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# **Poverty, coffee cultivation and deforestation in the Brazilian Atlantic rainforest: Achieving a sustainable livelihood through education and public participation**

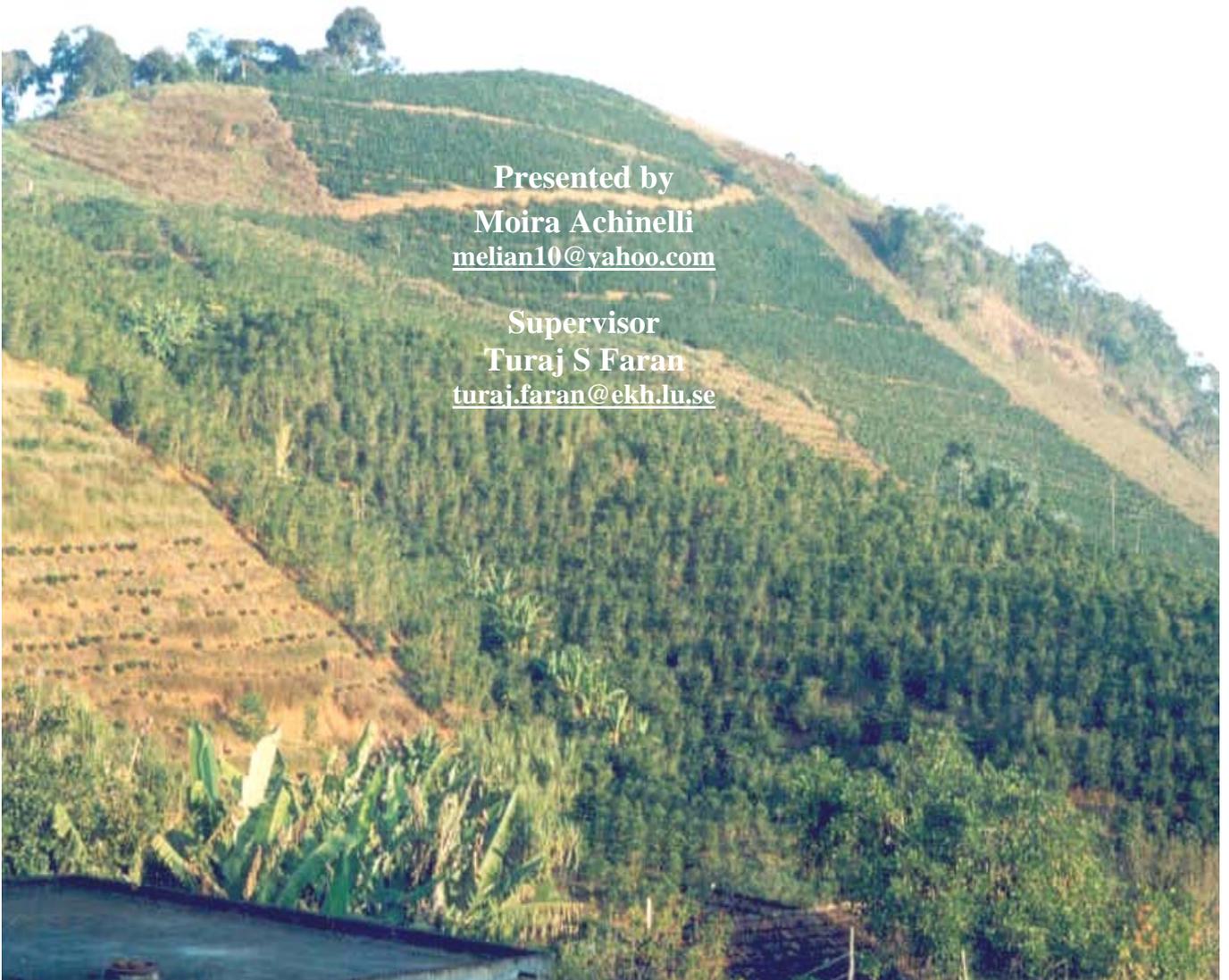
**LUMES Masters Thesis 2002-2003**

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## Table of contents

ABSTRACT .....	4
LIST OF ABBREVIATIONS .....	4
GLOSSARY .....	5
DEFINITIONS .....	5
ACKNOWLEDGEMENTS .....	6
1. INTRODUCTION .....	6
1.1 Problem definition .....	6
1.2 Organization of this paper .....	7
2. METHOD .....	7
2.1 Field Work .....	7
2.2 Complementary literature .....	8
2.3 Analytical Framework .....	8
2.5 Study Limitations .....	8
3. The Brazilian 'Mata Atlântica' rainforest .....	9
3.1 The original and current Atlantic rainforest domain in the Minas Gerais state .....	11
4. THE MINAS GERAIS, THE MOST IMPORTANT COFFEE PRODUCER OF BRAZIL .....	12
5. THE MURIAÉ AND ROSÁRIO DA LIMEIRA MUNICIPALITIES .....	12
5.1 The Belizario and Rosário da Limeira Communities .....	12
5.2 Pattern of Land Use and Distribution .....	13
6. PRECEDING PROBLEM ANALYSIS .....	13
7. PROBLEM ANALYSIS REVIEW .....	14
7.1 Defining poverty in the Rosário da Limeira and Muriaé regions .....	14
7.1.2 Poverty itself .....	15
7.1.3 Isolation .....	16
7.1.4 Vulnerability .....	16
7.1.5 Powerlessness .....	17
7.2 Poverty, the principal cause of deforestation? .....	18
7.2.1 Historical Motivations behind poor people's deforestation .....	18
7.2.2 Land Degradation .....	18
7.2.3 Is the lack of capital driving poor peasants to plant more coffee? .....	18
7.2.4 Coffee Prices .....	19

7.2.5 Charcoal Production Demand .....	19
<b>7.3 The land management plan, merits and shortcomings.....</b>	<b>20</b>
7.3.1 Land Suitability.....	20
7.3.2 Competing land uses .....	21
7.3.3 Land –use allocation.....	22
7.3.4 Crop diversification .....	23
7.3.4 Public Participation .....	25
<b>7.4 Summing-up .....</b>	<b>26</b>
<b>8. A NEW PROBLEM ANALYSIS .....</b>	<b>27</b>
<b>8.1 Analytical Scope.....</b>	<b>28</b>
<b>8.2 Coffee cultivation, deforestation and economic strategies for development.....</b>	<b>29</b>
8.2.1 The driving force of the iron and steel industry demand .....	29
8.2.2 The contribution of agriculture to deforestation .....	30
8.2.3 The demand for coffee exports -an engine of economic growth and foreign exchange.....	30
8.2.4 The agricultural shift in São Paulo and Paraná states and the expansion of coffee cultivation in Minas Gerais .....	31
<b>8.3 Linkages between deforestation and different patterns of economic development.....</b>	<b>32</b>
<b>9. A PATH TOWARDS SUSTAINABLE LIVELIHOODS IN THE ROSÁRIO DA LIMEIRA AND MURIAÉ RURAL COMMUNITIES .....</b>	<b>32</b>
<b>9.1 THE SHORT-TERM PLAN, BALANCING STRATEGIES BETWEEN FOREST PROTECTION AND POVERTY ALLEVIATION .....</b>	<b>33</b>
<b>9.2 THE LONG-TERM PLAN: EDUCATION, AN IRREPLACEABLE REQUISITE FOR LIVELIHOOD DIVERSIFICATION .....</b>	<b>38</b>
<b>10. CONCLUSIONS .....</b>	<b>39</b>
<b>10.1 Recommendations.....</b>	<b>40</b>
<b>CAUSAL LOOP DIAGRAMS.....</b>	<b>41</b>
<b>TABLES .....</b>	<b>44</b>
<b>REFERENCES .....</b>	<b>46</b>

## Abstract

A previous research, carried out by Watson (2000) in the Rosário da Limeira municipality, indicates that the major cause related to the Brazilian Mata Atlântica rain forest destruction has been connected to the expansion of the agricultural frontier principally for coffee cultivation. Therefore, a land management strategy has been proposed by the author to break out of the cycle of deforestation, coffee cultivation and land degradation.

It is argued throughout this paper that, in the first place, poverty is not the primary cause behind deforestation and that the main driving forces of deforestation in the Rosário da Limeira and Muriaé municipalities are the consequence of the economic pattern of development. Second, the study is concerned not only with poverty as a cause of deforestation but also with poverty in itself in order to show possible pathways towards a more sustainable livelihood. Third, the land management plan proposed by Watson (2000) is considered to be a valuable short-term strategy to slow deforestation but not sustainable in the long run. The paper analyzes the livelihood diversification through community education as a strategy to promote economic diversification and agriculture as a sideline activity in order to reduce poverty and prevent deforestation. It is argued that education is not only a necessary requisite for livelihood diversification but also to promote and improve public participation.

The results of the analysis demonstrate that the possibilities of a sustainable agricultural use of the land, if a land management plan were implemented, are rather limited. In addition, this study reveals that although poor people clear forested areas to maintain or improve their income levels, poverty is only the proximate cause of deforestation in the Rosário da Limeira and Muriaé regions and that the steel and iron industry charcoal demand, as well as the expansion of the agricultural frontier are the primary causes of deforestation in the region. The extension of the agricultural frontier for coffee cultivation in the Minas Gerais state can be attributed to the country's reliance on export crops, as well as to the shifting composition in crop cultivation within the São Paulo and Paraná states. The foreign debt, as well as the conditional reforms supported by the World Bank and the IMF to generate export income have encouraged coffee cultivation. In addition, economic policies aimed to promote the industrialization of the country have promoted coffee cultivation and encouraged charcoal production in the region.

## List of abbreviations

ANA	Agência Nacional das Águas (Water National Agency)
CEESP	IUCN Commission on Environmental, Economic and Social Policy
CMWG	Collaborative Management Working Group – South America
CONAB	Companhia Nacional de Abastecimento (National Council of Supply)
CONAMA	Conselho Nacional do Meio Ambiente (National Council of Environment)
CTA-MG	Centro de Tecnologia Alternativa (Centre for Alternative Technology of Minas Gerais)
EEA	European Environment Agency
EMATER-MG	Empresa de Assistência Técnica e Extensão Rural do Estado de Minas Gerais (State Agricultural Extension Agency of Minas Gerais)
FAEMG	Federação da Agricultura de Minas Gerais (Federation of Agriculture of Minas Gerais)
F.A.O.	Food and Agriculture Organization of the United Nations
FUNATURA	Fundação Pró-Natureza (Pro-Nature Organization)
GEF	Global Environmental Facility
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
ICO	International Coffee Organization
IEF	Instituto Estadual de Florestas (State Forest Institute)
INPE	Instituto Nacional de Pesquisas Espaciais (National Institute of Outer Space Research)
ISA	Instituto Socioambiental (Social and Environmental Institute)

ISI	Import Substitution Industrialization
IUCN	The World Conservation Union
MAPA	Ministério da Agricultura, Pecuária e Abastecimento (Ministry of Agriculture, Cattle breeding and Supplying)
PESB	Parque Estadual Serra do Brigadeiro (Serra do Brigadeiro State Park)
PNUMA	Programa das Nações Unidas para o Meio Ambiente (The United Nations Environment Programme)
PRONAF	Programa para Apoio a Agricultura Familiar (National Programme to Strengthen Smallholder Agriculture)
PRRC	Plano de Renovação e Revigoramento dos Cafezais (Plan for the Renewal and Strengthening of Coffee Plantations)
RMA	Rede de ONGs da Mata Atlântica (The Mata Atlântica NGOs)
RFTF	The Pilot Program to Conserve the Brazilian Rainforest
SAS	Superintendência de Conservação de Água e Solo (Superintendence of Water and Soil)
SLP	The Sustainable Livelihood Programme
SNE	Sociedade Nordestina de Ecologia (Northeast Ecology Association)
STR	Sindicato de Trabalhadores Rurais -Agricultural Labor Union
TC / BR	Tecnologia e Consultoria Brasileira S.A (Brazilian Technology and Consultancy)
TILCEPA	WCPA-CEESP Task Force on Indigenous and Local Communities, Equity and Protected Areas
UNDP	United Nation Development Programme
WCPA	IUCN World Commission on Protected Areas – Brazil

## Glossary

*Artesanatos*: handicrafts such as embroideries, straw baskets

*Associação de Mulheres Rurais*: Rural Women Association

*Carvão vegetal*: charcoal

*Cipó*: liana

*Córrego*: micro catchment

*Escola Família Agrícola Novo Horizonte*: Family Agriculture School of Novo Horizonte

*Fazendeiros*: big landowners

*Feijão*: Beans

*Fraco*: weak, a soil without fertility

*Jornaleiros*: People who are not permanently employed by the owner of the land and are paid only for the workday

*Mandioca*: cassava

*Mata Atlântica*: Atlantic Forest

*Morros*: hills and low mountains

*Milho*: corn

*Município*: an administrative unit with its own elected local government.

*Palmito*: palm tree

*Polícia Florestal*: Forest Police

*Sindicato do Trabalhadores Rurais*: Rural Worker Union

*Torrefação*: toasting

*Varzea*: Low lying land subject to flooding

*Zona da Mata*: Region of Minas Gerais state covered by the Atlantic Forest

## Definitions

<sup>a)</sup> **Biome**: The major terrestrial ecosystems that cover regional or subcontinental areas (Kormondy, 1996).

- b) **Primary rainforest:** Original (pioneer) plants developed in regions of completely bare ground (Packham R.J. et al., 1992)
- c) **Secondary forest:** Vegetation that regenerates after being damaged on a disturbed ground with an existing soil (Packham R.J. et al., 1992)
- d) **Community:** A community is the geographic area, including one or more micro catchments or 'córregos', where families are located and where usually social structures such as a church, a school, and soccer field are found (IEF, 2000).
- e) **System:** It is defined as the total area cultivated in the study region (Faria et al., 2002)

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## 1. Introduction

### 1.1 Problem definition

The major causes related to the Brazilian Mata Atlântica rain forest destruction have been connected to the expansion of the agricultural frontier principally for coffee cultivation (Watson, 2000). The author, who is a current Alumni of LUMES Programme, conducted her research on coffee production in Rosário da Limeira, a small municipality in the Brazilian state of Minas Gerais, during 2000. The field work and the author's study was written in cooperation with three months of work with the non-governmental organization *Amigos de Iracambi*.

In her thesis, Watson, who had a similar thesis topic, explains that the demand for more productive land from the small-scale coffee farmers and the continued land degradation, considering the instability on the world coffee market, is a serious threat not only to the Atlantic rain forest conservation but also to the livelihood of the farmers living in the Rosário da Limeira. Therefore, a land management strategy has been recommended to break out of the cycle of deforestation, coffee cultivation and land degradation (ibid). This approach combines the use of sustainable land management techniques, crop diversification and the development of alternative markets to improve the economic and social conditions for small-scale rural farmers (ibid).

It is argued throughout this paper that, in the first place, poverty is not the primary cause behind deforestation and that the main driving forces of deforestation in the Rosário da Limeira and Muriaé municipalities are the consequence of the economic pattern of development. Second, the study is concerned not only with poverty as a cause of deforestation but also with poverty in itself in order to show possible pathways towards a more

sustainable livelihood. Third: the land management plan proposed by Watson (2000) is considered to be a valuable short-term strategy to slow deforestation but not sustainable in the long run.

The paper analyzes the livelihood diversification through community education as a strategy to promote economic diversification and agriculture as a sideline activity in order to reduce poverty and prevent deforestation. Considering that this is a long-term strategy, the land management plan proposed by Watson (2000) is evaluated to tackle the problem of land degradation during the transition period. In addition, the importance of public participation to implement the land management plan is discussed, as well as, to improve the family income during the transition term. It is argued that education is not only a necessary requisite for livelihood diversification but also to promote and improve public participation.

