

## **SUMMARY**

### **FEASIBILITY AND EFFECTIVENESS OF FOREST CORRIDORS AND THEIR INTEGRATION IN SUSTAINABLE LAND MANAGEMENT. CASE STUDY: IRACAMBI RESEARCH CENTER, ATLANTIC FOREST**

By

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## **1. Introduction**

### **1.1 Initial approach**

The debate about forest corridors is not a recent one and has troubled many researchers during the last 30 years. It became a contemporary topic, due to the extensive deforestation, which is further accentuated with fragmentation, as one example of the great and rapid stress that humans place on the natural environment.

The issue in fact is tracked down to the pace of the human intervention, which destroys the defenses of the forests, causing deleterious effects such as reduction in animal population sizes, genetic consequences, species loss, microclimate changes and finally survival threat to species with large home ranges, that will be constrained to live in small fragmented patches (Bierregaard et. al, 1992).

As Meffe and Carroll (1997, p.323) mentioned, as long as the widespread habitat fragmentation and isolation are major contributors to the biodiversity loss, it is reasonable that reconnection of the areas will confront these adverse effects. These are the consequences that the corridors are called to moderate and potentially eliminate, contributing in the biodiversity conservation.

The literature about this topic is quite abundant and has focused on many aspects of forest corridors. However, many researchers agree that knowledge is still not enough to make conclusions and safe decisions therefore more data is needed. Moreover, there is consensus about the difficulty to provide recommendations for such strategies. The latter are deemed as area and species specific, while many other factors that will be analysed in the following chapters influence them.

Being inspired from the great debate about the effectiveness of forest corridors I initially aimed at analyzing the biological factors that affect their success. Despite my original thought, once I settled in my case study area, I realized that it was essential to broaden my scopes because there were more and very pressing issues associated with the forest corridors; it would be inappropriate not to include them in the analysis.

Consequently I decided to focus on the social aspects that arise from a forest corridors strategy, based on interviews with local people, conducted in the area adjacent to my case study: IRACAMBI. Nonetheless the existing corridors in my case study area are recently established. Therefore instead of conducting experiments and observational studies, external organizations with more experience were asked to illustrate their strategies; thus I was able to heed biological aspects of the corridors, based on various experiences.

The aspects that were heeded are related to land ownership and public participation in the environmental management. Indeed it proved that these are the most important issues that should be tackled with. As Bennett (1999) suggested '*biological issues have a strong influence on the way in which linkages function and on their effectiveness and in the same time socio – political issues are important influences on the successful outcome of such projects*'. Such matters include the status and tenure of the land, local communities support along with their education and awareness. Indeed a strategy aiming solely to conserve the forest isolated by social and political issues is deemed unpromising and the least successful.

In this context, texts related to sustainable development were very enlightening about the relationship between the authorities and the stakeholders. Many of the core texts also focused on sustainable practices that could contribute in achieving a compromise between environmental protection and local peoples' rights and needs.

The aspiration behind my attempt was to produce a thorough piece of work, which application extents to all spatial levels, based on my case study, IRACAMBI research center. In the same time its importance expands from the environmental protection, till the recognition of the importance of the local communities needs and opinions.

This paper is divided in 6 chapters. In the first chapter the issue of forest corridors will be heeded, by examining relevant published bibliography, mostly books and journals that tackle the problem in its global scale. In the second chapter the profile and background of my case study will be presented. The third chapter discusses the methodology that I followed to gather and analyze my information and present the results. This chapter leads to the fourth chapter, containing the analysis and discussion of my findings. The final chapter presents

recommendations about actions to be carried out and suggestions about future research, both in local and international level.

## **1.2 Research questions**

### **Aim of the study**

The ultimate aim of this research is to assess the feasibility of forest corridors and their contribution in enhancing biodiversity conservation while promoting sustainable development.

### **Objectives**

A. To investigate how factors such as width, length, vegetation and surrounding matrix are crucial elements in a corridor design.

