Microfinance for Ecosystem Services
Lessons from Proyecto CAMBio in Nicaragua

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Abstract

Recently there has been quite some discussion on the role of microfinance to support environmental management for micro-enterprises or poor households: green microfinance. In this paper we assesses, for the first time, the role, outcomes and limitations of green microfinance programmes in ecosystem conservation and rural development. We use as case study the first large scale green microfinance programme for biodiversity conservation: namely Proyecto CAMBio. It has been implemented in five Central American countries and it is composed by green credit, dedicated technical assistance, and conditional payment for environmental services (PES). In particular we focus on its implementation done in Nicaragua by the MFI called FDL and the NGO Nitlapan. Building on a unique sample of primary data concerning 128 rural producers, collected by one of the author, we perform a careful econometric quantitative analysis to assess the clients' characteristics that influenced the evolution of the environmental value of their farm. Moreover we assess the effectiveness of PES to rewarding improvement of environmental value of the farm.
Our results underline the importance of the local territorial dynamics and the complexity of the socio-environmental systems that do not seem to simply respond to environmental reward or green credits. Indeed it appears that green credits dedicated to foster more environmentally sustainable and economically rewarding rural practices are not able to influence the positive evolution of the environmental value of the clients' farm. Other factors related to livelihoods pathways, such as the decision to change activities, or clients' strategies or opportunities in land accumulation, have instead significant influence in the evolution of the environmental value of the farm. Moreover the PES does not seem to be able to reward environmental improvement, while, embedded in credit logic it rewards more creditworthy clients in term of land, access to credits and activities, and a reduced density of planted trees in the farm.
We hence call for a more proactive role of green microfinance, that articulating with local actors and territorial dynamics, aim at reshaping existing livelihood strategies toward more socially inclusive and environmental friendly pathways. Moreover our results support the compelling need of carefully designed environmental credit policies that should support the provision of green credits.

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1. INTRODUCTION

There are a great number of reasons why agricultural actors and landscapes deserve attention from academics and policy-makers. In addition to its clear purpose of food (and energy) production for an increasing world population, it is also the main source of income or subsistence for poor people living in rural areas –representing 70% of the world's poor (World Bank, 2015). For its presence and expansion in the developing world and its role in people's livelihoods, it is a key area to focus on for poverty alleviation and food security. There are concerns, however, about the distribution of economic opportunities, costs and benefits related to agricultural production and value chains, which impact the viability of smallholder farming (Vermeulen and Cotula, 2010). In addition to these social concerns, there are also environmental issues related to present agricultural practices. Through its pressure on natural resources –e.g. through the advancement of the agricultural frontier or the over-exploitation of existing agricultural areas– it has an important role in the loss of biodiversity, land degradation, deforestation and water contamination, while also playing a role in the provision of other environmental services (Kroeger and Casey, 2007, Geist and Lambin, 2002). In turn, the rural territories and livelihoods dependent on agriculture are highly vulnerability to these environmental stresses, shocks and climate change.

These –interlinked– social and environmental concerns indicate why agricultural landscapes are and should be at the centre stage of the current quest for 'sustainable development'. A myriad of proposals have been made to try to link environment and development in rural areas, including protected areas (Brockington, 2002), integrated conservation and development programmes (Berkes, 2007), and the currently popular policy instrument of payments for ecosystem services (Wunder, 2005). Another recent trend is the emergence of green microfinance (Allet, 2014b), as microfinance practitioners and stakeholders are starting to worry about the environmental impact that microfinance (MF) might have, and its potential as an environmental policy tool.

It is not sufficient to recognise the role of agriculture and rural development, though; the question is also about *how* you engage with these issues (Pretty and Ward, 2001, Huybrechs et al., 2013). Any initiative or intention to engage with issues of rural development and environment, however, requires an understanding of what drivers of environmental degradation or conservation are. In this paper we wear microscopic lenses and we try to assess the characteristics of clients and their interaction with local territorial dynamics and opportunities, that influence the environmental performance of small rural producers. Moreover we assess how green microfinance interacting with such dynamics is able or not to foster better environmental practices and environmental value cumulation, and if environmental subsidies in term of Payments for Environmental Services (PES) are able to promote and reword more sustainable practices and better environmental outcomes.

The analysis is based on a survey conducted in Northern-Central Nicaragua, and applies to a specific microfinance for ecosystem services project, Proyecto CAMBio. We thereby provide the first quantitative analysis of characteristics that influence environmental outcomes of Green Micorfinance programmes for ecosystem service provision.

The remainder of the paper is structured as follows. In the next section we will elaborate on the links between rural development, agriculture and the environment. We also introduce the concept of Microfinance for Ecosystem Services – of which Proyecto CAMBio is an important pilot programme. In section three we will be introducing our research questions and main hypothesis.

Section four is dedicated to methodology and dataset. The results emanating from the different tests and regression analyses will be presented and discussed in section five, after which we proceed to the conclusion. An appendix with correlation matrix complete the paper.

2. LITERATURE REVIEW

2.1 RURAL DEVELOPMENT AND ENVIRONMENT

Agriculture and rural development are key elements for sustainable development, that is however wrought with opportunities and limitations regarding the economic, social and environmental pillars of development. With smallholders' current adverse inclusion in value chains, the pressure on land holdings and rural populations' vulnerability to different stresses and shocks, there is much work to do to make the current development pathways in rural areas more inclusive.

A lot of attention in research and policy circles has also been given to the role of agriculture in deforestation and environmental degradation (Angelsen et al., 2001, Geist and Lambin, 2002); and the understanding of the relation between poverty and environmental degradation. Research on this relationship is inconclusive, especially regarding causality and regarding the question of how to create pathways out of poverty through the sustainable use of natural resources (Suich et al., 2015). Furthermore, Lambin et al. (2001) warn from focusing too much on poverty as a cause of deforestation, and others point to how depicting poverty as main driver for environmental degradation falls short of recognising more structural patterns where different actors and responsibilities can be highlighted (Ravnborg, 2003).

In trying to understand impacts and driving forces, Geist and Lambin (2002) stress the importance of distinguishing between 'proximate causes' – a human activity with a direct impact on forest cover/land management, and 'underlying driving forces' – which tend to relate more to processes which are in turn related to and fuelling these proximate causes (such as population dynamics, institutions, agricultural policies,…). An increasing number of authors thereby point to the need to look at the very local level, and then to see how this is influenced and relates to broader, more global dynamics (Shriar, 2014, Lambin et al., 2001, Suich et al., 2015).

Development pathways and complexity

The analytical framework of this paper relates to this recognition of the linkages between different social, economic and ecological aspects of rural development. We do this in combination with the recognised importance to disaggregate outcomes and responses for different actors (Daw et al., 2011, Suich et al., 2015) and to be aware of different feedbacks, interactions, and mediating factors (Lambin et al., 2001, Suich et al., 2015, Bacon et al., 2012)

The analytical framework for analysing rural development and environmental issues that we will apply in this paper, is strongly influenced by complexity theory and socio-ecological systems analysis (Bastiaensen et al., 2015). We conceive rural territories not simply as a set of individual rural producers, but emphasize their interaction with the socio-economic and environmental structure. New properties emerge from the interaction between different actors and the social, economic and political structures: formal and informal rules, entitlements, access to knowledge, credit and economic opportunities, etc.

This makes the system intrinsically non-linear and complex and feedback effects can strongly modify final outcomes. Relating to the latter, our analytical framework refers to a link between what producers and services providers do and what socio-political context they are interacting with;

Within this framework we very much look at the micro-level of farms, but will be interpreting the results in its broader institutional context (Bacon et al., 2012).

2.2 GREEN MICROFINANCE AND ECOSYSTEMS

There is a long tradition of initiatives that try to deal with rural development and environment. In this article we will be focusing on the specify recent trend of Green Microfinance (GMF). Green microfinance (GMF) aims at a triple bottom line: providing economic, social and environmental benefits. GMF is a multidimensional topic that includes environmental risk management, credits or non-financial services dealing with access to renewable energy or energy efficient devices; implementation of organic or agroforestry activities; support of practices to better adapt to climate change; etc (Allet, 2012a). The main rationality is that micro entrepreneurs are among the drivers and the main affected actors of environmental degradation, and that microfinance, interacting with them ad microscopic level, compared to other more macroscopic strategy, can promote better environmental management and have comparative advantages.

Debates are ongoing regarding the actual ability, willingness and need of MFIs to implement such GMF initiatives (Allet, 2014b, Forcella and Hudon, 2014, Wenner et al., 2004).
Nevertheless, when the environmental performance of microfinance institutions is being analysed it is mostly focused on the 'processes': e.g. existence of dedicated policies, procedures and products (Forcella and Hudon, 2014, Allet and Hudon, 2015, Allet, 2012a, Allet, 2014a), and generally, there seems to be an assumption that engaging with these issues will lead to positive outcomes.
The effectiveness and limitations of the interventions to tackle socio-environmental problems remains still largely unexplored. Very little research is being done on actual implementation and results, nor is there much reflection on the theory of change underlying the approach, wondering about how the tool might interact with the clients' practices and motivation, or with the local context in which he/she is operating. Notable exceptions are Allet (2012b), Forcella (2012), Lucheschi (2014).

This paper deals with environmentally friendly rural development and it focuses on a subtype of GMF, which seeks to engage in active support of rural practices such as agroforestry and silvopastoral activities, by providing specific incentives to its clients, and non-financial services. We refer to this kind of GMF as 'Microfinance for Ecosystem Services' (Cranford, 2011), which hints to the currently popular environmental policy tool PES. There is indeed a widespread belief that a solution to the problem of environmental degradation is the creation of payments or markets for ecosystem services (ES) –benefits people derive from nature– in order to encourage economic actors to include the otherwise unvalued positive externalities (i.e. ES) in their decision-making. The expectation is thus that the provision of this economic incentive (in this case, in combination with relieving constraints on access to credit (Cranford and Mourato, 2014)) will lead clients to making decisions towards the adoption of more environmentally-friendly investments.

Proyecto CAMBio

As case study we will analyse the project: Proyecto CAMBio (Central American Markets for Biodiversity) (Proyecto CAMBio, 2013a), that has been designed to remove fundings, political, market barriers and support an enabling environment for the development of environmentally friendly practices of small rural producers and foster biodiversity conservation in order to increase ecological connectivity among protected areas. It offers micro-credits to finance agroforestry activities such as coffee, cocoa and cattle raising, integrating trees into the productive system. Additionally, it provides conditional incentives –similar to PES (Wunder, 2005)– that are supposed to reward the additional efforts towards adopting biodiversity-friendly practices such as planting more trees. A third component is the provision of technical assistance to actually implement the activities financed with the credit.