## 1.2 Organization of this paper

The first section of the paper presents some background information related to the Mata Atlântica, the Minas Gerais state, the Muriaé and Rosário da Limeira municipalities and the Graminha and Buracada communities.

Section II presents a briefly critical review of the problem analysis supplied by Watson in her research conducted in Rosário da Limeira municipality. In this part a framework for analyzing poverty in Rosário da Limeira and Muriaé rural communities is presented, as well as an evaluation of the magnitude of poverty as a driving force of deforestation. In addition, there is an examination of the supports and constrains regarding the implementation of a Land Management Plan suggested by Watson.

Section III comprises a reformulation of the problem analysis including new factors and their interconnections.

The final section addresses livelihood diversification as a potential path to tackle the problem of poverty and deforestation.

## 2. Method

### 2.1 Field Work

The study of the local conditions, as well as the interviews were carried out with the assistance of the Iracambi Atlantic Rainforest Research Center, located in Rosário da Limeira, Minas Gerais, Brazil. Besides the current research programmes, the Research Center offers logistical, linguistic and technical support for outside researchers. The Center is owned by *Amigos de Iracambi*, an NGO created to promote sustainable conservation of the Mata Atlântica in the immediate area, to raise local peoples awareness of the process of forest degradation, to encourage sustainable management of the forest and to channel funds for this purposes.

Research consisted of daily interaction with *Amigos de Iracambi* and informal conversations with local peasants, rural women and communities' leaders. In addition, the author participated in the activity entitled 'The First Week of the Family Agriculture' carried out in the 'Novo Horizonte' agricultural school in Pirapanema community, Muriaé, Minas Gerais and visited the project PETI (Child Labor Eradication Programme) in Rosário da Limeira. The author also attended an environmental education lecture given by volunteers of *Amigos de Iracambi*, and a meeting conducted in Pirapanema between Paulo Braz de Andrade, a representative of the Secretary of Agriculture and Environment in Muriaé, Francisco Rabiello, the leader of Pirapanema community, and local farmers.

Supplementary primary sources were obtained through semi-structured interviews. The questions were adapted to the interviewees and conducted in a form that allowed them to organize their thoughts, to emphasize what

they judged necessary and to repeat the inquiry when necessary. More than twenty hours semi-structured interviews were conducted with key informants, including the leaders of Buracada, Pedra Alta, Pirapanema, Graminha and San Geraldo communities, in Rosário da Limeira and Muriaé municipalities, as well as with the president of the Coffee Cooperative in Muriaé, the Secretary of Agriculture and Environment of Muriaé, the Mayor of Rosário da Limeira and representatives of IEF (State Forest Institute), the Forest Police, CTA-MG (Centre for Alternative Technology of Minas Gerais), school 'Novo Horizonte', The Rural Women Association of Rosário da Limeira, The Agricultural Labor Union of Small-Scale Producers, EMATER-MG (State Agricultural Extension Agency of Minas Gerais) and the Iracambi Atlantic Rainforest Research Center. Additional interviews were also conducted with different random groups of rural women and farmers, children from different communities and from the 'Novo Horizonte' school.

## **2.2 Complementary literature**

In addition to the empirical information, this report is also based on a broad literature review including specific local information obtained from unpublished papers, scientific reports, newspapers and informal brochures from EMATER-MG, IEF, Iracambi Atlantic Rainforest Research Center, CTA-MG and the Federal University of Viçosa.

## **2.3 Analytical Framework**

The analytical framework of the paper is set up in the sustainable livelihood concept and the subject matter is evaluated through a systems analysis perspective. The 'Sustainable Livelihood' term included in this study is defined by using the concept supplied by the IDS (Institute of Development Studies) team, which is as follows: 'A livelihood that 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 resources base'. Systems thinking is incorporated in the study as a means to deal with the problem from a holistic approach and to understand connections and cause-and-effect-relationships between different apparently isolated factors (Haraldsson, 2000). 'By shifting the attention towards an interdisciplinary approach, system thinking becomes inevitable part of analyzing problems' (ibid).

## **2.4 Causal-loop diagrams (CLDs)**

To complement the analytical study, conceptual models (CLDs) have been included in order to explain cause-and-effect-relationships and feedback loops as a complementary technique of the system dynamics approach.

## **2.5 Study Limitations**

Unfortunately, most of the recorded interviews were lost by the flight company during the trip from Brazil to Sweden. Therefore, detailed information, regarding those interviews, is not included in the report. However, the written notes taken during the meetings, the interviews of the Secretary of Agriculture and Environment, and Maria Aparecida Moisés de Matos are incorporated, as well as information obtained through questionnaires which were sent from Sweden to Robin Le Breton and Maria Emilia Vieira Filippini. Supplementary data has been acquired from interviews conducted by volunteers of the Iracambi Atlantic Rainforest Research Center, who were present at the meetings or whose research was obtained from the data base of Iracambi Atlantic Rainforest Research Center.

Given the limitations described above, most of the information obtained from others volunteers refers principally to Graminha and Buracada communities; therefore the study area is described on the base of those particular communities. However, and according to the author field experience, the Pirapanema, Pedra Alta and San Gerardo communities are rather similar to Buracada and Graminha ones concerning their high economic dependence on coffee cultivation, their lack of opportunities to improve their livelihoods and the fragile environmental characteristics where those communities are located.

Another important limitation of this study is the multidisciplinary character of the subject matter, which attempts to analyze taking into consideration the diversity of aspects involved. Approaches considering social, economic and environmental aspects are necessary in order to find possible alternative solutions for a more sustainable livelihood in the Muriaé and Rosário da Limeira rural communities. The complexity of the problem requires, no doubt, an interdisciplinary group of researchers.

## Section I

### 3. The Brazilian ‘Mata Atlântica’ rainforest

*‘Man has lost the capacity to foresee and forestall...he will end up destroying the earth’*

Albert Schweitzer (1875-1965)\*

The Atlantic forest stretches along the east coast of Brazil like a narrow band from about 7°S near Recife to about 28°S in Rio Grande do Sul (Richards, 1996). There is a wide biome<sup>a)</sup>, ‘cerrado’, and dry deciduous forest that divide the Matã Atlântica from the Amazon (ibid). It covered originally an area of approximately 1,290, 692. 46 Km<sup>2</sup>, which represents around 15% of the Brazilian territory and seventeen states (S.O.S Mata Atlântica et al. 2001).

The importance of the Atlantic rainforest in terms of its biodiversity has been widely recognized. For instance, the ‘Dossiê Mata Atlântica 2001’<sup>1</sup> of the Social and Environmental Institute (ISA), the Mata Atlântica NGOs Network (RMA) and the Northeast Ecology Association (SNE) highlight not only its significant diversity of species, indeed proportionally more important than the Amazon, but also the elevated degree of endemism of the Brazilian Atlantic rainforest. Lieth et al. (1989 p.3) also mention different authors who agree with the fact that species diversity in the South American tropical forest seem higher and that local species densities and endemism are remarkable. A detailed revision of the Mata Atlântica rainforest, its economic value and species richness, as well as the forest typologies is given by Watson (2000).

The Atlantic rainforest has played an important role in the Brazilian economy history (Maretti et al., 2003). For instance, the pau-brasil (*Caesalpinia echinata*) exploitation, coffee plantations, sugar-cane cultivation, part of the gold mining together with urbanization and industrialization (ibid). Nowadays, over the Mata Atlântica domain and the southern grasslands together run the economic activities responsible for 70 percent of the Brazilian GDP. As a result, an important devastation has been produced (ibid), accounting for 90 percent of the Atlantic rainforest (Brooks, 1996 p. 26). For the reason that only 7.5% of its primitive area remains today, (ISA

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\* EEA, 2001. Late lessons from early warnings: the precautionary principle 1896-2000, Environmental issue report No 22, Copenhagen, Denmark.

<sup>1</sup> Dossier of Mata Atlântica 2001

et al., 2001, Le Breton, 2000) and because of its high biodiversity; this biome is considered a 'hot spot' for the world conservation (Maretti et al., 2003).

### **Box 1. Biodiversity and endemism: Does only the number of species matters?**

Biodiversity is in itself a concept that has been referred in the literature as something that should be quantified despite the fact that only few components of biodiversity can be simply measured (Malcom et al.,1999). It is generally referred as biological diversity in the sense of number of species in a given area (Swingland, 2001). However, this simplified definition includes only one component of biodiversity without considering its more extensive scope, which comprises elements beyond species diversity or numbers (ibid). As Gaston (1996) emphasizes biodiversity is an abstract concept, which is not only wide but also very difficult to comprehend. The most widespread meaning of the term is 'variety of life' (ibid). However, Malcom and Hunter (1999) suggest the broader definition of Hunter (1990), 'the diversity of life in all its forms and at all its levels of organization'. Some other definitions include not only biological components but also the multiplicity of ecological processes and ecosystems in the sense that they are crucial in maintaining biodiversity (Swingland, 2001). Furthermore, Gaston (1996 p. 3) explains how the concept have been broaden in the light of a recent and different approach of the biodiversity' studies. It is stressed the interdisciplinary character of the work on biodiversity and how it multidisciplinary perspective have questioned not only the number of species of a given area but also how species richness and ecosystem process interact and which species are functionally most important (ibid).

The economic and ecological points of view, among others, from where biodiversity is often analyzed are usually used to highlight the importance of its conservation. However, the number of species richness is only one feature of such a complex concept and 'discussions of instrumental values almost always focus on what is useful here and now, but this is very shortsighted given the enormity of our ignorance' (Malcom et al.,1999). Thus, it is important to mention that when assessing the effects of management on biodiversity, researchers need to consider a large-scale perspective (ibid).

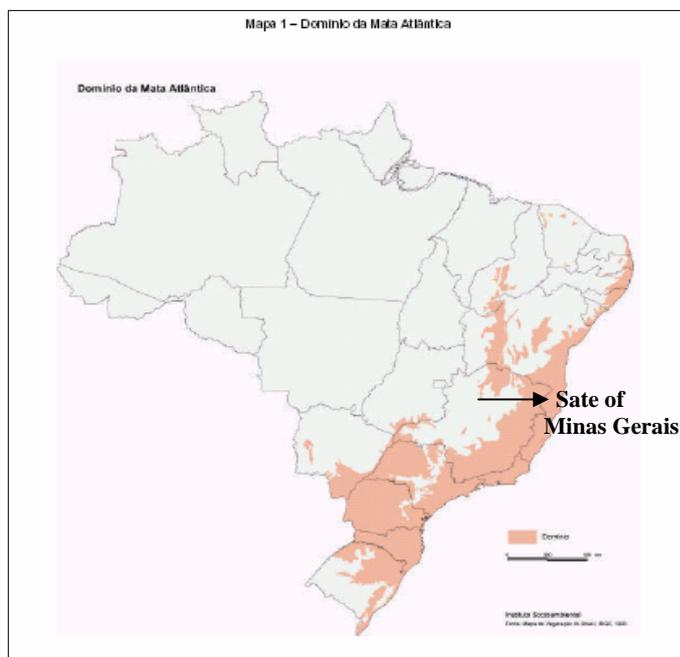
Another singular attribute of the Atlantic rainforest is its high endemism. It reefer to species confined to a limited area (Huston, 1994), which cannot be found somewhere else. Endemic species are extremely important as contributors to high species diversity in tropical forest (ibid). Those areas extraordinarily rich in species are called 'biodiversity hotspots' (Cox et al., 2000). Therefore, if a region where such species are distributed were seriously disturbed, probably an important number of species would be extinct since they are exclusively restricted to that area.

In view of the lack of full scientific certainties, regarding the environmental implications caused by the loss of biodiversity, the precautionary principle should be taken into account by the decision makers when assessing problems related to land use and forest conservation. Governments, according to their capabilities, should apply the precautionary principle as a general rule of public action to be implemented in situations of potentially critical or irreversible threats to the environment before there is strong proof of harm considering cost and benefits of action and inaction (EEA, 2001).

### 3.1 The original and current Atlantic rainforest domain in the Minas Gerais state

According to the definition given by the National Council of Environment (CONAMA, 1992) the Mata Atlântica domain is defined as those areas of the Brazilian territory, which were originally covered by the following vegetation type included in the ‘Mapa de Vegetação’<sup>2</sup> do IBGE (1989): dense tropical rain forest, mixed tropical rain forests, open tropical rain forests, seasonal semi- deciduous forests, seasonal deciduous forests, mangroves, restinga, higher montane, inside marshlands and the enclaves of northeast forests (ISA et al., 2001).

The Mata Atlântica original domain represented 47,81% of the Minas Gerais state’s area, corresponding to 281,311 Km<sup>2</sup> (ISA, 1999). Figure 1 shows the original area represented in the Vegetation Map of IBGE (1993).



**Figure: 1 The Mata Atlântica Domain in Brazil**

Source: **S.O.S Mata Atlântica** (2001)

‘Zona da Mata’ reefers to the Atlantic rainforest area of influence in the Minas Gerais state. Historic data reveals that the Mata Atlântica’s domain in Minas Gerais has been reduced from an area of 30, 356, 792 ha to 1,187, 528 ha during the years 1500 to 1995 (S.O.S. Mata Atlântica et al., 2001, p.352). In other words, an area of

<sup>2</sup> Vegetation Map of IBGE (Brazilian Institute of Geography and Statistics)

approximately 51% of the Minas Gerais state, covered by the Atlantic rainforest, became reduced to 2% between 1500- 1995 (ibid).

#### **4. The Minas Gerais, the most important coffee producer of Brazil**

When São Paulo and Paraná states, which were the biggest coffee producers from the 1950s until the 1970s, started to diversify into other types of crops such as orange trees, soy beans and wheat, Minas Gerais emerged as the principal coffee producer of the country (Andrade, 1994).

Nowadays, the Minas Gerais state is considered to be the most important state with approximately 50% of the country's share of coffee production (FAEMG, 1996). 74% of the total income produced by agricultural activities in Minas Gerais comes from coffee, followed by milk (10%), cereals (7%), meat (6%) and in lower shares sugar cane, fruits and others (ibid). This is relevant not only for its important scale of production but also for the income and employment generated in the region (ibid).

#### **5. The Muriaé and Rosário da Limeira Municipalities**

Before 1996, Rosário da Limeira was an administrative district of the 'município' of Muriaé. The total population is of 3,869 people with 1,649 settled in urban areas and 2,220 in the rural part (IBGE, 2000). The 'município' of Muriaé stretches on an area of 843 Km<sup>2</sup>, which is larger compared to Rosário da Limeira with only 112 km<sup>2</sup> (ibid). 92,101 people live in Muriaé with an important urban population of 83,923 and just a reduced number of 8, 178 living in the rural region (ibid).

Despite that both 'municípios' of the Minas Gerais state, Rosário da Limeira and Muriaé, are enclosed in the 'Zona da Mata' region; their economy is highly reliant on agriculture. In fact, 90% of the population of Rosário da Limeira relies on agriculture as their main source of income (Le Breton, 1998). The reduction of the Atlantic rainforest domain over time shows how the economy of the region has become highly dependent upon agricultural activities.

#### **5.1 The Belizario and Rosário da Limeira Communities**

The Belizario district belongs to the 'município' of Muriaé. It encloses a region of 113 km<sup>2</sup> (França, 1997), comprising almost the same area of the 32<sup>3</sup> families municipality (Le Breton, 2000). The community<sup>d)</sup> called Graminha is located in the Belizario district while the Buracada one lies between both Rosário da Limeira and Belizario districts. 32<sup>3</sup> families live in Graminha with a population of 70 adults over 18<sup>4</sup>, while approximately 25 are located Buracada community<sup>5</sup>. Those communities are representative of many others of Rosário da Limeira and Muriaé rural areas.

