Success factors and constrains of community based ecosystem management – A case study of the voisin rotational grazing system in a rural community in Brazil

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Success factors and constrains of community based ecosystem management – A case study of the voisin rotational grazing system in a rural community in Brazil

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ABREVIATIONS

AnC	Agritourism Association Hosted in Cologne
AGRECO	Rural state agency
APP	Permanent preservation areas
CCA	Centre of Agricultural Sciences
CBC	Community based conservation
CSOs	Civil society organizations
UFSC	Federal University of Santa Catarina
EPAGRI	Rural state Agency
ECOCERT	Organic certification organization
GHGs	Green House Gases
GIEE	Gund Institute for Ecological Economics
GPVoisin	Voisin grazing group
INMETRO	Brazilian Ministry of agriculture and the national institute of metrology, quality and technology
RL	Legal reserve
PES	Payment for ecosystem services
PRONAF	National program for strengthening family farming
UVM	University of Vermont
VRG	Voisin rotational grazing
NGO’s	Non-governmental organizations
WUR	Wageningen University

Preface

The choice of the field of my Master thesis research was preceded by a four month internship period at ZALF (Leibniz Centre for Agricultural Landscape - Germany). During this period I was working in a project called CiVi.net, a European Union project which deals with the “capacity of Civil Society Organizations (CSOs) and their networks in community based environmental management”, focusing in four case study areas in Latin America (Brazil and Costa Rica).

After the internship period, I found myself very interested in the project approach – “action research approach” – as well as in the initiatives taken in place in the projects case studies regions, and I sought to understand how community based environmental management works in practice.
Additionally, immediately after the internship period, I had the opportunity to join the project team to the first case study visit in Brazil (as part of the project team), and after that I extended my stay in Brazil where I conducted my research with the focus on one of the four projects case study regions that is located in the South of the country.

The realization of this research was possible due to the support of several people and institutions.
First, I would like to express my sincere gratitude to Dolf de Groot - my internship and thesis supervisor - who connected me to the Civi.net project.
My gratitude is extensive to all CiVi.net family members spread in Europe, Brazil and Costa Rica, specifically to Claudia, Barbara and Tim for their support and feedback whenever I asked for it. A very special thanks goes to Gissu for the unconditional support and to Professor Abdon who besides the daily supervision and arrangements for the realization of the field work, also connected me to other people from UFSC who helped me during my staying in Brazil, including the members of the GPVoisin - Jociel, Juliano and Luiz - and Professors Fantini and Cibele. I also would like to express my gratitude to my WUR colleagues, to my family and friends, particularly to my parents, my Godmother Eduarda and to Laruscas.

Last but not least, my gratitude goes to the Ford Foundation who made it possible for me to pursue my M.Sc degree from Wageningen University.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

Summary

Santa Catarina State is located in the centre of the Atlantic Forest in Brazil, which although considered one of the richest ecosystems in terms of the planet's biological diversity, is also one of the most endangered (Cruz *et al.*, 2007). The forested areas are threatened mainly by the traditional management practices developed in the region through contamination from pesticides resulting from the tobacco industry, expansion of pine trees monoculture, and expansion of pasture in small properties. These activities also result in negative impacts in the maintenance of ecosystem services associated with its conservation at the landscape scale.

Because farmers are the major holders of the remaining Atlantic Forest Biome (Schitt et. al., 2011), and understanding that livestock is one of the management practices that has an outstanding social and economic importance in most properties (Farley et al., 2011), sustainable livestock production practices and less environmental impact strategies can be seen as essential to maintain and recover the remaining biome (Farley et al., 2011; Schmitt et al., 2011).

Since 1998 the voisin system, a dairy farming technique that divides pasture land into different paddocks, developing rotational grazing, has been implemented in the Encostas da Serra Geral region as an alternative for the traditional cattle grazing based on semi confinement. Many stakeholders including farmers, political leaders and the scientific community have been involved in this transition process and the majority of them claim that the adoption of the VRG system has brought several improvements in case study area.

Influenced by these claims the CiVi.net project considers that the voisin system adopted in the case study region might be an example of a successful community based ecosystem management (CBEM) initiative. However, there are ambiguities regarding the criteria used by the CiVi.net project to classify this system as “successful”. Similarly, there is no clarity whether farmer’s management practices under the voisin system are in accordance or fulfil the essential elements to be considered CBEM.

Because no studies that link the voisin system (as employed in the region) to community based ecosystem management were found in literature, this study provides such a contribution by analysing the reasons for the adoption of the voisin system in the region, the success factors of the system in the region, and the CBEM elements under the voisin system management practices. To reach these goals five research questions were formulated, namely: RQ1: which key ecosystem services can be identified in the study area?; RQ2: What are the drivers that led to the adoption of the voisin system in the case study region?; RQ3: What political and institutional factors characterized the transition from the traditional milk production to Voisin in the case study area?; RQ4: What environmental and socio-economic changes are perceived by the farmers as a result of the adoption of voisin system? and; RQ5:What are the community based ecosystem management elements (if any) of the voisin system management practices?

To answer the research questions a methodology based on the triangulation approach was used, by combining different analytical methods - such as the Ecosystem Services Assessment (ES), stakeholder and institutional analysis, and the DPSIR framework – and different data sources, including literature review which was supported by a field work period where semi-structured interviews, a stakeholder workshop, and participant observations were conducted.

The main findings of the research include the identification of 19 ES in the region, which its maintenance is threatened by the traditional management practices developed in the region. The DPSIR framework was used to identify these management practices, the pressures they exert, and

consequent impacts. Measures taken in the region to mitigate the impacts of these practices were subsequently analysed. These measures include the switch from traditional practices to more agro-ecologic ones, including the production of green organic products, the development of Eco-tourism, and the replacement from the traditional way of cattle grazing to the voisin system. A stakeholder and institutional analysis was conducted and nine stakeholder groups were identified as part of the voisin system network, although their interests, roles, and degree of importance have varied over time.

Socio-economic and environmental impacts of the voisin system where also addressed, and according to farmers' perceptions, there are great environmental changes that are translated in improvements on biodiversity (amount and diversity of species), soil and water quality, and in the reduction of climate variability. Similarly, farmers perceive several socio-economic benefits, including the increase in production and productivity, resulting from the increased pasture support capacity, increase in cattle size, reduction of animal disease, and reduction of costs. These factors lead to the increase of farmers' income and consequently an increase in family welfare.

Finally, strong CBEM were found under the voisin system management practices, however this system is a technology developed in the private domain of the farmer, and the decision to adopt it or not is entirely dependent on the farmer himself and not necessarily involve the whole community as often happens in CBEM initiatives.

The main fragilities encountered this research were firstly, the fact that most of the information obtained during field work was merely qualitative based on farmers' perception; secondly, the sample size was rather small, only 19 farmers were interviewed in a universe of approximately 300 farmers living in the region; and finally, the fact that only farmers who implement the voisin system in their properties were interviewed hence, a control group lacked to ensure the reliability of the results achieved.

Two key conclusions were reached with this study, namely: (1) the voisin system is indeed an example of success in the region, if one takes into consideration farmers' perception in relation to the environmental and socio-economic changes (improvements) after its adoption; and (2) despite the fact that solid CBEM elements were found, the land property rights are private, which results that the voisin system cannot be considered CBEM initiative.

Chapter 1. Introduction

1.1 Background

In the last decades there has been much attention, globally, to the importance of the relationships between human beings and the ecosystem and how these can be managed to achieve sustainable development. This focus has heightened in the last years as climate change occurs and there is evidence that these variations may have adverse impacts on the lives and livelihoods of the most vulnerable populations unless natural resources management is prioritized. Human well-being depends fundamentally on the variety of natural resources and the services they provide. Ecosystem services (ES) are conventionally defined as the human benefits provided by natural ecosystems and include the capacity of those systems to reproduce or replenish themselves (Farley et.al, 2012). Humans depend on ES for their activities and at the same time human activities influence and change ES provision and often cause environmental problems (ZALF, 2011). As a consequence it is inevitable to incorporate and address these dynamic interactions between the human beings and the natural systems (Berkes, 2004).

According to the Millennium Ecosystem Assessment (MEA, 2005) natural resources management is required to enhance the contribution of ecosystems to human well-being without affecting their long-term capacity to provide services. Talles et al. (2007) argues that the main idea of the MEA is that the human condition is tightly linked to environmental condition which suggests that conservation and development projects should be able to achieve both ecological and social progress without detracting from their primary objectives. Other authors also argued about the link between ES and sustainable development, mainly the development to reduce rural poverty. Talles et al. (2007) suggest two ways where ES can contribute to both nature conservation and sustainable development. Firstly, by developing payment schemes, for example, payment for ecosystem services (PES)[1]; and secondly by stimulating projects with a focus on both nature conservation and improvement of rural poor welfare by developing markets for the goods and services that local people produce or extract from ecosystems. These projects could be characterized as more ‘‘community based’’ because their goal is to foster more organic or grassroots development of small business, such as ecotourism, the production of bush meat, or non-timber forest products, which are enhanced by better protection of local ecosystems (Talles et al., 2007). The focus of this study research will be on the latter approach.

Community Based Ecosystem Management (CBEM)[2] is one of the various characterizations given for projects of this nature. It rises from the co-existence of people and nature, and refers to actions developed by the local communities (including decision-making processes using participatory approaches) with the final aim of natural resource management. According to Berkes (2007),iin general, local communities benefit in different ways from CBEM initiatives, once they have the possibility to improve their socio-ecological environment.

[1] PES - accounting of ES and a better understanding of how and at what rates ecosystems producing these services can be used to motivate payment for nature conservation. For example, if rural poor are asked to take actions that reduce farm productivity to protect and regulate water supply, those farmers could be compensated for the reduced productivity they experience (Tallis, 2007).

[2] Several articles found in literature provides different designations - such as community based conservation, integrated conservation, community based management, ecosystem management, community based natural resource management, ecosystem management, community based forest management and others – to describe processes with more or less the same characteristics (socio-economic, political, ecological, etc.), with the final aim of nature resource management. Because the focus of the present research is on the ecosystems, here the term in use will be community based ecosystem management (CBEM).

In the field of agriculture, there is an increasing trend of changing from traditional practices which have negative economic impacts; such as high production costs as well as negative impacts on ecosystem conservation which may cause problems such as deforestation, soil erosion and groundwater contamination among others, to more sustainable ones. One example of this change is the adoption of agro-ecology which can successfully couple agriculture with conservation (Farley et. al., 2012). Agro-ecological systems can be defined as (natural) ecosystems that have been deliberately simplified by people for the purpose of production of specific goods of value to humans (Swift et. al., 2004). When properly managed, agro-ecological systems can generate ecosystem services, in addition to goods and products (Surdi, 2011).

The concentration of this research will be on the voisin rotational grazing (VRG) system, an agro-ecological practice adopted by rural communities in southern Brazil since 1998, as an alternative to the traditional (extensive) cattle grazing system. Amongst other advantages, the VRG system provides economic benefits for the farmers such as increasing net primary production and reduction of production costs, as well as in the context of ES provisions, for instance, by promoting better nutrient cycling, improvement of soil quality, more carbon storage *inter alia*, which in the long-run may contribute to the mitigation of the climate change (Surdi, 2011). This study analysis the causes and impacts of the adoption of the voisin system in the case study region, in a CBEM perspective. According to POLIS (2011) ecosystem management is a key element in any strategy to support community economic development and to protect critical ecosystems. In this way, this research will address the role of the local community in ecosystem management.

1.2. Context and delineation of the research

The CiVi.net project

This thesis is inspired by a project called CiVi.net[3] initiated in October 2011 with a three years duration as an initiative developed by ZALF[4] in cooperation with four Civil Society Organizations (CSOs) from Latin America and three Research Technology Development (RTDs) performers from Europe (see description of the CiVi.net partners in annex 1) .

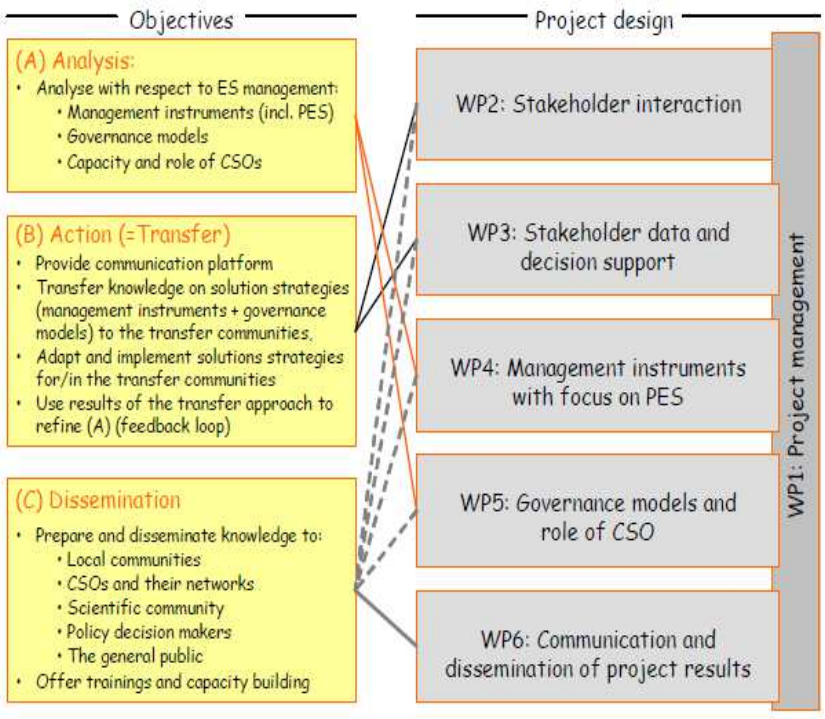
Fundamentally, the CiVi.net project deals with the "capacity of Civil Society Organizations (CSOs) and their networks in community based environmental management" focusing on four case study areas in Latin America (Brazil and Costa Rica), where successful community based management solutions worked out. As stated in the project proposal, "the aim of the project is to analyze, transfer and disseminate successful and sustainable community based solutions with regard to ecosystem service management" (ZALF, 2011). Essentially, each case study area (designed original case study area) has its own "successful solution", best practices, which are intended to be transferred to other(s) communities (transfer region) facing a similar challenges (annex 2 - table summarizing the civi.net case study areas).

The CiVi.net project has three main objectives, analysis, action and dissemination, which are aimed to be achieved step by step through the different project Work Packages (WPs), as illustrated in the figure below:

[3] The project is sponsored by the European Union

[4] Leibniz Centre for Agricultural Landscape Research, Germany

Figure 1: Main contributions of the work packages to the objectives of the CiVi.net project (ZALF, 2010)



It is important to refer that the figure above provides an overview of the complexities and interconnections within the CiVi.net project (objectives and work packages roles) and this thesis will only be developed in the scope of the work package 2 (WP2) - stakeholder interaction.
In this WP, a field work trip took place by the project partners, in order to attain more insights about the communities in study, to get know the stakeholders, and to understand their views and their willingness to cooperate in the process of knowledge transfer of their successful solution. Although the project has four case study areas, the focus of this research will only be in one of them, which is located in the Southern Brazil in a region called Encostas da Serra Geral.

1.4. Problem Statement

Fourteen years after the adoption of the Voisin rotational grazing (VRG) system, an alternative for the traditional cattle grazing (based on semi-confinement) which proved to be unsustainable, most of the stakeholders involved in the transition process and those who joined later - including farmers, political leaders and the scientific community - claim that the adoption of the VRG system brought several improvements in the Encostas da Serra Geral region.Influenced by these claims the CiVi.net project considers that the voisin system adopted in the case study region might be an example of a successful community based ecosystem management initiative. However, there are ambiguities regarding the criteria used by the CiVi.net project to classify this system as “successful”. Similarly, there is no clarity whether the farmer’s management practices under the voisin system are in accordance or fulfil the essential elements to be considered community based ecosystem management.

Because no studies that link the voisin system - as employed in the region – to community based ecosystem management were found in literature, hereby I intend to provide a contribution by analysing three main aspects:
(a) The reasons for the adoption of the voisin system in the region;

(b) The factors that determined the success of the Voisin system in the region; and
(c) The CBEM elements (if any) of the voisin system management practices

1.5. Purpose of the study and research questions

This research aims to analyse (i) why the voisin was adopted in the region, (ii) if the voisin system is indeed successful, (iii) to identify the main factors that define the voisin system management practices as community based ecosystem management.

In order to achieve this aims, the following research questions have been designed:
RQ 1: which key ecosystem services can be identified in the study area?
RQ 2: what are the drivers that led to the adoption of the voisin system in the case study region?
RQ 3: What political and institutional factors characterized the transition from the traditional milk production system to the voisin system in the case study area?
RQ 4: What environmental and socio-economic changes are perceived by the farmers as a result of the adoption of voisin system?
4a: Which Ecosystem services are perceived by the farmers as being generated or improved after the transition from the traditional milk production to the voisin system in the case study area?
4b: What socio-economic changes are perceived by the stakeholders as result of the transition from the traditional milk production to voisin system in the case study area?
RQ 5: What are the community based ecosystem management elements of the voisin system management practices?

1.6. Theoretical Framework

Before focusing on the analysis to answer the research questions it is useful to elaborate some definitions associated with the concept Community Based Ecosystem Management, the different and interrelated concepts. This conceptualization has the intention to provide the reader with an overview of these aspects for a better understanding of the rationality behind the research.

1.6.1. Important concepts

As stated in above (in the point 1.2), the Civi.net project envisages to investigate community based (environmental) management. Because this concept is very broad and susceptible to different interpretations, here key elements will be defined, under the perspective of the CiVi.net.

Environmental Management: interactive acting between the fronts

Environmental management can have different meanings. In literature, it is often linked to conservation. According to Schröter (2012), conservation is a goal of environmental management hence CiVi.net project treats this term equally, in the sense that the conservation approach is adapted to the environmental system management approach. The most publicly visible environmental management activities are those with regards to climate change Schröter (2012). Since the Brundtland Report, in 1987 published by the United Nation´s World Commission on Environment and Development (WCED), the first Earth Summit in 1992, and the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, climate change presents a continuous topic in the international political agenda. In the aforementioned conferences, the participating nations discussed this environmental problem and have been searching ever since for strategies on how to manage it (Schröter, 2012)

Environmental management generally covers three dimensions namely:

(a) *International and national* - at a first glance, it appears to be an international approach of environmental management, conducted by commitments on carbon dioxide (CO_2) emission reduction strategies negotiated by different countries. On a second glance, the national level becomes clearer as some states are not willing to support certain solutions and abide by agreements decided in the international forums. This is mainly because states are not always convinced about certain strategies or because they have their own agenda's which are not always in line with international environmental management practices;

(b) *State and society* - using the example of the climate conferences as a field of interaction, parties in the final negotiation processes are representatives of the state´s national governments. Nevertheless, there are a number of other actors involved, mainly non-governmental organizations (NGOs) as representatives of the civil society – civil society organizations (CSO) [5]. They latter act as advocates for those without voice or whose voices are usually not heard during decision making processes. CSO's campaign to change politician's, entrepreneur's and people's opinions and their decisions about issues they face and also provide solving strategies, they also play a crucial role as they usually have much knowledge of the issues they advocate for. CSO's are a kind of think-tank, who bring in their expertise in consulting politicians, addressing the media, publishing or lobbying (Brunnengräber 2011:25). The NGOs themselves are operating on different levels, being transnational, national or even smaller local organizations, this to say, they operate in a globalized world (Schröter, 2012).

(c) *Top-down and bottom-up* - which leads to the ever present question: Which was first, the hen or the egg? However, to foster environmental management using a bottom-up approach is a newer approach arising in the second part of the 20th century (Schröter, 2012). Initiatives from local people to form coalitions in order to start a green movement are often seen as the start of community-based management (World Resource Institute, 2011). It can be seen as a reaction to a top-down idea, that effective conservation can only be achieved through the hand of the state, the market, or through private property rights. This is why national parks and protected areas were created. Successful management mechanisms by local people in the past have been forgotten or lost.

Community

The most important element of community based management is the existence of a community. A community can be defined as social groups of any size whose members reside in a specific locality, share a government, and often have a common cultural and historical heritage (Reference Dictionary[6]). In traditional social science it is described as a small spatial unit with a homogeneous social structure where common interests and shared norms prevail (Agrawal and Gibson, 1999). However in reality, communities rarely are homogenous structures. Areas may be inhabited by multiple different stakeholders and power relations may lead to inequalities and conflict (Agrawal & Gibson, 1999). According to Agrawal and Gibson (1999), three aspects that can be used to define community, these being: (1) the spatial unit; (2) the social structure; and (3) shared norms.

For successful conservation management at community level most researchers propose that the community should be small in terms of area and number of individuals, and should be territorially attached. But defining the size of community brings a lot of problems in practice as the geographical

[5] Civil Society organizations (CSO's) - are the advocacies for those who have no voice or whose voice is not heard. They campaign to change politician´s, entrepreneur´s and people´s minds and their decisions about the problems and solving strategies and finally because of their huge knowledge they are a kind of think-tank, to bring in their expertise in consulting politicians, addressing the media, publishing or lobbying (Brunnengräber 2011:25). In the 1980s, the state recognized the economic advantage of CSO in engaging in environmental problem solution. Because they are cheaper and closer to the people they should be more active than the state who could downsize the state apparatus (Berghöfer/Berghöfer, 2006:84).

[6] http://dictionary.reference.com/browse/community

spread of resources can be larger than the community, and more than one community can live near the resource and have interests, property rights, or control over the resource. The Civi.net project approach avoids taking the whole community hence only focuses on one group with the same interests and shared norms, specifically, the norms that advocate ecosystem service conservation. As being subject to the same norms, the community will be able to prohibit actions of ecosystem destruction and promote cooperative decision-making amongst all stakeholders (Schröter, 2012).

Participation

The idea of community-based management leads to the term participation. Therefore the community should in some way participate in environmental management. Participation means involvement of all relevant stakeholders in a certain process, being management or decision making. It can be part of the top-down approach by including local people in co-option and consultation. Their special knowledge is recognized and is asked to be incorporated into the process. However, local people are not always necessarily considered as active agents. They would be active agents if they took part in management and decision-making processes[7], if they had the power to take decisions and to veto against decisions taken by the other stakeholder. This leads to the term of empowerment, a "process by which people, especially poor people, are enabled to take more control over their own lives and secure a better livelihood with ownership of productive assets as one key element" (Chambers 1993, cited as Brown 2002). Connecting knowledge and decision-taking is a means and end on its own. Stakeholders should take action, take decisions, influence policy makers and implement decisions. They should be able to change the political and social context they live in.

In consequence, participation and development are two aspects that should go hand-in-hand. "Political participation is not assumed anymore to be the fruit of higher stages of development (i.e. a luxury of the well-fed and educated), but it is considered a necessary ingredient, even a pre-condition to development in a more holistic sense" (Berghöfer/Berghöfer 2006: 83). However, participation does not automatically mean that a there is an effective management of a project, decision or action (Berghöfer/Berghöfer, 2006: 101).

According to Berghöfer/Berghöfer(2006:90), participation should be analyzed around four axes of differentiation to obtain a complete picture of the situation: 1) "Who participates?"; 2) "In what dimension?"; 3) "How"?; and 4) "For what purpose"? An explanation about what is aimed by these questions is provided below based on Schröter (2012):

1) *"Who participates?"* tries to identify the participants, namely the communities, institutions or stakeholders. Depending on the socio-economic background, the participants will take part in a different manner. A discussion with representatives of a community council will be different to one with fishermen of the community. Further questions to be taken into consideration or to be solved would be: How can stakeholders be identified? Who are the poor or the marginalized? Who is excluded? What makes a community? What are the limitations of a place? And so on.