The programme ran from 2007 till 2013 in five Central American countries (Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica). It was led by the Central American Bank for Economic Integration (CABEI), the Global Environmental Facility (GEF) and the United Nations Development Programme (UNDP) and implemented by 26 local financial institutions.

Proyecto CAMBio is the first large-scale programme mixing MF with PES. The evaluation of some of its main outcomes –which we present here for the specific case of its implementation in the Northern Central region of Nicaragua– is then fundamental.

In this paper, we focus on the implementation of Proyecto CAMBio by the microfinance institution Fondo de Desarrollo Local (FDL) in Nicaragua, together with its partner for technical assistance, Nitlapán. An interesting characteristic of the way in which FDL-Nitlapán implemented the project, is that it seemingly most closely related to the idea of coupling three incentives of specific credits with reduced interest rates, PES and TA[3]. As we can see in, in Nicaragua they received more than a third of the available funds for lending, but almost all the resources for TA and the PES. Also, it was considered by UNDP as one of the most successful implementers of the project (Mendoza et al., 2012).

IFI	Proportion of credits to IFIs	Proportion of TA beneficiaries	PES	
Coop 20 de Abril	0,78%		$ 2.232,07	0,76%
FDL	38,60%	95,71%	$ 291.372,94	99%
Lafise-Bancentro	49,77%	3,67%		
Banpro	10,55%	0,61%		

Table 1: Distribution of credits, TA and PES per intermediary financial institution. Situation per December 2012

Source: Proyecto CAMBio (2013b)

[3] In this case the PES is equal to the 14% of the credit, and it is offered to the clients that have successfully fulfilled the environmental targets established within the contract: namely usually planting a certain number o trees in a given area of the farm. In this way the PES is thought to reward the additional ES provided by the clients, while the credit is used to fund the implementation of an environmentally friendly and economically rewarding activity, and the TA to provide the missing human capital.

3. RESEARCH QUESTIONS AND HYPOTHESIS

In this paper we will investigate the two main research questions:

1. Are green microcredits (also coupled with TA and PES), targeting ecosystem management, able to induce positive environmental outcomes?

2. Is PES, in a GMF programme, an effective tool to reward the environmental improvement of farm land?

These two main questions will be supported by two further secondary questions, respectively:

1'. What are the characteristics of microfinance clients that influence the evolution of the environmental value of their farm?

2'. What are the clients' characteristics that influence the provision of PES, and how do they interact with MFIs' credit strategy?

For the different research questions, we will now present a number of subjacent hypotheses, that will drive our investigation in the rest of the paper and will support our analysis.

3.1 HYPOTHESIS FOR RESEARCH QUESTION 1

Research questions one tries to assess if the provision of green credits is enough to foster positive environmental outcomes, or if green credits, interacting with the underlying complex socio-economic and environmental dynamics, culture, values, habits and development pathways end instead to have no effect or even negative outcomes on environmental value. Namely it tries to compare a linear economic vision with a complexity socio-environmental vision of reality. With this aims we select a set of possible simple proxies, other than the green credit, that could underline the influence of such complex dynamics on the environmental outcomes at farm level, and we organise them into hypothesis. We generically refer to such proxies as "clients characteristics", however they actually deal with the characteristics of the client that are induced by its interaction with the socio-economic-environmental local dynamics.

Access to credit

It is reasonable to believe that more credit could foster better land management activities: the improved access to financial means could increase the productive capacity of the land; thereby being less intensive in land use. The discussion on poverty and the environment (Ravnborg, 2003, Suich et al., 2015) underlines different points of view on whether or not the provision of credit could be related to the more or less damaging effect of smaller farms. However one the key ideas behind microfinance's attention to its environmental bottom line (Anderson et al., 2002, Wenner et al., 2004) is that the activities of poor households or micro enterprises might exacerbate the impact on the environment. In addition, Gerber (2014) points to increased short-termism in a debtor's management, as it needs to reply to the immediate demands of creditors. At a more regional level, a number of studies also point to the relation between more credit and more deforestation (Angelsen et al., 2001)

***H1**: Having access to more credit induces a worse environmental performance of the farms*

Access to green credits

The straightforward hypothesis – which is also the underlying idea behind GMF – is that receiving specific green credits induces better environmental performance on the farms. Cranford and Mourato (2014) point however to the low conditionality that is related to 'concessional lending', as is the case here, as the loan is provided for an activity but cannot be retrieved if the activity has not taken place. For its relationship with the other incentives (TA, PES, etc.) we do see some level of conditionality and will apply the hypothesis that underlies the project.

***H2**: access to green credit induces better environmental performance on the farms*

Principal Activity

There are some specific linkages between the type of agricultural activity that is undertaken, and the environmental performance of the farm. Additionally, the main economic activity that has been chosen or that is being imposed due to circumstances also influences the specific investment choices that can or will be taken (Forcella, 2012). The stress on client's choices put the accent on the client development trajectory and ultimately its livelihood strategies and decision patters. This suggest to look not only the client's activity at a given time, but also its evolution over time – and a possible change in main economic activity – that can teach us something about the livelihood trajectories within the existing pathways (de Haan and Zoomers, 2005), and how this evolution characterizes environmental performance. Hence it seems unlikely that clients activities, shaped by local possibilities, would not influence the environmental performance. However its actual influence would depend on the activity and the livelihoods path

***H3**: The principal economic activity of the household influences its environmental performance.*

Size of the farm

Land holdings tend to be strongly related to the socio-economic position of farmers in rural areas. But, a farm can be reduced in size for different reasons, as it can be either an economically poor farmer, or a farm which very intensive production on little area. On the other hand, some consider bigger farms to be more efficient, although it could be based on more intensive mono-cropping practices. This will depend on context, type of crop, and the set of externalities that are taken into account.

Farm surface however is linked with the debate between family-based farming and more entrepreneurial forms, where the former might have more diversified farming practices, leaves more land fallow because of rotating crops and lack of capital, and arguably could hold a more altruistic attitude towards its immediate surroundings and the impact of the farming practices.

***H4**: The size of the farm negatively affects its environmental performance*

This would also bring us to hypothesize that in terms of land dynamics – i.e. the evolution in farm size over the years – an increase in area would also negatively affect the environmental performance.

***H5**: An increase in farm area negatively affects its environmental performance*

Historical environmental value

On the one hand, one could state that if a farm is already performing well in terms of environmentally-friendly land-uses, it is more difficult to improve it. This is sometimes discussed in terms of the targeting of certain environmental programmes, trying not to direct the incentives towards people who are already complying to some standards (Blackman and Naranjo, 2012, Wunder, 2005). There might also be a level of saturation at some point. Nevertheless, one might also argue that farms who are performing well in environmental terms do so in relation to what they find rewarding practices (be it economically, environmentally (e.g. water, timber, micro-climate,…) or socially (altruistic behaviour, interdependencies,…)), and that they wish to maintain or further increase said performance, while producers whose farm has lower environmental value, reasonably do not link it with rewarding economic activities and they do not have incentives to preserve it. We should also recognise that farmers are acting according to some strong beliefs and habits that might not be so easily redirected (Hiedanpaa and Bromley, 2014).

H6*: The higher the environmental value at a given moment, the more difficult it is to increase it.*

3.2 HYPOTHESIS FOR RESEARCH QUESTION 2

For the expected conditional relation between the incentive and the outcomes, the logic behind the payments would be that 'the more you pay, the more you get'. Expectations of additionality and the relation between the supposed underlying motivation for changes in practices would require the payment to reflect the improvements (Engel et al., 2008). This relationship is arguably also important in line with warnings about potential motivation crowding with such payment schemes. Indeed, by bringing in an economic/market logic in relation to environmental conservation, there is the risk of eroding other, intrinsic motivations; a risk which is higher when payments are considered low or insufficient (Rode et al., in press).

There is a variety of studies on the impact of PES in relation to the promoted practices, which obtain different conclusions depending on the settings and the theoretical approach/depth of the analysis; with e.g. Arriagada et al. (2012) finding a significant impact of PES on forest cover on farms in Costa Rica; and Van Hecken and Bastiaensen (2010) and Pagiola et al. (2007) coming to different conclusions regarding the same project in the same area.

We then subdivide research questions 2 into three main hypothesis:

PES and environmental objective of the project

For well implemented project the PES should reward the environmental objective of the programme in term of the indicators established to measure them. However misalignment of programmes objectives or bad governance could disentangle PES and environmental targets.

H7: *PES to reward higher environmental engagement in the project*

Effectiveness of PES to reward environmental betterment

In a more broad vision PES should reward better environmental management, also beyond the environmental targets of the programme. However as explained above results are inconclusive.

***H8**: A higher payment is related to a bigger improvement in the farm's overall environmental value*

Existence of other clients characteristics that influence the environmental reward

In theory the PES should reward the environmental added value provided by the additional ES provided by the clients, independently from other clients' characteristics. A pure economic vision would conclude that every actor independently from its characteristics can provide an ES if the PES is high enough and aligned with its need. However there are two main reason to confute this vision. On one side the local dynamics would shape the possibilities and opportunities of a farmers to provide a certain ES and that would depend on clients' characteristics. On the other hand the PES is liked with a credit provision that is implemented by a MFI and that would be influenced by clients' characteristics in its credit decision.

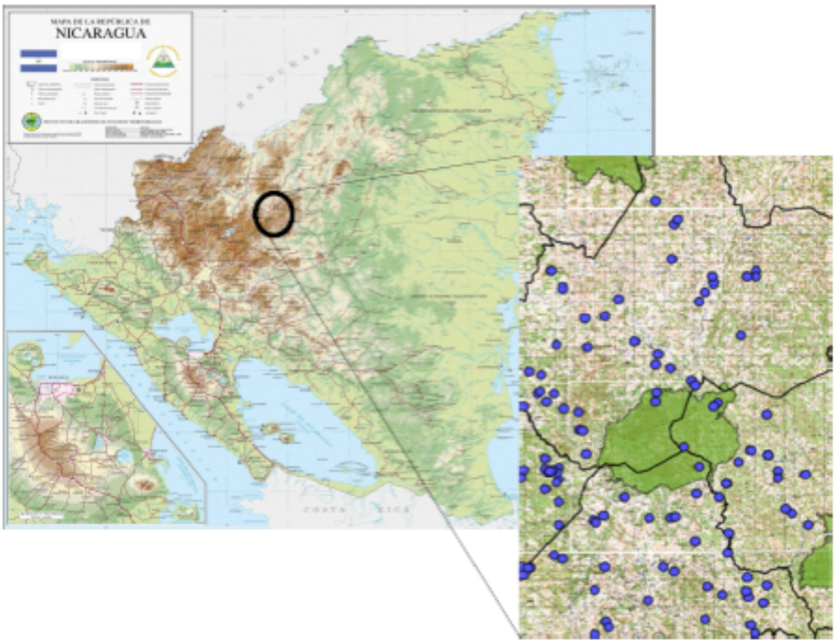
***H9**: Clients characteristics, other than the ES provided, influence the provision of PES*

4. METHODOLOGY AND DATASET

The geographical location of our study were the municipalities of El Cuá, La Dalia and Rancho Grande in Nicaragua. This area, which surrounds the natural reserve 'Macizo de Peñas Blancas', was chosen due to its importance for biodiversity and environmental connectivity, as it is part of the Meso-American biological corridor and lying in the buffer zone of the Bosawás Biosphere reserve (see Figure 1). These characteristics also led to the region being a focus area for Proyecto CAMBio. From the participants of Proyecto CAMBio, as implemented by FDL-Nitlapán, 21% were located in this area.

Figure 1: Geographical location of the study region (blue dots indicate Proyecto CAMBio participants)

Source: authors' own elaboration based on INETER (2009)



To answer the research questions, we analyse a unique set of primary data concerning 128 rural producers: 88 clients of FDL that participated in Proyecto CAMBio and 40 clients of FDL that did not participate. Data were collected by one on the authors –and a team of five enumerators– in the period October-November 2013. In addition, long-term presence in the zone, conducting semi-structured interviews and participatory observation, provides for necessary qualitative data to understand and interpret better the quantitative results; and vice-versa.

The questionnaire was inspired by previous assessments done for PES and Proyecto CAMBio in Nicaragua (Forcella, 2012, Van Hecken and Bastiaensen, 2010), and asked for information concerning: the economic activities, credit sources and use of credit, family structures, membership of organisations, livelihood strategies, and these characteristics' evolution during the last five years. For the evaluation of the environmental performance of the farms, we use the Ecosystem Services Index (ESI), further subdivided into a carbon index (CI) and biodiversity index (BI), as a proxy for the environmental outcomes of the combined land uses of the rural producers. It is a specific index designed by regional rural development organisations, indicating the biodiversity and carbon offsetting potential of the various activities in the farm (Murgueitio et al., 2003). It ranges from a value of 0 for land uses who are assumed not to deliver neither carbon sequestration nor biodiversity, like degrade pasture, to 2 for the land use supposedly contributing most to the delivery of both, like primary forest. In between, incremental improvements in the delivery of the service are reflected in higher indices (Murgueitio et al., 2003, Alpízar and Madrigal, 2008).

	Carbon index	Biodiversity index	Ecosystem Services Index

Annual crops	0	0	0
Degraded pasture	0	0	0
Natural pasture without trees	0.1	0.1	0.2
Improved pasture without trees	0.4	0.1	0.5
Sun-grown coffee	0.2	0.3	0.5
Natural pasture with low tree density (<30/ha)	0.3	0.3	0.6
Natural pasture with high tree density (>30/ha)	0.4	0.4	0.8
Living fences (per km)	0.4	0.45	0.85
Windbreaks (per km)	0.5	0.6	1.1
Improved pasture with low tree density (<30/ha)	0.5	0.3	0.8
Improved pasture with high tree density (>30/ha)	0.7	0.6	1.3
Monoculture fruit plantation	0.4	0.3	0.7
Fodder banks	0.5	0.3	0.8
Fodder banks with woody species	0.5	0.4	0.9
Cocoa with shade	0.5	0.6	1.1
Shade-grown coffee	0.7	0.6	1.3
Scrub habitats	0.8	0.6	1.4
Riparian forest	0.7	0.8	1.5
Secondary forest	1	0.9	1.9

Table 2: Values of indices for different land uses

Source: adapted from Van Hecken (2011) and Murgueitio et al. (2003)

Based on the survey information, we look at the evolution of the ESI/ha, BI/ha and CI/ha (for reasons of comparability among different farms with different sizes, and excluding possible effect coming from increase or decrease farm surface without actively work for change its environmental value) in the last five years. We decide to look at the whole farm – not just the 'influence area' as we want to understand potential spill-overs (Arriagada et al., 2012). This strategy aims to assess if the intervention of GMF in a limited farm surface and for a give time is able to induce changes in the full environmental value of the farm.

The sample of Proyecto CAMBio producers is obtained as a random sample of 115 producers from the list of contracts of Proyecto CAMBio, looking for a distribution that matched the population in terms of activity (agroforestry and silvopastoral) and in terms of being client of the El Cuá or La Dalia FDL branch.

The group of FDL clients who did not participate in this project is intended to inform us about patterns of change of non-participating farms. The distribution of such 'control' sample in terms of branch and sector is chosen to reflect the spatial and sectoral distribution of the sampled Proyecto CAMBio contracts. The size of the sample was mainly driven by temporal and financial constraints, with the main emphasis being on the necessary size of the sample of producers of Proyecto CAMBio.

The randomly chosen sample has to some extent been adapted for logistical reasons. Additionally, the samples were cross-checked to see whether producers had been involved in Proyecto CAMBio (PC).

Of the combined sample, we obtained information from 99 PC producers; a response rate of 85%. For the non-PC group, 48 of the 58 respondents were found and replied; a response rate of 83%. 19 were rejected for incomplete or inconsistent information, leaving us with 88 for PC and 40 for non-PC client group.

4.1 DESCRIPTIVE STATISTICS AND SAMPLE REPRESENTATIVENESS

Table 3 reports the descriptive statistics of the main variables we use in our analysis and the comparison with data at National level and in the same region.
At national level FDL had 1079 clients that participated to Proyecto CAMBio, and 238 clients in our region of investigation. In the area of investigation FDL had 1005 clients with a credit for coffee actives and 69 clients with a credit for cattle at November 2013.
This implies that our sample is quite big corresponding to 37% of the clients that participated to Proyecto CAMBio in the same area (full population) and 8,2% at national level. Moreover the full sample correspond to the 11,9% of the clients of FDL in that area.
The majority (80,7%) of the clients in the PC group received a credit for agroforestry (AF) activities for an average amount of 3066,4 USD, while 19,3 % received it for silvopasture (SP) activities of an average amount of 2282,9 USD. The distribution between producers with SP or AF credit is very similar to the one at regional level: 78,6% and 21,4% respectively. The average credit received with Proyecto CAMBio is 2915,2 USD in our sample, that is comparable with the average credit from Proyecto CAMBio in the region of study: 2642,4 USD, but bigger than the average credit at national level: 2070,3 USD. Both at regional and at national level the amount of credit per PC activities is bigger than the one for AF activities, while for our sample the trend is the reverse. However simple statistical tests show that this difference is not significant.
The credit was received on average in 2010 with 65% of the clients that received it between 2009 and 2011. Only 2 clients received the credits two times from Proyecto CAMBio.
In the last five years the clients in the sample cumulated (sum of all credit received excluding Proyecto CAMBio) on average 6132 USD.

Five years ago 57,5% of the clients in the sample had coffee as main activity, 15.0% cattle, 6,3% mentioned more than one principal activity (from now on diversified producers), while the rest had staple crop production as principal activity. It reflects the strong focus on coffee production in this region, while pointing to a heterogenous set of producers (Arribard, 2013).

However in the last five years there has been quite some dynamics with 11,9% of the producers changing their principal activity to coffee; while 3,2% changing it to cattle and 9,5% becoming diversified producers. Only one producer moved to staple crop production as a main economic activity.

In our sample the surface of the farm five years ago was of 19,7 Ha. This is a relatively high average for a region where about 80% of the farms are smaller than 14 Ha (INIDE-MAGFOR, 2013a, INIDE-MAGFOR, 2013b); although it does to some extent reflect the unequal distribution of land holdings (Gómez et al., 2011), as our sample has a long tail with a few larger farms.

We observe that in the clients in the sample on average increased their farm surface of 3,49 Ha in the last 5 years.

The clients that participated to Proyecto CAMBio plated on average 173 trees on 2,07 Ha with an average density of 120,4 trees per Ha thanks to the credit received from Proyecto CAMBio. The number of trees planted and the area invested are similar to the ones of the full population in the same area, while the trees density is higher compered to 81,4 tree per Ha for the full set of PC group.
98,9% of clients in PC group achieved the previously agreed environmental targets and 90,8% received the environmental reward (PES). The PES was on average of 390,4 USD equivalent to 3,04 USD per tree, very similar to the values for the full population of clients that received Proyecto CAMBio in the region.

Five years ago the ecosystem value per Ha in the sample was on average 0,894, further subdivided in a the biodiversity value per Ha of 0,424 and the CO2 capture value of 0,470.

In the last five years we observe in the sample a tendency of improvement of the environmental value of the farm both per Ha and for the total environmental value of the farm, with an average increase of 0,137 for the ecosystem value per Ha 0,0583 for the biodiversity value per Ha and 0.0785 for the CO2 capture value per Ha.

In the rest of the paper we will also use other three proxies to characterise the clients interviewed: access to electricity from the grid: a dummy variable with 45,2% of our sample that have access to the electricity from the grid. This variable is meant to measure the remoteness of the clients, and their access to energy and market (road, trading centres, etc.). Family working force in the farm is the ratio between the number of family members (women plus men) working in the farm over the number of people living in the house, it measures the working force of the family employed in the households farming activities with average score 0,659. Finally the social index capital, consisting in the sum of four dummy variables that assess wether or not the client is part of a cooperative, a producers' association, a church or a political organisation. It aims to estimate the social capital of the clients: the average value in the sample is 0,623.

Table 3: Profile of the respondent rural producers and comparison with regional data: descriptive statistics							
	Number of observations	Min	Max	SE	Mean	Regiona l Data	National
Producers with PC	128	0	1	0,465	0,688	-	-
Producers with PC for Agroforestry	88	0	1	0,397	0,807	0,786	0,697
Producers with PC for Silvopasture	88	0	1	0,397	0,193	0,214	0,303
Evolution Ecosystem value per Ha	128	-0,938	1,3	0,329	0,137	-	-
Evolution Biodiversity per Ha	128	-0,522	0,6	0,158	0,058	-	-
Evolution CO2 Capture per Ha	128	-0,415	0,7	0,176	0,078	-	-
Evolution Ecosystem value Total	128	-14,49	52,29	9,46	5,49	-	-
Evolution Biodiversity value Total	128	-6,51	22,05	4,16	2,45	-	-
Evolution CO2 Capture per Total	128	-7,98	30,24	5,38	3,04	-	-
Number of planted trees with PC	63	20	1000	205,6	173,0	162,9	-
Density of planted trees with PC	62	9,5	1428,6	193,4	120,4	81,4	-
Surface invested in P CAMBio (Ha)	78	0,175	14,7	2,28	2,07	1,98	-
Credit PC Agroforestry (USD)	70	469,5	10000	2386,0	3066,4	2508,1	1795,1
Credit PC Silvopasture (USD)	17	669,6	6000	1688,3	2282,9	3139,3	2669,4
Credit No PC received last 5 years (USD)	122	0	62000	9445,4	6132,0	-	-
Environmental Reward: PES (USD)	84	65,7	1400	317,1	390,4	381,7	-
Environmental Reward per tree (USD/ tree)	62	0,34	12	2,54	3,04	3,1	-
Ecosystem Index per Ha 5 years ago	128	0,122	2,1	0,365	0,894	-	-
Biodiversity Index per Ha 5 years ago	128	0,067	1,09	0,176	0,424	-	-
Carbon Index per Ha 5 years ago	128	0,056	1,01	0,193	0,470	-	-
Total farm surface 5 years ago	128	0,875	150,15	26,19	19,66	-	-
Cattle as Principal Activity 5 years ago	127	0	1	0,358	0,150	-	-
Diversified production 5 years ago	127	0	1	0,244	0,063	-	-
Coffee as Principal Activity 5 years ago	127	0	1	0,496	0,575	-	-
Change principal activity to Coffe	126	0	1	0,325	0,119	-	-
Change principal activity to Cattle	126	0	1	0,176	0,032		
Change principal activity to diversified prod.	126	0	1	0,295	0,095		
Evolution in the surface of the farm (Ha)	128	-18,73	56	9,92	3,49		
Access to electric grid	126	0	1	0,500	0,452		
Family working force in the farm	127	0	1	0,252	0,659		
Social Capital	128	0	2	0,615	0,625		

Comparisons between Proyecto CAMBio and non-Proyecto CAMBio clients

Before proceeding with our analysis concerning our two main research questions, it is interesting to explore if there is any observed difference between the clients in the PC group and the non-PC group.

We see that on average the PC group has a higher percentage of producers with cattle raising and coffee growing as principal activity five years ago: 16,1% and 60,9%, respectively, compared to 12,5% and 50% respectively for the non-PC group. The latter has instead and higher percentage of producers with staple crop as principal activity five years ago: 30% compared to 16,5% of the PC producers. Indeed, it seems that the producers that participated to Proyecto CAMBio are producers who were involved in more rewarding activities five years ago, compared to the clients in the non-PC group.

To better understand the differences between the two samples we perform some simple statistical test between the PC and non-PC group on the variable reported in Table 4. We first perform a two side t test to for the two groups to assess difference of the means, without assuming equal variance for the two populations. However we observe that in many cases our sample do not allow to conclude that the two populations are normally distributed - as required by the t-test - and there is not a standard variables transformation that makes the sample more normally distributed. As robustness check we decide to perform also the Mann–Whitney–Wilcoxon (MWW) test, that is a non-parametric test that does not assume normality of distributions. Results are reported in Table 4.

Table 4: differences between PC and A group clients

	Ecosystem value per Ha 5 years ago	Biodiversity value per Ha 5 years ago	CO2 capture value per Ha 5 years ago	Farm surface 5 years ago (Ha)
Proyecto CAMBio				
Clients (Num Obs)	0.90 (88)	0.42 (88)	0.47 (88)	24.0 (88)
No-Clients (Num Obs)	0.89 (40)	0.43 (40)	0.46 (40)	10.1 (40)
t-test	0.05	-0.26	0.34	**3.71*** **
MWW-test	-0.00	-0.29	0.18	**3.98*** **
	Tot Cumulated credit in the last 5 years (USD)	**Access to electric grid**	**Family working force in the farm**	**Social Capital**
Proyecto CAMBio				
Clients (Num Obs)	9297.0 (86)	0.46 (87)	0.68 (87)	0.70 (88)
No-Clients (Num Obs)	5686.7 (36)	0.45 (39)	0.61 (40)	0.45 (40)
t-test	**1.81***	-0.14	1.52	**2.31****
MWW-test	**3.81*** **	-0.14	1.38	**2.15****

t test: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$, MWW-test: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 4 clearly shows that clients in group PC are more capitalised (they own larger farms) they have more easily access to credit[4], and they have higher social capital.
These facts make us conclude that Proyecto CAMBio was offered with to better off clients. Moreover the fact that the environmental value of the farm is not different between the two groups implies that Proyecto CAMBio was not used as a reward for past better environmental performance.

Local territorial dynamics

As highlighted in the presentation of our analytical framework, an understanding of the characteristics of rural producers that influence the environmental value of the farm requires the assessment of local territorial dynamics in which farmers decisions and actions take place. To complement our broader, qualitative, understanding of regional dynamics, and to further link the developments on the farms in our sample to broader territorial dynamics, we decided to analyse the land and environmental dynamics of our sample. In the previous section we observe that there is a tendency towards land accumulation and improvement of environmental value of the farm. In this subsection we want to assess if this average tendency is indeed significant or if it is instead peculiar of our sample.

To fulfil this objecting we perform two statistical test: the paired, or dependent, t test: that test the mean difference between dependent distribution. This test however assume the difference in the two distribution is normally distributed,which we cannot always assume at a high enough level of confidence in our sample. We then decided to perform as robustness test the Wilcoxon signed rank sum test, that is a non-parametric version of the t test that however does not assume normality. We apply these tests to the difference between the ecosystem, biodiversity and CO2 capture value per hectare today and five years ago, and to the total farm surface today and five years ago. These tests assess the difference between two dependent distribution and are suitable
for sample of the same variable measured in the moment in time, while the usual t test or MWW test are not applicable because they assume the independence of the two distributions. The results are reported in Table 5.

From Table 5 it is clear that there is an overall ongoing process of land accumulation and at the same time a tendency of improvement of the environmental value of the farm per Ha. This is the case also for the two subgroup of producers: the ones eligible for Proyecto CAMBio and ones that simply have access to credit but not Proyecto CAMBio.

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[4] It is maybe worth to observe that the cumulated credits amount (excluding credits from Proyecto CAMBio) received in the last five years is 6318,4 USD for the PC group and 5686,7 USD for the non-PC group. The difference in cumulated credit volume between the two groups is not significant, however it become significant including the credit from PC, implying that the PC group as overall a better access to credit.

Table 5: evolution of environmental value and land between today and 5 years ago					
	Number Observation	Ecosystem value per Ha	Biodiversity value per Ha	CO2 capture value per	Farm surface (Ha)
Full Sample					
Today	128	1,03	0,482	0,549	23,1
5 years ago	128	0,894	0,424	0,470	19,7
paired t test		**4,72*** **	**4,18*** **	**5,04*** **	**3.98*** **
Wilcoxon signed rank sum test		**5,06*** **	**4.51*** **	**5,10*** **	**4.65*** **
PC Group					
Today	88	1,03	0,476	0,549	27,0
5 years ago	88	0,896	0,420	0,475	24,0
paired t test		**4,87*** **	**4,53*** **	**4,94*** **	**3,25*** **
Wilcoxon signed rank sum test		**4,93*** **	**4,35*** **	**4,87*** **	**3,58*** **
A Group					
Today	40	1,04	0,495	0,548	14.7
5 years ago	40	0,89	0,431	0,460	10,1
paired t test		**2,10** **	**1,78* **	**2,33** **	**2,34** **
Wilcoxon signed rank sum test		**1,99** **	**1,83* **	**2,14** **	**3,06*** **

* p < 0.10; ** p < 0.05; *** p < 0.01

4.2 EMPIRICAL METHODOLOGY

The objectives of this paper are to assess the main characteristics of the rural producers that influenced the change in environmental value of the clients' farm, if Proyecto CAMBio was able to foster the environmental betterment of the farm, and if the environmental incentives (PES) were effective in rewarding and fostering better environmental practices. To reach this objective, we con ducted some statistical and econometric analysis. Our strategy is to first perform mean difference t-tests and non-parametric test of distribution difference to assess the main characteristics that influence the evolution in environmental value of the farm and the amount of environmental reward received by the producers. We then perform ordinary least square regression on such variables plus some other control variables.

To assess the characteristics that influence the evolution of the environmental value of the farm we compare the ecosystem, biodiversity and CO2 capture value per Ha of the farm along seven main categories.

i) We analyse the difference between clients that participated to Proyecto CAMBio compared with the ones that did not.

ii) We assess the difference between the producers of the group PC that received a credit for AF activities compered to the ones that received a credit for SP activities.

iii) We assess the influence on environmental evolution of the principal activity (the one that generate more revenue for the household) of the producers five years ago. With this aim, we divided our sample into four categories of producers with main activities respectively: cattle raising, coffee growing, diversified producers, and staple crop.

iv) We assess the influence of the capitalisation of the producers on the evolution of the environmental value of their farm. We used as a proxy the total surface of the farm: we divided our sample in two groups: we define small producers the ones in the sample with a farm smaller than 10,5 Ha while we define big producers the ones that own a farm larger than 10,5 Ha. The value 10,5 Ha seems a reasonable values to distinguish big and small producers in the region of study and it has been chosen because it is the median of our sample.

v) We divided our sample into the clients that increase their farm and the ones that instead decreased it or did not change their farm surface in the last five years.

vi) the access to credit is included to assess the influence of fundings on environmental outcomes. We defined clients with easily access to credits the ones that received more than 4615 USD (the median value in our sample) in credits in the last five years and while the ones with low access to credits the ones that received less than 4615 USD.

vii) As proxy of the livelihood trajectory of the clients we subdivided the clients along the ones that changed their principal activity in the last five years into: coffee, cattle, or became diversified.

To assess the effectiveness of the PES, we compared the amount of PES and the amount of PES paid per tree planted with the evolution of the environmental value of the farm in terms of: evolution of ecosystem, biodiversity and CO2 capture value per Ha, and in term of the number of trees planted, surface invested and density of trees installed within the Proyecto CAMBio. Moreover we analyse the amount of PES and PES paid per tree along five dimensions: principal activity, farm surface, cumulated credit volume in the last five years excluding the credit from Proyecto CAMBio, activity financed with Proyecto CAMBio (AF or SP), farms land dynamics.