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<sup>3</sup> Joaquim de Melo, leader of Graminha community (Interview, 2003)

<sup>3</sup> Joaquim de Melo, leader of Graminha community (Interview, 2003)

<sup>4</sup> Information from the referendum carried out by the municipality of Rosário da Limeira in May 2003. (personal communication Robin Le Breton, 2003)

<sup>5</sup> Personal communication Robin Le Breton, 2003

<sup>a)</sup> The major terrestrial ecosystems that cover regional or subcontinental areas (Kormondy, 1996).

<sup>b)</sup> Original (pioneer) plants developed in regions of completely bare ground (Packham R.J. et al., 1992)

<sup>c)</sup> Vegetation that regenerates after being damaged on a disturbed ground with an existing soil (Packham R.J. et al., 1992)

<sup>d)</sup> A community is defined as the geographic area, including one or more micro catchments or 'córregos', where families are located and where usually social structures such as a church, a school, and soccer field are found (IEF, 2000).

The region enclosed by Belizario and Rosário da Limeira is mountainous, with elevations from 300 to 1500m (Le Breton, 2000, Silva 1981) without almost any primary rainforest<sup>b)</sup> except some patches of about 100 ha situated in very inaccessible areas and patches of secondary forest<sup>c)</sup> on top of the ‘morros’ and around springs (ibid). The major continuous area is of primary forest, and lies on the protected area of the ‘Serra do Brigadeiro’ State Park at an altitude from 1,000 to 2,000 m (França, 1997).

## 5.2 Pattern of Land Use and Distribution

Despite the fact that Brazil, among others Latin American countries, has one of the most uneven land distribution systems in the world (Kay, 1999); the land in the Belizário and Rosário da Limeira municipalities is mainly distributed in small-scale private properties (França, 1997). Indeed, the major number of small size properties of the Minas Gerais state are located in the ‘Zona da Mata’ region with an average size of 9-ha/per property (FAEMG, 1996). In spite of this, it must be underlined that the land distribution is skewed considering that 20% of the owners are in possession of 60% of the land (Le Breton, 1998).

Although there are ‘fazendeiros’, close to the Sierra do Brigadeiro state park, properties bigger than 100 ha represent only 3% of the total private land adjacent to the park. It is interesting to note, however, that big landowners are located in more favorable lands while the small-scale producers generally occupy marginal lands on steep slopes<sup>6</sup>.

The pattern of land use is principally cash crop agriculture production and according to FAEMG, (1996) the family is the most important labor force followed by the partnership system. In addition, there are farmers that work as agriculture wage-labor for big landowners, as well as ‘jornaleiros’. Coffee is the principal agricultural production and source of income generation in the Belisário (Campos, 1995) and Rosário da Limeira communities (Watson, 2000) followed by milk and; generally for family consumption, corn, beans, sugar cane, vegetables, rice and fruits<sup>7</sup>.

## Section II

### 6. Preceding problem analysis

According to Watson (2000) the problem of deforestation in the Rosário da Limeira region has been largely a consequence of the rainforest exploitation for development and agriculture expansion, especially for coffee cultivation.

The author explains the existence of a reinforcing relationship between coffee prices, poverty and the loans given by the ‘Banco do Brazil’ to the small- scale farmers for planting coffee. Peasants without the means for self-sufficiency, or the personal capital, are in need of bank loans. Its economic incentive provokes more land clearing, as more land is needed to plant coffee. Because more land is being available the production rises

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<sup>6</sup> PESB ‘Sierra do Brigadeiro’ State Park Proposal for the Management Plan (2000)

<sup>7</sup> CTA-MG and Sindicato de Trabalhadores Rurais -Agricultural Labor Union- (2001). Samuel Clements’ interview (2003), volunteer of Iracambi Atlantic Rainforest Research Center

generating an increased output that eventually will lead to a reduction in global coffee prices (ibid). It means less income generation for the small- scale producers, in other words more poverty, and more demand for loans causing the reinforcing relationship (ibid).

In addition, there are some other forces interlinked with poverty that contributes to deforestation such as soil erosion, which depletes the soil fertility and consequently favors land clearing, as more fertile soil is required for coffee plantations (CLD 1).

In order to address this difficult problem of deforestation, coffee cultivation, and land degradation a land management plan is proposed by the author. The author suggests that 'lands with marginal productivity, and thus profitability, could be turned over to reforestation (either naturally or through reforestation efforts),' in order to improve conservation efforts of the Mata Atlântica in the region.

Moreover, it is stated that diversification of production, besides coffee must be made available, economically feasible, and socially acceptable for the rural farmer (Watson, 2000). Efforts, focused on local improvements, should provide incentive for forest conservation and, at the same time, income generation for the farmers (ibid).

## 7. Problem Analysis Review

In order to make an evaluation of the preceding research, the concept of poverty is first discussed from different perspectives and tailored to the existing living conditions in the rural communities of Muriaé and Rosário da Limeira municipalities. Second, the factors used by Watson in her problem analysis are examined, as well as their interconnections. Third, new lacking elements related to the problem analysis are included. In addition, the Land Management strategy is assessed taking into consideration supports and constrains regarding its implementation.

### 7.1 Defining poverty in the Rosário da Limeira and Muriaé regions

*'El problema de la pobreza no es un problema de los pobres de siempre. Es el de la sociedades que producen la pobreza como un componente orgánico de sus victorias y sus fracasos'*

(Poverty is not a problem of the always poor, it is a problem of the societies that produce poverty like an organic component of their success and failures)

Carlos Blanco (1993)\*

Poverty has been explained in many ways and referred to in many different situations. It reveals that the concept is dynamic in the sense that it has been changing over time and also analyzed from many different perspectives. In view of this, it should be conceptualized in the 'real context'. As Mikkelsen (1995) points out, any practical study concerned with poverty must start with a definition that is suitable for that particular society. In other words: What does poverty mean in the Rosário da Limeira and Belisário regions?

Conventionally, poverty has been defined in terms of lack of consumption or income, thus poverty income lines are based on the cost of a basic diet and sometimes in only some non-food necessary items (UNDP, 2003). The

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\* Bernardo Kliksberg, 1993. Un Singular Desafío in *Pobreza Un Tema Impostergable*, CLAD. Centro Latinoamericano Para El Desarrollo, CFE. Fondo De Cultura Economica, PNUD. Programa De Naciones Unidas Para El Desarrollo, Caracas, Venezuela.

most common definition of income poverty, established by the World Bank (1993), is subsisting on US\$ 1; or even less (UNDP, 2003). However, poverty has multiple dimensions and is generally related to many variables, in consequence, it is extremely difficult to define (Wunder, 2001). The “welfare” definition describes poverty as having insufficient food, income and other goods to sustain an adequate standard of living (Arnold, 2001). While “welfare” poverty is connected to total restrictions (Wunder 2001), “asset poverty” identifies the significance of access to assets (natural, financial, human, etc.) to produce an appropriate and sustainable level of livelihood (Arnold, 2001). Mikkelsen (1995) goes further emphasizing that the concept in the ‘new poverty agenda’ has been extended beyond the ideas of inadequate private income or expenditure towards a more complete perspective where poverty is considered as the lack of ‘a secure and sustainable livelihood’.

Taking into consideration the income poverty definition, most of the families of the Belizario and Rosário da Limeira communities are above the line of poverty. This has been confirmed by Watson (2000) who mentions that small- scale producers in Rosário da Limeira are considered to be just barely above the subsistence- based level. A similar situation is found in the Belizario communities. For instance, farmers who do not hold their own land and work as agriculture wage-labor for big landowners receive in average the same amount of the minimum federal wage salary and ‘jornaleiros’ earn between R7.50 FAEMG (1996) and R10 a day<sup>3</sup>. Although, the lowest incomes generated in the Minas Gerais state belong to ‘Jequitinhonha’ and ‘Zona da Mata’ regions, generally of rural workers earn about the same or just above the present minimum wage (ibid).

However, Chambers (1983) highlights that the condition of being poor implies some other disadvantages besides lack of income. Therefore, poverty is not only a condition of deprivation but also a state of vulnerability (Mikkelsen, 1995), which generally means ‘lack of protection against contingencies’ (Chambers, 1983).

The next paragraph amplifies the income poverty definition using as a reference the disadvantages of the poverty trap stated by Chambers (1983), in order to examine in detail whether the Belizario and Rosário da Limeira communities can be considered poor even if they are above the line of poverty and for what reasons.

### 7.1.2 Poverty itself

A household is considered poor when, among other circumstances, ‘the stocks and flows of food and cash are low, unreliable, seasonal, and inadequate’ Chambers (1983). As mentioned before most of the people in the Rosário da Limeira and Belizario communities rely on agricultural activities as their main source of income, being coffee the most important one. The income generated from this cash crop is not only seasonal but also unreliable due to fluctuation in coffee prices. Although milk is an extra source of agricultural income generation, its contribution is relatively low compared to the coffee one. ‘The income coming from milk is generated each month although it is lower than the coffee one’<sup>8</sup>.

Poor families are those, in which all family members have to work on the land in order to survive; when the land is marginal and generally of a small size (ibid). Indeed, this is not only a common feature of the small-scale farmers living within the study area but also of a great part that belongs to ‘Zona da Mata’ FAEMG (1996 p. 33)

Some other household poverty conditions that Chambers (1983) mentions are common in the Belizario and Rosário da Limeira communities. For instance, women have a high load of work principally during the coffee harvest, when they work not only at home but also at the farm, low returns to the household labor, which in some situations and depending on coffee prices, cost of fertilizers, slack seasons and debts can be very low or even any at all.

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<sup>8</sup> Marhnia Aparecida Moisés de Matos: a wage labor farmer’s wife living at Iracambi Recursos Naturais Ltda. (Interview, 2003)

### 7.1.3 Isolation

Most of the typical conditions of isolated households are well represented in the communities of the study area. Households are situated in remote rural areas, family members are often illiterate or without access to reliable information, their participation in community meetings is restricted and children do not attend school or go and drop out early (Chambers, 1983).

Lack of electricity and paved roads in rural areas of Rosário da Limeira are frequent and most families have no more than a horse and a cart as their means of travel (Watson, 2000). The principal paved road in the municipality is in the main square of the town and it was finished in March 2000 (Le Breton, 2000)<sup>9</sup>. There is also a half paved road of 36 km which connects the rural communities of both ‘municípios’, Muriaé and Rosário da Limeira, with Muriaé city (Silva, 1981).

Although the Graminha community belongs to the ‘município’ of Muriaé, it is located closer to the ‘município’ of Rosário da Limeira. Hence, the community obtains more services and other kind of benefits from the latter one<sup>10</sup>. The number of roads, which communicate the households of the community among them and their maintenance improved since the ‘município’ of Rosário da Limeira became independent from the Muriaé<sup>9</sup>. However, the state of the roads without pavement in the rainy season is an obstacle for transport and communication. Silva (1981) mentions that the families in the Belisário district referred to this as one of their principal worries. Nevertheless, this problem is still unsolved which shows their lack of voice to influence political decisions.

Illiteracy is a common situation among Brazilian peasants (França, 1997). ‘Zona da Mata’, in the Minas Gerais state, presents the highest levels, being 28.4% of the farmers who are illiterate and 66% that only completed primary school (FAEMG, 1996). Among them women are often less educated, Silva (1981p. 62) for instance mentions that the relative level of education among different groups of people in the Belizário district were always lower for women than men.

### 7.1.4 Vulnerability

The lack of safeguards to cope with stressful situations or against contingencies increases household’s vulnerability (Chambers, 1983). As Watson (2000) mentions the high coffee dependence and the lack of opportunities of new sources of income generation put farmers in a vulnerable situation. This is common for many rural communities in the Minas Gerais state. In general, the economy diversification in the state is low (FAEMG, 1996), which means that peasants are highly dependent on coffee. For example, according to a study of the communities of Buracada and Graminha, carried out by CTA-MG and the workers union, from a total of 21 families interviewed, 19 of them depend exclusively on coffee and the other 2 on coffee and milk for their supervivence<sup>7</sup>.

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<sup>9</sup> Master Plan for the Development of Iracambi Atlantic Rainforest Research Center

<sup>10</sup> According to the referendum, carried out by the municipality of Rosário da Limeira in May 2003, on whether Graminha wanted to become part of Rosário da Limeira; 100% of the voters answered yes. Robin Le Breton, personal communication (2003)

Basic needs are met by, for example, spending the money of small reserves of cash or by a reduction in consumption (Chambers, 1983). 'Every woman does the coffee harvest. This is the only time at the year that the women get some money. Thus, they can buy something different that is not for...the home, some clothes'<sup>8</sup>.

Usually, the entire family works on the land when coffee grains are harvested. Relatives or friends collaborate if extra help is needed. Children generally work drying coffee grains or helping their mothers during the harvest. Children are especially vulnerable because the workload can be an impediment for their education and also because they are exposed to several kinds of risk for instance, the poisonous cobra snakes, which are very common in the coffee plantations.

Disasters such as crop failure, an accident and fines among others 'have to be met by becoming poorer' (ibid) while, at the same time, they are often dependent and limited by debts, obligation to patrons and basic needs that must be satisfied (ibid). Loans and credits from the Agricultural Ministry of the Brazilian government are made available through the 'Banco do Brazil' supporting coffee production (Watson, 2000). Even though 'small-scale farmers do get subsidized lower interest rates under a government support schemes called PRONAF (Programme to Strengthen Smallholder Agriculture), farmers still have to pay back and very often it represents a significant economic burden for them, which puts peasants in an even more vulnerable situation when coffee prices decrease or fluctuate.

### **7.1.5 Powerlessness**

The household is situated in a low social status and its position is weak regarding any kind of negotiating situation, such as labor or products for sale and it is vulnerable of being exploited by moneylenders, landlords, merchants among other more powerful groups (Chambers, 1983).

Lack of negotiation power is shown for example when farmers without money are forced to sell their coffee production immediately after the harvest thus generating low returns<sup>6</sup>. Moreover, they are not only constrained by lack of capital but also because their high dependence on coffee as the main source of income generation. In other words, they must sell the coffee if they need to obtain some cash.

Another important factor, which contributes to their incapacity to negotiate, is farmers' illiteracy that keeps them less informed and thus limits their opportunities to influence political decisions. For instance, community participation in the natural resource management, a requisite established in the Brazilian Agenda 21 (Consórcio, 2000), can be significantly restricted when people are illiterate. An example of this is the creation of two publicly protected areas: 'Pico Itajuru' and 'Serra do Brigadeiro' State Parks, which are discussed below.

Political activity may be avoided if it endangers future employment, loans of some other benefits (Chambers, 1983). Silva (1981) has arrived at the conclusion that in the Belisário district, communities' participation is being significantly restricted due to political conflicts and pacts between different parties.

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<sup>11</sup> Charlie Evans' interview (2003), volunteer of Iracambi Atlantic Rainforest Research Center

## 7.2 Poverty, the principal cause of deforestation?

### 7.2.1 Historical Motivations behind poor people's deforestation

The 'Polícia Florestal' recognized that poor people used to cut down the forest in order to sell the charcoal as an extra source of income generation. In this regard, Le Breton<sup>15</sup> also mentions that the major cause of deforestation in the region between 1980 and 1990 has been charcoal production. Likewise, peasants supported this opinion. For instance, Joaquim de Melo the leader of the Graminha community<sup>11</sup>, recognized that people used to chop down the forest for 'carvão vegetal' production fifteen years ago, which resulted in rapid deforestation of the region. However, he also claims that deforestation rate has been considerably reduced since 1995 mainly due to people rising awareness of the forest's benefits and law enforcement<sup>11</sup>.

However, small-scale farmers also cut down the forest in order to increase their productive area due to the declining land productivity<sup>15</sup> and the lower returns from coffee.

### 7.2.2 Land Degradation

Certainly, deforestation occurs even if peasants do not obtain loans from the bank. Land degradation over time is an important factor related to productive land demand (CLD 1). 'At present some farmers growing coffee are running at a loss as the price of fertilizer per acre is more than the amount that they will receive for the coffee growing on that land. However, they continue to farm in the hope that the price will rise<sup>12</sup>.'

'As coffee is often planted on very steep slopes, water erosion down the slopes is a big problem. After a heavy rain, the entire top layer of the soil can be lost<sup>12</sup>. 'The soil was constantly referred to as 'fraco' (weak). A number of farmers recognized that the soil was poorer now that there were fewer trees around. They explained that the soil dries out faster now and thus it would be beneficial to have more trees surrounding coffee fields, particularly in the areas above fields. However, as planting these trees would use up land that could be used for coffee it had not been done to a large extent on any of the farms'.

Soil erosion affects peasants as well as big landowners. Therefore, productive land demand for coffee cultivation is also linked to 'fazendeiros' for the same reason that it is connected to peasants without resources (CLD 2). However, there are two important differences. The first of these differences is the peasants' economic constraints to improve soil fertility given the increasing cost of fertilizers and the second fundamental difference is the relative high scale of agricultural land exploited by the big landowners compared with the small-scale producers.

### 7.2.3 Is the lack of capital driving poor peasants to plant more coffee?

Not only peasants without capital get loans from the bank for coffee plantation but also big landowners. The difference between them is that the government helps small producers, through the PRONAF to get reduced interest rates<sup>15</sup>. Bank assistance is, in fact, a factor connected to policies of agricultural expansion rather than an

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<sup>14</sup> Charcoal

<sup>15</sup> Robin Le Breton (Questionnaire, 2003)

aspect acting in response to poor peoples' demands for loans. What the lack of capital produces is to force small-scale producers to be even less self-sufficient because first, they are indebted and secondly, they are forced to sell their coffee production immediately after being collected<sup>6</sup>. Moreover, it doesn't mean that coffee cultivation will be reduced if farmers had the funds to invest in agriculture activities. An example of this is given by a study of the São Pedro, Santa Catarina and Buracada communities, located in Muriaé and Rosário da Limeira region, carried out by the CTA and the 'Sindicato de Trabalhadores Rurais. It shows that from 22 families interviewed, the majority would choose to plant coffee, among other crops and agriculture activities, if they had the capital. Moreover, it mentions that 11 of them do not plant the crop they prefer because their lack of money. (CLD 2)

## 7.2.4 Coffee Prices

Declining coffee prices puts pressure on peasants to clear more land (Watson, 2000). Slash and burn is principally used to extend agricultural areas or to obtain pasturelands. This can be illustrated with empirical evidence from Graminha community obtained in 2002. 'There are two main fields of coffee which are planted [...] The one farthest from the house has been planted for seventeen years, a newer field, just cleared recently (three years ago) has been planted for the last three years with more coffee, to supplement their income since the coffee prices were falling'<sup>12</sup>. In addition, during 1990 an area of 400 ha of the 'Sierra do Brigadeiro' State Park were cleared, as well as an additional area of 100 ha of its surroundings. Although, this practice has been reduced, four events were registered during 2002, which occasioned a lost of 57 ha of forest<sup>13</sup>.

Reduction in coffee prices will have a greater negative effect on people having less assets and hence being more vulnerable. It is interesting to note that lower prices are not only a function of the international coffee market but also because the production is sold right away after the harvest.

Therefore, if coffee prices decrease farmers will be even poorer, which could be a 'barrier' to obtain loans from the bank if they cannot guaranty they are able to pay back. According to the 'Sindicato do Trabalhadores Rurais', even if poor peasants need loans for their survival, credits are obtained according to farmers' capability to pay back<sup>11</sup>. For that reason, if 'poverty' increases beyond certain limits, probably farmers will not obtain any economic help from the banks. In addition, a reduction in the family income increases the burden of the current farmer's debts, generating more poverty and increasing vulnerability. (CLD 2)

## 7.2.5 Charcoal Production Demand

Farmers, who obtain loans for planting coffee, cannot be considered the only driving force of deforestation in the area, since there is evidence that poor peasants clear land for 'carvão vegetal'<sup>14</sup> production. In this regard, Antonio de Fátima da Silva, the leader of San Gerónimo community in Muriaé, mentioned that this practice is not common nowadays; 'since the fines have been substantially increased'<sup>15</sup>

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<sup>12</sup> Graminha community. Iracambi Atlantic Rainforest Research Center's interview (2002)

<sup>13</sup> PESB ('Sierra do Brigadeiro' State Park) Proposal for the Management Plan (2000)

<sup>16</sup> According to the 'Policia Florestal' -Forest Police- (Interview ,2003)

It is important to note, that the ‘carvão vegetal’ demand comes from the iron- and steel making industry (Ackerman, 1990; Consorcio 2000 p. 62), interested in a ‘cheap’ source of energy. In addition, it is worth to mention that not only the metallurgic sector has benefited from deforestation but also the big landowners, who have obtained cleared land for pastures after being deforested by the poor<sup>16</sup>. Le Betron<sup>15</sup> also mentions that ‘fazendeiros’ (big landowners) usually clear forested areas to sell charcoal and to obtain more grazing lands. According to the ‘Policia Florestal’ the number of small- scale producers fined is bigger compared to big landowners but the latter are responsible for a more extensive deforestation in the region. In view of this, ‘poverty’ should be considered a ‘deforestation tool’ of the metallurgic industry and the big landowners rather than a cause in itself.

## 7.3 The land management plan, merits and shortcomings

The land management strategy, proposed by Watson (2000), was formulated based upon the analysis of the relationships between deforestation, land degradation, and coffee cultivation. The goal of such strategy is to prevent the further exploitation of the farmers’ resources, which are the land and the forest, in the Rosário da Limeira region while at the same time provide social and economic prosperity for the farmer (ibid). It includes soil conservation measures to reduce land degradation, alternative markets, crop diversification and continued forest conservation efforts (ibid).

This part of the paper examines the land management plan as a strategy to achieve sustainable agriculture not only in Rosário da Limeira but also in the Muriaé municipality. New components of the land management plan are included to evaluate it from a wider perspective using as a reference the guidelines provided by F.A.O. (Food and Agriculture Organization of the United Nations).

### 7.3.1 Land Suitability

Agricultural expansion on hill slopes generally provokes serious erosion of slope materials, with losses of organic matter and other nutrients giving as a result declines in crop yields (Gupta, 1988). Because the nutrients are not naturally refilled (ibid) farmers are obliged to use fertilizers (Consórcio, 2000). However, there are some constrains such as the cost to purchase them in the face of declining coffee prices. In addition, fertilizers have restricted efficiency on steep slopes and previously eroded lands as chemicals may be washed away by runoff, and therefore not well retained by the soil (Watson, 2000).

The soil nutrient base can be preserved through the reduction of erosion via three principal techniques; soil management, agronomic improvement and mechanical means (ibid). Of the measures recommended, those which best fit into the region are the use of vegetative ground covers, green manures, vegetative barriers, and interplanting techniques with nitrogen fixing species (Le Bretton, 1998; Consorcio 2000) for instance leguminous trees and fast-growing timber species. There is also evidence; tailored to the small farms conditions of the ‘Zona da Mata’ region, that agroforestry systems perform better than conventional agriculture in reducing the organic matter and nutrients losses (Franco et al., 2002; Consórcio, 2000 p. 16). However, land fertility in the ‘Zona da Mata’ region is not only restricted by soil erosion but also because of its natural properties.

Tropical soils are very variable in both chemical and physical characteristics, being some of them exceptionally fertile and productive while others are extremely infertile (Sombroek, 1984; Lathwell and Grove, 1986)\*. Until

recently, it was usually accepted that soils formed in tropical humid climates were generally highly weathered, leached and therefore, infertile (Sanchez, 1989). However, reasonably fertile soils, where intensive cultivation has been developed, cover around 33% of humid tropical Asia (ibid). On the other hand, South America encloses the highest proportion of soils with low nutrient content (52,3%) and the lower percentage of those with fertile properties (13.7%) (Huston, 1994). In fact, the smallest area of moderately fertile and well-drained soils is found in Latin America (Sanchez, 1989).

Indeed, the tropical rain forest areas, which have the highest biodiversity, are usually infertile (Gupta, 1988; Huston, 1994) and the 'Zona da Mata' region is not an exception. It not only has weathered soils and low natural fertility but also steep slopes (Franco, 2002), which exacerbates loss of soil by erosion. Therefore, poor soil fertility, or degraded land, in Rosário da Limeira and Muriaé is not only the result of the anthropogenic actions such as deforestation but also a restrictive natural condition. This is an important factor that should be considered carefully before any land management plan being implemented.

Land suitability is expressed by the land qualities needed for sustained production (F.A.O., 1993). The term 'land quality' comprises those characteristics with direct effect on land use, for instance, availability of water and nutrients and erosion hazard among others (ibid). As it was described before, nutrients availability and erosion hazard are general restrictive properties of the 'Zona da Mata' soils. For that reason, it is important to discriminate land that is appropriate from that which is not, for instance steep slopes are not suitable for agriculture. In short, 'the land should be able to support the land use on a sustained basis', that is, its 'use must not progressively degrade the land'. A land use is considered 'not suitable' if it constantly degrades the land (ibid).

According to Le Bretton (1998), coffee plantations are the most important sources of soil erosion. The substitution of the Mata Atlântica domain with coffee plantations has modified the ecosystem's nutrient cycle reducing significantly soils fertility through two principal processes, soil erosion and the removal of nutrients from the soil with the harvests (Dean, 1996; Cardoso 2001). As Watson (2002) also mentions, due to the low content of nutrients found in cleared land, the average productive life of a coffee plantation in Minas Gerais does not exceed 20 years, which has provoked even more deforestation due to the fertile land demand for agriculture (Dean, 1996).

Soil conservation measures and agricultural techniques, if correctly applied and tailored to the local conditions, are palliative solutions. In other words, implementation of soil conservation techniques is not equivalent to sustainable agriculture (Consortio, 2000 p.18). As Watson (2000) mentions they help to reduce land degradation and thereby, to recover the land quality and its productive life, which in turn will slow deforestation. In spite of this, land use decisions are not just taken on the basis of land physical conditions, but also in relation to the demand for products and the degree to which the use of a given region is crucial for a particular objective (F.A.O. 1993).

### **7.3.2 Competing land uses**

Compared with other agricultural areas of Brazil, the 'Zona da Mata' region can be considered an agriculturally marginal land regarding its topography, poor soils and comparative low coffee productivity. For that reason and taking into consideration that the government is committed to decreasing coffee supply and at the same time to preserving the remaining forests, coffee cultivation appears not to be the appropriate land use for that region. Next paragraphs provide some relevant information to support this opinion.

### **Coffee production in the 'Zona da Mata'**

Even though, the Minas Gerais state is the principal coffee producer in Brazil (FAEMG, 1996), its production varies greatly between different regions. 'Zona da Mata' is the region where coffee cultivation was first introduced in Minas Gerais, being the most representative coffee area of the state for a long period of time (Andrade 1994). However, due to its difficult access and steep topography 'Zona da Mata' has restricted possibilities for agriculture and coffee is the only crop that has generated some level of profitability (Le Bretton, 1998). Moreover, its productivity is smaller in comparison with other regions where coffee cultivation was developed over time. In fact, 'Zona da Mata' is considered the least productive of the state (FAEMG, 1996).

It has to be recognized, however, that coffee production in the 'Zona da Mata' was higher than in the 'Triângulo e Alto Paranaíba' region during the years 1980 to 1990 (Andrade 1994). On the other hand, its production decreased considerably in the period between 1995-1996 (FAEMG, 1996). For instance, while the 'Triângulo e Alto Paranaíba' zone produced 20 to 40 sacks/ha, the 'Zona da Mata' region generated only 5 sacks/ha (ibid). In addition, of 26,900 coffee properties a percentage of 13.5% was diminished during 1984/1985 and 1995/1996 (ibid). Data from CONAB (National Council of Supply) shows that the harvest of both regions, 'Zona da Mata' and 'Jequitinhonha', together are lower compared with the production of the 'Sul e Oeste' area, as well as with the 'Triângulo e Alto Paranaíba' one, for the years 2003/2004 (Table 1)\*.

### **Coffee Demand**

Tendencies of coffee demand are not positive. In fact, 'eight percent more coffee is currently being produced than consumed' at the world level (Oxfam, 2002). For instance, the total coffee production, for the years 2001/02, was approximately 113 million bags whereas global consumption was estimated at around 106 million bags (ICO, 2003). Therefore, coffee-producing governments are committed to decrease the supply by improving the quality of coffee trading (Oxfam, 2002). The Secretary of Agriculture and Environment of Muriaé explained that '[the Government] is encouraging producers to implement technologies that can allow them to improve the production, taking into consideration not only an increment in the quantity but also in the quality. 'This is important because producer's profits decrease mainly due to the low quality of the production'. In view of this, EMATER-MG has been promoted coffee quality. For instance, the agricultural agency held a competition of coffee producers in Muriaé during July and August 2003 in order to seek for new market opportunities and more value-added products<sup>17</sup>, as well as, courses of coffee quality during the '1ª Semana da Agricultura Familiar'<sup>18</sup> carried out at the agriculture school of Pirapanema community: 'Escola Família Agrícola Novo Horizonte'<sup>19</sup>. Results of this campaign are found in the declining trend of the Brazilian coffee exports, even though they fluctuated, during the period of August 2002 to 2003 (ICO, 2003) (Table 2).

### **7.3.3 Land –use allocation**

A possible option to improve the current pattern of land use and thereby the rain forest conservation is the allocation of land according to conservation standards. Although this measure is more difficult to implement when land is already occupied (F.A.O., 1993), it can be useful to correct current misuses of land and prevent further mismatches between land use and land suitability.

In a simple planning implementation case, for instance that of new land settlement, land areas should be allocated to concrete uses (F.A.O., 1993). But, currently, the land is previously settled and different land uses such as grazing or cultivation are already carried out (ibid) even if those areas are not suitable for those

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<sup>17</sup> EMATER-MG, informal brochure

<sup>18</sup> The First Week of the Family Agriculture

<sup>19</sup> Muriaé, Minas Gerais

purposes. With respect to this, Le Breton<sup>20</sup> mentions that ‘there are many areas in Rosario da Limeira and Belisario which are suitable for coffee growing, but there are also many others that should have never been cleared of forest’. Consequently, the objective of the plan should be to concentrate on solving problems of the present land-use systems (F.A.O., 1993).

Conservation standards such as ‘no cultivation within 40 m of streams or on slopes greater than 12°’ (ibid) are useful guidelines for allocations of land use. For instance, forestry should be maintained in steep slopes and stream reservations whereas agriculture restricted to bottomlands (ibid). The steep slopes of the ‘Zona da Mata’ region ranges from 11° to 24° (Cardoso, 2001). Recently, the Municipality of Muriaé and ‘Amigos de ‘Iracambi’ NGO have developed some initiatives<sup>20</sup> related to a better allocation of land in the Rosário da Limeira and Muriaé regions. The principal ideas behind both projects are water resources protection and reduction of soil erosion. The study area comprises the ‘Paraíba do Sul’ catchment, which includes the ‘Rio Fumaça’ and ‘Rio Preto’ micro-watersheds that feed the Muriaé river<sup>20</sup>.

Inappropriate land use such as slash and burn and extensive grazing are probably the main causes of springs degradation in the region (Silva, 2003). Although the most obvious physical effect of land clearing is soil erosion (Kartawinata, 1989), it also has detrimental effects on the water cycle, since forests play an important role in the maintenance of the it<sup>22</sup> (Gupta, 1988; Richards 1996; Consorcio 2000). EMATER-MG has started to increase awareness among the small-scale producers about the significance of the water basin preservation<sup>24</sup>. This is not only aimed to improve water resources but also to promote the idea that small producers could be economically benefited in the future from the ‘Programa do Produtor de Água’<sup>23</sup> of SAS and ANA.

### 7.3.4 Crop diversification

According to Watson (2000) crop diversification is a promising strategy to decrease coffee cultivation and therefore prevent the area from further deforestation. However, the adoption of new crops aimed to replace coffee plantations not necessarily assures a decrease in agricultural land demand (CLD 3). As Douglas (1987) emphasizes ‘area rather than yield increases have characterized the performance of Brazilian agriculture up to the early 1980s’. In addition, there are several constraints that limit the possibilities to diversify crop production.

For example, data from the Rosário da Limeira and Muriaé communities<sup>24</sup> show that crop diversification in the region is rather limited. For instance, of 45 families interviewed, from the Buracada and Graminha communities, 20 of them cultivated corn, 19 beans, 5 rice and 1 other crops besides coffee. Dona Preta, a woman from the Gramhnia community; cultivates coffee, corn, and beans. ‘She used to plant rice as well but none is cultivated now because the lack of market to sell the crop’. ‘From all the crops she plants, only coffee is for sale’. This is the same situation of Antonio da Costa and most of the farmers in the region; only a few of them are able to trade with different products besides coffee.

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<sup>20</sup> Robin Le Bretton (Questionnaire, 2003)

<sup>20</sup> Unpublished paper: *Amigos de Iracambi, Prefeitura Municipal de Rosário da Limeira, Projecto de Hidrobacias*, Iracambi Atlantic Rainforest Research Center (2003)

<sup>22</sup> **According to Consorcio (2000), of 1.138 watercourses of Minas Gerais, 558 were dried up by 1990, due to deforestation and the consequent reduction of water infiltration into the soil.**

<sup>23</sup> Francisco Ofeni Silva, unpublished paper: ‘Uso racional da água dos recursos hídricos’. Francisco Ofeni Silva, 2003. ‘Dia de Campo em Eugenópolis’, *Informe Rural* newspaper, (Muriaé), July.

<sup>24</sup> CTA-MG and STR s interview (2001)

Another constraint is the topography of the region. According to Joaquin de Melo, the leader of the Graminha community, farmers are willing to turn over to crops different from coffee such as beans and corn and 'most farmers expressed interest in moving into other types of agriculture if they were going to be more profitable than coffee'. Crop diversification in 'Zona da Mata' is limited due to the topography of the region; for example corn and soy cultivation requires mechanization, which is very difficult to implement in hilly landscapes (de Andrade 1994, p. 33). According to the IBGE (2000) most of the land in the Muriaé (Table 3) and Rosario da Limeira (Table 4) region has been devoted to coffee cultivation and among other products there are 'feijao' and 'milho' followed by other less significant crops.

CTA- MG<sup>27</sup>, university researchers and small- scale farmers have started to investigate the implementation of agroforestry systems in 'Zona da Mata' through a long-term participatory process (Cardoso, 2001). As mentioned above, these systems are particularly useful in improving soil quality (Consortio, 2000), however, the results in terms of production and decrease in inputs have not been yet accomplished (Cardoso, 2001). In addition, there are some other restrictions such as markets' availability and the time for the investment begins to pay off. (Vosti, 2002). Most of the agroforestry systems implemented in the region have not been successful in terms of their productivity due to the low quality of the soils, which have been historically overexploited principally with coffee cultivation (Ferrari, 1996).

Furthermore, the fact that crop diversification has not taken place until now might be an indication that the agricultural quality of the area restricts the cultivation of other different crops besides coffee. A study based on geographical space analysis was carried out to examine the geographical evolution of coffee cultivations (Faria, 2002). Substitution indicators were used to visualize changes in the agricultural composition of the 'Zona da Mata' region during the period 1985 to 1995/96 (ibid). The table 5 illustrates which crops have been replaced and which ones have become more predominant. Negative substitution values indicate a reduction of the cultivated area, the replacement of the crop or that the crop grew slower than the system<sup>e</sup> (ibid). Corn, rice, beans, sugar cane and coffee, among others, displayed negative values while pastures and fodders, related to cattle grazing activities, presented positive indicators (ibid). Generally speaking, the study reveals a stagnant state of the agriculture in the Zona da Mata region, as well as, a decrease in crop diversification (ibid). Peroni et al., (2001) also mention that there is a tendency toward a reduction of species and varieties cultivated, which benefits the 'Mata Atlantica' cover but at the same time affects the on-farm biodiversity with significant consequences on the resilience of the agricultural system.

### ***A current trend towards simplification: the replacement of coffee degraded areas for pastures lands***

Because crop diversification in the region is rather difficult and agroforestry systems present economic constrains, it is highly probable that coffee degraded areas will turn into grazing lands. 'If [people] abandon coffee lands, it becomes pasture, they no longer move away<sup>28</sup>. Indeed, Faria (2002) points out that pastures, mainly due to the steep topography of the 'Zona da Mata' region, are substituting cultivated areas of 'milho', rice, 'feijão' and sugar cane. According to FAEMG (1996), 61.8% of the 'Zona da Mata' region is devoted to grazing lands, 17.6% to coffee plantations and 11.6% is covered with tropical rain forest. Cardoso (2001), Andrade (1994) and Franco (2002) also emphasize that cattle grazing is the principal agricultural activity, which has commonly been used to replace coffee cultivation in the Minas Gerais state.

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<sup>e)</sup> **System:** It is defined as the total area cultivated in the study region (Faria et al., 2002)

<sup>28</sup> Robin Le Bretton (Questionnaire, 2003)

Milk is the most important current agricultural activity besides coffee cultivation that small-scale farmers commonly use to diversify their production in order to spread risk provoked by the fluctuations in coffee prices. 'Coffee works well. However, coffee income generation is once a year and the profits obtained in each year are not always gainful. Thus people cannot only cultivate coffee'<sup>29</sup>. 'People cultivate a share of coffee but [they] like to have milk as well'<sup>29</sup>. Nowadays, 86% of the families living in the Buracada and Graminha communities hold cattle farms<sup>30</sup>.

Not only areas where forest has been turned over pasture degrade quickly (Cardoso, 2001) but also the shift in the land use pattern brings changes in terms of labor absorption. Perennial crops, such as coffee are labor-absorptive (Douglas, 1987; Andrade 1994) compared to the low labor requirements of extensive pasture systems (Vosti, 2002). Consequently a significant rise of unemployment in rural areas (Andrade, 1994), an increase in seasonal labor (Douglas, 1987), migration of land users (Cardoso, 2001), as well as, more poverty are likely to be expected. Indeed, coffee cultivation in the Minas Gerais state, as mentioned above, generates 74% of the total revenues coming from agricultural activities whereas pasturage only produces 16% (FAEMG, 1996).

### 7.3.4 Public Participation

According to F.A.O. (1993) a land-use management should include the involvement of different people in order to accomplish its goals such as, land users, decision-makers and the planning team. In this regard, Le Breton, (1998) mentions that existing institutions, in the Rosário da Limeira municipality, consider that only trained technicians are able to get involved in the land use planning work because peasant farmers are not educated enough for this purpose. Therefore, agricultural circumstances are narrowly interpreted as technical issues and social conditions are underestimated or not considered at all (ibid).

An example of public participation, related to land resource management in the region, is the creation of two public protected areas: 'Pico Itajuru' and 'Serra do Brigadeiro' State Parks. Both reserves belong to the 'município' of Rosario da Limeira and 'Muriaé and the latter encloses an area of 13,000 ha which in part is private owned land, as well as, all of the area outside the Park much of it belonging to small-scale producers<sup>31</sup>

Literature related to the development of both protected areas highlights that their creation process was characterized by a broad involvement of many different actors, such as worker unions, government sectors, farmers and NGOs (Consórcio, 2000). However, experiences from the field show that the participation process has faced difficulties. For instance, one important obstacle for public involvement has been community education. According to Silva (1981) public participation in the Belisário district, is positive correlated to farmers' literacy.

As mentioned earlier, illiteracy is a common feature among farmers in the Muriaé and Rosario da Limeira regions. For that reason, CTA-MG, EMATER, RURALMINAS, IEF and the University of Viçosa have begun to research specific participatory methods, in the Belisário district, in order to improve the participation of illiterate people in land use management (França, 1997).

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<sup>29</sup> Maria Aparecida Moises de Matos, a wage labor farmer's wife living at Iracambi Recursos Naturais Lta (Interview, 2003)

<sup>30</sup> CTA-MG and STR's interview (2001)

<sup>31</sup> Master Plan for the Development of Iracambi Atlantic Rainforest Research Center

<sup>32</sup> PESB ('Sierra do Brigadeiro' State Park) Proposal for the Management Plan (2000)

The deficient education of those communities, close to the area of the Park, reflects the significant problem of rural Brazilian education and the lack of a political project to encourage it<sup>32</sup>. People have a lot of uncertainties regarding the creation of the Park, as well as, difficulties to understand the utility and the meaning of a land management plan (ibid).

On the other hand, people are afraid of the negative impacts that the delimitation of the Park would provoke on their fragile economy, regarding that some of their productive lands are inside its limits and most of them use forest resources such as: ‘taquara’, dry wood, ‘palmito’, ‘cipó’ and medicinal plants for their living<sup>33</sup>.

Hence, impediments for public participation are not only linked to education. People may decide not to get involved in such a land management project if once implemented would diminish their income, reduce their possibilities to maintain it or impede extra economic benefits supplied by the use of the forest. Joaquim, a peasant from Graminha community, believes that revenues obtained from tourism in the ‘Serra do Brigadeiro’ State Park would only increase the municipal budget and that people, who had to leave their lands, would not obtain any economic benefit at all<sup>11</sup>.

## 7.4 Summing-up

- People living in Graminha and Buracada communities can be considered poor, even if the majority of them are above the line of poverty, because they are vulnerable, powerless and live in isolated conditions.
- Poor people clear forested areas to maintain or improve their income levels, however, poverty is only the proximate cause of deforestation in the Rosário da Limeira and Muriaé region.
- There are irreconcilable competing uses of land between the preservation of the rain forest domain and the demand of land for coffee cultivation and other types agricultural activities like cattle grazing.
- Bank assistance for coffee cultivation is connected to policies of agricultural expansion and it is obtained not only by peasants but also by ‘fazendeiros’.
- ‘Fazendeiros’ have a relatively high impact on agricultural land demand compared with the small-scale producers.
- Declining coffee prices increase poverty and results in increased coffee production, which in turn creates a conflict regarding the government’s commitment to decrease the amount of coffee to be traded. In addition, the reduction in coffee prices leads to deforestation since more land is needed to plant coffee in order to maintain peoples’ income.
- Charcoal production is an extra important contributor of deforestation besides coffee cultivation and it is connected to the iron and steel industry energy demand.
- The current land use, namely coffee cultivation and cattle grazing, is not sustainable because it progressively degrades the land and also leads to deforestation since more agricultural land is recurrently required.
- The possibilities of a sustainable agricultural use of the land, if a land management plan were implemented, are rather limited due to the following reasons.
  - i) The topography, poor soils and comparative low productivity of ‘Zona da Mata’ region restrict significantly its use as an agricultural land.
  - ii) Soil conservation measures and agricultural techniques are palliative solutions to reduce soil erosion and improve the fertility of the land. Therefore, they can help to slow deforestation but their implementation is not equivalent to sustainable agriculture.

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<sup>33</sup> CTA-MG and the STR’s interview (1997)

<sup>11</sup> Charlie Evans’ interview (2003), volunteer of Iracambi Atlantic Rainforest Research Center

- iii) Due to the stagnant state of the agriculture in the ‘Zona da Mata’ region, as well as its current decline in crop diversification, the adoption of new crops aimed to replace coffee plantations is rather restricted. Therefore the present situation is likely to be maintained. It means that coffee is expected to persist as the principal crop and pasturelands are likely to replace degraded coffee areas.
- iv) The participation of the communities living in the Rosário da Limeira and Muriaé region could be restricted not only because their deficient education but also because some measures included in the land management plan, such as protection of fragile areas, could affect their economies.

## **Section III**

### **8. A new problem analysis**

In the following, a new problem analysis will be presented. This analysis has a much wider point of view, both spatial and temporal, to show the principal causes of the current problems and how they are affected by processes and actors. It starts off with a causal loop diagram showing the main variables and connections.

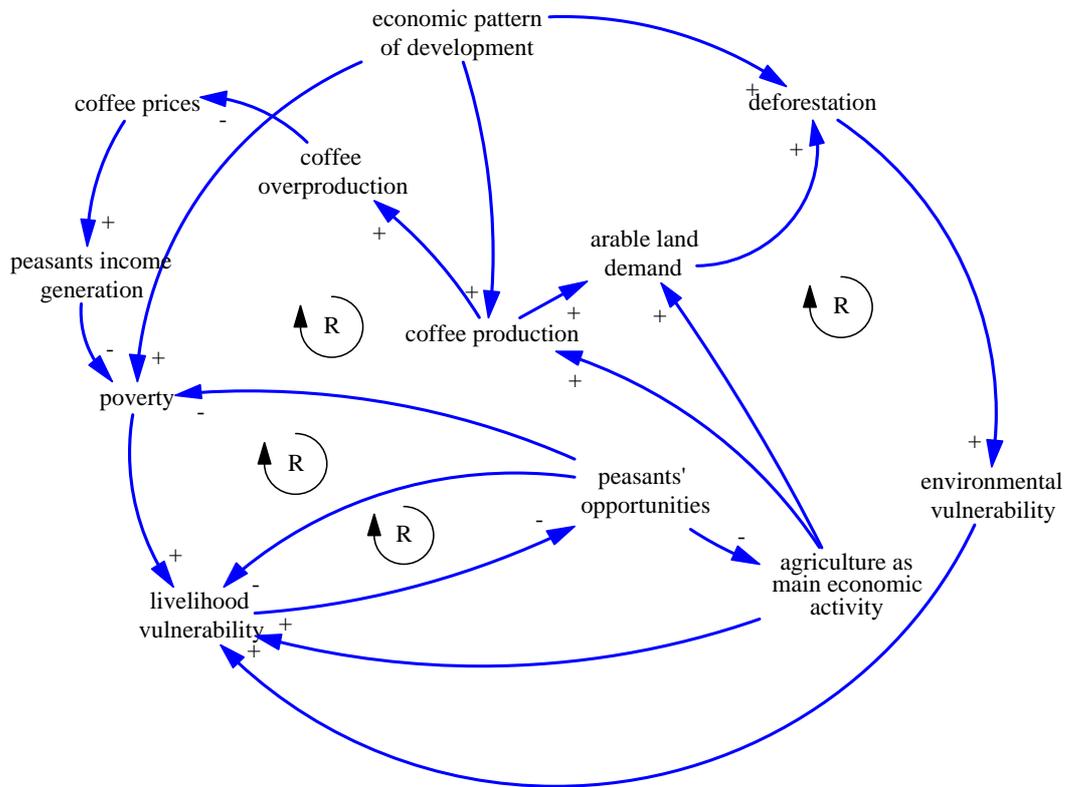
According to empirical information, there is a wide agreement, as mentioned above, that the principal causes leading to deforestation in Muriaé and Rosário da Limeira municipalities are related to ‘carvão’ production and agricultural activities, especially coffee cultivation.

The following causal loop diagram (CLD) illustrates the development pattern as the primary factor leading to poverty, coffee cultivation and deforestation in Muriaé and Rosário da Limeira rural regions. The term ‘development pattern’ is used here to refer to the development strategies, implemented to fuel economic growth and foreign debt payments, which have provoked deforestation either through charcoal production or an expansion of the agriculture frontier.

It is assumed that an increase in coffee production leads to more arable land demand. In addition, it provokes coffee overproduction and therefore a reduction in coffee prices. As a result, there is a reduction in peasant’s income generation and consequently more poverty. Therefore, livelihood vulnerability increases, which in turn reduces peasant’s opportunities. Consequently, agriculture as the main economic activity rises leading to more coffee cultivation and closing the reinforcing loop.

If livelihood vulnerability augments peasant’s opportunities will be reduced provoking more vulnerability. This is another reinforcing loop. At the same time, fewer opportunities mean more poverty, generating more vulnerability and therefore decreasing peasant’s opportunities in another reinforcing loop.

When farmers’ opportunities are being reduced, agriculture as the main economic activity rises. As a consequence of this, coffee production increases and more arable land is required. As the demand for arable land rises more forest is cleared generating more environmental and livelihood vulnerability and therefore reducing peasant’ opportunities in a reinforcing loop.



## 8.1 Analytical Scope

Although the ‘economic pattern of development’ is established as a fundamental factor leading to poverty, it is beyond the scope of this paper to analyze this topic in detail. With regard to the ‘fazendeiros’, as mentioned earlier, although they are connected to agricultural and grazing land demand and linked to charcoal production as well, the present analysis does not delve further into this subject.

The problem analysis, therefore, focuses on the primary causes, which according to the experiences on the field, have contributed to deforestation in Rosário da Limeira and Muriaé municipalities. In addition, its section attempts to underline the linkages between those factors and different patterns of development.

## 8.2 Coffee cultivation, deforestation and economic strategies for development

### 8.2.1 The driving force of the iron and steel industry demand

It is interesting to note that the IEF (State Forest Institute) and the 'Polícia Florestal' agree that the iron and steel industry energy demand contributed significantly to the land clearing in the region. In fact, the initiative for the creation of the protected area 'Sierra do Brigadeiro' State Park, emerged as a preventive reaction to the large-scale deforestation, caused by charcoal production.<sup>34</sup>

According to the World Bank (2002), Brazil is the only state that employs charcoal as a reducing agent for the iron production. In this regard, it is worth mentioning that Brazil was almost completely reliant on imported sources of energy (D'Agostino, 2001) when the oil shocks of 1974 and 1979 seriously increased the cost of petroleum imports. The elevated prices of petroleum generated pressure for all the countries to finance their energy expenditures (Fraser, 2001) and the Brazilian energy policy started to focus on the substitution of imported oil with domestic energy resources (Araujo et al., 1987). Industrial sectors such as iron and steel, among others, signed protocols to increase their utilization of fuel wood and charcoal in order to decrease the consumption of petroleum (ibid). The protocols also committed the industry to use planted forest (ibid).

However, attempts to reduce natural forest consumption have not been successful. Nowadays, 110 steel and iron industries are located in the Minas Gerais state and their energy demand is mostly supplied by the remainder natural forests (PNUMA et al., 2002). Currently, only 25% of their energy is provided by cultivated trees (ibid). Moreover, it should be pointed out that as law enforcement has become more effective in Minas Gerais, other native forest from the Bahia and Goiás states started to be deforested in order to fulfill the charcoal demand (ibid).

In this respect, the World Bank mentions that since 1992, *Eucalyptus sp* plantation cover in Minas Gerais has begun to decline steadily since fiscal incentive for fuel wood trees ended. According to the Bank, 130,000 ha per year should be cultivated in order to maintain the current timber supply. Since this does not happen, there is a deficit of 7%, which is expected to increase to 50% in 2007. Because the accessibility of charcoal from plantations is declining, industries using charcoal have lately shifted to 100% coke-base production (ibid).

On the other hand, an increase in *Eucalyptus sp* plantations is not always a guarantee to reduce deforestation. On the contrary, rather than being a solution there is evidence that *Eucalyptus sp* plantation has been an incentive of deforestation in the region. According to Le Breton<sup>35</sup>, The World Bank financed the Minas Gerais Forestry Development project of November 1987 with a loan for \$48.5 million. 'Ironically, the World Bank [supported] the Forest Project, which was supposed to encourage farmers to plant eucalyptus instead of cutting native forest, but often farmers cut down native forest in order to make the space for the eucalyptus' (CLD 4)

Given that law enforcement in Minas Gerais shifted deforestation for charcoal production to the Bahia and Goiás states and, that *Eucalyptus sp* plantation operated as an incentive of deforestation; the most practical and radical solution seems to be the replacement of charcoal for coke-base production.

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<sup>34</sup> PESB ('Sierra do Brigadeiro' State Park) Proposal for the Management Plan (2000)

<sup>35</sup> President of Iracambi Atlantic Rainforest Research Center's, personal communication (2003)

## **8.2.2 The contribution of agriculture to deforestation**

Besides charcoal production the other factor that has provoked, as mentioned before, extensive deforestation (Consortio, 2000) in the 'Zona da Mata' region has been coffee cultivation (Franco 2002). According to Gupta (1988), extension of farming areas can occur in response to an increasing demand for a specific crop or as a result of large-scale agricultural developments, which extended on the more fertile areas, force migration of peasants to marginal lands such as areas of steep slopes and poor soils.

## **8.2.3 The demand for coffee exports -an engine of economic growth and foreign exchange**

During the first postwar period (1950- 63), the Brazilian agricultural development was characterized by sustained extension of traditional export-crop cultivation, particularly coffee, which experienced a boom in world prices (Douglas, 1987). At that time, the most important coffee producers were the São Paulo and Paraná states (Andrade, 1994 p.33). This period was characterized by a significant expansion of coffee plantation areas especially in the Paraná region (Douglas, 1987). Agricultural production represented 90% of the Brazilian total exports (ibid), of which coffee accounted for 50% of the country revenue (Andrade, 1994 p. 8).

The Minas Gerais state was the first priority when policies related to agricultural expansion, mainly for coffee cultivation, were implemented in the 1970s (Andrade, 1994). At that time, the major goal of the Brazilian government was the industrialization of the country through import substitution (ibid). Foreign exchange coming from coffee exports was necessary for buying new engines and therefore for the industrialization of the country, especially for the siderurgy and petroliferous sectors (ibid).

It is generally accepted that ISI policies penalized agricultural exports (Kay, 1999; Harper et al., 2001) through their restriction, as well as export taxes and price controls (Andrade, 1994). At the same time, the agriculture sector in Brazil was benefited with domestic credits although they were highly restricted during the 1970s (Andrade, 1994). Credits for agriculture were allowed, however, with an uneven distribution since the majority of the loans were allocated to no more than 3%-4% of the agricultural producers (Sopolador, 2002; Andrade, 1994). Consequently, whereas policies penalizing agriculture affected all producers (Andrade, 1994), the loans benefited mostly big landowners (Sopolador, 2002). 'Thus government policy was biased not just against agriculture but within agriculture against peasants and rural workers' (Kay, 1999).

In addition, poor social sectors were also affected because the increase of export crops led to a decline in food crop production (Gutman, 1988) since most of the agriculture growth, not only in Brazil but also in Latin America, has been the result of area expansion rather than yields (Kay, 1999; Douglas, 1987). Its replacement had negative consequences for poor people since they mostly consume domestic food crops (Gutman, 1988). Douglas, (1987) highlights that the substitution of domestic food crop areas with export crops plantations has been a growing dilemma in the Brazilian agriculture.

ISI strategies had the results that structural economist expected for a variety of consumer goods (Martinussen, 1988) and Brazil, among other Latin American countries, was successful in fostering some economic growth through import substitution industrialization (Fraser, 2001). However, it was more difficult than expected to implement the import substitution policies for intermediate products and production equipment (Martinussen, 1988). As a consequence, industrial growth declined, and financial balance-payment problems, as well as public sector deficits were experienced not only in Brazil but also in most other Latin American countries (ibid). By the end of the 1970s Latin American countries remained immersed in exchange problems and debt (ibid) dependent on external financing with scarce domestic savings and high inflation (Gwynne, 1999).

To avoid Brazil from defaulting on their loans, the World Bank and the IMF, acted in response to the rising debt crisis by renegotiating debts and extending extra loans (D'Agostino, 2001). In addition, they imposed conditional reforms in order to release their funds (Gwynne, 1999). SAPs (Structural Adjustment Programmes) usually included currency devaluation to encourage exports, as well as cuts in state's expenditure to balance budget and decrease inflation (Fraser, 2001).

'In general, Latin American countries continue to rely heavily on the direct exploitation of their natural resource wealth in order to generate export income' (Murray, 1999). Nowadays, the principal Latin American exports are coffee, minerals, oil products and other agricultural products such as soy, bananas, and meat (Harper et al., 2001). The conditional reforms towards primary sector export activities are increasing pressures on the physical environment (Murray, 1999). More and more, the region's natural resource wealth is being used as current income, rather than being administrated a basis for sustainable development (ibid).

#### **8.2.4 The agricultural shift in São Paulo and Paraná states and the expansion of coffee cultivation in Minas Gerais**

Due to the unfavorable situation of coffee prices, in the beginning of the 1960's, two coffee eradication programmes were implemented during 1962 and 1967 in order to decrease the excess of coffee production and to eliminate the old unproductive plantations (Andrade, 1994; Douglas, 1987). The Minas Gerais state had the most successful eradication process among all the coffee producers states and 'Zona da Mata' was the region where the great majority was eliminated<sup>36</sup> (Andrade, 1994). However, during the 1970s there was a recovery of coffee enterprises in the Southeast, especially in Minas Gerais (Douglas, 1987). Coffee production grew from around 18% in the beginning of the 1960's to 26% during 1979/80 (Andrade, 1994).

A regional shift in agricultural production occurred in the southeast states of São Paulo and Paraná (Douglas, 1987). In response to the international demand of soybeans (Gutman, 1988) the traditional coffee producers, São Paulo and Paraná states, began shifting into more profitable crops such as soybean enterprises (Douglas, 1987). According to Gutman, (1988) soybeans and fodder have been the crops which best performed in Latin America during the postwar period. In this respect, Gutman (1988) also points out that Latin America is the region where the most important changes in crop composition have been found during the last 20 years, with an increasing trend of soybeans and fodder cultivation mainly influenced by the Brazilian 'boom' soybean production.

When analyzing the causes of coffee cultivation expansion in the Minas Gerais state, Andrade (1994) stresses that in the first place, the financial credit availability from PRRC (Plan for the Renewal and Strengthening of Coffee Plantations), during the seventies, was not the only reason of its increment since the São Paulo and Paraná states were also benefited in the same proportion. The author explains that the low cost of the land<sup>37</sup> and labor<sup>38</sup>, the topography (which limited crop diversification with soybeans and corn) and the climate played an important role. Coffee plantations not only expanded in the traditional coffee areas such as 'Zona da Mata' and 'Sul de Minas' but also to the 'Cerrado' region, which previously has been considered not suitable for agriculture (Andrade, 1994).

At the same time, while coffee cultivation was expanding in Minas Gerais, the contrary trend developed in the São Paulo and Paraná states. By the late seventies, soybeans had replaced a great part of the coffee activity in the

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<sup>36</sup> As was mentioned before, pastures replaced most of the areas where coffee plantations were removed

<sup>37</sup> According to the author land areas in the agricultural frontier were less expensive than those lands located in São Paulo and Paraná states

<sup>38</sup> Cheap and abundant labor force' (Andrade, 1994 p. 32)

Paraná state (Douglas, 1987). The decade was characterized by an agricultural geographical change, where coffee production was pushed out<sup>39</sup> from more frost-prone areas in Paraná to the warmer climate of Minas Gerais (ibid). For instance, the frost that occurred in 1975 damaged the total coffee production in Paraná and seriously affected the São Paulo one (Andrade, 1994). Producers shifted to cultivate soybeans and wheat instead of coffee in Paraná and sugar cane, soybeans and orange trees in São Paulo not only because of the unfavorable climate conditions but also because of their higher economic returns (ibid).

In contrast to Minas Gerais; the Paraná and São Paulo states are favored with more fertile soils and a gentle topography (Andrade, 1994), which allows the cultivation of mechanizable export crops such as soybeans (Douglas, 1987). The use of machinery and tractors led to an increase in seasonal and part-time labor, as well as land concentration (ibid). In this manner, producers benefited economically from the agricultural shift but at the same time it had negative social consequences for peasants (Andrade, 1994). Consequently, massive migration of rural workers occurred to frontier areas of Brazil such as Rodônia, Matto Grosso do Sul among others (ibid).

### **8.3 Linkages between deforestation and different patterns of economic development**

- Economic policies aimed to promote the industrialization of the country provoked deforestation for two principal reasons. First, they supported coffee cultivation, since foreign exchange was essential for the import substitution process and second; they encouraged domestic source energy, such as charcoal, in order to supply the iron and steel industry demand.
- The extension of the agricultural frontier for coffee cultivation in the Minas Gerais state can be attributed to the country's reliance on exports crops and to the shifting composition in crop cultivation within the São Paulo and Paraná states. In addition, the low cost for land and labor, as well as the climate, favored its expansion.
- The foreign debt and the conditional reforms, supported by the World Bank and the IMF to generate export income, have encouraged coffee cultivation in the 'Zona da Mata' region.

## **Section IV**

### **9. A path towards sustainable livelihoods in the Rosário da Limeira and Muriaé rural communities**

Previous sections of this paper drew the attention to the incompatible uses of land between coffee cultivation, the preservation of the rain forest and other agricultural activities such as cattle grazing. In addition, it has been underlined that the topography, poor soils and comparative low productivity of the 'Zona da Mata' region restrict significantly its use for agricultural reasons, which is confirmed by the present stagnant state of the agriculture and the declining trend in crop diversification of the region.

Therefore, alternatives means of living, besides agriculture, are explored in this section within the framework of sustainable livelihoods and livelihood diversification in order to find a path for improving the living conditions in Rosário da Limeira and Muriaé rural communities while at the same time maintaining the natural resource base of those communities.

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<sup>39</sup> Onto more marginal lands

The term ‘sustainable livelihoods’ encompasses the relationships between poverty and the environment (Scoones, 1998). Livelihoods are sustainable when the assets and activities required for a means of living are obtained, maintained or improved without undermining the natural resource base while at the same time reducing people’s vulnerability (ibid). Thus, a livelihood approach addresses strategies that can effectively alleviate poverty and sustain the natural resource base (Arnold et al., 1999).

‘Livelihood diversification refers to attempts by individuals and households to find new ways to rise incomes and reduce environmental risk, including both on and off-farm activities which are undertaken to generate income additional to that from the main household agricultural activities’ (Hussein et al., 1998).

Based on such approach, two plans are proposed in order to achieve more sustainable livelihoods in the Rosário da Limeira and Muriaé rural communities.

## **9.1 The short-term Plan, balancing strategies between forest protection and poverty alleviation**

This plan is a combination of short-term strategies aimed to reduce soil erosion and deforestation but also taking into consideration their negative effects regarding poverty intensification. Therefore, possibilities for increasing the family income and reducing vulnerability are considered. Here, existing strategies used by the communities to widen and improve their family income are analyzed in order to find possible measures to improve them.

### **9.1.1 Preventing soil erosion and recovering existing secondary forest**

Coffee plantations located on fragile areas such as steep slopes, rivers’ margins and stream reservations should be gradually replaced with native forest either naturally or through reforestation efforts, restricting agricultural activities to the bottomlands. In addition, all possible soil conservation techniques, tailored to the local conditions, should be implemented in order to reduce soil erosion.

However, the land allocation measures referred to above may have negative effects on peasants’ income since restrictions on farming steep slopes reduce the area available for agriculture. In addition, poor farmers are likely to be the most affected in view of the fact that, as referred to in earlier sections, they usually occupy less favorable lands on steep slopes<sup>6</sup>. Therefore, since those changes could leave them even poorer, additional sources of income generation, besides coffee cultivation, should be provided to the farmers.

### **9.1.2 Current side-line and income generation activities**

Non-agriculture sources of income generation, as well as increasing income generation strategies, are not only important to spread risk, in the face of declining coffee prices, but also to maintain incomes levels when land allocation measures are implemented.

Leaders of several communities have different opinions regarding the most effective means to increase farmers’ incomes. For instance, Gerardo Filipi, the leader of the Pedra Alta community in Muriaé, stressed the importance

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<sup>6</sup> PESB ‘Sierra do Brigadeiro’ State Park Proposal for the Management Plan (2000)

<sup>8</sup> Marhnia Aparecida Moisés de Matos: a wage labor farmer’s wife living at Iracambi Recursos Naturais Ltda. (Interview, 2003)

of public participation in rising incomes activities<sup>40</sup>. The leader explained that the Pedra Alta community has been successful in selling milk with a higher price after small-scale producers managed to organize a small cooperative. Francisco Rabiello, the leader of the Pirapanema communities in Muriaé, pointed out the introduction of coffee processing technologies<sup>41</sup>, such as torrefação, as an important means to obtain a more value-added product to generate higher incomes.

However, peasants face several constraints to widen their income earnings. For instance, they usually do not have extra time to get involved in other activities after a long day working on the land. In addition, their poor education is usually an obstacle to additional employment opportunities. 'It is more difficult for men to find another kind of job. Here, people don't have enough education. We have little education. Men have to work on the land. However, women can work in other kind of activities such as sewing, embroidering and so on, but some of them don't have the skills and also the income earned through these activities is quite low<sup>8</sup>

## Off- farm activities

Rural women generally occupy their time in domestic activities at home, working at the dairy, during the coffee harvest and making handicrafts.

The most important constraints commonly faced by the rural women for selling the 'artesanatos' are the lack of capital, restricted market opportunities – the isolated living conditions of the Muriaé and Rosário da Limeira rural communities should be borne in mind - as well as, women's lack of skills. Most of the women interviewed generally agreed that they have restricted possibilities of selling the 'artesanatos'. Therefore they are obliged to sell the handicrafts to a middleman, obtaining in this way lower earnings. 'It doesn't make sense to make 'artesanatos' because the middleman is absorbing the profits and the money I could earn is so little that it is not worth to spend time and work in this activity<sup>42</sup>.

The association of rural women 'Associação de Mulheres Rurais' has organized a group of women from Rosário da Limeira in order to help them to improve their skills, to find new markets opportunities and to sell their work for a higher price. Filippini<sup>43</sup>, a representative of the organization, explained that all the people working at the association are volunteers; since this is the only means that women can get a higher income from the products the organization sells. She stressed that through the association women's incomes are augmented without increasing prices due to the amount of 'artesanatos' sold thanks to <sup>42</sup>the help of the volunteers. The actual markets, where the organization usually organizes the exhibitions of sale, are the Belo Horizonte, Juiz de Fora, Leopoldina, Rio de Janeiro, Viçosa and Muriaé cities among others.

However, women who have already joined the association, also work harvesting coffee since the income generated from coffee is higher than the earnings coming from the handicrafts<sup>41</sup>. In this regard, Filippini mentions that economic capital for buying raw materials and additional markets are needed in order to improve the assistance that the association offers to the rural women.

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<sup>40</sup> According to Le Breton Pedra Alta is one of the most organized communities (interview, 2003), which is also confirmed by da Silva (1981 p. 33).

<sup>41</sup> 'Torrefação' (coffee roasting), a processing technology used to peel, dry and roast coffee grains

<sup>42</sup> Rural women from the Independência community, Muriaé.

<sup>43</sup> Emilia Viera Filippini, interview (2003)

**ABC: A humanitarian aid organization founded in Lund, Sweden in 1998, [www.abcsweden.org](http://www.abcsweden.org)**

In addition coordinated actions of local and international networks are also necessary to support and strengthen the association's activities by exploring new market opportunities and helping local volunteers to organize rural women.

## **BOX 2. Recovering the native forests by selling handicrafts through a promising international network**

ABC -Sweden-, Amigos de Iracambi, and the 'Associação de Mulheres Rurais' of Rosário da Limeira could help jointly to recover the existing secondary forest and improve the living conditions of the Rosário da Limeira rural communities. The following project, written by the author, is being examined by the ABC representatives in Lund, Sweden.

### **Proposal for a different source of income generation, besides the land use, in rural communities from Muriaé and Rosário da Limeira, Minas Gerais, Brazil**

#### Objective

The general idea is to create a compromise, between the local communities and the international network, for land's afforestation with native species when handmade products are sold in order to generate a new source of income besides agriculture. For each homemade product sold a native tree has to be planted.

Its shift from income generation shows the value of the effort made by the local communities and the NGOs - ABC, Amigos de Iracambi and the 'Associação de Mulheres Rurais'- in preserving the Mata Atlântica while at the same time improving the livelihood of local communities.

#### Project Implementation

- *Market opportunities*

The characteristics of the region, rural and quite isolated, as well as the average low income of the people living in the communities from Muriaé and Rosário da Limeira, do not favor a local market for selling the handmade products. Therefore, the opportunities of an international market, which can be accessed through the international network, might be a solution for these constrains.

- *Women's Organization*

Women from local communities should be organized with the help of the local NGOs so that their opinions regarding the project on going design and implementation can be taken into consideration.

When dealing with the group's activities a person responsible for coordination will be needed. This should be carried out in turn by different women of the local communities.

In addition, the afforestation work has to be in accordance with the number of products sold. Thus, these should be registered as well as the trees that are being planted. This is a crucial point that has to be carried out with particular care in order to safeguard the project's 'legitimacy'.

Moreover, there could be a potential opportunity for tourism if people, not only interested in buying the products but also in protecting the forests, were offered to come to visit the communities and the women's work and 'check' for themselves the work that is being carried out.

Finally, the accountability as well as the details related to the money earned (bank account and so forth) have to be organized by someone who is not only capable of doing that but also competent in doing a reliable and transparent work. In addition, any kind of information has to be available for every single person involved in the women group.

- *Products Design*

The packaging of the products should reflect the project objective in the sense that it has to be as 'environmental friendly' as possible, as well as maintaining the good product's quality. A volunteer with design background will be necessary in order to achieve this goal.

An idea for the products' brand could be 'hands from the forests'. The brand should name the link between the products and the forests preservation, and it has to be acknowledged when designing not only the brand but also the packaging.

## **On-farm activities**

The state agricultural agency EMATER-MG, has been involved in the promotion of side-line activities such as honey production, aquiculture and fruits craftwork manufacturing in order to improve poor rural families' incomes.

In addition, the 'Sindicato do Trabalhadores Rurais' -Rural Worker Union of small- scale Producers- is concerned with the diversification of on- farm income earning activities. In this regard, the 'sindicato' has started to organize rural workers for selling their products. Honey, sweets, handicrafts, liquors and other products are sold through the 'Sindicato do Trabalhadores Rurais' under the brand name 'Sabor da Mata'.

The success of the gradual substitution of coffee with other on-farm products is likely to increase according to the demand for such products and the access to new market opportunities. Therefore, efforts of government agencies and social networks should be made in this direction.

### **9.1.3 Increasing coffee prices**

Strategies aimed to increase coffee prices are important means to alleviate poverty and diminish deforestation rates. Moreover, it is of interest to note that higher coffee prices not only have a positive effect on incomes but also on the peasants' time availability to get involved in other income generation and social activities. This is based on the assumption that if coffee prices increase less agricultural land is needed to maintain equal incomes levels.

There are three principal means to increase coffee prices, without considering additional alternatives that are beyond local control. Options such as state intervention or possible international price agreements are beyond the scope of this paper.

- Bypassing the middleman
- Processing raw coffee grains in order to obtain a more value added product
- Reducing coffee production in order to reduce the supply of coffee at the world level

## **Bypassing the middle man**

According to Andrade (1994), small-scale producers benefit from cooperatives since they reduce the commercial chain. Small-scale producers, who belong to the cooperative, are able to sell the raw coffee production to the exporters, directly to the international market or selling raw coffee production to the coffee roasting owners, who finally put the processed coffee production on the domestic or international market (ibid). In short, the role performed by the middleman is carried out by the agricultural workers' cooperative.

The most important barriers faced by peasants to participate in cooperatives are heavy workload, isolated living conditions (some families have to travel more than 40 km), as well as poor access to education (Silva, 1981). In this regard, Silva (1981) highlights that better educated small-scale producers participate more actively than those poorly educated.

## **Processing technology**

As mentioned above, 'torrefação' -coffee roasting process- adds value to the product, which in turn generates higher prices and incomes. However, rural communities usually have to deal with a bureaucratic process in order to obtain some support from the local authorities to buy or rent the equipments to process the raw coffee <sup>44</sup>.

It is clear that capital is crucial to pursue any livelihood strategy (Scoones, 1998). This is a good example which shows that even if the community is organized, and people are willing to participate; the opportunities to improve their livelihoods are seriously restricted by the lack of capital and power to influence political decisions. Thus, financial resources have to be allocated to encourage small-scale producers to improve their opportunities of rising incomes, which will alleviate the pressure farmers put on the land to maintain their income levels and therefore reduce deforestation rates.

## **Reducing coffee production**

This is a desirable measure for many reasons. First, a decrease in coffee production will probably reduce the expansion of farming areas into forested lands since the Brazilian agriculture has historically increased production via the extension of the agricultural frontier. Second, this strategy is in accordance with government's commitment to reduce the coffee supply to the international market. Finally, this measure is expected to raise coffee prices and, as described above, alleviate poverty and diminish deforestation rates.

However, a decrease in coffee production at the regional, or even national level, does not assure that the international coffee supply at the world level will be reduced. In other words, such a measure of reducing coffee production at the regional scale is workable only if other coffee producing countries are also committed to reduce the international coffee supply.

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<sup>44</sup> Francisco Rabiello, the leader of Pirapanema communities in Muriaé

### **9.1.4 The replacement of charcoal for coke-base production**

Since one of the two primary causes of deforestation is charcoal demand, strategies to diminish deforestation rates, not only in Minas Gerais but also in the remaining forested areas located in other states, have to target the center of the problem, namely the demand of charcoal coming from the steel and iron industries. Therefore, government's efforts should concentrate on means to oblige the industry to shift to 100% coke-base production.

For doing that, not only specific legal action is needed but also financial capital. It should be provided to the industry in order to accomplish this goal. For instance, World Bank's loans if provided to the private sector could have several advantages. First of all, it is clear devolution of responsibility to the private sector involved in illegally harvested native forest. Second, because credits are provided directly to the private companies, the Brazilian state does not run into the responsibility of debt payments. Third, through this strategy the problem is solved at the real root avoiding unfortunate side effects such as those provoked by the replacement of native forest with *Eucalyptus sp.* plantations referred to in earlier sections.

## **9.2 The Long-Term Plan: Education, an irreplaceable requisite for livelihood diversification**

*If you don't have education you will not get a job. We believe that it can be possible for our children but not for us. Our children still have a future...*

Maria Aparecida Moises de Matos (2003)<sup>45</sup>

Why do people from the Rosário da Limeira and Muriaé rural communities not get a more gainful job? The great majority of interviewees agreed that lack of education is the principal impediment for those communities to find a more rewarding activity.

The long-term plan pursues coffee eradication in the Rosário da Limeira and Muriaé rural areas, as well as a shift in agriculture to a side-line activity providing, at the same time, an improvement in the living conditions.

### **9.2.1 The deficient education of the Muriaé and Rosário da Limeira communities, a common problem of rural Brazil**

Davi Diaz Maciel, a teacher from the agricultural school 'Escola Família Agrícola Novo Horizote', in the Pirapanema district, Muriaé, is convinced of the important role of the school in spreading knowledge to the rural family. Maciel, among other teachers, is concerned with the poor facilities of the school's library, as well as the lack of a telephone, which the local government has promised to provide the school with. They have also promised other services which have not been supplied yet.

According to Edson Curi, the Mayor of Rosário da Limeira, many small schools with one-room classes and mixed age groups have been replaced by one big and well-equipped school in Rosário da Limeira city since the municipality became independent from Muriaé in 1996.

However, low teachers wages, lack of textbooks and high seasonal absence due to agricultural activity is a reality of impoverished and isolated areas in Latin America (Arnove et al., 2001) and Brazil is not

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<sup>45</sup> Rural women from Rosário da Limeira

the exception (Arriagada, 1989). Illiteracy is widespread among Brazilian peasants (França, 1997) and the 'Zona da Mata' region has the highest levels compared with other regions of the Minas Gerais state (FAEMG, 1996).

### **9.2.2 Coffee eradication and the shift in agriculture to a side line activity**

The eradication of coffee cultivated areas and the restriction of pasture and other agricultural activities to the bottomlands will reduce the land available for agriculture. A shift in agriculture to a side-line activity necessarily requires new and reliable sources of incomes to be available for peasants in order to prevent them from becoming poorer.

Skills, knowledge and ability to labour are important for the successful implementation of different livelihood strategies (Scoones, 1998). In other words, education is indispensable to find new income opportunities, besides the main household agricultural activities, while at the same time maintaining the natural resource base.

### **9.2.3 A key challenge for the World Bank, investing in education as a strategy to achieve forest conservation**

The World Bank claims to be the most important international funding source for biodiversity projects (World Bank, 2002). The Pilot Program to Conserve the Brazilian Rainforest (RFTF) and Global Environmental Facility (GEF) are two examples of projects executed by the World Bank for the conservation and sustainable use of the forest (ibid).

On the other hand, the World Bank has imposed conditional reforms such as the Structural Adjustment Programmes (SAPs) to reduce the state's spending, as well as encouraged exports crops. Adjustment policies have increased poverty due to the drastic reduction in the state's social expenditure (Arnove et al., 2001) and the promotion of export crop, such as coffee, has led to deforestation.

Therefore, given the fact that education is necessary to find non- agricultural income opportunities in order to decrease agricultural land demand and improve the living conditions of the communities; a reallocation of investments is required. In other words, World Bank's grants are likely to be more effective, in reducing poverty and protecting the Mata Atlântica biodiversity, if are allocated not only to biodiversity conservation efforts but also to education programmes.

## 10. Conclusions

- Although poor people clear forested areas to maintain or improve their income levels, poverty is only the proximate cause of deforestation in the Rosário da Limeira and Muriaé regions.
- The steel and iron industry charcoal demand and the expansion of the agricultural frontier for coffee cultivation are the primary causes of deforestation in the Muriaé and Rosário da Limeira regions.
- Economic policies aimed to promote the industrialization of the country promoted coffee cultivation and encouraged charcoal production in order to supply the iron and steel industry energy demand.
- The extension of the agricultural frontier for coffee cultivation in the Minas Gerais state can be attributed to the country's reliance on exports crops, as well as to the shifting composition in crop cultivation within the São Paulo and Paraná states.
- The foreign debt and the conditional reforms, supported by the World Bank and the IMF to generate export income, have encouraged coffee cultivation.
- The possibilities of a sustainable agricultural use of the land, if a land management plan were implemented, are rather limited due to the following reasons.
  - v) The topography, poor soils and comparative low productivity of the 'Zona da Mata' region restrict significantly its use as agricultural land.
  - vi) Soil conservation measures and agricultural techniques are palliative solutions to reduce soil erosion and improve the fertility of the land. Therefore, they can help to slow deforestation but their implementation is not equivalent to sustainable agriculture.
  - vii) Due to the stagnant state of the agriculture in the 'Zona da Mata' region, as well as its current decline in crop diversification, the adoption of new crops aimed to replace coffee plantations is rather restricted. Therefore, the present situation is likely to be maintained. It means that coffee is expected to persist as the principal crop and pasturelands are likely to replace degraded coffee areas.
  - viii) The participation of the communities living in the Rosário da Limeira and Muriaé regions could be restricted not only because their deficient education but also because some measures included in the land management plan such as protection of fragile areas, could have detrimental effects on their income.