2) *"In what dimension?"* means in which participants are taking part in different things, for example in elections or local politics, in evaluation of project proposals, in developing local tourism or in social activities such as playing football or simply living in the same village. This leads to the identification of four dimensions of participation: political participation, project participation, economic participation and social participation. Further questions would be: In what dimensions of social life can people participate? How to relate these various dimensions? What effect does the project as a frame have on the process?

3) "*How does the process of participation take place?"* five sub-groups or sub-axes have to be considered:

[7] Definition of participation in the Oxford English dictionary: http://oxforddictionaries.com/definition/participation?q=participation

- The type of facilitation/initiation/ leadership: external facilitation, “insider” or local facilitation, traditional leadership, self-governed process, conjoint leadership, invited, elected, nominated, selected, claimed, coerced, voluntary, etc.,
- The way in which one becomes a participant: by invitation, election, nomination, selection, claim, coercion, volunteering, own initiative etc.;
- The activities in which one participates: information sharing, learning, defining the problem, decision-making, discussion, evaluation, planning, implementation, working, etc.;
- The form/rules of the activities: informal, formal, pre-defined, adaptive, imported, endemic, etc. and;
- Consideration of difference and conflict: consensus orientated, negotiation orientated, majority vote, etc.

1) *“What is the purpose of participation?”* this is the most difficult question to answer as it is quite subjective and depends on the perspective taken. And there is an infinite number of possible answers. Further important questions are: What is stated and what remains un-stated? What is intended and what is achieved? Can the intended aim be reached by the adopted strategies? What is “full participation”? What is the difference between perspectives from “above” and from “below”? For what/why are people empowered? Who decides what is empowering and what not? , amongst others.

Berghöfer/Berghöfer (2006: 101) similarly conclude that in the analysis of participation, some topics such as (a) the property of important rules and institutions, (b) the balance between process and output, (c) the role of the facilitator, and (d) the assumptions about procedural justness should be treated with special consideration and attention.

Community Based Management

The roots for community based management can be found in a call for social justice and environmental management. Arguments such as communities ‘know better’ as well as the trend towards neo-liberalism are named as drivers for development (Berner & Philips, 2005).

Community-Based conservation (CBC) is built on the idea that if conservation[8] and development could be simultaneously achieved, the interests of both could be served. It has been controversial because community development objectives are not necessarily in line with conservation objectives in a given case (Berkes, 2004). There is a belief that the interests of local communities and the goals of conservation are contradictory because conservation requires protection of threatened resources such as pastures, fisheries, forests, irrigation flows, wildlife, and drinking water (Hardin, 1968). On the other hand Agrawal and Gibson (1999) state that “local communities rely on these resources for their livelihood and therefore will exploit them without restraint” (Agrawal & Gibson, 1999). So there is a positive and negative view on why communities should be included in environmental conservation, because they have more exact local knowledge or because they may make use if resources in an unsustainable manner if they are not included in the management process. In including them, they could become overseers giving them some benefits as incentives. Berkes (2004) calls this the “conservation dilemma”. Either, conservation is pursued independently of local resources use and livelihood needs, or local users are integrated as allies for conservation while at the same time producing community benefits. Development and conservation go together in this point of view. Blaikie and Jeanernaud (1997), cited by Brown (2002), distinguish three conservation paradigms: the classic approach, the populist approach, and the neo-liberal approach. The first sees local people as a threat to biodiversity and conservation, the second sees participation and empowerment of local people as a key of finding solutions for sustainable environmental use, and

[8] Conservation - is a social and political process by which natural resources, including forests, are managed to maintain biodiversity (Alarcon, ?)

the third sees the solution in adding economic value to biodiversity to mitigate institutional, market and policy failures.

Property rights

For several years it has been stated by conservationists that "secure" tenure rights are crucial components for community based conservation initiatives (Lynch & Alcorn, 1994). Tenure is often described as a relation between people and property when in fact it is more a way of defining social relations between people (Lynch & Alcorn, 1994). Tenure gives people certain types of social status for example, whether they are allowed to use certain resources or not. It can be an intervention with a lot of interconnections affecting communities on different levels. Tenure rights can be held by different parties such as state, a corporation, an individual, a family clan, a neighborhood or a community. Rights often are trans-boundary and mostly overlap and contain temporal, spatial, demographic and legal dimensions. For example natural resources may include rights of direct and indirect use, rights of control, symbolic right, indirect economic gain, and rights of transfer (Smajgl & Larson, 2007). The concept of resource tenure is built on institutional norms regularizing people's ownership and access which are based on different kinds of normative systems such as informal social relations and formal jurisdictional norms (Lynch & Alcorn, 1994).

According to Feder & Feny (1991) Berkes et. al. (1989), four land property rights regimes can be distinguished, namely:

(i) Communal property – the resource is held by an identifiable community of users who can exclude others and regulate use (allocates exclusive rights to a group of individuals);

(ii) Open access (or none) - absence of well- defined property rights. Access is free and open to all (rights are left unassigned);

(iii) State property or state governance (or crown) - assigns management of the land/resource to the authority of the public sector. The government has the right of exclusivity and they control access and the level of exploitation.

(iv) Private property – when an individual or corporation has the right to exclude others from using the resource and to regulate its use (the rights are assigned to an individual.

These four categories are ideal analytical types. However, in practice, resources are often held in overlapping combinations of these four regimes and there is variation within each (Berkes et. al., 1989). For instance, if a group of exclusive communal rights is large, the differentiation between communal and open access become small. If in the case of private property the rights are not being seen as legitimate or are not properly applied, it can become an open access area. Additionally, the same area can be categorized under more than one category. For example, in several societies, some or all land is by law the property of the state, but if exclusive use rights are given under contractual arrangement with the state to individuals for a long term duration, the difference towards private property becomes minor (Feder & Feny, 1991). The advantage of private community-based property rights over public community-based property rights is an often increase in local control and an often decrease in the need for governmental regulation.

1.7. Intended Audience

Since this report is part of the Master study program of Environmental Sciences, at the University of Wageningen, at the first stage the intended audience are the examiners and supervisors of the Master thesis – in the System Analysis chair group - for the evaluation of the author's ability to conduct scientific research. At the same time, it is hoped that this work will be of interest to the CiVi.net project and other projects with the same nature (focus in CBEM), as well as to other students and scientists interested in the proposed topic.

1.8. Structure of the report

The report consists of eight chapters. In the first chapter, the background information is given together with the study objectives and research questions as a basis of the findings and discussion.
The second chapter describes the methodology used to answer the research questions, followed by the chapter three where is provided detailed information about the case study region. Chapter four, provides the characterization of the human population of the study, jointly with stakeholder analysis.
Chapter five describes the socio-economic and environmental impacts of the management practices under the voisin system and the chapter six addresses to what extent can the voisin system, as employed in the case study region, can be considered a successful CBEM initiative.
Chapter seven provides the discussion of several aspects of the research and finally chapter eight provides the main conclusions and recommendations of the study.

Chapter 2. Research Methodology

This part of the study describes the scientific base of the research. Three analytical frameworks (DPSIR framework, function analysis and stakeholder's analysis) were used to analyse, discuss and present the data obtained. These were supported by a combination of various data collection methods (literature review, participant observation, stakeholder workshop and semi-structured interviews) used to generate the data and answer the research questions. The research frameworks and the respective data collection methods are described below.

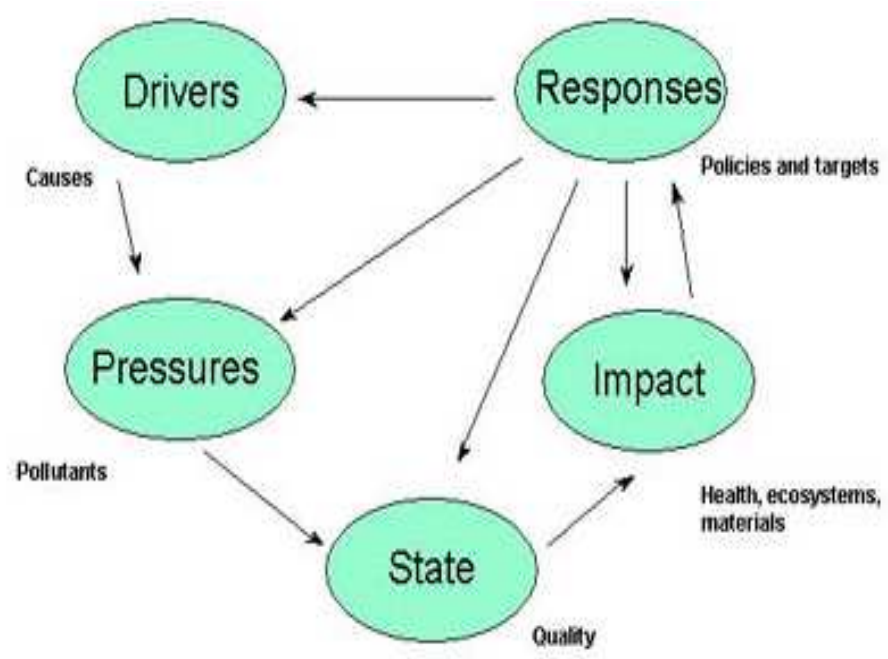
2.1. Research frameworks

2.1.1. DPSIR Framework

The DPSIR framework is a tool used by regional or global organizations such as the European Environment Agency (EEA), which have adopted it as a general protocol to tackle environmental issues (EEA, 1999).

The DPSIR Framework establishes the cause- effect relations between the driving forces (economic sectors, human activities) that exert pressures (emissions, depletions) to states (physical, biological, chemical) resulting in impacts (on ecosystem, human health, functions) that eventually draw political responses (prioritisation, target setting, indicators). Therefore, the DPSIR Framework provides an important overview to policy makers on the resultant impacts on environmental quality as a result of politic choices made or to be made in the future (Kristensen, 2004). The DPSIR Framework is used in this research fundamentally to summarize, the main driving forces and pressures behind the adoption of the voisin system - already one of the responses.

Figure 2: DPSIR framework (Kristensen, 2004)



2.1.2. Ecosystem Services Assessment

The ecosystem approach links people, their needs with the natural systems. Ecosystems are a vital source of goods and services that are crucial for sustaining life on earth.
Ecosystem goods (such as food) and services (such as waste assimilation) [9] represent the benefits human populations derive, directly or indirectly, from ecosystem functions (Costanza, et. al, 1997).

The Millennium Ecosystem Assessment[10] (MA, 2005) enabled the scientific progress of the ES concept, applied to the assessment of the planet's ecosystems. The MA links ecosystems to human well-being, identifies drivers of change and indicates the existence of spatial and time scales (Arends, 2012).
Based on the MA, the TEEB[11] (The Economic of Ecosystem and Biodiversity) study was initiated, it unifies ecologists and economists in the economic valuation of ecosystem services.

Ecosystem function analysis is defined as *the capacity of natural processes and components to provide goods and services that satisfy human needs* (de Groot, 1992). When addressing ecosystem functions, goods and services four main categories can be identified, according to the TEEB database (adapted by de Groot, 2011):

(1) *Provisioning services* (= production and some Carrier functions) – which are products obtained from ecosystems, such as water, food, fibre, medicines, genetic material, and ornamental resources;

(2) *Regulating Services (*= Regulation Functions*)* – direct benefits obtained from the regulation of ecosystem processes, incl. climate regulation, water purification and biological control;

(3) *Habitat services* (= Habitat and some Supporting Functions) - importance of ecosystems for gene pool protection and nursery (underpinning other life support functions such as photosynthesis, biogeochemical cycling, soil formation and evolutionary processes);

(4) *Cultural & Amenity Services* (= Information Functions) - these are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.

2.1.2.1. Linking ES and human needs

There is a reciprocal relationship between ecosystems and human activities (Cunningham&Cunningham 2009). The functions provided by ecosystems directly or indirectly influence human activities and vice versa (de Groot et al. 2010). Human needs and activities, are the physiological needs, for example, the use of oxygen, water, food, physical health, *inter alia*, and the psychological needs, for instance, the need of mental wellbeing, the freedom to establish social contacts and the need for safe future, for both present and future generations. In order to satisfy these necessities, human society and individual people engage in all sorts of activities, including agriculture, house-building, industry, transport, recreation amongst others (de Groot, 1992). However, these activities often result in environmental problems and therefore it is necessary careful planning and management of ecosystems and human activities in order to sustain a balanced relationship between human activities and the ecosystems, enabling its sustainability in the long term.
A framework showing the interconnections between the ecosystem, its functions and services and the benefit to human well-being is provided in the figure below, which translates the ecological complexity into a limited number of ecosystem (or landscape) functions, which, in turn, provide a range of goods and services to humans (de Groot, 2006).

[9] To simplify the analysis, ecosystem goods and services will be together referred as ecosystem services.
[10] http://www.maweb.org/en/index.aspx
[11] http://www.teebweb.org/

Figure 3: Framework for linking ecosystems to human wellbeing (adapted by de Groot et al. , 2010 from Haines –Young and Postchin)

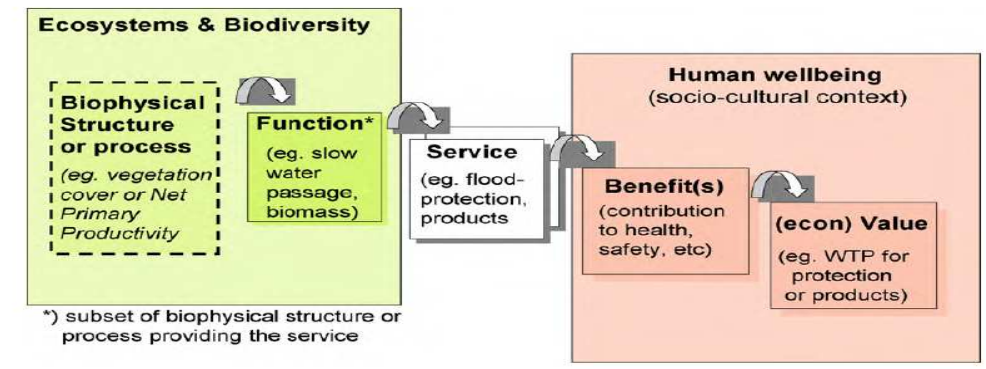


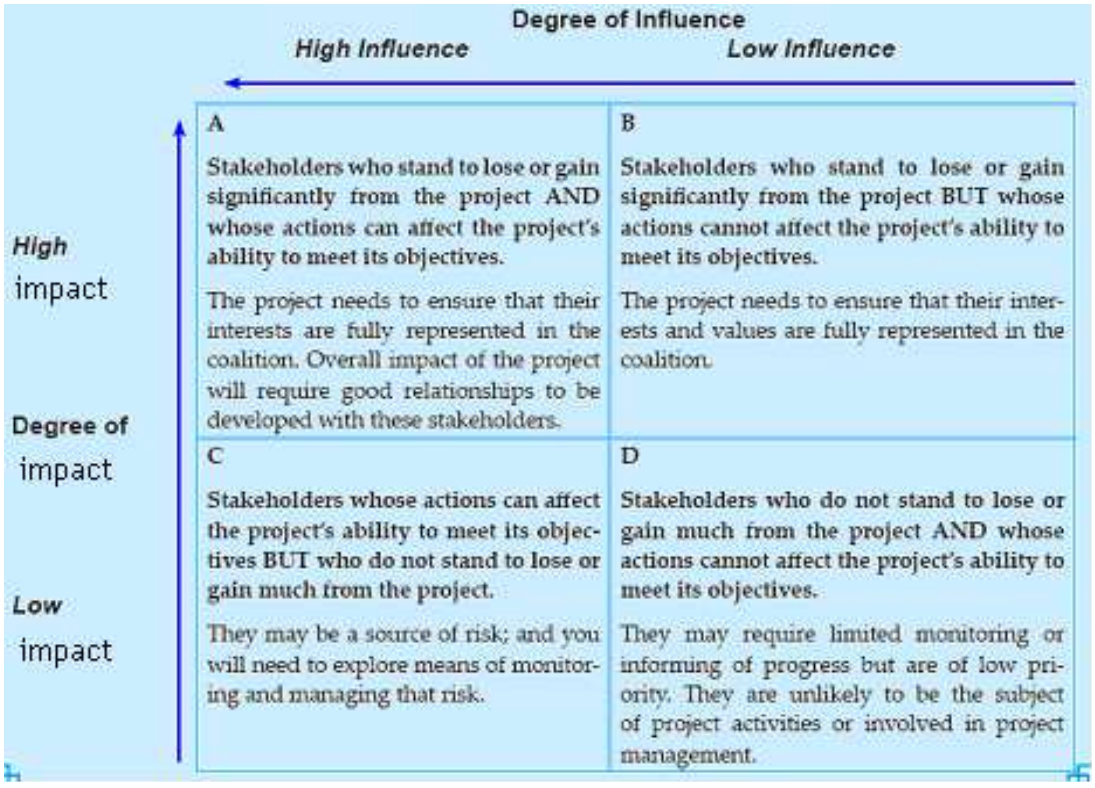
Figure 3, shows that ecosystem services are generated by ecosystem functions which in turn are supported by biophysical structures and processes. Ecosystem functions are thus intermediate between ecosystem processes and services. Real use of a good or service provides benefits (nutrition, health, pleasure, etc.) which in turn can be valued in economic terms and monetary terms (de Groot et.al 2010).
This study do not focus on the valuation (economic and monetary), but on identifying and describing the ecosystem services existing in the study area and the impacts of the management practices developed by the local communities on the ecosystems provision and mateinance.

2.1.3. Stakeholder Analysis

Stakeholders are in general defined as actors (individuals, groups or institutions) that have a concern or interest in an issue, project or program, affecting or being affected by a potential decision-making regarding the issue. In the scope of the integrated ecosystem assessment, de Groot (2006) outlines stakeholders as a person, organization, or group with interests in an issue or particular natural resources.
According to the same author, stakeholder analysis is a system for collecting information about such groups of people, categorizing them, and explaining the possible conflicts that may exist between important groups and areas where trade-offs may be possible (de Groot, 2006). Brown et. al (2001) in turn, define stakeholder analysis as a systemic way of generating information from or collecting information about a group or individuals that are affected by decisions, and the categorisation and analysis of the information to determine the potential impacts of the decisions on the individuals' interests and the conflicts that may exist among the groups.
It is important to conduct a stakeholder analysis, because this tool can be used to generate knowledge about the relevant actors as well as to understand their behavior, intentions, interrelations, agendas, interests, and the influence or resources they have brought – or could bring – to bear on decision-making processes (Brugha and Varvasovszky, 2000).

In this research study, stakeholders are analysed with the aim of determining their roles/responsibilities, and hence their degree of influence on the decision making process under the implantation of the VRG within the case study area. The analysis is made in three main steps: identification, prioritization and involvement of the stakeholders. Different groups of stakeholders are identified, similarly as in figure 8: primary stakeholders – group of people located in cells A and B; secondary stakeholders - groups of people located in cells A and C; and external stakeholders – those located in the cells C and D.

Figure 4: Stakeholder's prioritization (de Groot et al., 2006)



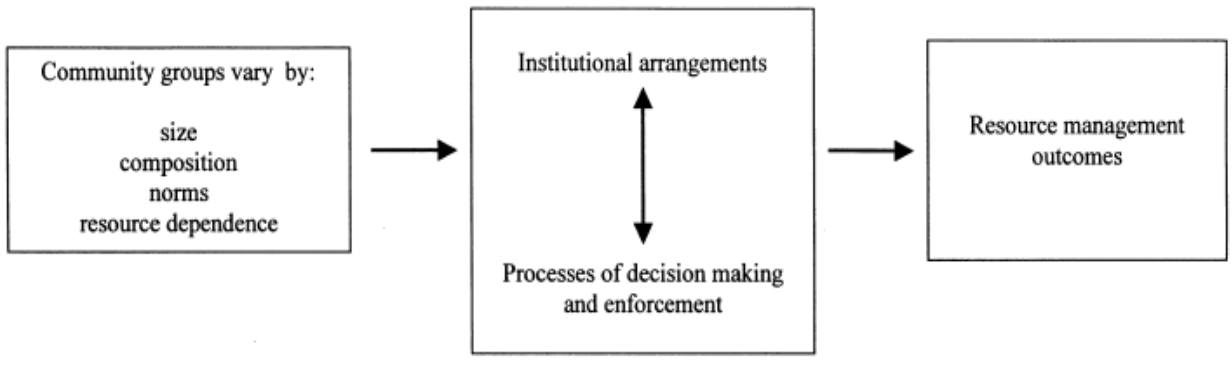
2.1.4. Institutional analysis

Institutions are defined by Imperial (1999) as an enduring regulatory of human action structured by rules or shared strategies and the realities of the physical and biological world. Leach et al. (1999), in turn sees institutions not as the rules themselves, but as regularized patterns of behaviour that emerge from underlying structures or sets of rules in use. Institutions include families, churches, government agencies and most organizations since they are frequently defined in terms of rules, norms or shared strategies. Institutional analysis is an attempt to examine a problem that a group of individiduals (organizations) face and how the rules they adopt address a problem(s) (Imperial, 1999).The institutional analysis is a useful tool when analysing CBEM, because it considers and examines:

- multiple actors within a community
- multiple interests within a community
- influence of actors in the decision making process
- internal/external institutions that shape de decision making process

This analysis "requires identifying the possible multiple and overlapping rules, the groups and individuals affected by such rules, and the processes by which the particular sets of rules change in a given situation" (Agrawal/Gibson 1999:638). The proposed model looks like the following:

Figure 5: a view of community and conservation (Agrawal/Gibson, 1999)

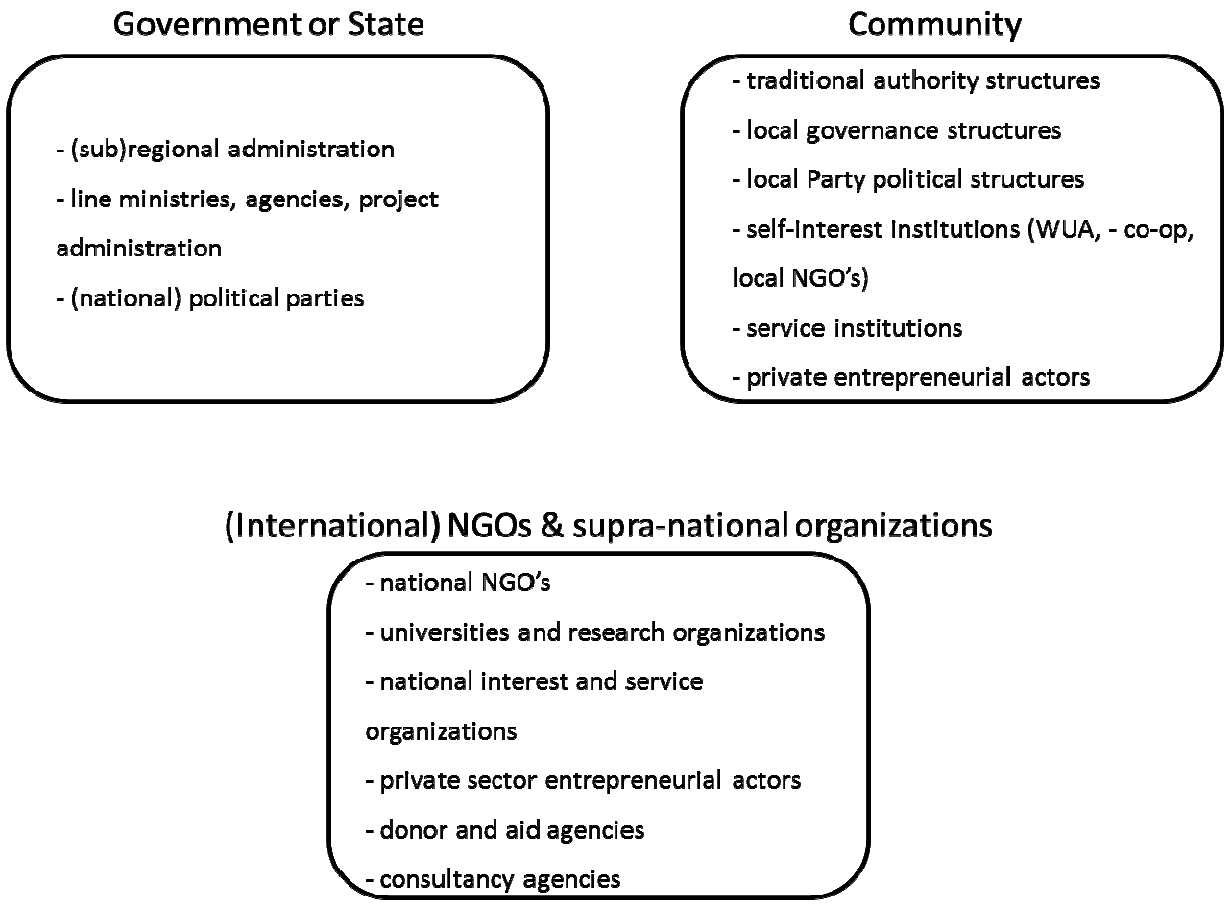


Institutions are very dynamic and they involve different actors, scales and they can act formally or informally to influence the decision making process.