B. To examine how much people can contribute in a strategy of afforestation and forest corridors.

C. To examine the feasibility of future corridor projects in my case study, by combining biological and social aspects.

D. To suggest generally applicable solutions to conserve the biological heritage, through forest corridors creation.

## **6. Suggestions and recommendations**

### **6.1 Local Level**

#### **6.1.1 Biological aspects of corridors**

As many scientists have argued, general guidelines for a successful corridor project cannot be produced. The specific ecological conditions and the aims of the projects are the factors that affect each corridor which differ significantly in various aspects, such as aims and extent, while their contribution has been deemed very important.

For my case study no particular faunal species is more important than any other and the ultimate aim of preserving the forests and connecting the remnants by corridors is preservation of biodiversity. However birds and insects are the most frequent inhabitants of the forests, while monkeys are less frequent (LeBreton, personal communication).

It has been presented that birds are generally more mobile than non – flying animals but behavioral avoidance is the reason that many forest – interior birds

are inhibited by forest gaps. They prefer moving through vegetated linkages, where available, rather than crossing gaps of open land (Bennett, 1999).

In order to support the forest corridors importance for birds, demonstrating that certain species occur within a linkage with greater frequency than in the surrounding altered landscape can be critical. In such a case it would be reasonable to infer that these links increase the population continuity and the habitat enhancement. Knowledge about the species movements within a fragmented landscape, with no corridors should be complementary to the above action. The necessary information could also contain behavioral characteristics and food and habitat requirements of the species. Consequently the comparison of the two situations could further inform the practitioners about the necessity and effectiveness of the corridor (Bennett, 1999).

For a project though to be successful into the long run, corridors could be incorporated into a system of several corridors, connecting adjacent patches. This is exactly what the “Instituto Sul Mineiro” attempted to achieve, as presented in the results chapter, by creating a ring of three corridors, to connect the most important forest fragments that exist on their land.

However, as many of the participants in my research pointed out, when it comes to create a corridor, the width dimension should follow the axiom ‘as wide as possible’. This has been proved necessary by many researches and Bennett (1999) argued there are three important benefits that accrue from this. These are the reduction of edge effects, since corridors contain more interior habitats; the increase in habitat and wildlife diversity, complying with the species – area relationship; and finally that they can accommodate species with large area requirements and specialized needs.

In the article 3 of the ATLANTIC FOREST DECREE (750/93), also, there are recommendations regarding the form and the composition of the corridors. It is highlighted that the minimum width for a corridor should be 100 meters and not less than 10% of the total area that the corridor covers. It seems more applicable, though, the width measured as percentage of the area, since the scales of corridors vary.

Despite all these suggestions, more attention should be given to the statement that the width per se couldn't be as crucial as the ratio width/length of a corridor (Friend, 1991). Accordingly, the distance between the patches is a crucial factor that determines the length of a corridor and consequently the width.

Regarding the type of vegetation to be used, more preferable is to include native species, so as to enhance the local environmental conditions that prevail in each location. Even in the ATLANTIC FOREST DECREE (750/93) it is suggested that in the areas that are good enough, the intervention concerning the flora composition should take place by using native local species. Such species could be Caroba (*Jacarando spp*), which is one of the unique species that produces flowers during winter or Xixim (*dicksonia sellowiana*), an ancient plant family native in the region, that is dated back in the dinosaurs era. Additionally, fast growing species could be planted, in order to provide rapidly a forest cover, which will serve for both economical and ecological reasons.

In the case of a corridor that primarily aims at certain animal species, priority should be given on trees that are mostly used by these animals (e.g. fruit trees). Consequently both animals and pollination of the trees would be accommodated. Moreover, Mirriam (1991) noted that species assisted in their dispersal by animals are known to move along corridors, together with pioneers species as well as weeds.

In this context and as Padua et al. (2002) suggested, agro – forestry practices could form a means to protect the forests and in the same time enhance the living condition of local communities. Despite the little attention that had been given to these practices since recently, there are some scattered evidences that they might bring the conservation efforts to the right direction.

Practising agro – forestry around the edges of the forest corridors, as well as the edges of the forests, could minimise the edge effects. This could be a gradual change of vegetation while pasture or agricultural land takes over, as the dominant feature of the landscape. Accordingly they can support the genetic viability of several faunal species and the dissemination of native floral species, through seed dispersal and pollination corridors (Padua et al., 2002).

