bushes and whatever beans are left over we can sell in town.” Maria is also hopeful for her teak tree saplings. “They told us that this tree is a hardwood, rare and fast-growing. I’m curious to see how the saplings will get on.”

On their smallholding, she and her husband, Antônio, grow rice, maize and beans. They have planted eucalyptus trees and regional fruit-bearing species such as graviola and pupunha on a patch of land where they had previously grown beans. “We learned from Ecológica how to use the beans as ‘green manure.’ They told us that the beans fix nitrogen, enriching the soil and keeping it covered, ready for the next crop,” Maria explains.

Her son, José Wilson, has ambitious plans. “I want to turn my land into an experimental plot. I’m trying to negotiate a partnership deal with the state university, Unitins, through which I would make my land available for research purposes. I think that in this way we would all gain something, I myself, the university students and the environment.” Ecológica is considering José Wilson’s proposal with a view to acting as intermediary in the agreement, so as to ensure favourable terms for the settler.

“Currently we have to clear land and fell trees because we have no other option, but what I am proposing is to do things differently. Generally speaking, we clear a meter to harvest a centimeter nowadays, but I want to turn this around. I want to clear a centimeter to harvest a meter and I believe that this should be possible,” José Wilson opines.

José Wilson’s objective is to work in partnership with the universities in Tocantins state in a way which would encourage environmental conservation. “I want to do everything in an ecologically correct way. I’ve
José Wilson's concerns caused him and his family to opt for the procedures which had once been used by his forbears, but which have since been forgotten. Ecológica has provided technical advice to support these techniques. “Every year we had to buy fertilizer that failed to produce the expected results. So we went back to basics with green manures, using leguminous species and crop rotation instead of monoculture.”

Meanwhile, in the União II settlement in Caseara, Milton has opted for bee-keeping as a self-sustaining environmental alternative. “For the past five years, my crop yields have been poor, so the honey we get from our bees has been a very useful solution for us.”

The recurrent failure of his rice and maize crops has hit Milton hard, but problems like these are common in the settlements. Some years ago, settlers like Milton received start-up funding from the National Agrarian Reform Programme (Pronaf) and most of them invested in agricultural equipment such as tractors and machinery. With time, however, they have become unable to pay for the maintenance of this equipment, and much of it is no longer operational. The only solution they have is to request use of a tractor from the municipal council, but this process is so slow that by the time the tractor arrives, the sowing time has passed.

Last year began pretty well for Milton. His rice crop was well established and he was expecting a yield of 100-120 sacks (5-6 tonnes). “When the rice grains were just beginning to form, an infestation of caterpillars destroyed the whole crop.” He claims that it was only by resorting to a lucky charm that he managed to harvest eight sacks of rice (400 kg).

“I’ve since learned other ways of protecting the crop from caterpillar attacks, and I’m very glad that Ecológica is working with us. Beforehand, there was no sense of unity at all in the settlement, but we can now see that if things are to get any better, we all have to take action. Ecológica has given us a lot of support in this,” Milton comments. This year, apart from protecting his new rice crop from caterpillars, Milton hopes to take part in Ecológica’s agroforestry initiative, planting coffee bushes and cashew
trees as well as saplings of teak and regional timber species like aroeira and pau-ferro.

Milton’s wife, Regina, is pleased with the success of the “Delícias do Cerrado” sweet factory, and recalls that the first products from this cottage industry were sold in the Caseara region. In 2000, she and the other women working in the enterprise took part in a trade fair in the state capital, Palmas, and saw that there is a promising market for their produce.

Soon after, the women were invited to take part in the “Meeting of Cerrado Peoples” event in Goiânia, capital of the neighbouring Goiás state. To this they took produce exclusively derived from fruit species native to the cerrado region, such as mangaba, puçá, cagaita, araticum and pequi. “I was surprised with our success there and at how well-received our products were.” Subsequently, they began to receive regular orders from outlets in Paraíso, Caseara and Goiânia, and whenever there is an event or a public meeting in Caseara, Regina’s factory is asked to supply sweets and fruit liqueurs.

“Now we have money to cover the running costs of the production unit and there’s some left over at the end of the month to share among the women who work there. They are all feeling very positive and our life has improved a lot. I know that we owe much of this to Ecológica’s work with us here in the settlement,” Regina says. She has been able to help her husband, Milton, with the household expenses and has bought bedclothes and towels, and even some new clothes for him.

Regina has two specific goals now. One of them is to set up an alternative source of energy, such as solar energy, to power the refrigeration equipment which has already been purchased for the production unit. This will enable the enterprise to store the crystallized fruit and fruit pulps it produces for a longer time, enhancing production capacities. Her other goal is to become manager of the sapling nursery, along with the other settlement women. Ecológica has transferred the responsibility for this nursery to the local community, but it is currently not operational. The success of the “Delícias do Cerrado” enterprise has proven the ability of the União II settlement’s women to manage a project like the nursery, which requires care and dedication.
In the future, Regina wants to use her experience and leadership in the settlement to establish fruit production systems specializing in native cerrado species. “What we want to do is to set up a large orchard here, enriching this whole area with cerrado fruit species. I know that, with Ecológica’s help, this will be possible,” Regina affirms.
CHAPTER 8

Biodiversity Corridors role in the conservation of natural resources

Ricardo B. Machado
Mário Barroso Ramos Neto
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Conservation International
Biodiversity conservation is undoubtedly one of the major challenges faced by humankind, especially if we consider our growing and inexorable demand for natural resources. According to data from the UN Population Division (www.un.org), in the year 2000 the human population was somewhat above 6 billion, but estimates are that in 2050 there will be about 8.1 billion people. The current trend indicates that most part of this population (about 60%) will be living in urban centers, but the demand for natural resources will exert a huge pressure over ecosystems and biodiversity in general. In addition to the exploitation of species, the demand for space for areas destined for food crops shall be an important negative factor over natural communities and ecosystems.

Native areas will probably only exist in places that are not fit for economic exploitation and for the development of human society, or that has previously been reserved for environmental protection. Presently, this can be noticed in ecosystems such as the Brazilian Atlantic Forest and the cerrado, whose remnants are located in areas that are either mountainous or subject to periodic flooding, or in inappropriate soil for agriculture or cattle-raising. Considering the area occupied by humans (Figure 1), we should expect a dismal picture for the future, in case of a continuing exploitation of natural resources in a trend similar to that of present models.
Threats to biodiversity

Pressure over biodiversity may take place in several ways, but there is a consensus among conservationists that the factors with negative action on the terrestrial biota may be grouped into five main topics: native ecosystems suppression; ecosystems fragmentation; over-exploitation of natural resources; pollution and climate change; and the introduction of exotic species. The first topic, the suppression of native ecosystems, may represent the clearest and most measurable set of impacts caused by human beings on Earth. While competing for physical space, human beings have been substituting huge areas that were previously occupied by native vegetation for farming, pasture and urban areas. Some natural ecosystems had over 90% of their original area suppressed. In Brazil we have the example of the Atlantic Forest. This tropical forest formation, which once occupied approximately 247 million acres along the Brazilian coast, is reduced today to less than 9% of its original area. The cerrado, the second
largest Brazilian biome in terms of extension, is reduced today to about 41% of its original area, which once corresponded to almost 500 million acres (Figure 2).

Figure 2. Main remnant cerrado areas in their core area. Source: Conservation International-Brazil Program.

Two aspects that cause concern in the suppression of native areas is the extension of such impacts, which presently compromise whole ecosystems, and the speed with which such changes are taking place. In the case of the Brazilian Atlantic Forest, estimates provided by Fonseca (1985) suggest that an expressive part of this biome still existed in certain portions (as in the case of the Doce river basin, in the eastern Minas Gerais state) in the 1940’s. In about 50 years, the forests in that region were almost totally suppressed. The Brazilian cerrado is bound to provide a similar picture, but with an aggravating factor: the conversion speed has been extremely high. In the beginning of the 1990’s, Dias (1992) estimated
that the loss of vegetal covering of the cerrado was about 37%. Six years later, in 1998, Mantovani and Pereira, by means of visual inspections of Landsat images, have noticed that the deforested area of this biome reached 49%. In 2003, Machado et al. (2003), using MODIS sensor images, have estimated that the deforested cerrado area already totaled 54%. These three estimates, carried out at different points in time, suggest that the cerrado deforestation rate is around 1.5% per year, an extremely high and worrying figure. If this conversion rate is maintained, expectations are that the remnant cerrado areas will disappear by the year 2030, when approximately 94.5% of that biome will have been destroyed, with the exception of the remaining legally protected areas (if we are able to avoid political pressure to reduce their official limits).

A second source of expressive impacts over biodiversity is the fragmentation of ecosystems. The term 'fragmentation of ecosystems' has been defined in specialized literature in several ways. Kattan et al., 1994 describe the term as “the modification or removal of large areas of natural vegetation that result in the creation of a mosaic of fragmented and isolated environments”. Andrén, 1994 refers to the “process of subdivision of continuous habitats into small portions”. Wiens (1994) defines the fragmentation of ecosystems as the set of “external disturbances that alter large continuous areas, thus creating several isolated or weakly connected fragments, that remain inserted within a mosaic made up by other types of environments” (Wiens, 1989). For other authors, such as Lord and Norton, 1990, the term would simply represent the “break of a continuity.” Even though there is such a variation in conceptualization, the main consequence of the fragmentation of ecosystems for the species and their populations is the reduction or elimination of a natural process of exchange among individuals. With the creation of small native areas, isolated from each other by a set of inhospitable areas (Figure 3), the species’ populations tend to become isolated and subject to local extinction events, caused by a number of factors, from the increase in parasitism and predation to the genetic complications deriving from the mating of too closely related individuals. Besides such factors, the fragmentation of ecosystems also causes an abrupt change in the characteristics of the remaining areas and such changes include, for example, alterations in the local microclimate.
The third group, formed by activities that cause impact on biodiversity, includes the over-exploitation of natural resources. The term indicates the situation in which a certain resource, which may be a plant or animal species, is used in an unsustainable manner, thus leading to the exhaustion of the source. One of the clearest examples is the depletion of fishing stocks. According to FAO data, the production of sea fishing through capture has decreased from 84.7 million tons in 1995 to 82.5 million tons in 2001. FAO estimates are that approximately 75% of the main sea fishing stocks are being over-exploited and that about 10% of these resources are exhausted.

As to the invading species, there is a huge concern regarding the impacts caused by the introduction of species upon the local fauna and flora. According to data from the World Resources Institute-WRI (www.wri.org), approximately 20% of the vertebrate species considered threatened with extinction are presently facing such a situation due to the action of exotic species. The effects of the introduction of exotic species, the so-called
“biological pollution”, go from the competition for resources to predation and transmission of disease. Even though a major part of all species are intentionally introduced, there are worrying cases in which species are transported by human beings in a passive or unconscious manner. An example are the almost 3,000 aquatic organisms that are transported in the ballast water of cargo ships and that are discharged in different regions of the globe. In some cases, the species transported by ships and introduced in other regions may cause serious problems to human health, as is the case of a micro algae (*Alexandrium tamarense*) which produces a paralyzing toxin (saxitoxin) capable of causing severe intoxications in people (Persich & Garcia, 2000).

Finally, the impacts caused by the several forms of pollution and climate changes are among the factors most strongly associated to the large expansion of human concentrations on the planet. The burning of fossil fuel, burnings and vegetal suppression would be the main causes for increase in the concentration of certain gases in the atmosphere, especially carbon dioxide (Figure 4). Under such circumstances, the average global temperature is expected to increase. As a consequence, rainfall patterns may suffer alterations, the polar caps may be reduced and the overall climate on Earth can change. Expectations are that in certain regions there would be too much rainfall, while others would face extreme draughts. Should the trend towards a significant increase in global temperature be confirmed, consequences could be tragic, for the terrestrial biota as well as for human beings.

Making conservation a priority

The present picture of global biodiversity is of great concern, especially if we take into account the combined effects of these five main sources of environmental impact. Several regions of the planet are being threatened, an aspect that calls for the immediate adoption of conservation measures. Nevertheless, due to lack of time and financial and human resources for acting on the whole planet, conservation efforts must concentrate upon areas deemed critical for conservation. In 2000, Myers and collaborators (Myers et al., 2000) carried out a large study aimed at identifying priority
areas for global conservation. Through the combination of two simple but effective criteria, the 25 main areas for conservation purposes have been determined (Figure 5). The first criterion used was the selection of areas that held at least 1,500 species of endemic plants, and the second was the identification of regions whose vegetal cover had been removed by over 70%.

Figure 5. Location of the 25 conservation priority regions (hotspots) on the planet. Source: Myers et al., 2000.
The original area occupied by the hotspots was somewhat above 4.2 billion acres, but considering the state of degradation of such areas, estimates are that the natural ecosystems in those places represent only 1.4% of the Earth surface. Aggregating secondary data about the biodiversity of other taxonomic groups, such as mammals, birds, reptiles and amphibians, it is noticed that the total of endemic species in the hotspots covers at least 60% of the analyzed biota. In other words, the adoption of conservationist measures in this small surface may assure the survival of a large number of taxa with a small distribution area. These species also include those of priority to conservation, since estimates are that about 81.6% of birds and 57.4% of mammals threatened with extinction are present at the hotspots.

If the ecosystems integrity criterion were reversed, that is, if areas holding at least 70% of their natural ecosystems untouched were identified, we would have another set of priority areas for conservation: the so-called large wilderness areas (according to the concept provided by Mittermeier et al., 2003) (Figure 6).
Strategies for biodiversity conservation

One of the strategies most widely used in biodiversity protection has been the establishment of legally protected areas at determined places. In the Convention on Biological Diversity – CBD, the establishment of protected areas has been turned into a commitment by the countries that integrate this initiative. In its article 8, the CBD text indicates that each party shall “establish a system of protected areas or areas where special measures need to be taken for the conservation of biological diversity.” A protected area is considered a “geographically defined area that is destined or regulated and managed with the aim of achieving specific conservation objectives” (CBD – Article 2).

Even though the approaches as to the ways of defining the sites, their extension and the type of management of such protected areas vary along time and in different regions, conservation units have been fulfilling quite well their role of protecting biodiversity. An analysis carried out by Bruner and collaborators (Bruner et al., 2001) about the situation in the surroundings of 93 protected areas in several regions has indicated that such areas have been fulfilling the important role of avoiding deforestation and loss of local biodiversity.

Nevertheless, what may be observed in different regions of the planet, including Brazil, is that the establishment of conservation units by itself is not sufficient for maintaining biodiversity. A simple visual analysis of recent satellite images (as shown in Figure 7) indicates that if complementary conservation actions are not undertaken, the protected areas, either conservation units or land destined for indigenous populations, will become isolated and fragmented.
Figure 7. Areas of deforestation in the surroundings of indigenous areas (yellow polygons) in the region of southeastern Pará, northern Mato Grosso and western Tocantins. Areas in red indicate existing forest regions, and areas in shades of blue (except in most of Tocantins) indicate deforested sites. Source: Brazil Conservation International (MODIS image from August of 2002).

Population growth has been quite expressive in some regions, and even considering an ideal situation of total implementation of the conservation units (regularization of land ownership situation, management plan designed and functioning regularly), it is quite possible that the pressure over the protected areas will be felt very soon. Presently, the management of conservation units is carried out by solely considering the site’s territorial limit. Thus, a typical inspection and surveillance system of a protected area covers the unit’s demarcation and signaling, the installation of fences, gates, watch-towers, surveillance and inspection teams, communication system, among others. Nevertheless, the greater the level of threat to a conservation unit, the greater will be the need for investing in such items.
This situation derives, in part, from the way a unit is established, planned, implemented and managed. In a traditional view, these stages did not allow for the participation of the surrounding communities, which were always seen as an external threat. Even considering that Brazilian law has advanced towards assuring popular participation in several phases of the establishment and management of a conservation unit, there are no guarantees that, due to the way units are managed, external threats will cease to exist. The current vision about conservation units and how they must be regionally contextualized must change dramatically.

In general, what happens in the surroundings of a conservation unit is not included in the conservation equation of a certain region, but this in consideration may cause a great deviation from the outcome expected by the protected areas’ managers. In order to illustrate the issue, let us take as example the situation of the municipalities located around the federal integral protection conservation units. We have used this management category (equivalent to the IUCN categories I and II) as an example, since this type of unit, which does not allow for human presence within its boundaries, is always indicated as a source of conflict between conservation and the regional social and economic development.

By using data from the Brazilian Institute for Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE – www.ibge.gov.br), we have carried out a survey of the existing population in the municipalities covered by 106 federal conservation units (biological reserves, ecological stations and national parks). Three conservation units have been excluded from this survey, because they are located in municipalities near state capital cities: the Brasília National Park, in Brasília, the Tijuca National Park, in Rio de Janeiro, and the Chapada dos Guimarães National Park, in Cuiabá. The remaining units we have worked with cover partially 221 Brazilian municipalities that, according to the 1991 census, total 6.2 million people. In 2001, the population of these municipalities jumped to 7.5 million people, corresponding to an average growth of 2.11% (against a national average of 1.64% during the same period). Out of the universe of municipalities considered, 50 of them have shown a growth rate over two times higher than the national average. Two of the
municipalities with the highest growth rates (Campo Novo de Rondônia and São Francisco do Guaporé) are partially covered by two conservation units with serious implementation problems: the Pacáas Novos National Park and the Guaporé Biological Reserve, both in Rondônia state.

One of the main consequences of such lack of interaction between conservation units and the surrounding communities is that conflicts are enhanced: since people do not share the vision that these areas are a public asset of benefit to them, solutions are always very complex. Examples of this lack of vision and interaction can be noticed in the status of several Brazilian conservation units. The São Joaquim National Park, located in the Santa Catarina state, was established in 1961, with 121,000 acres for the protection of Atlantic Forest ecosystems, especially the Brazilian pine (Araucaria angustifolia) forest formations. In 2001, a motion was presented by a state representative aiming at reducing the Park to 49,400 acres, in order to benefit local heifer, apple and potato producers. In the State of Rondônia, the Bom Futuro National Forest is targeted by another law proposal, which intends to reduce the unit’s area by 24,700 acres for new farmer settlements. In Pará state, a group of quilombolas (the descendants of former refugee slaves) requests that the areas of the Trombetas River Biological Reserve and the Saraquá-Taquera National Forest be released for transforming into a 2 million acre reservation for their exclusive use. Unfortunately, there are several such examples throughout Brazil. If we take into account that only 5% of the Brazilian territory is protected by this kind of mechanism, a much deeper reflection on the way the ecosystems’ conservation is being promoted is required.

The biodiversity conservation corridor approach

The above-mentioned data make clear that minimalist actions, focusing only on conservation units, will not be able to avoid that species, communities and ecosystems persistence in the long run. There is consensus among conservationists that ecological and evolutionary processes shall only be maintained if planning strategies aimed at conservation are expanded to incorporate a larger number of variables. In general, the establishment of
Biodiversity Corridors role in the conservation of natural resources

conservation units still constitutes the basis for any desired protection system, but their management needs to be urgently improved. Thus, a regional scale planning must be promoted so as to cover the protected areas as well as the mosaic of landscapes and ecosystems that exist in their surroundings.

Within this perspective, the adoption of the biodiversity conservation corridor approach represents a major progress in the conservation model adopted in Brazil and several other countries. The term may be defined as “a specific geographic area established with the basic function of promoting the maintenance of natural ecological processes and, at the same time, turning the biodiversity conservation compatible with regional social and economic development”. Thus, a biodiversity corridor (Figure 8) is seen as a regional planning unit holding two aspects: the consolidation of a network of protected areas and the regional management of a mosaic of multiple land uses.

Figure 8. Schematic representation of a biodiversity conservation corridor and its implementation stages. Source: Conservation International.
A biodiversity conservation corridor may be established in a hotspot, as well as in a wilderness area. In the case of hotspots, the corridor’s basic guidelines become the management of the landscape, in order to provide for the reestablishment of connections between isolated fragments and the adoption of best practices in the land use in the surroundings of native areas. In a wilderness area, the biodiversity corridor’s basic guidelines are the maintenance of existing connections and the adoption of an occupation model that may assure the sustainable use of landscape. In both cases, in a hotspot as well as in a wilderness area, specified core areas must be established, setting up the basis for a regional network of protected areas, conserving native species and communities. In a complementary manner, new protected areas must be established in the surroundings of the core areas, and ecological corridors must be designed and implemented between them. This maintenance scheme of core areas is based on the theoretical approach of metapopulation models, which considers that certain areas in the landscape act as ‘sources’ of individuals, while other satellite areas act by facilitating or by increasing the potential of individuals’ dispersion throughout the landscape matrix (Gotelli, 1991, Hanski and Gyllenberg, 1993).

The term ‘ecological corridor’ corresponds to a management action that aims at reversing or attenuating the harmful effects of ecosystems’ fragmentation. Therefore, it is used for promoting the connection between two core areas into a biodiversity corridor and assuring that the flow of individuals between species’ groups, sub-populations or populations be maintained. The ecological corridor principle as a management action was incorporated by the SNUC Act (Law # 9985 of July 18, 2000, regarding the National Nature Conservation Units System – SNUC) that, in its 2nd article (numeral XIX) defines the term as:

... ecological corridors: portions of natural or semi-natural ecosystems, connecting conservation units, that allow for the flow of genes and the biota movement between units, facilitating the dispersion of species and the re-settlement of degraded areas, as well as the maintenance of populations whose survival requires areas with an extension larger than that of individual units.
Considering what has been presented above, a biodiversity conservation corridor shall be implemented and managed in order to fulfill the following objectives:

- To avoid the local extinction of species;
- To maintain and assure the natural dynamics of the movement and dispersion of species;
- To increase the protected areas’ state of protection and level of implementation;
- To promote the local communities’ involvement in the biodiversity conservation process;
- To promote the integration of public policies for conservation and socio-economic development.

Since a biodiversity conservation corridor represents a planning unit aimed at the large scale conservation of biodiversity, it should be established in regions that have high biological importance and are of high priority for conservation. Hence, one of the first stages of a biodiversity conservation process must be the identification of the priority sites for conservation at hotspots and wilderness areas.

In the case of Brazilian hotspots (cerrado and Atlantic Forest), a few biodiversity conservation corridors are being planned. Two of them presently are in an implementation stage: the Atlantic Forest Central Biodiversity Corridor, in the Bahia state, and the Cerrado-Pantanal Biodiversity Corridor, between the states of Goiás, Mato Grosso do Sul and Mato Grosso.

