REDD+ and Climate Smart Agriculture in landscapes

From national design to local implementation

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1

Introduction

1.1 Background

Climate Change (CC) paired with the rapidly growing world population call for new approaches to land management that are both sustainable and accommodate the complex interactions between social systems and environment. To this end, it is important not only to mitigate CC by reducing greenhouse gas (GHG) emissions, but also to adapt to the changing environmental conditions (Locatelli, 2011).

Agriculture, forestry and other land uses are responsible for almost a quarter (24%) of global anthropogenic GHG emissions (IPCC, 2014) and hence have a high potential for both CC mitigation and adaptation. Additionally agriculture and forests coexist in the same landscape and are deeply interlinked. Agriculture is central in CC discourses not only because it`s the largest driver of deforestation and forest degradation (Hosonuma, 2012) but also because it`s the sector that is highly impacted by CC, which most often results in a decline in agriculture yield. This highlights the need of innovation towards adaptive agriculture, entailing higher production with fewer inputs. Forests are important because they play a major role in CC mitigation, via carbon storage in their biomass, and in providing ecosystem services that are crucial for agriculture, such as water, pollination and control of pests and diseases.

The recognition of interlinkages amongst forests, agriculture and other land uses led to a new line of thinking: the “Climate-Smart Landscape” (CSL) approach (Scherr et al., 2012; Minang et al., 2013). CSL is an integrated, landscape-level approach that widens the scope from the farm level to the landscape level, allowing analyses of landscape dynamics that lead to deforestation and assess the trades-off between land uses (Reid et al., 2010). “Landscape” is defined here in broad conceptual terms: rather than being simply a physical space, it represents a complex system with mutually interacting social, biophysical, human ecological and economic dimensions (Farina, 2000). Additionally, CSL emphasizes stakeholder involvement and simultaneous achievement of multiple objectives (Sunderland, 2012) including food security, Ecosystem conservation, rural livelihoods, CC mitigation and adaptation.

The transition to CSL relies upon effective policies and the involvement of stakeholders in different layers of governance, such as policy makers, local farmers, researchers, NGOs and agribusiness companies. Additionally, effective CSL rely upon communication and social learning among these stakeholders. It`s based upon national policies that take into account drivers of deforestation and forest degradation (DD) and upon regional policies that take into account how local stakeholders make land use decisions: without such understanding policies are unlikely to be effective. Moreover, a shift towards CSL relies upon the organization aspect of innovation: CSA adoption, as any other innovation is not only based upon technical knowledge, but also social learning and social organization. Such learning also contributes to promote adaptive capacity, which is based upon continuous learning by doing and trial and error. Additionally CSL can be supported by collective action: a shift towards CSL cannot be achieved by a single individual but it relies upon collaboration among different stakeholders.

Despite the interlinkages of forests and agriculture and their role in CC mitigation and adaptation, these sectors have been managed by different initiatives in the policy arena. In particular, two initiatives gained attention to enable CC adaptation and mitigation. The first one is the United Nations Collaborative initiative on Reducing Emissions from Deforestation and forest Degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of carbon stocks (REDD+). REDD+ is a potentially powerful vehicle for stimulating developing countries to practise mitigation by reducing GHG emissions and also to implement adaptation measures through sustainable forest management. REDD+ incorporates safeguards as well, such as requirements for transparency, participation, protection of biodiversity and the rights of local people (UNFCCC, 2011). The United Nations Framework Convention on Climate Change (UNFCCC) emphasizes that co-benefits should be promoted while implementing REDD+ and that 'the needs of local and indigenous communities should be addressed' (UNFCCC, 2007: 8). Although REDD+ is increasingly acknowledging the importance to address drivers of DD, its emphasis is mainly on CC mitigation and forest preservation rather than CC adaptation.

The second one is Climate Smart Agriculture (CSA) initiative, initiated by FAO with the aim of achieving the triple wins of CC mitigation, adaptation and food security. CSA involves the use of 'climate-smart' farming techniques to produce crops or livestock, which could help lowering deforestation for agricultural use as well as enhancing productivity, build resilience to CC and mitigate the GHG emissions (Meybeck, 2013). Although CSA represents a step forward towards greater integration of adaptation and mitigation, its emphasis in practice is mainly on agricultural goals and CC adaptation (Graham, 2012) rather than on CC mitigation goals.

1.2 Effective REDD+ should address drivers of deforestation and degradation

Despite their high potential, issues related with implementing REDD+ and CSA strategies are numerous. A major challenge in implementing REDD+ is the selection of national policies and interventions that effectively address drivers of deforestation and degradation (SBSTA, 2013). Drivers of deforestation and degradation (DD) are the direct and indirect causes of forest conversion. These vary in scale from local pressures resulting in land use conversion to global macro-economic incentives, and are often the product of complex interactions between social, environmental and political factors. The major drivers of DD originate from the non-forest sector and include agriculture, infrastructure development and mining (Hosonuma et al., 2012). REDD+ interventions can be divided into direct and enabling activities. Direct interventions are specific, often local activities that result in a direct change in the carbon stock (i.e. reforestation, protected area strategies, agricultural intensification to reduce pressure on forests).

Enabling interventions are aimed at facilitating the implementation of direct interventions (i.e. improved law enforcement against illegal logging, and land tenure regulation). Hence direct interventions are more directly linked to direct drivers and are focused on local, context-specific activities. REDD+ strategies that focus solely on direct drivers to demonstrate quantifiable emissions reductions may place less emphasis on addressing the critical underlying drivers. It is crucial that these are also addressed if interventions are to succeed in achieving the emissions reductions (Kissinger et al., 2012). Despite the importance of designing interventions that address specific drivers of DD, there is very little literature available on how different countries are selecting and designing interventions. Questions also remain about how countries prioritize different interventions, given their analysis of what the drivers are.

Additionally, systems need to be in place to monitor the effectiveness of such drivers in addressing deforestation and forest degradation (Romijn et al., 2012). Monitoring drivers of DD is needed for several reasons: to understand their importance and processes at work, to attribute emissions to specific causes (i.e. nationally), track their activities over time, to design dedicated mitigation actions that address them, and to assess the impact of these (Herold and Skutsch, 2011). Monitoring drivers that lead to DD provides essential information for keeping track of the effectiveness of direct REDD+ interventions. However, current REDD+ monitoring efforts are largely focused to meet international reporting needs and thus are concentrated on the assessment of change in forest area (deforestation) and related carbon emissions, while in only a few cases is the forest area change analysed by linking it to specific driver activities and follow-up land use (GOFC-GOLD, 2011, Herold et al., 2011).

1.3 Designing policies for Climate Smart Landscapes

Despite the importance of adopting an integrated management, via CSL, the latter is still mainly at a conceptual stage, and there have been few efforts to elaborate practical mechanisms for land-based actions to achieve its goals (Scherr et al., 2012). To encourage adoption of CSL strategies for achieving both mitigation and adaptation, it's crucial to identify the right policy mix to steer local stakeholders' land use decisions in such a way that trade-offs are well understood and carefully considered. Additionally, in the process of designing these policies, local stakeholders should be taken into account, because they are key drivers of landscape dynamics, and they will change their land use only if such changes are in line with their goals and needs (Weatherley-Singha and Gupta, 2015). Nevertheless, so far most policies have failed to attain their envisaged effect because they were designed in a top-down manner without consideration of local specifics and the goals and needs of local stakeholders (Ducrot et al., 2013). Research is still needed to develop policy formulation and planning approaches that entice farmers to reflect upon and change agricultural practices to reduce pressure on the forest, increasing carbon storage. Integrated assessment tools, such as mapping, scenario analysis and simulation models, can guide stakeholders in exploring trade-offs between different factors such as agriculture production, forest preservation, CC mitigation and adaptation. Hence such tools support stakeholders to identify the best options for landscape management across agricultural and forestry systems at various temporal and spatial scales (Beddington et al., 2012; FAO, 2013; Minang, 2013).

1.4 The role of agribusiness companies in landscapes

Besides national policies, other important factors play an important role in achieving CSL. CSL are based upon land use decisions linked to the multiple and often conflicting interests of different stakeholders in different level of governance and are influenced by multiple factors such as regional trade, power dynamics, subsistence forest dependency, resource and technology access, population growth and poverty. Hence effective CSL implementation relies upon engagement of multiple stakeholders in different layers of governance. Important actors are agribusiness companies, as they often have resources such as physical, financial, human and social capital (Dentoni and Krussmann, 2015). They may influence the sustainability of the landscape where they operate depending on how they develop linkages with local stakeholders. Such stakeholders are in their supply chain, such as farmers or producers of raw materials and local buyers, as well as non-market actors such as municipalities, extension officers, non-governmental organizations, communities, research institutes or civil society organizations.

At the same time, a growing amount of agribusiness companies are facing challenges related to resource limitation, land scarcity and CC impacts. Such challenges originate from outside the farm/production plot and have unprecedented effects on business performance. For instance, deforestation, groundwater depletion and habitat fragmentation can strongly influence the stability of key sourcing and operational regions leading to a decrease in agriculture production and income (KPMG, 2012). To cope with these challenges a growing number of companies are making a shift from the value chain approach to a landscape-scale approach (Kissinger et al., 2013). Adopting a landscape-scale approach provides several benefits. For instance, investments in healthy communities and ecosystems enable a stronger position in strategic sourcing areas and hence a long-term business success. Additionally such investments help to lower reputational and organizational risks including by achieving by achieving corporate sustainability and compliance with national laws or voluntary standards (Kissinger et al., 2013). Management of land use interactions at the landscape scale is essential to enhance the multi-functionality of landscapes over time. To this aim, it’s crucial that agribusiness coordinate with local stakeholders and planners to identify, negotiate and manage the impacts and trad-offs of different land uses in the landscape. Despite the fact that a growing amount of agribusiness companies are adopting a LA, current understanding of LA initiatives by agribusiness is fragmentary. In particular more light should be shed upon what are the objectives of agribusiness companies initiating the LA, whether project activities contribute to achieve the multiple objectives of CSL, how stakeholders involved and whether the project aim at monitoring project activities.

1.5 Social learning and organization for CSA adoption

Besides agribusiness companies, the engagement of local stakeholders is crucial in achieving CSL, via the adoption of CSA practices and by lowering pressure of forests. CSA adoption from local farmers is not straightforward and questions still remain about how the transition towards CSA will actually materialize (FAO, 2013). As any other type of agriculture innovation, the adoption of CSA by local farmers relies upon several factors that go beyond technology transfer and include socio-economic factors and organizational factors. A transition towards CSA requires innovation processes based on social learning (FAO, 2013), which refers to learning by various types of social actors. Through knowledge sharing, actors gain insight in the issue-at-stake, they create mutual understanding and a joint vision on the problem. Additionally they can agree on possible solutions, and engage for collective action (Leeuwis et al., 2002; Koontz, 2014). This may lead to technical, social and/or institutional transformations (Gerlak and Heikkila, 2011).

Participatory tools used to encourage social learning and collective action are numerous, among which Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) (Engel and Salomon, 1997) and 'Platforms for Resource Use Negotiation' (Röling and Jiggins, 1998; Steins and Edwards, 1999). A particular tool is increasingly used to encourage social learning among different stakeholders: Role-Playing-Game (RPG), an approach in a form of a board game, which have a great potential in improving communication, discussion (HarmoniCOP, 2003) and promote social learning and social organization. Despite this potential, there is little research that assesses its role in triggering social learning and social organization for the adoption and up-scale of CSA practices.

1.6 Research objectives

The main objective of this thesis is to assess policies and approaches for integrating REDD+ and CSA in landscapes. I performed this assessment via different levels of analysis, from policy assessment to local implementation, structured in the following four research sub-objectives:

- Sub-objective 1: Analyse how REDD+ national policies link to drivers of deforestation/degradation and elaborate on implications for monitoring systems;
- Sub-objective 2: Explore synergies and trade-offs between REDD+ and CSA policies in landscapes by considering local decision-making;
- Sub-objective 3: Evaluate the role and drivers of agribusiness companies in shaping Climate Smart Landscapes (CSL);
- Sub-objective 4: Design and implement a Role-Playing-Game to trigger social learning and social organization for the adoption and up-scale of CSA practices.

1.7 Thesis outline

This thesis consists of six chapters of which chapter two to five form the core of the thesis (figure 1.1). Chapter 2 presents a comprehensive and comparative assessment of interventions proposed by 43 REDD+ countries in 98 readiness documents. We summarize the types of interventions and assess if they are formulated referring to the drivers of deforestation and forest degradation that they are aiming to address. Based on this assessment we consider the implications for systems for monitoring effectiveness of proposed interventions. Chapter 3 introduces and applies a framework for ex ante assessment of the impact of land management interventions and for quantifying their impacts on land-based mitigation and adaptation goals. Chapter 4 provides a review of projects initiated by agribusiness companies and their contribution to achieve CSL goals. Chapter 5 presents an assessment of the impact of a role-playing game conducted with local farmers in Apuí (Southern Amazonas) on social learning and social organization aimed at adopting CSA practices. In chapter 6 the findings from previous chapters are summarized and a discussion is presented on the main findings of this thesis, future research opportunities are proposed and conclusions are drawn.

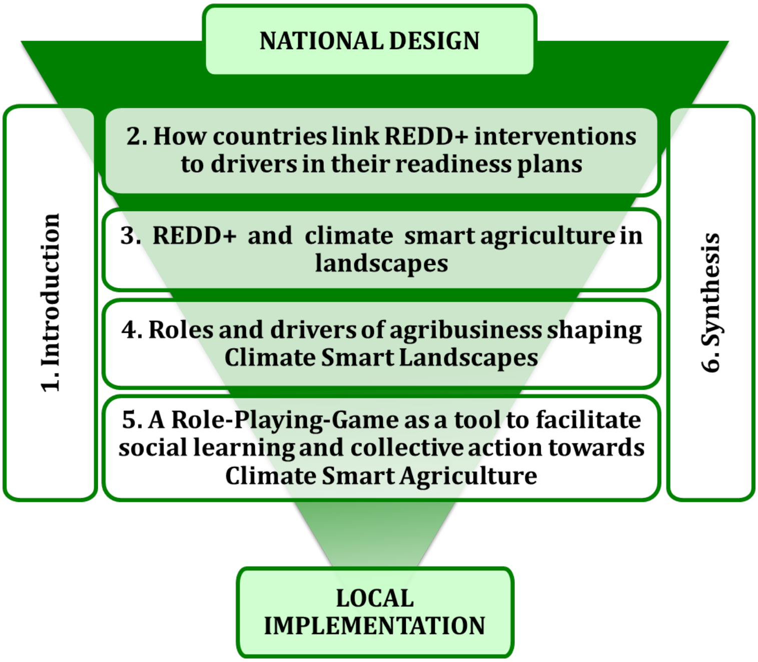

Figure 1.1: Overview of the chapters of the thesis.

Chapter

2

How countries link REDD+ interventions to drivers in their readiness plans: implications for monitoring systems

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Maria Brockhaus and Margaret Skutsch

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Abstract

Countries participating in the REDD+ scheme are in the readiness phase, designing policy interventions to address drivers of deforestation and forest degradation (DD). In order for REDD+ interventions to be effective, it is essential that they take into account the specific drivers that they aim to address. Moreover it is crucial to design systems that monitor the effectiveness of the planned interventions.

In this chapter we provide a comprehensive and comparative assessment of interventions proposed by 43 REDD+ countries in 98 readiness documents. We summarize the types of interventions and assess if they are formulated referring to the drivers of DD that they are aiming to address. Based on this assessment we consider the implications for systems for monitoring effectiveness of proposed interventions. Most countries reviewed link proposed interventions to specific drivers of DD. The majority of the countries making this link have better driver data quality, in particular those that present their data in ratio or ordinal terms. Proposed interventions focus not only on activities to reduce deforestation, but also on other forest related REDD+ activities such as sustainable forest management, which reduce forest degradation and enhance forest stocks. Moreover, driver-specific interventions often relate to drivers not only inside but also outside the forest sector. Hence we suggest that monitoring systems need to assess not only deforestation rates through remote sensing, but also degradation and other carbon stock changes within the forest, using more detailed ground level surveys and measurements. In addition, the performance of interventions outside the forest need to be monitored, even if the impacts of these cannot be linked to specific changes in forest carbon stock in specific locations.

Keywords: Drivers of deforestation and forest degradation, monitoring systems, proposed REDD+ interventions, REDD+, readiness documents.

2.1 Introduction

In recent years the *Reducing Emissions from Deforestation and forest Degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of carbon stocks* (REDD+) scheme has gained increased attention in the policy arena. REDD+ represents a potentially valuable incentive for developing countries to reduce greenhouse gas (GHG) emissions and promote sustainable forest management. Nevertheless, issues related to the implementation of the REDD+ scheme are numerous, including how to enhance its effectiveness in addressing the drivers of deforestation and degradation (Angelsen, 2010). Following the UNFCCC requirements for REDD+ implementation, countries should implement a shift from business as usual (BAU) through activities in the following areas: i) Reducing Emissions from Deforestation, ii) Reducing Emissions from forest Degradation, iii) Conservation of forest carbon stocks, iv) Sustainable management of forests and v) Enhancement of carbon stocks. These activities can be implemented through aggregates of concrete interventions that result in verifiable REDD+ through a three-phased approach (UNFCCC, 2011). Most countries are still in the first, preparatory or 'readiness' phase, designing a national strategy aimed at tackling drivers of Deforestation and forest Degradation (DD) (Korhonen-Kurki et al., 2014). The second phase focuses on the implementation of a REDD+ strategy, supported by grants or other financial support for capability building and enabling policies. During the third phase REDD+ activities will be implemented using performance-based compensation (UNFCCC, 2010).

Strategizing REDD+ interventions requires consideration of the drivers of deforestation/degradation (SBSTA, 2013). Drivers of deforestation and forest degradation are complex to study because they are related to multiple biophysical, social and economic factors that are interdependent, and which result in dynamic land use patterns (Mohamed, 2000). These factors include the multiple and often conflicting interests of different stakeholders, which in turn are influenced by other factors such as existing national policies, regional trade, power dynamics, subsistence forest dependency, resource and technology access, population growth and poverty (Angelsen and Kaimowitz, 1999). A distinction can be made between direct and underlying drivers of deforestation and forest degradation (Geist and Lambin, 2002; De Fries, 2002). Direct drivers are human activities and actions that directly impact forest cover and result in loss of carbon stocks. Underlying drivers are complex interactions of social, economic, political, cultural and technological processes that affect the direct drivers of deforestation and degradation (DD). They act at multiple scales: international (markets, commodity prices), national (population growth, domestic markets, national policies, governance) and local (subsistence, poverty) (Rudel et al., 2009, Boucher et al., 2011). Clearly, for effective REDD+ interventions both direct and underlying drivers need to be taken into account.

REDD+ interventions can be divided into direct and enabling activities. Direct interventions are specific, often local activities that result in a direct change in the carbon stock (i.e. reforestation, protected area strategies, agricultural intensification to reduce pressure on forests). Enabling interventions are aimed at facilitating the implementation of direct interventions (i.e. improved law enforcement against illegal logging, and land tenure regulation). Hence direct interventions are more directly linked to direct drivers and are focused on local, context-specific activities. REDD+ strategies that focus solely on direct drivers to demonstrate quantifiable emissions reductions may place less emphasis on addressing the critical underlying drivers. It is crucial that these are also addressed if interventions are to succeed in achieving the emissions reductions (Kissinger et al., 2012).

Despite the importance of designing interventions that address specific drivers of DD, there is very little literature available on how different countries are selecting and designing interventions. Questions also remain about how countries prioritise different interventions, given their analysis of what the drivers are. However, some information on this can be found in documents prepared by countries in their readiness phase, such asReadiness Preparation Proposals (R-PPs), and UN-REDD National Programme Documents, as well as documents prepared by research organizations and country partner organizations, such as REDD+ country profiles by the Centre for International Forestry Research (CIFOR). These documents, referred to as “readiness documents” in this paper, are an interesting source of data to be analysed with a view to assessing how countries are linking drivers and interventions.

We build upon these considerations stating that monitoring systems are needed to assess the effectiveness of interventions in addressing drivers of DD (Romijn et al., 2012). Monitoring drivers of DD is needed for several reasons: to understand their importance and processes at work, to attribute emissions to specific causes (i.e. nationally), track their activities over time, to design dedicated mitigation actions that address them, and to assess the impact of these (Herold and Skutsch, 2011). Monitoring drivers that lead to deforestation and forest degradation provides essential information for keeping track of the effectiveness of direct REDD+

interventions. However, current REDD+ monitoring efforts are largely focused to meet international reporting needs and thus are concentrated on the assessment of change in forest area (deforestation) and related carbon emissions, while in only a few cases is the forest area change analysed by linking it to specific driver activities and follow-up land use (GOFC-GOLD, 2011; Herold et al., 2011). In Mexico for example a deforestation threat map has been developed by correlating past deforestation with social and agricultural data available in secondary sources at the county level (INECC, 2012). Nevertheless such analyses rarely incorporate underlying drivers, as they are usually not readily detectable using remote sensing and forest inventory data and would require monitoring capacities beyond these techniques. Moreover, some underlying drivers are not represented in existing databases and their analysis would require more detailed socio-economic data. Others relate to sectoral policies and to conditions in domestic and international markets (Kissinger et al., 2012), which are generalized and difficult to connect with specific land cover changes in particular locations.

The above-mentioned three elements (drivers, interventions and monitoring capacities) are interlinked through a logical chain: in order for REDD+ interventions to be effective, they need to be developed with an understanding of specific drivers of DD that they aim to address. Improving monitoring capacities should provide data of progressively better quality and hence increasingly detailed information about drivers, allowing the (re)design of REDD+ policy interventions which are more appropriate to the local conditions and hence more effective. This logic has been described by the Forest Carbon Partnership Facility (FCPF) as follows: "countries are realizing that the objective of reference level analyses is to better understand and to quantify the relationships among the driver activities of DD, and historical and potential future emissions. The logical chain of: 1) driver analysis, 2) REDD+ strategy development, 3) REL (Reference Emission Levels) exploration, and 4) Measurement, Report and Verification (MRV) design is strongly interlinked. Nevertheless this logical chain has been weak in most RPPs to date" (FCPF, 2010). Perhaps one reason for this is that only limited scientific research has focused on these interlinkages. Given the current gap in current knowledge and understanding of the above-mentioned issues, this chapter focuses on three main objectives: i) synthesize the direct and enabling REDD+ interventions proposed by each countries, ii) assess whether the proposed interventions take into account current knowledge of drivers of DD, iii) reflect on possible implications for future systems to monitor the effectiveness of the proposed interventions (figure 2.1). The structure of the chapter reflects these three objectives, as it first presents an analysis of readiness documents and identifies the direct and enabling interventions proposed by different countries.

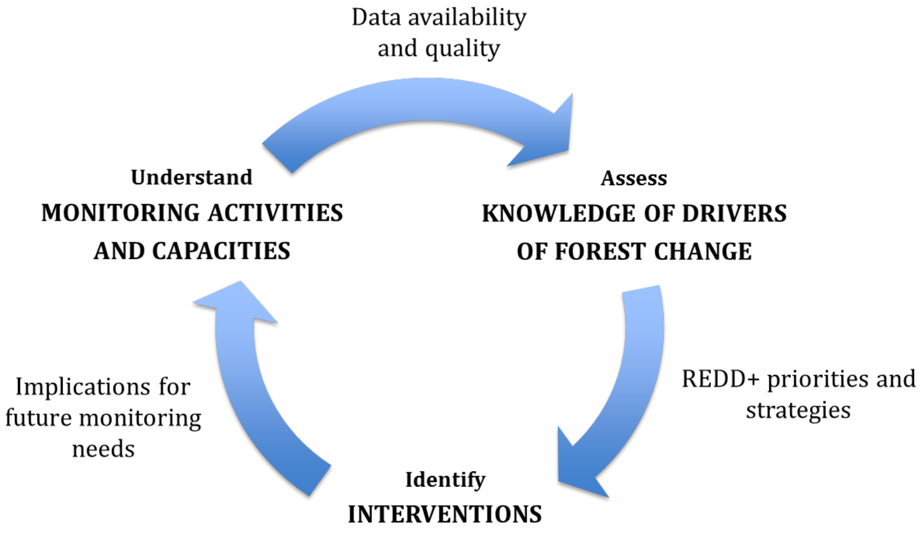

Figure 2.1: Linkages between knowledge of drivers, interventions and monitoring capacities in the context of national REDD+ schemes.

This is followed by a second part focussing on the objective to assess to what extent countries explicitly relate interventions considering existing knowledge about DD drivers. In particular, we assessed whether proposed interventions refer to both the relevant direct and underling drivers. Interventions that are proposed to address specific direct drivers of DD have been summarized. The discussion section deals then with possible implications for future monitoring systems, in particular how they could monitor the effectiveness of the proposed interventions. In a concluding section suggestions are made about how to expand monitoring systems beyond the forest sector, through a landscape approach.

2.2 Materials and methods

Countries participating in REDD+ are being assisted during the readiness phase by two main initiatives: the UN-REDD Programme and the World Bank FCPF. The UN-REDD Programme supports 15 countries, while FCPF assists a total of 36 countries (13 in Africa, 15 in Latin America, and 8 in Asia) following a review of their Readiness Preparation Idea Notes (P-PIN), of which 33 countries have taken the next step by submitting more detailed Readiness Preparation Proposals (R-PP) (FCPF, 2013). A number of bilateral programs including Norway's Government International Climate and Forests Initiative (NICFI) (Ministry of Norwegian Environment, 2009) are facilitating the REDD+ readiness process in some countries, such as Indonesia and Brazil. Another source of information used for this paper to add qualitative analysis are country profiles prepared by CIFOR and REDD+ country partners, which followed specific guidelines to analyse contextual conditions that affect the REDD policy environment in each country, and which in particular looked at the politico-economic conditions that drive deforestation and forest degradation in the respective countries (Brockhaus et al., 2012).

The authors reviewed a total of 98 readiness documents of 43 countries: 35REDD+ R-PPs, 15 UN-REDD National Programme Documents and six CIFOR-country profiles (Appendix 1), available at the websites of World Bank FCPF (http://www.forestcarbonpartnership.org/), UN-REDD (http://www.un-redd.org/) and CIFOR (http://www.cifor.org/) respectively. Six countries (see Appendix 1) submitted R-PPs to the FCPF as well as documents to the UN-REDD-National Programme. In this study more focus has been given to R-PPs because they contain a more extensive explanation of the proposed interventions, which allowed a more consistent analysis.

Readiness documents have been reviewed to analyse the strategy that each country proposes to address deforestation and forest degradation based upon their initial knowledge of both direct and underling drivers. The review has been done by identifying and listing all the interventions proposed in all the readiness documents. This list has been used to build intervention categories of enabling and direct interventions.

Readiness documents were evaluated to meet the following objectives:

1. Synthesize the direct and enabling REDD+ interventions proposed by each countries
2. Assess whether the proposed interventions take into account current knowledge of drivers of DD; in particular:
    a. Assess whether the proposed interventions refer to both relevant direct and underling drivers
    b. Summarize the interventions that are proposed to address specific direct drivers of DD
3. Reflect on possible implications for future systems to monitor the effectiveness of the proposed interventions.

These objectives expand on the work carried out by Kissinger et al. (2012), who made a preliminary analysis of drivers and interventions described by REDD+ countries in 46 Readiness documents.

2.3 Synthesis of the direct and enabling REDD+ interventions

To meet the first objective, 98 readiness documents were reviewed to synthesize the direct and enabling REDD+ interventions that each REDD+ country is proposing. Particular attention has been given to the section "REDD+ Strategy Options" of the R-PPs, the section "Draft REDD+ Strategy and Implementation Framework" of UN-REDD National-Programme-Documents and the section "Future REDD+ policy options and processes" of CIFOR country profiles.

