This item is the archived peer-reviewed author-version of:

Can financial incentives change farmers' motivations? An agrarian system approach to development pathways at the Nicaraguan agricultural frontier

Reference:

Van Hecken Gert, Merlet Pierre, Lindtner Mara, Bastiaensen Johan.- Can financial incentives change farmers' motivations? An agrarian system approach to development pathways at the Nicaraguan agricultural frontier
Ecological economics - ISSN 0921-8009 - 156(2019), p. 519-529
Full text (Publisher's DOI): <https://doi.org/10.1016/J.ECOLECON.2016.12.030>
To cite this reference: <https://hdl.handle.net/10067/1408120151162165141>

CAN FINANCIAL INCENTIVES CHANGE FARMERS' MOTIVATIONS? AN AGRARIAN SYSTEM APPROACH TO DEVELOPMENT PATHWAYS AT THE NICARAGUAN AGRICULTURAL FRONTIER

Gert Van Hecken^{a,b,*}, Pierre Merlet^{a,b,c}, Mara Lindtner^d, Johan Bastiaensen^{a,b}

July 2016

^a Institute of Development Policy and Management (IOB), University of Antwerp, Prinsstraat 13, B-2000 Antwerp, Belgium.

^b Research and Development Institute Nitlapan, Central American University (UCA), 14003 Managua, Nicaragua.

^c Association pour améliorer la gouvernance de la Terre, de l'Eau et des Ressources Naturelles (AGTER), 45 bis avenue de la Belle Gabrielle, 94736 Nogent sur Marne Cedex, France.

^d Centre for Development Research (CDR), University of Natural Resources and Life Sciences, Gregor Mendel-Strasse 33, A-1180 Vienna, Austria.

* Corresponding author: Institute of Development Policy and Management (IOB), University of Antwerp, Prinsstraat 13, B-2000 Antwerp, Belgium.

Fax +32 (0)3 275 57 71; E-mail address: gert.vanhecken@uantwerpen.be (G. Van Hecken)

Can financial incentives change farmers' motivations? An agrarian system approach to development pathways at the Nicaraguan agricultural frontier

Abstract:

This article offers a conceptual-methodological approach to assess how new institutional frameworks, such as PES (Payments for Ecosystem Services), interact with motivations for land use change at the individual and collective level. Increasing empirical evidence suggests that the effects of payments on inducing long-term behavioural change can vary substantially, depending on how they are integrated in territorial dynamics. We show how individual motivation is the result of collective societal pathways that generate particular opportunities and constraints, as well as guiding ideas and habits that 'work' within these pathways. Through an illustrative case study at the agricultural frontier in Nicaragua, we show how an 'agrarian system' approach offers a more nuanced understanding of the dynamic interactions on the ground, and allows us to better connect farmers' individual motivations to collective development pathways in that territory. Our case study also demonstrates how a local PES intervention is unlikely to lastingly alter the production system logic of farmers, or stimulate long-term 'pro-environmental' behaviour, unless accompanied by other types of policies.

Key words:

Payments for Ecosystem Services (PES); motivation crowding; development pathways; agrarian system; conservation

Acknowledgements:

This research was funded by a postdoctoral grant of the Flemish Fund for Scientific Research (FWO). We thank Frédéric Huybrechs, Vijay Kolinjivadi, Christophe Maldidier, Jacques Pollini, the anonymous reviewers and the editors of the special issue for very useful

comments and suggestions. The responsibility for the positions expressed as well as any remaining errors is exclusively ours.

1. Introduction

Conditional payments to incentivize land users to adopt environment-friendly practices are found to be a very attractive idea as witnessed by the skyrocketing amount of both pilot projects and scholarly articles on Payments for Ecosystem Services (PES) (Schomers and Matzdorf, 2013; Wunder, 2015). Especially in agricultural contexts, direct payments are deemed to be more efficient and effective than alternative top-down or indirect approaches (Ferraro and Kiss, 2002; Wunder, 2005). Since the participants are often poor farmers in the Global South, PES schemes also tend to be hailed as attractive win-win scenarios, conserving nature while alleviating poverty (Muradian et al., 2013; Pagiola et al., 2005). Empirical evidence shows, however, that the presumed advantages of PES are not unequivocal. A growing number of studies underline the unpredictable outcomes of PES and point to ambiguous results both in terms of environmental and social outcomes (e.g. Adhikari and Agrawal, 2013; Pattanayak et al., 2010). These findings are also reflected in a body of critical literature warning of potentially detrimental social and ecological effects of interventions rooted in overly simplistic, apolitical and techno-economic (conceptual) frameworks (Büscher, 2014; Kosoy and Corbera, 2010; McAfee, 1999; Van Hecken et al., 2015a).