For all these eighteen categories (seven for research question number one and eleven for research question number two), we performed a two side t test on the scores of the evolution of the ecosystem, biodiversity and CO2 capture per Ha value for the first 7 dimensions, and for the PES and the PES paid per tree for the other 11 dimensions; without assuming equal variance of the two populations. However, the t-test for difference of means uses the hypothesis that the two samples belong to populations that are normally distributed. As we observe that in various cases this hypothesis is not satisfied at an acceptable level of confidence, and that there is not a standard simple variables transformation that solve this issue, we decide to support and check the validity of the t-test with a non-parametric test: the Mann–Whitney–Wilcoxon (MWW) test. We do so for the eighteen categories, and report it in the tables. The MWW does not require normality; it compares the ranks for the two samples and it tests if they could come from the same population. However, the MWW is less efficient for normally distributed samples compared with the t test.

We use the results of the t test and the MWW test to build nine multivariate regressions: the first three to assess the hypothesis concerning our first research question, while the other six to analyse our second research question.

The first group of three regressions have as dependent variables respectively: the evolution of the ecosystem value per Ha (EVOIseHa), the evolution of the biodiversity value per Ha (EVOBioHa), the evolution of the CO2 capture value per Ha (EVOCiHa). The explanatory variables we use are: PCAF: credit amount received for agroforestal activity, PCSP: credit amount received for silvopasture activity, TOTCRNOPC: the total credit amount (excluding the credits within Proyecto CAMBio) cumulated in five years, ESiHA5y, BIOiHA5y, COiHA5y in order one per each one of the three regressions: the ecosystem, biodiversity and CO2 capture value per Ha five years ago, TOTHA5: the total surface of the farm five years ago, CATTLE5y, DIV5y, COFFE5y: three dummies variables with values 1, 0, distinguishing the clients that had cattle, were diversified, or coffee as principal activities five years ago, ChCoffee, ChCattle, ChDiv: other three dummy variables that assess if a client changed her/his main activity, respectively to coffee, cattle or became diversified, ToTEvoHa: assess the increase or decrease of farm land within the last five years. We also added other three control variables to the set of explanatory variables already described. These additional variables are introduced because it is reasonable to believe that they could influence the environmental evolution of the farm and some simple statistical tests on the regressions without including such variables points out that there are some missing variables in the regression and the t-test would not be valid. They additionally explanatory variable introduced are: AcElGrid: a dummy variable assessing the access to electric or not of the clients, FAMIndex: assessing family members working in the farm over the full family components, and SOCIALIndex: assessing the social capital of the clients: sum of four dummies variables assessing the link of the client to cooperative, association, churches, or political organisation.
The regressions are hence defined as follow:

EVOEnvValueHa(j)_i = a_i + b1*PCAF_i + b_2*PCSP_i + b_3*TOTCRNOPC_i + b_4*EnvValueHA5y(j)_i + b_5*TOTHA5_i + b_6*CATTLE5y_i + b_7*DIV5y_i + b_8*COFFE5y_i + b_9*ChCoffee_i + b_10*ChCattle_i + b_11*ChDiv_i + b_12*ToTEvoHa_i + b_13*AcElGrid_i + b_14*FAMIndex_i + b_15*SOCIALIndex_i + e_i the index j=1,2,3 runs on the three measurements of environmental value we use in the paper, namely : EVOEnvValueHa(1)=EVOIseHa, EVOEnvValueHa(2)=EVOBioHa, EVOEnvValueHa(3)=EVOCiHa; and EnvValueHA5y(1)=ESiHA5y, EnvValueHA5y(2)=BIOiHA5y, and EnvValueHA5y(3)=COiHA5y.

We then run other two sets of regressions to answer to our second research question: the first one has as dependent variable the amount of money received as environmental reward (PES) by the clients that participated to Proyecto CAMBio; while the second one has as dependent variable the logarithm of the amount of money they received as reward per planted trees (Log(PERperTree)). We had to take the logarithm of the PES received per tree because the residues of the regression done for PERperTree are not normally distributed and the t-test are not valid, while the Log is the transformation that provide residues distributed as normal distribution at the best level of confidence. The explanatory variables we use include some of the ones used in the previous set of regressions and some additional variables: EVOIseHa, EVOBioHa and EVOCiHa in order for the two group of regressions, ARBPC1: counting the number of trees planted by the clients according to the targets established within the first credit received with Proyecto CAMBio, TreeHaPC: the density of the trees planted, TOTCRNOPC, AF a dummy variable with value 1 for clients that received a credit for agroforestry and 0 for clients that received a credit for silvopasture, TOTHA5, CATTLE5y, DIV5y, COFFE5y, ToTEvoHa, AcElGrid, FAMIndex, SOCIALIndex.
We do not include the area of the farm invested in the activities financed by Proyecto CAMBio because it is highly correlated with ARBPC1, TOTCRNOPC and TOTHA5 and introduce important multicollinearity in the regression. In the second set of regressions we do not include the last tree variables because they do not seems to be relevant neither statistically significant and due to the reduced number of observation (restricted to PC group) we prefer do not include them.

The first three regressions are hence defined as follow:

PES_i = a_i + b1*EVOEnvValueHa(j)_i + b_2*ARBPC1_i + b_3* TreeHaPC1_i + b_4*TOTCRNOPC_i + b_5*AF_i + b_6*TOTHA5_i + b_7*CATTLE5y_i + b_8*DIV5y_i + b_9*COFFE5y_i + b_10*ToTEvoHa_i + b_11*AcElGrid_i + b_12*FAMIndex_i + b_13*SOCIALIndex_i + e_i

while the second three are defined as:

Log(PESperTree)_i = a_i + b1*EVOEnvValueHa(j)_i + b_2*ARBPC1_i + b_3* TreeHaPC1_i + b_4*TOTCRNOPC_i + b_5*AF_i + b_6*TOTHA5_i + b_7*CATTLE5y_i + b_8*DIV5y_i + b_9*COFFE5y_i + b_10*ToTEvoHa_i + e_i

For all these nine regressions we first perform a careful analysis of possible outliers that could wrongly influence our results. We first plot the residue against leverage for all the observations and we carefully analyse the observations that have unusual residue or leverage or both. For the most relevant of them we run regressions with and without including them (we perform this procedure one by one for all the possible outliers) and we check if coefficients or their significancy change or not. We then systematically exclude the potential outliers that influence the regression in relevant way: one single observation cannot change the results if statistics is sound. We proceed like this for all potential outliers till we reach stable point for which single observations do not influence the results and the regressions are robust.

For all the nine regressions we perform various checks to verify that the assumptions for OLS regression are satisfied. First, we verified that none of the explanatory variable is highly correlated with the others (we report the correlation Table for the first group of regressions in the Appendix: where we also check if correlations are significant). We then proceed to check the normality of the residuals by drawing a Q–Q plot and doing a Shapiro–Wilk test that turned out significant. We then checked the absence of heteroscedasticity using the White's test and the Breusch–Pagan test. We use the Variance Inflation Test to check the absence problems related to multicollinearity. We then performed a couple of simple tests to check the absence of problems related to omitted variables. We also checked that the residues has zero expectation value.

5. RESULTS AND DISCUSSION

In this section, we present the main results of our analysis to test our hypotheses. We divided our analysis into two subsections one per each research question.

5.1 FINDINGS FOR RESEARCH QUESTION 1

Our first research question aims to assess if an external carefully design green microfinance product can improve the environmental performance of rural micro-enterprises or if, interacting with the local dynamics, habits, and development pathways, it ends having no effect or even indirectly supporting potentially dangerous activities, simply because socio-culturally accepted or part of the main development pathways. With this aim we test the characteristics of the rural producers that influence their environmental outcomes and the effect of the intervention of Proyecto CAMBio in the region studied.

The t-test analysis and MWW test do not allow to conclude that producers that participated to Proyecto CAMBio have better environmental evolution than the other clients. While other factors such as the principal activities and the livelihood of the producers (the activity to which they change to) had significant influence. The three multivariate regressions strength this result and underlines the importance of the underlying dynamics in term of livelihood strategy, land dynamics, past environmental assets, access to credits, and capitalisation in term of farm land are the variables influencing the environmental outcomes.

Let us briefly go through hypothesis per hypothesis.

Access to credit

Our results for equality of means and distributions refute hypothesis that more access to credits induces worsen environmental performance of the farm (H1) pointing instead toward no influence of the credit on the environmental value of the farm. This is also confirmed by the correlation analysis in table Appendix A. However the three multivariate regressions point towards the opposite conclusion namely that more credits (no matter if green) provide better environmental outcomes. However even if positive correlated with environmental improvement the effects of access to credit is extremely small and the significancy quite small.
This results could be expelling by the vision that underlying socio-economic and environmental territorial dynamics influences the effects of credits that, by itself does not foster innovations and new

trajectories but intend it passively supports the local preexisting dynamics. Indeed in a previous section we have shown that in the region there is a ongoing process of environmental improvement and the access to credit is reasonably supporting this dynamics, without targeting or being the source of it. The effects of credit on the environmental outcomes probably depends a lot on the underlining dynamics. Indeed in another analysis (qualitative) the opposite conclusion has been reached (Forcella, 2012): access to credit, also green credits, worse environmental outcomes. In that other region however the dynamics is quite different and mainly dominated by extensive cattle raising with negative effects on the environment. The two results together then support the passive nature of credits that limit to support pre-existing dynamics.

Access to green credit

Our results for equality of means and distributions, correlations, and the three multivariate regressions refute the hypothesis that access to green (specific) credit has a positive influence on the environmental performance of the rural clients (H2). Neither is there a difference in evolution of environmental indicators depending on the activity that was financed with the green credit. Neither is the amount of green credit a significant variable.

This surprising results, moreover considering that normal credits have marginally positive influence on the environmental outcomes of the micro enterprises, need further explanation. First of all it points towards the non-panacea vision of green microfinance: namely that it is not enough to provide a green products, not even if linked with technical assistance and specific monetary incentives, to contribute to improve the environmental value of clients' activities. Moreover looking at table in appendix A, it is tempting to infer that one of the reason of this results could be attributed to the targeting of the MFI for this green products. Indeed it appears that programmes was not able to couple with the favourable underling socio-economic dynamics and trying to foster choices of producers towards more environmentally positive livelihood strategies, but instead it meanly rewards bigger producers, with the tendency to increase their farm, and with more profitable activity in the area: namely coffee and cattle.

However such characteristics have no or negative influence on the environmental outcomes (see forthcoming analysis). While the main characteristics positively influencing the environmental value of the farm: namely the switch towards coffee was not targeted. This results support the hypothesis that green credits should couple with the underling socio-economic and environmental dynamics and strategically work to foster more sustainable trajectories. The targeting of clients should then not simply be done according to a financial risk analysis or clients' ability to repay, but rather it should include an assessment of the potentialities to better improve the local environment. With this aim strategies should be developed to articulate with local actors to support the upgrading of producers towards more sustainable trajectories.

Similar conclusion has been reached in (Forcella, 2012) in a region dominated by environmentally dangerous trajectories. The results in this paper, in an environmentally positive underlying dynamics, strength the overall hypothesis for the need of an institutions-territorial approach in green credit provision.

Principal activity

Our results for equality of means and distributions, correlations, and the three multivariate regressions support the hypothesis that the principal activities influence the evolution of the environmental value of the farm (H3).

When farms primarily dedicated to cattle farming are compared to the other the test for equality indicate a negative influence on environmental performance, while a positive influence is underlined for staple crop. However our regressions underline that it is not the principal activity per se that influence the environmental outcomes, while its influence on the livelihood trajectories of the clients that induce a positive or negative effect on the environmental value of the farm. The switch toward coffee foster a betterment of the environmental value of the farm, while the switch towards cattle has negative influence.
Such results could be explained thanks to the relevance of the livelihood trajectories in influencing environmental outcomes and the correlation between economic opportunities, depending on goods market value and products characteristics, and environmental results. It underlines the need to focus on what are the opportunities and constraints that shape decisions and evolutions for different farmers.

Size of the farm

Our results for equality of means and distributions, correlations, and the three multivariate regressions provide a mixed vision on hypothesis that the bigger is the farm the worse would be the evolution of its environmental value (H4). Only the evolution of the carbon capture value of the farm is negatively influenced by the farm surface. This mixed results only partially confirm H4 and point towards the need to focus more on the kind of trajectories of the producers rather than the farm surface itself. Indeed the for a given farm surface the activities and strategies of a producers can very much change the environmental impact: larger farm could sometimes have better efficiency and hence lower environmental impact, while other time have less incentive to intensify their production and hence support environmental degradation. The client's livelihood strategy can than pretty much influence the environmental value of the farm.

An analysis of the land dynamics indeed support this hypothesis. The correlation table in appendix A show indeed a negative and significant correlation between the increase of farm land and the environmental outcomes: namely the more a rural prodders increase its farm surface the more the environmental value per hectare is reduced. This fact is explained due to a reduce incentive towards intensification if the underling dynamics support land accumulation. The three regressions indeed confirm the hypothesis that increase the farm negatively affects the environmental value (H5).

'Historical' environmental value

Our results for correlations in appendix A, and the three multivariate regressions confirm the hypothesis that the higher is the environmental value of the farm the more difficult is to further increase it (H6). Indeed the associated coefficient in the three regressions is the biggest one and very significant. This result support the reasoning that at a certain level of environmental value there is a tradeoff between environmental betterment and economic activities. Indeed coffee is a more rewarding activity in this area –which additionally has a strong cultural importance in the zone - and strongly influences habits and pathways and it had intrinsically a high environmental value. Going beyond the value of coffee with shadow in all the farm would probably imply a reduction in the profitability of the clients activities that stop the will and possibility of a producer to go beyond a certain level of environmental value.

Other significant variables

Performing the regressions it appear that without some further control variables we introduced before, there would have been some missing variables implying bias in the regression coefficients. Once these additional control variables are introduced it appears that the family working force in the farm has a negative and significant influence on the evolution of the environmental value of the farm. This results could be explained considering that the more are the family members that work in the farm, the less it is likely that they will have access to more modern and sustainable practices, because they have less exchange other experiences and the word outside the farm. They would then be stuck on older less environmentally friendly practices that, in particular in some of the region in Nicaragua, see the tree as an obstruction to development.

Table 6: equality of means and distribution tests per environmental outcomes

	Num Obs	EVOIseHa	EVOBioHa	EVOCiHa
Proyecto CAMBio				
Clients	88	0,130	0,056	0,074
No-Clients	40	0,153	0,064	0,088
t-test		-0,30	-0,21	-0,32
MWW-test		0,04	-0,05	0,17
Activity financed				
SP	17	0,111	0,033	0,075
AF	71	0,134	0,061	0,074
t-test		-0,61	-1,39	0,06
MWW-test		-0,33	-0,70	0,81
Principal Activity 5 years ago				
Cattle	19	0,096	0,028	0,067
Coffe	73	0,081	0,034	0,046
Diversified	8	0,317	0,144	0,182
Staple crop	26	0,263	0,116	0,144
Cattle-Other				
t-test		-0,89	-1,30	-0,47
MWW-test		-0,32	-1,08	0,17
Coffee-Other				
t-test		**-2,09****	**-1,82***	**-2,28****
MWW-test		**-2,38****	-1,62	**-2,61*****
Diversified-Others				
t-test		1,09	1,11	1,13
MWW-test		0,67	0,63	0,74
Staple Crops -Others				
t-test		1,53	1,47	1,50
MWW-test		**2,58*****	**2,33****	**2,38****

	Num Obs	EVOIseHa	EVOBioHa	EVOBioHa
Farm Dimension				
Big (> 10,5 Ha)	64	0,100	0,038	0,059
Small (<10,5 Ha)	64	0,175	0,078	0,097
t-test		-1,29	-1,44	-1,22
MWW-test		-1,78	-1,56	-0,95
Land dynamics change farm surface				
Increased	83	0,135	0,052	0,083
Reduced	45	0,141	0,069	0,070
t-test		-0,102	-0,57	0,40
MWW-test		0,49	-0,15	0,92
Access to credit in the last 5 years				
High >4615USD	61	0,136	0,055	0,081
Low <4615USD	61	0,154	0,069	0,085
t-test		-0,30	-0,47	-0,12
MWW-test		-0,28	-0,61	0,044
Change in main activity to				
Coffee	15	0,477	0,220	0,257
Cattle	4	0,113	0,033	0,071
Diversified	12	0,21	0,087	0,12
Others - to Coffee				
t-test		**2,89****	**2,99*****	**2,81****
MWW-test		**3,28*****	**3,35*****	**3,17*****
Others - to Cattle				
t-test		-0,40	-0,85	-0,27
MWW-test		0,01	-0,43	0,28
Others - to Diversified				
t-test		0,89	0,73	0,99
MWW-test		1,18	0,81	1,23

t test: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$, MWW-test: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 7: OLS regressions for the evolution of environmental value of the farm

		Evolution Ecosystem EVOIseHa	Evolution Biodiversity EVOBioHa	Evolution CO2 Capture EVOCiHa
Credit PC Agroforestry	PCAF	4.26e-06	1.14e-06	3.71e-06
Credit PC Silvopasture	PCSP	1.59e-05	2.06e-06	1.48e-05
Credit No PC received last 5 y	TOTCRNOPC	**4.69e-06***	**2.21e-0.6***	**2.48e-06***
Ecosystem Index Ha 5 y ago	ESiHA5y	**-0.609*****	-	-
Biodiversity Index Ha 5 y ago	BIOiHA5y	-	**-0.600*****	-
Carbon Index Ha 5 y ago	COiHA5y	-	-	**-0.628*****
Total farm surface 5 y ago	TOTHA5	-1.77e-03	-6.51e-04	**-1.17e-03***
Principal Activity cattle 5y ago	CATTLE5y	6.22e-02	2.25e-02	4.25e-02
Diversified production 5y ago	DIV5y	6.22e-02	3.05e-02	3.74e-02
Principal Activity coffee 5y ago	COFFE5y	9.00e-02	4.02e-02	5.18e-02
Change to Coffe	ChCoffee	**0.275*****	**0.125*****	**0.150*****
Change to Cattle	ChCattle	**-0.211***	**-0.116****	**-9.77e-02***
Change to diversified	ChDiv	-4.45e-03	-6.836e-03	8.917e-04
Evolution in area of the farm	ToTEvoHa	**- 6.73e-03*****	**-3.92e-03*****	**-2.73e-03****
Access to electric Grid	AcElGrid	4.43e-02	1.74e-02	2.60e-02
Family working force	FAMIndex	**-0.187****	**-9.78e-02*****	**-9.32e-02****
Social Capital	SOCIALIndex	-2.06e-02	1.31e-02	-1.76e-03
Number Observations	_	115	115	115
R2	_	0,678	0,682	0,674
F	_	13.88	14,14	13,63
Prob > F	_	0,000	0,000	0,000

t test: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

5.2 FINDINGS FOR RESEARCH QUESTION 2

In this section we want to discuss out findings concerning our second research question: the effectiveness of economic environmental incentives to foster environmental conservation.

As first observation we look at the correlations (Pearson and Spearman) between the PES paid per producers and per tree and some of the possible proxy to measure its environmental outcomes.
In addition to the environmental proxies we have already used up to now, we also include as additional proxies the number of trees planted, the density of the trees planted, and the part of the surface of the farm dedicated to implement the activity agreed with Proyecto CAMBio. These last three indicators are quite limited, because they only measure the environmental improvement directly related to the activity financed and agreed on with Proyecto CAMBio. In our analysis they are then used as first step analysis to assess if the PES was first able to reward more the clients that engaged more in the programme, while the ecosystem, biodiversity and CO2 capture indicators we have used till here, will be employed to assess if the PES rightly reward the ones that had overall better environmental outcome and was then an effective incentive to foster environmental betterment. In table 8 we report the results the correlating between PES and the various environmental proxies. To do that we excluded the three producers that participated two times to Proyecto CAMBio. Various producers do not report on the number of trees planted, and this unfortunately limits the dimension of the sample. Moreover, among the clients that received Proyecto CAMBio, we had to exclude the ones that reported activities that are difficult to compare with more standard ones (coffee or cattle for example) in term of number of trees planted. Two producers that implement a coffee filter and one that declared to have invested the credit form Proyecto CAMBio in fodder plants were then excluded from the analysis. The reaming sample is than reduced to 63 rural clients.

Table 8: Pearson / Spearman Correlation

	PES per client	PES paid per tree
Number of planted trees	**0,35*** / 0,43*****	**-0,30** / - 0,44*****
Surface invested in P CAMBio	**0,53***/ 0,72*****	0,03 / 0,17
Density of planted trees	0,05 / -0,18	-0,20/ **-0,71*****
EVOIseHa	-0,13 / -0,08	-0,19 / -0,11
EVOBiHa	-0,12 / -0,07	-0,20 / -0,16
EVOCiHa	-0,14 / -0,07	-0,19/ -0,08
ToTEVOIse	**0,40*** / 0,56*****	0,03 / 0,12
ToTEVOBi	**0,45*** / 0,55*****	0,06 / 0,09
ToTEVOCi	**0,35*** / 0,50*****	0,00 / 0,10

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 8 shows that the PES was able to foster the instalment of more trees and the employing of larger surface of the farm for the activity financed with Proyecto CAMBio. Moreover the total environmental value in term of ecosystems, biodiversity and CO2 capture value of the farm was rewarded too. However the density of trees and the environmental value per hectare was not rewarded neither

fostered. Moreover the amount of money paid per tree is negatively correlated with the number of trees planted, and paying more per tree does not seem to have influenced better environmental evolution and the Spearman correlation point toward a strong negative and significant correlation between the PES received per tree and the density (see intensification) of trees planted.
These results ask for a more in dept investigation. In table 9 we report equality of means and distribution tests per environmental outcomes using the ttest and the MWW test, while in table 10 we report six multivariate regressions assessing the drivers that influenced the amount of PES per clients and the amount of PES per tree per client. Due to data constraints the regressions are performed on a limited number of observation and then they should be interpreted together with the equality of means and distributions tests.

We then divide our analysis according to the hypothesis previously formulated.

Effectiveness of PES to reward higher environmental engagement in the project

Results for the equality of means and distribution provide a mixed vision on hypothesis (H7). Indeed, they reveal that the higher is the number of planted trees and the amount of surface engaged within the activity promoted by Proyecto CAMBio higher is the amount of PES paid per producer. However they also underline that the density of planted trees does not influence the amount of environmental reward received. Moreover it results instead that the surface of the farm dedicated to activities promoted by Proyecto CAMBio does not influence the amount of money paid per tree, while the number of trees and the density of trees instead negatively affect the PES received per tree.
The multivariate regressions presented in table 10 confirm these results and they unveil that the number of trees planted has a significant influence on the PES received, while however the density of trees planted has negative influence on the PES received. Moreover the number of trees and density of trees negatively influence the amount of PES received per tree. Such results underlined the inability of PES to stimulate the intensification of trees cover in the farm. They can be explained by the purely economic structure of PES that, following the efficiency economic paradigm, provide a reward proportional to the amount of credit received without direct interlink with the environmental betterment achieved. Such strategy could be in principle effective and less costly than others. However it implicitly assumed that more green credit would imply better environmental outcomes, hypothesis that we have previously refuted. Indeed the results here provided support one more the hypothesis that green credit without a careful linked green policy will end to be influenced by a finical logic and reward more the more credit worthy producers, without necessarily being the actors with better environmental outcomes. Namely the absence of a careful environmental strategy reward the pre-existing socio-environmental dynamics.

Effectiveness of PES to reward environmental betterment

The analysis of equality of means and distributions refute the hypothesis that the higher is the environmental reward the better is the improvement of the environmental value of the farm (H8). Indeed in table 9 there is no significant effect of positive environmental outcomes in term of ecosystem, biodiversity or CO_2 capture on the PES received per producer or per tree. It is interesting to underline that such analysis unveil instead an average tendency to reward more the producers that decrease their environmental value compared to the ones that instead improved it. Such average tendency is however not significant.
The multivariate regressions straighten such results and contribute to refute the hypothesis (H8) .
Indeed the regressions do not underline any significant effect of the improvement of the environmental value of the farm on the amount of PES received per producer or per tree. Such result could be explained, and in the previous subsection, by the too simplistic economical approach of green MF that without considering the underling dynamics mainly adapt a financial strategy for client targeting, products provision and subsidy that end supporting non-effective environmental subsidies that are not able to reward environmental improvement.

Indeed the existence of other characteristics of the producers that are able to influence the accumulation of environmental incentives, independently from their environmental outcomes is underlined in the next subsection.

Existence of other clients characteristics that influence the environmental reward

The results for equality of means and distribution, and the multivariate regressions support the hypothesis that other characteristics of the producers could influence the amount of environmental reward received in green microfinance programmes (H 9)
Indeed the from Table 9 and Table 10 it clearly appears that the environmental subsidy (PES per clients) rewarded clients with better access to credits, while having bigger farms and cumulating land in the last five years positively influence both PES per clients and per tree. Such results could be explained by the purely financial approach/logic used to decided to whom and at which condition providing green credits, in term of better guarantee, more rewarding activities, and less cost, instead of targeting better environmental outcomes. This seems to be true also for products such as Proyecto CAMBio that adopts a "financial plus" perspective including training and environmental conditions in the credit provision.
Moreover the regression also show the significant influence of the activity financed on the amount of PES per client and per tree that reward more clients with Agroforestry activities compared to silvopasture. This result can be explained by the tendency of an MFI to finance the more rewarding and culturally accepted activities: coffee in the region of study.
The influence on PES of such characteristics seems also to provide better understanding of way PES per tree and per clients is higher for clients that invested more of their land in the green credit: it is indeed a variable highly correlated with the access to credit and the total surface of the farm.

Table 9: equality of means and distribution tests per environmental incentives

	Num Obs	PES (USD)	Num Obs	PESperTree (USD)		Num Obs	PES (USD)	Num Obs	PESperTree (USD)
EVOIseHa					***EVOBioHa***				
Pos	60	378,40	43	3,00	Pos	54	384,22	39	3,00
Neg	24	449,31	20	4,04	Neg	30	424,64	24	3,86
t-test		-0,84		-0,92	t-test		-0,54		-0,87
MWW-test		-0,41		-0,71	MWW-test		-0,15		-1,03
EVOCiHa					***Activity financed***				
Pos	57	369,65	40	2,84	SP	15	296,29	10	2,99
Neg	27	459,89	23	4,17	AF	69	420,91	53	3,39
t-test		-1,06		-1,26	t-test		**-1,87***		-0,55
MWW-test		-0,17		-0,80	MWW-test		-1,39		0,48
Principal Activity 5 years ago					***Farm Dimension***				
Cattle	12	462,56	8	2,73	> 10,5 Ha	49	537,22	34	4,27
Coffe	51	423,25	39	3,60	< 10,5 Ha	35	204,67	29	2,23
Diversified	5	387,57	4	5,02	t-test		**6,25*****		**2,65****
Staple crop	14	295,36	10	2,42	MWW-test		**5,03*****		**2,33****
Cattle-Other					***Land dynamics***				
t-test		0,75		-1,14	Increased Farm	49	429,49	37	3,26
MWW-test		1,05		0,65	Reduced Farm	35	355,49	26	3,41
Coffee-Other					t-test		1,08		-0,16
t-test		0,83		0,82	*MWW-test*		1,44		0,61
MWW-test		0,15		0,48	***Total Credit volume received in the last 5 years no PC (USD)***				
Diversified-Others					High (> 3000)	42	505,44	32	4,04
t-test		-0,15		0,77	Low (< =3000)	*42*	275,42	31	2,60
MWW-test		0,42		0,43	t-test		**3,55*****		**1,74***
Staple Crops -Others					MWW-test		**3,52*****		0,82
t-test		**-1,86***		-1,49	***Surface invested in P Cambio***				
MWW-test		-1,05		-1,26	>1.4 Ha	27	572,35	21	3,96
Density of Trees planted (Trees/Ha)					<=1.4Ha	46	235,34	41	2,79
> = 85,71	32	316,09	32	1,98	t-test		**5,07*****		1,09
< 85,71	30	417,48	30	4,48	MWW-test		**5,26*****		0,71
t-test		-1,31		**-3,21*****	***Number of Trees planted***				
MWW-test		-1,10		**-4,34*****	> 100	30	515,43	30	2,49
					< = 100	33	242,92	33	4,09
					t-test		**3,79*****		**-1,95***
					MWW-test		**3,66*****		**-2,63*****

t test: * p < 0.10; ** p < 0.05; *** p < 0.01, MWW-test: * p < 0.10; ** p < 0.05; *** p < 0.01

Table10: OLS regressions for Environmental Subsidies

		PES (USD)	**PES (USD)**	**PES (USD)**	**Log PESperTree**	**Log PESperTree**	**Log PESperTree**
Evolution of Ecosystem value per Ha of the farm	EVOIseHa	-7.96	-	-	0,209	-	-
Evolution of biodiversity value per Ha of the farm	EVOBioHa	-	-17,83	-	-	0,420	-
Evolution of Ecosystem value per Ha of the farm	EVOCiHa	-	-	-17,39	-	-	0,382
Number of planted trees with PC	ARBPC1	**0,408*** **	**0,409*** **	**0,409*** **	**-1,84e-03*** **	**-1,84e-03*** **	**-1,84e-03*** **
Density of planted trees with PC	TreeHaPC1	**-0,545** **	**-0,545** **	**-0,547** **	**-3,21e-03*** **	**-3,23*** **	**-3,20e-03*** **
Total volume of credit received in the last 5 years without	TOTCrNoPC 5y	**7,43e-03***	**7,42E-03***	**7,42e-03***	-1,23E-05	-1,21E-05	-1,22E-05
P CAMBio for AF (1) or SP (0)	AF	**198,12*** **	**198,25*** **	**198,00*** **	**0,410** **	**0,408** **	**0,414** **
Total farm surface 5 y ago	TOTHA5	**8,93*** **	**8,93*** **	**8,92*** **	**1,55e-02*** **	**1,54e-02*** **	**1,55E-02*** **
Cattle as Principal Activity 5y ago	CATTLE5y	-117,64	-117,87	-117,24	7,60E-02	8,38E-02	6,84E-02
Diversified production 5y ago	DIV5y	16,07	16,25	15,68	**0,686** **	**0,682** **	**0,686** **
Coffee as Principal Activity 5y ago	COFFE5y	15,36	15,46	15,24	2,23E-02	1,82E-02	2,20E-02
Evolution in area of the farm	ToTEvoHa	**10,08***	**10,05***	**10,10***	**3,88e-02*** **	**3,94e-02*** **	**3,82e-02*** **
Access to electric Grid	AcElGrid	-54,95	-55,06	-54,57	-	-	-
Family working force in the farm	FAMIndex	117,13	116,91	117,11	-	-	-
Social Capital	SOCIALIndex	-28,65	-28,51	-28,56	-	-	-
Number Observations	_	56	56	56	57	57	57
R2	_	0,8228	0,8228	0,8228	0,7611	0,7547	0,7557
F	_	15	15	15	10,29	14,15	14,23
Prob > F	_	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

t test: * p < 0.10; ** p < 0.05; *** p < 0.01

6. CONCLUSIONS

This paper provides, to the best of our knowledge, the fist quantitative study of the clients' characteristics that influence better environmental outcomes, the ability or not of green microfinance to foster environmental betterment, and the effectiveness or not of environmental rewards to promote environmental improvement.

The simple possibility of performing such a detailed analysis on an existing and large scale programme, clearly shows that complex programmes linking green credits, technical assistance and PES can be actually incorporated into the operations of certain MFIs and that they can fulfil the indicators required by the programme. This possibility should open the way to the implementation of innovative green microfinance projects, incentivises better environment management and conservation.

However the results of our quantitative analysis shows that green credits, also supported by adapted environmental technical assistance and environmental rewards, could not be able to influence the evolution of the environmental value of the clients' farm that is instead influenced by clients characteristics and livelihoods trajectories. Indeed our analysis clearly shows that elements such as the access to credit, the strategic choices of producers towards which kind of activity to invest in, their capitalisation in the term of land accumulation, the pre-existing environmental value of their farm and their family characteristics and working strategies instead have relevant influence on the environmental value evolution of farm.
We interpret the influence of such other dimensions on the environmental evolution of the farm as a support of a complexity system theory for the human-environmental system and the needed for a territorial strategy to better tackle environmental issues. The provision of green credit indeed interact s with the pre-existing socio-economic dynamics that it is by itself shaped by culture and habits, socio-economic inequalities, unequal access to opportunities, uneven power structures, and existed livelihood strategies and development pathways. The green credits interacting with this complex dynamics cannot by itself revert environmental degradation but it more naturally ends financing the pre-existing dynamics or not having significant outcomes. However the existence of clear characteristics of the clients that positively or negatively influence the evolution of the environmental value of the farm points towards strategies and actors with whom green microcredit programmes should try to articulate to redirect the local territorial dynamics towards more socially-inclusive and environmentally friendly outcomes.

The analysis of the environmental rewards supports such conclusions and moreover it underlines the necessity of not only consider the interaction of green credits with clients' characteristics, but also the relevance of the interaction with financial providers and the organisations implementing green credits programmes and their strategies and decision to whom and why provide green credits. Indeed our results clearly shown that a green credit without a clear green policy that directs the decision of financial intermediaries to invest more in more environmental rewarding activities, ends supporting allocation of environmental subsidies towards more credit worthy clients that are not necessary the ones with better environmental outcomes. Our analysis shows that PES did not reward better environmental outcomes neither in term of ecosystems, biodiversity and carbon capture value, or in term of the density of trees planted.
While more capitalised clients and less trees or trees density was rewarded by the PES.
Such results points towards the necessity to work to align the incentives of the various stakeholders participating in the green microfinance programme towards environmental betterment, the necessity of a carefully design green credit policies, and the need to articulated with the underlying socio-economic and environmental dynamics.

The message from this paper is to build on the actual experience of Proyecto CAMBio, and other existing rural green microfinance programmes, to foster a more territorial approach that recognises the intrinsic link between socio-economic inequalities, existing power structures and environmental degradation. Our results call for a more proactive role of green microfinance in reshaping existing livelihood strategies toward more socially inclusive and environmental friendly pathways.

In this case, in the context of land accumulation and social differentiation in the region, we want to raise attention to the inevitable political stance taken by suchlike projects and MFIs more broadly when wondering about whom to support, how, and what for.

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APPENDIX A

Pearson and Spearman correlations for the variables used in the regressions

Pearson/ Spearman	Evo ISE Ha	TotEvo ISE	EvoBI Ha	TotEvoBI	EvoCI Ha	TotEvoCI	PC AF	PCSP	TOTCRNOPC	ESiHA5y	BIOiHA5y	COiHA5y	TOTHA 5	CATTLE5y	DIV5y	COFFE5y	ChCoffee	ChCattle	ChDiv	ToTEvoHa	AcElGrid	FAMIndex
TotEvoISE	0,061 0.34***																					
EvoBIHa	0,99*** 0.98***	0,013 0.28***																				
TotEvoBI	0,076 0.34***	0,99*** 0.99***	0,035 0.29***																			
EvoCIHa	0,99*** 0.99***	0,12 0.38***	0,97*** 0.94***	0,11 0.36***																		
TotEvoCI	0,051 0.34***	0,99*** 0.98***	-0,003 0.26***	0,97*** 0.95***	0,10 0.39***																	
PCAF	-0,039 -0.037	0,30*** 0.21***	-0,17 -0.0009	0,35*** 0.23**	-0,054 -0.44	0,26*** 0.17*																
PCSP	-0,051 0.0054	-0,12 0.0045	-0,074 -0.059	-0,16* -0.032	-0,033 0.034	-0,07 0.032	-0,22** -0.40***															
TOTCRNOPC	-0,056 0.054	0,47*** 0.36***	-0,07 0.037	0,46*** 0.35***	-0,041 0.066	0,46*** 0.34***	0,35*** 0.25***	-0,099 -0.086														
ESiHA5y	-0,69*** -0.66***	-0,012 -0.18**	-0,69*** -0.61***	-0,02 -0.17*	-0,69*** -0.67***	-0,007 -0.18**	0,12 0.13	-0,012 -0.082	0,89 -0.0059													
BIOiHA5y	-0,69*** -0.65***	0,003 -0.16*	-0,69*** -0.61***	-0,006 -0.16*	-0,68*** -0.65***	0,009 -0.17*	0,095 0.12	-0,021 -0.095	0,092 0.0032	0,99*** 0.99***												
COiHA5y	-0,69*** -0.67***	-0,027 -0.19**	-0,68*** -0.61***	-0,035 -0.18**	-0,70*** -0.68***	-0,022 -0.21**	0,14 0.13	0,001 -0.070	0,85 -0.0162	0,99*** 0.99***	0,98*** 0.97***											
TOTHA5	-0,084 -0.11	0,31*** 0.38***	-0,076 -0.12	0,33*** 0.37***	-0,092 -0.12	0,29*** 0.35***	0,54*** 0.40***	0,29*** 0.21**	0,33*** 0.34***	0,04 0.017	0,026 0.016	0,065 0.028										
CATTLE5y	-0,053 -0.024	0,099 0.17*	-0,079 -0.073	0,057 0.15	-0,027 0.0084	0,13 0.19**	-0,078 -0.11	0,41*** 0.23**	-0,073 0.0044	0,20 -0.005	0,032 0.0004	0,010 -0.013	0,40*** 0.35***									
DIV5y	0,14 0.052	-0,039 -0.012	0,14 0.044	-0,038 -0.027	0,15* 0.059	-0,036 0.0020	-0,036 -0.067	0,016 0.10	0,20** 0.12	-0,11 -0.10	-0,10 -0.094	-0,13 -0.12	0,015 -0.041	-0,11 -0.12								
COFFE5y	-0,20** -0.27***	-0,043 -0.16*	-0,17* -0.18*	-0,026 -0.15	-0,22** -0.25***	-0,055 -0.18**	0,21** 0.24***	-0,29*** -0.25***	0,078 0.047	0,35*** 0.37***	0,32*** 0.35***	0,37*** 0.37***	-0,21** -0.19**	-0,49*** -0.47***	-0,30*** -0.32***							
ChCoffee	0,38*** 0.30***	-0,034 0.016	0,37*** 0.30***	-0,026 0.026	0,37*** 0.29***	-0,041 0.011	-0,063 -0.11	-0,089 -0.073	-0,13 -0.18*	-0,27*** -0.26***	-0,26*** -0.25***	-0,27*** -0.25***	-0,14 -0.20**	-0,15* -0.15	0,11 0.10	-0,42*** -0.45***						
ChCattle	-0,014 -0.0055	0,012 0.045	-0,029 -0.048	0.017 0,0282	-0,009 0.021	0,007 0.062	-0,091 -0.11	0,027 0.074	0,010 0.095	-0,20** -0.21**	-0,19** -0.21**	-0,19** -0.20**	0,58 0.13	-0,076 -0.074	-0,047 -0.05	-0,026 -0.032	-0,067 0.072					
ChDiv	0,072 0.099	-0,0009 0.051	0,057 0.062	-0,01 0.0437	0,082 0.11	0,004 0.054	0,079 0.043	0,23** 0.22**	-0,023 -0.012	-0,10 -0.11	-0,092 -0.10	-0,11 -0.12	0,23** 0.13	0,17* 0.32**	-0,084 -0.091	-0,10 -0.11	-0,12 -0.13	-0,059 -0.063				
ToTEvoHa	-0,24*** -0.059	0,83*** 0.72***	-0,28*** -0.13	0,81*** 0.70***	-0,19** -0.0010	0,84*** 0.72***	0,17* 0.062	-0,10 -0.0057	0,42*** 0.20**	0,19** 0.076	0,19** 0.089	0,18** 0.047	0,14 0.081	0,0015 0.096	-0,039 0.017	0,12 0.054	-0,16* -0.15*	-0,041 -0.070	-0,075 -0.053			
AcElGrid	0,17* 0.21**	0,18** 0.24***	0,139 -0.18*	0,19** 0.24***	0,20** 0.22**	0,18** 0.21**	0,065 0.083	0,065 0.021	0,11 0.21**	-0,15* -0.17*	-0,12 -0.16*	-0,16* -0.18**	0,032 0.14	0,13 0.15	0,089 0.10	-0,09 -0.083	0,005 0.020	-0,077 -0.072	-0,083 -0.073	0,065 0.098		
FAMIndex	-0,42 -0.035	-0,20** -0.13	-0,048 -0.065	-0,21** -0.14	-0,042 -0.047	-0,19** -0.14	-0,05 -0.027	0,10 0.16*	0,019 0.053	-0,084 -0.10	-0,09 -0.094	-0,74 -0.091	0,070 0.16*	0,082 0.012	0,092 0.099	-0,10 -0.078	0,029 0.036	0,073 0.076	0,045 0.045	-0,17* -0.15	0,010 0.043	
SOCIALIndex	0,0054 -0.0056	-0,76 -0.017	0,039 0.024	-0,049 0.0013	-0,022 -0.026	-0,095 -0.047	0,22** 0,26***	-0,16* -0,16*	-0,017 0.056	0,073 0.074	0,05 0.064	0,09 0.077	0,091 0,16*	0,049 0.31	-0,10 -0.11	0,03 -0.043	0,034 0.040	-0,033 -0.037	-0,15* -0.17*	-0,072 -0.050	0,085 0.14	0,035 0.070

Statistically significant correlations are written in bold, with the following indication of significance: * p < 0.10; ** p < 0.05; *** p < 0.01

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