Agro - forestry generally is the type of land management in which plants and trees are grown next to agricultural crops, with economical and ecological interactions between the various sections. Benefits that arise, supported by MacDicken and Vergara (cited in Padua et al., 2002) include improved microclimate, increased soil protection and thus fertility, increased water quality and quantity, reduced wind effects, improved weed and pest control thus decreased requirement for fertilisers and finally increased economic sustainability.

In my study case, the cultivation of fruit trees and medicinal plants has already been tried and many local people have been growing them for their personal

consumption. Their potentials, which have been mentioned in the third chapter, have considerably increased during the last decades. Based on earlier surveys (unpublished documents), people are willing to change practices and increase the proportion of these alternative cultivation practices, as opposed to the widespread coffee plantations that dominate.

Especially fruit trees have positive environmental benefits as they provide perennial cover protecting the soil and store and recycle plant nutrients and organic matter. (Haq, N. & Atkinson, M. 1999). Farmers are cultivating papaya, avocando, mango, banana, carambola, biriba, orange, tangerine and acerola (unpublished research). Papaya is a fast growing species pollinated by wind (Kricher, 1997), therefore it can be included in a forest corridor regeneration. Acerola is a tree that has been successfully introduced to sub-tropical Brazil and it is used in great extent ([www.crfg.org/pubs/ff/acerola](http://www.crfg.org/pubs/ff/acerola)). It has also many medicinal characteristics, being used to combat diseases and illnesses (fever, dysentery, anemia, diabetes, high cholesterol, liver problems, rheumatism, tuberculosis). So both of these species could form components of the planted vegetation in corridors and material for further research.

A tree, which serves for all the above purposes and is particularly prominent in the area, is embauba (*cecropia glaziovii*). Apart from being native to South America, is a fast-growing tree, but short-lived, and is propagated by the many small fruit seeds it produces (bats, monkeys, and birds eat the succulent fruit and disperse the seeds). Its medicinal characteristics are also very popular in Brazil, where it is used for all types of respiratory complaints, for diabetes, Parkinson's disease, kidney disorders, high blood pressure

Other trees that could be used are: *Cassia fistula* or *Canafistula*, a native in Brazil, medium-sized, deciduous tree, which has documented properties & actions as analgesic, antiviral, astringent, choleric.([www.rain-tree.com](http://www.rain-tree.com)); Fedegoso Leguminosae or Cassia is an other indigenous tree. Its roots and leaves are considered a tonic, febrifuge and diuretic being used for several diseases, among them fevers, dysmenorrhea, tuberculosis, anemia, skin disorders and wounds ([www.rain-tree.com](http://www.rain-tree.com)).

Consequently the eucalyptus plantation shouldn't be favored in the expense of the native forest. Despite the fact that eucalyptus tree is an exotic species, the mayor argued that 'the local authorities in some occasions encourage them instead of native forest, because they retain water, conserve springs and can be cut for wood (unpublished document). Nevertheless, this statement is hardly acceptable and the native forest is invaluable.

Buffer zones could be though another important factor in increasing the effectiveness of a corridor, by ameliorating the adverse edge effects (Friend, 1991). These areas could enhance the forest and protect viable core areas of the corridors. Similarly they could consist of native trees and even by medicinal plants and fruit trees that have the extra advantage of generating income for the local people. The buffer zones and gradual edges have been suggested in a discussion report by Start (1991), in which also fencing of the boundaries has

been also presented as a solution to minimize external adverse effects on the corridors.

### **6.1.2. Local social aspects**

As Bennett (1999) mentioned, the corridors are a visible solution to the fragmentation problem, therefore local people have the chance to participate in local level.

During the interviews that I conducted with the local farmers, the dependence of the people on their land was revealed. It was also made clear that in order to protect the forests that have been remained, apart from attempting to connect them, considering only environmental criteria, the needs and the well being of the local people should be also heeded. Therefore, agro – forestry practices, which have been initially suggested as a component of a strategy for biodiversity conservation, could achieve the marriage of conservation and economic development.

Even the mayor (unpublished documents) referred to the fact that farmers are getting lower and lower yields from their land, as the soil is getting tired. The profit margin is always decreasing and more investment through fertilisers is needed. Therefore crop diversification or further deforestation is more of a vicious circle than a long-term solution.