The episteme underpinning much PES advocacy is based on technocratic notions of human-environment relationships as manageable systems which can be altered in predictable ways by capitalizing on a universal economic rationality underpinning the actors' motivations (Van Hecken and Bastiaensen, 2010a). Recent studies suggest that non-financial incentives – agricultural extension support, information sharing or social pressure – can be more potent motivations in land stewardship schemes than payments, and that payment schemes do not

necessarily enhance economic efficiency and sustainability of conservation activities (Hayes, 2012; Narloch et al., 2012; Rode et al., 2014; Van Hecken and Bastiaensen, 2010b). The effects of payments on environmental behaviour depend on a variety of factors including the characteristics of the payment agreement, local notions of justice, and the psychological, cultural, and social embeddedness of the desired behaviour (Gneezy and Rustichini, 2000; Martin et al., 2014; Muradian et al., 2013; Van Hecken et al., 2012). Payments will inevitably interact with intrinsic motivations and historically institutionalized logic and practices, undermining (crowding-out) or reinforcing (crowding-in) more environmentally beneficial attitudes and behaviour (Rode et al., 2014).

Empirical evidence about the interactions of monetary and non-monetary incentives, and corresponding institutional arrangements, and their sustained effect on the governance of ecosystems is gradually emerging (Ezzine-de-Blas et al., this issue; Rode et al., 2014). The initial research has been rooted mainly in experimental economics and the use of framed field experiments (Bowles, 2008; Cardenas et al., 2000, Kits et al., 2014; Narloch et al., 2012). While these approaches generate valuable insights into the dynamics of decision-making, one of the drawbacks is that these studies assume that people's behaviour in artificial and simplified experiments actually reflects their behaviour in the much more complex, varied and repeated interactions in the real world. Since the argument of crowding-in or crowding-out builds precisely on the possibility of a change of perceptions and motivations, and thus unstable preferences and choices over time and across institutional arrangements, the external validity of these approaches might be in jeopardy.

Current research on motivation-crowding builds on conceptual frameworks such as the Self-Determination Theory (Ezzine-de-Blas et al., this issue), which links individual psychological processes to external incentives, assuming that particular individual motives result in

particular actions. While these theories recognize that motivations are socially constructed¹ and thereby offer interesting insights into the influence of institutional contexts on personal motivations, they offer only limited methodological-conceptual tools to understand the nature of these interactions. Thus, the unequal effects of structural or institutional constraints on individual agency are often overlooked. Understanding the differential behavioural outcomes of particular incentive structures therefore requires attention to social inequalities, differential room for manoeuvre and the diversity of livelihoods (Milne and Adams, 2012; Cleaver, 2005) precisely because the various positions from which actors become involved in decision-making processes not only affect their motives but also their scope for action (Cote and Nightingale, 2012). Hence it is crucial to understand that institutions carry different meanings as well as diverse enabling or constraining factors for different actors (Leach et al., 1999).

In order to understand how people react to the introduction of new institutional frameworks our analysis at the individual level must include an understanding of the dynamic and recursive relationship between the micro-level (individual decision-making concerning land use change) and the meso-level (interactive socio-institutional dynamics in specific territories). Understanding the effects of motivation-crowding, the sustainability of pro-environmental behaviour, and the socially-situated dynamics of human agency thus means that we should adopt an historical and socially-informed approach to the emergent socio-ecological dynamics in particular territorial contexts. In this article we offer a conceptual-methodological approach for assessing the interactions between the individual dimensions of motivation-crowding and the personal and interpersonal contexts in which these are embedded and from which they emerge.

¹ i.e. they interact with what Ezzine-de-Blas et al. (this issue) have called the ‘interpersonal context’, including the institutional context and cultural values.