Institutional actors

An analysis of who is involved in which decision-making level is important. Three pillars can be set: community, government and state, and NGOs and supra-national organizations (figure 8). These pillars can be organized in various ways with different types of actors.

Figure 6: Actors within communities (ZALF, 2011)



Institutional scales

In addition, when analyzing CBEM, the different levels in which decision making can take place play an important role. Decision making in CBM can take place on different levels. The way this decision making is constructed will define the power relations and can influence the degree of effectiveness of CBM.

Formal and informal institutions

Formal institutions may be considered as rules that require exogenous enforcement by a third-party organization. For instance, the rule of law; usually upheld by the state through organizational means such as law courts, prisons and so forth. Informal institutions, however, may be endogenously enforced, they are supported by mutual agreement among the social actors involved, or by relations of power and authority between them (Leach, 1999).

2.2. Data collection and analysis

This part of the study describes how data was collected during this research. Data was collected using the triangulation of methods, where the preliminary information was obtained through desk study, which was further complemented by field research. The data obtained include official and internal documents of the CiVi.net project and other published and unpublished information related to the topic under study, including reports, articles, papers, information from websites among others.

The field work period took three months and the majority of the information obtained was qualitative based on (individual and group) interviews, a stakeholder's workshop[12], oral histories and participant observation.

An overview of the research questions, the research methods and data collection methods is provided in the table x below:

[12] The stakeholder workshop took place on the 10th February, promoted by the CiVi.net project team with the participation of 38 people (including farmers from different municipalities of the Encostas da Serra Geral region and other relevant stakeholders).

Table 1: Research questions, analytical and data collection methods

RESEARCH QUESTIONS	METHODS			DATA COLLECTION			
	Ecosystem Services Assessment	Stakeholder & Institutional analysis	DPSIR Framework	Literature review	Interviews	Stakeholder workshop	Participant observations
1. Which key ecosystem services can be identified in the study area?	✓			✓			✓
2.What are the drivers that led to the adoption of the voisin system in the case study region?			✓	✓	✓		
3.What political and institutional factors characterized the transition from the traditional milk production to Voisin in the case study area?		✓	✓	✓	✓	✓	
4.What environmental and socio-economic changes are perceived by the farmers as a result of the adoption of voisin system?				✓	✓		
5. What are the community based ecosystem management elements (if any) of the voisin system management practices				✓	✓		✓

2.2.1. Interviews design and sample selection

Interviews were conducted in a 7 days period (from 9 until 15th April) to 30 stakeholders, 19 of them being farmers which adopted the VRG system.
Two different interviews were created, one for the farmers and the other for the other stakeholders (experts). Both interviews have more or less the same content, although for farmers more specific and easier questions were designed to make sure that all farmers could understand the questions.

In total, the interviews for the farmers contained several questions which were designed to create a profile of each individual farm by extracting data on the background, socio economic, political and environmental aspects of the transition from the traditional to the VRG system and questions related to the CBEM elements of this transition. The questions centred on three primary sections:
(1) Background: general information about the stakeholders, such as characterization of the farmer (name, age, dairy house he works with), and property (size, property rights, economic activities);
(2) Factors that determined the transition: (a) socio economic factors including changes in production and productivity, farmers income, hours of labour, family well fare; (b) assessment of ES, where questions referring to changes in soil, water and biodiversity were asked and (c) political/

institutional where questions regarding the stakeholders and interactions or conflicts among them where asked.
(3) CBEM elements of the transition.
Interviews for the other stakeholders had more or less the same structure, although a bit more general and the main focus was in (1) how the process occurred, (2) what their involvement was, and (3) their perception about the CBEM elements of the process.

For both farmers and other stakeholders, semi-structured questions were designed with the specific aim of getting the required response in the most efficient and easily manner. The selection of the farmers was made with the support of the technicians of the municipality and a Professor from UFSC (my local supervisor in Brazil) who initially provided me a list of all farmers that implanted the voisin system in their properties (around 45) since the beginning of the project. From this list, farmers were contacted by phone calls, or by a short visit to their properties to make an appointment. Due to time limitation and also because not all farmers from this list were available, it was only possible to interview 19 of them.

The selection of the other stakeholders to be interviewed was done based on the preliminary information acquired from the CiVi.net project during my internship period in ZALF, in combination with the observations in the field during the stakeholders workshop's and informal conversations with the local people regarding the role of the institutions in the process.

All the data collected was combined together to extract qualitative and (where possible) quantitative information. Written notes and audio recordings taken in the field, originally in Portuguese, were later translated and codified.

It is important to refer that with the data obtained it was not possible to prove co-relations in a quantitative way, since the sample size is too small and it was not possible to prove causality between one variable and another (in a quantitative way).
To facilitate the narrative I frequently refer to population distributions using verbal qualifiers: "almost all" (90–100% of referred population), "most" (60–90%), "many" (40–60%), "some" (10–40%), "a few" (0–10%), as inferred by the information I managed to collect from the interviewees.

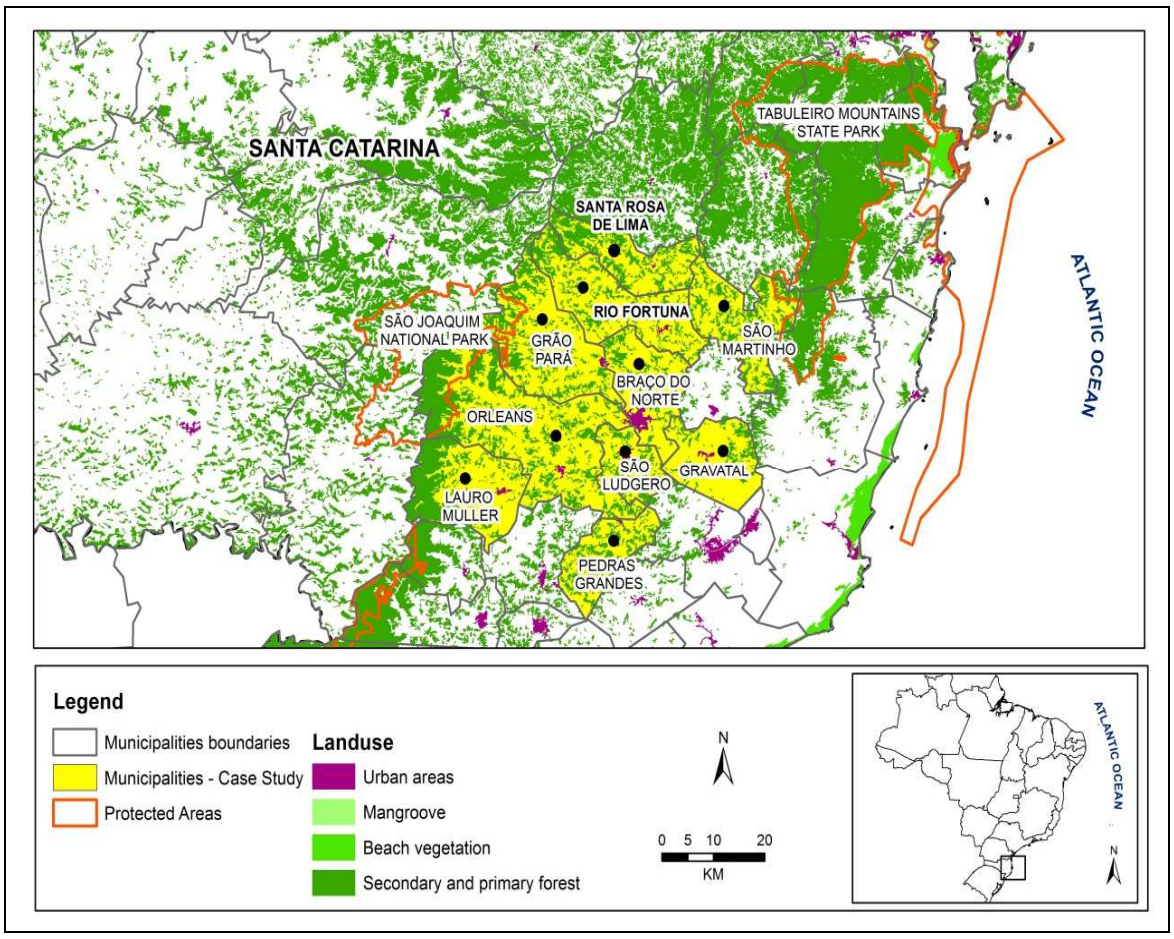
Chapter 3. Study Area

In this section, a description of the main features of the study region is given focusing on the historic-cultural, socio-economic aspects, including the assessment of the Ecosystem Services found in the region. Additionally an overview of the main production system and its environmental and legal impacts, in order to provide the panoramic situation that culminated with the adoption of the voisin rotational grazing system.

3.1. Encostas da Serra Geral

Encostas da Serra Geral is located in the south of Santa Catarina, and comprises of 10 municipalities: Santa Rosa de Lima, São Ludgero, Orleans, Lauro Muller, Pedras Grandes, Grão Pará, Gravatal, Rio Fortuna, São Martinho e Braço do Norte (figure 9) (Alarcon, 2011).

Figure 7: Map of Encostas da Serra Geral region, Santa Catarina (Alarcon, 2011)



The region is extremely rich in terms of biodiversity. It is located between the coastal mountains and the Brazilian Southern Plateau, with altitudes varying from 200 up to 1000 meters, which a 1800mm of annual rainfall.

The area was originally fully covered by the Atlantic Forest *stricto sensus*, considered one of the ten top world hotspots of biodiversity. Nowadays, less than 13% of it is left and fragmentation is the highest threat to the maintenance of species diversity and ecosystem services provision (Alarcon, 2012).The region is **c**onsidered strategic for the preservation of natural resources, since it is located

in a future ecological corridor[13] connecting two Conservation Units - Sao Joaquim National park and Tabuleiro Mountains state park (figure 7).

3.2. Ecosystem Services Assessment

Encostas da Serra Geral is inserted in the Atlantic forest biome (rain forest) where there are also several sub-biomes including wetlands, lakes and rivers, woodland and scrubland, grassland/ rangeland, cultivated among others. Several ecosystem services were identified and categorized as showed in the table below:

Table 2: Overview of the ES of the case study area (adapted from Costanza et. al (2007), de Groot et al. (2002), MA (2005))

Service typology	Description of the Ecosystem Service
I. PROVISIONING SERVICES 1.Food	Agricultural products, including vegetables, dairy products, fish, orchard products, food for grazing animals
2.Water	Water for irrigation and other agricultural uses, household and industrial uses. Drinking water from wells
3.Raw materials	Wood from agro-forestry, biomass, reed from marshlands and other water bodies
4.Genetic resources	Wild varieties of cultivated species for crop improvement
II. REGULATING SERVICES 5.Air quality regulation	Filtering of fine dust, removal of chemicals and allergens
6.Climate regulation	Temperature regulation, CO2 sequestration
7.Moderation of extreme events	Natural flood protection and prevention
8.Regulation of water flows	Maintenance of natural hydrology, natural drainage and removal of excess water, natural irrigation
9.Waste treatment	Water purification, removal from excess nutrients, chemicals and biological pathogens
10.Erosion prevention	Wind breakage, roots keeping soil together
11.Maintenance of soil fertility	Soil (re)generation and preservation
12.Biological control	Control of pests and diseases, maintenance of biological balance
13.Pollination	For reproduction of plants and crops
III. HABITAT SERVICES 14.Maintenance of life cycles of migratory species	Nursery service, habitat for (migratory) species for feeding, breeding and resting.
15.Maintenance of genetic diversity	Habitat for biodiversity
IV. CULTURAL AND AMENITY SERVICES 16.Aesthetic information	Appreciated scenery of landscape enjoyment
17.Opportunities for recreation & tourism	Recreation & eco-tourism
18.Inspiration for culture, art and design	Cultural events (e.g.: Gemusse festival)
19.Information for cognitive development	Research opportunities, school trips

[13] Future ecological corridor -The study area is located between major areas of environmental protection and acts as a future ecological corridor connecting the remaining of the Atlantic Forest, which provides a strategic location for the conservation of biodiversity. The official creation of this ecological corridor is under debate at the Ministry of Environment, in Brasília (Alarcon, 2011)

The table above provides an overview on the main ES identified in the study region, also providing a general description of each of them.
Most of these ES result from the existence of the Atlantic forest (tropical forest) which is well known for its biodiversity richness, the capacity to store and sequester carbon, water regulation, scenic beauty and cultural services.

Looking specifically at grassland/ rangeland and woodland and shrub land sub-biomes where the voisin system is developed - cattle grazing system - the following ES were identified:

***Provision services*:** meat and milk production

***Regulating services*:** flood control; water quality control; carbon storage and climate regulation through greenhouse gas emissions; disease regulation; and waste treatment (e.g. nutrients, pesticides).

***Habitat services*:** genetic biodiversity for use in breeding crops and livestock, nutrient cycling and the provision of water.

***Cultural services**:* scenic beauty, education, recreation and tourism, as well as traditional use. Agricultural places or products are often used in traditional rituals and customs that bond human communities. Conservation of biodiversity may also be considered a cultural ecosystem service influenced by agriculture, since most cultures recognize appreciation of nature as an explicit human value. In return, biodiversity can contribute a variety of supporting services to agro ecosystems and surrounding ecosystems (Daily, 1997).

However, these ES and the services they provide are being greatly threatened by management practices developed in the region. These include the destruction of native forests, extensive cattle grazing systems, intensive chicken and pig creation, tobacco production, among others. In the next section these management practices, their impacts and some of the mitigation measures to respond to them will be addressed.

3.3. Atlantic forest biome and its biodiverse richness

The case study area is located within the Atlantic forest biome. This biome has an area of 1,315,460 square kilometres, comprising 17 States and corresponding to approximately 15% of the Brazilian territory (SOS MATA ATLANTICA and INPE, 2009b).
The Atlantic forest biome is characterized as a set of forest formations, such as the rain forest (dense, mixed and open), semi deciduous seasonal forest and deciduous tropical forest, mangroves, sandbanks, grassland, wetlands which compose heterogenic and biodiversity (Dubois, 2008). According to SCDB (2010), it is expected that the remains of the Atlantic forest contain up to 8% of all terrestrial species.
The Atlantic Forest is designated as a World Biosphere Reserve and as one of the top 5 world biodiversity hotspots, as many flora and fauna species are highly endangered and endemic to this biome (CiVi.net report, 2012). Its richness in biodiversity is so expressive that it presents the largest botanical diversity per hectare for woody plants in the world. The world record was registered in Bahia State, where in a single hectare 454 species were found (SOS MATA ATLÂNTICA and INPE, 2009b). According to Stehmann et al. (2009), the vascular plants found in Atlantic forest, representing 14,552 6,933 species (47.7%) are endemic, for instance, almost half of the diversity of vascular plants belong to that biome, which represents approximately 2% of the total number of plant species on the planet. In addition to the diversity of plants, the biome maintains approximately

849 bird species, 370 species of amphibians, 270 mammals and around 350 species of fish. Of vertebrates, almost 70% (118 species of birds, 16 amphibians, 38 mammals, and 13 species of reptiles) of endangered species are found in the remaining of the biome (Stehmann et al.; 2009).

Flora follows a similar pattern, with 472 species that integrate the official list of endangered species, 276 (> 50%) are from the Atlantic forest (Schaffer, 2010). From the 1711 vertebrate species existing in the Atlantic forest, 700 are endemic, being 55 of mammals' species, 188 of birds, 60 of reptiles, 90 of amphibians and 133 of fish. Of the approximately 20,000 plant species, 8,000 (40%) are also endemic (SOS MATA ATLÂNTICA, 2011c).

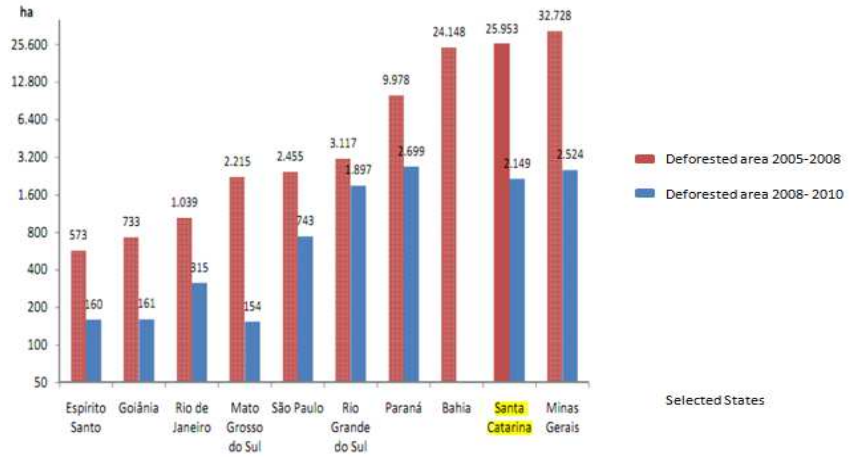
Nowadays, the biome is reduced to about 27% of its original area, including all stages of regeneration in all traits, however, only 7.91% of the remnants are relatively conserved (Schaffer, 2010), being the most endangered species of the ecosystem with Brazil (WWF, 2009).
Although the remnants are distributed in thousands of fragments, it is estimated that such a vegetation present levels of biodiversity of flora and fauna with ability to generate ecosystem services such water purification, flood regulation, nutrient cycling, and other invaluable ecosystem services, which some two-thirds of Brazil's population depends on the Atlantic forest for. Other nations depend on it for global services such as climate regulation and habitat for biodiversity (Farley et al, 2012). Failure to restore the system is likely to result in massive extinctions in the near future, destroying critical ecosystem services, many essential for agriculture. For example, deforestation, fragmentation, and poor management practices in the Atlantic Forest already contribute to higher temperatures, more fires, reduced water quality and supply, landslides, flooding, erosion, and reduced soil quality and nutrient cycling, all of which threaten agricultural output (Farley et al, 2012). The conservation of this biome and its ecosystems is a priority, based on its current critical situation, especially caused by deforestation, contamination by pesticides due to the tobacco industry, expansion of pine trees monoculture and expansion of pasture in small properties (Alarcon, 2011). Besides its environmental importance, the preservation of species that occur in these ecosystems is fundamental to the maintenance of local culture. The pinion, fruit of the main species of Araucaria forest – angustifolia araucaria or Brazilian pine - is historically inserted into food system in the region of the Serra Geral. Angustifolia araucaria is a critically endangered plant found only in southeastern Brazil and small parts of Argentina and Paraguay[14] (Orofino, 2011).

3.3.1. Atlantic forest biome and the Santa Catarina State

The whole State of Santa Catarina is located in the Atlantic forest biome, where the forest remnants are 23% (2,210,062 ha) of the State territory - being the highest percentage of Atlantic forest in relation to the original area (SOS Mata Atlantica and INPE, 2011a). However, the region shows the highest rates of deforestation in the last years (figure 8, below):

[14] Besides the southern states of Brazil (Paraná, Santa Catarina and Rio Grande do Sul), Atlantic forest also reaches portions of Paraguay and Argentina.

Figure 8: Deforestation of Atlantic Forest (MMA and Brazilian Forestry Service, 2010)



The figure shows that despite a reduction from 2005-2008, data for 2008-2010 still show that Santa Catarina is in the third position at the ranking of deforestation in ten selected States of the country. According to Schäffer (2010), only 2.8% of forest remnants are protected by conservation units in the State, which means that the vast majority (97.19%) of unprotected forest remnants are located in private small farms. The State of Santa Catarina has 1685.544 family farms, representing 87% of rural properties throughout the State (agricultural census; 2006). Therefore, the maintenance of this biome is closely related to practices developed by farmers of the region.

Cattle grazing are present in the region, occupying 62.6% of properties with up to 50 ha. In these properties, milk production is corresponding to 85% of the total production of the State (RODIGHERI et al., 2011). Much of the State's production units have some grazing area, either natural or planted. This panorama shows that any measure to improve the condition of forest remnants, should as a matter of priority, consider a collective action with family farmers (Surdi, 2011). Since farmers are the major holders of the remaining Atlantic Forest biome (Schmitt et al., 2011), and understanding that livestock has an outstanding social and economic importance in most properties (Farley et al., 2011), sustainable livestock production practices and less environmental impact strategies can be seen as essential to maintain and recover the remaining Biome (Farley et al., 2011; Schmitt et al., 2011).

3.4. Description of the legal settings

Brazil already has the legal apparatus to protect vital ecosystems and the services they provide (Martinelli & Filoso, 2009). Due to the fast speed of Atlantic Forest destruction, in 1965 the Brazilian government promulgated the second Forest Code[15] (first one was from 1934), restricting deforestation across the five Brazilian biomes (Alarcon, 2012).

As stated above, the land managed by farmers in the Encostas da Serra Geral region, is located in a very sensitive area, with altitudes varying from 120 until 1400 meters above the sea level. The main conservation instruments established within the Forest Code that interfered directly in private properties were the permanent preservation areas (PPA) and the legal forest reserves (LR).

[15] The Brazilian environmental legislation is based in the law 4.771 of 15 September so called Forest Code.

According to the PPA mandate farmers must set aside the riparian forest along the rivers and streams (minimum 30 meters), around springs (50 meters), in areas with declivity higher than 45 degrees or 100% and on the top of the hills.
Besides the PPA law, within the Atlantic Forest biome, farmers must have 20% of their property under Legal Reserve (LR), destined to forest management (conservation).
The main goal of these laws is the preservation of hydrological resources, geological stability, protect the soil, and ensure the well-being of human populations, maintenance of the fauna and flora gene flows and biodiversity conservation.
Nevertheless, the enforcement of such laws is still weak throughout the country, and some of the rural properties (often the small ones) do not have any protected area. However, although law enforcement is under intense debate in the country at present, the revision of some aspects of these laws, especially with regard to small farmers who are often left with an area too small for their activities has to be prioritized (Martinelli & Filoso, 2009).

3.5. Production systems in Santa Catarina State

The production chain of Santa Catarina is formed largely by production systems from the productive reconversion activities of pigs, poultry and annual crops (such as tobacco), which migrated to the dairy. This occurred mainly because of the instability of agricultural income, due to the requirement of production scale, technological improvement, climatic conditions, the downward trend in agricultural commodity prices and the loss of competitiveness for other agro industrial chains (EPAGRI, 2006). Thus, faced with the need to generate a steady stream of income in rural establishments and also intensifying demand from which milk is produced for industrial processing, dairy become an increasingly competitive market, leading to a rapid adaptation to new institutional policies of agribusiness implemented (EPAGRI, 2006).