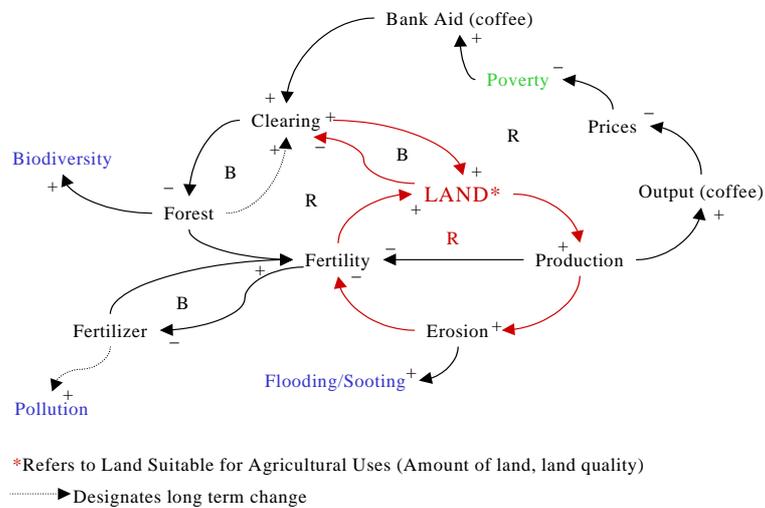
### 10.1 Recommendations

- In order to prevent the Rosário da Limeira and Muriaé regions from further deforestation, coffee should be gradually eradicated and agriculture should be transformed to a side-line activity.
- Additional non-agricultural sources of income generation are needed for the farmers if coffee plantations are to be gradually replaced with native forest and agricultural activities restricted to the bottomlands.
- Capital, local and international social networks are necessary to improve current side-line activities, as well as to create other income generating works.
- Government's efforts should concentrate on means to oblige the industry to shift to 100% coke-base production.

- Investment allocated to education is indispensable to find new non-agricultural income opportunities, and to improve the living conditions in the Rosário da Limiera and Muriaé rural communities while at the same time maintaining the natural resource base

## Causal Loop Diagrams

### (CLD) 1. Watson's problem analysis



Source: Watson (2000)

'This conceptual model presents the causal loops between deforestation, land degradation, and coffee cultivation. The central loop, begins with Clearing of the forest. More clearing provides more Land (which represents "land suitable for agricultural uses") for the farmers, and this allows for more Production. Continuing on the central loop, more production causes more Erosion, and this leads to decreased soil Fertility. Also affecting soil fertility is the production itself, as crops deplete the soil's nutrient base. Decreased fertility leads to less land, and this in turn leads to more clearing. This is a reinforcing loop, and is the central problem of the study.

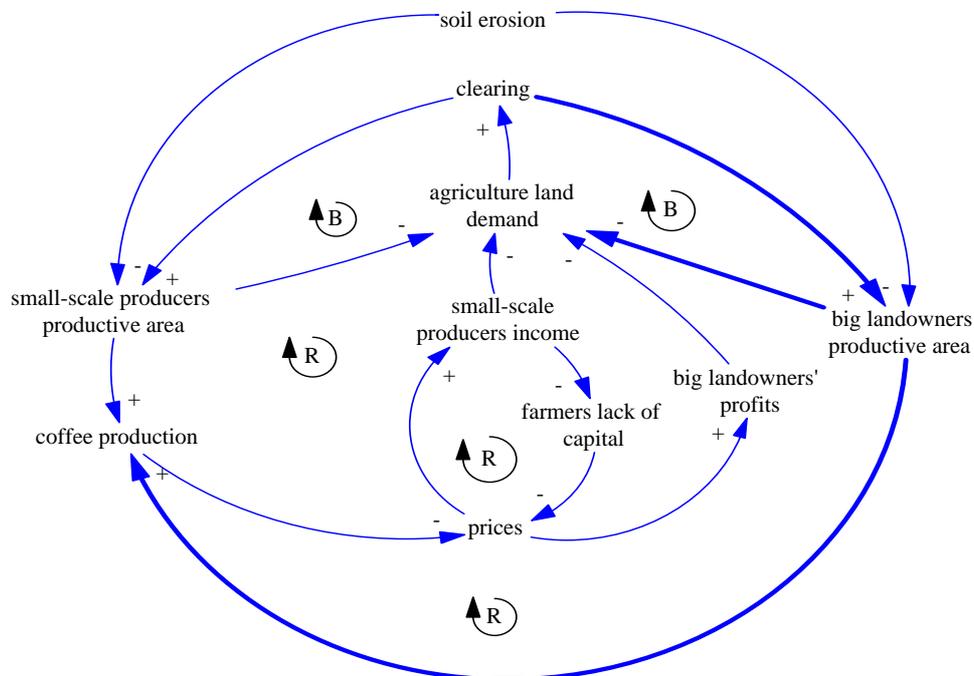
Clearing leads to less Forest, and this in the long-term will lead to less clearing since eventually the forest will reach its maximum felling potential. This is shown by a dotted arrow, representing change over the long-term. This is a balancing loop.

Continuing from the decrease in forest, a reduction in Biodiversity is shown. The loss of biodiversity, represents one of the key ecological problems of deforestation. Also a direct result of forest loss is a decrease in soil fertility, since the soil is dependent upon the trees for the regeneration of nutrients and moisture. Another ecological problem area is the Flooding and Sooting of waterways, which increases with greater erosion.

When soil fertility is low, one solution used by many farmers is the increased usage of Fertilizer to remedy degenerating soils. More fertilizer can be a solution, as it results in a balancing loop of increased fertility, but the side effect is the eventual increase in Pollution.

Returning to the central loop, the increase in coffee production leads to an increased Output. While increased output may initially appear as a positive result of greater production of the land, the causal loop shows that more output leads to a reduction in global coffee Prices. Lower prices mean less money for the farmers, thus a resultant increase in Poverty, shown in green as an economic and social problem. Without the means for self-sufficiency, or the personal capital, farmers turn to Bank Assistance and receive loans and credits in order to plant coffee. More coffee planting leads to more clearing, and the cycle begins again. This is a reinforcing loop'. Watson (2000)

## (CLD) 2. Land Clearing



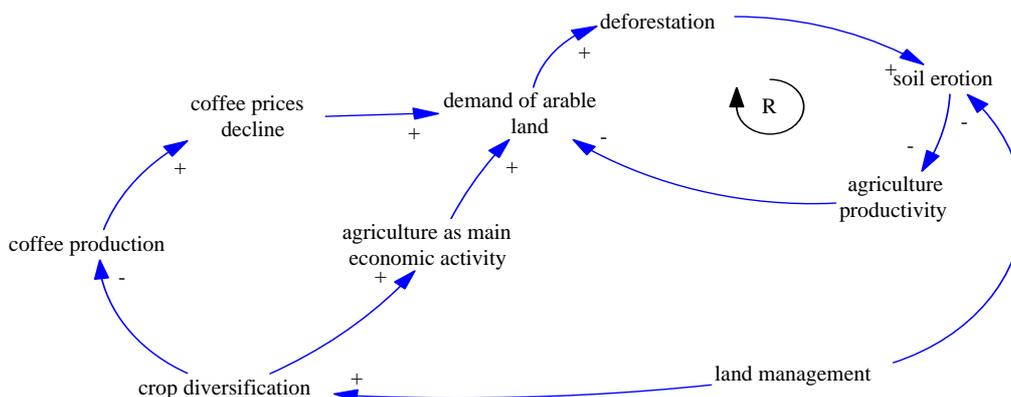
The above conceptual model shows that soil erosion affects both small-scale production, as well as landowner's productive areas. A decrease in soil fertility will reduce the productive land available for agriculture. Therefore, the agriculture land demand will increase and consequently deforestation too. If more forest is cleared, the productive area suitable for coffee cultivation will increase. This is illustrated by the two balancing loops.

Once both productive areas are enlarged, coffee production will augment and therefore coffee prices will decline, resulting in lower income generation for both, small-scale producers and landowners. However, given the small-scale producers' lack of capital, prices will be lower because their production is sold after the harvest. This is a reinforcing relationship.

As prices are reduced, more agriculture land is required in order to maintain small-scale producer's income and landowners' profit levels in the face of declining returns from coffee. As a result, the productive land area is increased, which leads to more coffee production and thus a reduction in coffee prices. This is a reinforcing loop.

The thick arrows designate the difference in magnitude in both the land clearing process and coffee produced. This is considering the productive area available in relation to a family unit.

### (CLD) 3. Agricultural Land Demand including Land Management Plan

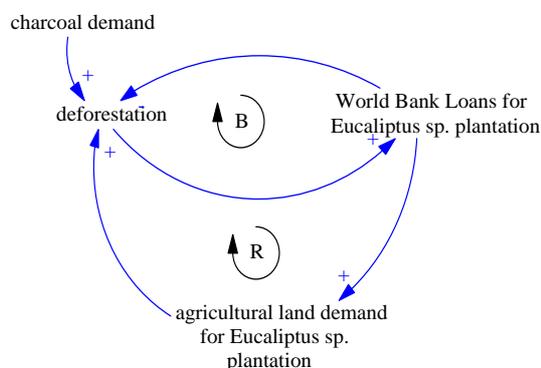


Land management techniques, part of the land management strategy, are predictable to improve soil quality and therefore contribute to slow soil erosion. On the other hand, the land management plan will encourage crop diversification and therefore agriculture as the principal economic activity in the region.

At the same time, agricultural diversification, besides coffee production, is expected to reduce coffee cultivation. However, because the Brazilian agriculture has usually increased production via area expansion, a diversification into other types of crops probably will not reduce the demand for agricultural land.

Consequently, deforestation is expected to increase, contributing unavoidably to soil erosion and thereby a decrease in soil fertility aggravating agricultural productivity, which in turn will demand more arable land, creating a reinforcing connection.

### (CLD) 4. Fixes that fail, The World Bank's loans for *Eucaliptus sp.* plantation



The World Bank's financial support for fuel wood trees plantation is expected to reduce deforestation since the charcoal demand will be supplied with cultivated trees instead of native forest. However, as *Eucalyptus sp.* plantation is encouraged more land for trees cultivation is required leading to deforestation instead of preventing it. This is a typical example of how a political decision considered to be a solution for a problem is paradoxically a contribution to exacerbate it. Finally, charcoal demand still persists as a driving force of deforestation with the addition of an extra deforestation force not expected.

It is interesting to note that this pattern is actually reproduced in some other examples of the World Bank policies. For instance, loans given to promote biodiversity protection increase the burden of the foreign debt of the country and therefore the country obligation of foreign exchange, which in turn generates a demand of export crops such as coffee, which, as shown, provokes deforestation, soils erosion and an important loss of biodiversity

## Tables

**Table 1. Coffee benefited -Harvest 2003/2004-**

*Final Production*

Coffee Regions (Minas Gerais)	Productivity bags/ha
Sul/Oeste	24.22
Triângulo Alto Paranaíba	28.81
Zona da Mata/Jequitinhonha	19.66

Source: CONVÊNIO: MAPA S.P.C./CONABA. Adapted from Ministério da Agricultura, Pecuária e Abastecimento (Ministry of Agriculture, Cattle breeding and Supplying), [www.agricultura.gov.br](http://www.agricultura.gov.br), access October 27, 2003

**Table 2. Exports by exporting countries to all destinations August 2003**

60 kilo-bags	Aug-03	Oct-02 to Aug-03	Sep-02 to Aug-03	Aug-02	Oct-01 to Aug-02	Sep-01 to Aug-02
Brazil	1,860.950	24,912.759	27,681.676	2,873.137	23,207.680	25,512.645

Source: International Coffee Organization (ICO)  
Adapted from International Coffee Organization (ICO), [www.ico.org](http://www.ico.org), access October 27, 2003

**Table 3. Principal Agricultural Products of Muriaé Region (2002)**

Product	Harvested area (ha)	Production (t)	Average Yield (Kg/ha)
Irrigated rice covered by shell	400	1,600	4,000
'Varzea' rice covered by shell	140	420	3,000
Banana *	160	1,920	12,000
English Potato (3rd	2	2	1,000

harvest)			
Sugar Cane	170	10,200	60,000
Coffee	1,700	2,550	1,500
Beans (1st harvest)	250	150	600
Beans (2nd harvest)	400	240	600
Orange tress (1)	170	2,510	14,764.71
Cassava	80	960	12,000
Corn	500	1,500	3,000
Tomato	9	450	50,000

Source: (IBGE) Brazilian Institute of Geography and Statistics

(1) Thousand of fruit production and fruits yield/ha

(2) Thousand of bunch and bunch yield/ha

Adapted from Assambléia Legislativa do Estado de Minas Gerais, 'Legislative Assembly of Minas Gerais', [www.almg.gov.br](http://www.almg.gov.br), access October 27, 2003.

**Table 4. Scale and Substitution Effects in 'Zona da Mata' Region, Minas Gerais, 1985-1995/96**

Zona da Mata	Area 1985 (ha)	Area 1995/96 (ha)	Area Variation (ha) (%)		*Scale Effect (ha)	**Substitution Effect (ha)	***Indicator
Pastures	106,125	372,809	266,684	25.29	16,562	250,122	<b>214.7</b>
Fodder	18,375	37,751	19,376	105.45	2,868	16,509	<b>14.8</b>
Orange trees	2,754	4,234	1,480	53.72	430	1,050	<b>0.90</b>
Tomato	662	1,630	968	146.19	103	864	<b>0.74</b>
Banana	4,540	5,824	1,284	28.29	709	576	<b>0.49</b>
Pineapple	9	13	4	41.54	1	2	<b>0.002</b>
Wheat	0	1	1		0	1	<b>0.001</b>
Cotton	18	3	-15	-85.39	3	-18	<b>-0.01</b>
Peanut	122	131	9	7.24	19	-10	<b>-0.01</b>
Onion	319	210	-109	-34.02	50	-158	<b>-0.13</b>
Pumpkin	560	473	-87	-15.62	87	-175	<b>-0.15</b>
Soy	204	51	-153	-74.95	32	-185	<b>-0.16</b>
English potato	272	47	-225	-82.84	42	-268	<b>-0.23</b>
Sweet potato	615	96	-519	-84.31	96	-615	<b>-0.53</b>
Cassava	3,668	2,828	-840	-22.89	572	-1,412	<b>-1.21</b>
Coffee	<b>157,715</b>	<b>170,191</b>	<b>12,476</b>	<b>7.91</b>	<b>24,613</b>	<b>-12,137</b>	<b>-10.4</b>
Sugar Cane	56,286	40,847	-15,439	-27.43	8,784	-24,223	<b>-20.8</b>
Beans	114,046	86,289	-27,757	-24.34	17,798	-45,555	<b>-39.1</b>
Rice	78,677	23,348	-55,329	-70.32	12,278	-67,607	<b>-58.5</b>
Corn	201,290	115,941	-85,349	-42.40	31,413	-116,761	<b>-100</b>
<b>Total</b>	<b>746,257</b>	<b>862,716</b>	<b>116,459</b>	<b>15.61</b>	<b>-</b>	<b>-</b>	<b>-</b>

Source: Faria et al., 2002.

\* Positive values denote an expansion in the cultivated area while negative ones represent a contraction of the area.

\*\*A positive substitution effect means that the crop substitutes others. On the contrary, a negative value signifies that others are replacing the crop or that the crop grew slower than the system.

\*\*\* Negative values indicate a reduction of the cultivated area, the replacement of the crop or that the crop grew slower than the system (ibid)

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