In order though for the local authorities to initiate a project on forest corridors, it seems promising to start with the big farmers. In fact, as people from the municipality stated, the big farmers own the biggest part of the Aranhas area and would be both reasonable and effective to get their consent for a community level project (personal communication).

Evidently, the big farmers, as opposed to the small ones, are more willing to participate in projects that require their land to be used, e.g. in order to create a corridor. On the other hand farmers that own small parts of land are more concerned about their income and therefore environmental protection isn't among their most urgent priorities.

As a conclusion from the conversations I had with Robin LeBreton, the use of medicinal plants could be of great importance, not only in biological terms but also as an alternative income for the local communities. According to Elliott (1999) less than 1% of known natural substance compounds are currently being used as medicines, while increasing attempts are being made to extract new substances. Around 10% of the western pharmaceuticals are based on plants found in developing countries.

Ballick et al (1997) conducted a research on medicinal plants potentials, concluding that it is economically profitable to use at least part of the land in a rainforest ecosystem as extractive reserves for medicinal plants. If this strategy is

coupled with native trees, the results will be significant for both the environment and the economic conditions for local people. Despite their positive results, the lengthy processes for a pharmaceutical product to be produced don't bring immediate economic benefits. Moreover, as past experiences have showed, discoveries of natural medicines led to destructive and unsustainable yields and the profits for local people haven't proven much.

Fruit trees are undoubtedly another good opportunity to generate income for the local communities and in the same time be used to increase the forested areas. According to some previous researches (unpublished document) native fruit trees such as *Psidium guajava* L. (Guava) or Palmitos (hearts of palm) have great potentials for commercial use and even for export to Europe. The mayor noted that four industries that produce fruit juices have already been established in the area, pointing out the possibilities for the growth of the fruits commerce (personal communication). He also revealed that a scheme to grow fruit trees, on a commercial basis, has already started on behalf of the local municipality and despite that it is in its initial stage the Bank of Brazil supports some of them, e.g. the passion fruit (*Maracuja*), although it is a vine, not a tree.

However the market conditions and the willingness of people to participate in fruit trade determine the feasibility of such an attempt. Reluctance of the farmers to experiment with new cultivations and the lack of information about the potential outcomes has been noticed. The mayor argued that is hard to convince people to try new products, whereas the market doesn't form a discouraging factor. On the other hand producers do feel that the market and the access to it form an obstacle and dissuade them to participate. Half of farmers that participated in a survey (unpublished document) and especially the remote ones either don't see a market or see transport and storage of fruits as a problem. Most would like to sell fruit but are both worried about transport and are used to planting coffee. However there are some promising aspects, since some farmers mentioned that if they had training they might consider it.

We can't ignore though the counterviews on agro - forestry practices that have been suggested by Wells and Brandon (1992, cited in Southgate and Clarks, 1992). They argued that the untested hypothesis that local population will give up their activities to devote in agro – forestry is often an illusion. They justified it by referring to surplus labour, which can be channelled in these new practices, while maintaining agriculture and cattle ranching as additional income sources.

At this point it appears that education could play a major role in bringing the local communities closer to conservation issues. In the municipality, where my interviews were conducted, various projects have been initiated, aiming mostly at students. All these efforts are important and it has been proven that coordinated attempts by the authorities and the NGOs that are working in the area, such as Iracambi, are welcome by the people and have the potential to boost the efforts and the results. Education, however, in this occasion is a two – way procedure and both local people and the authorities could gain important knowledge.

It has been also greatly supported that incentives can boost the conservation strategy. An important economic instrument is allowances or even direct payments. These practices are illustrated in the conservation reserve program initiated in 1985 in the USA, which aimed at persuading farmers to substitute agricultural land with forested areas, by planting trees and grasses. The inducement for the farmers was a 10 – 15 years contract, during which they received an annual payment (Bean M.J., cited in Meffe & Carroll & contributors, 1997).

Incentives such the above, if organized well, could deliver better results than prohibitions and penalties could. The latter are most probably to be ignored, as was the case of many Brazilian laws especially in the past. Despite this, the 'ICMS Ecologico' exists, which gives incentives to the Brazilian states to retain and increase their protected areas (personal communication). However its implementation is not very prevalent and it should be enhanced, by conducting further research about its so far success and contribution

Keeping all the above in mind, it is extremely important, for the local level, that research about medicinal plants and fruit trees continues, which can lead to very practical suggestions about their use in forest corridors. In the same time the close cooperation with the inhabitants is deemed essential.

## **7. Conclusions**

This research, in great extent, focused on the particular circumstances that prevailed in my case – study. However the input from the questionnaire survey was really valuable and shed light to many aspects that should be tackled.

In international level, general applicable guidelines are more difficult to produce, due to the fact that solutions are case specific, something that many researchers have so far stressed out. Especially, the tropics are the areas that are depleted the most and actions are necessary to reverse the trend of destruction. This challenge will be addressed successfully if only public and private organizations, scientists and researchers collaborate

However, given that knowledge is insufficient, more research is required as well as integration of all knowledge. Long-term results should be aimed at, something that opposes to the current situation that typically rules in the developing countries. The interest should shift from an immediate to a sustainable and constant profit, but this doesn't imply that the needs of the present generations should be totally neglected. On the contrary as the term of sustainable development dictates, the needs of both present and future generations should be taken into account.

A holistic approach for the protection of the forests, in biological context, shouldn't only incorporate connectivity of habitats, but also expansion of protected habitats, maximization of habitat quality and minimization of impacts from surrounding land uses (Bennett, 1999). It is doubtful that corridors alone could provide adequate protection to the forests. Thus, the primary aim is the protection of the remaining forests and especially the so precious tropical forests, limiting the threats that they are facing. Priorities should be set, depending on the available knowledge and the budget.

Moreover it was stressed out the importance of the tropical rain forests, for both biological conservation and the local communities. This in turn, implies that what should be done needs to be rewarding for the people and in the same time environmentally benign. Practices that have potentials to fulfill these requirements could be eco-tourism, extraction of non-timber products (cultivation of fruit and medicinal plants, as presented in the previous section) or sustainable timber production (Southgate, 1997). Southgate (1997) also suggested that strategies that result in total exclusion of people from their land wouldn't be appropriate, because they bring about fierce oppositions from the various stakeholders.

In order then, to fully and successfully protect these ecosystems integrated measures should be undertaken, focusing on all aspects and all scales, (preferably initiated by national or international communities). There are not negligible the number of cases, where environmental problems have arisen from independent decisions, which individually were reasonable but as a whole they created undesirable environmental conditions (Lovejoy, 1997, pp. 653).

A required approach is to work together with the local communities, as long as they are, either directly or indirectly, the recipients of every action. In the fields of development and the environment, there is now an evident consensus that sustainable development is an important rallying point for research and action and a desirable policy objective, which should be striven for (Elliott, 1999; p.5). It is very important though to keep in mind the view that Southgate and Clark (1992) presented, according to which *it is naïve to suppose that people who live in forests always have strong economic interest in keeping natural ecosystems intact.*

Education, initiated both in local and national level, is an answer to the above remark. As the German Advisory Council on Global change (2001) pointed out, the majority of the public still remains uninformed. Therefore education is an important component of a holistic strategy and it was an issue raised from the

participants in my questionnaire research. All the organizations revealed how crucial the education of, and the collaboration with local communities is.

The pinnacle though to this strategy is a reformed forest policy, which has already started to take place. Environmental policy plays a great role in shaping trends that lead to biodiversity protection and in both national and international level could be one of the first steps for a successful environmental strategy. Government policies in Latin America, have contributed to accelerating deforestation by adopting measures to increase the profitability of agriculture in forested areas; constructing roads in frontier areas; adopting patterns of agricultural growth favoring large – scale mechanized production and low employment generation (Jaramillo C.F and Kelly T., 1997).

According to the World Bank the outcomes of such a process will be slow and marginal results will be generated, therefore a holistic approach should be implemented. The strategy should consider the reasons why the deforestation continues and certain measures are necessary for the situation in Brazil ([www.worldbank.com](http://www.worldbank.com))