2.4 Assessment of the linkage between intervention and current knowledge of drivers

The second objective aimed at assessing if countries design interventions taking into account their current knowledge of drivers of DD. This objective has been met through two analyses. The first analysis focused on assessing whether the strategies proposed refer to specific drivers that they are aiming to address.
To this aim countries have been classified in two main categories: *Interventions with linkage* and *Interventions without linkage* (column 1 of table 2.1), which were further subdivided in two subcategories: i) Interventions aimed to address both direct and underling drivers, ii) Interventions aimed to address only the direct drivers, iii) Interventions aimed at increasing carbon stocks and iv) No linkage reported (column 2 of table 2.1).

Table 2.1: Description of categories and subcategories of interventions proposed by 43 REDD+ countries.

Main category	**Subcategories for objective 2.1**	**Subcategories for objective 2.2**
Interventions with linkage: includes countries that propose interventions referring to drivers	*i) Interventions aimed to address both direct and underling drivers*	*Group 1 and 2*
	ii) Interventions aimed to address only the direct drivers	*Group 1 and 2*
Interventions without linkage: includes countries that propose interventions without referring to drivers	iii) *Interventions aimed at increasing carbon stocks*	*Group 2*
	iv) *No linkage reported*: includes the remaining countries of category iii)	

These subcategories were created for two purposes. The first one was to assess whether countries are able to propose interventions linking them to specific drivers of DD; the second one was to assess whether the ability to make this link is related with the current knowledge about drivers. The quality of data on drivers has been used as an indicator of current knowledge about drivers of DD. This data was derived from the work carried out by Hosonuma et al. (2012), who classified data on drivers of DD as reported by countries using a scale which reflects the form in which this data was reported: Ratio scale (quantitative information about drivers), Ordinal scale (ranking of importance of drivers) and Nominal scale (simply listing drivers).

The second analysis aimed at assessing the types of direct interventions proposed to address specific direct drivers of DD. To this aim readiness documents that explicitly link the intervention to each direct driver of DD (for instance using a table) have been further analysed. The countries that made this explicit link (a total of ten countries, Appendix 1) have been grouped into a subcategory of countries (Group 1), which is a subset of the main category "*Interventions with linkage*" (table 2.1). The interventions proposed by Group 1 have been compared to interventions proposed by all the other countries, which we grouped into a second subset of countries (*Group 2*).

2.4.1 Implications for future monitoring systems

The third objective was approached by considering and discussing implications of the findings of this chapter in the light of current literature on systems for monitoring the implementation of the proposed interventions. In particular we reflect on the importance of monitoring activities not only in the forest sector but also outside of it. We suggest a conceptual method/framework to link interventions with their possible impacts on carbon stocks.

2.5 Results

2.5.1 Direct interventions

Sustainable forest management is the most commonly identified direct intervention, proposed by 62% of countries, followed by fuel wood efficiency/cook stoves and Agroforestry (Table 2.2). This is perhaps not surprising given the fact that this term is used to cover a wide range of different interventions including sustainable yield management, and can be applied to different organisational forms of forestry, from government led to community led.

Table 2.2: Percentage of reviewed countries pursuing direct interventions as part of REDD+.

Direct interventions	
Sustainable forest management	62%
Fuel wood efficiency/cook stoves	47%
Agroforestry	44%
Protected areas strategies	41%
Afforestation/reforestation	38%
Agricultural intensification/Permanent agriculture	38%
Plantations establishment/management	29%
Livestock/rangeland management	27%
Rehabilitation of degraded land	23%

A substantial number of countries also place emphasis on interventions appropriate to mosaic landscapes, such as *Agroforestry,* It appears to be seen as useful in addressing the range of drivers that persist in many tropical frontier landscapes, particularly in mosaic and multiple-use landscapes. *Agroforestry* was identified by 44% of countries as part of their REDD+ strategy. About 38% of countries include afforestation and reforestation in REDD+ strategies. These countries recognize afforestation and reforestation as essential strategies to address demand for fuel wood and construction materials, to increase carbon stocks and to restore degraded lands. *Livestock/rangeland management* has been proposed by 27% of countries as a strategy to improve agricultural production and lower forest degradation. Finding solutions to the fuel wood driver of forest degradation is a clear priority for 47% of countries reviewed, which seek to find alternatives to fuel wood, and more efficient cooking stoves. While a number of countries seek REDD+ finance to support *Agricultural intensification* (38%) and promote *Rehabilitation of degraded land* (23%), no country explicitly ties these two strategies together.

In many cases of course countries propose not just one but several interventions to deal with a specific driver. For instance, of the countries that propose Agriculture Intensification 30% propose also Agroforestry and improvement of livestock management, 20% propose Sustainable Forest Management while 10% of them combine it with Rehabilitation of degraded land. This indicates the understanding of countries that drivers are complex and require multiple approaches¨.

Most direct interventions proposed focus on forest related activities to reduce mainly forest degradation rather than deforestation. This might be due to the fact that deforestation is much more difficult to tackle since it is increasingly caused by large commercial actors, which often are capable to lobby the State for favourable decisions about the use of land, e.g. concessions (Rudel, 2007; Angelsen and Rudel, 2013). Hence reducing deforestation would imply interference with decision-making and rent-seeking at levels remote to the locality in which the deforestation activity occurs, and which are linked to political and economic forces that are often the main underling drivers of deforestation (Di Gregorio et al., 2012). In contrast measures to reduce forest degradation can be justified politically as being beneficial for local communities through interventions (such as more sustainable land use and agroforestry) that are already known and partially implemented.

2.5.2 Enabling interventions

Reported enabling interventions have been grouped in 12 main categories (table 2.3). The complete list of interventions can be found in Appendix 2. A large amount of countries (83%) propose interventions to address weak forest sector governance, through strategies aimed at improving governance. However, these proposals remain rather vague and explicit linkages to existing or planned policies and national development programmes that are potentially driving deforestation are rarely made as stated in the country profiles provided by CIFOR. For instance we find that proposed enabling interventions have little concrete proposals to remove perverse incentives that drive deforestation such as ranching in Brazil, palm oil development in Indonesia, and tackle large scale drivers such as timber extraction through concessions in Cameroon, cross border trade in Mozambique, or supply and demand gaps in industrial timber processing in Vietnam (Dkamela, 2011; May et al., 2012; Sitoe et al., 2012; Pham et al., 2012; Di Gregorio et al., 2012; Brockhaus et al., 2013).

Concerning policy development, countries are candid about the need for governance (83%) and policy reform (51%) as a key strategy to address drivers, and this is a core component of country readiness activities to prepare for REDD+. Stakeholder involvement is also mentioned as a key enabling intervention (46%), which includes various forms of community-based forest management approaches (appendix 2), often tied to REDD+ benefit-sharing arrangements. Tenure and rights of access is a priority for 43% of countries. Depending on the national and regional circumstances, this may relate to benefit-sharing and/or community forest management. Those few countries that articulate cross-border approaches (related to commercial agriculture and illegal/legal wood flows) express interest in information sharing with neighbouring countries, particularly for tracking leakage effects (9%).

Table 2.3: Main categories of enabling interventions expressed in percentages ofreviewed countries (N=43). Subcategories are listed in Appendix 2.

Enabling interventions	
Good governance	83%
Policies	51%
Stakeholder involvement	46%
Tenure and rights	43%
Financial incentives	40%
Land management	34%
Technology improvements	31%
Institutional capacity	31%
Benefit sharing	26%
Appropriate disincentives	17%
Promote complementary voluntary private sector initiatives	14%
Addressing leakage	9%

2.5.3 Interventions proposed referring to direct and underling drivers

The majority of countries (68%) are aware of the importance of designing interventions that are specifically linked to the drivers of DD that they aim to address (figure 2.2). About 48% of the countries fall into subcategory i) *Interventions aimed to address both the direct and underling drivers* and 20% belong to subcategory ii) *Interventions aimed to address the direct drivers*. The minority of countries (32%) propose interventions without referring to the drivers (category *Interventions without linkage*). In this category 12% of the countries belong to subcategory iii) *Interventions mainly aimed at increasing carbon stocks* and 20% belong to subcategory iv) *No linkage reported*. Concerning the linkage between the category of interventions and the quality of national driver data, within category Interventions with linkage, about half of countries of subcategory i) have good-quality driver data (Ratio scale).

A different trend is shown in subcategory ii) to which belong countries which propose interventions that refer to specific direct drivers, and where the majority have low data quality (Nominal scale). Although the pattern is not very clear, there is tendency that countries with better quality driver data also do a better job in aiming to link both drivers, direct and underlying, with interventions.

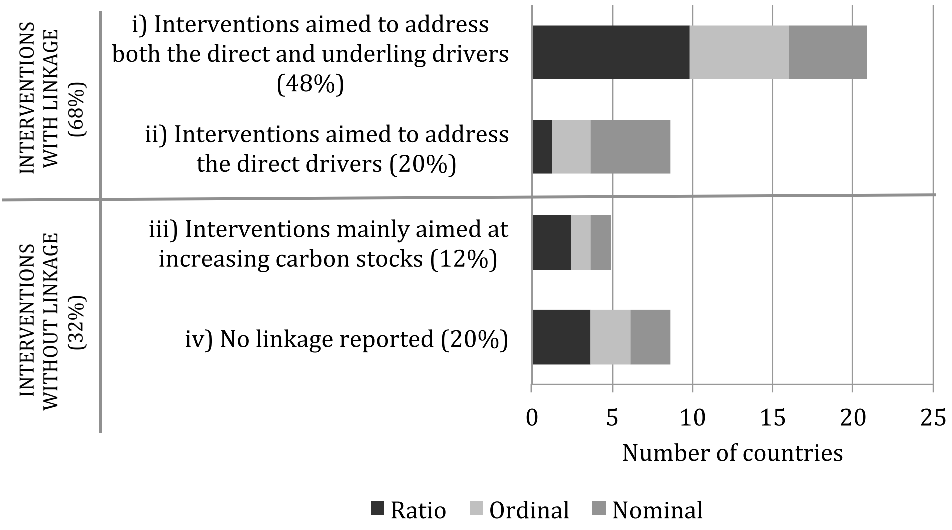

Figure 2.2: Number of countries proposing different types of interventions divided based upon driver data quality (Ratio scale: quantitative information about drivers; Ordinal scale: ranking of importance of drivers; Nominal scale: listing of drivers)

There are also a number of countries that have low quality driver data but are still able to link the interventions to drivers. This raises the question whether the proposed interventions based on lower quality data will be targeting the highest priority drivers. It can be expected that these countries will build monitoring capacities to gain better understanding on drivers if this is properly considered and integrated in their REDD+ readiness program. There are also countries that have good quality driver data but it seems these were not used when designing their interventions. In this case countries should be encouraged to better use their available data for their REDD+ intervention planning.

2.5.4 Direct interventions proposed to address specific direct drivers

Out of the ten countries that have provided information on linking direct drivers and interventions, *agricultural intensification* is the most common intervention proposed to address agriculture as a driver, followed by *Agroforestry* and *Improvement of livestock management* (table 2.4).

Table 2.4: List of main drivers and direct interventions described in readiness documents and percentage of countries proposing each intervention. The driver "Agriculture" includes livestock management activities.

Main driver	Specific intervention	
Agriculture	Agricultural intensification	50%
	Agroforestry	40%
	Improvement of livestock management	40%
	Sustainable forest management	30%
	More efficient land use	20%
Unsustainable production of biomass energy	Improve charcoal efficiency use	50%
	Sustainable management of forests/woodlands for biomass harvesting	30%
	Alternative renewable energy sources (wind, solar, biogas)	30%
	Increase biomass/trees on farmland	20%
Firewood harvesting	Expansion of electrification network	10%
	Community-based use of biofuels for lighting and cooking thus reducing demand for fuel-wood	10%
	Plantation establishment of fast growing fuel wood	10%
	Agroforestry	10%
Timber harvesting	Forest management planning (zone and protect timber production that meets demand and restock for future)	10%
	Increase timber stocks in natural forests	10%
Unsustainable/illegal logging	Forest plantations to avoid deforestation of primary forests	30%
	Sustainable forest management	30%
	Strengthen urban planning and zoning	20%
	Afforestation/reforestation	10%
Urban development	Minimizing conversion of forests during construction	10%
Mining	Sustainable mining	20%
	Protected areas and buffer zones	10%
Forest fires	Fire management and control plan	20%

Improving charcoal efficiency use has been proposed by 30% of countries to address unsustainable production of biomass energy and firewood harvesting, followed by sustainable management of forests/woodlands for biomass harvesting (30%) and increasing biomass/trees on farmland (20%). Interventions to address timber harvesting are mentioned by a minority of countries, while the most common interventions to address unsustainable/illegal logging are forest plantations and sustainable forest management.

2.5.5 Comparison of types of interventions proposed by countries in different groups

As figure 2.3 shows, interventions proposed by countries of Group 1 (described in paragraph 2.2) are mentioned by a different percentage than the interventions proposed by countries in Group 2.

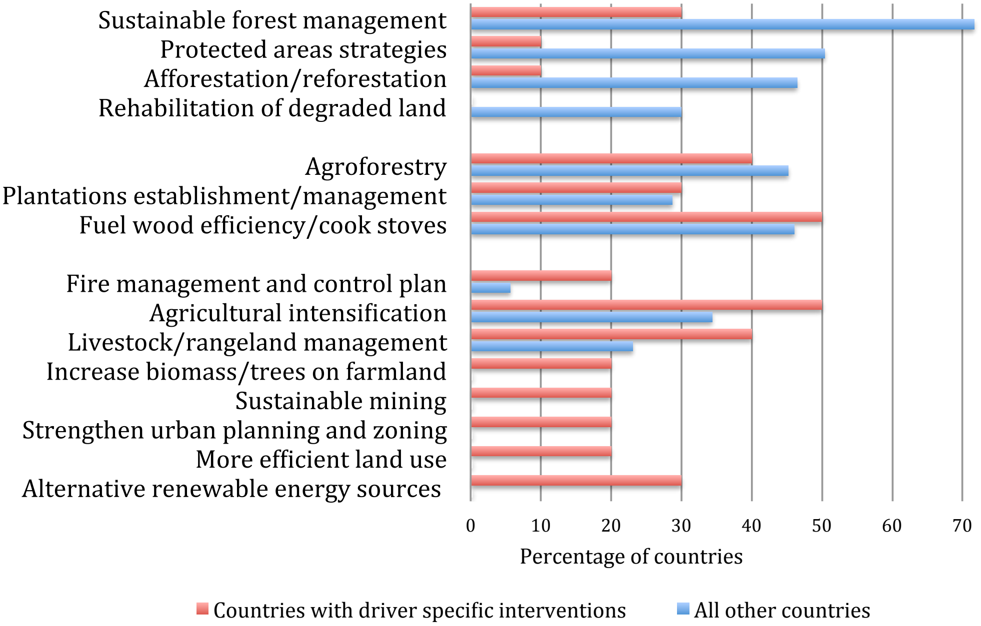

Figure 2.3: Comparing the percentage of interventions proposed by *Group 1 countries (Countries with driver-specific interventions;* N=10) and *Group 2 countries (All other countries;* N=33).

In particular the majority of interventions proposed by Group 1 tend to be related to the non-forest sector (Livestock/rangeland management, Agricultural intensification), while the majority of countries in Group 2 propose mainly forest-related interventions (Sustainable management of forest, Protected areas strategies, Afforestation/reforestation). It should be noted however that neither group provides much evidence in their documentation about track record of these different strategies in their countries, and whether they are in reality likely to be effective.

2.6 Discussion

2.6.1 Monitoring systems for forest based interventions will have to be ground based

As table 2.5 shows, most of the direct interventions proposed by all countries focus on forest-related activities designed to reduce forest degradation, rather than deforestation, such as promoting sustainable forest management, efficient fuel-wood use, agroforestry and protected area strategies. Many of these REDD+ activities are likely to have a relatively low carbon impact per unit area but can have large cumulative effects over vast areas. Hence monitoring the related change in carbon stocks to obtain emissions factor data will be relatively costly and challenging since annual changes tend to be small (Herold et al., 2011; GOFC-GOLD, 2012). Such data cannot easily be obtained using common remote sensing time series (De Sy et al., 2012), hence different approaches are needed to obtain activity data. For instance household surveys and interviews with local experts can provide information about the specific location of activities that result in changes in stocks within the forest. If this current priority intervention list (Table 2.2) were to become reality in terms of actual REDD+ mitigation activities, the implications for monitoring are that it would have to be much more focused on assessing small-scale impacts at ground level, and this would results in higher monitoring costs per unit area (Pratihast et al., 2013).

2.6.2 Activities on non-forest land should also be monitored, but in terms of performance, not in terms of carbon impacts in the forest

Table 2.4 shows how most of *driver-specific interventions* are associated with driver activities that relate not only to the forest sector (logging, firewood and timber harvesting, forest fires) but also to a large extent to the non-forest sector (agriculture, urban development and mining). However current efforts are focused on monitoring carbon dynamics within forest stands to meet national and international reporting requirements (Romijn et al., 2012). While this is essential for REDD+ monitoring and MRV (Sanchez et al., 2013), we suggest that countries extend monitoring systems beyond the forest sector, to monitor the effectiveness of policy interventions in addressing drivers of DD. This would allow tracking activities and provide feedback to policy makers to improve their policies and making them more appropriate to the local conditions and hence more effective. Table 2.5 lists examples of possible performance indicators to monitor common interventions outside forests.

Table 2.5: Non-forest related indicators to monitor the effectiveness of the interventions (derived from table 3) and the expected impact in forest-land (carbon stock).

Sector	**Direct interventions**	**Possible performance indicators**
Non-forest sector	Agricultural intensification	Increase in yield productivity/hectare
	More efficient land use	Increase in productivity/hectare
	Improve livestock management	Improved livestock yield/hectare
	Agroforestry	Increase in yield production, more trees and carbon stocks on farmland, less extraction and carbon loss from neighbouring forests
	Increase biomass/trees on farmland	Increased number of trees and enhanced carbon stocks on farmland
	Improve charcoal efficiency use	Number and use of functioning energy-saving stoves
	Alternative renewable energy sources (wind, solar, biogas)	Installation and operation of alternative energy-sources (windmills, solar panels, biogas harvest)
Forest sector	Forest plantations to avoid deforestation of primary forests	Increased carbon stock in forest + lower deforestation and degradation rate for (fire)wood collection
	Sustainable forest/woodland management	

For example, improved agricultural practices (such as sustainable agriculture intensification) which are intended to reduce pressure on the forests could be monitored using indicators such as increase of yield production/hectare, which indicates not the impact on the forest carbon but rather whether the intervention has been effectively implemented or not.

Nevertheless there are limitations in the use of these performance indicators that should be taken into account. In fact a certain activity implemented to reduce DD might itself cause emissions or induce DD. For instance if increased crop yields occur

due to water or fertilizer use, degradation might occur due to a change of water quality and quantity downstream as well GHG emissions.
Moreover there are issues relating performance indicators with the effectiveness of interventions in terms of forest carbon. For instance the change in yield gap could indicate the successful implementation of intensive agriculture but it does not easily translate into forest-related GHG emissions: although agricultural intensification may be expected to lower deforestation rates, the locations of the related avoided deforestation and the resulting carbon impacts will be very difficult to assess. This implies that it can be almost impossible to attribute specific reductions in forest emissions to REDD+ activities outside forests. The results of such activities can only be registered in their cumulative effect through national forest monitoring, and the question on what activity and which actors have generated how much carbon credit is very difficult to be answered. This fact may have important implications for the distribution of REDD+ benefits (Skutsch et al., 2013).

Moreover, besides measuring performance indicators, in the process of assessing the effectiveness of interventions, robust policy analysis should be carried out to assess the issue of attribution. In fact, performance indicators and measurements of carbon stock changes do not provide insights into causal linkages between drivers, interventions, and outcomes: while change may occur, actually attributing it to the intervention can be complex. For instance a newly passed law restricting harvesting in certain areas may appear to be highly successful: however, the effect might alternatively be due to a quite different stimulus, such as an economic slowdown. Hence robust policy analysis is important to carefully collect all relevant information and further explore these aspects.

2.7 Conclusion

This study provides a comprehensive overview of the current strategies for addressing drivers of DD as presented by 43 REDD+ countries in 98 readiness documents. The analysis allowed for a deeper understanding of implications for monitoring systems. We build our assessment upon a logical interaction between identified (and reported) drivers of DD, proposed REDD+ interventions and systems to monitor the effectiveness of interventions. In order for REDD+ interventions to be effective they should be directly linked with the drivers of DD that they aim to address. The effectiveness of interventions in addressing drivers should be monitored systematically. Improving monitoring capacities provides data of progressively better quality and hence increasingly detailed information about drivers, allowing to (re)design REDD policy interventions, so that they will be more suited to the local conditions and hence more effective.

We explored the elements of this logical chain in three steps. Firstly we synthesized information on the direct and enabling interventions proposed by countries wishing to participate in REDD+; secondly we assessed to what extent countries propose interventions by taking into account what they know (and report) about drivers of DD; thirdly we considered the implications for future monitoring of the effectiveness of interventions.

Results show that the interventions proposed by many countries focus less on activities to reduce deforestation, but rather on those that should result in reducing forest degradation and enhancing forest carbon stocks. These results indicate a need for a deeper understanding of why countries tend to focus in their proposals on tackling forest degradation instead of deforestation, and the possible implications for effectiveness of proposed interventions if further evidence on drivers of DD indeed suggest a mismatch. The currently proposed measures do have already strong implication for monitoring systems. While monitoring deforestation greatly relies on remote sensing time series, monitoring other forest-related activities relies more on ground level approaches, such as interviews with local experts, who can provide information about the location of activities such as fuel-wood use, forest degradation and tree planting. These monitoring approaches will be much more focused on assessing smaller-scale impacts, which generally tend to be more costly.

In addition, most of the driver-specific interventions proposed address drivers not only inside but also outside the forest sector. However current monitoring efforts are focused on monitoring carbon dynamics within forest stands to meet national and international reporting requirements. These findings suggest that REDD+ monitoring should be extended by looking at effectiveness of REDD+ activities also outside the forest sector, including agriculture and other land use changes. This is important for two main reasons. Firstly it helps to capture interactive effects: where for instance agriculture is driving forest loss and where management (such as agroforestry) is driving carbon sequestration. Secondly it addresses confusion over boundaries –where one land use begins and another ends, what is forest and what is not. This is important because shifts in boundaries can result in large shifts in carbon accounting over time or across countries.

Nevertheless developing capacities to extend monitoring systems beyond the forest sector implies the use of additional resources for monitoring, which already accounts for a large part of countries' REDD+ readiness activities (Romijn et al., 2012). Hence REDD+ countries should carefully evaluate how to employ their resources in such a way that is cost-effective. One way in which this could perhaps be done is by involving local communities in monitoring, which is also vital to increase the quality and quantity of data and at the same time might empower local communities and generates local employment opportunities (Danielsen et al., 2011).

Concerning enabling interventions, a large number have been described, of which the most common are *Stakeholder involvement, Tenure and rights regularization* and *Policy and governance reform.* Proposed enabling interventions remain rather vague and explicit linkages to existing or planned policies and national development programmes that are potentially driving deforestation are rarely made. Moreover, for enabling interventions to be effective, they need to be bundled. For instance agricultural intensification should be combined with zoning, protected areas or rehabilitation of degraded lands to prevent further forest clearing. Only few of the readiness-documents reviewed explicitly mention the importance of implementing interventions in a combined way, and countries may need to give more attention to this.

Appendix 1: Readiness documents per country reviewed

All countries (43)	FCPF* (34)	UNREDD ** (15)	CIFOR*** (6)	Group N
Argentina	June 2010			1
Bolivia		March 2010		2
Brazil			2012	2
Burkina Faso	June 2012			2
Cameroon	January 2013		2011	2
Cambodia	March 2011	May 2011		2
Central African Republic	September 2011			2
Chile	January 2012			2
Colombia	September 2011			1
Congo, Democratic Republic of	July 2010	March 2010		2
Costa Rica	August 2010			2
El Salvador	June 2012			1
Ethiopia	May 2011			1
Ecuador		March 2011		2
Ghana	December 2010			2
Guatemala	March 2012			1
Guyana	April 2010			1
Indonesia	May 2009	May 2009	2012	2
Kenya	August 2010			2
Laos Democratic Republic	October 2010			1
Liberia	June 2011			2
Madagascar	October 2010			2
Mexico	June 2011			2
Mozambique	March 2012		2012	1
Nepal	October 2010		2013	2
Nicaragua	June 2012			2
Nigeria		October 2011		2
Panama	May 2009	January 2010		2
Papua New Guinea	February 2013	January 2011		2
Paraguay		November 2010		2
Peru	March 2011			2
Solomon islands		July 2011		2
Sri Lanka		November 2012		2
Suriname	January 2010			2
Tanzania	October 2010	October 2009		1
Thailand	February 2013			2
The Philippines		November 2010		2
Uganda	June 2011			1
Vanuatu	September 2012			2
Vietnam	November 2011	August 2009	2012	2
Zambia		March 2010		2

* http://www.forestcarbonpartnership.org/redd-country-participants

** http://www.un-redd.org/PublicationsResources/tabid/587/Default.aspx

*** http://www.cifor.org

Appendix 2: Complete list of enabling interventions, grouped in 12 main sub-categories. The right column lists the percentage of countries proposing each intervention.

Good governance	**83%**
Improved governance	34%
Improved law enforcement	31%
Environmental and social impact assessment	17%
EU Voluntary Partnership Agreements-FLEGT	17%
Improve transparency (against corruption)	14%
Policies	**51%**
Policy and governance reform	43%
Promotion of alternatives to deforestation (including alternative land use)	26%
Cross-sectoral coordination	31%
Harmonization of policies	23%
Promotion of alternatives to wood fuel (energy sector)	14%
Stakeholder involvement	**46%**
Community forest management/Participatory forest management	46%
Stakeholder involvement/ Participatory planning	17%
Tenure and rights	**43%**
Tenure and rights regularization	43%
Financial incentives	**40%**
Financial incentives (agriculture sector)	26%
Payments for ecosystem services (PES)	26%
Financial incentives for re-/af- forestation	11%
Land management	**34%**
Land use planning/zoning	34%
More intensive agriculture and livestock practices	9%
Agriculture sustainable practices and deforestation planning	3%
Reduce emissions from other biomes	3%
Deal with settlement/displacement and infrastructure	3%
Shifting expansion to/reforestation on degraded lands	26%
Technology improvements	**31%**
Capacity building for improved agriculture techniques	29%
Improve agricultural, silvicultural, livestock technologies and productivity	23%
Assess other renewable energy sources, energy efficient stoves	6%
Institutional capacity	**31%**
Institutional (re)organization/strengthening	31%
Decentralization	6%
Benefit sharing	**26%**

Chapter

3

REDD+ and climate smart agriculture in landscapes: A case study in Vietnam using companion modelling

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Abstract

Finding land use strategies that merge land-based climate change mitigation measures and adaptation strategies is still an open issue in climate discourse. This chapter explores synergies and trade-offs between REDD+, a scheme that focuses mainly on mitigation through forest conservation, with “climate smart agriculture”, an approach that emphasizes adaptive agriculture. We introduce a framework for ex ante assessment of the impact of land management policies and interventions and for quantifying their impacts on land-based mitigation and adaptation goals. The framework includes a companion modelling (ComMod) process informed by interviews with policymakers, local experts and local farmers. The ComMod process consists of a role-playing game with local farmers and an agent-based model. The game provided a participatory means to develop policy and climate change scenarios. These scenarios were then used as inputs to the agent-based model, a spatially explicit model to simulate landscape dynamics and the associated carbon emissions over decades. We applied the framework using as case study a community in central Vietnam, characterized by deforestation for subsistence agriculture and cultivation of acacias as a cash crop. The main findings show that the framework is useful in guiding consideration of local stakeholders’ goals, needs and constraints. Additionally the framework provided beneficial information to policymakers, pointing to ways that policies might be re-designed to make them better tailored to local circumstances and therefore more effective in addressing synergistically climate change mitigation and adaptation objectives.

Keywords: Agent based model, companion modelling, participatory approaches, policy assessment, REDD+, role-playing games.

3.1 Introduction

Climate change (CC) paired with the rapidly growing world population call for new approaches to land management that are both sustainable and accommodate the complex interactions between social systems and environment. To this end, it is important not only to mitigate CC by reducing greenhouse gas (GHG) emissions, but also to adapt to the changing environmental conditions (Locatelli, 2011).