In the Encostas da Serra Geral region, the production process has a similar pattern, although in a smaller scale. The traditional activities such as pig production, poultry, tobacco amongst others, have been gradually replaced to milk production from grazing cattle, which became one of the most predominant forms of agriculture practiced in the small farms.

The geographical location in combination of these different management practices, including the traditional way of cattle grazing for milk production brought some socio-economic, political and environmental restrictions that prevailed in the region in the last years. For instance the traditional cattle grazing system based on semi-confinement was dependent on high investments and only rich farmers could support it while the other farmers (majority) were facing problems due to low productivity. In addition, due to the increase of environmental monitoring - against the Atlantic forest deforestation - the expansion of pasture areas was restricted.

Pork production, also an important source of income, was stimulated by an integrated system with the installation of big enterprises in the neighbouring municipalities. Similarly, tobacco plantations were also fostered as an economic option with a better income for many small farmers. Big companies developed an integrated system, where the company provides the whole technological package to the farmers, who are supposed to plant and sell the tobacco to them for a certain price establish at the end of the harvest by the company (also known as out-grower schemes). The tobacco enterprises and the rural extension agencies also started to foster eucalyptus and pine tree plantation as an alternative to native wood and for income generation due to the proximity to the capital and important urban centres in the south (Alarcon, 2012).

The stimulation of all these agricultural activities, associated with investment of infrastructure in the region and the growing of market demand, resulted in the increase of environmental problems such

as pollution of the rivers, air and below ground water, and caused the slowly loss of native forest to eucalyptus and other agricultural activities, besides generating many social problems (Alarcon, 2012). Farley et al (2012) points that these traditional practices in the soil erosion on denuded pastures, pesticides and fertilizer application, use of rivers and springs as watering holes, and conversion of native forest to pasture all brought serious environmental impacts. In addition, economic returns are generally quite low, averaging only $10–$100 (USDs) per hectare per year.
The need to tackle these problems, associated with the political environment in place, boosted a movement of changes in the management practices, which resulted with the adoption of the Voisin rotational grazing system.

3.5.1. Voisin rotational grazing system

Voisin grazing is an agro-ecological[16] alternative for raising cattle for dairy or meat production (Alarcon, 2011). This technique, emphasizing the management of cattle, pastures and soil, was designed by the French researcher Andre Voisin in 1957 (Machado, 2004). The main objective of the voisin system is the maintenance of the balance of trinomial soil-grass-livestock, without a benefit of one at the expense of another (Melado 2003).
In a voisin system, dairy farm portable electric fencing is used to subdivide pastures into small areas called paddocks. Cows are moved to a fresh paddock once or twice a day. Grazed forage is the primary source of protein and energy for the cows, eliminating the need for feed crop production and its expensive, energy-demanding infrastructure.
Although rotational management of fields was already practiced, André Voisin was the one who established the system's principles through the four "universal laws of Rational Grazing", namely (Machado, 2004 & freitas, 2009):

1. Law of rest – After being cut by the animal's tooth, the forage plant should only be grazed again after a period of rest enough that she recovers. For instance, there is a period of rest after which grazing is in a position to be eaten, providing maximum yields.
2. Law of occupation – the time of animals on each parcel must be short enough so that the cattle do not cut twice on the same plant. Otherwise, the first law will not be fulfilled.
3. Law of maximum Income - It is necessary to help animals with higher nutritional requirements, so that they can reap greater amount of pasture and that this is of the highest possible quality.
4. Regular income Law – the animal must not be in the same paddock for more than 3 days and income will be maximized if the animal stays 1 day in each paddock, because as the grassland is grazed, the animal will reap increasingly smaller amounts of pasture and less nutritional value.

The number of paddocks needed depends on their recovery time after usage, which again depends on the local site conditions (e.g. soil quality, precipitation, etc.).
Water is pumped from rivers and streams to each paddock (figure 9). Hence riparian zones are fenced off and blocked for the animals. Voisin Grazing plans and calculates the whole process of grazing resulting in increased milk production with lower costs and labour to the producer (Oliveira, 2006).
This system allows optimal forage growth in the different paddocks and increases net primary production. Additionally, it promotes nutrient cycling and reduces the need for fertilizers (Surdi,

[16] Agro ecology is defined by Farley et al (2012) as the study, design, and management of agro ecosystems based on ecological principles, with particular attention to the needs of small farmers—is capable of increasing the production of both food and ecosystem services while reducing the use of harmful and expensive agricultural inputs. They are simpler than natural ecosystems and dependent on human action for their maintenance, nevertheless they retain many properties of natural ecosystems (Surdi, 2011).

2011). According to Alarcon (2011), under the VRG system, pastures store more carbon, improve soil quality, and help mitigate climate change.

Figure 9: Voisin rotational grazing system

The VRG system started being implanted in the Encostas da Serra Geral region, with the support from the local Federal University of Santa Catarina (UFSC) and in particular the Voisin Working Group (GPVoisin) based at UFSC.

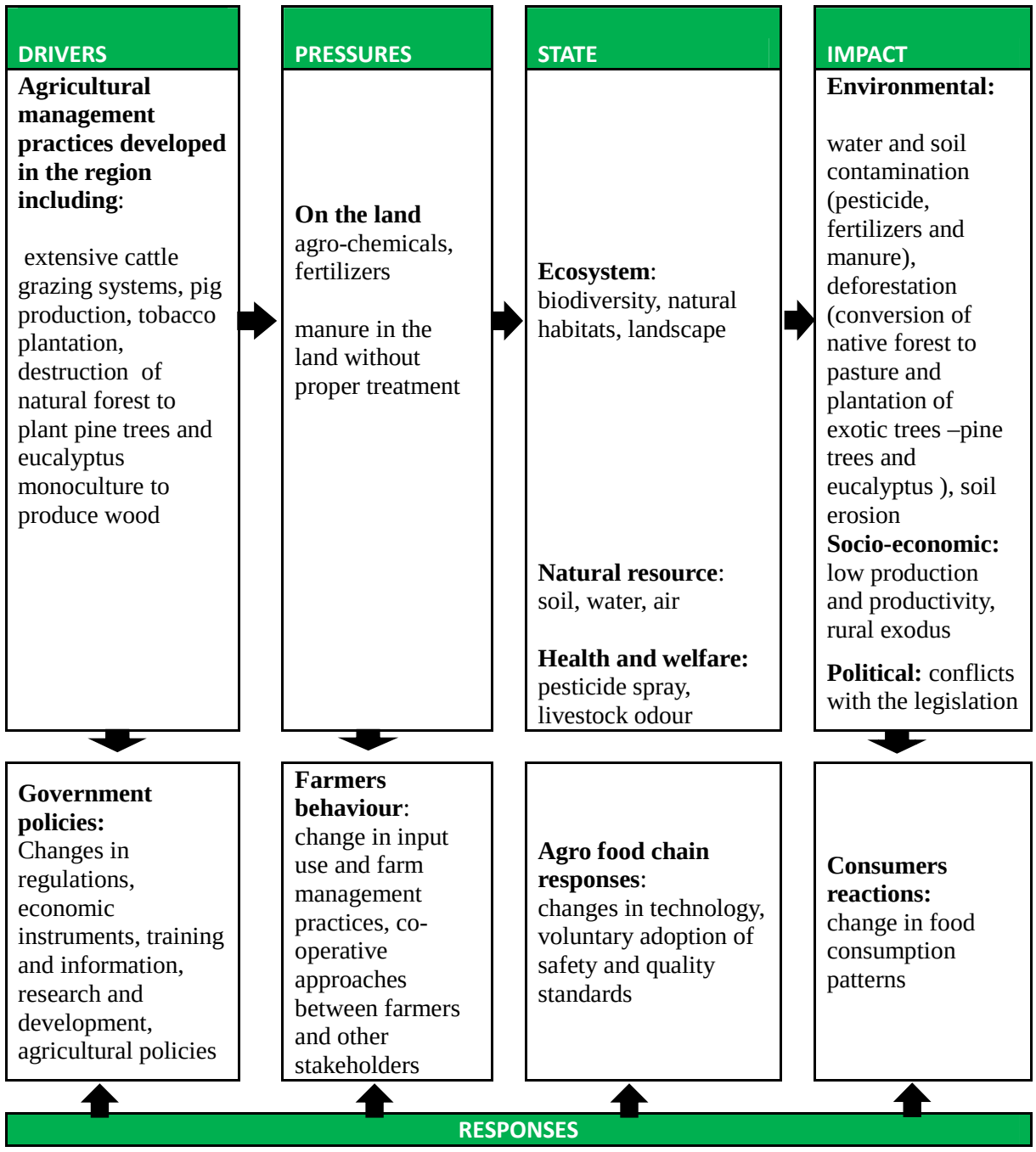
At present, about 480 families have the Voisin system in place on their farms throughout the region (CiVi.net report, 2012). Santa Rosa has a total of 370 farmers, of which around 45 implemented the VRG, since the beginning of the projects in 1998. Many of the farmers who have implemented the Voisin system in their properties have also taken additional efforts to improve the productivity of the pastures. They upgraded the basic Voisin system by spreading a variety of grass seeds (leguminous[17]) to improve the turf and/or planting grass species for which no seeds are available. More than 50% of the farms that have the Voisin basic system implemented improve the system through these kinds of activities (CiVi.net report, 2012).

[17] *Leguminosas* – are nitrogen fixing species (plants). They work as a sort of green fertilizer, favoring the increase in primary production of feed, animal performance and impacts on biological and chemical properties with the potential of carbon sequestration (carbon fixation) and reduction of GHG emission (due to the reduction of methane emission) (Barcellos, 2008).

3.6. DPSIR Framework

Within the DPSIR framework (figure 12) the voisin system can be seen as one of the responses taken in the case study region to address socio-economic and environmental problems faced.

Figure 10: DPSIR framework



As showed in the figure, the driving forces include extensive cattle grazing systems, chicken and pig produced intensively, expansion of pine trees and eucalyptus monocultures and tobacco production involving big enterprises. The goal of increasing productivity and consequently profits drives to the intensification of these practices which results in a pressure on the environment caused by pollution and contaminations. These changes have a degrading effect on the environment, such as water and

soil contamination (excessive use of pesticides and fertilizers, not proper treatment of manure), deforestation (conversion of native forest to pasture and plantation of exotic trees –pine trees and eucalyptus) and soil erosion. Similarly socio-economic problems such as rural exodus, and health problems, including depression (and even suicides in extreme cases), were registered, as result of the low production and productivity, since all these practices require great investments and only rich farmers could afford to maintain themselves in the activity. Several policy measures have been taking in place to mitigate these impacts. They include government policies (changes in regulations) - for instance the establishment of permanent preservation areas (APPs) and Legal reserve (RL), - changes in farmers behaviour translated in a switch in input use and farm management practices – production of organic green goods, development of eco-tourism activities and the adoption of the voisin system, - co-operative approaches between farmers and other stakeholders among others

Chapter 4. Characterization of the human population of the and stakeholder analysis

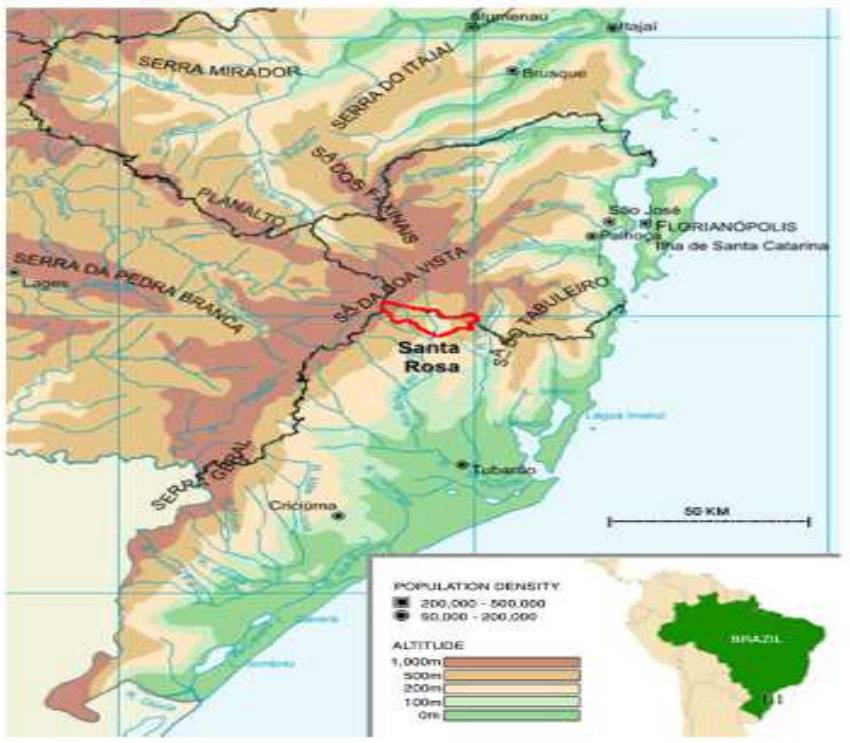
This chapter aims at answering the research question three “What political and institutional factors characterized the transition from the traditional milk production system to VRG in the case study area?” In order to answer this question, firstly is provided the description of the human population in the case study municipality followed by the stakeholder analysis.

4.1. Santa Rosa de Lima

The municipality of Santa Rosa de Lima (herein after Santa Rosa), has an area of 154 km2 and is located at the edge of the greater Brazilian *planalto* (mountain plateau), in a hilly area within the Atlantic forest biome. Altitude varies from 200m in the river valley to 1200m next to the mountains (Sierras), which literally separate Santa Rosa from the western *planalto* (Peñaranda & Kallis, 2010). Today, some 2000 people live in Santa Rosa and of this total, approximately 80% still resides in the countryside being occupied small family farms, scattered along the lower altitudes cultivating a variety of products for local and faraway markets (Peñaranda& Kallis, 2010). Most of these properties are located in rugged terrain, resulting on average in 60% of the area as unfit for agriculture (Müller, 2001).

The original vegetation consisted of dense rain forest and Araucaria Forest. Today, secondary forests prevail in the landscape of the municipality and the existing remnants of primary forest are mainly along the Serra Geral (Orofino, 2011). The community is 120km away from state capital Florianópolis (Fig. 10) and the region is characterized by its relative geographical isolation, as it is outside of any major road (Müller, 2001).

Figure 11: Location of the municipality of Santa Rosa and surrounding region in Santa Catarina state, Brazil (Peñaranda & Kallis, 2010)



Santa Rosa, as the other municipalities of the region, was colonized by European immigrants who arrived in Brazil in the twentieth century. Their agricultural activities were restricted by terrain, dense forest, and had lack of government support and geographical isolation, which in a way later assured its wealth in natural resources and scenic beauty.

The economy of Santa Rosa focuses on the primary sector. Predominant agricultural activity are performed in small family-based properties, including the temporary crops (maize, tobacco, sugarcane, cassava, beans, sweet potatoes, English potatoes and other products of subsistence), reforestation, the production of charcoal, fruit and livestock (cattle, pigs, poultry and sheep husbandry) (Orofino, 2011; SRL City Hall, 2009).

It is considered that the territory of the region is under construction, as there are several local initiatives for sustainable development (Orofino, 2011). Most families in this region are dedicated to agro-ecology and agro-tourism projects. Due to important ecological agriculture initiatives present in this territory, the Municipality of Santa Rosa received in 2007 the title of the Santa Catarina Capital of Agroecology, through a project approved by the Legislative Assembly of Santa Catarina (Weber, 2007). The presence of strong natural elements combined with colonial culture and traditional agriculture and ecological confers a unique landscape of the municipality – considered a reference in rural tourism in Brazil by the Ministry of tourism (Orofino, 2011).

Santa Rosa has a total of 370 family famers, of which 45 implemented the voisin system in their properties (SRL City Hall, 2012). Of these 45 about 5 abandoned the projects and from the remaining 40, 19 were interviewed corresponding to 47% of the total of farmers producing milk under the voisin in Santa Rosa. In the region, the land ownership rights are private, which gives the farmer autonomy to decide upon the activities he wants to develop in his property and the area of the property he wants to use, though there are some restrictions imposed by law, such as the requirement to keep the 20% area of legal reserve (RL) in the properties.

The distance from one farm to another is around 1km, and in general farmers own lands with an area ranging from 25 to 50 ha and the main activities undertaken by these farmers are cattle grazing (milk production), which is combined with other activities - reforestation for cutting wood, tobacco and pig creation - as complementary sources of income and also crop production for the family consumption. Farmers do not contract outsiders to work in their properties, hence women, men and children participate in the farm work, although children and women allocate less time in the fields because they also have to go to school and dedicate to household activities. Almost all of the farmers interviewed are working with the voisin system for more than 6 years and they are quite familiar with the system.

4.2. Stakeholder analysis

Nine important stakeholders group were chosen for this study, their role was initially analysed based on pre-information obtained through literature review. During field work period, interviews were conducted with the majority of them in order to acquire complementary information regarding their actual role in the transition process and the role they play at present. A description of these stakeholders and their roles is given below.

1. Farmers- There are three different groups of farmers. Those who implemented the VRG, those who kept in the traditional practices, including crop production (tobacco, sugarcane, rice, etc.), and those who are producing organic products and also engaged in agro-tourism. Farmers belonging in these three groups develop charcoal production for self-consumption[18] and forest monocultures for

[18] Previously natives trees were used to produce charcoal, but today it is only allowed to produce wood from exotic species

wood production as an additional source of income. The target group in this research are the farmers who implanted the voisin system.

2. **Voisin Grazing Group (GPvoisin)** [19] – This group was created in 1998 in the Federal University of Santa Catarina - UFSC[20] in the centre of agricultural sciences (CCA). Since its creation the GPvoisin implemented more than 900 projects on family farms in 58 municipal districts in Santa Catarina state. GPvoisin activities in Santa Rosa started in the year 2000 and at the beginning the groups' activities depended only on voluntary engagement of students, for instance, students did not have any financial support and without their commitment the implantation of the voisin system would not be possible at all as stated by one of the farmers interviewed *"the students were very motivated when implanting new projects. They were spending they weekends in our properties, working for several hours without being paid. (…) they were very excited about putting into practice what they learnt at school and also about learning from us.*

   It was also mentioned that farmers and students had in general a very good relationship and students could stay with the families whilst helping to set up the system on the farms (plan the paddock divisions, do the fencing *inter alia*).

3. **Dairies** – Overall, about 30 small dairy houses were created in Encostas da Serra Geral region to add value to milk production. Farmers actually can chose the dairy processing facility for their milk as dairy houses sort of compete for the farmers to ensure that their plants can run at full capacity. This creates a unique and very convenient situation for the farmers as milk prices stay relatively high because of this competition. Often the dairy houses have one or two technicians (agronomist and/or veterinary) who provide technical assistance to the farmers. A challenge for the dairy houses is the condition of roads since the milk car needs sufficiently maintained infrastructure to get to the farms. Time needed to get from one farm to the next is also an issue as farms are located quite far from each other. Each dairy plant has to figure out the best route for picking up the milk which sometimes is quite a logistic effort (CiVi.net report, 2012). The farmers from Santa Rosa work mainly with three dairy houses namely: Geracao, Fortuna and Lateli.

4. **EPAGRI**[21]– is the state's rural extension agency, founded in 1991 under the initiative of the state government through the Ministry of Agriculture and Fisheries. In the Encostas da Serra Geral region, EPAGRI works in coordination with the municipalities of the region, acting as a bridge between the City Hall and the farmers. Although it is a state policy to advocate the implementation of the Voisin system due to its "apparent" economic benefits, at the beginning of the process, not all extension workers of EPAGRI approved or got involved. However, with time EPAGRI got linked to UFSC and GPVoisin in so far as quite a lot of former students have become extension workers employed by EPAGRI. The extension workers' responsibilities are organized per municipality. All farms in one municipality are advised by a specific person and cannot freely choose between extension workers. In terms of costs, EPAGRI provides technical assistance when implementing the Voisin system, while the farmers have to take the monetary costs, for example for fencing and for putting up the drinking water system for the animals. Sometimes the farmers can get credit access through local rural credit cooperatives or also through PRONAF[22] (CiVi.net report, 2012).

[19] www.gpvoisin.ufsc.br
[20] Federal University of Santa catarina - www.ufsc.br) is a public university based in Florianópolis.
[21] EPAGRI - Empresa de pesquisa Agropecuária e Extensão Rural de Santa Catarina (http://www.epagri.sc.gov.br)
[22] PRONAF - National Program for Strengthening Family Farming, the program fund individual and group projectsthat generate income for family farmers in Brazil

5. AGRECO[23] **-** is the association of Ecological Agriculturists from the Encostas da Serra Geral. Established in 1996, the association seeks new alternatives in the region, especially for the continuity of a family-based agriculture. AGRECO has as main principles the agro ecological production and the fair trade. In addition, AGRECO aims to increase organic food production and food processing as well as to support the marketing and commercialization of organic products. Successful activities involve the creation of a well-recognized label for the marketing of all products. AGRECO also offers capacity trainings for agro-industries e.g. with respect to optimized production and waste reduction. Right now, AGRECO is the biggest initiative of its kind in Santa Catarina, despite the fact that there are several private enterprises competing with them. The developed brand and logo is quite known throughout Brazil and all main supermarkets have the products in their shelves nowadays. However, up until now, attempts to build up a market for organic milk or pork were not successful.

At present, about 30 family farms of the region are members of AGRECO. They had almost 50 families as members some time ago, but a contract with one supermarket chain did not work out, so they lost the other families as producers. The most challenging part of AGRECO's work is related to the logistics, as the low infrastructure poses a general obstacle. The market for organic products in Brazil is fast growing; nevertheless right now AGRECO only produces for the national market.

6. AnC[24] **–** Agritourism Association Hosted in the Cologne - was created in 1998 by some familiar farmers involved in agro-tourism activities in the region, with the support from AGRECO, UFSC and the Accueil Paysan Network[25]. The association has promoted tourism in the region, as a complement to the other economic activities of the family property. In principle the initiative is also open to conventional farmers, but these have to make the commitment to switch to organic production once they join AnC.
AnC's target group as visitors are in the first place families from the urban areas. Until now 14 farm hostels were built that offer lunch and dinner for day-tourists or accommodation for people who want to stay overnight. Some *pousadas* also offer hiking or biking tours to natural attractions or implement self-guided trails. AnC's goals also include educating visitors of the region about the local food production. Besides, they offer technical assistance to those families that are part of the initiative. AnC is also part of a bigger touristic network based in France and AnC has to comply with the overall rules of the network. The region receives mostly tourists form Brazil itself, but also, thanks to the link with the French network, some more international tourists start visiting. In 2005/2006, 2,000 tourists were estimated, but there are no official numbers so far. Roughly 180 local families are now affiliated to AnC, only in Santa Catarina state (25 families are from the Encostas da Serra geral region). Besides the main office of the association is located in Santa Rosa, the most expressive results of the association performance are visible in this municipality (Orofino, 2011).

7. EcoCert Brazil - is the representative of the French certification organization of organic food in Brazil. Headquartered in Santa Rosa, EcoCert is responsible for auditing and giving technical support to the 30 families that are affiliated to AGRECO. EcoCert is accredited by the Brazilian Ministry of Agriculture and the National Institute of Metrology, Quality and Technology (INMETRO) and the certified products from this organization have access to the main national and international organic markets.

8.Gund Institute for Ecological Economics (GIEE) –is a non-local stakeholder – is located at the University of Vermont, US - which has cooperated with UFSC/GPVoisin during the past years in

[23] AGRECO- Associacao de agricultores agroecologivos (www.agreco.com.br)

[24] AnC - Acolhida na Colonia (http://acolhida.com.br/quem.html)

[25] French organization engaged in eco-tourism.

several projects to promote sustainable agriculture. Right now both parties are working on a new project proposal related to the Voisin silvopastoral[26] system (CiVi.net report, 2012).

9. Researchers, scientific institutions, academy (in general) - responsible to conduct research and advice the government (or policy makers). E.g.: the CiVi.net project.

Table 3 summarizes the role of these stakeholders in the voisin implantation process in the case study area, based on three distinct categories as described below:

(a) *Primary stakeholders*: have high influence of the process and who stand to gain or lose much
(b) *Secondary Stakeholders*: stand to gain or lose much but whose influence on the process is low
(c) *External stakeholders:* can exert influence but who do not tend to gain or lose much

Table 3: Stakeholder analysis

Stakeholders		Role/Responsibility	Interest	Position/Category	Degree of Influence
Public	Voisin Grazing group –UFSC	Responsible for the adoption of the new physical technology in the case study area.	To disseminate better technologies to help farmers to improve their management practices related to the milk production	External	+++
	EPAGRI (representing the Municipality)	Involvement in several programs to support family farmers in the region	Provide support to farmers and develop synergies with other stakeholders to promote rural development in the region	External	++
	AGRECO	Proponent of sustainable Rural Life Project in partnership with Sebrae has resources for hiring of UFSC to implement the voisin system in the region.	Support local sustainable development.	Primary	+++
	GIEE	Partner of UFSC in conducting research in the fields of agriculture and ecosystems (exchange programs)	Develop research projects between Brazil and USA to help local rural communities and provide advices to decision makers	External	++
Private	Dairies	Make sure that they can cover a big number of farmers milk production and have available and fully operational all the facilities (cars, machines, technical assistance, etc.), in order to achieve this goal	Have a major number of farmers selling the milk to them and ensure that farmers produce milk in good quality and quantity	Primary	++
	AnC	Promote eco- tourism in the region and agro-ecological production to complement other economic activities of the family property	Partner of AGRECO, AnC wants to engage a major number of farmers in agro-tourism in the region	Secondary	0

[26] Voisin silvopastoral – combination of the voisin system and the plantation of threes to provide shadow to the animals.

	ECOCERT	Responsible for auditing and giving technical support to the farmers that are affiliated to AGRECO	Certification of organic products in the region	External	0
CSOs	Researchers, scientific institutions, academy	Conduct research. E.g.: the Civi.net project	Provide advice to the government and policy makers	External	++
	Farmers	Land owners who might get interested or not in implanting the VRG. They are crucial in this process because only if they agree the projects can be implanted in their properties	Farmers want to increase their production and productivity as a way to increase their income and consequently their well fare.	Secondary	++

KEY: +++ most powerful; ++ very powerful; + powerful; 0 neutral; - weak; -- weaker; --- weakest

The table above points *UFSC and AGRECO* as the most powerful stakeholders in the process of implantation of the voisin, where *UFSC* is an external while *AGRECO* is a primary stakeholder. Wilson Schmidt, a Professor at *UFSC* created *AGRECO* and due to his political prominence he managed to obtain financial support from the State to promote local initiatives. *AGRECO* enabled the creation of dairy houses in the region and established cooperation agreements with *UFSC* for the implantation of the projects in the region. The Centre of Agricultural Science (CCA) of the state University (*UFSC)*, through its students (GPvoisin), under the supervision of Professor Abdon Schmitt[27] started designing and implementing the projects in farmer's properties. Due to their expertise they were also able to provide technical assistance to the farmers, organise meetings, workshops and field days to exchange ideas with the farmers.

At the beginning of the process *EPAGRI*'s role (as representative of the City Hall) was to follow the projects and provide technical assistance. They also supported the students providing them basic conditions such as transport, accommodation and meals. Currently, *EPAGRI* owns the voisin technology and the technicians from EPAGRI – extensionists - are leading the process, for example, they are responsible for spreading the system to other farmers in the region and surroundings. However some farmers commented that the assistance provided by UFSC was more efficient as explained by a farmer *"back in the days, when UFSC was leading the process we had more exchange of ideas and different groups participating (…) now we are missing the field days, we are missing the engagement of the students from UFSC"*.

Dairies were in turn classified primary stakeholders. In order to maximize the quality and quantity of milk collected in farmer's properties, the technicians of the dairy houses (agronomists and veterinaries) strongly encourage farmers to use techniques/technologies that improve their production and productivity. Most of these technicians were former members of the GPvoisin, so they also encourage farmers to use this system. One of my interviewee, technician of a dairy house stated that "*some of the dairy houses prefer to establish contracts exclusively with those farmers who are producing milk under the VRG system because their production pattern is more stable compared with the other farmers in the region"*. As farmers want to sell more milk as they can, they follow the advices of these technicians from the dairies, so to say, dairy houses have high influence in the process and also stand to gain or lose.

[27] Professor Abdon Schmitt – former member of the Pasture Outreach Program, University of Vermont, USA (1992-1998), creator of the GPvoisin.

Although farmers were the ones providing the final decision on whether or not to implement the voisin system in their properties, since they own the land, here they are classified as secondary stakeholders, since most of those who adopted the voisin were facing problems with the traditional system and they decided to take the risk and try this new technology suggested by the GPVoisin. The fact that important and credible institutions in the region such as EPAGRI (and the municipality), AGRECO where involved in the process also encouraged the farmers. One of the farmers interviewed explained that *"we rely in the advices that we receive from these young people who went to study in the city and now are here helping us developing our activities (...) they were born here, they know this land and they know what is better for us"*.

AnC was classified as secondary stakeholder. Jointly with AGRECO they are trying to encourage farmers to produce organic milk. From the interviews conducted to the farmers all of them stated that are interested in produce organic milk, but in reality none of them is producing it yet due to the high costs as stated by an farmer *"I am very interested, but then if do so, I will not produce the same amount of milk I am producing today because I cannot use fertilizer and I believe I will have more costs, then I cannot survive in the market"*.

ECOCERT, GIEE and research institutions and academia where categorized as external stakeholders. *ECOCERT* will probably have a more important role when/if the farmers start producing organic milk, as they will have to be certified by *ECOCERT*, but at the moment this organization has a neutral influence in the milk produced under the voisin system. *GIEE* and *research institutions and academia* are external stakeholders classified here as very powerful as they entail an outsider view in the local initiatives, which can lead to synergies, boost development in the region and provide better advices to the local decision makers.

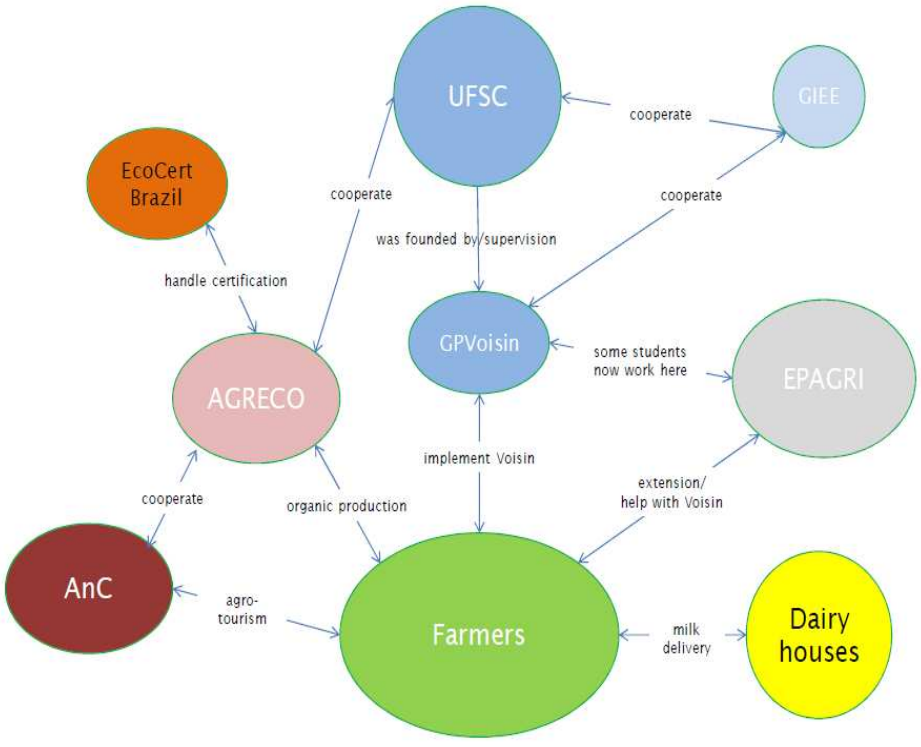
4.3. Institutional analysis

As showed above, different actors where identified within the case study community, including the nature of the institutes they represent (public, private or CSO) and their role and degree of influence in the decision making process. Besides these elements addressed above, institutions operating in the case study region simultaneously interact in an administrative and geographical context as described below.

The administrative context comprises three main levels: the *community level* which is represented by the farmers, dairy houses and AnC; *government and state level* represented by EPAGRI, AGRECO and UFSC and the *supra-national level*, represented by ECOCERT, GIIE, research institutions, NGO's, amongst others.

Looking to the geographical context, three levels were identified: *local, regional and international levels*. The figure below illustrates these interactions:

Figure 12: graphical representation of stakeholder relations (Civi.net report, 2012)



Farms and dairy houses interact on the local and sometimes regional level within and between municipalities in the region. The university UFSC is run by the state and is part of a large network at the regional, national and international level. GPVoisin clearly has a regional focus, but co-operations also exist with institutions form abroad (e.g. GIEE). GIEE is affiliated to the state-run University of Vermont and is likewise UFSC partner in a large multi-level network. EPAGRI is a state-wide agency, but the responsibilities of their extension workers are organized per municipality and per individual farm at the regional and local level. AGRECO and AnC are regional initiatives in the first place, but AGRECO receives state funds and thus is embedded into the political developments at the national level, and AnC is also linked to the French network abroad. Finally, EcoCert Brazil is a pro-profit organization at the national level under the umbrella of the mother organization which operates at the international level.

Chapter 5. Environmental and socio-economic impacts of management practices under the voisin system

This chapter aims at answering research question number four: “What environmental and socio-economic changes are perceived by the farmers as a result of the adoption of voisin rotational grazing system?”

Here the socio economic and environmental changes are taken as determining factors of the success or failure of the voisin system, according to the perception of the farmers. In order to answer this question, the sub question 4a will be answered first: “which ecosystem services are perceived by the farmers as being generated or improved after the transition from the traditional milk production to the VRG system in the case study area?”, followed by sub question 4b: “what socio-economic changes are perceived by the stakeholders as a result of the transition from the traditional milk production to VRG system in the case study area?”

5.1. Environmental Impacts

In order to answer question 4a, farmers were asked questions about their perceptions on the changes (if any) on the biodiversity, soil, water, and changes in the climate due to the adoption of the VRG system and a link is made with the related literature.

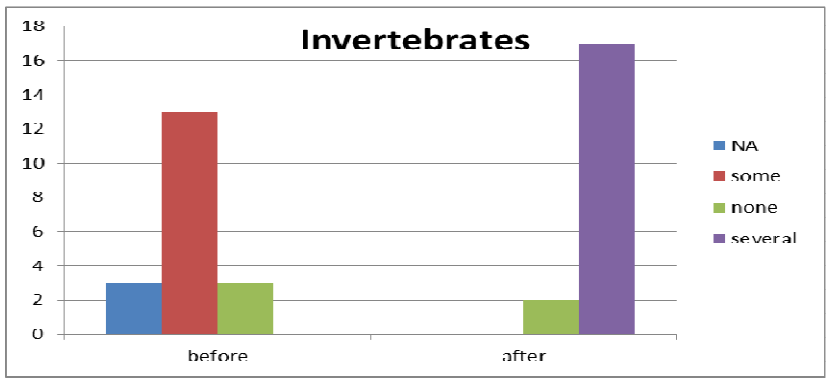
Biodiversity

Biodiversity refers to the variability amongst organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; it includes diversity within species, between species and of ecosystems (UNEP, 2008).
In an agricultural field, biodiversity can be viewed in layers: microorganisms and worms living in the soil; native plants, crops, and trees growing on top of the soil; and insects, birds, and animals inhabiting the plants, crops, and trees. The greater the number of microorganisms, plants, and animals in an ecosystem, the higher the level of biodiversity is. Plant and animal species fulfill a number of important roles in regulating the natural and agricultural environment. Microorganisms and worms in the soil convert nitrogen and other nutrients into a usable form for plants and trees. Plants help to manage water runoff, filter impurities and toxins from water sources, cycle oxygen, and provide habitat for animals. Animals, such as bats, spiders, birds and other insects help regulate insect and rodent pests. Insects such as bees help to pollinate crops and wild plant species. Many of these species interact and depend upon one another, making high levels of biodiversity important for the functioning of the entire system (Alves et. al, 2004). In the ecosystems of pasture, vegetation cover composed mainly of grasses, is the foundation of this biodiversity and that the herbivorous animals play a fundamental role in the dynamics of vegetation through grazing (Dias Filho & Ferreira, 2009). Some studies, carried out in pasture, have related biodiversity with increasing biomass production, ecosystem stability and with the input resistance of invasive plants (Soder et al., 2007).

When asked questions about the changes in the diversity of species in the pastures farmers stated that the diversity of flora species increased after the adoption of the voisin, with positive impacts on dependent fauna species, such as bees, bumble-bees, beetles, birds, small mammals, etc. Likewise, farmers stated that a major number of invertebrates are visible nowadays including earthworms, beetles, etc. From the 19 farmers interviewed, 13 of them stated that in the past they use to see some

invertebrates, but the amount was less comparing with the amount that they see nowadays, i.e., when asked the same question about today, 17 of the 19 farmers affirmed that they see more (quantity and quality) small animals than before as showed in the graph below:

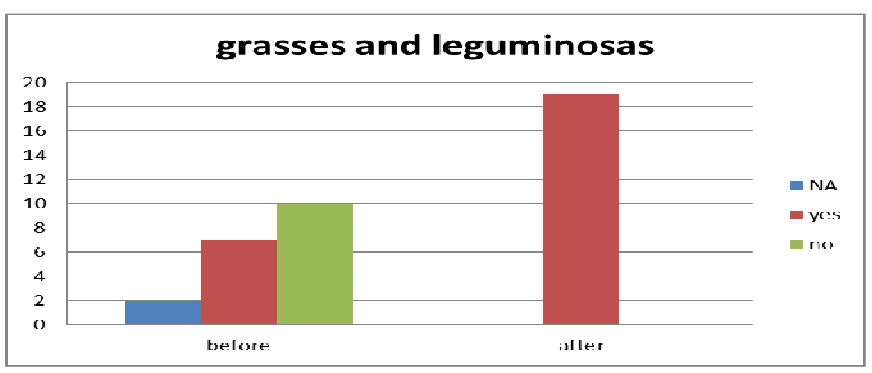
Figure 13: Farmers perception in relation to the presence of small animals (invertebrates) in pastures



This result can be supported by theoretical studies. Soils of pasture have a great potential to sustain and maintain an extraordinary diversity of species, especially invertebrates that inhabit the soil. According to Machado (2004), the appearance of beetles and worms is indicative of the evolution of soil biota. Beetles bury manure from animals to feed their larvae. In this process, the recycling rate of minerals is accelerated, increases the permeability of the soil and reduces the population of various parasites of cattle. According to the same author, earthworms play physical and chemical functions therefore they dig galleries contributing to soil porosity and increase the solubility of nutrients. The presence of earthworms and beetles are indicative of good environmental conditions, because they are sensitive to the use of agrochemicals (Bauer, 2009).

Similarly all farmers pointed that by growing *leguminosas* and grasses they increase the genetic diversity in the areas of pastures. Before the voisin, farmers grew only four species of *leguminosas* (oats, ryegrass, white and red clover), nowadays besides these they also grow others species such as *capim elefante, missioneira gigante*, *macu*, *angolinha*, *amendoim forrageiro*, *aruana*, *brizanta*, *encrenca do vizinho*, among others[28]. As can be seen in the graph below, only some (7) of the interviewed farmers confirmed that they were growing *leguminosas in* few parts of their pasture lands (in average 25% of the total pasture area) whilst currently all farmers are growing different qualities of them, occupying in average 75% of the area.

Figure 14: farmers growing grasses and *leguminosas* before and after the adoption of the voisin



[28] Local names of *the leguminosas*

"*Leguminosas*" are very important because these weeds constitute one of the major sources of nitrogen, allowing toincrease its availability in soil-plant-animal (nitrogen fixing plants). They enable significant increases in carbon fixation to the soil, as well as reduce the emission of greenhouse gases per unit of product produced (Barcellos, 2008).

Another aspect that many farmers referred as positive regarding the division of pasture in paddocks is that it is no longer necessary to expand areas for pasture (as in the traditional system), which means that forest areas in the surroundings of farmers properties are kept intact. During the interviews some farmers mentioned to have noticed that because of the existence of forests, rain water infiltrates into the soil lesser and slower than in plain soil preventing flood formation. Similarly forest holds more water into the system and diminishes the effects of droughts (Fearnside, 2005). Few farmers also referred to the importance of forest as a habitat for animals and the role of the trees in erosion reduction which can be supported by Fearnside (2005) which when referring to the link forest – agriculture, states that forest enables the control erosion, reduce and recover soil compaction, replace nutrients, organic matter, protect the soil from the impact of rains and the sun and assist in the process of rock weathering of rocks and soil formation.

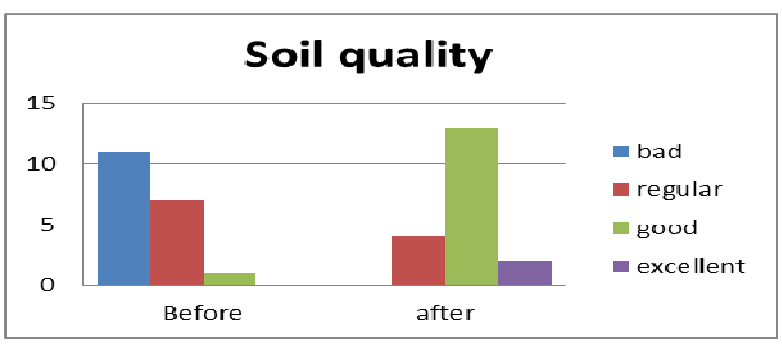
Soil of the pastures

Soils are essential sources of a wide diversity of ES. They contribute to all four different dimensions of ES. They support most agro-sylvo-pastoral production systems (production services) through the beneficial services that they mediate: soil formation, nutrient cycling and primary production. Soils also participate in the provision of regulation services (climate regulation by controlling greenhouse gas fluxes and C sequestration; flood control, detoxification, protection of plants against pests) through their influences on organic matter dynamics and the wide-ranging effects on soil physical properties. Soils finally contribute to cultural services although to a rather minor degree given the surprisingly widespread lack of interest of many societies in the sustainable use of this key resource (Lavelle et. al. 2006; (Barrios, 2007).

In farmers perception, soil is one of the elements that most beneficiates from the adoption of the voisin system. Farmers were also asked questions about changes on soil coverage, humidity and soil quality in general. From the total of the interviewees, 80% stated that after the adoption of the voisin system the soil of pasture became totally covered. Regarding the humidity and soil quality, all farmers stated that the soil is more humid and that the soil quality improved when compared to the time they were producing milk under the additional system.

Figure 15, shows farmers perceptions on the changes in soil quality before and after the adoption of the voisin system. As can be seen, many (11) farmers said that the quality was bad before and a when asked about the soil quality today most of the farmers (13) said that the quality improved greatly.

Figure 15: Farmers perception in relation to changes in the soil quality



Few farmers associate these enhancements to the decrease in the use of chemical fertilizers and pesticides, that started being replaced by the organic ones (swine and chicken manure) after the adoption of the voisin. However, a considerable number of farmers (almost all) still combine both chemical and organic fertilizers (which they claim that it is necessary for improve land productivity) although in a more balanced way.

In addition, farmers said that the voisin grazing system concentrates the manure in the paddocks, so in a short period of time its concentration allows regular growth of the area which does not happen in the semi-confined system, where manure is undesired. In the extensive system manure is not well used, because it does not concentrate its' formulation in small but in scattered areas. The accumulation of manure activates the micro and meso soil biota, which recycles nutrients and makes them available to the plants (Melado, 2004).

If analysed in a global perspective, the improvement in soil coverage, combined with a better soil fertility contributes to carbon sequestration as there are a greater number of plants assimilating CO2 and less soil exposed, decreasing the rates of decomposition of organic matter in the soil. Consequently, there is an increase in soil organic matter content and more soil biota (such as earth worms.) which leads to an improvement in water infiltration and retention in the soil. Other impacts include the reduction of soil erosion, through improved soil cover; soil becomes de-compacted due to more root growth; improved nutrient cycling and thus less use or need for fertilizers. As a result, the production system becomes more stable, requiring less pesticide input (Surdi, 2011).

Water

Agriculture accounts for about 70 per cent of global water use being also polluter of this indispensable resource (FAO 2003). The water cycle provides bloodstream for the biosphere that enables the generation of ES (Gordon et. al. 2009). The provision of sufficient quantities of clean water is an essential ecological service provided to agro ecosystems (Power, 2010).

Water quality can be influenced by several factors such as the vegetation cover, topography, as well as the use and management of soil (Surdi, 2011). Water provision and purification fulfil requirements for water of sufficient quantity, timing, and purity for agricultural production (Zhang, 2007). Water availability in agro-ecosystems depends not only on infiltration and flow, but mainly on another ecosystem service, such assoil moisture retention, since 80 per cent of agricultural water use comes from rainfall stored in soil moisture (Power, 2010). Water storage in soil is regulated by plant cover, soil organic matter and the soil biotic community (bacteria, fungi, earthworms *etcetera*). Trapping of sediments and erosion are controlled by the architecture of plants at or below the soil surface, the amount of surface litter and litter decomposition rate. Invertebrates that move between the soil and litter layer influence water movement within soil, as well as the relative amounts of infiltration and runoff. These soil processes provide essential ecosystem services to agriculture (Swift et. al. 2004).

Almost all farmers interviewed have water courses (rivers, springs, streams) passing by their properties. All of them affirmed that in the past cattle used these water courses as a direct source of drinking water. With the adoption of the VRG system, there has been a change in this habit and water has been provided in the paddocks. This change resulted in water quality improvements as cattle are kept out of the riparian and river areas which diminishes silting of water bodies; prevents water contamination by manure and urine that might cause eutrophication, as stated by Assenheimer (2007), "waste consisting of organic matter is used by bacteria that develop rapidly, consuming the oxygen from the water, causing eutrophication".

There is also a reduction in erosion of river banks resulting from their trampling whilst drinking. Additionally, there is a decrease in the contamination of superficial and underground waters due to a

better vegetal coverage. The root system of forage species (grasses and l*eguminosas*) has a high filtering capacity of soil contaminants, water retention, decrease surface run-off, brake erosion processes, among other regulating ES (Surdi, 2011).

Climate change

Climate change is resulting from a global concentration of greenhouse gases (GHG), namely carbon dioxide, methane and nitrous oxide in the atmosphere. While in developed countries the main source of greenhouse gas emissions is the use of fossil fuels, in Brazil the main cause is the change in land use.

In a global perspective, these improvements in biodiversity, soil and water, results in positive impact on mitigation of climate change. For instance the growth of *leguminosas* and grasses result in a better nitrogen fixation and significant increase in carbon fixation to the soil, as well as reduction of greenhouse gases emissions (reduction of CO2 and methane emission and a balanced C:N ratio).