In line with recent literature (e.g. Fazey et al., 2015; Leach et al., 2010), this article adopts a pathways approach, but goes beyond its current metaphorical use by developing a more operational approach to rural territorial pathways (Bastiaensen et al., 2015). We also explore how the use of an ‘agrarian system’ (AS) approach (Cochet, 2012; Dufumier, 1996; Mazoyer and Roudart, 2005) can help us in the analysis of such pathways, allowing for a more meaningful and comprehensive understanding of the dynamic and reflexive interactions between institutional structure and individual agency. We illustrate the usefulness of our approach with empirical findings from a review of the historical evolution of agrarian dynamics at an agricultural frontier in Nicaragua where a PES project has recently been implemented. The article is structured as follows. In section 2 we discuss the epistemological basis and methodological implications of the AS approach, and demonstrate how it allows to reflexively relate different types of farmers’ individual ‘livelihood trajectories’ to broader collective ‘development pathways’. In section 3 we illustrate the potential of this conceptual-methodological approach through an interpretation of the territorial dynamics and farmers’ motivations in the Nicaraguan agricultural frontier. Finally, in section 4 we show how these findings allow us to more meaningfully reflect upon the implications of PES and other conservation and development interventions in terms of their potential impact on farmers’ motivations and land use practices.

2. Unravelling Social-Ecological Complexities in Rural Territories through the ‘Agrarian System’ Concept

2.1. Development Pathways and Livelihood Trajectories

Rural territories are complex dynamic systems resulting from the interaction of natural and human processes giving rise to particular physical landscapes shaped and bounded by people’s actions, perceptions, ideas and aspirations (Rizzo et al., 2013; Setten, 2004). Human

and natural aspects are intertwined and continually coevolve (e.g. Folke et al., 2005). It is pointless to analyse the social and the natural separately precisely because the dynamics of the system only exist in their interaction (Hukkinen, 2014; Van Hecken et al., 2015a). As rural territories have been co-produced by human activity, their present state depends on historical trajectories and on choices at critical junctures in the past (Liu et al., 2007). The historical and multi-dimensional reconstruction of the evolution of social-ecological systems therefore must receive sufficient attention in order to understand the current status of the latter and thus avoid ‘snapshot’ appraisals of rural reality (Leach et al., 2010).

From this perspective economic interactions among human beings take place within specific historical and agro-ecological conditions, and lead to the emergence of development pathways around social mobilization projects that generate and condition the desirability and viability of individual trajectories (Bastiaensen et al., 2015; Scoones and Wolmer, 2002). A development pathway emerges via the creation and maintenance of a set of shared ideas, observed regularities or livelihood patterns among particular social groups (de Haan and Zoomers, 2005:42; Bastiaensen et al., 2015). A specific pathway reflects culturally and historically shaped practices about ‘the right way of doing things’ (Cleaver, 2012) which circulate within social networks and give rise to specific ‘rules’, leading to particular relational patterns. These pathways influence a person’s agency and opportunities, and thus enables or constrains the implementation of distinct individual livelihood trajectories (Bastiaensen et al. 2015). In particular, territorial development pathways will determine how different actors access resources, i.e. their ‘ability to benefit from things’ (Ribot and Peluso, 2003:153). In the process of gaining and maintaining access there will be winners and losers, depending on actors’ ability to sway others to their own views through the use of power, resources, knowledge and voice.

None of these pathways are cut in stone; they open and close dynamically. Despite the presence of situated, differentiated and constrained agency, households and individuals are constantly interpreting, testing and developing ideas; reproducing, reworking, contesting and renegotiating rules of the game as well as maintaining or changing their social networks throughout their livelihood trajectories. Through their successes and failures they continuously co-construct the human territories they belong to and impact the processes that define those territories' pathways. In so doing they realize their potential to change the development pathways and open opportunities for implementing future trajectories. From a conservation and development intervention perspective, this reflects a critical need to understand the differential effects on specific actors that ensue from the emergence of specific development pathways and, based on that understanding, inform debates as to which actors should be engaged in which ways.

2.2. The Agrarian System Concept

A useful theoretical-methodological approach for unravelling the multi-scale complexities of rural realities, their dynamics of change and resulting development pathways, and which explicitly focuses on farmers' practices and motivations at different levels, is the 'agrarian system' (AS) concept as developed within the 'comparative agriculture' approach (Cochet, 2011; 2012; Dufumier, 1996; Mazoyer and Roudart, 2005). Contrary to more traditional agronomic studies which often limit their focus to the farm level, the AS approach begins the analysis of rural dynamics at the landscape level where the aggregated consequences of individually implemented farm practices ultimately unfold (Rizzo et al., 2013).

Although the AS concept has been described in different ways², we follow Cochet (2012) in arguing that:

² We refer to Jouve (1988) and Cochet (2012) for an extensive overview of these different conceptualizations.

(...) the agrarian system encompasses first of all the mode of exploitation of a given environment. This mode of exploitation includes: (1) the characteristics of one or several agro-ecosystems; (2) a *modus operandi*, which itself is characterized by the farmers' technical heritage (tools, knowledge, practices, know-how that have evolved over time); (3) the way the environment has been transformed by man over time; (4) the resulting landscape; (5) the relationships between the different agro-ecosystems that make up the environment; and (6) soil fertility renewal mechanisms. The agrarian system also includes the social relations of production and trade that have led to its implementation and development (particularly the conditions influencing access to resources) as well as the conditions affecting the distribution of resulting value added. It includes a limited number of production systems, the mechanisms that differentiate these systems, and their respective trajectories. Finally, it includes the characteristics of the specialization and social division of labor, within each sector, and the economic, social and political conditions—particularly relative pricing systems—that influence the farmers' integration in global markets. (Ibid: 130).

One of the main premises underlying this approach is that at every moment in history, farmers always have reasons to do what they do (Cochet et al., 2007). In order to analyse rural territories it is then key not only to identify farmers' practices but also to understand what multiple motivations lie at the core of these actions. Within this approach, it is argued that producers' actions are not merely motivated by dimensions of economic rationality such as maximization of production, income or profit; management of risk, cross-generational capital creation, etc., nor that they can be unequivocally explained by mere reference to culture or traditions. Farmers' agency is also shaped by an evolving hybrid set of cognitive (e.g. knowledge, worldviews), material (e.g. natural resources availability, animal species, plant

varieties, soil fertility), and social factors (e.g. institutions, power structure, social relations) (Cochet, 2011). Human behaviour is thus often rational, but not always conscious, intentional or strategic; rather, deeply habituated ‘on the basis of long experience with what seems to work’ (Hiedanpää and Bromley, 2014:182). Thus, motivations are, to a great extent, shaped by the institutional, cultural, historical and power contexts and thus less consciously determined than often suggested. This is also in line with our conceptualization of evolving territories as the result of interplay between collective development pathways and individual trajectories.

As an entry point the AS approach builds on the concept of ‘production systems’, which represent the farm level where agricultural practices are implemented (Brossier, 1987; Cochet, 2012). Production systems are however more than a simple sum of farm-level practices; they are embedded in interrelated social, ecological, and technical elements that together shape and simultaneously feed back into these practices. It is the combination of different production systems that crystallizes into an AS. In this way the ‘comparative agriculture approach makes it possible to zoom in and zoom out on different levels of analysis, and move frequently from one scale of analysis to another’ (Cochet, 2012:133). The process of zooming in is a mental tool that allows us to better understand a complex reality, and should always be accompanied by a zooming out process, that situates concrete agricultural practices in a broader reality beyond the plot or farm level, i.e. in the broader socio-institutional, geographic and cultural contexts in which they are embedded. The analysis of these interactions does not only help us to explain what farmers do, but also elicits the reasons or motivations behind certain actions, as well as the aggregated consequences that follow in terms of territorial dynamics (Cochet, 2012) and the feedback into what farmers are able and motivated to do. The continuous analytical switching among scales is one of the major strengths of the AS approach even though its application in practice is challenging.

2.3. Methodological components

In order to assess AS dynamics, the ‘comparative agriculture’ approach has developed the ‘agrarian diagnosis’ methodological package (Apollin and Eberhardt, 1999; Cochet, 2011). This diagnosis is based on substantial fieldwork and uses a combination of methods including landscape transect assessments³, participant observations and semi-structured open interviews. It consists of three general stages: a bio-physical landscape analysis, an historical analysis and a technical-economic analysis. These stages are neither linear nor independent of each other; they are implemented in an iterative way, stimulating the researcher to continuously move back and forth between them.

The *landscape analysis* aims to identify physical and human patterns and map coherent geographical spaces that are characterized by similar management practices and use of natural resources. This allows the researcher to discover the relationship between agricultural practices and ecological conditions. The *historical analysis* aims at identifying and assessing the trajectories followed by different types of farmers in terms of their changing production systems. Through detailed interviews with farmers it relates the past processes of social and technical differentiation to broader socio-institutional changes (e.g. changing public policies, price relations, demography and migration). Together the landscape and historical analyses allow the researcher to construct a contextual typology of interacting local production systems. Finally, the *technical-economic analysis* enables a detailed understanding of the production systems typology in terms of agricultural practices and their economic results, as well as how these practices shape and are shaped by the changing social-ecological context. This last analysis is informed by in-depth case studies for each type of production system, and

³ Transect assessment is a method in which the researcher walks through the territory in order to identify and analyse ecological land use patterns, environmental characteristics (e.g. type of soil, slopes, water system), and human infrastructures (e.g. types of human settlement, roads).

results in a technical-economic model for each⁴. This in turn facilitates the calculation of socio-economic indicators such as the agricultural income for family farms, internal rate of return and return on capital for entrepreneurial farms, as well as land and labour productivity.

The AS approach thus locates current observed practices in an historical pattern of change, and as such can help us assess how practices have evolved over time, the conditions that have spurred certain changes, and further changes likely in the future (Cochet, 2011; Cochet et al., 2007). One major limitation of this approach is that the methodological package is largely oriented towards analysis of the more technical and economic aspects underlying decision-making and processes of social differentiation, partially disregarding the contextualization of beliefs, needs, and aspirations in relation to power and institutions. However, by emphasizing the influence of structural elements in shaping individual and collective action, it engages with power issues at a political economy level. Moreover, the diagnostic results can feed in to a broader analytical process by incorporating other methods thus allowing us to more comprehensively reflect on the social and relational factors influencing rural dynamics.

3. Paying Farmers at the Nicaraguan Agricultural Frontier

Our case-study to illustrate the potential of the AS approach for interpreting the complex relationships between development pathways and livelihood trajectories is located in the buffer zone of the Indio-Maíz Biological Reserve in southeastern Nicaragua, specifically in the *Manola* forest-edge community⁵ in Río San Juan Province near the border with Costa

⁴ In order to build these models, a range of technical and economic data is gathered in the field, that can be subdivided in three categories: (1) Agronomical practices, necessary tools, labour needs and availability, farm infrastructure, etc.; (2) Production system outcomes – e.g. yields, type and quantity of products for sale, for own consumption or for re-use within the system; (3) Economic analysis, e.g. market prices for inputs and outputs, cash flows, depreciation of material, taxes and subsidies, etc.

⁵ In order to protect the identity of all participants, we have changed the names of all communities and actors involved in this study.

Rica. The reserve was established in 1990 and is one of the biggest protected areas in Nicaragua with a surface of 264,000 ha. It is part of the Mesoamerican Biological Corridor and is home to a variety of endangered species (MARENA, 2015). Even as a strictly protected area, with no human activity legally allowed, complex socio-political and economic dynamics have resulted in the agricultural frontier steadily moving from the established buffer zone into the reserve. A long history of immigration and extensive cattle raising make it one of the country's most intensive agricultural pioneer fronts (Nygren, 2004).

Alarmed by the detrimental ecological consequences of deforestation in this area, the response of the Nicaraguan government has mainly been restricted to the establishment of the reserve, and subsequent attempts to promote a settled population in the buffer zone through the legalization of settlers' land rights (Larson, 2010:59; Nygren, 2000). Due to its remoteness and the limited willingness and ability of the state to halt further invasion into the reserve, the region saw a growing presence of conservation and development NGOs in the 1990s taking an increasingly active role to defend Río San Juan's tropical forests (Nygren, 2000). While initially most NGOs were largely guided by conservationist approaches that 'appeared totally insensitive to the realities of peasant livelihood needs (...) by the late 1990s, however, the conservation organizations appeared to understand that peasants must have clear benefits in order to support their projects' (Larson, 2010:60).

One of the peasant-oriented organizations that experienced this evolution is *Conservación con Desarrollo*. This environmental NGO was founded in 1990 and is rooted in the Río San Juan region. It aims to halt environmental degradation mainly through projects involving community development and raising awareness. Since its creation the NGO has experimented with interventions ranging from projects focused on environmental education and agricultural diversification to the promotion of alternative income-generating activities such as

ecotourism. A remaining concern the NGO has is that their interventions have offered only limited livelihood alternatives for local people, and therefore have not succeeded in halting deforestation.

3.1. Project Description

In 2006 *Conservación con Desarrollo* launched a PES programme, funded and co-designed by a European conservation NGO. In this programme the NGO pays farmers in the buffer zone of the Indio-Maíz for protecting parts of the remaining forests on their farms. The main objective is to create a monetary value for standing forests and thus generate additional income that would inhibit further farmer migration into the reserve. Only farm households legally possessing and willing to enrol a minimum forest area of 10 ha are eligible to sign a five-year contract with the NGO. The maximum size of eligible forests per household is 100 ha. Farmers receive an annual payment of USD 28.5 per hectare of protected forest. Since the NGO considers these payments to be low, farmers are free to choose the plots of forest they wish to include, and are not obliged to preserve all their forests. Forests under contract must be left undisturbed. Participants are also responsible for preventing other inhabitants from extracting (fire)wood and poaching wildlife. The programme is funded by the European NGO through the sale of forest protection certificates to the public in Europe.

In the 2006-2009 pilot phase, 13 contracts were signed, covering a total of 280 ha of forest. A self-assessment in 2010 concluded that the programme lacked a long-term vision and questioned farmers' future willingness to protect the forests once the payments ended. Consequently, in 2012 an adapted second five-year phase was initiated, aiming to include an additional 60 farmer households by 2016, covering a total forest area of 2,000 ha. The contract now requires previous and new participants to design sustainable farm management

plans – e.g. based on agroforestry systems, ecotourism, or the production of cacao or *raicilla*⁶ – and to use the payments to implement these plans. This would ‘buy time for the forests by putting an economic value on them, meanwhile helping farmers to implement sustainable land use practices that generate alternative incomes in the long term’ (interview project coordinator, 17/11/2014). The alternative incomes should lower the pressure on forests once payments end. In order to assist farmers *Conservación con Desarrollo* organizes collective workshops on agro-ecological and sustainable production, and offers on-farm technical assistance. Due to budget constraints, at the time of our research (2014-2015) only 14 families had enrolled, covering a total forest area of 468 ha. Most of the current participants were chosen on the basis of previously established relationships with the local NGO. Table 1 shows the main characteristics of the participating households. The contracts were signed for a period of five years and almost all participants decided to enrol all the forests on their farm in the project.

[TABLE 1 ABOUT HERE]

Three years into the second phase of the programme and confronted with limited future funding, the NGO has started a series of internal reflection processes on the effectiveness and potential unforeseen long-term consequences of its intervention. One of the main concerns expressed by the organization is that the hoped for adoption of sustainable practices seems to be largely absent in reality or has failed to generate the expected alternative income. Even more worrisome is that some participants seem to be using project payments to invest in cattle-related activities, undermining the long-term objectives. The project staff fear that the financial incentives provided to farmers are ineffective in promoting ‘environment-friendly’ behaviour and might even generate perverse effects in the long term, especially once

⁶ *Carapichea ipecacuanha*. This is a plant used to extract emetine, a substance used in the pharmaceutical industry.

payments cease. As we argued above constructing meaningful alternatives that might change the land use practices of local farmers requires a deeper understanding of the historical, socio-cultural and economic context of the local territory and its evolving development pathways: we have assessed these using an agrarian diagnosis.

3.2. Field Research Methods

The agrarian diagnosis focused on one of the communities involved in the PES programme, located at the edge of the Indio-Maíz reserve. It was conducted by the third author during a 4.5 months (April-August 2014) research stay in the field, in which the steps described in 2.3 were carried out. Sixty-six local inhabitants were interviewed, some of them on several occasions. Additionally, eight transect walks and 38 farm visits were undertaken to obtain a detailed overview of the landscape and the specific production systems and land use practices. Focus group discussions on the history of the study area were conducted with inhabitants who have lived longest in the region. Finally, participant observation and informal talks offered the possibility of elaborating on the information obtained from the qualitative interviews.

Between November 2013 and June 2015, the first three authors also carried out more specific research on the PES intervention. They conducted several interviews and focus groups with project staff from the local NGO, organized workshops with project staff and participants, and performed ten on-farm in-depth interviews with project participants. As per the interactive pathways framework, the interviews and focus groups mainly focused on the motivations, opportunities, and constraints for participants vis-à-vis the PES project and its different components, and on farmers' long-term perspectives in terms of land use changes and future plans.

3.3. Assessing Agrarian Dynamics and Deforestation in Río San Juan

3.3.1. The Dominant Cattle-Based Development Pathway in Río San Juan⁷

Although the extraction of timber and non-timber products in Río San Juan started well over a century ago, the colonization process rapidly accelerated about 60 years ago with the appropriation of large areas of land for cattle raising by the authoritarian ruler Somoza and his associates (Larson, 2001; Rabella, 1995). This process was accompanied by state and multilateral policies to promote meat exports (mainly to the US), including the construction of roads and processing infrastructure. Attracted by the abundant presence of valuable timber species, various private companies were given logging rights to the forests (see also Nygren, 2004). In the 1950s the Nicaraguan government also conceived of this region as one of the escape valves for growing social discontent caused by increasing land concentration in the hands of large export-oriented cotton and cattle producers in the Pacific region (Larson, 2010). As a result the government initiated a process of state-led agricultural colonization (Ibid), a process which was amplified by the complementary spontaneous migration of peasants. Land ‘improvement’ (*mejoras*) through forest clearing was the basis for obtaining de facto land rights and led to the gradual conversion of forests into agricultural land (Larson, 2010; Nygren, 2000).

Colonization of primary forests was temporarily halted by the guerrilla war of the 1980s when many peasants fled to Costa Rica or were evacuated to government resettlement areas. Despite the existence of strict regulations on permitted land uses in the buffer zone of the newly created reserve, the deforestation process picked up pace rapidly after the 1990 peace agreements when land owners returned to reclaim their land. In addition, the new government compensated demobilized soldiers with tracts of land in this region (Nygren, 2000). Hundreds of new migrants coming from more established cattle-raising regions arrived. Between 1989

⁷ This section is primarily based on our ‘agrarian diagnosis’, and triangulated/complemented with existing literature focussing on the same study area.

and 1995 at least 17 new communities totalling more than 1,500 families were formed in the buffer zone (Larson, 2010). During this same period government policies to promote cattle-related exports resumed, now also including massive investments in dairy processing. This contributed to rising milk and cheese prices, while meat prices hit historic highs due to higher international demand and the trade connection of Nicaraguan cattle production with Mexican beef production for the US (Bastiaensen et al., 2013). At the same time, due to the arrival of a German chocolate manufacturer, cacao production for export led to expansion and transformation of the infrastructure for collection and processing thereby increasing demand and local prices for this traditional but relatively ignored crop.

Currently pioneers mostly arrive from ‘old frontier’ areas overrun by pasture, and often repeat their (grand)parents’ pattern of converting forest to pasture as a way of improving their livelihood. Many peasants participate in a two-step migration process in which they eventually convert their land into pasture and, if they do not manage to establish a large cattle farm, sell it to wealthier livestock farmers thus giving rise to a domino effect in which land ownership is steadily concentrated into the hands of a few better-off cattle ranchers who replace an initial wave of small-scale farmers (Nygren, 2000; Maldidier, 2004). The latter are pushed and pulled ever more towards and inside the agricultural frontier, consolidating the dominant socially exclusionary and environmentally destructive pathway of cattle-driven development.

3.3.2. Agrarian Change in Manola

Our diagnosis of the dynamics in Manola, a community which comprises about 80 families, allows us to further zoom in on the main drivers underlying this livestock-based frontier advancement. