

## **LAND MANAGEMENT AND SUSTAINABLE DEVELOPMENT IN THE ATLANTIC RAINFOREST OF BRAZIL: THE IRACAMBI EXPERIENCE**

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### **ABSTRACT**

*The Atlantic Rainforest of Brazil, known in Portuguese as Mata Atlântica, is an area of exceptional biodiversity, but is severely threatened, and has been reduced to only 7.5% of its original extent. The principal causes of its destruction have been its exploitation for industrial development and agriculture, especially coffee cultivation. Though the Brazilian environmental protection law gives special recognition to the Mata Atlântica, it has been unable to prevent continuing deforestation.*

*The paper shows how these factors relate to land degradation in Rosário da Limeira, a small municipality in the south-east of the state of Minas Gerais, typical of many others throughout the Mata Atlântica. Enforced legal protection is not the solution: measures are needed that address the problem of land degradation, not just the symptoms of deforestation. This requires a systematic approach that involves the participation of all the people concerned in the diagnosis of its causes and the development of appropriate technical measures to combat it.*

*Concerned by the continuing destruction of the forest and land degradation, a small private enterprise, Iracambi Recursos Naturais Ltda (Iracambi), has taken the initiative to address the problem of land degradation. With ten years of experience of sustainable production of milk, fish and timber from its own lands, Iracambi believes that that biodiversity conservation can only be secured over the long term if the private sector assumes a great part of the responsibility for it: for this to be possible, conservation must provide a pay-off in terms of commercial viability. Iracambi has therefore set up a Research and Conservation Centre, to provide facilities on a commercial basis for researchers who would not otherwise have access to the Atlantic Rainforest for their research, and to feed the research results back into its own development programme. The research will focus on two main aspects: sustainable land management technology, and the development of alternative products from forest land that can generate income and provide an incentive for forest conservation.*

*The paper describes the current work of the Centre and how it plans to attain its objective. In the initial phase, international volunteers are assisting Iracambi in collecting basic data for its databases, and 2001 it will begin more specific research. Iracambi will translate the research done at the Centre into practical terms, and work with farmers' groups to develop these into conservation management technology that addresses the concerns of local farmers. Presently, Iracambi is acting as a resource provider for training for farmers and technicians, in support of two local development programmes. One of these, led by the State Agricultural Extension Agency, EMATER, focusses on watershed management, and the other focusses on sustainable agricultural development and is led by the Rural Workers Union. In addition, Iracambi supports the environmental education programme of local schools, by producing educational materials and holding field days for school teachers and schoolchildren to raise awareness of conservation issues and to show how environmental concepts relate to real life situations. Thus, through the systematic participation of all levels of the community, Iracambi seeks to make conservation of the forest more attractive than its destruction.*

**Keywords:** sustainable land management, deforestation, land degradation, biodiversity conservation, Minas Gerais, Brazil

## **1. INTRODUCTION**

### 1.0 Introduction

At the time of the first settlement by Portuguese colonists in 1532, the Atlantic Rain Forest of Brazil covered more than 1,000,000 square kilometres, nearly eleven times the size of Portugal itself. Today only 7.5% of the original forest cover remains, though the region still maintains the name of the Atlantic Forest: *Mata Atlântica*, in Portuguese. Less than 10% of the remnant is still in primary forest cover, and the rate of destruction is accelerating. In 1988 the government prohibited any further cutting - yet in the six years from 1985 to 1990 at least another 500,000 ha were destroyed (Consórcio *Mata Atlântica*, 1992).

This paper looks at the problem of deforestation and land degradation as it occurs in the município of Rosário da Limeira, in the Zona da Mata region of the state of Minas Gerais. It is an area typical of the hundreds of small districts all through the southern part of the *Mata Atlântica*. The little remaining forest there is fast disappearing as it is cleared to make way for agriculture despite the legal prohibition on felling the forest, but productivity on the cleared land is very low and declining, as the land degrades. The paper describes the attempt being made by a small private natural resource management company (Iracambi Recursos Naturais Ltda) to find solutions to the problem.