The improvement in soil coverage, combined with a better soil fertility contribute to more carbon sequestration as there are a greater number of plants assimilating CO2 and less soil exposed. In addition, since cattle are kept out of the riparian and river areas - which diminish silting of water bodies – there is prevention from water contamination by manure and urine that might cause eutrophication.

Table 4 provides an overview of the impacts of these two different management practices in soil, water and biodiversity comparing the dimension of the impacts, i.e., if on site, local or global.

Table 4: Summary of the environmental impacts of the voisin system

Impact on	Related ES	Criteria	Scale of impact			Type of grazing system	
			on site	Local	Global	Traditional	Voisin system
Soil	nutrient cycling, organic matter, natural control of pests in the pasture, soil formation, erosion control	Soil fertility and permeability	X			-	+
		nutrient supply	X			-	+
		nutrient acquisition	X	X		-	+
		forage growth	X	X		-	+
		use of chemicals	X	X		+	-
Water	water provision, water regulation	Conservation of water resources		X		-	+
		quality of surface and groundwater	X	X		?	+
		fluctuations of ground water levels	X			?	-
Biodiversity	plant production, biological control, pollination, resilience	species richness		X		-	+
		species diversity		X		-	+
		crop/pasture insect pests					
		cover crop	X			-	+
		Forest protection				-	+
Climate change	Carbon sequestration	GHG emission (methane and carbon dioxide)			X	+	-
		Soil carbon		X		-	+

Key: + more or increase; - less or decrease; 0 same; X – impact on; ? – no information provided

5.2. Socio economic aspects

"I started the milk production activity only with 10 cows and today I have more than 40 cows in the same area as before…"

In order to answer the question 4b, farmers were asked questions related to the changes (if any) in their economic activities (and main source of income), production and productivity, family welfare, community and social aspects, among others. In combination, where also asked questions about changes in the cattle size, animal welfare and sanity, which in a way have a cause - effect relationship with the socio-economic changes in farmers life. The assessment of these factors was made by comparing the situation before and after the adoption of the VRG system, as described below.

Initial Investment

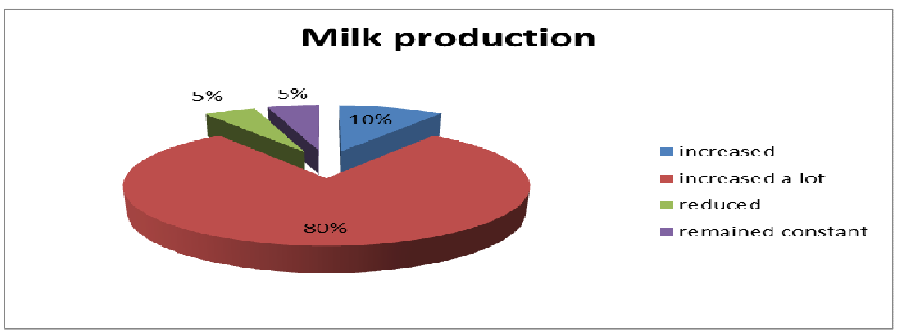
Almost all farmers used their own resources for the initial investment to implement the voisin system in their properties and according to them the investment was recovered in 2 to 3 years, period in which the project has not yet reached its production peak that is in general in the eight year. When asked whether the investment (in monetary terms) was high or not, almost all farmers said that it was fair, since apart from buying new materials (such as wire, posts) they were also able to re-utilise material from their properties (trunks from fallen trees, some seeds) to construct the paddocks.

Production and productivity

In general, production and productivity seeks to measure factors such as kilos per hectare, litres per day, litres per hectare, lambing percentage, among others (Alves et al. 2011).

When comparing their milk production at present to the period before the implementation of the voisin, almost all farmers affirmed that their milk production (litres per day and litres per animal) duplicated and in some cases even triplicated (figure 16).

Figure 16: farmer's perception on the variation of milk produced after adoption of the voisin



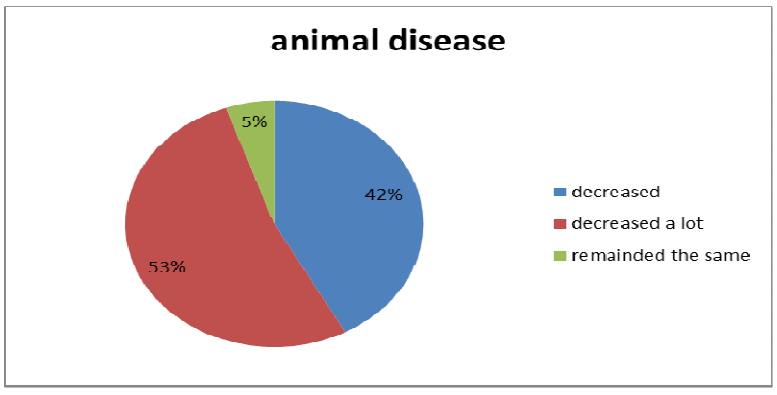
Farmers associate this improvement mainly to the higher quantity and quality of the forage, due to the introduction of more productive species in the field - grasses and *leguminosas*, as supported by Moreira (2004), who suggests well managed projects can easily duplicate milk production, since production of quality forage enables better milk production. According to Barcellos et al. (2000), the nutritional value of forage has direct reflections on animal productivity. Participating in animal diet, *leguminosas* contribute to increase the gain in weight as well as bring greater amount of nutrients to the diet and can reduce the production of methane, for instance, forage has a more beneficial C:N relation which reduced methane emissions per cow due to the improved digestion of the better forage. Melado (2000) points out that the animals are widely benefited with the Voisin as under the system cattle have a more varied food with a higher nutritional level, once the grass is at its optimum resting point.

In addition to improved quality and quantity of pasture, other factors positively influence the milk production, such as increase in support capacity, decrease of diseases, animal welfare and genetic potential of the cattle, for instance farmers have two racial cattle composition in their properties, Jersey and *Holandes* (Dutch) and they affirm that the Jersey cows perform better on pasture than the more common black and white dairy cows. Productivity increased most on farms where high productivity cows were brought into the system from outside or where artificial insemination was performed when compared to farms with self-bred animals (CiVi.net report, 2012).
It is important to refer that apart from *leguminosas* and grass being the main source of feed, most farms, despite of the increased productivity, still grow some silage maize for 'insurance' reasons, esoecially to have forage for their livestock when there is food shortage during the winter months.

Cattle size
Almost all farmers confirmed that the division of the pasture in paddocks resulted in an increase in the number of cattle without the need to extend or acquire new pasture areas and they relate this fact to the increase of support capacity in pastures. According to farmers, pasture can support more animals per unit of area than before.Melado (2003) sees this better use of space has one of the main advantages of the voisin system since the increased stocking per hectare, reduces the need to explore other areas or the devastation of forests for cattle management, influencing in the conservation of forest remnants.

Animal welfare and sanitation aspects
Animal welfare and sanitation issues are undoubtedly linked to the variations on the size of cattle. Many farmers said that with the adoption of the voisin system health problems of the animals reduced as illustrated in the graph below.

Figure 17: farmers' perceptions on changes in animal diseases



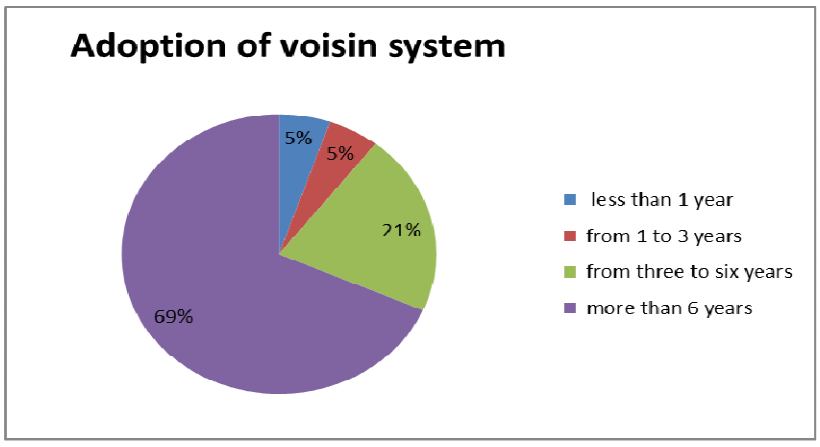
Farmers say that this reduction might be linked to the reduction of antibiotics used comparing to the period before the implantation of the voisin. This happens because the rotational system works has kind of pest control since the life cycle of parasites is in general shorter than the pasture rest period, for instance, pest tend to die before they manage to infect the cattle, this way breaking the pest's development cycle (Melado, 2007). Bauer (2009) suggests another cause that might be behind this reduction is that under the voisin system animals stay for a short time in the milking parlour were there are huge concentrations of manure causing contaminations (Bauer, 2009). Other authors point out that animals with more balanced food (e.g. *leguminosas*) are better prepared to resist and fight diseases (Schvarz *et al*., 2007). Farmers also stated that after the adoption of the voisin system, the animals even became more gentle and happy, probably due to the improvement in these conditions.

Farmer's income and family welfare

Associated to the increase in production and productivity, all farmers registered an overall growth in their economic profits[29] which they associate to the increase in in contrast with the reduction in production costs, due to less use of corn silage, chemical fertilizers and medicines.

All farmers stated that their quality of life improved significantly after the adoption of the voisin. They began to have more financial stability resulting in better living conditions. Almost all farmers re-built or reformed their houses, making them more spacious and luxurious; they also began to use modern equipment and machinery in their farming activities. For instance during the visits to farmer's properties, one could see the very sophisticated furniture in their houses, modern cars in their garages, as well as the modern equipment and machinery such as pipelines from the cow (or barn) to the refrigerator. However is important to refer that although all farmers seem to be happy with the voisin (all of them stated that they would recommend this system to other farmers), there is a slight difference between the living conditions of those farmers who have adopted the voisin for more than 6 years (they live in much better conditions) and those who have just adopted the system. This may be related to the "maturity" of the project as described by Machado (2004), who states that the voisin system in general reaches stabilization between the fifth and eighth year, and where or when it is possible to obtain the largest stocking rates and the greatest productive gains. The figure below provides an overview of the age of farmer's voisin projects.

Figure 18: age of the projects

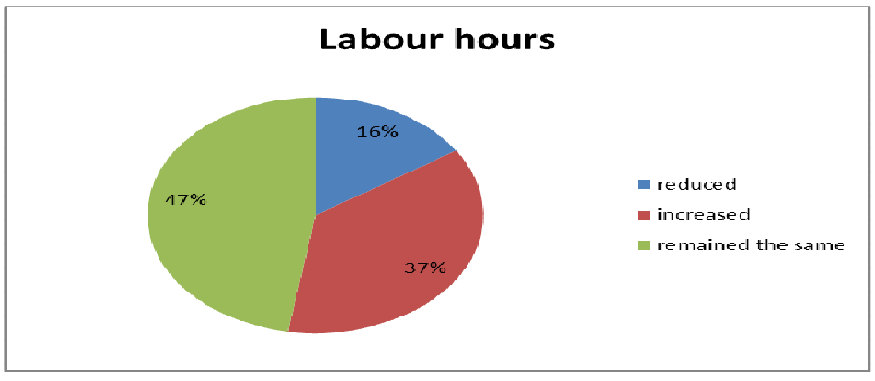


Hours of labour

Regarding the time spent in the activities, there are contradictions amongst the farmers. While 7 of them state that the workload increased, 3 mentioned that it decreased and the remaining 9 stated that it remained constant, although less stressful, as showed in the figure below:

[29] Although all farmers confirmed that their income increased, they did not quantitatively prove this increasing.

Figure 19: Farmers perception on the hours of labour after adopting the voisin system



It was also stated that Voisin is more labour intensive, but most farmers affirmed that this is only the case during the transition phase and once they get a better command on the management of the paddocks, labour demand goes back to normal or even decreases (CiVi.net Report, 2012). Farmers explained that the Voisin system is more complex than the traditional one and due to this requires much attention and they (farmers) need to understand the system as a whole and have to monitor it closely in order to make the right management decisions. According to Rizzoli (2004), the adoption of Voisin positively interferes on the workmanship of production unit, since it makes the work less stressful. During the interviews, some farmers referred that the voisin reduces work since there is no longer an excessive accumulation of manure in the milk parlour and the reduction of need for food in troughs due to good amount of grazing in paddocks.

Community (health)

Community health refers to the health or the strength of the community in which a farmer operates (Alves et al. 2004). It includes factors such as community relations, access to infrastructure, technical assistance, farmers respect and prominence, farmer's management capacity among others. Several farmers referred that due to the difficulties they faced when using the traditional practices they had depression and low self-esteem problems, started isolating themselves and participating less and less in the social life within the community and there were also cases of suicides. With the adoption of the voisin system there was a change in this tendency, they slowly started getting exposed to the outside world, starting being contacted by the institutions, participating in the field days, etcetera. They also began consulting and being consulted by other people, and in a way this enabled them to start believing in themselves and with the success of the projects in their properties, they started receiving visits in their properties, which in a way brought back their confidence, respect and prominence. Another aspect that farmers stressed during the interviews was the reduction of rural exodus, since young people started to see more perspective to take over the farm from their parents and continue farming in the future. In some of the visited farmers, young people (daughters or sons of the farmers) are the ones managing the voisin projects in their properties, since they participated in a local program promoted in the region so called CEDEJOR[30] (Centre of Development of Rural Youth), where young people receive a full training in human, technical and managerial areas, developing skills for managing income generation projects and quality of life in

[30] CEDEJOR – is a non-profit association created in 2001, which is present in 3 States in Southern of Brazil, reaching about 45 municipalities. The main objectives of this association are to promote social, educational and cultural action that contribute to sustainability and improvement of quality of life in regions where it operates. The institution develops participatory educational processes that seek the formation of rural youth and allowing alternative management geared to economic and social development and sustainability of rural communities. Its target group are young people from family farms that have the intention of live and promote the sustainable development in the rural environment (CEDEJOR, 2012).

families and to assume leadership roles in communities and municipalities where they live (CEDEJOR, 2012).

Table 5 below, summarizes these socio-economic changes, based on the comparison between the voisin system and the traditional milk production based on semi-confinement:

Table 5: summary of the socio economic impacts of the adoption of the voisn system

Impacts on		Type of management grazing system	
	Criteria	Traditional system	Voisin system
Production and Productivity	Litres per day	-	+
	Forage production	-	+
	Cattle size Pasture support capacity	-	+
Animal welfare	Overall health	-	+
	Animal living conditions	-	+
Farmers Income	Investments	+	-
	Income		+
	Costs/expenses	+	-
Family welfare	General quality of life	-	+
	Family comfort	-	+
	Hours of leisure	0	0
Hours of labour	Intensity of labour	-	+
	Hours of labour	0	0
Community	Community relations	-	+
	Technical assistance	-	+
	Farmers health	-	+
	Rural exodus	+	-
	Farmers self esteem	-	+
	Farmers management capacity	?	+
	Farmers respect / prominence	-	+

Key: + more or increase; - less or decrease; 0 - same or neutral; ? – No information provided

Chapter 6. To what extent can the voisin system, as employed in the case study region, be considered a successful Community Based Ecosystem Management initiative?

This chapter answers research question five: “can the voisin system, as employed in the case study area, be considered a CBEM initiative?” To answer this question, an overview on the main elements criteria to evaluate CBEM projects, found in literature which will be compared with the CiVi.net approach will be provided firstly. Secondly, the information obtained in the previous chapters will be used, combined with the answer provided by farmers and other stakeholders to understand their involvement in the process. Finally a linkage between all these elements will be made.

6.1. Criteria for evaluating Community Based Ecosystem Management

Any attempt on evaluation is based on comparing reality to a set of criteria. Defining criteria for analysing CBEM might be subjective, depending fundamentally on the reasons for the evaluation and perceptions of the evaluator, as well as the extent and characteristics of the CBEM project being evaluated. The decision about what makes a process successful or not often depends on the values of the one who is evaluating, and different evaluators are likely to judge the same process differently (Conley and Moote, 2003).

Several criteria and indicators were found in literature to analyse CBEM which are summarized in the table below:

Table 6: summary of a typical evaluation criteria, according to different authors (adopted from Conley and Moote , 2003)

Typical evaluation criteria	
Process Criteria	Broadly shared vision Clear, feasible goals Diverse, inclusive participation Participation by local government linkages to individuals and groups beyond primary participants Open, accessible and transparent process clear written plan consensus - based in decision making Decisions regarded as just Consistent with existing laws and policies
Environmental outcome criteria	Improved habitat Land property from development Improved water quality Changed land management practices Biological diversity preserved Soil and water resources preserved
Socio economic outcome criteria	Relationship is built or strengthened Increased trust Participants gained knowledge and understanding Increase employment Increase capacity for dispute resolution Changes in existing institutions or creation of new institutions

The table above results from a combination of indicators pointed by different authors. From this table one can observe that it is possible to develop a single, comprehensive, and broadly accepted criterion. However, instead of advocating for a comprehensive list of criteria, Conley and Moote (2003) stress that the criteria, weightings and methods used should be made clear if evaluations are to be fairy compared to each other.

In this research, criteria will be defined taking the table above as reference and comparing with the items found essential for this analysis, obtained from the criteria established by the CiVi.net project[31], which are summarised below (full criteria establish by the CiVi.net and the respective scores and weights are provided in annex 3):

1. Involvement of CSOs

- One of the CiVi.net CSO partners is part of the local community network in the case study region and it plays an active role in ecosystem management (they need to be actively involved in the activities developed in the region);

2. Governance

- Governance involves CSO at one level;
- Governance structures involve multiple levels (local =community, regional = municipality/state, national = federal and maybe even international = e.g. international active NGOs);
- Governance structure has policy relevance/impact: solution strategy can be a role model for policy solutions; can the developed solution strategy serve as a role model, so policy is motivated to support and promote the solution strategy in general/for other regions/on a larger scale.

3. Environmental issues addressed

- Different environmental issues are addressed: the project aims to analyze a broader range of environmental problems that include different ecosystems and different ecosystem services;
- Environmental and social-economic aspects are considered in equal measures: solutions strategy improves environmental situation (= ES provision) but also improves (economic) livelihoods of local people/communities;
- Quantification of ES: Is there any information on the physical level of ES provision by the project?: Are there any measurement results on the quantity of the physical good providing the ES (e.g. amount of CO2, number and type of species, amount of clean water, etc.)? Or at least models?

4. Community based ecosystem management

- Contribution to diversity: the case study should cover a different aspect of community based management in a different embedding that is in combination with other instruments, as only the analysis of the whole instrument package provides a complete understanding of the developed solution strategy;
- Contribution to complementarity: the case study should contribute with its specific factors constellation to the understanding of community based management as a whole in different frame conditions (frame conditions: i) environmental = different eco-systems; ii) socio- economic = different community characteristics, iii) institutional/political = different institutional and political infrastructures);

[31] Criteria was defined by the CiVi.net project team through the Delphi method. The objective of establish this criteria is to provide a common understanding among the project partners about the vision of the project about the elements to take into consideration when analysing each of the four case studies of the project.

- There is a collective action situation related to the ES in either case study or the transfer region.
- Property rights: resource must be a common resource or common pool resource, i.e., the resource under consideration shall be a common (pool) resource and should be managed not only by a private owner.

Despite the different perspectives and backgrounds of the authors who established the two criteria provided above (from literature and from the CiVi.net project), there are some similarities in the indicators and criteria proposed. For instance in both criteria, environmental and socio-economic aspects are addressed, the decision making process includes participation at different levels, as well as the existence of different institutions that also perform at different levels, and property rights (land and resource), among others.

6.2. Community based ecosystem management elements of the voisin system

The main question to be answered here is whether the voisin system is a successful CBEM initiative or not. Going back to the definition of CBEM provided in the first chapter of this research, suggesting that CBEM should cover natural resource management and sustainable development, one would immediately conclude that the voisin system is indeed a successful CBEM initiative, since the adoption of this system resulted in both socio economic and environmental improvements in the region, as showed in the previous chapters.

However, these socio-economic and ecological interactions in which CBEM is embedded are very complex and dynamic, and consequently other aspects should be taken into consideration when addressing CBEM. Among others elements, CBEM presupposes the existence of several actors/ stakeholders within the community, representing different institutions (and their networks), with different interests, operating or participating in a multi-scale level and influencing the decision making process in different ways. Additionally, CBEM deals with the conservation vs. sustainable development antagonist relationship, the issue of land and resource tenure rights (common pool vs. private) amongst others.

The table below focuses on some of these aspects and establishes a comparison between the criteria established from literature review and the CiVi.net project, with the information obtained during field work to classify the extent in which the voisin system is a successful CBEM project.

Table 7: comparison between criteria found in literature combined with the CiVi.net criteria and the findings during field work

Criteria	Indicators	Literature review +CiVi.net project	Field work: Voisin system management practices	Classification (comparison between lit+ CiVinet) Vs field work
Process	**Institutions, participation and decision making**	Multi-level institutions, participation and decision making process: different actors involved in the decision making process, including local representing the community, regional= representing the community/state, national and international (NGOs and supra national organizations). Not necessarily a clear bottom up or top down approach in the decision making process. Decisions are taken in a collective and inclusive way, involving different actors	Multi-level and dynamic process: participation at multiple levels, with changes of institutions roles over time, and different level of participation and involvement	**High similarity**
Environmental	**Protection of Ecosystems and provision of ES**	Development of management practices that maintain or improve ES provision at different scales (e.g.: biological diversity preserved, soil and water resources conserved)	The management practices under the voisin system resulted in the increase of flora and fauna diversity, improvement of soil coverage, humidity and quality in general and protection of water resources such as rivers, riparian areas, springs, etc., among other environmental benefits	**High similarity**
	Land property rights and natural resource use	The resource under consideration shall be a common (pool) resource and should be managed not only by a private owner. If the resource is privately owned the use of the resource must have important implications for the community/communities, i.e. is of common interest. It should not be the case that it is only private business	**Private**: Since the property rights in the region is in farmer is on control of activities he develops in his property, including the cattle grazing and other management practices regarding planting, soil protection.	**No similarity**
			Common: There are collective resources such as water sources, the forest in the surroundings of the properties, etc., where its use is regulated by law. Household management practice may influence collective resources use (e.g.: forest)	**Some similarity**
Socio economic	**Social learning, gaining knowledge and understanding, community building**	Through the participation, communities develop a more knowledge and understand the ecosystems and consequently they are aware of the consequences of their management practices	Participation in the so called "field days", group meetings/ discussions to exchange knowledge between farmers and the other institutions involved in the process. However this process only involve farmers who adopted the voisin system, restringing other groups from the community	**high similarity**
	Increasing trust	Local communities gain trust and credibility with a wide range of community members, federal agencies, and outside environmental organizations.	Farmers rely on the expertise of the other institutions involved in the process (GPvoisin, EPAGRI, technicians from dairy houses), who provide technical support.	**High similarity**
	Collective action situation	Decisions that have an interlinked effect on ES provision are taken by more than one household	The collective action situation is not visible on the voisin system itself, but instead in the other practices management practices developed in the region, such as ecotourism and the organic production	**No similarity**

The table above summarizes the most relevant aspects found in the case study area during the field work, and compares it with the criteria established by the CiVi.net project and the criteria found in literature. As can be seen in the table, there are aspects that have “high similarities” such as the existence of institutions, participation in the decision making process at different levels, among others; there are also aspects with “some similarity”, for instance regarding social learning, gaining knowledge and understanding; and finally there are aspects that have “no similarity” at all, for example, the collective action situation and the fact that the voisin system (technology) does not involve the whole community.

The voisin system is inserted in a government program with the final goal of promoting sustainable development in the region, in order to improve the quality of life of the inhabitants. Since the technology itself is implemented in the private property of the farmers, the decision about implementing the system or not is up to the farmer, which means that it is a more individual than collective decision, has aforementioned, farmers had the power in deciding if they wanted to implement the system or not in their properties. Clearly, behind this “farmer decision” there is an entire panorama that favoured the acceptance of the system in the region. As described in the previous chapters farmers were facing several problems with traditional practices and they took this new technology as an opportunity to change their situation, and the fact that credible institutions where involved (UFSC, EPAGRI, AGRECO, Municipality) encouraged the farmers even more. These institutions created conditions to make the voisin system “attractive”, for instance, they chose to install the pilot projects in properties of farmers with some sort of social leadership and local prominence in the region, inviting other farmers to participate in the process. They promoted field days where farmers could discuss with the experts as well with the other farmers about their doubts regarding the proposed technology, as stated by one farmer “*I decided to implement the voisin system in my property after accompanying and seeing the results of the pilot projects”*. Another aspect is that farmers felt secure because the technical assistance was available (students from UFSC) at least twice a month (field days), as referred by another farmer “*I was not afraid to fail, because I felt that I was not trying something alone. I could rely on the students from UFSC and in the other farmers who already had implemented the voisin in their properties with success”*.

Apart from the voisin system, other initiatives were developed simultaneously in the region, namely the eco-tourism and the organic production. It is easier to see more community involvement and a strong conscience of natural resource management under the whole organic production and the eco-tourism networks (AGRECO, AnC, etc.) than in the voisin system. All the farmers producing organic products are affiliated in AGRECO and all involved in eco-tourism are also part of the AnC association. They are locals, they belong to these local associations, and they strongly participate in the decision making processes. In contrast, farmers who have implanted the voisin system in their properties operate more in an individual manner, there is no association of voisin farmers although the farmers in the region know each other quite well and they could explore more local knowledge by themselves. To say that farmers involved with the voisin system do not take initiative to sit together in plenaries and group discussions to exchange their experiences and ideas if there is no involvement of “externals”.

To summarize, although several CBEM elements were found concerning the management practices developed in the region, the voisin system cannot be considered CBEM initiate, since the management of the system itself do not occur collectively, i.e., the voisin system lacks to be CBEM due to the fact that the land property right are private in the region.

Chapter 7. Discussion

This chapter will focus on evaluating the methods used in this study including the limitations the limitations of the research, uncertainty of the results and comparison with other studies related to the topic.

7.1. Discussion of the methods

Three analytical tools were used during the preparation of this report, namely, the DPSIR framework, stakeholder (and institutional) analysis, and the ecosystem services assessment. Here, an evaluation of these tools will be made, with a focus on the strong and weak points encountered when applying them.

DPSIR framework

The DPSIR framework addresses environmental problems in which human needs and impacts are an integral part of the scheme. It was useful to apply this tool in this research for many reasons: the DPSIR requires the establishment of causal relationships between a sequence elements, it was a good starting point to provide a precise overview of the main environmental and socio-economic drivers that stemmed the adoption of the voisin system in the case study region – already a response. On the other hand, the DPSIR also provided a good frame to the same aspects in different perspectives, for instance instead of only addressing the voisin system as a response, it was also possible to evaluate the impacts of the management practices under this system. Additionally, this tool helped contemplate about other measures and management practices (different from the voisin system) that mayt also be employed in order to influence impacts, pressures and drivers from other environmental problems associated with the management practices adopted in the region. Finally, the DPSIR also facilitated in pointing out other responses (such as environmental legislation and other management practices developed in the region, etcetera.), as a way to mitigate these socio-economic and environmental impacts resulting from the driving forces. The voisin system, joined with the other responses suggested, might facilitate the development and evaluation of integrated policy responses to the environmental and socio-economic problems in the region.

Nevertheless, some constrains using this method were also faced since it presupposes the creation of static categorizations, assigning a specific role (driver, pressure, state, impact, response), which is not always that linear. For instance, it was difficult to decide in which category of the DPSIR to place a specific aspect. Sometimes the voisin system was understood to be a driving force and at other times considered a response, which makes one reflect that the way people fill in the spaces of the DPSIR framework, can be subjective, depending on each person's perceptions and backgrounds. Another constrain found is that the DPSIR framework fails to address multiple and complex causal relationships between the drivers, pressures and impacts on the state, in some cases, isolated chains of factors may not be enough to reproduce the complexity of systems. For instance, it is difficult to assign impacts on the ES directly resulting from these complex causal relationships. Although the DPSIR framework establishes linear causal relationships, this tool does not include feedback, and feedback is important to understand an environmental system.

Nevertheless, it was useful to use this tool, although its' main strength is also its' weakness: on one side the DPSIR helped reduce the complexity of the problem by helping organize concepts and information, but on the other side each time improvement or expansion was intended , the adjustment of the framework as whole would be required.

Stakeholder and institutional analysis

This tool was very important to identify, prioritise and analyse the involvement of stakeholders, as suggested by de Groot (2006). Since baseline information regarding the stakeholders and institutions and their networks in the region was already available, from internal documents from the CiVi.net project, literature review and during the stakeholders workshop during the CiVi.net project case study visits, this tool was fundamentally used to evaluate these stakeholder's interest and their power in the decision making process, using the institutional perspective. The tool was essential for the mapping of those involved or affected by the project, it also helped to understand why certain decisions (mainly for economic purposes) are taken and their impacts (environmental, socio-economic).

However, it was relatively difficult to classify some stakeholders and their degree of importance objectively, since stakeholder involvement is a dynamic process and their roles are changing over time. For instance, at the beginning of the research, a smaller group of stakeholders involved with the adoption of the voisin system in the region were identified, but as the research evolved, the list adjusted. Another aspect is that since different stakeholder groups were interviewed with different views about the same process, this led in a certain way to doubts in relation to the impartiality of results.

Ecosystem Services Assessment

Due to time limitation and lack of data available, the ES approach was conducted merely to identify the ES existing in the case study region - especially those related to pasture based agriculture - and to access how they are affected by the management practices developed in the region.

Although the ES approach is increasingly being recognised in Brazil, the tool was not explored fully, due to the lack of quantitative data relating to ecosystem services in the case study region. Consequently, for the inventory of the ES available in the region, information found in literature related to ES generated by agriculture or pasture based agriculture in the broad way was used. This information was combined with observations on site and in this way; the results obtained were produced through an iterative process of inductive and deductive reasoning.

7.2. Discussion of field work and data collection

The field work period was crucial to gather the majority of the information provided in this report. However, during this period, some unexpected events occurred which resulted in some "last minute" adjustments that in a way limited the research as described below.

Due to the local isolation of the case study community, all interviews and site visits had to be arranged in advance[32]. At the beginning a list of around 30 farmers to interview was available, but in reality it was only possible to meet 19 of them. The same happened with the other stakeholders (experts), initially 20 people of which only 10 were interviewed.

This happened for several reasons. Because of the distance and the costs associated, there was no opportunity to test the interview questions or to adjust them where necessary. I realise the interviews where too long and sometimes I spent up to four hours talking to a family farm and since my schedule was tied I had to prioritise questions I expected them to answer. In addition the distances from one property to another were quite big and I did not count on that when planning my timing in the case study region. Apart from that, not always farmers or experts were available, so even though I had made an appointment with them in advance, some were not willing to cooperate at the last

[32] The list with farmers name and contacts was provided by Professor Abdon Schmmitt and for technicians from EPAGRI

time. Later I understood that it is a cultural thing in Brazil, that people (mainly from the rural areas) feel more comfortable and cooperate more, when there is someone local involved. So as much as I could I had to find someone local from the region or at least someone they know (from EPAGRI, AGRECO, UFSC) to accompany me in order to facilitate the communication.

Finally, another aspect that could be a limitation in this research, is the fact that only farmers who had implemented the voisin system were interviewed in their properties and it would be more accurate to also interview those who dropped out from the project or even those who never implemented it to obtain a good base of comparison, for instance, farmers who adopted the voisin vs. farmers who did not adopt the system. In addition, the region has some 370 farmers and from this total only 40 are using the voisin system, representing only 10% of the farmers. From these 40, I only interviewed 19, representing 47% of the farmers under the voisin system and 5% of the total farmers of the region, which means that the results might not be representative to be generalized for the community as a whole.

In this way, the combination of these factors – isolation of the case study community, the time limitations and financial constraints, turned the sample size smaller than expected, which in a way is reflected in the results obtained, as described in the next section.

7.3. Discussion of the results

Because the fieldwork was essential for the realization of this research, the results obtained, are strongly associated with how the research was organized and conducted in the field.
As referred previously, it was difficult to obtain quantitative information from the case study region, so the results presented are strongly supported by qualitative information, based on perceptions, which may be a methodological limitation of the research. Nevertheless, an attempt was made to support all the data obtained during field work with information found in literature.
For the first and second research questions, aimed at identifying the drivers for the adoption of the voisin system and political and institutional framework in the region, information before the field work period was available – through the internal documents from the CiVi.net project, provided by the local partners of the project. This preliminary data was then compared with the answers provided by the stakeholders during the field work. In most of the cases, the information provided by farmers and other stakeholders was in line with the data previously acquired and also with data obtained from observations.

Regarding the assessment of the environmental impact from the adoption of the voisin system, general information was obtained from farmers about changes in the state of the environment, and when analysing their answers these were coded and three main elements farmers constantly refereed to were identified: biodiversity, soil and water.

Similarly, concerning the socio-economic changes, it was difficult to use proper and recognised indicators, since they are mostly evaluated quantitatively. Answers provided by the farmers were also coded/ categorised and based on this the socio-economic impacts used in the research such as production and productivity, income, family welfare, hours of labour were defined. In both cases, the results found were supported with information obtained from literature.

Lastly, to identify the extent to which the voisin can be considered a successful CBEM system, findings from the field work were strongly supported with information from literature, providing clear examples and comparisons to stress the validity of results. To conclude, despite the methodological issues referred above, the results of this research are considered accurate, consistent and they meet the purpose of the research.

It is not possible to determine whether or not if other methods had been used - for instance focus group method to conduct the stakeholder analysis, questionnaires, and more quantitative measures to identify the environmental and socio-economic indicators to evaluate the impact of the adoption of the voisin system in the region – the results would have been different. The same is valid for the ES approach; since the ES existing in the region has already been identified, it would be interesting to go more in-depth in this analysis by quantifying (e.g., amount of CO2, number and type of species existing, amount of clean water, etc.), and putting a value on them. All these aspects referred leave room for more research to be conducted in the future.

7.4. Comparison with other studies

In Brazil there is a strong environmental awareness and the ecosystem approach is gaining great importance in the country. Several studies were found in literature addressing the importance of the Atlantic Forest biome due to its richness in biodiversity and the danger of the practices developed by local communities inserted within this biome, which are threatening its maintenance. Environmental legislation is one of the main instruments designed to mitigate the negative impacts on the environment, although its compliance is not yet effective. In the case study region, there is also a strong awareness for collective management of natural resources which is translated by the existence of some local initiatives involving different stakeholder groups from the region, operating at different levels, formally or informally, from small to large farmers associations of regional and international institutions, and their role and engagement in these activities is starting to be documented. This study only focused on one of the management practices developed in the region - the voisin system - and there is also a wide range of information regarding the process of implantation and development of the system in the region. Most of the information obtained during field work period, matches with the information found in literature.

However, not much information (almost none) exists with respect to community engagement in the development and management of the voisin system. Thus, comparisons were made based on criteria found in the literature for other projects of community management and through these, was established the criteria to analyse the community management under the voisin system network.

This study supports community-based management and goes in the same line of thought of many authors, as Ostrom et al (1999), Agrawal and Gipson (1999), Berkes et al. (1989) among others who argue that not always the collective action leads to natural resources destruction as suggested by Hardin (1968), in his famous “tragedy of the commons” theory.

Nevertheless, it is important to emphasize that the community ecosystem management referred in this study, only makes sense if addressed in a broad sense, for instance, considering all management practices developed in the region involving the local community (not exclusively the voisin system). As mentioned in previous chapters, the land property rights are private in the region and the voisin system is applied in the farmer's private property, depending only on his willingness, which does not necessarily imply collective action, even if the management practices he develops on his property has impacts for the rest of the community.

Chapter 8. Conclusions and Recommendations

8.1. Conclusions

This case study achieved its intended objectives, namely, identifying whether the voisin system can be considered an example of success in the Encostas da Serra Geral region; and identifying the community based ecosystem management elements of the management practices under the voisin system. Moreover, the study managed to answer the five research questions it set out to look into as will be discussed below.

The answers to the first research question - “which key ecosystem services can be identified in the study area?” - was achieved through the ecosystem approach. The case study region is inserted in the Atlantic forest biome (rain forest) where there are also several related ecosystems including wetlands, lakes and rivers, woodland and scrub land, grassland/ rangeland, cultivated among others which provides multiple functions. The provision of ecosystem services in the region is directly related to the management practices developed. Nineteen ecosystem services were broadly identified and special attention was given to those generated by agro-ecological practices developed in the region (semi-natural ecosystems). They include *provision services* (meat and milk), *regulating services* (flood control, water quality control, carbon storage and climate regulation through greenhouse gas emissions, disease regulation, and waste treatment (e.g. nutrients, pesticides), *habitat services* (genetic biodiversity for use in breeding crops and livestock, nutrient cycling and the provision of water), and *cultural services* (scenic beauty, education, recreation and tourism). However, these ES and the services they provide are greatly threatened by the traditional management practices developed in the region.

The case study also managed to answer the second posed question - “what are the drivers that led to the adoption of the voisin system in the case study region?” - by using the DPSIR framework. Several drivers were pointed; all of them associated with the traditional management practices. They include extensive cattle grazing systems, chicken and swine produced intensively, expansion of pine trees and eucalyptus monocultures, and tobacco production involving big enterprises.

The goal of increasing productivity and consequently profits drives the intensification of these practices which results in a pressure on the environment caused by pollution and contaminations. These changes have a degrading effect on the environment, such as water and soil contamination (resulting from excessive use of pesticides and fertilizers, not proper treatment of manure), deforestation (from conversion of native forest to pasture and plantation of exotic trees – pine trees and eucalyptus) and soil erosion. Similarly socio-economic problems such as rural exodus, and health problems, including depression (and even suicides in extreme cases), were registered, as result of the low production and productivity, since all these practices require great investments and only rich farmers could afford to maintain themselves in the activity. Several policy measures have been put in place to mitigate these adverse impacts. They include government policies (changes in regulations),for instance the establishment of permanent preservation areas (APPs) and Legal reserve (RL); changes in farmers behaviour translated in a switch in input use and farm management practices; production of organic green goods, development of eco-tourism activities and the adoption of the voisin system; and co-operative approaches between farmers and other stakeholders among others.

In order to answer the third research question, “what political and institutional factors characterized the transition from traditional milk production to VRG in the case study area?” the stakeholder and

institutional analysis was conducted. Several actors and institutions are involved in the network that resulted from the switch from traditional practices to more agro-ecologic ones, including organic production, the agro-tourism initiative, and the adoption of the voisin rotational grazing system. However the implementation and development of these practices has been a dynamic process and consequently there have been changes in the role and interests of institutions, and the way they affect or are affected by decision making also varies over time. Taking into consideration these dynamics, nine stakeholder group were identified in this study. Although not all of them are directly related to the voisin rotational grazing system, they were taken as a part of the same network – the network of the institutions involved in the agro-ecologic activities developed in the region.

AGRECO (Association of Ecological Agriculturists from the Encostas da Serra Geral), UFSC (Federal University of Santa Catarina), the UVM (University of Vermont) and Santa Rosa City Hall were initially the most relevant stakeholder groups in the process of implementing the voisin system in the region (from 1998 to 2000). The role of these institutions changed over time, as in 2004 the voisin system started being developed in the region by the government, under EPAGRIs (rural state agency) leadership. Apart from EPAGRI, nowadays the dairy houses which exist in the region also play an important role, since they have direct contact with the farmers – they provide advices regarding better techniques to improve production and productivity - these include the voisin system. Currently, the network is wider, involving a multiple level administrative and geographical context. The former includes the community, government and state and supra-national levels, and the latter refers to the different levels were institutions operate, namely local, regional and international levels.

Regarding the research question four, “what environmental and socio-economic changes are perceived by the farmers as a result of the adoption of voisin rotational grazing system?” several socio-economic and environmental benefits are perceived by farmers as being generated by the adoption of the voisin system.

Environmental impacts were determined by analysing changes in biodiversity, soil, water and in climate change. Impacts on biodiversity include increase of flora species, with positive impacts on dependent fauna species, such as bees, bumble-bees, beetles, birds, and small mammals amongst others. Likewise, after the adoption of the voisin system, a major number of invertebrates are visible including earthworms and beetles. There was also an increase in the genetic biodiversity in areas of pasture. Regarding the impacts on the soil of pastures, the soil became more covered and humid and there is a great improvement in soil fertility. Concerning the impacts on water quality and availability, the adoption of the voisin system resulted in a better protection and less pollution of water sources, since animals no longer directly use rivers, springs and other water bodies as source of drinking water, there has also been a reduction in erosion of river banks which resulted from the trampling of animals whilst drinking. Additionally, there is a decrease in the contamination of superficial and underground waters due to a better vegetal coverage. Finally, in a global perspective, these improvements in biodiversity, soil and water, result in positive impacts on mitigation of climate change. For instance, the growth of *leguminosas* and grasses result in a better nitrogen fixation and significant increase in carbon fixation to the soil, as well as reduction of greenhouse gases emissions. The improvement in soil coverage, combined with a better soil fertility contribute to more carbon sequestration as there are a greater number of plants assimilating CO2 and less soil exposed. In addition, since cattle are kept out of the riparian and river areas, which diminish silting of water bodies, there is prevention from water contamination by manure and urine that might cause eutrophication.

The socio-economic impacts, in turn, were determined by analysing changes in production and productivity, farmers’ income and family welfare, hours of labour and community health aspects.

Concerning production and productivity, almost all farmers affirmed that due to the improved quality and quantity of the pasture after the adoption of the voisin system, their milk production (litres per day and litres per animal) duplicated and in some cases even triplicated. The division of pasture into multiple paddocks resulted in an increase in the number of cattle without the need to extend or acquire new pasture areas, which is as well related to the increase of pasture support capacity. Likewise, other related factors influenced positively milk production, including better animal welfare resulting from more balanced feeding, and reduction of diseases and other sanitary problems. Farmers also registered an overall growth in their economic profits which they associate to the increase in production and productivity in contrast with the reduction in production costs, due to less use of corn silage, chemical fertilizers and medicines. Farmers started having more financial stability resulting in better life conditions and family welfare, better labour conditions (proper work equipment, machinery, etc.), and even the recovery of farmers respect and prominence in the region, since farmers started getting more exposed to the outside world and were contacted by institutions, participating in the field days, etc., and were involved in consulting and being consulted by other people. The adoption of the voisin system resulted in the reduction in rural exodus in the region. This happened because young people started to see more advantages in staying in the region and taking care of their parents' properties or in acquiring land to start developing cattle grazing activity under the voisin system.

Last but not least, research question five, "what are the community based ecosystem management elements (if any) of the VRG system management practices?" was answered by identifying criteria (process, environmental and socio economic) to analyse the community based ecosystem management elements of management practices under the voisin system. Based on these criteria, it was found that there are in general strong CBEM elements under the voisin management practices, although with some exceptions.

Firstly, concerning the process, the CBEM elements are related to the existence of multi-level institutions, participation and decision making processes. Different actors are involved in the decision making process, including local (community), regional (community/state), national and international (NGOs and supra national organizations). There is not necessarily a clear bottom up or top down approach in the decision making process. Decisions are taken in a collective and inclusive way, involving different actors.

Secondly, environmental aspects were identified with a focus on ES protection, land property rights and resource management. The adoption of the voisin system resulted in the maintenance and improvement of existing ES at different scales in the region. Although the land property rights present in the region are private, there is a strong link between management practices under the voisin system and natural resource management, since management practices related to natural resources use go beyond the private property of the farmer. On one side the farmer is in control of the activities he develops on his property, e.g. cattle grazing, management practices regarding planting, soil protection, etc., but on the other side there are resources that are collective such as water sources, the forest in the surroundings of properties, etc., where its use is often regulated by law. The voisin system (technology and management practices) occurs in the private property without any effect or interference to the neighbouring farm activities (at least directly). However it is on important to refer that actions taken by individual farmers, for instance bad management practices, may have influence on the resource use of other farmers.

Finally, the socio-economic aspects, crucial in CBEM initiatives, include social learning, gaining knowledge and understanding, community building, and increasing trust and collective action situation. The first three aspects are reflected in the voisin system network, though participation in the "field days", group meetings/ discussions to exchange knowledge between farmers and other institutions involved in the process. The voisin system network also involves strong trust since farmers rely on the expertise of other institutions involved in the process (GPvoisin, EPAGRI,

technicians from dairy houses) that provide technical support. However, the collective action situation is not visible on the voisin system (due to the private property rights), which turns that the voisin system itself cannot be considered a CBEM.

8.2. Recommendations

Further research may be conducted within the CiVi.net project framework, not only to facilitate the achievement of the project goals, but also to stimulate improvements in management practices developed in the region and as well in potential transfer regions. Some suggestions for future research are provided below:

- Since the biodiversity of the region is seriously threatened by the management practices, it is important to conduct an integrated ecosystem assessment and management in the region in order to give a value on the identified ES and provide policy recommendations;

- Study the potential of developing Payments for Ecosystem Services and design the ideal payment scheme for the region, to compensate farmers due to the restrictions on the land use imposed by the environmental legislation (PPAs, LR);

- The CBEM that is referred should not only focus on the voisin system but in whole activities developed to mitigate the impacts of the traditional practices in the region (organic production, eco-tourism, etc.). In this way, the CiVi.net project should consider looking at the whole package of management practices developed in the region, and learn and record the best practices/ lessons from them in order to transfer these to other regions;

- The CiVi.net project should also consider recording and understanding the failures and reasons for failures of the management practices developed in the region, to ensure that when experiences are being transferred these to other regions, the latter are alerted of the risks;

- It is important to establish a framework for management that make it possible to evaluate the costs and benefits of different resource management strategies in relation to productivity and sustainability of the system as a whole;

- Introduce the concept community based ecosystem management in the region and provide feedback to farmers and other stakeholders on the impact of the management practices they adopt, and it is also important to stimulate other practices that might have positive environmental impacts;

- When defining the success criteria of the voisin rotational grazing system, or any other CBEM project or initiative it is important to have in mind that criteria should be defined considering the goals of the project, i.e., CBEM projects should have goals clearly defined and the criteria to assess the success or failure of the management practices under the CBEM initiative should be in relation to these goals.

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Annexes

Annex 1: CiVi.net partners
Partner 1: ZALF, Leibniz-Centre for Agricultural Landscape Research
Müncheberg, Germany (www.zalf.de)
Partner 2: EI, Ecologica Institute
Palmas, Tocantins, Brazil (www.ecologica.org.br, www.socialcarbon.org)
Partner 3: ETH, Swiss Federal Institute of Technology,
Zurich, Switzerland (www.pepe.ethz.ch)
Partner 4: FSD, Foundation for Sustainable Development
Main tasks: Lead of WP6, participant of WP2 and WP3
Address: Droevendaalsesteeg 7, 6700 AN Wageningen, the Netherlands (www.fsd.nl)
Partner 5: IDC, Organisation for International Dialogue and Conflict Management
Austria (www.idialog.eu)
Partner 6: NEO, Neotropica Foundation
San José, Costa Rica (www.neotropica.org)
Partner 7: FUNDAG, Foundation for Agricultural Development, Brazil
Vila Itapura, Campinas-SP Brasil 13023-200
(E-mail: fundag@fundag.br)

Annex 2: Summary of CiVi.net case study regions

Characteristics	CiVi.net CASE STUDIES			
	Case study#1. Ecoticos Mango Benin	**Case study# 2. Social Carbon**	**Case study#3. Santa Cararina**	**Case study#4. Maruja Community**
Original case study name	Management for Wetland Ecosystem Service Conservation: Térraba Sierpe and Golfo Dulce Mangrove Reserves, Osa Region, Costa Rica	?	Encostas da Serra Geral, focus in the Municipalities of Rio Fortuna and Santa Rosa de Lima.	Marujá
Type of ecosystem	Mostly Wetlands which can be seen as a keystone ecosystem of the pacific coast of Central America	Forest, wetlands and savanna.	Forest	Coestal/forest
Number of involved/ affected communities in the region	6 communities within the ECOTICOS project and 11 communities within the Mangle-Benin project	?	Several families from Santa Rosa de Lima and Rio Fortuna municipalities.	one community with around 174 inhabitants
Property status	Public property status	An area of 5,577.26 km² is preserved as Araguaia National Park further 13,584.99 km² is a cultural preserve for indigenous peoples. The northern third of the island is designated as a national park.	This area consists of 23% of the Atlantic Forest less than 3% falls under Protected Area	The community is living in a national park
Threats	Mass sea tourism, pressure from real estate and tourism infrastructure development hydroelectric dams international airport, lacked management guidelines and funding for effective state run conservation.	?	Rural exodus; lack of financial support to the native species; loss of ES. Contamination by pesticides due to the tobacco industry, expansion of pine trees monoculture and of pasture at the small properties which threats the forested areas and the maintenance of ES associated with its conservation at the landscape scale. Contamination in the main rivers as result of pig production. .	Assure that its culture can survive; Manage their ES (such as palm leaves and timber; fisheries; ecotourism); self-organization, community resource allocation, wealth distribution (they see as a solution) .
Aim for the solution	To mediate in the environmental management conflicts of the area with a clear participatory approach - community advocacy and direct community conservation	i)To help project developers to identify areas that can be improved in their projects and measure the impact of changes in different areas; ii) provide opportunities to involve stakeholders on a local level; this can enable sharing the profits from carbon credits on a community level; iii) reduce the project risk and improving stability on the long term, and iv) add value to the carbon credits to generate additional income in the communities.	Adoption of systems for dairy production and the creation of local and familiar dairy processing houses, making familiar agriculturists less dependent on enterprises.	To enforce the local participation of the community in the management plan of the park to continue defending their interests in order to guarantee that new modifications on the PEIC plan maintain the right of people to continue managing their ecosystem services. The solution aimed is:
Models used	Ticos model and integrative model (for further explanation see underneath)	SOCIALCARBON® methodology which has already been replicated successfully to other projects and regions in Brazil, Colombia, Turkey, and China.	The solution established by familiar agriculturists is related to the implementation of voisin and silvopastoral and familiar dairy processing houses, making familiar agriculturists less dependent on enterprises.	Management Plan of the PEIC.

Social environment	Traditionally low community engagement in wetlands conservation, low income and rural communities associated with object of conservation	The project took place in the Bananal Island surroundings. Social programs were focus on the small farmers living outside of the reserve. Many of the region's inhabitants had previously lived on the island itself but, following the federal government's establishment of the Araguaia National Park and the Araguaia Indian Reservation there, they have been re-settled in neighboring municipalities.	The communities are descendants from germans and italians, mixed with portugueses and local indigenous.	The Marujá is the most important local traditional community, with 174 inhabitants, 90,6% being there for generations. - The community has organized itself creating the Marujá Community Association (AMOMAR) which has an important role in the PEIC management.
Political environment	The current government wants to push mega projects of infrastructure in the area (hydro dams, airport development). There is political support for large scale tourism and real estate comes from local and national authorities but is not expressed openly due to the bad reputation of the experience in the Northwest region of Costa Rica (Nicoya Gulf, Guanacaste, Puntarenas). The administrative environmental tribunal has recently brought to the public its actions to stop the accelerated degradation of the Térraba-Sierpe area.		stable	stable
Economic environment	The CiVi.net case study can be considered as an "underdeveloped" area compared to the rest of the country with less opportunities for higher salaries and access to "social validating" consumption. It is an area that generates a significant amount of revenue for the country in terms of agricultural production and tourism. The tradition in the area for these last named revenues is mainly in the hands of large foreign corporations.	In terms of income, the settlement's situation was precarious, with most earnings being generated by men working in agricultural production. Bananal Island region has only rudimentary transport and communications infrastructure and some areas could not be reached during the raining seasons. Project workers found that the region's inhabitants tended to view the forest as an obstruction, hindering the expansion of pastoral and agricultural lands	The municipalities have in the agricultural activities their main yields. The familiar agriculture is dominant and there is a pressure by big enterprises for pine tree monoculture implementation. Tobacco is one of the main incomes for the familiar agriculturists, causing impacts on the natural resources by pesticide contamination as well as impacts on the agriculturists' health. Milk and corn production represent also an important income for these municipalities, especially in Santa Rosa de Lima and Rio Fortuna.	Tourist own 1/3 of the existing 77 buildings in the community. The Maruja community think the ecological tourism can help them to resist the pressure. Presently almost of all of them put their house and/or their backyard to rent in the holidays seasons. They also started restaurants, bars and small hostels. That is now the main reason the press the authorities to invest in sanitation infrastructure.

Annex 3. Semi structured interviews

3.1. Interviews to farmers

My name is Vassilca and I'm developing my Master thesis research under the CiVi.net project, a partnership between the University of Wageningen and the centre of agricultural sciences of Federal University of Santa Catarina (UFSC). The goal of the research is to understand what factors have contributed to the implementation and development of voisin system in the municipality in some agricultural properties of Santa Rosa de Lima, in order to assess the potential to transfer this experience to other areas in other countries in the world. I would like to ask you some questions. I assure you that information provided by you will be treated as confidential and will be used for academic purpose only.

I - IDENTIFICATION

1.1. Name:
1.2. Age:
1.3. Gender:
1.4. Land property rights
1.5. Size of the property:

II. Economic activities:

2.1. What are the economic activities developed in the property?

___ agriculture (_____)

___ milk production

___ meat production

___reforestation

___pig production

___chicken production

___other: _____

2.2. What is the activity that generates the greatest economic profitability?

_____

2.3.What is the income generated by this activity per hectare/year?

_____

III. Voisin System

3.1. Do you think that the voisin system is a sustainable practice?

(a) yes _____ (b) no_____

why?

_____

_____

3.2. Why do you implemented the voisin system in your property?

_____

_____

3.3. In your opinion what are the main advantages/benefits obtained by the deployment of the system voisin? (answer in hierarchical order: 1, 2.3)

(a)___ increase in income

(b) ___ increase of production and support capacity

(c) ___ Improvement in control of animal desiese

(d) ____Easy to manage

(e)___Improvement on soil coverage

(f)___ Other (specify)_____

3.4. In your opinion what are the main disadvantages obtained by voisin system deployment? (answer in hierarchical order: 1, 2.3)

(a) ___initial cost
(b) ___ labour required
(c) ___ lack of techical assistance after implantation
(d) ___sensibility
(e) ___ other specify) _____

IV. the voisin system

4.1. How do you classify the investment for the adoption of the voisin system in your property?
(a) _____high (b) _____ low (c) _____ fair

4.2. The resources were
(a) _____ own (farmer) (b) _____bank (c) ____ other

4.3. How long it take to recover the investment?
(a) ____ 0-2 yrs (b) _____ 3-6 years (c) ____other (specify) _____

4.4. In your view, the implementation of the project was:
(a) ____very difficult (b) ___dificult (c)___ not dificult

4.5. In your opinion, what were the main difficulties in the implementation of projects?

(a)___ financial resource (b) ___ lack of know-how (c) ___farmers didn't believe in the system
(d)___ interest conflicts (e)____ other (specify) _____

V. Changes after the adoption of the voisin system

5.1.What environmental changes (if any) you perceive when you compare before and after the adoption of the voisin system?
Biodiversity _____
Water (quantity/quality) _____
Soil _____
Climate change _____

5.2. What socio-economic changes (if any) you perceive when you compare before and after the adoption of the voisin system?
Production and productivity _____
Costs _____

Support capacity _____
Income _____
Family Welfare _____
Hours of labour _____
Animal welfare _____
Cattle size _____
Other _____

v. Political/ institutional aspects

5.1. What are the main the main actors involved in the implementation of the voisin system in the region?

EPAGRI _____
AGRECO _____
UFSC _____
Dairy houses _____
Other _____

5.2. What was/is the role of each of them?

_____
_____
_____

5.3. How was the decision making process?

(a) _____ Collective involving all the stakeholders
(b) _____ some institutions had more power than others in the decision making process
(c) _____ farmers where the more important
(d) _____ other _____

VI. Community based ecosystem management

6.1. In your opinion, the voisin (at the time of implantation) was managed in a collective or private way?

(a) ___collective (b)___private (c)____other (specify) _____

6.2. Why you think it was collective/private?

_____

6.3. How it is nowadays? There is any change?

(a) _____ yes (b) _____no

Explain_____
_____

VII.To conclude:

7.1.Do you would recommended the voisin system to other farmers?

(a) ____yes (b) _____no

Why? _____

7.2. Do you would like to say something else before we finish this interview?_____

Annex 3.2. Expert interviews

My name is Vassilca and I'm developing my Master thesis research under the CiVi.net project, a partnership between the University of Wageningen and the centre of agricultural sciences of Federal University of Santa Catarina (UFSC). The goal of the research is to understand what factors have contributed to the implementation and development of voisin system in the municipality in some agricultural properties of Santa Rosa de Lima, in order to assess the potential to transfer this experience to other areas in other countries in the world. I therefore kindly solicit your cooperation in filling out the attached questionnaire, while assuring you that all furnished information would be treated with utmost confidentiality and strictly for academic purpose.

RESPONDENT'S CHARACTERIZATION

Full name: _____

Age:_____

Profession: _____

5. **INTRO**

1.1. General, what are the problems that this municipality has attended over the years?

1.2. Environmental problems _____

_____

(a) Social problems _____

_____

(c) Economic problems _____

_____

(d) Political/institutional problems _____

_____

(f) Other_____ _____

1.3. The land property rights in the region are:

(a)___ private property of the farmer (b) ___ State/ municipality property (c) ___other

II. <u>VOISIN SYSTEM IMPLEMENTATION</u>

2.1. In your view, the implementation of the project was:

(a) ____very difficult (b) ___dificult (c)___ not dificult

2.2. In your opinion, what were the main difficulties in the implementation of projects?

(a)___ financial resource (b) ___ lack of know-how (c) ___farmers didn't believe in the system

(d)___ interest conflicts (e)____ other (specify) _____

2.3. Do you think that the voisin system is a sustainable practice?

(a) yes _____ (b) no_____

Why?_____

_____

2.4. The voisin in the Encostas da Serra Geral was implemented because:

(a) ____ many farmers were facing difficulties in traditional systems

(b) ____ farmers have seen the results of pilot projects

(c) ____ farmers wanted to take chances and innovate

(d) ____ Other

(specify)_____

_____

2.5. There were improvements in Santa Rosa de Lima after the implementation of the pro-
ject?_____
_____

2.6. There are any specific problems that occoured in the region after the adoption of the voisin system?
_____
_____

3. <u>Acotors and Interactions</u>

3.1. In hierarchical order, which were the main actors involved in the adoption of the the voisin system in the region?Numbering (1, 2, 3 ...)

(a)____UFSC (b) ____EPAGRI (c)____ AGRECO (d) ____Municipality (e) ____Dairies
(f) ___ farmers (g) ___ all these actors (g) other _____ (specify)

3.2. what was the role of each actors (including yours)?

AGRECO:_____
_____
_____

EPAGRI:_____
_____
_____

UFSC:_____
_____
_____

Municipality:_____
_____
_____

Farmers:_____
_____
_____

Other_____
_____
_____

3.3. That institutional arrangements were needed for the adoption of the voisin system (ie, institutions involved and interactions between them)?

IV. <u>COMMUNITY BASED MANAGEMENT</u>

4.1. The way the project was conducted in the community, was in accordance with the decision of farmers?

(a)____ yes (b) ____no (c) ___ sometimes

Why?
_____
_____

4.2. In your opinion the field days were important in the decision making process?

(a)____ yes (b) ____no (c) ___ sometimes

Why?

_____
_____

4.3. The opinion of the farmer was approached in the days of field?

(a)___yes (b) ___no (c) ___sometimes

Why?

_____
_____

4.4. In his opinion the decisions of AGRECO/EPAGRI/UFSC were discussed with all farmers involved or affected? (a)____ yes (b) ____no (c) ___ sometimes

Why?_____
_____

4.5. And today, the decisions of the other institutions AGRECO/EPAGRI and involved in voisin are discussed with all farmers involved or affected?

(a)____ yes (b) ____no (c) ___ sometimes

Why?

4.6. In your opinion, the voisin system at the time of implantation was managed in a collective or private way?

(a)___collective (b)___private (c)____other (specify) _____

4.7. Why do you consider collective or private?

_____
_____

4.8. Do you would like to add any information before we close the interview?

_____

Annex 4. CiVi.net case study Delphi Scoring

4.1. Selection criteria

Selection of criteria			Indication	Weighting
nr	**Criteria***	**Explanation**		**%**
1	One of our CiVi.net CSO partners is part of the local community network there	*see DoW, p. 7*		**2.09%**
2	A CSO plays an active role in ecosystem management	In order to analyze the role of CSOs, they need to be involved actively. (DoW part B, page 8 upper part, 3rd bullet point)	0= There is no CSO involvement in ecosystem management 5=A CSO is working on ecosystem management but only as a minor task among many other things 10 =There is a dedicated CSO that focuses primarily on ecosystem management	**3.39%**
3	Governance involves CSO at one level	Governance: CSO involvement at least at one of the levels		**3.91%**
4	Different environmental issues are addressed	*see DoW, p. 7* We want to analyze a broader range of environmental problems that include different ecosystems and different ecosystem services		**1.17%**
5	Environmental and social-economic aspects are considered in equal measures	*see DoW, p. 7* Solutions strategy improves environmental situation (= ES provision) but also improves (economic) livelihoods of local people/communities		**4.69%**
6	Governance structures involve multiple levels	Governance: Multiple levels: local =community, regional = municipality/state, national = federal and maybe even international = e.g. international active NGOs		**1.56%**
7	Governance structure has policy relevance/impact	Governance: Policy relevance/impact (solution strategy can be a role model for policy solutions, e.g. ICMS-E Policy relevance/impact with respect to: can the developed solution strategy serve as a role model, so policy is motivated to support and promote the solution strategy in general/for other regions/on		**2.74%**

		a larger scale.		
8	Strong/very committed local partner	Transfer: Strong/very committed local partner in charge to organize case study activities, specifically transfer activities		**4.30%**
9	Contribution to diversity	CBM: Contribution to diversity: each case study makes an interesting case for analysis (WP4 and/or WP5), i.e. covers a different aspect of community based management in a different embedding that is in combination with other instruments, as only the analysis of the whole instrument package provides a complete understanding of the developed solution strategy. *different in terms of: different aspects in CBM, CBM in combination with different other instruments (in the whole solution package), different embeddings/frame conditions get considered		**1.56%**
10	Contribution to complementarity	CBM: Contribution to complementarity: each case study contributes with its specific factors constellation to the understanding of community based management as a whole in different frame conditions (frame conditions: i) environmental = different eco-systems; ii) socio-economic = different community characteristics, iii) institutional/political = different institutional and political infrastructures)		**2.61%**
11	There is a collective action situation related to the ES in either case study or the transfer region	Required for experimental workshops, large parts of DoW part B discuss Ostrom and collective action. “Collective Action” means more than 1 household are able to take decisions that have an interlinked effect on the ES provision		**3.78%**
12	Is there any information on the physical	Are there any measurement results on the quantity of the physical good providing	0= No information available 5= Models are available,	**2.87%**

	level of ES provision by the project?	the ES (e.g. amount of CO2, number and type of species, amount of clean water, etc.)? Or at least models? ES are a key concept in the DoW and it implies quantification. As there are no natural science partners in CiVi.net, we can only gather social data and not perform any measurements within the project ourselves.	but no data 10 = There is physically measured data on ES available covering most of the ES provided by the instrument	
13	Resource must be a common resource or common pool resource	The resource under consideration shall be a common (pool) resource and should be managed not only by a private owner (interface with criteria 6). If the resource is privately owned the use of the resource must have important implications for the community/communities, i.e. is of common interest. It shouldn`t be the case that it is only private business.		**3.91%**
TRANSFER REGION				
14	First ideas for possible transfer regions do exist	*see DoW, p. 7*		**1.83%**
15	Transfer region is defined and close by the case study region	Transfer: Transfer region is close by (in terms of accessibility and practicability) by for practical reasons, such as organizing field days, etc.		**4.04%**
16	Transfer region shows genuine interest in solution strategy	Transfer: If transfer region shows high interest in solution strategy this goes together with high motivation to get engaged into project activities, high likelihood of success (assumption)		**4.69%**
INSTRUMENTS				
17	There is at least one management instrument that has components of both "community based" and	See DoW, abstract, 1st bullet point and DoW part B, page 8 upper part, 4th bullet point	0= Neither components of community based nor environmental management can be identified in any instrument 5= There is at least one instrument that is strongly community	**3.39%**

	"environmental management"		based but does not involve environmental management OR There is at least one instrument that is not community based but is fully about environmental management / There is at least one instrument that has weak components of both community based and environmental management 10 = There is at least one instrument that is fully community based and focuses primarily on environmental management	
18	Community based management is one aspect in the solution package	CBM: Community based management (=CBM) is one aspect in the whole instrument package		**1.84%**
19	Payments for ecosystem services could be one of the options for management instruments	See DoW 7		**2.61%**
20	Several ES addressed and/or co-benefits to other ES	ES: Solutions strategy addresses several ES or co-benefits with other ES occur		**3.65%**
21	High socio-economic benefits (livelihood impacts)	Solution strategy goes with high socio-economic benefits, that is impacts positively on livelihoods of communities		**4.17%**
22	The key instruments are implemented already	Evaluation of not-yet-implemented instruments is difficult and theoretical, transfer is irresponsible as success is not proven (DoW part B, page 6 lower part, 1st bullet point: wording: "*have been* developed" and many other parts of the DoW using past tense regarding implementation of management instruments)	0= The instruments are not implemented 5= The instruments are by and large implemented but are still expected to change significantly 10= The instruments are fully implemented since several years and are in a stable state of only incremental improvements	**2.61%**
23	The key instruments	It's not responsible to transfer a non-successful or	0= The instruments failed, the natural	**2.35%**

	can be considered successful in terms of natural resource management	non-proven solution, (DoW part B, page 6 lower part, 1st bullet point) (wording: "*successful* solutions for the *management of natural resources*")	resource is detoriating 5= The instruments have shown some improvement but large challenges remain in resource management 10 =The resource is managed sustainably.	
24	Importance /relevance of the environmental problems to the region which are solved/shall be solved by the instruments	Problems which the instruments try to solve are main problems or just secondary issues		**3.13%**
25	Sustainability of the model	There are no major obstacles, difficulties, risks, etc that substantially challenge the model's continued implementation now and in the future (sustainability)	0= Major challenges for sustainability can be identified 5= difficult to say and estimate 10 = no major challenges can be identified	**2.35%**
26	Match of management instrument and problem-solving impact: degree of success	In how far does the instrument here adequately respond to the main environmental / ecosystem related problems in the region?		**3.65%**
COMMUNITY				
27	Level of Commitment of community members to support transfer and share experience of the solution	Estimated or expressed willingness /objections of community members to contribute to the transfer of the identified solution / model.	0 = Most community members have expressed/shown unwillingness to support transfer 5 = Community members have neither clearly expressed support nor unwillingness (difficult to estimate (un-)willingness) 10 = Most community members have expressed/ shown willingness	**2.09%**
28	Particularities of the community do not impede the solution's transferability	Any specific aspect (e.g. leader, economical and ecological condition, etc.) should not impede successful replication of the model.	0= Major specific aspects with high risk to impede successful replication 5= Minor specific aspects that may impede transferability (difficult to estimate) 10= no impeding specific aspects	**2.35%**

29	The ES management solution is considered successful by the majority of community members	The model is supported by the majority of the community members.	0 = Only very few community members consider ES management solution successful 5= ES management solution is considered successful by many (but not the majority), resp. difficult to estimate 10= ES management solution is considered successful by the majority	**1.30%**
30	The model contributes towards strengthening the community identity	Does the solution contribute towards the self-identification of the community?	0 = model has no obvious impact on community identity 5 = has some impact 10 = is important for community identity	**4.17%**
		OTHER		
31	High chance that CiVi.net can make a difference/impact	Success: High chance that CiVi.net can make a difference/impact (e.g. revive/strengthen community engagement) (or the other way round: low chance of failure of our activities!)		
32	Synergies	Success/Win-Wins: Synergies with other local projects (aim for win-wins)		
33	Data availability and access-ability			

***Take into account that the criteria should be suitable to be weighted in a scale from 1-10 (1 not fulfilled 10 completely fulfilled)**

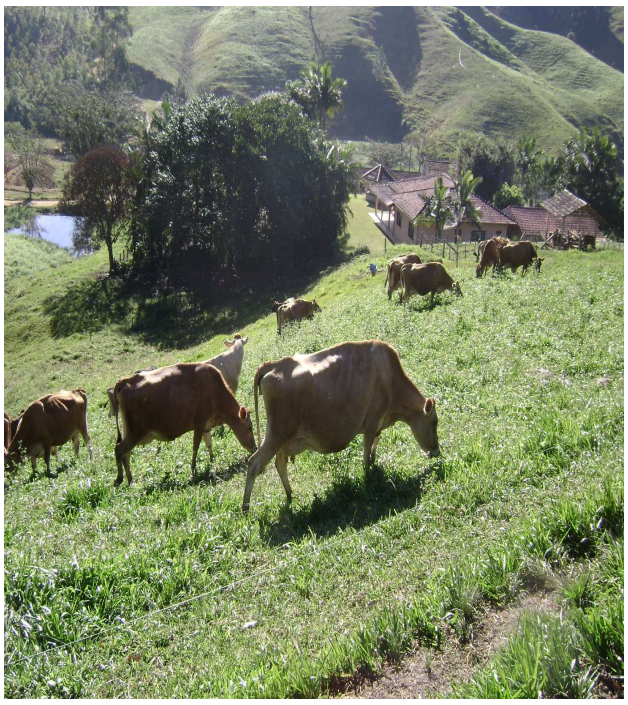
*** Explanation when word model is used in a criteria: Depending on the case study it might be governance model or pure PES scheme.**

Annex 4.2. Outcome criteria

		Santa Catarina
Criteria NR	**Weighting %**	**Score per criteria**
1	2,09	70
2	3,39	79
3	3,91	82
4	1,17	71
5	4,69	89
6	1,56	74
7	2,74	74
8	4,3	89
9	1,56	83
10	2,61	80
11	3,78	50
12	2,87	48
13	3,91	70
14	2,61	81
15	1,83	67
16	4,04	59
17	4,69	72
18	5,21	69
19	3,38	43
20	1,84	78
21	2,61	88
22	3,65	81
23	4,17	65
24	2,61	75
25	2,35	72
26	3,13	64
27	2,35	82
28	3,65	84
29	3,39	90
30	2,09	68
31	2,35	60
32	1,3	64
33	4,17	80
		Final Score
		73

Annex 5. Some field work pictures

5.1. Destruction of the native forest to plant pine trees and eucalyptus monoculture to produce wood



5.2. Visiting properties and interviewing farmers

5.3. Visiting a family dairy house