**The Cerrado-Pantanal Biodiversity Conservation Corridor – CPBCC**

As a result of much more accurate analyses carried out in 1998 within the cerrado hotspot, a group formed by about 200 people has suggested that much more integrated and spatially broad conservation measures should be adopted (MMA, 1998). A set of such regions corresponds to
the Emas National Park and its surroundings and the springs and the axes of the Taquari and Negro rivers, both of which are tributaries of the Paraguay river (Figure 9).

With funds received from Moore Foundation and USAID Global, the research, diagnosis and local institutional strengthening have been started in 2001. The research carried out was developed by partner institutions or by Masters and Doctor program students from the universities associated to the CPBCC (University of Brasília, Federal University of Goiás, São Carlos Federal University, University of Campinas, University of São Paulo), pointing towards the existence of 400 bird species, 60 mammal species, 90 reptile species, and over 600 vascular plants species (Batalha...
and Martins, 2002). The basic mapping of the region has significantly evolved and has allowed the skill building of new professionals in the fields of geographical information systems and remote sensing.

In addition to biodiversity surveys, socio-economic analyses have been performed, as well as analyses of the threats to biodiversity that exist in the region. This information has allowed to identify the main players, characteristics and bottlenecks that determine the project's action line. Thus, in addition to the implementation of protected areas (conservation units, Permanent Conservation Areas and Legal Reserves), the project has been working in other fronts in order to assure the region's conservation. The main actions include the increase in the public authority's capacity for planning, monitoring and inspecting, the valuation of best practices in agricultural production areas, the population’s awareness raising and engagement in environmental issues (information, teacher’s capacity building etc.), aspects that are directly linked to the corridor’s maintenance mechanisms in the long run.

The advance achieved so far is very much encouraging. Regarding the increase in protected area, two new state parks were established at the corridor: the Taquari Springs State Park, with 74,131 acres, and the Negro River State Park, with 192,740 acres. Nine new natural private reserves (Reservas Particulares do Patrimônio Natural – RPPN) have been recognized in the region. The management plan of the corridor's main conservation unit, the Emas National Park, is being reviewed and updated.

The integration of partners located inside the corridor has been very useful and dozens of educational and research institutions, public bodies and local administrations (prefeituras) are presently engaged in research, training and capacity building activities for their technical staff. As to the latter, a specific project for strengthening the infrastructure of local administrations covered by the CPBCC is being started. They are receiving training, programs, equipment and geo-referenced data so that a better territorial management may be promoted.

CPBCC activities are expected to enter a phase aimed at the recovery of degraded areas in rural properties. The ecological corridors begin to be designed, and this process will be highly participatory. Complementary
environmental education actions will provide support to the environmental recovery initiatives, highlighting the importance of environmental services associated to conservation. Economic sustainability mechanisms of CPBCC activities are being studied, and one of the most promising is the commercialization of carbon credits.

Conclusions

The conservation of biodiversity will only be possible through the adoption of concrete measures for the protection of the remaining areas and the recovery of degraded areas, with a view at re-establishing the connections that allow for the maintenance of natural ecological processes. As stated earlier, such actions must be adopted, as a priority, in regions highly impacted by human action, such as the hotspots. In those areas, the implementation of biodiversity corridors will allow for conservation to take place in a sufficiently broad and comprising scale, so that natural processes are considered in their totality. If environmental recovery procedures – essential for avoiding the collapse of biodiversity – could be associated to carbon sequestration, we can conclude that this strategy will represent a huge evolution towards uniting the present worldwide efforts: biodiversity conservation and the attenuation of climate change. The conservationist model enabled by the biodiversity corridors requires few but continuous financial resources to be invested in research, monitoring, environmental education and other incentives. The possibility of promoting this model by means of carbon sequestration will certainly be one of the most expressive advances in recent biodiversity conservation efforts.
Biodiversity Corridors role in the conservation of natural resources

References


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