## 1.2 BACKGROUND

### 1.2.1 Biodiversity in the *Mata Atlântica*

Brazil is a country of tremendous biodiversity on the global scale. It contains the third highest number of mammals and birds in the world, the fourth highest number of reptiles, and the greatest number of amphibians - many of which have yet to be identified. Brazil's richest area of biodiversity is the *Mata Atlântica*, which the United Nations ranks among the neotropical forests of globally outstanding importance: its conservation is in a critical condition and of the highest priority. (Dinersen *et al.*, 1995). Over 80% of the species classified as endangered in Brazil come from it. The total number of plant species is unknown, but is probably in the region of 10,000. In the State of Minas Gerais alone - an area smaller than the state of Texas - there are 780 bird species (Mattos *et al.*, 1993), as against 450 in the whole USA. Twenty one species and subspecies of monkeys are found there: 14 of these are endangered and several are literally on the verge of extinction (Mittermeier in Wilson, 1986). One hundred and seventy one of the 202 species in Brazil threatened with extinction come from the *Mata Atlântica* (IBAMA 1989), and the list is still growing.

Destruction of the forest has been continuous for the past five hundred years, and still continues at an alarming rate. The main cause of destruction has been the expansion of the agricultural frontier, mainly for coffee production. Land cleared of forest rapidly loses fertility, and ever-increasing pressures on agricultural productivity force farmers to clear yet more land in order to be able to maintain their income levels. The causes and effects of deforestation in the area in terms of land degradation, the loss of productive lands and siltation of the rivers have been little studied, and there are no quantitative data relevant to the study area.

### 1.2.2 Conservation of the *Mata Atlântica*

The traditional approach to forest conservation in Brazil has been through enforced protection by the public powers (Brazil 1965, Minas Gerais, 1991). Thus the Brazilian Constitution declares the Atlantic Rainforest to be a national heritage and forbids its destruction (Brazil 1988, Art 225). Unfortunately, such measures have been notably unsuccessful. Lack of resources to implement the laws is one problem, but a more serious flaw in the policy is that it overlooks the prime cause of deforestation: it stems not from mere wanton destruction, but from the poverty of the inhabitants who are driven to destroy the forest in order to make a living. As long as conservation policies overlook this, and concentrate on the symptoms of deforestation rather than the cause of land degradation, the problem will not be solved.

It is also clear that rainforest conservation cannot depend indefinitely on charity. The demands are too great, and "aid fatigue" will set in long before conservation needs are met. It needs to be supported by new private sector initiatives, and to seek commercially viable solutions. One way is by integrating biodiversity conservation issues with land management and the productive use of natural resources. If the future of the tropical rainforests is to be assured, it is essential that these forests be seen to have a value, both in economic and in environmental terms.

### 1.2.3 The study area

The area on which this study focuses is the *município* (an administrative unit, with its own elected local government, approximately equivalent to an American county) of Rosário da Limeira, in the state of Minas Gerais. It lies about 300km to the south-east of the state capital, Belo Horizonte, 35km north-west of the town of Muriaé of which until 1996 it was an administrative district. The village of Rosário da Limeira, the municipal seat, has a population of about 2000 and is the only centre with any degree of urbanisation. The rest of the population live in scattered homesteads and there are four or five larger hamlets each with a chapel. The only paved road in the *município* is in the main square of the village and was laid down in 2000. Ninety percent of the population depend directly on agriculture or indirectly on services that support agriculture. Coffee, milk and beef are the main products of the area.

The *município* has a population of about 10,000 people, with an area of about 117 sq km, including the watersheds of two confluent of the Muriaé river. Mountainous, with elevations from 300 to 1500m, it has strongly acid soils and an annual rainfall of 1000-1200mm. It no longer contains any "virgin" forest: some patches remain of cut-over primary forest not bigger than 100 ha, mainly in inaccessible areas, and patches of secondary forest on crests and around springs. Subjective estimates indicate that within the micro-region, in the last five years, another 1000 ha of forest have been cut. There is also subjective evidence of a decline in soil fertility, and ample evidence of soil erosion, but again there are no hard data. Rainfall records over the past fifty years show a declining trend, but the statistical series is not long enough to establish a conclusive link between this and deforestation, given the normal cyclical nature of weather patterns over a long period.