Land and forests have a high potential for both mitigation and adaptation, but their management is not always straightforward, due to trade-offs between land use options and the high stakes and diverging interests of multiple stakeholders (Giller et al., 2008). Finding land use strategies that merge land-based CC mitigation and adaptation measures is therefore still an open issue in climate discourse. Adoption of such strategies can be encouraged by national and regional policies and concretized in land management approaches that are suitable to local contexts. Such strategies include PES and integrated ecosystem management approaches, which provide incentives to local stakeholders to improve ecosystem management. Examples of such approaches are numerous, among which Integrated Silvopastoral Approaches to Ecosystem Management facilitated by the World Bank in Latin America, where payment incentives were introduced to farmers for adopting integrated silvopastoral farming systems in degraded pasture lands (Pagiola et al., 2014).

In the policy arena, increasing attention has been focused on the United Nations' Reducing Emissions from Deforestation and Forest Degradation (REDD) programme, and the REDD+ scheme, which goes further to also include the role of conservation, sustainable management of forests and enhancement of carbon stocks. REDD+ is a potentially powerful vehicle for stimulating developing countries to practise mitigation by reducing GHG emissions and also to implement adaptation measures through sustainable forest management. REDD+ incorporates safeguards as well, such as requirements for transparency, participation, protection of biodiversity and the rights of local people (UNFCCC, 2011). The United Nations Framework Convention on Climate Change (UNFCCC) emphasizes that co-benefits should be promoted while implementing REDD+ and that 'the needs of local and indigenous communities should be addressed' (UNFCCC, 2007: 8). Nonetheless, REDD+ has remained forest-centred and strongly geared to mitigation, leaving adaptation in a second place (Thompson, 2011).

This sector-oriented approach has resulted in inefficient resource use and often conflicting outcomes, since trade-offs may occur over different spatial or temporal scales (e.g., Rosenzweig and Tubiello, 2007; Verchot et al., 2007; Smith and Olesen, 2010). On the spatial scale, for example, introduction of fast-growing tree monocultures or biofuel crops for mitigation purposes may enhance carbon stocks, but could potentially reduce the land available for agriculture and compromise water availability downstream (Huettner, 2012). Conversely, increased adaptation to climate change impacts and higher yields could perversely increase incentives for expansion in forest areas (Ewers et al., 2009; Rudel et al., 2005) to the detriment of mitigation (Angelsen, 2010). Concerning the temporal scale, consideration of both short-term and long-term trade-offs is crucial, since some outcomes will manifest immediately, while others may show only after substantial time. For example, conservation agriculture (practices that minimize soil disturbance, maintain soil cover and diversify crop rotation, see Hobbs 2007) results in greater productivity and carbon sequestration in the long term, but may reduce short-term agricultural yields (Rusinamhodzi et al., 2011).

The design and implementation of REDD+ that do not acknowledge these trade-offs are unlikely to be effective. Deforestation is driven by local stakeholders' (adaptation) needs and goals, which therefore have to be taken into account and satisfied. REDD+ policies that focus on forest protection without promoting adaptation and development are likely to fail because the underlying drivers of deforestation will persist (Locatelli et al., 2011; Kissinger, 2011). The Intergovernmental Panel on Climate Change (IPCC, 2014) has found that policies governing land use and REDD+ are more effective when they involve both mitigation and adaptation. Yet many REDD+ initiatives still overlook development goals and poverty alleviation and neglect benefit-sharing mechanisms for enhancing local livelihoods (Corbera and Schroeder, 2011). It remains crucial to identify an optimal policy mix that tackles synergistically all of the above-mentioned goals at the various different levels of governance (Kissinger et al., 2011).

Many CC adaptation programmes centre on agriculture, because CC-related shocks and stresses in the natural environment are considered to require innovation towards adaptive agriculture, entailing higher production with fewer inputs. Despite this, agriculture continues to contribute to CC (Tubiello et al., 2015), particularly since agricultural expansion is the main driver of deforestation (Harris et al., 2012, Hosonuma, 2012). Various approaches have been launched to sustainably increase agricultural yields while enhancing the adaptive capacity of vulnerable communities (Jones et al., 2012). "Sustainable intensification", for example, seeks to increase production from existing farmland while minimizing pressure on the environment (Perfecto and Vandermeer, 2010; Fisher, 2010). "Climate-smart agriculture" (CSA) aims to achieve the “triple wins” of food security, adaptation and mitigation (FAO, 2010), enhancing adaptation and mitigation synergistically. Although CSA represents a step forward towards greater integration of adaptation and mitigation, its emphasis in practice has remained on agricultural goals and adaptation (Graham, 2012).

To further the merging of adaptation and mitigation goals, a new line of thinking has emerged: the “Climate-Smart Landscape” (CSL) approach (Scherr et al., 2012; Minang et al., 2013). CSL is an integrated, landscape-level approach that considers both adaptation and mitigation objectives, as well as other dimensions, such as food security and livelihood improvement (Sayer et al*.,* 2013; Scherr et al., 2012). Unlike CSA thinking, CSL widens the scope from the farm level to the landscape level, allowing analyses of landscape dynamics that lead to deforestation and assess the trades-off between land uses (Reid et al., 2010). “Landscape” is defined here in broad conceptual terms: rather than being simply a physical space, it represents a complex system with mutually interacting social, biophysical, human ecological and economic dimensions (Farina, 2000). Additionally, CSL emphasizes stakeholder involvement and simultaneous achievement of multiple objectives (Sunderland, 2012). For example, projects that aim to sequester carbon in forest plantations might reduce potential impacts on water and biodiversity by establishing diverse, multi-species plantings of native species; by minimizing the use of heavy machinery and pesticides in plantation establishment and management; and by locating plantations on degraded lands (Brockenhoff et al., 2008; Stickler et al., 2009: Harvey et al., 2014). An example of CSL planning approach is the case of the ‘Climate Cocoa Partnership’ in Ghana. The project was a partnership between the Rainforest Alliance and Olam, one of the world’s largest agribusinesses. It aimed to improve local livelihoods by promoting climate-smart cocoa cultivation, while also limiting encroachment on natural forest, promoting forest restoration in the landscape, and preparing communities for future REDD+ projects (Noponen et al., 2014).

Nevertheless, CSL is, as yet, still at a conceptual stage, and there have been few efforts to elaborate practical mechanisms for land-based actions to achieve its goals (Scherr et al., 2012). To encourage adoption of CSL strategies for achieving both mitigation and adaptation, it’s crucial to identify the right policy mix to steer local stakeholders’ land use decisions in such a way that trade-offs are well understood and carefully considered. Additionally, in the process of designing these policies, local stakeholders should be taken into account, because they are key drivers of landscape dynamics, and they will change their land use only if such changes are in line with their goals and needs (Weatherley-Singha and Gupta, 2015). This is a complicated matter, as

stakeholders have different aims in land use, which are often conflicting (Giller et al., 2008). The landscape approach should take into account this diversity, consider trade-offs and explore synergies and win-win options.
As local stakeholders are most knowledgeable about their context, about their goals and needs, and about the plausible effect and social acceptance of certain land use options, CSL planning, when done in a participatory manner, could improve and better suit local circumstances. Nevertheless, so far most policies have failed to attain their envisaged effect because they were designed in a top-down manner without consideration of local specifics and the goals and needs of local stakeholders (Ducrot et al., 2013).

Research is still needed to develop policy formulation and planning approaches that entice farmers to reflect upon and change agricultural practices to reduce pressure on the forest, increasing carbon storage. Capacity building in needs assessment and participatory planning can be particularly supportive of such processes, while also providing insight on the multiple other factors that might constrain adoption of new practices (Wollenberg et al., 2011). Integrated assessment tools, such as mapping, scenario analysis and simulation models, can guide stakeholders in exploring trade-offs between mitigation and adaptation, enabling them to identify the best options for landscape management across agricultural and forestry systems at various temporal and spatial scales (Beddington et al., 2012; FAO, 2013; Minang, 2013).

Participatory land use modelling represents an evolution of integrated assessment that is gaining currency as an instrument for collecting data about land use decisions in specific contexts and supporting CSL management (FAO, 2013). Participatory integrated assessment (PIA) may help stakeholders identify policies and local interventions that merge mitigation and adaptation objectives. To ensure that policies remain appropriate to the local context, PIA should be done in an iterative way and in close cooperation with local actors, thus allowing for monitoring, feedback and continuous policy re-design (Ridder and Pahl-Wostl, 2005).

The current chapter introduces and applies an iterative, participatory framework for analysing the potential impact of proposed policies on landscape dynamics and carbon emissions in the face of CC. The framework was applied in Vietnam by local stakeholders (farmers) and a policy actor (a representative of a national policy advisory department) to explore the impact of REDD+ and CSA policies on mitigation (forest conservation) and adaptation (food security) at the landscape level. In particular, the value of the ComMod process (Bousquet, 2003) is highlighted as a means of developing simulation models. Stakeholders participate in scenario development, which facilitates dialogue, shared insights, collective learning and decision-making. The technique provides a way to deal with the increased complexity of integrated natural resource management problems and to strengthen the adaptive capacity of local communities (Gurung, 2006). The core of the ComMod approach is a role-playing game that contributes to scenario development. The scenarios developed in the game are then fed into an agent-based model, which allows inclusion of both spatial and temporal considerations in simulations of long-term and short-term effects of trade-offs and synergies associated with different strategy options.

Figure 3.1 depicts the overall conceptual framework. In it, policymakers and local actors learn from one another and exchange information, the aim being to achieve consensus on territorial planning and identify policies tailored to the local setting. Key elements are local actors' decision-making and policymaker decision-making. Local actors make land use decisions based on their main objectives, needs and other factors that encourage or constrain them (Croppenstedt et al., 2003). Constraints might include agro-ecological factors such as land accessibility (Angelsen and Kaimowitz, 2000) or quality (topography, slope, soil, climate), socio-economic factors and farmer characteristics (Valbuena et al., 2008). Examples of socio-economic factors are access to information, agricultural technology and markets, and availability of credit. Constraints related to farmer characteristics include land ownership, income and assets levels, and resource constraints, alongside farmers' experience and knowledge of land use techniques, the agro-technology employed and risk aversion (FAO, 2013). All these factors are influenced by policies, such as regulatory reforms (e.g., restrictions on forest access and use) and capacity building/technology transfer and incentives (e.g., training in new techniques and provision of assets such as seeds of new crop varieties).

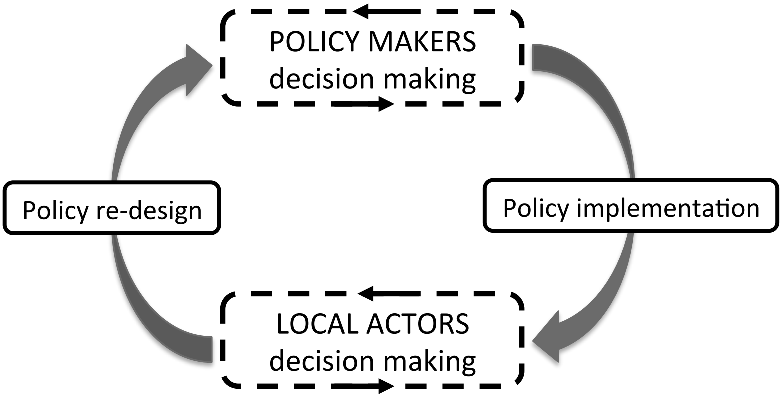

Figure 3.1: Landscape policy design: the conceptual framework.

We applied the conceptual framework to model deforestation outcomes under various policy and climate scenarios using our case study village in the central highlands of Vietnam. The application had three specific aims:

- to assess policies and interventions planned for CC mitigation and adaptation,
- to analyse local stakeholders' current land use decisions and their adaptation needs,
- to assess spatially and temporally the impact of the proposed policies and of CC via scenarios developed in a participatory way.

3.2 Materials and methods

3.2.1 The governance context of Vietnam and the case study area

Vietnam is the first of 47 United Nations REDD partner countries moving to the second phase of the REDD+ scheme. It is therefore in the process of identifying, planning and implementing land use practices that are sustainable, climate-smart and adapted to local needs (UN-REDD, 2013). Vietnam is also implementing CSA strategies in various places. Despite the purported aim for an integrated approach, REDD+ policies in Vietnam have been designed in parallel and not in synergy with CSA. This lack of coordination has undermined combined achievement of mitigation and adaptation goals locally.

Policies dealing with mitigation and adaptation in Vietnam are embedded in a complex governance system, with multiple levels and stakeholders and overlapping objectives and project components (Pham et al., 2012). At the national level the Ministry of Agriculture and Rural Development (MARD) and the Ministry of Natural Resources and Environment (MONRE) provide technical guidance for agriculture and forest management, which they manage via separate offices and programmes, with little coordination of objectives. Activities of MARD and MONRE are supervised by the Ministry of Planning and Investment (MPI) and the Ministry of Finance (MoFi), which make decisions about the actual implementation of programmes via allocation of financial resources (Pham et al., 2012). At the subnational level, Vietnam has three administrative layers: provincial, district and commune. These governmental levels play a crucial role in facilitating local land management and administration, such as the issuance of Land Use Right Certificates (LURCs), through which land parcels are allocated or leased to individuals, households or entities for use in accordance with the Land Law (2004). The case study area is the Tra-Bui Commune located in the Vu Gia-Thu Bon River Basin (Quang Nam Province, Central Vietnam) (Figure 3.2).

A community of about 500 households was resettled here in 2008, to accommodate the construction of the Song Tranh 2 hydroelectric dam (ICEM, 2008). The consequence of this resettlement was deforestation of primary forests located in the surrounding areas, as the resettled farmers needed land for crop production and logging (Tranh, 2011). Crops (mainly rice, corn, cassava and banana) are cultivated using mainly slash-and-burn practices, with few techniques for improving soil fertility and agricultural yield. Due to CC, yields in the study area are projected to fall by up to 5.9% by 2030 (IFPRI, 2010). This diminished productivity will likely aggravate deforestation, as farmers will need to seek additional agricultural land. However, such encroachment would compromise CC mitigation, as forests play a major role in the mitigation of CC, via carbon storage, while also providing important ecosystem services such as water storage, soil fertility regulation and biodiversity preservation.

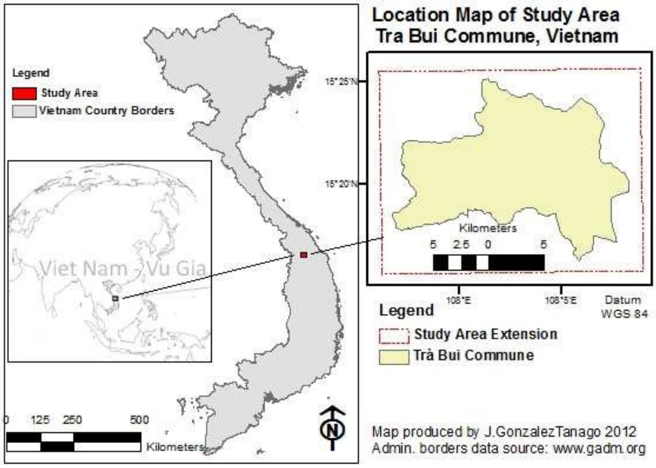

Figure 3.2: Map of the study area: Tra Bui Commune, central Vietnam.

The government of Vietnam has recognized the threat and begun designing policies to reduce deforestation and preserve existing forest stands. These policies will be undermined, however, if the main drivers of deforestation persist, particularly the expanding need for agricultural land. It is thus crucial to adopt landscape management strategies that synergistically ensure sufficient food production (adapting to CC impacts) while limiting deforestation (mitigating CC). As in several other countries, this integrated management challenge poses a particular difficulty in Vietnam, as the government works along sectorial lines. The forests are managed by the Forestry Department, under MARD, while agricultural land management is the responsibility of the District Office of Agriculture and Rural Development (DARD).

3.2.2 A method for landscape policy design

The landscape policy design method introduced here allowed to analyse adaptation and mitigation policies ex ante by engaging local stakeholders in dynamic scenario development at the landscape level. The method follows the logic of the framework introduced in Figure 3.1. It was structured in three main steps: (i) identification of policies (at the provincial level) and local interventions (at the district level); (ii) analysis of local land use decisions; and (iii) the ComMod process, entailing participatory development of land use scenarios via a role-playing game and simulation of the effects of the scenarios developed at the landscape level over decades using an agent-based model (ABM) (Figure 3.3). The cycle was completed with the communication of the results of the ComMod process to policymakers, allowing them to reformulate policies to tailor them better to the local context, thus rendering them more effective.

The process began with an assessment of policies and interventions. Interviews were conducted in March 2012 with representatives of the provincial branch of the MARD Forestry Department and DARD. The aim was to gather information about planned policies for mitigating CC (by reducing deforestation) and adapting to CC's effects (by increasing food production and incomes). This information was used in the ComMod process (step iii in Figure 3.3) to develop policy scenarios for the role-playing game and to simulate landscape dynamics in the ABM.

Local land use decisions were explored using participatory rural appraisal (PRA). PRA is a growing family of approaches and methods that enable local people to express, share and analyse their knowledge of land management, to plan and to act (Chambers, 1994). We carried out a one-day PRA with farmers in the research area, facilitated by a local translator, to obtain an initial overview of landscape dynamics, the stakeholders driving these dynamics and possible conflicts and livelihood problems related to them. Participants identified the main problems their community was facing, discussed possible causes of these problems and considered possible solutions. Following the PRA, semi-structured expert interviews were conducted with a village leader and a People's Committee leader. The aim here was to gain greater insight into the key landscape processes affecting the villages and the land management interventions that had already been implemented.

We further conducted interviews in 56 households during a four-week fieldwork period in March 2013. Persons interviewed were heads of household, most of whom were men. Information was sought on farmers' demographic profile, farm biophysical resources, crops cultivated and associated yields, deforestation practices, soil fertility, land ownership and management and knowledge of fertility-improving techniques.

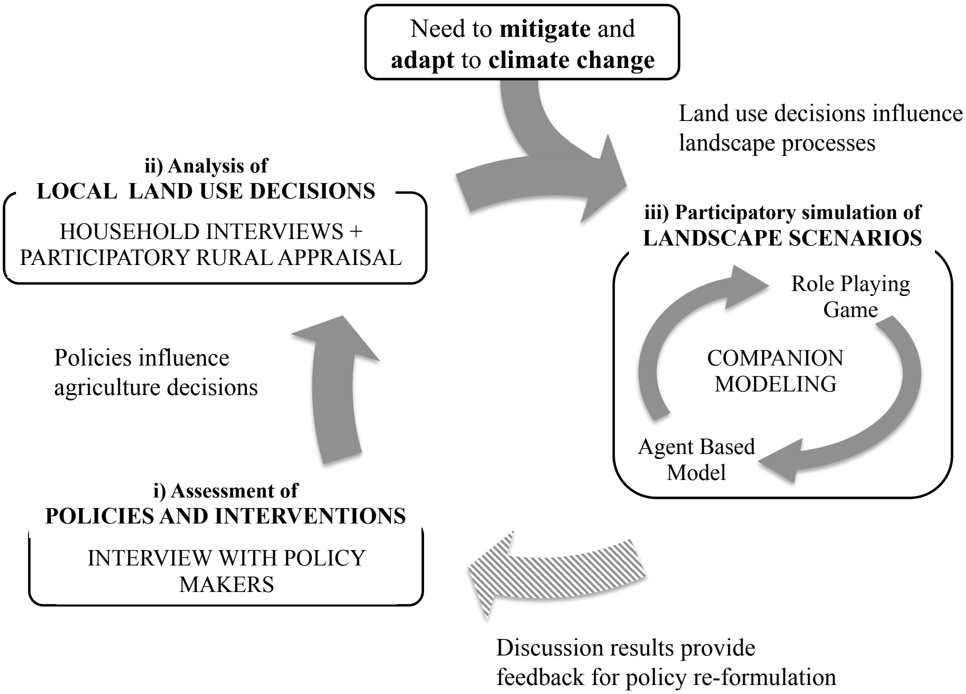

Figure 3.3: Landscape policy design framework with three main steps: (i) assessment of policies and interventions via interviews with policymakers, (ii) analysis of local land use decisions via household interviews and participatory rural appraisal (PRA) and (iii) the ComMod process, entailing participatory development of land use scenarios via a role-playing game and simulation of the effects of the scenarios developed at the landscape level over decades using an agent-based model (ABM). The developed landscape scenarios provide ex ante information to policymakers, allowing them to redesign policies so that they are better tailored to local settings and hence more effective.

The interviews provided sufficient information for an initial characterization of the study site and farmers. Various categories of farmers (the “agents” in our ABM) were identified, based on assets, knowledge and risk aversion. This information was used to build a conceptual model reflecting the local context, and subsequently fed into the role-playing game and ABM.

3.2.3 Participatory simulation of landscape processes: the ComMod approach

3.2.3.1 Role-playing game

The core of the ComMod process was a role-playing game followed by development of an ABM. The role-playing game was designed with reference to the household interviews and PRA previously conducted. Its aim was to assess the land use decisions that individual stakeholders might make under various possible future policy scenarios. Since our objective was to ascertain how CC would influence land use decisions, we explored each policy scenario in two situations: (i) current climactic conditions and (ii) with impacts of CC. CC scenarios were deduced based on IFPRI (2010), while the policy scenarios were inferred from the interviews with policymakers. The role-playing game had four main aims: (i) to investigate land use decisions and dynamics under different policy scenarios, (ii) to stimulate discussion and knowledge sharing between farmers and policymakers, (iii) to explore factors that might prompt farmers to adopt different land use practices and (iv) to investigate synergies and trade-offs associated with alternative land uses (e.g., mitigation versus adaptation benefits). The scenarios developed during the role-playing game were subsequently used to develop the ABM. This is a computer simulation model designed to reproduce the landscape dynamics observed during the role-playing game and project them into a long-term timeframe (decades).

Role-playing game participants were local farmers and a DARD representative. As they played the game, farmers were asked to make land use decisions as they would in real life. The DARD representative played the game in the role of policymaker, learning the outcomes of the planned policies. A translator acted as facilitator.

The game lasted four days. On the first day, farmers were divided into three groups of five people each, each group representing an agent type. Categories of agents were distinguished based on assets (land area used or owned and type of crops cultivated) and main farming objective(s) (food or cash crop production). In each group, with the facilitator's assistance, participants set up a landscape on the game board resembling their own village, household and agricultural land. For this, they used prepared cards representing the different aspects, such as family composition and number of agricultural fields they worked in real life (Figure 3.4).

Figure 3.4: The setup of the role-playing game board: local farmers select land use types and the associated labour and yield.

Cards displayed the different land uses (rice and acacia) and represented land use decisions in space and time. Players had to state their objectives (such as feeding their family and/or selling cash crops) and explain the land use decisions made during the past year to meet those objectives. Land suitability questions were answered as well, such as what type of land covers they used for what purpose and how far they were willing to walk to convert forest to new agricultural land. Based on their choices in the game, rules were derived for the ABM. For an individual action to become a rule, it had to be either repeated by many players independently or agreed upon by the participants as the common practice in the context of their village.

On the second, third and fourth day, alternative land use scenarios were explored, based on the interviews with policymakers. Four categories of scenarios were included: (i) “business as usual” (BAU), (ii) “REDD+”, (iii) “climate-smart agriculture” (CSA) and (iv) “climate-smart landscape” (CSL). This last category, CSL scenarios, was characterized by REDD+ and CSA interventions implemented at the same time.

3.2.3.2 Scenarios

All of the alternative land use scenarios were assessed for both of the climate scenarios. The first climate scenario assumed continuation of the current climate and associated rice yields (mean of 730 kg/ha/year). The second climate scenario assumed an impact of CC on rice yields: decreasing yields by 5.9% by 2030, as estimated by IFPRI (2010). The facilitator explained the climate change scenario to the farmers in terms of the impact on their rice yields: they were asked to imagine that their rice yield was 1-3 bags less than usual and make land use decisions accordingly.

The BAU scenario represented the current situation: no policy intervention had been introduced to protect the forest, so local farmers continued using slash and burn techniques to convert forest to cultivatable fields. Furthermore, in this scenario no agricultural techniques were introduced to improve soil fertility, so crop yields remained low (mean of 730 kg/ha/year).

For the REDD+ scenario, two possibilities were explored for policies to reduce deforestation. The first was payment of a subsidy to farmers for forest protection. This scenario was further subdivided into two “payment for ecosystem services” (PES) sub-scenarios. In the first, labelled “PES for forest protection” (PES_FP), farmers received the already planned compensation payments for protecting the forest, amounting to 6,700 dongs (0,28 euros) /ha/year. The second PES sub-scenario, labelled “PES for avoided acacia” (PES_AC), was one suggested by farmers during the role-playing game. It reflected farmers’ assertion that they would only agree to stop deforesting for establishing acacia plantations if they were given sufficient compensation to cover the opportunity cost of not establishing acacia (said to be 7 million dongs/ha/year). In addition to the two PES scenarios, a REDD+ scenario was explored in which stricter forest protection was implemented (ForPro). This scenario was characterized by more stringent forest protection, with farmers forbidden from expanding cultivation area into forest stands.

The CSA scenario category represented sustainable agricultural intensification. Two agricultural practices were assessed, each captured in a sub-scenario. The first, “CSA_manure”, entailed use of manure to improve soil fertility. This scenario was proposed by DARD. The second, “CSA_Tephrosia”, entailed provision to farmers of seed for Tephrosia, a soil fertility-improving legume indigenous to South-East Asia (Oyen, 1997). Planting Tephrosia as a fallow crop has been found to enhance soil carbon retention, while also providing fuelwood so farmers collect less firewood from the forest. The technique has resulted in rice yield increases of up to 19% in similar ecological conditions in northern Vietnam (Fagerström, 2001). This scenario also emerged from the role-playing game.

The CSL scenario incorporated both REDD+ and CSA interventions implemented at the same time. Here, two sub-scenarios were explored. The first was “ForPro_CSA”, in which strict forest protection and Tephrosia fallow were implemented at the same time. The second was “PES_CSA”, in which a PES for avoiding acacia plantations (PES_AC) and Tephrosia fallow (CSA_Tephrosia) were simultaneously implemented.

3.2.3.3 Agent-based model

The ABM was used to explore the impact of the policy scenarios at the landscape level. Agent-based modelling allows consideration of a diversity of local contexts, as well as a variety of local stakeholders' decision-making (Matthews et al., 2007; Robinson et al., 2007; Berger, 2001). Such modelling has several advantages over other techniques for simulating changes in land use. Firstly, differently from other type of methods, the input data to the ABM is derived from a RPG, which allows exploring the interactions among actors and to simulate scenarios as a collective. The informal and dynamic setting of the game encourages players to behave more naturally than they would during individual interviews (Barreteau et al., 2001; Bousquet et al., 2005). Secondly, agent-based modelling incorporates individual stakeholders (agents) and the decisions they make in different scenarios, leading to landscape dynamics. Hence, an ABM aptly depicts the heterogeneity of agricultural systems. Thirdly, agent-based modelling allows simulation of agents' interactions in social networks, which is an important element of landscape dynamics. Fourthly, the spatial representation of farm households in the ABM allows to couple land use decisions with land use changes (Parker et al., 2003; Castella, 2005; Valbuena et al., 2010; Marohn et al., 2013) and hence deforestation. Finally, with agent-based modelling landscape dynamics can be projected forward in time, to assess the potential impacts of policies on yields, incomes and carbon stored over a longer timeframe than the role-playing game.

ABM simulations can produce information that is useful for policymakers, such as what interventions may be most suitable in a particular local context to promote a shift in land uses towards a synergy of adaptation and mitigation goals. Because model outcomes represent ex-ante assessments of policies' possible impacts, the ABM connects different levels of decision-making – the government level with the local level – while encouraging learning and shared understanding. The purpose of the ABM was to provide ex ante information to policymakers on key processes driving change in the landscape – it was not meant to indicate exact outcomes for each scenario.

Our ABM was constructed by assigning decision rules to each agent (farmer) type as derived from the role-playing game. We assumed that the decisions made by the different agents were representative of the whole population of that agent type. The number of people per agent type in the village was derived from the expert interviews. The ABM has been developed using the GAMA simulation platform (Grignard et al., 2013). Details of the model can be found in the supplementary material of this manuscript, structured according to the Overview Design concepts and Details (ODD) framework, as introduced by Grimm et al. (2006, 2010) to describe the ABM in detail. Simulations were run to estimate the changes in carbon stock associated with each policy and climate scenario. Carbon emissions or removals were related to land use activities in each land cover class (Table 3.1). The land cover information for the study area was obtained from a map produced for the Vu Gia-Thu Bon River Basin at 30 m resolution for the year 2010 (Schultz and Avitabile, 2012) (Figure 3.6).

Table 3.1: Land cover, land use and associated carbon stock changes.

Land cover	**Land use activity**	**Carbon emissions (-) and removals (+) (ton/ha)**
Forest rich (over 30 years)	Deforestation	-110
Forest medium (15-30 years)	Deforestation	-56
Forest poor (10-15 years)	Deforestation	-30
Forest regrowth (7-10 years)	Deforestation	-13
Cropland/grassland	Plant acacia	+13
	Rice cultivation	N.A.
	Normal fallow	+0.9
	Woody fallow	+9.6

The map was derived from Landsat satellite images and geospatial information (i.e., with national forests, rivers and road networks) using a supervised classification algorithm trained and validated with field information and high-resolution satellite images (SPOT 5, 2.5 m). The map identified the six IPCC classes (forest, grassland, cropland, other lands, settlements and wetlands) and further distinguished rich, medium, poor, regrowth and plantation forest. The overall accuracy of the map was 82.3 per cent. It is expected to be even higher in the study area since the map was calibrated there using local ground reference data. Carbon density values per land cover were derived from a carbon stock map, also produced for the Vu Gia-Thu Bon River Basin for the year 2010 (Avitabile, 2012). The carbon stock of vegetation was calculated at plot level and then spatialized by averaging the plot values for each land cover class. The plot dataset included research observations and national forest inventory plots, and consisted of 261 primary sampling units and 3,191 secondary sampling units (subplots) with an area between 500 and 1,256 m^2. For each plot, diameter and species of trees larger than 5 cm were identified and employed to compute the carbon stock using a generalized allometric equation for moist tropical forest (Chave et al., 2005) applying a 0.5 carbon/biomass conversion factor. The IPCC Tier 1 default carbon stock values (IPCC, 2006) were applied for classes without field plots (cropland, settlements and other land). The changes in carbon stock due to land use activities (i.e., carbon emissions or removals) were computed using the stock-change method by subtracting the carbon stocks of the classes before and after the change.

3.3 Results

3.3.1 Climate change-related policies in Vietnam

Experts interviewed at the provincial Forestry Department summarized the aim of Forest Protection Decree 99 as to protect forest by issuing payments for watershed maintenance, carbon storage and landscape beauty (SocRepViet, 2010). At the local level, the decree was to be implemented through compensation payments to local farmers amounting to 180,000 dongs (7,42 euros)/ha/year to protect the assigned forest parcels. Interviews conducted at DARD revealed details of Programme 134, which aimed to reallocate land to households and stimulate them to improve soil fertility (SocRepViet, 2004). District-level experts revealed that the land use strategies planned for implementation in the study area were manure application to improve soil fertility and encouraging fixed cultivation.

3.3.2 Results from household and expert interviews

Household interviews provided the information needed to characterize local land users based on their assets (the amount of land they cultivated and type of land ownership) and main objectives (subsistence farming or cash crop production). Land ownership in the study area was formalized by Land Use Right Certificates (LURCs). Three main types of land users (agents) were distinguished:

- **Agent 1 (81 per cent of households engaged in farming).** *Households engaged in subsistence farming without LURCs*. This type of agent owned no land, so they claimed some land, just enough to satisfy their food needs. If rice yields were low they expanded land use into the forest to acquire additional fertile land. They cultivated acacia on public lands because the government tolerated it (max 1 ha). The average area farmed by this type of household was 1 to 2 ha.
- **Agent 2 (14 per cent).** *Households engaged in subsistence farming with LURCs.* This agent type had more land than Agent 1. They cultivated 1 to 2 ha acacia on their own lands. The average area farmed by this type of household was 3 to 5 ha.

- **Agent 3 (5 per cent).** *Households engaged in cash crop production with LURCs.* This type of agent had ample land (inherited or bought), including private forestland, which they often used for acacia (2-3 ha). The average area farmed by this type of household was 8 to 30 ha.

3.3.3 Results of the participatory rural appraisal

The results of the PRA showed the study area to be characterized by massive deforestation on steep slopes. This was to acquire fertile land to satisfy the food demands of the expanding population. This was confirmed by remote sensing data of the area (Gonzalez, 2012). The majority of farmers highlighted low agricultural yields as their main problem, caused by the topography (steep slopes), the stony soils and insufficient knowledge of soil conservation techniques. Low yields led farmers to clear forestland for cultivation, exacerbating land degradation and flood risk. Farmers indicated their need for new agricultural techniques to increase yields in the face of the increasing land scarcity.

3.3.4 Role-playing game

The role-playing game allowed us to assess how the different policies (REDD+, CSA and CSL) might change land use decisions and what their mitigation and/or adaptation effects might subsequently be in the two different climate scenarios. Each farmer type tended to make certain land use decisions in the different policy scenarios. In each scenario farmers, were asked to indicate if they would use manure, adopt Tephrosia fallow, plant acacia or deforest. Figure 3.5 presents a decision-making tree that was built through the role-playing game. The tree displays two main drivers of deforestation: to claim land for rice cultivation in order to satisfy family food needs and to establish acacia stands as cash crop.

Table 3.2 presents descriptions of land use decision-making by different farmer types in the different policy scenarios. Land ownership was found to play a major role in decision-making: the lack of land ownership of farmer type 1 had two important impacts on their land use decisions. First, farmer type 1 was unwilling to adopt Tephrosia because this new agricultural technique requires an investment of labour that they were not willing to make on land they did not own. Type 1 farmers were willing to adopt Tephrosia as a fallow crop only if forest protection became stricter. The second impact of lack of land ownership is farmers' use of public lands to plant acacia. For these farmers, stricter forest protection measures would therefore reduce the income they could derive from sales of acacia as a cash crop. Farmer types 2 and 3 were more open to adopting Tephrosia because they owned the land they cultivated and hence were more willing to invest in improving soil fertility. Additionally, they were not affected by stricter forest protection because they could deforest their own land to establish acacia.

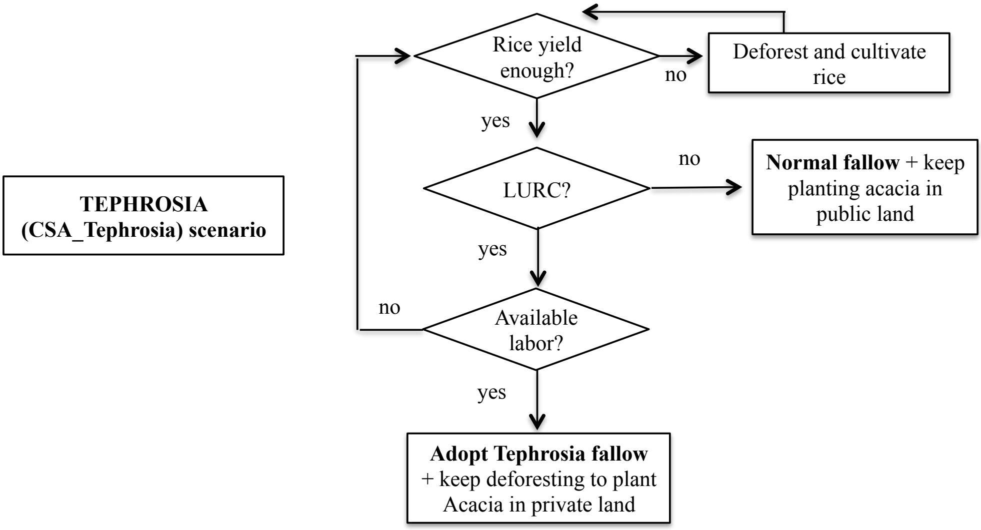

Figure 3.5: A land use decision tree, associated with the policy scenario CSA_Tephrosia. The decision tree was used to develop rules for the agent-based model (ABM). A complete overview of all decisions trees (in each policy scenario) can be found in the Appendix of the additional material of this manuscript.

Table 3.2: Land use decisions of different famer types in different policy scenarios, derived from the role-playing game.

SCENARIO	FARMER TYPE	SCENARIO DESCRIPTION
REDD+		
PES for forest protection (PES_FP)	All farmer types	None of the farmer types stated to be interested in accepting this PES to avoid deforestation because they considered the payment too low.
PES for avoided acacia (PES_acacia)		All farmers would accept this PES and would stop establishing acacia plantations.
Forest protection (ForPro)	Farmer type 1	Farmer type 1 would stop deforestation due to the establishment of acacia plantations, but would continue deforestation for rice cultivation (for own consumption)
	Farmer type 2 and 3	Farmer types 2 and 3 would continue deforestation on their private land to cultivate corn and rice and they would keep establishing acacia plantations in their own forestland.
CLIMATE SMART AGRICULTURE		
Manure (CSA_Manure)	All farmer types	In this scenario none of the farmers were open to use manure to increase soil fertility because of the slope steepness that would not allow the retention of manure in the soil and because they did not find it hygienic.
Tephrosia (CSA_Tephrosia)	Farmer type 1	Most of farmer type 1 do not implement Tephrosia fallow because they see a risk associated to its adoption; the technique requires more labour per hectare than a traditional rice farming technique and the outcome (increased yield per unit area) is not sure. Moreover, farmer type 1 will deforest in public land to establish acacia
	Farmer type 2 and 3	Initially only farmer types 2 and 3 would adopt Tephorosia because they have more land where they can experiment new agriculture techniques. Additionally, they will keep growing acacia in their private land.
CLIMATE SMART LANDSCAPES		
Forest protection and CSA (ForPro_CSA)	Farmer type 1	The introduction of stricter forest protection would lead farmer type 1 to adopt Tephrosia fallow. This is because they fear to be punished to deforest for rice cultivation, so they would be motivated to use more efficiently the existing agriculture land (by increasing the yield per unit area).
	Farmer type 2 and 3	Farmer type 2 and 3 would keep cultivating acacia in their own land and adopt Tephrosia fallow.
Payment for Ecsystem Service and CSA (PES_CSA)	All farmer types	All farmer types would adopt Tephrosia fallow and stop cultivating acacia if the opportunity cost of not planting acacia is covered.

3.3.5 Agent-based model

Model simulations were run for each category of policy under each climate scenario, to calculate and compare the resulting landscape dynamics and associated CO^2 emissions. The model produced land cover maps (Figure 3.6), alongside annual estimates of changes in land cover and carbon storage per year (Figure 3.7). Figure 3.6 shows the spatial pattern of projected land use change in 2024 and 2044 compared to the current situation (2014) in the BAU and PES_CSA scenarios. We see from the maps that in the BAU scenario rice and acacia cultivation leads to widespread deforestation, which occurs at progressively greater distances from the settlements. In the PES_CSA scenario, deforestation driven by rice production is slower and less extensive compared to the BAU scenario, and there is no deforestation due to acacia cultivation. Figure 3.7 shows changes in land cover areas and associated carbon stock in different policy scenarios. Most emissions are associated with deforestation first of poor forest and later of medium forest, due to the fact that poor forest is located closer to the settlements and hence easier to access. For this reason total carbon stock increases over time because medium forest becomes mature forest.

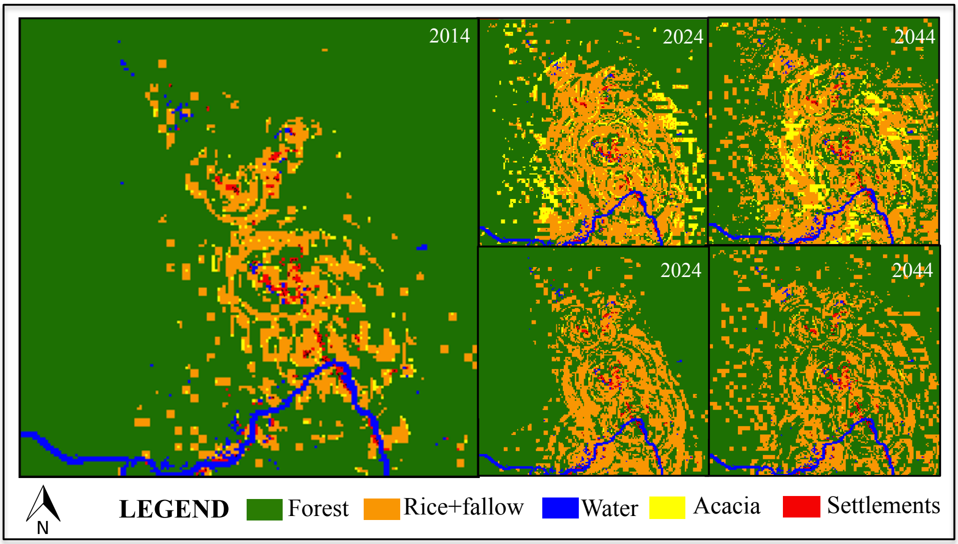

Figure 3.6: Current (2014) land cover map (left) and land cover projected in 2024 and 2044 in the BAU scenario (top) and PES_CSA scenario (bottom).

PES_CSA is the scenario with highest carbon stock because in this scenario there is less deforestation driven by both acacia cultivation and rice production. The second-best scenario in terms of emissions avoided is ForPro_CSA because in this scenario all farmers adopt Tephrosia fallow, which increases yields per hectare while storing carbon on the fallow land. Additionally in this scenario stricter forest protection prevents farmers from expanding further into forests, which reduces deforestation due to the claiming of forestland for rice cultivation. In the ForPro_CSA scenario more emissions are avoided than in the CSA_Tephrosia scenario because type 1 farmers do not adopt the Tephrosia fallow technique, as there is no policy preventing them from expanding rice cultivation into forests.

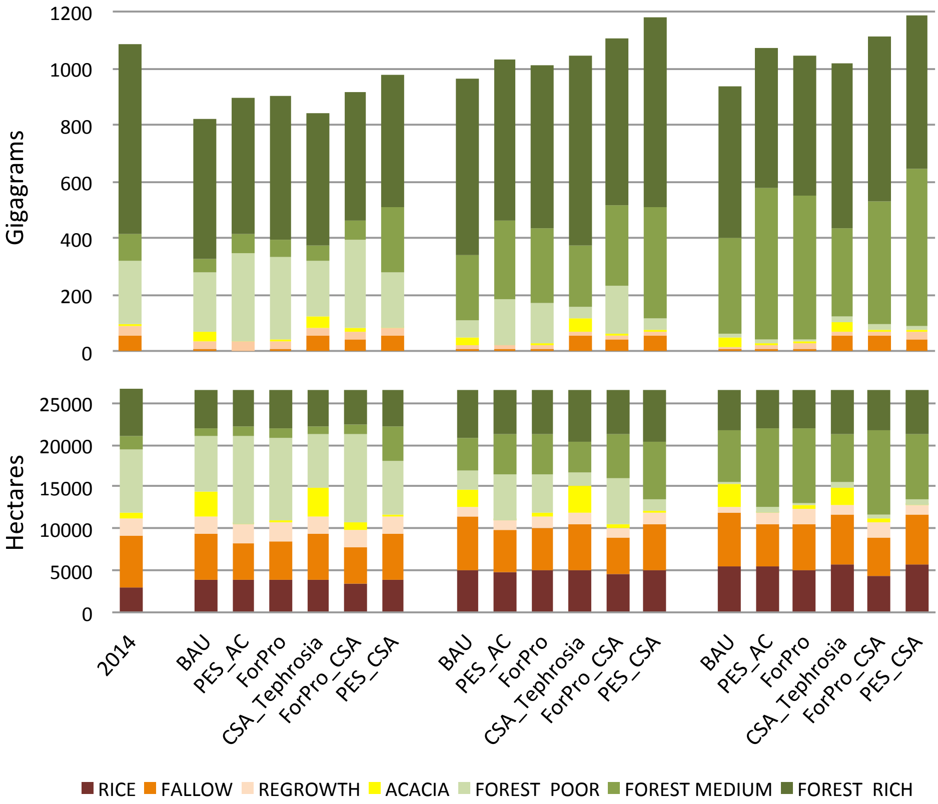

Figure 3.7: Area change (bottom) and associated carbon stock change (top) in different policy scenarios.

Figure 3.8 presents the avoided emissions (compared to the BAU scenario) calculated per policy category in each climate scenario. Overall the ABM results show the PES_CSA and the ForPro_CSA scenarios contribute most to avoided emissions. Results also show a considerable increase in emissions avoided over time, especially in the

PES_CSA scenario in which avoided emissions increases from 160 Gigagrams (Gg) in 2024 to 320 Gg in 2044.

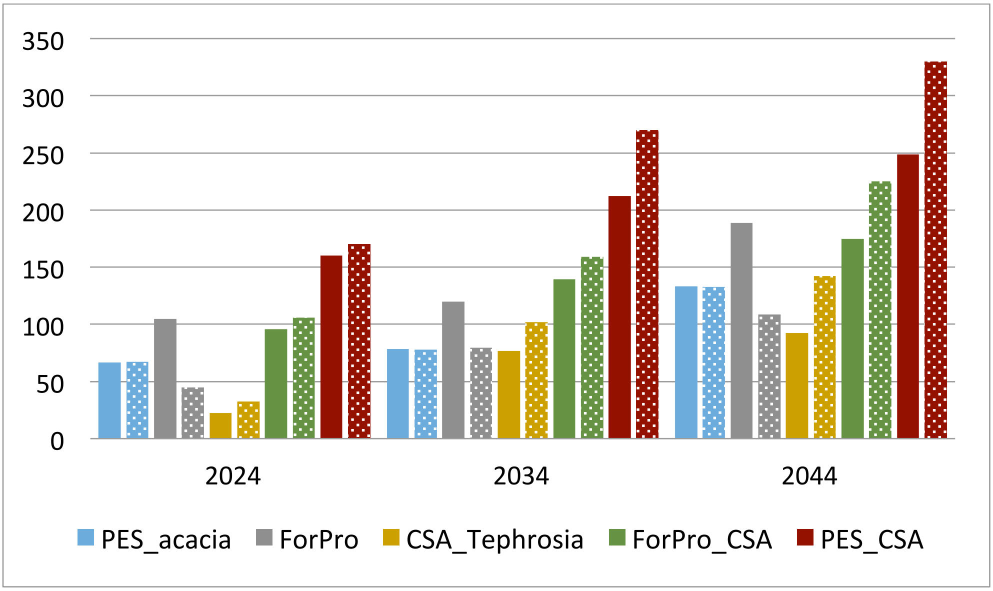

Figure 3.8: Avoided carbon emissions (in Gigagrams) for different policy categories (PES_AC, ForPro, CSA_Tephrosia, ForPro_CSA and PES_CSA) (i) in the current climate (solid colour) scenario and (ii) in the climate change scenario (raster colour).

PES_acacia would lower emissions by up to 130 Gg in 2044, but implementation of this policy requires a much larger government investment to compensate farmers for the income lost from acacia sales. ForPro has greater emission reductions than CSA_Tephrosia, because in the ForPro scenario farmer type 1 would stop deforestation linked with acacia establishment, which contributes to more emissions than rice cultivation. Nevertheless, in this scenario there is less income for farmer type 1; this is an important trade-off between mitigation goals (lower emissions from deforestation) and improvement of local livelihoods via selling timber from acacia plantations. In the CC scenario, ForPro is much less effective in reducing deforestation because CC is expected to reduce rice yields; hence deforestation for rice cultivation would persist as a major driver of deforestation even if stricter forest protection is introduced. CSA_Tephrosia would contribute to reducing emissions more in the long term, because of the effect of CC in progressively reducing rice yields. Tephrosia would contribute to maintain rice yields at a higher level than the BAU, hence reducing deforestation related to expansion to new rice fields. If forest protection is combined with the introduction of CSA (ForPro_CSA scenario), more emissions would be avoided because CSA would increase the rice yield per area, diminishing farmers' need to claim forestland. This is an important result of our analysis, because it demonstrates that synergy can be generated by simultaneous implementation of adaptation and mitigation policies: they are more effective if implemented together (ForPro_CSA scenario) rather than separately (ForPro separated from CSA_Tephrosia).

The combination of policies that would contribute the most to reduce emissions is the PES_CSA scenario, because deforestation due to both acacia and rice production would be reduced. Nevertheless, in this scenario a major government investment would be required to compensate farmers for the income they forfeit by not establishing acacia plantations.

Such scenario outcomes are based upon a series of assumptions and simplifications made while developing the ABM. For instance, the model currently uses rather generic decision rules, which represent the farmers only using three different agent types. Additionally, the ABM simulates landscape dynamics taking into account just rice as a food crop and acacia as cash crop. It does not include other locally produced crops such as corn and other cash crops such as cinnamon.

Moreover, several uncertainties exist related to the input socio-economic data, whose validity could be biased by the respondents. For instance, in the RPG a potential bias is linked with the fact that the land use decisions made during the RPG do not reflect their decisions in reality as players might take more risk than they would take in real life. A possible way to overcome such bias is to play the RPG multiple times and assess if there is consistency in the land use decisions of farmers and if the observed patterns are confirmed by multiple evidence. Additionally, interviews with local experts can be conducted to gather additional information about the plausibility of the observed land use decisions.

Despite the above-described uncertainties about the validity of the ABM, such uncertainties do not interfere with the main objectives of the introduced framework, which is not to predict future landscape dynamics, but to encourage knowledge sharing, to explore policy scenarios and to bridge the gaps between decision making of farmers and policy makers. Moreover, the game can be a very useful approach to induce players to discuss, identify common problems and eventually agree on how to better manage their landscape via a joint collaboration (Salvini et al., 2015). If such applications of the RPG are clear to players, they are perhaps more willing to make decisions in the game as if they would in real life.

3.4 Discussion and conclusions

This paper introduced a framework for analysing the impact of CC mitigation and adaptation policies before their actual implementation. The framework builds on the understanding that landscape dynamics are driven by the land use decisions made by local stakeholders, and the fact that active participation of local stakeholders is needed to ensure policy effectiveness. Moreover, policy design should take into account dynamics at the landscape level, using a multi-sectorial approach. The impacts of CC on agriculture will also need to be taken into account when selecting land use strategies appropriate for the local context.

The first part of the research consisted of an examination of the actual policies and land use strategies planned in our case study area for CC mitigation and adaptation. The second part consisted of a participatory integrated assessment of the proposed policies and plausible land use strategies, to determine the potential effectiveness of policies in the case study area, taking into account local stakeholders' needs, objectives and constraints in adopting alternative land uses. To this aim we use the ComMod approach, a participatory process for exploring how policies might affect local stakeholders' land use decisions and impact landscape changes – and thus mitigation and/or adaptation outcomes. This process provided ex ante information to policymakers, allowing them to redesign policies to make them more locally appropriate and therefore potentially more effective in achieving adaptation and mitigation goals synergistically.

After introducing the framework we demonstrated its application in our study area, by the Tra Bui Commune in central Vietnam. The landscape of Tra Bui Commune faces a dual challenge of protecting the forest while improving agricultural practices to adapt to CC impacts. We conducted participatory scenario development to assess policies and interventions planned by government, and we developed an ABM to project the impacts of the planned policies on landscape dynamics, deforestation and CO^2 emissions over a period of decades. Results of this process indicate that if policies are implemented separately, trade-offs will emerge, hampering their effectiveness. However, their simultaneous implementation in a landscape approach was found to enhance synergies. In particular, stricter forest protection law enforcement introduced without stimulating agricultural intensification was shown as unlikely to be effective because agricultural expansion would persist as a driver of deforestation. Additionally the compensation offered by government for preserving the forest was found to be considered insufficient by local farmers, so farmers were likely to continue deforesting to establish acacia plantations. Similarly, introducing agricultural techniques that increase yields without stricter forest protection would not automatically reduce deforestation. Moreover, the selection of agricultural intensification technique must consider the local setting and constraints of local farmers. In the case study presented here, farmers in Tra Bui Commune were unwilling to use manure to improve the fertility of their fields, though they seemed open to the use of Tephrosia fallow.

According to the ABM simulations, the greatest emissions reductions are achieved in the PES_CSA scenario, especially in the long term. This is because much of the current CO^2 emissions are related to deforestation for establishment of acacia cultivation. If farmers are sufficiently compensated to preserve the forest instead of planting acacia, emissions of up to 330 Gg could be avoided in the whole commune area in 2044. This scenario was developed with local communities, and the compensation they indicated as necessary to counterbalance the opportunity cost of not planting acacia was 7 million dongs/ha/year. This is much higher than the compensation DARD is currently planning to provide for forest protection (180,000 dongs/ha/year). These results suggest several conclusions and related issues that should be considered when designing policies aimed at achieving adaptation and mitigation synergistically.

The first conclusion is that planning for forest protection and rural development should be coordinated. In Vietnam such coordination is hampered by the fact that these goals are under the separate mandates of two different government departments (MARD and MONRE). The lack of administrative coordination is an obstacle to integrated land management in general and to REDD+ initiatives in particular, reducing the cost effectiveness of project implementation (Pham et al., 2008). For REDD+ policies to be effective they should look beyond the forest sector, to also address drivers of deforestation such as agriculture. CSA implementation, for its part, should consider forest protection policies too, with agricultural and land use strategies designed in line with them. A similar lack of coordination is reported in other countries as well, where REDD+ initiatives have been designed without considering the main drivers of deforestation (Salvini et al., 2014).

The second conclusion is that involvement of local stakeholders improves the design of local interventions, tailoring them so that they better fit the local context and hence making them more effective. Local communities in Vietnam are not currently actively involved in decision-making. Rather, the design of policies implemented by MARD and MONRE is currently top-down without consideration of the local setting, local knowledge and the goals and needs of local stakeholders. Our test application of the

ComMod process revealed that building scenarios with local communities in a participatory manner provides useful information to the extension worker. This information allows local interventions to be designed and redesigned with greater consideration for local goals and needs and hence more likelihood of being effectively adopted.

The third conclusion is that ownership status plays a central role in land use decisions and adoption of sustainable agriculture. In the Tra Bui Commune, as well as in many other regions of Vietnam, policies aimed at promoting agricultural development are hampered by the uneven distribution of Land Use Right Certificates (LURCs). Farmers without an LURC are less willing to invest in agricultural management than those who do have an LURC. For REDD+ initiatives to be effective, it will therefore be important to improve the issuance LURCs. This will not be straightforward, because in Vietnam issuance of LURCs by local government is very much dependent on decisions made by the higher government layers. Even if the process of issuing LURCs to millions of land users were to progress rapidly (Do and Iyer, 2008), it seems likely that the outcome would be seriously compromised by corruption (Markussen and Tarp, 2011).

The fourth conclusion is that benefit-sharing should be carefully designed. Results of our participatory scenario development suggest that the current compensation of 180,000 dongs/year/ha to local farmers for forest protection may be too low to stimulate farmers to modify their land use. For REDD+ policies to be effective, a carefully designed benefit-sharing scheme could be implemented for channelling funds to local communities. This is now hindered by the current structure of financial resource allocation. The private sector and state corporate groups are currently closely linked, which enables vested private sector interests to easily influence decision-making (Forsberg, 2007). Additionally, Vietnam's development continues to be strongly linked to economic growth, with a focus on infrastructural development (Forsberg, 2007) and few measures implemented to lower the deforestation associated with such development. Therefore, a major concern is how to ensure that resources are used for state industrialization priorities while financial support is transferred to local communities (Forsberg, 2011).

An overall finding from our case study is that the framework introduced stimulated active involvement of local stakeholders in land use scenario development and in the design of benefit-sharing mechanisms that could effectively steer land use decisions. The role-playing game initiated an iterative learning process, via discussions among local farmers and with the government representative about the possible outcomes of each policy. Building scenarios in such a participatory manner constitutes a powerful tool for informing policymakers about how land use decisions are made at the local level and allowing policymakers to redesign policies to make them more locally tailored and hence more effective. Additionally, the ABM projected the impact of each policy or combination of policies over a longer timeframe. This informed policymakers about which policies were most effective for achieving both adaptation and mitigation goals. This conclusion is expected to be valid for similar situations in other parts of the world, though this expectation awaits further investigation.

Despite the framework appeared to be useful to provide ex-ante information to policy makers, it presents challenges in linking different methods in an integrated approach. One of such challenges is to input the land use decision rules derived from the RPG into the ABM. Further work needs to be done to couple ABM with RPG. Currently this coupling is made using a qualitative method. More semi-quantitative methods should be sought in order to strengthen the validity of this approach. An example of a method to accomplish this is the use of fuzzy cognitive maps (Kok, 2009).

Finally, the framework as presented here does not yet consider aspects that should be taken into account when evaluating the impact of mitigation/adaptation policies on social issues such as income distribution and poverty. Hence we suggest that further research should be done on how to include such aspects, in order to have a more complete overview of the expected outcome of the policies under analysis.

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Chapter

4

Roles and drivers of agribusiness shaping Climate Smart Landscapes: a review

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Abstract

In recent years, agricultural and forest areas worldwide have experienced increasing pressures to support food production, sustain local livelihoods and contribute to climate change (CC) mitigation and adaptation. Agribusiness companies face natural resource constraints determined by these challenges, such as land scarcity, groundwater depletion and habitat fragmentation and CC impacts. These constraints originate from outside the company boundaries but may have unprecedented effects on their business performance. To cope with these challenges, the Landscape Approach (LA), has recently emerged as an integrated management strategy to address the multiple objectives of agricultural production, ecosystem conservation, rural livelihoods and CC mitigation and adaptation. Agribusiness companies play an important role in shaping the implementation of the LA, as they often have resources such as physical, financial and social capital. Despite the important role agribusiness companies have in LA, empirical evidence is still fragmented of which activities agribusiness companies undertake in landscape management, as well as the underling objectives driving these activities. To help filling in this knowledge gap, this article reports a review of integrated landscape management initiated by agribusiness worldwide. Results show that the main objectives that lead companies to start projects via a LA are sustainable sourcing, local community and operational risks reduction and voluntary standard compliance. Project activities (planned to be) implemented to achieve these aims include sustainable productivity increase, forest conservation, introduction of new cash crops, market links and PES. These activities contribute to landscape-scale benefits: ecosystem conservation, agriculture production, rural livelihoods improvements and CC mitigation/adaptation in different ways. Local stakeholders are (planned to be) involved via a wide range of strategies, spanning from training and logistical support provision toward more interactive engagement strategies, such as the establishment of a multi-stakeholder governing body and democratic and full participation.

Keywords: agribusiness, landscape approach, Climate-Smart-Landscapes,
stakeholder involvement, monitoring.

4.1 Introduction

In recent years, agricultural and forest areas worldwide have experienced increasing pressures to both support food and energy production while contributing to global climate change (CC) mitigation and adaptation. In face of these mounting and contrasting pressures, land and other natural resources are diminishing due to environmental degradation resulting from unsustainable practices and widespread deforestation.

To cope with these challenges, stakeholders active in agricultural and forestry have recently started to engage in a Landscape Approach (LA). The LA refers to a set of landscape management practices to address multiple objectives of agricultural production, ecosystem conservation and rural livelihoods (Sayer et al., 2013; LPFN, 2012). To reach these outcomes, LA approaches usually entail inter-sector coordination among multiple stakeholders in the landscape, including agribusiness companies at different stages of the value chain and across multiple commodities. For example, agribusiness companies in a landscape may include producers of timber, cocoa or metals (i.e. mining) as well as their input suppliers and investors upstream the chain, as well as their processors, manufacturers, traders, retailers downstream the chain. Such approach acknowledges the importance of seeking synergies and trade-offs among economic, social and ecological dimensions in a landscape, fostering collaborative decision-making among actors involved in it and developing market and policy contexts that support sustainable innovations (Scherr et al., 2014). Recent CC debates led scholars to talk about Climate Smart Landscape (CSL), which emphasizes the importance of strengthening measures to mitigate and adapt to CC (Scherr et al., 2012; Harvey et al., 2014). This is because CC remains a significant wicked problem that crosscuts several challenges in landscapes, thus it requires integrated landscape solutions (Kissinger et al., 2013; Sayers et al., 2013).

Agribusiness companies play an important role in shaping the implementation of CSL, as they often have valuable and rare resources such as physical, financial, human and social capital (Dentoni and Krussmann, 2015). Through their resources, companies may influence the sustainability of the landscape where they operate depending on how they develop linkages with local stakeholders. Local stakeholders are both agricultural and food supply chain actors (e.g. farmers or producers of raw materials and local buyers), as well as non-market actors such as municipalities, extension officers, non-governmental organizations, communities, research institutes or civil society organizations. While they are rich in the aforementioned resources, agribusiness companies face natural resource constraints such as land scarcity, groundwater depletion, habitat fragmentation and other effects of CC similar to (yet differently from) other stakeholders in a landscape. Although these natural resource constraints may not affect companies directly, they can still result in unprecedented effects on their business performance. For instance, deforestation, groundwater depletion and habitat fragmentation strongly influences the social and political stability of key sourcing and operational regions (KPMG, 2012). These problems concern agribusiness companies and require engagement with multiple stakeholders to be tackled and even understood (Batie, 2008; Dentoni et al., 2015).

Despite their importance in shaping landscapes, the role that agribusiness companies play (and should play) in the management of resource-depleting landscapes is still ambiguous and under debate. One line of thought argues that companies, similar to any other organization in a landscape, follow rules imposed by public institutions (North, 1990) and thus cannot be held responsible for regulatory weaknesses that may affect the governance of the landscape. A second view sees companies as active players in changing or complementing public institutions in governing environmental and social sustainability, for example introducing and enforcing private standards or codes of conduct (Pacheco et al., 2010). According to this second perspective, researchers discussed the role of companies in deliberating and taking collective decisions with multiple actors in a landscape Together with other actors in society, agribusinesses engage in knowledge-sharing, decision-making and enforcing processes that influence the use of resources in a landscape (Palazzo and Scherer, 2006; Mena and Palazzo, 2013).

Research is still fragmented about the activities undertaken by agribusiness companies in landscape management, as well as the underlying objectives driving these activities. Additionally, the agribusiness company contribution in achieving CSL goals is still not explored yet. To help filling in this knowledge gap, this article reports a review of integrated landscape management initiated by agribusiness that addresses the following research questions:

1. What are the objectives of agribusiness companies initiating projects via a LA?
2. Do project activities contribute to achieve the multiple objectives of CSL (Agricultural production, Ecosystem conservation, Rural livelihoods, Mitigate and adapt to climate change)?
3. How were stakeholders involved in such projects?
4. Did the project aim at monitoring project activities?

To address these questions, this article reports the findings from a review of secondary data that expands the work of Kissinger et al. (2013), who made a preliminary worldwide analysis of agribusiness-initiated projects with a landscape approach.

4.2 Role of agribusiness in initiatives based on a landscape approach

To cope with the mounting challenges of scarcity and overexploitation of resources, a number of agribusiness companies have complemented their supply chain management strategies with projects or partnerships following a LA. To this end agribusiness companies organize investments with their supply chain partners to improve the environmental and social performance along the chain - from producing farms and forests, to post-harvest operations and consumer behaviour. Via these investments agribusiness influence their business partners to adopt more sustainable production systems, via for instance certification, or better practices to reduce GHG emissions, or other environmental impacts.

Nevertheless, given its commodity focus, a limitation of a supply chain management approach is that it will likely not affect the interactions between multiple commodities or the relation between them in one location. For example, timber, cocoa and tourism industry may take place in the same landscape, causing either trade-offs or win-win across supply chains that need to be considered. For this reason, the supply chain management approach has been criticized for its limited suitability to cope with challenges arising from the wider landscape (Bitzer et al., 2008; Vurro et al., 2009).

Differently from supply chain management perspective, in a LA agribusiness companies invest with a (more) holistic view on the landscape. Specifically, beyond the boundaries of one supply chain, through a LA companies explore and exploit the interdependencies among different land uses and commodity chains (Termorshuizen and Opdam, 2009; Newton et al., 2013). As such, the LA builds on the idea that agriculture production is inextricably linked to the health of the surrounding forest ecosystem and provides relevant ecosystem services that support and sustain it (UNEP 2012). This idea stems from the concept of Green Economy (UNEP, 2011) and has been empirically supported by recent global assessments (IPBES, 2012; TEEB, 2010; WAVES, 2012). This idea recognizes that the management of land use interactions at the landscape scale is essential to enhance the multi-functionality of landscapes over time.

From the agribusiness management literature, three main reasons for engaging with multiple stakeholders beyond supply chain partnerships emerge. First, through multi-stakeholder engagements, agribusiness companies may develop, establish and enforce standards on sustainability. Agribusiness companies often decide to engage in standards setting with stakeholders to reduce coordination costs along the supply chain in the long run. For a company, in fact, the costs of coordinating actors along their supply chain decrease if the standards are widely established, measurable and enforceable, and if their suppliers have the capacity to reach them (Lee et al., 2012). Second, through multi-stakeholder engagements agribusiness companies may develop social networks or increase control over valuable and rare natural resources, and thus secure a stronger position in strategic sourcing areas (Dentoni and Velduizen, 2012; Formentini and Taticchi, 2016). Third and last, agribusiness companies may engage with multiple stakeholders beyond their supply chains to lower their reputational and operational risks (Freeman, 2010; Dentoni and Peterson, 2011; Kissinger et al., 2013). In particular, by developing capacities to understand, interact, learn and change based on stakeholders' needs and demands (Dentoni et al., 2015), companies manage socio-political risks that may jeopardize business operations at local or national level.

While an increasing amount of agribusiness companies adopt the LA, research is still fragmented of which activities agribusiness companies undertake in landscape management, as well as the underling objectives driving these activities. Additionally, questions remain open on how agribusiness companies coordinate with multiple local stakeholders (Offermans and Glasbergen, 2015) and if any monitoring mechanisms are (planned to be) enforced. These questions justify the need to further investigate companies' stated goals and activities in relation to the LA initiatives that they have recently invested in and their contribution to achieve CSL goals.

4.3 Materials and methods

We started by analysing the dataset of projects collected by Kissinger et al. (2013), who used a multi-step process to identify and select agribusiness projects: an initial online project selection via keywords was refined through the networks of experts and organizations participating in the Landscapes for People, Food and Nature Initiative (LFPN). Starting from this initial dataset we identified additional initiatives by searching online for other projects initiated by the same agribusiness company, reaching a total of 41 projects (appendix 1).

We conducted the review research by developing a framework with eight dimensions (figure 4.1). According to this framework, a landscape is a CSL if it contributes to the four CSL objectives: Agricultural production, Ecosystem conservation, Rural livelihoods and Climate change mitigation and adaptation. Companies can contribute achieving CSL aims via project activities that they initiate to satisfy their objectives. Additionally, the framework introduces the role of two enabling conditions for CSL: Multiple stakeholder engagement and Monitoring the effectiveness of interventions. Company's activities, Stakeholder engagement and Monitoring are interlinked through a logical chain: in order for company's objectives to be effective, they need to engage multiple stakeholders. Monitoring such activities is crucial to adjust company's activities and to re-define stakeholder engagement strategies that are more appropriate to the local conditions

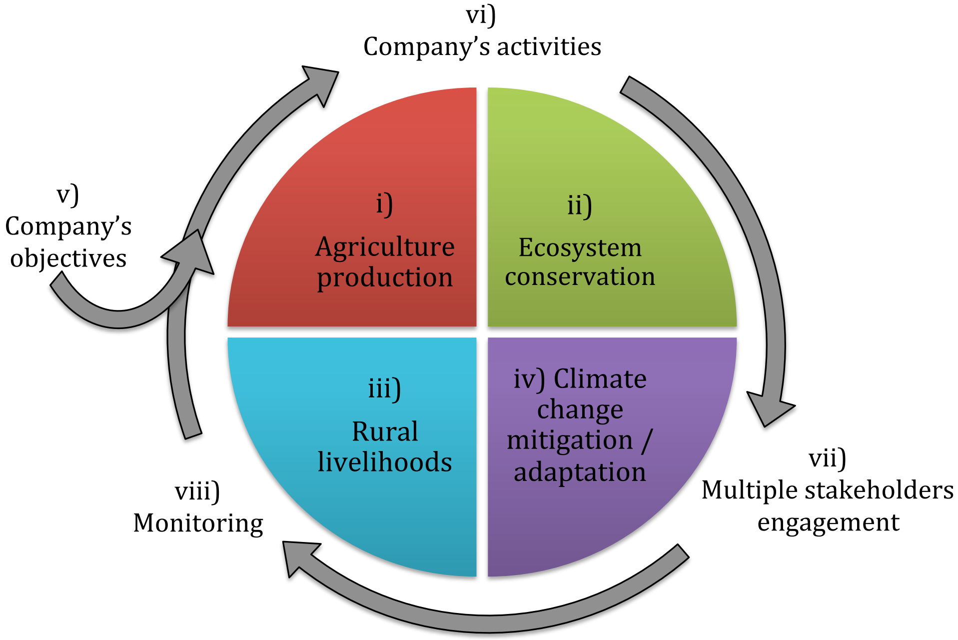

Figure 4.1: Our framework includes eight dimensions: four objectives of Climate Smart Landscapes (i. Agricultural production, ii. Ecosystem conservation, iii. Rural livelihoods and iv. Climate change mitigation and adaptation), v) companies' objectives, vi) companies' activities and two enabling conditions (vii. Multiple stakeholders engagement and viii. Monitoring).

We analysed strategies that agribusiness (plan to) adopt based upon the review of their project descriptions. We assessed the degree to which such projects contribute to one or more of the eight CSL dimensions introduced in our framework. In particular, we aim to meet the following objectives:

1. **Synthesis of the objectives of agribusiness projects:** we reviewed project descriptions to synthesize which objectives triggered companies to initiate projects beyond the farm/production level. To this aim we provided an overview of the objectives and we grouped them in categories. By comparing and contrasting the description of the selected projects with the recent literature on supply chain management and coordination of multiple stakeholders through a LA (Gereffi, 2005; Lee et al., 2012; Dentoni and Krussmann, 2015), such grouping allows drawing conclusions about the most common objectives and elaborate on them.

2. **Synthesis of the project activities:** we provided an overview of the companies` activities, as reported in the project description and we assessed whether they aimed at contributing one or more of the CSL objectives. Additionally we identified the type of incentives provided to local stakeholders to get involved in the projects. Furthermore, we provided an overview of which activities are mostly used to meet the objectives reported by the company and we reflected on their contribution to the CSL objectives.

3. **Assessment of the type of stakeholder involvement strategy**: we assessed if the project description contains any specification of the modality through which local stakeholders are (planned to be) engaged in decision-making. To this aim we created different categories of engagement and we elaborated on them.

4. **Assessment of project monitoring strategy**: we assessed if the company is planning to adopt any system to monitor the outcomes of their project, aimed at reporting and eventually improving their activities.

4.4 Results

4.4.1 Synthesis of the objectives of agribusiness projects

A variety of aims led companies to initiate the reviewed agribusiness projects, which we classified in four main groups: long-term sustainable sourcing, community and operational risks reduction, voluntary standard compliance and others (table 4.1). These main groups of objectives emerge from the aligning the reviewed agribusiness projects with the existing agribusiness management literature. In particular, reducing degradation (e.g., soil erosion, slash and burn, water pollution), restoring (e.g. landscape benefits) or preserving natural resources (e.g. enhance/maintain ES, integrated management) are ways for companies to secure long-term sustainable sourcing. Furthermore, improving local economy and livelihoods and enhancing food security relate to companies' objectives of lowering their reputational and organizational risks and establishing social legitimacy.

Table 4.1: Agribusiness objectives described in projects grouped in broader categories. Percentages represent projects with one or more aims in each group category.

N of projects	Objectives/problems	Group
23	Sustainable productivity increase	Long term sustainable sourcing (49%)
6	Integrated management	
7	Enhance/maintain ES	
4	Soil restoration	
3	Reduce soil erosion	
7	Landscape benefits	
9	Prevent / reduce deforestation	
14	Ecosystem degradation	
4	Water pollution	
6	Unsustainable water use	
1	Reduce agriculture expansion	
1	Reduce slash and burn	
16	Improve local livelihoods	Community and operational risks reduction (27%)
12	Food security	
18	Improve local economy	
5	Certification	Voluntary standard compliance (12%)
2	SAN certification	
1	CCB standard	
1	UTZ compliance	
1	VCS standard	
1	FSC compliance	
3	RSPO compliance	
1	RTRS compliance	
1	Sustainable palm oil	
4	Sustainable soy	
17	Biodiversity friendly practices	Other (13%)
3	Sustainable energy	
2	Carbon offsetting	

Finally, the establishment of codes of conducts, compliance practices and sustainability certification systems relate to companies' expectations of reducing their coordination costs (Lee et al., 2012). Based on these groups of objectives, the review of the agribusiness projects resulted in the following empirical findings. Long term sustainable sourcing was the aim of 49% of the reviewed projects and it includes various objectives such as sustainable productivity increase, integrated management and enhancement/maintenance of ecosystem services (ES). Specifically, a large amount of companies mention fighting ecosystem degradation as a major driver for adopting a LA. Community and operational risks reduction is another important objective, as described by 27% of the projects, although providing such benefits were linked with sustainable sourcing aims and not a stand-alone goal. Interventions in this category are: improving local livelihoods and local economy and food security. Finally, Voluntary standard compliance is a less common objective (12%) for agribusiness to engage in such projects, spanning from Roundtable on Responsible Soy (RTRS) and Roundtable on Sustainable Palm Oil (RSTPO) compliance to the Sustainable Agriculture Network (SAN) standard for sustainable agricultural practices.

4.4.2 Synthesis of the project activities

Companies adopted a wide range of activities, which we evaluated based upon their contribution to achieve the four CSL objectives: i) Agricultural production, ii) Ecosystem conservation, iii) Rural livelihoods and iv) Climate change mitigation and adaptation (table 2). From our review it shows that companies implement several projects activities, which contribute to achieve CSL goals in different ways. Agricultural production (CSL goal n 1) is mainly sustained by sustainable agriculture as reported by 27 companies, as well as agroforestry (introduced by eight companies), as a technique to increase agricultural production and at the same time contribute to lowering impacts at the landscape scale such as water scarcity and soil degradation. Tree planting was initiated by six companies to reduce siltation hence contributing to agriculture production, by reducing soil runoff. Projects appear to contribute to rural livelihoods (CSL goal n 2) via different channels. Besides the benefits of sustainable agriculture via increased food production, other activities that clearly contribute to rural livelihoods are linked to project incentives, such as introducing new cash crops, improving market link and creating new business opportunities. Ecosystem preservation (CSL goal n 3) is sustained via a wide range of project activities spanning from forest preservation, forest restoration, tree planting to reduce siltation, sustainable plantations and sustainable landscape management. Although most of the initiatives aimed at ecosystem preservation are implemented at the landscape scale, several activities related with farm conservation contribute at ecosystem services provision, such as agroforestry systems that retain water and hence contribute to water quality and quantity at the landscape scale.

Despite the fact that few projects state clearly to aim at CC mitigation and adaptation (CSL goal n 4), several projects contribute to them via numerous activities. For instance CC adaptation is promoted via sustainable agriculture in general and agroforestry in particular, via an increase in agriculture yield in face of CC-related impacts such as water scarcity and temperature increase. CC mitigation is promoted via forest preservation and landscape scale forest restoration and tree planting. Some of these activities are supported via payments for ecosystem services and/or payments for carbon offsets. Figure 4.2 provides an overview of the percentage of project activities that are used to meet the objectives reported by the company and their contribution to the CSL objectives. The project objectives are derived from table 1 and the project activities were selected from the most common activities in each group of table 2.

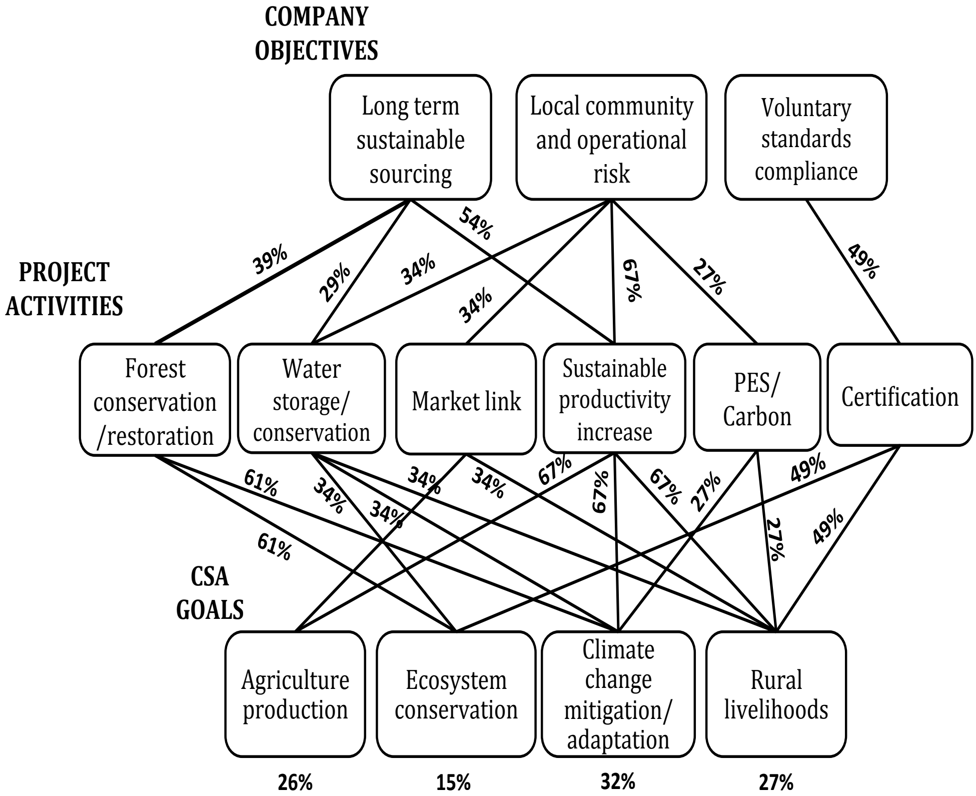

Figure 4.2: Overview of the link between company`s objectives, major project activities and their contribution to Climate Smart Landscape goals.

Table 4.2: Project activities as reported in the project description and their contribution to the CSL goals.

		CLIMATE-SMART-LANDSCAPES OBJECTIVES				
Group	**Activity**	**N° of projects**	**Agricultural production**	**Rural livelihoods**	**Ecosystem conservation**	**Climate Change mitigation /adaptation**
Agriculture	Sustainable productivity increase	27	X	X		
	Agroforestry	8	X	X		X
	Home gardening	1	X	X		
	Cultivation of rare species	2	X	X	X	
	Control of pests and diseases	2	X	X		
	Plant/cultivate in degraded lands	2	X	X	X	X
	Improve harvesting technology	2	X	X		
	Increase biomass in fields	1			X	X
	Village nurseries	2	X	X		X
	Control of invasive species	1	X	X		
Forest, plantation and ecosystem management	Forest conservation	17			X	X
	Forest restoration	7			X	X
	Tree planting to reduce siltation	6	X	X	X	X
	Landscape scale restoration	6			X	X
	Sustainable landscape management	4			X	
	Sustainable forest management	4			X	X
	Ecosystem management plans	4			X	X
	Intercropping with useful native species	2			X	X
	Sustainable plantations	6			X	
	Environmental Impact Assessment	1			X	

		CLIMATE-SMART-LANDSCAPES OBJECTIVES				
Group	**Activity**	**N° of projects**	**Agricultural production**	**Rural livelihoods**	**Ecosystem conservation**	**Climate Change mitigation /adaptation**
Water conservation	Water storage	8		X	X	X
	Water conservation	6		X	X	X
	Integrated watershed management	1		X	X	X
	Sustainable irrigation	1		X	X	X
New markets	New cash crops	17		X		
	Market link/new business	14		X		
Incentives	Carbon offset payment	6		X		
	Payment for Ecosystem Services	5		X		
	Training	5		X		
	Subsidies/grants	3		X		
Certification	Certification	5			X	
	SAN certification	2			X	
	CCB standard	1			X	
	UTZ compliance	1			X	
	VCS standard	1			X	
	FSC compliance	1			X	
	RSPO compliance	3			X	
	RTRS compliance	1			X	
	Sustainable palm oil	1			X	
	Sustainable soy	4			X	
Other	Technology and infrastructure	6		X		
	Pelletizing plant	1		X	X	
	Energy saving stoves	1		X	X	X

Figure 4.2 shows that the largest part of the companies that aim at improving long term sustainable sourcing achieve it via sustainable productivity increase, followed by forest and water conservation. Local community and operational risks are dealt via sustainable productivity increase, water storage/conservation and Payment for Ecosystem Services (PES), while Voluntary standards compliance is mainly achieved via certification/roundtables. Companies contribute to achieve CSL goals via multiple activities. Agriculture production is supported via sustainable productivity increase and promoted by an improved market link. Ecosystem conservation is accomplished via forest and water conservation and supported by certification.

CC mitigation/adaptation are promoted mainly via sustainable productivity increase, forest preservation and supported by PES. Finally, Rural livelihoods are sustained by improved market link and sustained by certification, which enables reaching further niche markets of sustainable products. Additionally, the figure shows the contributions of companies' activities to CSL goals. This is represented by the percentages below each CSL goal. Agribusinesses' objectives and activities contribute quite evenly to CSL goals. Most of the activities contribute to CC mitigation and adaptation, followed by rural livelihoods, agricultural production and ecosystem preservation. Table 4.3 shows the amount of CSL aims achieved via the projects' implementation. The majority of the projects (17) contribute to achieve all the CSL aims. Ecosystem conservation is the goal that is met by the majority of the projects of which seven link it with agricultural production and two with rural livelihood improvements. four projects link agriculture production with rural livelihoods.

Table 4.3: Amount of CSL aims achieved via the projects' implementation

N° of projects	**CSL aims**
17	i. Agricultural production, ii. Ecosystem conservation, iii Rural livelihoods, iv. Climate change mitigation and adaptation
7	i. Agricultural production, ii. Ecosystem conservation
2	ii. Ecosystem conservation, iii Rural livelihoods
4	i. Agricultural production, iii Rural livelihoods
8	ii. Ecosystem conservation

4.4.3 Assessment of the type of stakeholder involvement strategy

Table 4.4 displays an overview of the type of stakeholder involvement strategy as reported in their project descriptions. A large amount of companies (13) adopts capacity building as a strategy to involve local stakeholders. In particular, training and logistical support are mentioned in project descriptions as means to increase knowledge about more productive and sustainable land management practices.

Table 4.4: Type of stakeholder involvement strategy adopted by the agribusiness projects

N° of projects	**Type of stakeholder involvement**	**Group**
8	Training	Capacity building (13)
5	Logistical support	
1	Fully respect the rights of indigenous people	Active consultation with locals (3)
1	Engage in stakeholder dialogue	
1	Active consultation with local stakeholders	
3	Multi-stakeholder governing body	Multi-stakeholder dialogue (7)
2	Democratic and full participation	
1	Working in partnership with locals	
1	Public Private Partnerships	
3	Network for knowledge exchange	Promote local organizations (6)
2	Establishment of management groups	
1	Farmer organizations	
11	No stakeholders involved	No stakeholders involved (11)

This type of involvement is a one-way knowledge transfer and hence does not allow exchanges from the local stakeholders to the agribusiness company. Other companies adopt more participatory strategies, engaging in active consultation with locals, by for instance fostering stakeholder dialogues and actively consulting with locals in the course of project implementation. Other companies engage even more with locals, by creating a multi-stakeholder dialogue via for instance creating a multi-stakeholder governing body and seeking for democratic and full participation. Other projects aim to promote local organizations such as networks for knowledge exchange and platforms that allow for democratic and full participation of relevant stakeholders. Finally some companies do not report to adopt any stakeholder involvement strategy.

4.4.4 Assessment of project monitoring strategy

Table 4.5 displays an overview of the monitoring strategies as described by projects. Our assessment shows that the majority of the projects do not aim to adopt a system to monitor the effectiveness of the project activities. Three companies aim at monitoring the performance of agricultural innovation on water and soil, other three introduced a system to monitor social and environmental issues. Other two companies aim at monitoring High Conservation Values (HCV) forest management and one company to monitor carbon along with introducing an accounting system. Finally, despite a large number of companies aim at biodiversity, only four of them explicitly mention the aim to measure the impacts on biodiversity. Of these projects three are connected with Roundtable on Sustainable Palm Oil (RSPO), Roundtable on Responsible Soy (RTRS) and the Sustainable Agriculture Network (SAN) standards compliance, which require the maintenance of native vegetation, but do not explicitly mention about monitoring of biodiversity.

Table 4.5: Number of projects that aim at adopting a monitoring strategy

N° of projects	**Type of monitoring system**
3	Monitoring performance of agricultural innovation on water and soil
3	Monitoring of social and environmental issues
2	HCV Management and Monitoring Plans
1	Carbon Monitoring and Accounting System
4	Biodiversity impacts
30	No monitoring specified

4.5 Discussion

First of all, results from this review illustrate three key objectives that agribusiness companies target in adopting a landscape approach with local stakeholders. The first and most common objective is sustainable sourcing. This objective stems from the managerial realization that linking sustainable sourcing to business performance requires a long-term perspective. In line with the recent literature in this domain (Dentoni and Velduizen, 2012; Formentini and Taticchi, 2016), findings reveal that agribusiness companies seek to secure long-term access to their value chain and thus a competitive advantage vis-à-vis other industry actors. In line with their long-term sourcing strategies, companies support technological and organizational innovation that enhances productivity increase and forest conservation in their sourcing areas at both farm and landscape scale. Farm scale interventions mainly entail training on sustainable farm practices supported by improved market access. At a landscape scale the main activities involve forest and water conservation supported by PES and carbon offset payment. These activities contribute to preserve and/or restore ecosystem services that provide benefits both to the agribusiness companies and to local rural communities by increasing yield quantity and quality.

A second objective that leads companies to invest in landscape approaches is to reduce local community and operational risks in key sourcing areas. In general, reacting and engaging with local stakeholders in the ecosystem confirms to be a common agribusiness strategy in turbulent environments (Freeman, 2010; Dentoni et al., 2015). These risks are interlinked to issues at a landscape level and thus often not resolvable at a farm level. To cope with these risks, companies pursue interventions to support rural and sustainable development, via for instance producer support programs that combine productivity and profit with livelihood improvements. Supporting local livelihoods through capacity building and training can deliver benefits to multiple actors and producers in the supply chain. However, these interventions only become landscape approaches when implemented via integrated management beyond the farm-level, involving multiple sectors.

A third agribusiness objective entails voluntary standards compliance: setting and enforcing certification standards that meet at a wider range of environmental sustainability requirements such as the protection of forest with High Conservation Values (HCV) and biodiversity preservation. Additionally, some companies engage in multi-stakeholder platforms such as commodity roundtables, cross-sectoral dialogues or community-based forums to deliberate and decide on the standards to apply. By introducing and applying these standards in collaboration with stakeholders, agribusiness companies seek to manage the different and sometimes contrasting demands and expectations of multiple societal actors in the landscape.

The second purpose of the paper was to categorize the activities of agribusiness projects in relation to CSL objectives (Agricultural production, Ecosystem conservation, Rural livelihoods, Mitigate and adapt to climate change). Linking the specific agribusiness LA activities to the main objectives provides more depth to the understanding of how and why companies engage into local landscapes with a variety of stakeholders. Activities initiated by agribusiness projects meet CSL objectives both directly and indirectly. Projects contribute to agriculture production (CSL objective 1) via facilitating and supporting productivity increase and improving/providing links with external markets. Such interventions contribute as well to rural livelihoods (CSL objective 2), which are linked with resilient food production. Additionally, rural livelihoods are supported by other project initiatives such as PES, which represent a source of income and at the same time promote sustainable practices at the farm and landscape scale. Several projects contribute to ecosystem conservation (CSL objective 3), via forest management practices such as forest and water conservation, tree planting to reduce siltation and reducing extensive agricultural practices (e.g. slush and burn), which are implemented widely in the landscape. Additionally, sustainable forest management practices contribute indirectly to rural livelihoods and agricultural production via provision of ecosystem services that are crucial for agriculture (e.g. pollinators, water storage and control of pests and diseases). Finally, projects contribute to CC mitigation/adaptation (CSL objective 4), via several interventions spanning from carbon storage in forests (CC mitigation) and sustainable agriculture via resilient crops and control of pests and diseases (CC adaptation).

The third question of this research entailed the division of roles and engagement mechanisms that multiple stakeholders undertook in CSL projects. A first larger group of agribusiness companies take the role of capacity-building partners who train local suppliers. This engagement strategy involves mainly transfer of knowledge rather than an exchange of knowledge and joint decision-making. Instead, other companies engage in stakeholders in consultation through a joint process of dialogue and decision-making. Finally, other companies promote the creation or development of local organizations that facilitate networks for knowledge exchange and active participation by local management groups without an agribusiness-led agenda. These stakeholder involvement processes also vary in the formality/informality of these communication and decision-making mechanisms among stakeholders. In some CSL projects, there is no formal plan of stakeholder engagement, while in other projects the formal procedure to democratically involve stakeholders is fully articulated (for example, in the RSPO).

The fourth question of this research was, did the reviewed CSL projects aim at monitoring project activities? Results show that only few companies aim at assessing the impact of agricultural innovation activities on water, soil and forests management. Other companies state that they target to introduce systems to monitor also social issues, revealing their awareness of the importance to monitor the social components of their projects.

4.6 Conclusions

This article reports a review of 41 integrated landscape management initiated by agribusiness companies worldwide. It provides an overview of their activities undertaken in landscape management as well as the underling objectives driving these activities. Additionally, this article assesses the contribution of project activities to achieve CSL objectives: ecosystem conservation, agriculture production, rural livelihoods improvements and CC mitigation/adaptation. This review seeks to fill a knowledge gap between the literatures on LA, which have not shed light on the agribusiness companies' perspective to engage in this approach, and recent studies on agribusiness management, which did not focus on the drivers and practices of agribusiness activities in the context of LA. We conducted the review research by developing a framework that includes the four CSL goals along with four other dimensions: company objectives, company's activities, multiple stakeholder engagement and monitoring. According to the framework in order for company's objectives to be effective, they need to engage multiple stakeholders and they should be monitored to adjust company's activities and to re-define stakeholder engagement strategies that are more appropriate to the local conditions.

Results of the review show that the main objectives that lead companies to start projects via a LA are sustainable sourcing, local community and operational risks reduction and voluntary standard compliance. Project activities (planned to be) implemented to achieve these aims include sustainable productivity increase, forest conservation, introduction of new cash crops, market links and PES. These activities contribute to CSL landscape goals in different ways. Agriculture production is supported via sustainable productivity increase and promoted by an improved market link. Ecosystem conservation is accomplished via forest and water conservation and supported by certification. CC mitigation/adaptation are promoted mainly via sustainable productivity increase, forest preservation and supported by PES. Finally, Rural livelihoods are sustained by improved market link and sustained by certification, which enables reaching further niche markets of sustainable products.

To reach CSL and company objectives through the aforementioned activities, local stakeholders are (or plan to be) involved via a wide range of strategies, spanning from training and logistical support provision toward more interactive engagement strategies, such as the establishment of a multi-stakeholder governing body and democratic and full participation. Concerning monitoring project activities, results show that only few companies aim at introducing monitoring activities. Of these, the majority aims at assessing the impact of agricultural innovation activities on water, soil and forests management. Other companies state that they target to introduce systems to monitor also social issues, revealing their awareness of the importance to monitor the social components of their projects. A limitation of this review is that the data available do not allow assessing whether the stakeholder engagement strategies and the monitoring activities change depending on the company and CSL objectives. This may be a critical point worth to be investigated in future research, because the LA may be more or less inclusive of local stakeholders and impactful on the landscape depending on the process of how actors are involved in the knowledge-sharing and decision-making and controlled in the implementation of their activities.

Appendix

Agribusiness company	Name of initiative
African Wildlife Capital	Environmentally sustainable agriculture in Tanzania
Aliança da Terra	Producers for Biodiversity
Armarjaro	Biodiversity and Cocoa Farming: Ghana Case
British American Tobacco Biodiversity Partnership	Lombok Watershed Management Project
British American Tobacco Biodiversity Partnership	Addressing sustainable management for biodiversity and ecosystem services in tobacco growing regions of Uganda
Bunge Limited	Managing regulatory risk associated with ecosystem services in Brazil (Bunge)
Café Direct	Reforestation in the Sierra Piura
Cargill/TNC	Creating a Pathway to sustainable soy In Brazil
Conservation International	Produce and Conserve
Conservation International, Kimberly Clark, TNC, Fibria, Instituto BioAtlantica	Sustainable Forest Mosaics Initiative/Forest Dialogue for Atlantic Forest and Pampas
Co-operative Food Company	Plan Bee
Danone, Crédit Agricole, Schneider Electric and CDC Climat	Livelihoods Carbon Offset Fund
De Master blenders 1753- DE Foundation	"Sowing seeds of hope: re-establishing coffee production in Serrania del Perija"

Ethical Tea Partnership	Ethical Tea Partnership
Fuana and Flora International	Development of Carbon-finance Mechanisms for High Conservation Value Forests and Peatlands in Oil Palm-dominated Landscapes of Kalimantan
Guyaki Yerba Mate	Sustainable tea and yerba mate production in the Atlantic rainforest of Misiones (Argentina) and Parana (Brazil) Provinces.
John Bitar Company Ltd	Ensuring Best Practices in Cocoa-Agroforestry System for improved Livelihood and Sustainable Environment
Kiliobero a.o. Partners	Climate and Coffee
Mali Biocarburant SA (MBSA)	Mali Biocarburant, Sustainable production of bioifuels in West Africa
Mars	Mars Cocoa Sustainability Strategy and "Vision for Change" partnership
Mondi	Mondi New Generation Plantations
Natura	N. A.
Nestle Nespresso S.A.	Helping farmers to share workload, Jardin Colombia
Olam	Olam palmoil certification Gabon
Olam and Rainforest Alliance	Olam/RA Climate Cocoa Partnership for REDD+ Preparation
Province of British Columbia and Coastal First Nations	Great Bear Rainforest
Rainforest Alliance	Applying Sustainable Cocoa Practices through Agroforestry in Community Forest Areas as a Tool for Achieving Biodiversity Conservation Outcomes
Solidaridad	Fair Biomass Mozambique (FBM)
Solidaridad	Inclusion of Biodiversity Friendly Smallholder Soy in Preferential Markets
Syngenta Operation Pollinator	Operation Pollinator
The Coca-Cola Company, WWF	Project Khula
The Coca-Cola Foundation	The Guangxi Sustainable Sugarcane Initiative
The Coca-Cola Foundation, WWF	Project Catalyst
TNC	N. A.
Unilever, Syngenta, Kiliobero a.o. Partners	Southern Agricultural Growth Corridor of Tanzania (SAGCOT)
Yves Rocher	N. A.

Chapter

5

A role-playing game as a tool to facilitate social learning and collective action towards Climate Smart Agriculture: Lessons learned from Apuí, Brazil

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Abstract

Addressing the global challenges of climate change (CC), food security and poverty alleviation requires enhancing the adaptive capacity and mitigation potential of land use systems. To this end, Climate Smart Agriculture (CSA) aims to identify land use practices that sustainably increase productivity, enhance climate change (CC) adaptation and contribute to CC mitigation. A transition towards CSA require technical, but also socio-institutional changes, for improved smallholder agricultural systems. Such changes may be triggered by stakeholder participation processes that stimulate social learning and collective action. This chapter evaluates whether a role-playing game (RPG) is an effective participatory tool to encourage social learning and collective action among local stakeholders towards adoption of CSA strategies. We designed and implemented a RPG with three groups of farmers in Apuí (Southern Amazonas), evaluating the game's impact on social learning by interviewing each farmer before and after the RPG. Our findings show that the RPG induced not only technical learning, but also socio-institutional learning and engagement for collective action, though outcomes varied between different RPG sessions and among farmer participants.

Keywords: adaptation, Climate Smart Agriculture, collective action, role-playing games, social learning.

5.1 Introduction

Addressing the global challenges of climate change (CC), food security and poverty alleviation calls for new approaches to land management that are sustainable and take into account complex interactions within the social-ecological system. To this end it is important not only to mitigate CC by reducing greenhouse gas (GHG) emissions, but also to adapt to changing environmental conditions (Locatelli, 2011).

International CC debates extend beyond stimulating mitigation strategies, to include CC adaptation objectives via synergistic approaches at the landscape level (Duguma et al., 2014; Salvini et al., 2016). Many initiatives have focused on the agricultural sector, as it plays an important role in both CC mitigation and adaptation. Agriculture is linked to mitigation because agricultural expansion is the main driver of deforestation (Salvini et al., 2014; Harris et al., 2012; Hosonuma, 2012), and hence contributes to CC (Tubiello et al., 2013). Agriculture is linked to adaptation because local livelihoods must be safeguarded while adapting to CC (Harvey et al., 2014).

It is thus imperative to identify and introduce innovative land use practices that secure agricultural production while achieving mitigation goals. One approach for identifying such win-win solutions is Climate Smart Agriculture (CSA), an international programme introduced by the Food and Agriculture Organization of the United Nations (FAO) to tackle three main goals: (i) sustainably increasing food security by improving agricultural productivity and incomes; (ii) building resilience and adapting to CC; and (iii) developing opportunities for reducing GHG emissions compared to expected trends (FAO, 2010). CSA involves the use of ‘climate-smart’ farming techniques to produce crops or livestock. CSA could reduce deforestation linked to agricultural land uses by enhancing productivity, thus building resilience to CC and mitigating GHG emissions (FAO, 2013). Resilience is defined as “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks” (Holling, 1973).

Although CSA is an important step forward to achieve adaptive agriculture and land-based mitigation, its implementation is not straightforward. Questions remain about how a transition towards CSA could actually materialize (FAO, 2013). Such a transition requires not only new technical practices, but also new types of knowledge and modes of thinking, as well as new institutions and forms of organization (Woodhill and Röling, 1998; Leeuwis and Aarts, 2011). Due to the uncertain and dynamic nature of CC impacts, a transition towards CSA requires innovation processes based on social learning (FAO, 2013). There are various theories on social learning. Most underscore the contextual and social nature of learning and the continuous reflexivity needed to reform social practices in the face of new risks. However, these theories pay different levels of attention to individual and/or collective learning, depending on their theoretical foundations (Blackmore, 2007). Expanding on theories of social learning in the domain of communal natural resource management (CNRM), Muro (2008: 332) identified the following characteristics: (i) co-creation of knowledge; (ii) reflection and recognition of others' perspectives and others' underlying goals and values; (iii) understanding complexity and interdependence, leading to (iv) (partial) convergence of goals (vision), (v) mutual agreement and (vi) collective or coordinated action. Indeed, the CNRM literature posits collective action as an important outcome of social learning. This notion of collective action initially referred to institutional arrangements that facilitate coordinated management of common-pool resources (Ostrom and Gardner, 1994). Later, the terms social learning and collective action were also used for other shared pursuits. For instance, farmers' group formation and cooperation were considered crucial mechanisms to attain access to vital resources and markets (Meinzen-Dick et al., 2002, 2004; Markelova et al., 2009).

Stakeholder participation for social learning has become a normative approach to attain sustainable agriculture and natural resource management (Reed et al., 2010; Muro and Jeffrey, 2008; Berkes, 2009). It may also be a valuable approach for implementing CSA, which requires a continuous process of learning by doing. Several studies have cited the role of social learning in enhancing climate adaptation via collective action (e.g., Collins and Ison, 2009). In fact, continual learning via stakeholder participation may enhance group decision-making (Thorne, 2014) and provide technical and socio-institutional mechanisms for managing complexity and uncertainty through incremental adjustment (Pahl-Wostl et al., 2007).

Multi-stakeholder learning processes are crucial for innovation towards CSA, but they are difficult to attain in developing countries, where actor networks tend to be weak and characterized by sporadic and fragmented relationships (World Bank, 2006; Szogs, 2008). This points to the importance of social and institutional mechanisms that bring actors together (Howells 2006; Klerkx and Leeuwis, 2009). Thus, intermediary actors and organizations are needed to build networks and induce social learning (World Bank, 2006; Klerkx and Leeuwis, 2008). Important intermediary actors are agricultural advisory services and local non-governmental organization

(NGOs), because they have consolidated relationships with local stakeholders and know stakeholders' needs and constraints.

Numerous participatory methods are used by these bridging actors to encourage social learning and collective action, among them, Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) (Engel and Salomon, 1997) and Platforms for Resource Use Negotiation (Röling and Jiggins, 1998; Steins and Edwards, 1999). This chapter assesses whether a role-playing game (RPG) is a valuable method for engaging actors in social learning and collective decision-making and action. RPGs are usually associated with games played on the internet with many players, known as massive multiple online role-playing games (MMORGs). RPGs use an engaging narrative, character roles, practical and interactive challenges, room for collaboration and fantasy, and direct feedback to establish strong intrinsic motivation and a safe environment, fostering cognitive learning, collaboration and critical thinking (Rieber, 1996; Dickey, 2005, 2007; Lieberman, 2006). Similar attributes are also increasingly used in serious gaming, for cognitive and skills learning related to complex situations mimicking the real world (Hainey et al., 2011; Hauge et al., 2012). Serious RPGs often have a smaller number of concurrent users and are not necessary digital. Amongst others, serious RPG applications are found in leadership and management training (Sogunro, 2003; Aquino and Serva, 2005; Sronce and Arendt, 2009) and environmental negotiation training (Tucker and Tromley, 2005; Choy et al., 2011; Paschall and Wüstenhagen, 2012). RPGs are also increasingly used for social learning and collective action for natural resources management (Barretau et al., 2007; Barnaud et al., 2010; Ducrot et al., 2011; Speelman et al., 2014).

The current research explored application of an RPG (i) to stimulate exchanges of knowledge, which could be technical and scientific knowledge as well as local knowledge (Boissau and Castella, 2003; Etienne, 2003), and (ii) to facilitate collective decision-making and negotiation, by creating an experimental environment in which local actors are stimulated to engage and participate in discussions, fostering social learning about both technical and socio-institutional arrangements (Pahl-Wostl, 2002). In fact, such a playful atmosphere has been found to reduce social distance between players and improve open communication and dialogue (Trajber and Manzochi, 1996), which might lead to collective action (D'Aquino et al., 2002).

Hence, RPGs are considered potentially powerful tools for improving communication and discussion (HarmoniCOP, 2003). This suggests that RPGs may be particularly suitable for promoting the social learning necessary for CSA implementation. We tested and evaluated an RPG, implemented in a case study context. Our focus was on effectuated social learning as an indicator of the RPG's potential to promote CSA. The paper is organized as follows: section 2 introduces our case study area and analyzes the specific context; section 3 describes the used materials and methods used; section 4 outlines the results; section 5 presents the discussion and section 6 the conclusions.

5.1.1 The case study area

Our case study area, located in Apuí, Southern Amazonas (figure 5.1), is the third most deforested municipality in Amazonas state and is in the top ten of the Brazilian Amazon municipalities in terms of annual deforestation (INPE, 2015).

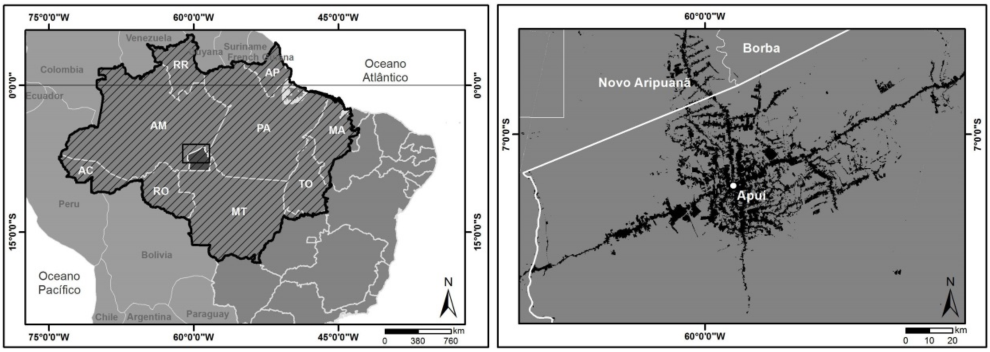

Figure 5.1: Location of our case study area: Apuí, Southern Amazonas.

In Apuí, deforestation is driven mainly by extensive cattle ranching. Of the area's 20,000 habitants, some 80% originates from southern and south-eastern regions of Brazil (Carrero and Fearnside, 2011). Extensive cattle ranching for beef production dominates the landscape, since it requires little labour and technical assistance (Pichón et al., 2002). However, the use of fire to control secondary vegetation growth on pastures rapidly degrades the soil, leading to low productivity per unit area and land degradation (Luizão et al., 2009). This extensive ranching system favours the spread of a pasture spittlebug called Cigarrinha (Hemiptera: Cercorpidae, *Deois*, spp.) (Sujii et al., 2000). Rainfall distribution and food availability affect the spittlebug's population and migration patterns (Valério, 2009). According to local knowledge, higher temperatures and a delayed rainy season provide favourable conditions for its population to grow. Cigarrinha-invaded pastures are detrimental to cattle health, reducing milk and meat production.

Besides pasture, important sources income for local farmers are various cash crops, such as coffee, guaraná and cocoa (IBGE, 2015). Coffee is particularly important in

Apuí, considering that many of the families residing here migrated from the more traditional coffee-growing regions of south-eastern Brazil (Carrero and Fearnside, 2011). Despite this, coffee production has declined due to poor management, low quality and productivity coffee beans and unfavourable market conditions. Local farmers indicated that changing rain patterns had also played a role in diminished coffee production, as droughts were said to be becoming more frequent.

In fact, despite high average rainfall, ranging between 2,800 and 3,100 mm/year (Alvares et al., 2013), local farmers stated that rain distribution was increasingly uneven, and a delayed start of the rainy season was more common. The last severe droughts documented in the Amazon occurred in 2005 and 2010, during which time agriculture yields were considerably reduced (Lewis et al., 2011).

The Institute for Conservation and Sustainable Development (IDESAM), a local NGO, promotes valorisation and sustainable use of natural resources through improved management and social development in Apuí. IDESAM works with 600 local farmers to identify land-use practices that (i) enhance local livelihoods by sustainably increasing production, (ii) encourage CC mitigation by reducing deforestation and enhancing carbon stocks and (iii) promote CC adaptation (especially with respect to droughts and Cigarrinha infestation), by improving the resilience of land management systems. IDESAM evaluated the potential of agroforestry for implementation of CSA. Woody perennials were used on the same land parcels as annual agricultural crops and/or animals, with the aim of obtaining greater outputs on a sustained basis (Nair, 1987). Two types of agroforestry systems were being implemented in Apuí: coffee agroforestry systems and intensive silvopastoral systems (for beef and milk production). These tree-based systems maximize carbon and nitrogen fixing, improve soil organic matter and decrease soil erosion (García-Barrios and Ong, 2004). Their benefits are threefold and in line with the objectives of CSA. First, they enhance local livelihoods, through sustainable improvements in productivity and increased income derived from sales of timber and non-timber forest products (Calle et al., 2013). Second, they contribute to CC mitigation, by alleviating the need to clear additional forest and enhancing carbon stocks (embodied in the trees of the agroforestry system) (Montagnini and Nair, 2004: Calle et al., 2013). Third, they contribute to CC adaptation, as these new production systems are more resilient to drought and soil degradation, as well as to insect infestations (Calle et al., 2013).

IDESAM implemented coffee agroforestry and intensive silvopastoral systems in a pilot with 35 farmers. The outcomes were positive: productivity per area of the coffee agroforestry and intensive silvopastoral system was three to six times greater than that achieved using conventional practices for beef, milk and coffee (Carrero et al., 2014; Carrero et al., 2015; Carrero and Figueiredo, 2015). Quality increases were also estimated to be threefold. Due to these success stories, IDESAM would now like to promote adoption of CSA practices among other farmers, to increase both production and have a higher impact at the landscape level. Before these CSA practices can be disseminated further, a participatory tool was deemed necessary, to assess the feasibility of CSA adoption among the wider population of farmers. The tool would identify the major constraints farmers face in CSA adoption and how those constraints could be resolved via social learning.

5.2 Materials and methods

Our research activities were conducted with three groups of farmers and consisted of three workshops centred on a RPG and interviews conducted with farmers participating in the RPG. Our study aim was to explore the specific effect of the RPG on social learning among the individual participants, rather than to conduct a large-scale analysis. For this reason, we conducted in-depth analyses of initial perspectives, role play behaviours and subsequent expressions of attained insights and engagement.

The RPG consisted of a board game, designed as a model of the local land-use system. We conducted interviews with each farmer before and after the game (figure 5.2) to assess the impact of the RPG on social learning and collective action.

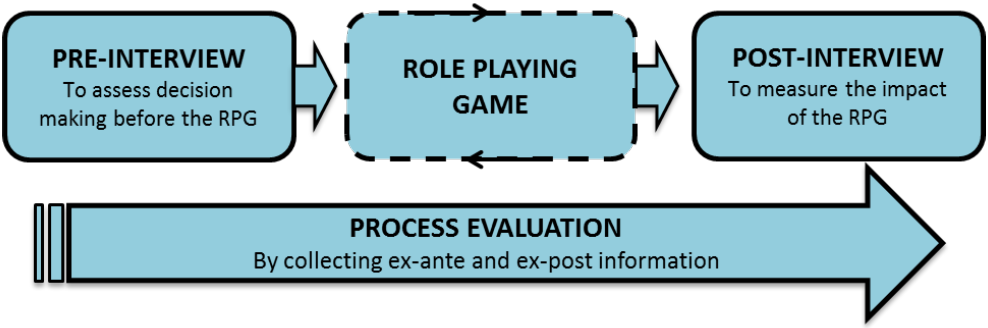

Figure 5.2: Research activities aimed at evaluation of the RPG as a tool. The RPG was designed using an iterative process, with improvements made after each iteration.

5.2.1 Role-playing game

The RPG centred on different land-use options, displayed in figure 5.3 (traditional coffee, agroforestry coffee, traditional pasture and intensive silvopastoral systems for milk and beef). Each was characterized by different implementation and maintenance costs (investment and labour) and product yields (coffee, milk and meat). The game design reflected our research aim to investigate social learning among the participants. Several items in the game were developed specifically with this aim in mind.

Three RPG sessions were conducted (games 1, 2 and 3) with three different groups of farmers. Each session involved seven farmers, of whom three had knowledge of agroforestry and intensive silvopastoral systems and four lacked such knowledge. Farmers also had different knowledge of and attitudes towards collective action. This setup was chosen to include different farmer types in the RPG aimed at or stimulating knowledge sharing, triggering social learning and initiating discussions about collective action. Farmer participants were randomly selected from among IDESAM partners in the region (around 650 farmers). Most farmers participating in the game were men (19 men and 2 women). This gender balance reflected local conventions, as men usually worked in and managed the agriculture fields; though women did take on this role when men had other off-farm pursuits.

The aim of the RPG was to induce farmers to explore the potential of agroforestry practices. At the start of the game, facilitators explained that agroforestry practices would require greater investment but also lead to higher and more sustainable farm production (see figure 5.3). To draw the players into the game, an engaging narrative was presented, with each farmer assigned a role emulating their actual situation. The narrative alluded to potential practical and interactive challenges and room for collaboration and direct feedback during game play, to establish strong intrinsic motivation, fostering cognitive learning, collaboration and critical thinking (Rieber, 1996; Dickey, 2005, 2007; Lieberman, 2006).

The parameters of the RPG (labour, costs and revenues) were derived from real parameters and calibrated to enhance playability of the game. Each player received an amount of resources reflective of their own situation, and they were first asked to use these resources 'as they would in reality'. This led to a certain production output and income. Players were then told they could deforest to obtain more land for expansion, but might have to pay a fine for this (determined by roll of the dice). Furthermore good prices for agroforestry products were made dependent on use of a collective marketing approach. These game attributes tended to stimulate players to experiment with strategies under their control, and got them into a flow of engagement, trying out different farm and collaboration options and receiving direct feedback, which has been shown to stimulate learning about the material and social effects of the choices made (Rieber, 1996; Dickey, 2007).

Several game rounds were played, of which three 'regular' rounds: the first to familiarize farmers with the game rules and the other players, followed by two rounds in which standard scenarios were introduced. In the first scenario a drought occurs, causing yield losses of coffee. The losses are very high for traditional coffee and very low for the coffee agroforestry system. The second scenario simulated a pasture spittlebug infestation. This scenario, like the drought scenario, was aimed to reflect situations that could occur in real life and to surprise or 'shock' participants. Experiencing such a setback has been shown to intensify participants' engagement in a game, causing them to more easily remember events and eventually relate them to real life situations, promoting social learning (Vervoort et al., 2012). These game scenarios were additionally meant to trigger discussions between project farmers and non-project farmers about the benefits of the new production system and resilience to drought and insects, such as pasture spittlebug.

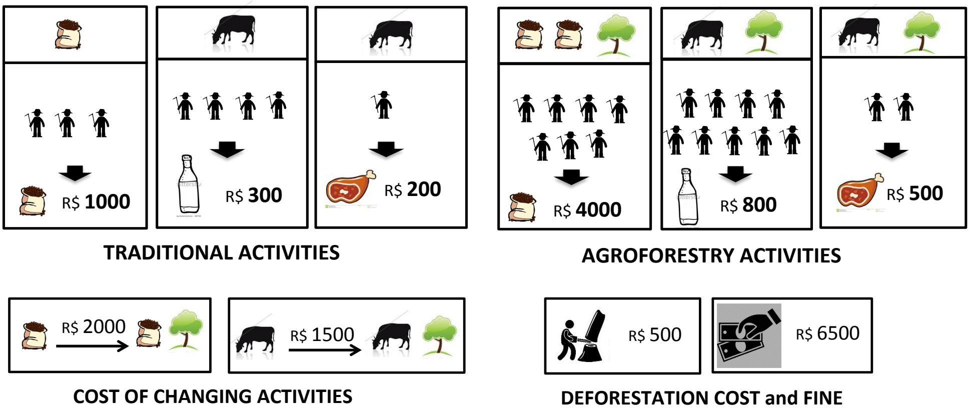

Figure 5.3: RPG cards depicted traditional production activities (without trees) and agroforestry activities (with trees). The farmers pictured on the cards represented the labour necessary to maintain the activity in each round, while the amount below the arrow was the revenue of that activity per hectare in each round.

In a final scenario an investor was introduced, willing to pay a higher price for outputs from the new activities, due to their higher quality (and certification label). This final round was meant to stimulate discussions among farmers and get them thinking about engagement in collective action. After each game round a debriefing session was held to get a more in-depth understanding of the reasoning underlying farmers' decision-making, both related to the RPG and in reality. The discussions during the RPG were recorded and the major outcomes analysed with the help of a local translator.

The RPG was designed using an iterative approach. After each iteration the game was progressively improved to better reflect local realities and farmers' needs and perspectives. The RPG prototype was produced during a series of meetings with local experts, held to gain an understanding of the local setting, including the main land uses, the typologies of stakeholders and the main socio-economic and ecological dynamics, particularly regarding the agroforestry coffee and intensive silvopastoral systems. In the field, before playing the RPG with the local farmers, the RPG was tested with staff and a programme manager who provided technical assistance to the more than 600 family farmers participating in IDESAM projects, to get their feedback on whether the game sufficiently reflected local realities. Questions were asked about missing or superfluous elements and about the playability of the game itself. Additionally, the RPG was improved by evaluating the result of the sessions played with the farmers. A major improvement of concerned the type of cards used to depict the process of adoption of the new activities. In the first version of the game, the set of cards depicting adoption of the new activities (start-up costs) was replaced by a second set of cards depicting maintenance of the activity per round (maintenance costs). This turned out to be overly complicated, which impacted the playability of the game and hence social learning amongst the farmers. We therefore decided to simplify the game, retaining just one set of cards (the maintenance cards). Other minor improvements were made as well. For instance, we enlarged the size of the game cards, which in the first version appeared to be too small and difficult to handle, which distracted the farmers from game play.

5.2.2 Interviews before and after the game

Forty-two interviews were conducted: each of the 21 farmers was interviewed before (pre-interview) and after (post-interview) the RPG to assess the impact of the RPG on their decision-making. Interview questions focused on land use and agriculture: farmer adaptation needs, crops produced, knowledge of the agroforestry coffee and intensive silvopastoral systems, perceptions of current and future CC impacts, opinions on farmer cooperatives (benefits, feasibility, trust, past experiences) and willingness to create or join a cooperative. The same questions were asked before and after game play, to evaluate the RPG's effect in stimulating social learning. The set of indicators used is described in the following section (see also table 1). Interviews were recorded and analysed with the help of a local translator.

5.2.3 Indicators for evaluating social learning during the RPG

To measure the impact of the RPG on social learning, we extracted indicators from the literature (Reed et al., 2010; Muro and Jeffrey, 2008; Muro and Jeffrey, 2012; Koontz, 2014), adjusting these to our case study (table 5.1).

Table 5.1: Indicator categories and specific indicators used to evaluate social learning

SOCIAL LEARNING CATEGORY	**INDICATOR CATEGORY**	**SPECIFIC INDICATORS**	
		Coffee agroforestry system	**Silvopasture system**
Technical learning	Technicalities of innovative land use	- Presence of trees on the coffee plantation - Pruning technique - Use of bio-fertilizer - Higher implementation cost	- Presence of trees on the pasture - Division of pasture into different areas via electrical fencing for rotation
	Benefits of innovative land use	- Higher productivity - Higher quality coffee output	- Higher productivity - Higher quality milk and meat
	Awareness of the impact of droughts and insect infestations	Stated awareness of the possible impacts of droughts on coffee production	Stated awareness of the possible impacts of insect infestations on pasture
	Resilience to droughts and insect infestation	Stated awareness of the resilience of the agroforestry system to droughts	Stated awareness of the resilience of the silvopasture system to insect infestations
	Deeper understanding	Understanding the implications of the new activity for long-term farm management	
Socio-institutional learning	Joint vision development	Joint understanding among players of the actual socio-institutional situation and the need for new goals, leading to shared expectations and relations of trust and respect	
	Definition of rules for a good cooperation	Definition of rules that would make a collective or coordinated action effective	
Engagement in collective action	Engagement in discussions about farmer cooperation	Discussions among participants during the game about how to create a cooperative	
	Change of attitude and willingness to join a cooperative	In the post-game interview participants stated that they were willing to join a cooperative	

We distinguished three aspects of social learning: technical learning, socio-institutional learning and engagement in collective action. Technical learning refers to a change in understanding of individual farmers, either superficially in the form of new knowledge gained or in deeper understanding. Socio-institutional learning encompasses relational elements of interacting, including development of a joint vision and group agreements, such as defining rules for good cooperation (Rist et al., 2007; Muro and Jeffrey, 2012). Engagement in collective action requires that social interactions occur among actors within a social network, leading to group-level emergent processes (Benson et al., 2015).

5.3 Findings and discussion

Our analyses of the interviews focused on detecting changes in technical learning, socio-institutional learning and engagement in collective action as a consequence of playing the RPG. The results are presented according the indicators set out above.

5.3.1 Technical learning

Our comparison of pre-game and post-game interview results suggests that farmers acquired technical knowledge about the new activities through the RPG. A clear distinction was found between the farmers who had been involved in IDESAM pilot projects and those not involved.

5.3.1.1 Non-project farmer learning

The non-project farmers learned about the technical aspects of the coffee agroforestry and silvopasture systems. In the pre-game interviews most stated that they had no in-depth knowledge about the new activities, though some were aware of their existence. The post-game interviews revealed that game play made them learn about the technicalities involved, such as the fact that greater investments would be needed in terms of infrastructure and other resources. Additionally, they learned about benefits of the new activities, such as greater productivity, product quality and profitability. Such learning was likely especially strong because the RPG introduced the new agricultural practices to farmers not only in theory, during the explanation of the game rules, but also via game play, during which farmers simulated adoption of the new practices. Additionally, the game enabled farmers to observe the implications (costs and benefits) of adoption of the new practices, for their own situation as well as for fellow participants. Such observations triggered curiosity, prompting farmers to talk and exchange thoughts about the new practices’ potential in real life. Therefore the game triggered technical learning, as it encouraged participants to associate game play with reality. Players used the RPG as a simulation platform. Such characteristics of RPGs enhance participants' understanding of issues at stake and to trigger engagement and active involvement (Barreteau et al., 2007).

A second important aspect of technical learning was increased awareness of the potential for and consequences of droughts. Prior to the game, more than half of participating farmers were unaware of the threat posed by drought to their agricultural yields. This was because many had moved to Apuí after the droughts of 2005 and 2010 or because they were cultivating crops that had not been affected by the droughts. In the post-game interview, some of these farmers stated that the RPG had raised their awareness of drought's potential impacts and triggered them to ask other farmers about the resilience of agroforestry coffee during a drought. Hence, they learned that coffee agroforestry was more resilient to drought than traditional coffee production. Similarly, farmers indicated that the game had raised their awareness of the greater resilience of intensive silvopastoral systems to pasture spittlebug, although this was not considered a major lesson.

Most farmers adopted the coffee agroforestry and silvopasture systems immediately in the first round of game play, making investments in their farm reflective of a positive attitude towards the new activities. "The game taught us how to work", said one farmer, "It's better to have quality than quantity of products". During the post-game interview, farmers were asked if they would adopt the new activities in reality. Most replied that they lacked the financial resources necessary to do so. In fact as these farmers had learned, the new activities required greater investments than their traditional production systems. Most of the farmers could afford to initiate a switch outright, without financial support from government or involvement of private investors (Carrero et al., 2014).

Another constraint that emerged from the interviews was lack of knowledge and skills to implement the new activities. This suggests that extension work will continue to play an important role in transferring knowledge and technology to interested farmers. Logistics posed an additional major constraint. For instance, one farmer stated that although he had substantial experience with the coffee agroforestry system and was willing to invest labour and money to adopt the new practices, he could not do so because he had no means of transportation. A possible solution would be agreements with trade intermediaries to pick up coffee directly from farms. At the time of our study there were no organizations positioned to accomplish this.

Despite most farmers exhibiting evidence of learning, the post-game interviews revealed that a few farmers had not acquired new knowledge about the technicalities or a deeper understanding of the implications of farm innovation. This could reflect a lack of interest in the new activities, or perhaps the RPG was difficult for these farmers to understand. Or they may not have felt involved during the RPG, causing them to detach themselves from the discussions.

5.3.1.2 Project farmer learning

Most of the project farmers experienced a different type of learning: hinged on a deeper understanding of the implications of the new activities for farm management. An important learning point for these farmers was the need to adopt a long-term vision on farm investment and land management. When asked about their plans for the coming years in the pre-game interview, the majority of farmers gave vague answers, reflecting a short-term vision and farm management plan. In the post-game interview, they provided more detailed answers about their plans, stating that the RPG had led them to realize that even though the implementation costs of the new activities were higher than traditional practices, they were more profitable in the long term. Hence, for the project farmers, the game served as an exercise and lesson on the need for long-term vision and farm management planning. This learning was possible because the farmers engaged in the game as an experimental environment in which round after round they could explore the consequences of their land-use decisions on their assets. Elsewhere, as well, RPGs have been shown to allow players to simulate and experience situations that would be too costly or risky to implement in the real world (Corti, 2006; Squire and Jenkins, 2003).

Moreover, project farmers learned that agroforestry activities led to a more efficient use of their land over time, compared to traditional (more extensive) practices. In the post-game interviews, some farmers noted that the more efficient land use would result in smaller land claims and hence reduced deforestation. This fact would make it easier for them to comply with the Forest Act, which states that 80% of their farmland should be under forest cover, though part of that could include agroforestry or intensive silvipastoral systems. Hence, the RPG provided stimulus for this type of farmer to better plan their farm management.

According to IDESAM, after the RPG some project farmers decided to expand the areas cultivated using the agroforestry coffee system. Additionally, some non-project farmers decided to adopt both the coffee agroforestry and the silvopastoral production system. Nevertheless, they employed more labour to initiate these systems than was actually necessary. This highlights the need for continuously provide technical assistance, to foster the most efficient and thus fullest transition to innovative agroforestry systems in Apuí.

5.3.1.3 Socio-institutional learning

Observations during the RPG and the interviews before and after the games provided some evidence of socio-institutional learning, though variations were found between the different RPG sessions and among the farmers participating. The liveliest discussions about social organization and institutions occurred during the game round in which an investor was willing to pay a higher price for outputs from the new activities, due to their higher quality. During this scenario, farmers discussed the potential for creating a farmer cooperative, which would have several advantages, among which financial benefits. A cooperative would allow to overcome one of the main constraint that farmers face to implement the new activities. For instance, it would allow buying inputs such as limestone in large amounts at a cheaper price, it would allow machinery costs to be split and offer better access to markets.

Farmer cooperatives have been implemented in Apuí in the past, but these were unsuccessful. In the pre-game interviews, almost all farmers reported negative experiences with cooperatives. Therefore, their level of trust in cooperatives was low, and farmers were dismissive of the idea of creating or joining a new one. Though these experiences strongly influenced current perceptions, some farmers were willing to entertain the idea. One farmer said, "I moved to Apuí 12 years ago and I never saw any cooperative working. I think it's important to be here today to talk about it as a group!"

The logistics of creating a cooperative were discussed during all three sessions of the RPG (i.e. how much investment would be required per participant, how duties and income could be shared). In games 1 and 3, such discussions were limited to the game play, and farmers did not refer to how a cooperative would work in reality. Game 2, however, triggered lively and in-depth discussions extending to how a cooperative might work in practice. These discussions explored many aspects, including reflections on why cooperatives had failed in the past and, most importantly, proactive thoughts about how previous constraints could be overcome and solutions found as a group.

In particular, farmers attributed the past failures of cooperatives to corruption and a lack of trust, transparency and honesty in decision-making. Other reasons mentioned were absence of communication and lack of involvement of members. One farmer said, "Past cooperatives didn't work because the cooperative's founder didn't communicate with the members about how the money was invested, and they did not involve them…. This type of information has to be available to everyone before they join the cooperative."

Cooperatives were also said to have failed because they were created too rapidly, with too many people – as a minimum number of participants was required to obtain government support (SEBRAE, 2009). Thus an important learning point mentioned during the discussions was that, to succeed, a cooperative had to start with a small group of people who trusted each other and were engaged and motivated to collaborate.

Socio-institutional learning seemed to be favoured by the RPG's setting, as the informality lowered communication barriers and the game provided a platform for discussion among participants (Vervoort et al., 2010; Mayer, 2009). Farmers discussed topics that they normally did not talk about as a group, including specific reasons why past cooperatives had failed (i.e. corruption, lack of trust and low engagement). The RPG can therefore be said to have promoted a shift from an individual perspective to a group perspective and shared understanding of the system (Muro and Jeffrey, 2012).

5.3.1.4 Engagement in collective action

In the pre-game interviews, all farmers stated that they did not plan to create or join a cooperative due to their past negative experiences. Nonetheless, the RPG triggered interest and engagement in collective action – though this varied between the groups. In the post-game interview, farmers participating in games 1 and 3 exhibited no change of attitude towards joining a cooperative. Yet, the majority farmers participating in game 2 stated after the RPG they were seriously considering creating a new cooperative with their fellow game participants. In fact, the RPG triggered them to meet again to further discuss the possibility of creating a cooperative. One participant said, "[in the RPG] we created a cooperative, we worked on common lands, we made profit and invested the profit to make more. We can do the same in reality!"

Besides the cooperatives, the RPG triggered discussions regarding other common problems, such as the pasture spittlebug. In particular, farmers discussed joint adoption of a biological pest control system and collaboration between neighbours to combat Cigarrinha infestations. One farmer underlined this intention as follows: "Single farm management is important, but to fight against Cigarrinha we need to find a better solution and join forces. For instance we could buy a fungus [biological control] as a group, so that we get it for a better price! Then we can reproduce the fungus here!"

Engagement in collective action was triggered by several factors during the RPG. The game's open atmosphere and subsequent discussions induced greater trust amongst the participating farmers. Some even envisaged creating a farmers' cooperative together to realize CSA more cost-effectively. Although the game represented an abstraction and simplification of reality and depicted hypothetical situations, it nonetheless struck a chord among some players, as they attached real-life value to the game outcomes. The simulated platform provided players freedom, along with the opportunity, to share knowledge and experiences and discuss the real problems they faced. Elsewhere, too, RPGs have been demonstrated as having high potential to trigger communication and enhance exchanges among players, not only in the game context but also beyond it (Ryan, 2000). The connection with reality is made in the debriefing phase (Lederman, 1992), during which relations to real-world circumstances can be debated, collective learning explicitly acknowledged (Ryan, 2000) and discussions about real problems triggered.

5.4 Conclusions

Our research demonstrated the RPG to be a valuable tool for promoting social learning for adoption of new CSA-consistent farming practices. The design and implementation of our RPG in the case study area of Apuí (South Amazonas) triggered three aspects of social learning: technical learning, socio-institutional learning and engagement in collective action. Regarding technical learning, the game familiarized farmers with the technicalities involved in implementing the new CSA practices, such as the greater investments required. Learning was likely especially strong because the RPG introduced the new practices not only in theory, during the explanation of the game rules, but also via game play, during which farmers simulated adoption of the new CSA-consistent practices. Another important aspect of technical learning was the deeper understanding gained by project farmers of the implications of the new activities for farm management. Farmers engaged in the game as an experimental environment in which to explore the consequences of their land-use decisions on their assets. Hence, the game served as an exercise and a lesson to pay more attention on long-term farm management and planning. The informal setting of the RPG stimulated socio-institutional learning as well, for example, by creating a discussion platform that eased farmers' interactions. Farmers reflected critically on their present practices and the institutional environment, they achieved a joint vision and defined rules for an effective cooperative. In sum, our findings suggest that RPGs have a high potential for engaging farmers in collective action towards CSA implementation. This is because even if our game was a simplification of reality, it contained sufficient representations of real life to stimulate participants to explore the various consequences of decision-making. Through the RPG and joint reflection on present practices, participants established a joint vision and clear rules for an effective cooperative, enticing action.

Acknowledgements

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Chapter

6

Synthesis

6.1 Main Results

The overall objective of this thesis is to assess REDD+ and CSA implementation in landscapes. The purpose of this chapter is to re-visit the sub-objectives and research findings and reflect on them. Direction for further research is also suggested.

Four specific sub-objectives were developed aimed at addressing the overall objective:

- Sub-objective 1: Analyse how REDD+ national policies link to drivers of deforestation/degradation and elaborate on implications for monitoring systems;
- Sub-objective 2: Explore synergies and trade-offs between REDD+ and CSA policies in landscapes by considering local decision-making;
- Sub-objective 3: Evaluate the role and drivers of agribusiness companies in shaping Climate Smart Landscapes (CSL);
- Sub-objective 4: Design and implement a Role-Playing-Game to trigger social learning and social organization for the adoption and up-scale of CSA practices.

Research objective 1: Analyse how REDD+ national policies link to drivers of deforestation/degradation and elaborate on implications for monitoring systems

I provided a comprehensive overview of the current strategies for addressing drivers of deforestation and forest degradation (DD) as presented by 43 REDD+ countries. The analysis allowed for a deeper understanding of implications for monitoring systems. This assessment was built upon a logical interaction between identified reported drivers of DD, proposed REDD+ interventions and systems to monitor the effectiveness of interventions. Results show that the interventions proposed by many countries focus on activities aimed at reducing forest degradation and enhancing forest carbon stocks, rather than on reducing deforestation. This has implications for monitoring systems: while monitoring deforestation greatly relies on remote sensing data, monitoring forest degradation relies more on ground level approaches, such as interviews with local experts, who can provide information about the location of activities such as fuel-wood use and forest degradation. These monitoring approaches will be much more focused on assessing smaller-scale impacts, which generally tend to be more costly. A distinction can be made between direct interventions and enabling interventions. Direct interventions are specific, often local activities that result in a direct change in the carbon stock (i.e. reforestation, protected area strategies, agricultural intensification to reduce pressure on forests). Enabling interventions are aimed at facilitating the implementation of direct interventions (i.e. improved law enforcement against illegal logging, and land tenure regulation).

Most of the proposed driver-specific interventions address drivers not only inside but also outside the forest sector. However current monitoring efforts are focused on monitoring carbon dynamics within forest stands to meet national and international reporting requirements. These findings suggest that REDD+ monitoring should be extended by looking at effectiveness of REDD+ activities also outside the forest sector, including agriculture and other land use sectors. Nevertheless developing capacities to extend monitoring systems beyond the forest sector implies the use of additional resources for monitoring, which already accounts for a large part of countries' REDD+ readiness activities. Hence REDD+ countries should carefully evaluate how to employ their resources in such a way that they are cost-effective.

Concerning enabling interventions, a large number have been described, of which the most common are stakeholder involvement, tenure and rights regularization and policy and governance reform. Proposed enabling interventions to reduce deforestation remain rather vague and do not explicitly link to policies and national development programmes that are potentially driving deforestation. Moreover, for enabling interventions to be effective, they need to be bundled. For instance agricultural intensification should be combined with zoning, protected areas or rehabilitation of degraded lands to prevent further forest clearing. Only few of the readiness-documents reviewed explicitly mention the importance of implementing interventions in a combined way, and countries may need to pay more attention to this.

Research objective 2: Explore synergies and trade-offs between REDD+ and CSA policies in landscapes by considering local decision-making

Regional policies play a major role in encouraging the adoption of innovative land use strategies that merge land-based CC mitigation and adaptation. The effectiveness of such policies depends from land use decisions made by local stakeholders. Hence when selecting policies appropriate for the local context, there should be a deep understanding of land use decisions of local stakeholders, taking into account their needs, objectives and constraints in adopting alternative land uses. I introduced a framework for ex-ante assessment of policy interventions and for quantifying their impacts on CC mitigation and adaptation goals. The framework includes a companion modelling (ComMod) process based on interviews with policymakers, local experts and local farmers. The ComMod process consists of a Role-Playing Game (RPG) with local farmers and an Agent Based Model (ABM).

I demonstrated the application of such framework in a study area, the Tra Bui

Commune in central Vietnam. The landscape of Tra Bui Commune faces a dual challenge of protecting the forest while improving agricultural practices to adapt to CC impacts. Via the RPG I developed participatory scenarios to assess policies and interventions planned by the government. The RPG stimulated active involvement of local stakeholders in land use scenario development and in the design of benefit-sharing mechanisms that could effectively steer land use decisions. Additionally the RPG initiated an iterative learning process, via discussions among local farmers and with the government representative about the possible outcomes of each policy. Building scenarios in such a participatory manner constitutes a powerful tool for informing policymakers about how land use decisions are made at the local level. Additionally it allows policymakers to redesign policies to make them more locally tailored and hence more effective. Through the ABM the impacts of the planned policies are projected on landscape dynamics, deforestation and CO^2 emissions over a period of decades. This informed policymakers about which policies were most effective for achieving both adaptation and mitigation goals.

Results indicate that if policies are implemented separately, trade-offs will emerge, hampering their effectiveness. However, their simultaneous implementation in a landscape approach was found to enhance synergies. For instance stricter forest protection introduced without stimulating agricultural intensification was shown as unlikely to be effective because agricultural expansion would persist as a driver of deforestation. Additionally a compensation offered by government for preserving the forest appeared to be insufficient by local farmers, who were likely to continue deforesting to establish acacia plantations. Such results suggest that planning for forest protection and rural development should be coordinated. In Vietnam, as in other countries such coordination is hampered by the fact that these goals are under separate mandates of two different government departments. The lack of administrative coordination is an obstacle to integrated land management in general and to REDD+ initiatives in particular. In fact for REDD+ policies to be effective they should look beyond the forest sector, to also address drivers of deforestation such as agriculture. CSA implementation, for its part, should consider forest protection policies too, with agricultural and land use strategies designed in line with them. A similar lack of coordination is reported in other countries as well, where REDD+ initiatives have been designed without considering the main drivers of deforestation (chapter 2 of this thesis).

Research objective 3: Evaluate the role and drivers of agribusiness companies in shaping Climate Smart Landscapes (CSL)

Climate Smart Landscapes (CSL) rely upon inter-sector coordination among multiple stakeholders in the landscape. To this end agribusiness companies play an important role in shaping the implementation of CSL, as they often have resources such as physical, financial, human and social capital. I conducted a review of integrated landscape management initiated by agribusiness to assess their role in facilitating CSL and their contribution in achieving CSL goals. Results of our review show that businesses adopting a landscape approach are driven by three main objectives. The first and most common objective is the search of long term sustainable sourcing. Companies are recognizing that long-term business success is tied to sustainable sourcing which allows a stronger position in strategic sourcing areas. To accomplish long term sustainable sourcing companies encourage and support sustainable productivity increase and forest conservation in their sourcing areas, which provide ecosystem services essential for local production.

A second objective that leads companies to invest in landscape approaches is to reduce local community and operational risks in key sourcing areas. To cope with these risks companies pursue interventions to support rural and sustainable development, via for instance producer support programs combining sustainable management objectives with livelihood improvements. Supporting local livelihoods and providing capacity building and training can deliver benefits to multiple actors and producers in the supply chain. However, these interventions only become landscape approaches when implemented via integrated management beyond the farm-level, involving multiple stakeholders in different sectors.

A third objective is voluntary standards compliance, by introducing certification standards that look at a wider scale of environmental attributes such as protection of forest with high conservation values and biodiversity preservation. Additionally some companies engage in multi-stakeholder platforms such as commodity roundtables, cross-sectoral dialogues or community-based forums. These multi-stakeholder platforms move from simple collaborations to landscape approaches when the dialogue and planning is done beyond the production unit scale and it results in integrated landscape-scale management. Activities initiated by agribusiness projects contribute to meet CSL objectives both directly and indirectly. Projects contribute to agriculture production via facilitating and supporting sustainable productivity increase and improving/providing links with external markets. Such interventions contribute as well to rural livelihoods, which are linked with resilient food production. Additionally, rural livelihoods are supported by other project initiatives such as Payment for Ecosystem Services (PES), which represent a source of income and at the same time promote sustainable practices at the farm and landscape scale. Several projects contribute to ecosystem conservation via forest and water conservation, tree planting to reduce siltation and reducing extensive agricultural practices (e.g. slush and burn), which are implemented widely in the landscape. Additionally, these practices contribute indirectly to rural livelihoods and agricultural production via provision of ecosystem services that are crucial for agriculture (e.g. pollinators, water storage and control of pests and diseases). Finally, projects contribute to CC mitigation/adaptation, via several interventions spanning from carbon storage in forests (CC mitigation) and sustainable agriculture via resilient crops and control of pests and diseases (CC adaptation).

Research objective 4: Design and implement a Role-Playing-Game to trigger social learning and social organization for the adoption and up-scale of CSA practices.

A transition toward more resilient landscapes relies upon a change in mind-set of local stakeholders to adopt land use practices that are more "climate-smart". Such a shift can be triggered by participatory approaches that stimulate social learning.
I evaluated whether a Role-Playing-Game (RPG) is a valuable participatory tool to promote social learning to attain CSA in a case study located in Apui (Southern Amazonas), where a local NGO is promoting the adoption of agroforestry systems, as a CSA local practice. I distinguish between three aspect of social learning: technical learning, socio-institutional learning and engagement in collective action. Our findings show that the RPG was an important trigger for all of these learning. Technical learning occurred because the RPG introduced the new agriculture practices to farmers not only in theory during the explanation of the game rules but also via the game play, during which they could experience a simulation of the activities' adoption.

Another important aspect of technical learning was centred on a deeper understanding of the implication of the new activities on farm management; farmers used the game as an experimental environment in which they could experience the consequences of their land use decisions on their assets. Hence the game served as an exercise and a lesson to pay more attention on long-term farm management and planning. Socio-institutional learning was favoured by the informal setting of the RPG, which helped creating a discussion platform among farmer participants. Farmers reflected critically on present practices, achieved a joint vision and defined rules for an effective cooperative. Additionally, farmers talked about topics that were normally not talked about as a group, including the specific reasons why past cooperatives failed: corruption, lack of trust, and low engagement.

Finally our findings show that the RPG has a high potential to lead farmers to engage in collective action for CSA implementation. This is because even if the game is a simplification of reality it contains representations of elements of real life which participants are interested in exploring. Socio-institutional learning was favoured by the informal setting of the RPG, which helped creating a discussion platform among farmer participants. Farmers reflected critically on present practices, achieved a joint vision and defined rules for an effective cooperative. Additionally, farmers talked about topics that were normally not talked about as a group, including the specific reasons why past cooperatives failed: corruption, lack of trust, and low engagement.

6.2 Reflection and outlook

REDD+ and Climate Smart Agriculture (CSA) are connected through the inherent relationship between agriculture and forests. Nevertheless the reality is that REDD+ and CSA are rather disconnected both in policy design and local implementation and there is a growing call for REDD+ interventions to lower deforestation via improved agriculture. At the local scale, the merging of REDD+ and CSA can be achieved via a Climate Smart Landscape (CSL) approach. Despite the growing recognition of its importance, the CSL approach is still at a conceptual stage and there are major challenges in its implementation. The following sections discuss the contribution of this thesis to address challenges related to merging REDD+ and CSA in landscapes, from policy design to local implementation. Additionally recommendations for future research are given.

6.2.1 Cross-sectoral policies are needed for the agriculture and forest sector

Findings of Chapter 2 show that drivers of DD originate not only from inside but also from outside the forest sector and that agriculture is the major driver of DD. These results suggest that policies aimed at reducing deforestation cannot be disconnected from policies in the agriculture sector. In fact, REDD+ strategies that focus solely on activities aimed at forest protection and/or reforestation without considering agriculture expansion as a driver of DD are unlikely to be effective. For instance, a stricter forest protection policy itself is not likely to reduce agriculture expansion unless coupled with other policy(s) which introduce more productive agriculture in existing agriculture land or in already deforested land.

Therefore policies and programs aimed at reducing deforestation and CC mitigation, such as REDD+ should be aligned with interventions aimed at improving agriculture and CC adaptation, such as CSA. Nevertheless, REDD+ and CSA tend to have a sectorial approach, running parallel processes without much coordination. Due to the inherent link between forests and agriculture in landscapes such coordination is needed, to enhance synergies and minimize trade-offs related to their implementation. Hence I consider REDD+ and CSA as two pieces of the same puzzle (figure 6.1), which miss a connecting piece that integrates and implement them coherently. Such missing puzzle piece could be the landscape approach, which underlines the importance to address CC mitigation in synergy with CC adaptation and other important CSL goals, such as ecosystem conservation, agriculture increase and rural livelihood improvement.

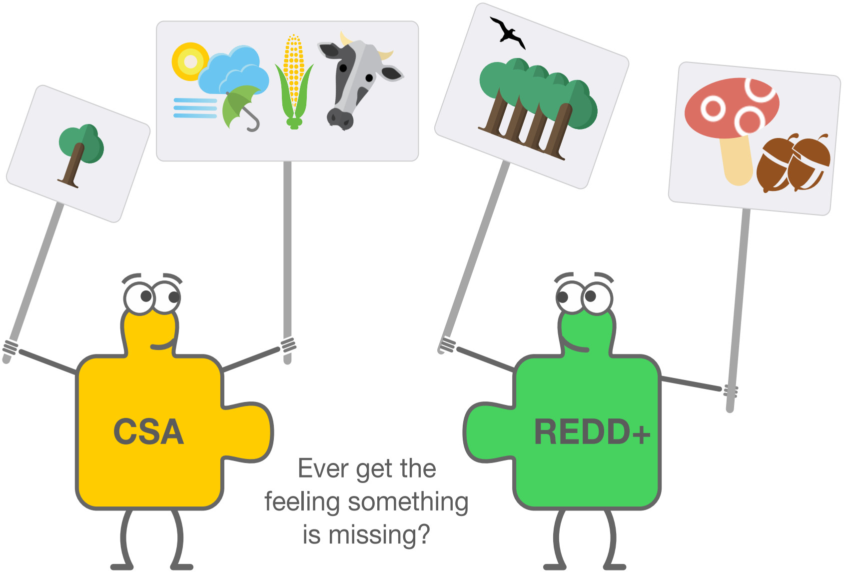

Figure 6.1: CSA and REDD+ provide benefits including CC mitigation and adaptation, sustainably increased food production, sustainable provision of forest products and forest protection. A missing puzzle piece is required to ensure that both mechanisms can be implemented coherently.

The importance to address deforestation in synergy with agriculture is recently underlined by the Paris agreement, which stated that actions for CC mitigation should not hamper food production. This is a major challenge, given the multiple and often

competing interests in different land use sectors. To this end cross-sectoral policies are needed for the agriculture and forest sectors.
Nevertheless addressing drivers of DD is certainly challenging. In fact, drivers of DD are often linked with primary needs of local communities (such as subsistence agriculture) or economic development goals, such as infrastructure and urban development or production and export of cash crops valuable for the country economy. Such needs and goals remain a higher priority for countries than reducing DD. Additionally underlying drivers are complex, involving social, economic, political, cultural and technological processes that are challenging to deal with. For instance removing perverse incentives given by governments for deforestation, such as providing support for the establishment of cash crops, imply that radical reforms are needed. These reforms are difficult to implement due to their link with underlying interests of governments. These conditions make it very challenging to implement REDD+ (Brockhaus and Angelsen, 2012).

Finally, effective policy implementation requires a constant monitoring of their implementation at the local scale. To this aim, top down data collection systems such as remote sensing should be coupled with more bottom-up approaches to collect data at the local level. An example of such bottom-up approach is crowdsourcing, a system through which local data is collected by individuals via mobile electronic devices (Patihast, 2012). Data collected via crowdsourcing would allow policy makers to monitor drivers of DD and the effectiveness of their interventions to address them. For instance, collecting data related to yield production would allow monitoring the effectiveness of interventions to improve agriculture production. Such monitoring would provide feedback to policymakers and hence allow them to redesign interventions that are more local specific and therefore more effective. Crowdsourcing is vital not only to increase the quality and quantity of data for improved policy design, but at the same time it empowers local communities and it generates local employment opportunities.

6.2.2 Multi stakeholders' engagement in Climate Smart Landscapes

Local implementation of CSL is hampered by two challenges. The first challenge is related to the different and often contrasting goals in land and resource use of different stakeholders (Giller et al., 2008). For instance, local small land holders use forest land for subsistence agriculture to satisfy their food needs, while large scale land owners and local (agri)businesses companies are interested in establishing lucrative activities such as cash crop plantations. Therefore landscape dynamics are steered by the multiple land use activities initiated by these different stakeholders. Often these activities are implemented without coordination and without assessing the impacts on forests and natural resources at the landscape scale, eventually leading to land degradation and ecosystem services depletion. This is due to the fact that forests and other natural resources are a public good and hence they are subject of the "tragedy of the commons" theory (Hardin, 1968), which states that within a shared-resource system, where individual users act independently and rationally according to their own self-interest, they behave contrary to the common good of all users by depleting that resource.

Moreover landscape dynamics are steered by other (non-local) stakeholders, such as policy makers and big international agribusiness companies, who have a stake in land and forests. These stakeholders enter into play with (monetary) resources and power, which enable them to grab land and in some cases marginalize local indigenous communities. I experienced this in a village in Ethiopia where I conducted interviews for a research that is not included in this thesis. In this village land use dynamics and deforestation were heavily steered by land grabbing from powerful companies that bought land (up to 400 ha per company) for coffee production, leading to widespread forest degradation. This land was expropriated from local communities that were depending from it. The result was that local farmers barely had land to satisfy their livelihood needs. Such situation was worsened by a fast local population growth; hence the question still remains of how local food demand will be satisfied in the years to come.

A second challenge in CSL implementation lays in policy design. First of all, policies are often designed in a sectorial manner, leading to trade-offs in land and resource use (chapter 3). Secondly, often policies aimed at reducing deforestation are designed in a top-down manner, without considering the local setting and needs. This top-down is likely to lead to ineffective implementation. This is because local stakeholders' are key drivers of landscape dynamics and they will change their land use only if such changes are in line with their goals and needs (Weatherley-Singha and Gupta, 2015).

Hence the transition to CSL relies upon the identification of the right policy mix that steers local land use decisions in such a way that trade-offs between different land uses are understood and carefully considered. Additionally, reducing deforestation relies upon the right policy incentive that entice local stakeholders in adopting agriculture land use practices that satisfy food demand and at the same time lower pressure on forests. To this aim, while designing plans aimed at more sustainable landscapes, efforts should be put in stimulating multifunctional land use. Agroforestry is the typical example of a multifunctional land use: it stores carbon, it prevents soil runoffs, it enhances soil productivity, it provides shade and a favourable microclimate (chapter 4).

In other words, in order to cope with these challenges, CSL implementation relies upon communication and coordination of policy makers, agribusiness companies, farmers, NGOs and other stakeholders in order to search win-win solutions that meet their goals via multifunctional land uses. Although this seems logical in theory, the practice is very complex to implement.

In chapter 3 we show the power of gaming to this aim, by bringing different stakeholders together, engaging them in discussions about common problems in their landscapes and eventually stimulating them to agree on possible solutions.
Despite these benefits, game development and implementation has challenges and limitations. A first challenge in the game development is to represent the complexity of reality in the game but at the same time define game rules that are simple to understand and playable. In fact if the game is too complex players might lose focus and hence not engage in it, while if it`s too simple important dynamics might be overseen. Another challenge is to identify and gather around the game table all relevant stakeholders. The identification of stakeholders might be a long process and it relies upon a deep understanding of the local social dynamics. Furthermore stakeholders might be reluctant to participate due to lack of interest or prejudgements about the usefulness of the game as a tool. Additionally, despite the fact that the game can be a very powerful tool in stimulating discussions and joint understanding and solutions, I believe that the game session itself is unlikely to determine long term changes in behaviour unless follow up workshops are initiated. To this aim, regular contacts with NGOs, land use planners and policy makers is essential to keep the process going, via for instance meetings and workshops that trigger changes in reality.

Moreover, games and participatory scenario development are useful if policy makers are open to different perspectives and to change their policies. Although this seems logical, I expect that this is normally not the case, since often policy makers have a quite sectorial and top-down approach in policy design. Therefore I recommend to interview policy makers before designing the game to assess whether they would find it useful. Additionally the framework presents methodological challenges associated with the linking of different methods in an integrated approach. One of such challenges is to input the land use decision rules derived from the RPG into the ABM. Further work needs to be done to couple ABM with RPG. Currently this coupling is made using a qualitative method. More semi-quantitative methods should be sought in order to strengthen the validity of this approach. An example of a method to accomplish this is the use of fuzzy cognitive maps (Kok, 2009).

6.2.3 Adaptive co-management is a key for Climate Smart Agriculture (and Landscapes)

Despite CSL is an important step forward to achieve adaptive agriculture, land-based mitigation, a transition towards CSL is challenging, since it requires not only technical learning, but also socio-institutional learning and social organization. Technical learning, socio-institutional learning and social organization require social networks at multiple levels of organization to mobilize and integrate knowledge from various sources, forming innovation coalitions or public-partnerships. Such coalitions need to work and think together to generate new knowledge in a coordinated manner. This is because landscape management is a dynamic process, which implies that land management actions need to be validated and adapted to changing circumstances.

This implies a shift from a purely top-down management, toward a management that merges top-down policy design with a bottom-up approach. Such approach is a way of dealing with the shortcomings of single agency, top-down management, leading to more legitimate management and to better compliance. In addition to this, justice, equity, and empowerment are also relevant because via a bottom-up approach people whose livelihoods are affected by management decisions can have a say in how those decisions are made. Hence CSL implementation at the local scale requires a shift of approach from knowledge transfer to knowledge exchange, mutual learning and adaptive co-management, through which different stakeholder groups and organizations with different goals and social positions interact to generate commonly shared knowledge and co-manage their landscapes.

Adaptive co-management is defined by Folke et al. (2002: 20) as "a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of learning-by-doing". In 2001, CIFOR defined a similar concept, adaptive collaborative management, as "a value-adding approach whereby people who have interests in a forest agree to act together to plan, observe and learn from the implementation of their plans (CIFOR, 2008: 2). In practice, adaptive collaborative management has three themes: horizontal interaction among stakeholders, vertical interaction of communities with actors at other levels, and iterative learning (CIFOR, 2008). Hence one of the strengths of co-management is that different stakeholders have the potential to bring to the discussion table knowledge that is acquired at different scales and decisions in a coordinated manner.

An example of horizontal interaction among stakeholders is farmer cooperatives. Farmer cooperatives provide several advantages. Firstly they enable a platform for knowledge exchange among local farmers and (social) learning process, essential for joint decision-making. Secondly they help farmers overcome major constraints they face in CSA adoption, such as lack of capital and bargaining power. For instance, implementation costs of inputs and the new technologies may be reduced by buying a large amount of input products at once as a cooperative and hence at a lower price per unit. Thirdly, there is evidence that cooperatives can help farmers to reduce barriers to enter markets by improving their bargaining power with buyers and intermediaries (Thorp et al., 2005; Devaux et al., 2011). In fact, many buyers prefer to work with producer groups because groups are better able than individual farmers to provide stable supply of quality products (Vorley et al., 2007). Such vertical linkages can be used, for instance, to obtain payments to support reduced deforestation and other sustainable land use practices.

Establishing vertical interaction of communities with actors at other levels enables CSA implementation. For instance collaborations between farmer cooperatives and investors allow farmers to tap into high value markets and to compete with larger farmers and agribusinesses (Stockbridge et al., 2003). The link with high value markets is particularly important in the case of CSA products because of their high value linked to the management system where they are produced. In fact CSA products derive from a management system that not only is sustainable, but it also contributes to adaptation and mitigation, such as the agroforestry systems described in chapter 4. Connecting with such markets is a key if the CSA activities are to be adopted by a larger community, broadening the scale of adaptation and mitigation achievements. Additionally, cooperatives of farmers can be used to channel REDD+ funding and/or to provide training to small holders who keep their land forested or establish agroforestry systems.

Finally, cooperatives allow knowledge share and join forces to face a common challenge that requires joint actions. Research in natural resource management has demonstrated the advantages of collective action for technology adoption, ensuring that resource use is efficient, equitable and sustainable (Meinzen-Dick et al., 2002). In our case study area in Brazil (chapter 4) an example of such advantage is the possibility to cope collectively with insect plagues: farmers recognized that a single farmer couldn’t cope with plagues because the insects will invade his/her field from the neighbour. Instead, if whole community engage in the management, there will be more likely effective outcomes.

6.2.4 The involvement of the private sector in CSL

Agribusiness companies play an important role in implementing CSL for two main reasons. The first reason is that agribusiness is responsible for much deforestation (DeFries et al., 2010). The second reason is that agribusiness companies often have resources such as physical, financial, human and social capital that can be invested in more sustainable landscapes. Hence they may influence the sustainability of the landscape where they operate, by developing linkages with local stakeholders in their supply chain (farmers or producers of raw materials and local buyers), as well as non-market (municipalities, extension officers, NGOs, communities, research institutes or civil society organizations).

Research shows that there is a potential for agricultural value chains to be further integrated in REDD+ and CSA strategies (Nepstad et al., 2013). For example, demand-side policies, such as the European Timber Regulation (EUTR), Forest Law Enforcement Governance and Trade (FLEGT) mechanisms and green public procurement policies (see for example the Roundtable for Sustainable Palm Oil and Round Table on Responsible Soy) could make agricultural production more sustainable and aligned to climate change objectives. One promising mechanism from the private sector is the zero-deforestation approach that many companies are adopting. Zero-deforestation is commonly understood as commitments from the private sector to eliminate deforestation from their supply chain (Meyer and Miller 2015). This is not straightforward, as companies are required to make binding commitments and consumers would need to adapt their behaviour.

Despite their relevance, I think that such pledges might have negative consequences on local livelihoods. In fact many rural communities own or use forested land, some of which they are allowed to clear even by law. Thus for some rural communities in tropical forest regions, “zero deforestation” can mean hunger and loss of economic opportunities. This is because many rural communities overcome the low fertility of their soil by clearing and burning forest patches and planting crops in the ash-enriched earth. Therefore I think that the involvement of agribusiness companies in reducing deforestation is a very delicate matter and even if pledging deforestation is beneficial for CC mitigation, it can imply negative consequences for the livelihoods of local communities. Hence I believe that agribusiness companies should actively engage in landscape approaches, by making land use decisions in coordination with local stakeholders, especially the marginalized communities that depend on forests for their livelihoods, via an adaptive co-management of the landscapes where they co-exist. To this aim I find that tools such role-playing games are a very powerful, by encouraging discussions among the different stakeholders and seek to achieve integrated solutions.

An example of such integrated solutions is cooperation between companies and producers, such as the Indonesian Palm Oil Pledge (IPOP) organization, which represents six of the world's largest palm oil buyers. IPOP has formalized a collaborative agreement to help smallholder farmers in Indonesia to adopt more sustainable, low-deforestation practices. Farmer`s involvement in reducing deforestation helps motivating them to be part of a discussion about how to build long-term sustainable production. Furthermore, farmer participation and organizations are important to help farmers to be seen and linked with (inter)national markets, by cooperating with progressive corporations that have pledged deforestation. Additionally, the support and coordination of policies with farmer's organizations is crucial for the effectiveness of such mechanisms. For instance policies aimed at improving smallholder farmer incomes are likely to reduce the negative impact on local livelihoods caused by zero deforestation pledges.

6.2.5 Recommendations for future research

In view of the research carried out in my PhD, I consider that relevant future research activities are to:

1. Identify methods to gather and integrate land use data in the forest and agriculture sector. Such methods should combine top-down data collection such as remote sensing analysis of satellite data, with more bottom-up approaches such as crowdsourcing via the use of novel Information and Communication Technologies. This data should be stored in accessible databases and used for monitoring and reporting, including: i) Landscape-level data (ie. earth observation products on forest and land cover change, carbon stocks, GHG emissions); ii) Farm data (ie. agricultural yield, resource use, etc.);

2. Develop novel approaches in using Role-Playing-Games (RPGs) to engage local stakeholders in co-managing their landscapes in coordination with non-local stakeholders. Landscape models can be employed to simulate the impact of land-use decisions made during the game on resources at the landscape level (e.g.: forest cover, agriculture yield, water quantity and quality). Emerging technologies, such as touch screens, can be used as game board displaying the landscape at stake and allowing stakeholders to discuss the impact of different management scenarios on deforestation, ecosystem services, agriculture productivity, CC mitigation and adaptation.

3. Research what are the challenges and opportunities for more holistic approach in policy design and identify the optimal policy mix that support the three CSL goals of adaptation, mitigation, food security in synergy.

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Summary

Global challenges posed by increasing food demand and climate change (CC) call for innovative and integrated mechanisms that include both agriculture and forests. Climate Smart Agriculture (CSA) and Reducing Emissions from Deforestation and forest Degradation (REDD+) are the main approaches dealing with these challenges and are currently high on the development agendas. CSA represents in principle a technical solution to food security and adaptation. REDD+ is a global mechanism that is particularly valuable in addressing CC mitigation. CSA and REDD+ are connected through the inherent relationship between forests and agriculture. Despite this, REDD+ and CSA are rather disconnected in reality and there is a growing call for REDD+ interventions to lower deforestation via improved agriculture. The merging of the two can be achieved via a Climate Smart Landscape (CSL) approach, an integrated landscape-level approach that allows to analyse the landscape dynamics leading to deforestation and to assess the trades-off between land uses. The CSL approach emphasizes stakeholder involvement and simultaneous achievement of multiple objectives including food security, rural livelihoods, CC mitigation and adaptation.

The transition to CSL relies upon coherent policies that acknowledge the linkages between forests and agriculture. Moreover CSL requires active involvement of stakeholders in different layers of governance, including policy makers, NGOs, agribusiness companies, local farmers and researchers. Hence such a transition is based upon an understanding of local stakeholders' decision-making, social learning and collective action. The main objective of this thesis was to assess REDD+ and CSA implementation in landscapes and to introduce a framework to enable CSL realization. We performed this assessment via different levels of analysis, from policy assessment to local implementation, structured in four chapters.

Chapter 2 provides an assessment of national REDD+ policies aimed at addressing drivers of deforestation and forest degradation (DD). Via this assessment we show that drivers of DD originate not only from inside but also from outside the forest sector (i.e.: agriculture, infrastructure development, mining, etc.). Such results contributed to a deeper understanding of how national REDD+ policies can be (re)designed to better address such drivers. Additionally, we draw considerations about the implications on monitoring systems and on the importance to monitor not only forest cover but also activities outside the forest sector. Such monitoring would provide increasingly detailed information about drivers of DD, allowing the (re)design of more effective REDD+ policy interventions

Chapter 3 introduces a framework for an *ex-ante* assessment of land management policies and interventions and for quantifying their impacts on land-based mitigation and adaptation goals. The framework is centred on local stakeholders involvement in a continuous process of policy (re)design, to make them more tailor made to the specific local context. It includes a companion modelling (ComMod) process informed by interviews with policymakers, local experts and local farmers. The ComMod process consists of a role-playing game with local farmers and an agent-based model. The game provided a participatory means to develop policy and climate change scenarios. These scenarios were then used as inputs to the agent-based model, a spatially explicit model to simulate landscape dynamics and the associated carbon emissions over decades. We applied the framework using as case study a community in central Vietnam, characterized by deforestation for subsistence agriculture and cultivation of Acacias as a cash crop.

Chapter 4 provides a first review of projects initiated by agribusiness companies via a Landscape Approach (LA) and their contribution to achieve Climate Smart Landscapes (CSL). Agribusiness companies play an important role in shaping the implementation of the LA, as they often have resources such as physical, financial, human and social capital. Hence they may influence the sustainability of the landscape where they operate by linking with local stakeholders. Our research investigates what drives agribusiness in initiating landscape scale projects and it provides a review of their project activities and their contributions to achieve CSL goals.

Chapter 5 describes the potential of a Role-Playing Game to stimulate social learning for the adoption of CSA by applying it in a case study area in Southern Amazonas (Brazil). In fact a major challenge in CSA implementation is that local farmers not always have technical knowledge about CSA practices and/or lack the resources to implement them. Additionally the implementation of CSA relies upon institutions and collaborations that facilitate the creation of rules and norms for its uptake and collective action. Our research shows that the RPG is a powerful tool to help overcoming these constraints, by stimulating technical learning of CSA practices, socio-institutional learning and by triggering collective action. In particular, collective action is important in the adoption of CSA practices because it allows farmers to interface with (external) markets, by achieving an economy of scale.

Finally, chapter 6 discusses the main findings of this thesis in a broader context. It draws conclusions about the main research findings and it describes contribution to the society and research. Finally it provides recommendations for future research.

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There were some very steep climbs, several points where I was completely stuck, but also great down hills! ;)

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List of publications

Peer-reviewed publications

Salvini G, van Paassen A, Ligtenberg A, Carrero G C, Bregt A K, 2016. Role-Playing-Game as a tool to facilitate social learning and collective action towards Climate-Smart-Agriculture: Lessons learned from Apuí, Brazil. Journal of Environmental Policy.

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Other publications

Salvini G, Avitabile V, 2015. Sub-national REDD+ implementation strategy and policy recommendations in Vu Gia Thu river Basin (Central Vietnam).

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About the author

Giulia Salvini was born in Milano (Italy) on May 31st 1982, where she spent her childhood and completed secondary school. She attended the 4th year of secondary school as a guest researcher at the Irondequoit High School of Rochester (NY).

In 2004 she received her BSc in Natural Science at the University of Milano. During her bachelor she spent six months at the University of Toulouse (France) following the Socrates Erasmus Program. During this experience she discovered her appetite for travelling, discovering new horizons and cultures.

Following this passion and her interest in natural science she moved to Bologna in 2004, where she enrolled at the Master course in Natural Resources Management, obtaining her MSc degree in 2007. Her MSc thesis was about "GIS mapping of Nadungoro forest for its sustainable development". She found that the best part of the master was her fieldwork in her case study area in Tanzania, where she her interest in sustainable forest management in tropical countries arose.

In 2007 Giulia won an award for a research project at the Institute for Environmental Studies at the Vrije University in Amsterdam. In this project she performed a spatial analysis of land cover changes in the Uluguru mountains (Tanzania) for its sustainable management. In 2008 her project was extended of an additional year and she worked at the Hydrology department of the same university.

In 2008 she moved back to Italy, in Venice, where she worked as a researcher in the field of Science and Management Climate Change. She collaborated within the F:ACTS! project, an European project that deals with exchanging ideas and good practices to adapt to climate change in five pilot projects in Europe.

In 2011 Giulia started her PhD research at the Laboratory of Geo-Information and Remote Sensing of Wageningen University, producing the present book. Her PhD was part of the LUCCi project, aimed at developing optimized land use and water resources management strategies in Central Vietnam. During her PhD she had enjoyed her field visit in Vietnam, Ethiopia and Brazil, in which she could experience "hands on" the complexity of forests and agriculture management in landscapes.

She is currently a Postdoc researcher at the Information Technology department at Wageningen University, working on the development of serious gaming for quality driven logistics. Her current research interest focuses on serious games for a variety of applications among which social learning, social cooperation and sustainable management.

PE&RC Training and Education Statement

The C.T. De Wit
Graduate School
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PRODUCTION
ECOLOGY
& RESOURCE
CONSERVATION

With the training and education activities listed below the PhD candidate has complied with the requirements set by the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 32 ECTS (= 22 weeks of activities)

Review of literature (5 ECTS)

- REDD+ readiness documents

Post-graduate courses (5.4 ECTS)

- Environmental decision analysis and decision support systems; University of Venice (2012)
- REDD@WUR learning event; WUR (2012)
- Companion modelling; CIRAD (2014)

Laboratory training and working visits (2.7 ECTS)

- Role playing game development; CIRAD, Montpellier (2015)

Invited review of (unpublished) journal manuscript (1 ECTS)

- Environment, Development and Sustainability: a review of reforestation approaches in Ghana: sustainability and Genuine local participation lessons for implementation REDD+ activities (2015)

Competence strengthening / skills courses (3.9 ECTS)

- Scientific publishing; PE&RC (2012)
- Scientific writing; PE&RC (2012)
- Social media training (COP Warsaw); CIFOR (2013)

PE&RC Annual meetings, seminars and the PE&RC weekend (1.2 ECTS)

- PE&RC Introduction weekend (2012)
- PE&RC Day (2013)

Discussion groups / local seminars / other scientific meetings (7.2 ECTS)

- REDD@WUR Seminar (2012)
- LUCCI Meetings (2012-2014)
- SIAS (Sustainable Intensification of Agricultural Systems) group (2014-2015)
- REDD+ Discussion group (2014-2016)
- Climate Smart Agriculture workshops @ WUR (2015-2016)

International symposia, workshops and conferences (3.2 ECTS)

- LUCCI workshop; poster and oral presentation; Vietnam (2014)
- Companion modelling workshop CIRAD; oral presentation; Montpellier (2015)

Lecturing / supervision of practicals / tutorials (0.6 ECTS)

- Interdisciplinary approaches in communication, health and life sciences (2015)

Supervision of MSc students (6 ECTS)

- Vincent Markiet: assessment of land cover and land use change dynamics in Sierra Leone: integrating satellite imagery interpretation with topographic and population data
- Astrid Bos: understanding drivers and processes involved in deforestation and modelling forest change dynamics in Central Vietnam