### 1.2.4 The problem of land degradation

Agricultural development in Brazil began in the sixteenth century, even before the Brazilwood trade began to decline. Cattle brought to the first Portuguese settlement flourished and expanded rapidly, so that soon the natural grasslands were fully occupied and farmers began to clear forest for pasture. More land was cleared for sugar plantations in the seventeenth century, and later gold mining, the development of the iron industry and the expansion of the railways brought yet more devastation to the forest. In the early part of the nineteenth century, coffee came to the *Mata Atlântica*. Under the purely extractive cultivation system then used, a coffee plantation remained economically viable for twenty years: very often it was then abandoned and turned into pasture. This has been the typical pattern repeated in the exploitation of coffee, cacao and sugar plantations all over the country in the course of 300 years (Dean, 1995).

With its lack of mineral resources and poor access, it was not until the 1920s that Rosário de Limeira became intensively settled, by farmers living from timber and subsistence agriculture. The boom in coffee prices in the 1950s spread the establishment of coffee plantations, and serious deforestation began, setting off a vicious circle from which there still seems to be no way out. As if the history of coffee production in the rest of the country 70 years earlier had never happened, the settlers in Rosário da Limeira began to follow exactly the same pattern of deforestation and over-exploitation of the land. As coffee prices declined in the late 1960s, the poorer coffee stands on depleted soils were replaced by pastures. The 1970s brought the so-called “economic miracle”, when Brazil’s military government printed money to pay for prestige investment projects. In the 1980s came the moment of truth when Brazil had to pay the bills for the grandiose dreams of its improvident military rulers. Inflation ran like the plague throughout the economy and subsidies to agriculture were drastically cut, just when the terms of trade all over the world had turned against agriculture. Under this pressure, marginal coffee land was converted to pastures, leaving hillsides criss-crossed by the cattle trails of bare earth, forming a perfect conduit for funnelling rain water into rills and gullies, exposing soils to severe water erosion. This then is the plight of the peasant farmers of Rosário da Limeira today: isolated from markets and technical assistance for any alternative cash crops to coffee, with declining competitiveness in rice production, and only maize and beans for subsistence, their future is bleak. Despite the forecast long term downward trend in coffee prices, no effort has been made to find a substitute cash crop for coffee. Government support for small-scale agriculture is limited to special lines of credit for coffee planting, and for most farmers, planting more coffee means clearing more land.

## **2. ANALYSIS**

### **2.1 Institutions**

Iracambi Recursos Naturais Ltda., (Iracambi) is a small natural resource management company that manages 500 ha. of land in the municipality of Rosário da Limeira. 200 ha. of its land is under forest in different stages of regeneration, including 70 ha that have been legally gazetted as a private reserve (RPPN - Reserva Particular de Patrimônio Natural) and it is adjacent to another 13,200 ha. of protected forest administered by local and state governments. In addition to its commercial activities of dairy production, aquaculture and a timber plantation, Iracambi has been experimenting with rehabilitation of the rainforest through enrichment planting and reforestation of degraded forest with indigenous species. It is also developing other income-generating activities consistent with the maintenance and improvement of forest biodiversity, such as apiculture and the cultivation of traditional and non-traditional forest products.

During the ten years in which Iracambi has been in operation, developing its agricultural operations, it has established links with the surrounding community and local government, and set up a system of participative management of a kind that was quite unknown previously in a traditional rural area, still governed autocratically by large-scale landowners. Having achieved a wide degree of local credibility, Iracambi is now in a position to tackle some of the more pressing environmental problems of the region as a whole.

Iracambi now seeks to make better use of its own forest resources and to take advantage of its proximity to other forest areas that have recently come under protection. In order to find out more about the potential value of biodiversity conservation, how forest ecosystems behave, and the process of forest degeneration and rehabilitation, Iracambi has set up and manages the Iracambi Rainforest Research Centre to create partnerships with outside researchers and draw on their experience.

This Centre provides services for researchers, offering them facilities to study forest ecology, forest degradation and rehabilitation, and related topics. It handles the logistics for researchers, provides them with access to research sites, maintains a database of relevant forest studies, and co-ordinates with other institutions and government agencies. In addition to its own research programmes, visiting researchers may direct and conduct their own research program. From the increased quantity and availability of research into methods of land management and forest biodiversity conservation, it will be possible to develop sustainable and economically viable management practices, which, in turn, will be able to be translated into practical recommendations for landowners and coherent policies for administrators.

The Centre is owned by Amigos de Iracambi (Amigos), constituted under Brazilian law as a non-profit civil association with the general objective of promoting activities that contribute towards the sustainable conservation of the Atlantic Rainforest in the surrounding areas. to promote the understanding of the mechanisms of forest degradation, to develop technologies to permit sustainable management of forest land in the area, and to channel funds to these activities. Amigos has an elected governing council and an advisory panel, and its membership is open to anyone. It has no executive staff but contracts services (including the management of the Centre) from Iracambi.

## 2.2 The conservation strategy

Taking into account the physical, historical and socio-political circumstances of Rosário da Limeira (Blaikie, 1985), a strategy for the preservation of the *Mata Atlântica* should include the following:

(i) clear demonstration of the benefits of an action plan to the participants. Significant improvement to the quality of life must be assured to bring about changes in behavioural patterns (Smith, 1994).

(ii) devolution of responsibility to the people involved. Given the limitations of the state infrastructure, much of the implementation must be entrusted to the people most concerned. The extent to which they will be prepared to assume responsibilities is directly related to the extent to which they participate in the decision making process (FAO 1990; Asamba *et al.*, 1992).

(iii) the dissemination of the basic technological practices that help to reduce land degradation and improve soil fertility. These are not to be offered as a 'package of practices' but as a menu of technical options from which farmers can chose elements that best meet their circumstances, or can adapt parts that are suitable and incorporate them into other practices (Gupta, 1989).

The opportunity for Iracambi to make a practical contribution to regional development has arisen in the form of two regional development plans that are being implemented in the area of the Centre's operation. In the Belizário district of Muriaé a watershed protection programme is being implemented under the leadership of the state agricultural extension agency, EMATER, and in Rosário da Limeira a sustainable development project is being implemented under the leadership of the Rural Workers Union. In both of these, Iracambi is being looked to as a resource provider and local catalyst.

## 2.3 Technical solutions

Unfortunately, very little research has been done on sustainable land use in degraded forest lands. The Federal University of Viçosa has done some studies on management of native forest (Machado and Sant'Anna e Castro, 1993; see also Fischer, 1987) but with little practical application for peasant farmers. The recommendations of the state extension agency focus on agronomic practices for individual crops, but not on land management practices that encourage economic use of the remaining primary forest, regeneration of the degraded forest, and sustainable production on the former forest land. Technology to reduce land degradation exists on a general level, mainly developed in other states (see da Costa, ed., 1994, and the references cited therein), but it has not yet been incorporated in EMATER's recommendations. Part of the process of joint research/extension/farmer generation of technology should involve both the adaptation of appropriate practices from other areas and the direction of research towards the particular problems of land degradation faced by farmers.

## 2.4 Iracambi's approach

Starting from the premise that local problems are best solved by local action rather than by waiting for an initiative from Government, Iracambi has been undertaking a series of empirical trials on different technologies to find more sustainable land management methods. Since Iracambi is run by farmers, impatient for results, not by methodical analytical scientists, it felt the need for a more systematic approach, and expects to attract to the Research Centre researchers whose knowledge can be used to develop suitable technology for the sustainable management of the forest and the lands around it. All that has been accomplished so far in setting up the Centre has been done with Iracambi's own resources, much of it by volunteers, both local and foreign. Local volunteers have been mostly children, who have helped with rehabilitation of the main Centre building. Foreign volunteers, mostly students of university age, have come to help with related aspects, such as laying out explanatory trails, making inventories of the flora and fauna, helping with the website which is the main marketing tool, mapping, fund raising, environmental education, and the composition of databases. The two main foci of the centre's work are on development of technology for better land management, and the creation of value of biodiversity conservation.

### 2.4.1 Land management technology.

Once the causes and effects of land degradation are understood, it will be possible to develop strategies to tackle the problems at their root, rather than attacking the symptoms. The main focus is on the maintenance of soil fertility, and soil and water conservation; the objectives of which are to reduce soil loss water run-off and, maintain water resources by improving the recharge aquifers and protecting water courses.

#### 2.4.2 Leguminous plants and vegetative barriers

Experience elsewhere (da Costa, 1994; Oster, 1981) has shown the potential of leguminous plants in maintaining soil fertility. Iracambi has successfully used *Mucuna* and *Canavalia* as a green manure in maize and beans, and plans to carry out more systematic trials to determine the best management practices. Attempts to grow it as a catch crop on residual moisture have not been very successful, particularly if the field is invaded by *Brachiaria* grasses that are very aggressive. Other legumes that should be tried are *Phaseolus heterophyllus*, and *Arachis pintoi*. In the project area it is a tradition to clean weed coffee, leaving coffee plantations especially exposed to soil erosion. While farmers concern to reduce nutrient competition from weeds is understandable, it is very unlikely that these losses are anything like as high as the loss of soil fertility though erosion: it is just that the erosion losses are not so easily perceived. Evidence from elsewhere indicates that soil losses from erosion in a steeply sloping clean weeded coffee fields could be as high as 90 tons per ha.

Vegetative erosion barriers using Vetiver grass (*Vetiver zizanoides*) used very successfully in Central America and elsewhere, and has been tried successfully in Espirito Santo (CIERs-ES, 1998) but Iracambi's own trials have not been promising and the grass has not developed well. *Phalaris* is widely used by the national Highways department though it has the disadvantage of spreading by seed dispersal, which vetiver does not. Iracambi intends to undertake more systematic trials of vegetative barriers in the 2000/01 season.

#### 2.4.3 Intercropping

Intercropping is a recommended practice to improve crop diversity, spread risks, and reduce soil impoverishment. Intercropping maize with beans is already the traditional practice. Since rice, maize and beans are almost the only common annual field crops Iracambi does not see much potential for improving the traditional system: the potential for improving this is constrained by the rainfall pattern that limit the times at which beans can be safely harvested without risk of rotting in the field. Intercropping of coffee with maize or beans is also common: here there is potential for developing alternatives. Pigeon pea (*Cajanus cajan*) is one with good potential in view of its nutritive value, both for humans and for cattle: Iracambi experience is that it grows well, but it is little known in the region and farmers have not adopted it.

#### 2.4.4 Composting

Although widely recommended as a good conservationist practice (Mollison, 1991; Rodale (ed) 1971), Iracambi's experience has been that composting in practice is not something that easily lends itself to adoption on a whole farm scale. It is time consuming to make, and even more so to spread, especially given the topography of the project region that do not allow mechanical spreading. It is a practice that adapts itself well to a vegetable garden, where the compost can be made in small quantities in the same area where it is to be applied.

#### 2.4.5 Agroforestry and reforesting gallery forests

Some work has been carried out at Viçosa university and at the Centro de Agricultura Alternativa (CTA) (a non-governmental organisation developing alternative land use and agriculture practices) on intercropping with forest species, but has not come to any conclusive recommendations. Iracambi has experimented with *Piptadenia* spp. in pastures. Ant control is a problem. In Central America, *Gliricidia sepium*, neem (*Azadirachta indica*) and *Leucaena leucocephala* are very successfully used. *Leucaena* grows well in the areas of lower altitude, but its sensitivity to acid soils is well known, and on Iracambi's soils it has not done well. It is also highly susceptible to attack by *Atta* ants. *Erythrina*, some varieties of which grow locally, would merit further investigation as the species generally has good nitrogen fixing capacity. An important element of the association of trees and pasture is the potential of the tree as a protein supplement for cattle. *Leucaena* is not ideal for this purpose as it can prove toxic. In other countries work has been done on this and a number of exotic species are known to be useful, but Iracambi has not found any study on indigenous trees for fodder. Bracatinga (*Mimosa scabrella*), a native species that used to be used for fuel plantations for the steam driven railways, has also been disappointing at Iracambi: of the two varieties tried, one has a very shallow root structure and is vulnerable to wind damage, and the other is too slow growing.

Reforesting gallery forest on water resources is a practice recommended in general terms by extension agents but more specific recommendations are required that take into account the incidence of flooding during the rains. Iracambi experience shows that Ingá (*Inga edulis*) is a useful tree in this respect as it is fast growing tolerant to water logging, and bamboo can also be used as a fast growing plant to provide shade for other slower growing species.

#### 2.4.6 Minimum tillage and direct seeding

These practices that have proved highly successful in other areas of Brazil, but are little known in the study area. Iracambi's experiment of this has been promising on certain types of soil that do not dry out too much during the winter. On newly cleared forest land it would be the best method of planting to replace the traditional slash and burn. On lateritic soils, we have found that the ground is too hard to direct seed by hand (the topography does not allow mechanical seeding) and if one waits until rains have softened the soil, the weeds have become uncontrollable.

#### 2.4.7 Management of native forests.

Iracambi has experimented with three types of forest management: establishment of new forest in an open field, reestablishment of new forest under phased shading, and enrichment planting of sparse existing regenerating forest. The open field method was an attempt to reforest a degraded pasture under *Brachiaria* and molasses grass (*Melinis minutifolia* - capim gordura): it was found that this is not a successful low input method as the depleted soils with very low organic material contents are not a favourable environment for most forest seedlings; the competing grasses either hinder root development (*brachiaria*) or overgrow the seedlings (*capim gordura*) and in both cases the new seedlings are very susceptible to *Atta* ant predation. The experiment of pre-establishing shade (using a mixture of guapuruvu (*Schlozobium parahyba*) and guava (*Psidium guajava*) is in its first season and it is too soon to make any evaluations. Enrichment planting under sparse regenerated forest is more promising: it is less labour demanding, and the survival rates of seedlings is better.

To reduce the effects of forest fragmentation and try and save islands of forest that are too small to maintain viable populations, forest islands can be reconnected by corridors. This has been successfully done at the Centro Sul Mineiro in Monte Belo, Minas Gerais, where studies have also been carried out on the most suitable tree species to be planted. In many places, a corridor could run along the boundary of two adjacent properties to reconnect islands, thereby sharing the burden of the land loss between landowners. A 20m wide corridor along either side of a boundary line this requires each land owner to give up 10m each, which is not a major sacrifice.

#### 2.4.8 Creating value for biodiversity

The other main focus of the Centre's work is on developing the awareness of the value of biodiversity and the rainforest. Much literature is devoted to the discussion of the economic value of biodiversity (McNeely *et al.*, 1990). The value of economic losses to Brazil from deforestation has been estimated at US \$ 500-\$1000 million p.a. (Brown (1991, p133); Repetto and van Bolhuis (1989)), but this is of more theoretical than practical interests for local small scale farmers whose immediate concern is their own subsistence. Iracambi has therefore focused its attention on only two aspects: the value of forests in the conservation of water resources, and the potential value of biodiversity as a source of revenue, that is to say in generating income for small-scale landowners. The Centre's extension and education programme therefore gives emphasis to the role of the forests in water conservation and how deforestation damages the water cycle.

The most valuable property of the tropical rainforest is often considered to be its biodiversity, a rich store of genetic potential for the development of products beneficial to people, particularly in the pharmaceutical field. For example, Farnsworth, in Wilson (1986), lists 119 pure chemical substances derived from higher plants and used in medicine. As part of its search for alternative sources of income, the Centre has started research on the use of plants for medicinal purposes. A database has been established of the local plants and their traditional uses. Five species have been identified as having particular potential. The next phase of this work is to identify possible markets and commercial partners, and Iracambi has contacted various commercial companies that market medicinal plants with a view to starting a pilot production that might later be taken up by interested farmers in the area. There are undoubtedly other possibilities too, such as hearts of palm (palmitos), honey and eucalyptus based products, the potential of which the Centre will investigate as funds and human resources allow.

#### 2.4.9 Extension and education programme.

Without the Centre embarking on any systematic publicity campaign, it soon found itself pressured from local interests to play a part in other environmental initiatives that were arising at the same time. It has become increasingly clear that the Centre cannot work in isolation from the community that shares the same problems, and that it has to have a role in the community itself. The Centre has therefore broadened its original focus on research to take on as well the role of a local conservation Centre, a focus point for environmental education and extension.

Working with local schools and farmers' groups, it has field days for teachers, schoolchildren and farmers' associations, when they can come and visit the Centre and get an explanation from the the importance of environmental conservation and what they can do about it. The Centre has prepared a basic set of education materials which will be added to over the course of time with an input from visiting school children and local community volunteers. The centre also hosts field visits for schoolchildren, who are given a basic introduction to the concept of conservation in the context of their daily lives showing why biodiversity conservation matters, and are then asked to write some material of their own which can be used for other children. The visitors are also invited to participate in some activity, such as making tree seedlings or planting them. Similar field visits are planned for local community leaders and farmers' groups.

As Iracambi develops its capacity, it will embark on the second phase of this programme, which will include:

(i) An intensive publicity campaign, using advertisements, the existing local community radio, school visits, farmers field days etc. to publicise the existence of Amigos and its objectives, raise awareness about conservation issues and their relation to land use, and to identify local activists and volunteers.

(ii) Using the volunteers so identified, to develop educational materials, designed and executed by the volunteers themselves, about problems of land management and land degradation, for use in local schools and in community groups.

(iii) Using primarily community activists and volunteers, but also supplemented with professional help from whatever resources can be found (such as the nearby Federal University of Viçosa and the CTA), to work with farmers groups in identifying land management problems, helping the farmers to propose their own possible solutions using technical support based on research work at the Centre. Iracambi will also join with other farmers in trying out new practices that are recommended by research findings.

### **3. CONCLUSIONS AND RESULTS**

The reaction of other researchers and institutions with whom Iracambi has been in contact has been highly encouraging and has strengthened Iracambi's belief that it is on the right track. The positiveness of response of the local community caught Iracambi by surprise and has pressured it into broadening its activities into the education and extension activities much earlier that it had planned. As a consequence, Iracambi has to consider how it can best expand its capacity to attend to local demand.

It is therefore formulating a proposal for funding for its conservation centre activities, to submit to an appropriate funding agency. The proposal will consist primarily of education materials and audio visual equipment, and the costs of visits to the Centre by schools and farmers' groups. Iracambi also has plans to expand the facilities of the Centre to accommodate up to twenty researchers at a time, and to equip it with basic equipment that would make it attractive to visiting researchers. This means principally a telephone/internet connection, a vehicle, and basic laboratory space and equipment. A proposal for the funding of this has already been submitted to an international agency.

A future project is the creation of a centre for the breeding of endangered species, partly to raise awareness of the value of the local fauna in terms of biodiversity and partly with a long term view of restoring native populations. Iracambi is at present identifying suitable species with which to work. In the long term, this might lead to the breeding of endangered species as a household revenue generating activity. This is being done in some Central American countries with modest success, but the existing legal environment does not favour its early realisation in Brazil.

The Centre is building partnerships with interested institutions to assist it in its access to potential researchers. It has an agreement with the University of Wisconsin to accept interns and has a partnership with the Smithsonian Institute in the share of conservation ideas and technology. It also has a technical collaboration agreement with the Centro Mineiro de Conservação da Natureza through which it can draw on the resources of the Federal University of Viçosa.

As the land management programme grows, it will need to have access to a fund to finance small on-farm investments by farmers' groups and communities on a matching grant basis. Iracambi, in collaboration with the other interested institutions, plans to draft a proposal for such a fund, to supplement other funding sources from local and state government. The mechanisms for the fund, to be controlled by an elected sub-committee of Amigos in which representatives of interested groups would sit, would depend on the requirements of the funding organ.

Although the Iracambi experience is still very young and open to the criticism of its lack of scientific rigour, the management of Iracambi believes that it has already shown that there is a clear demand for its activities, and that it can develop the capacity to meet it.

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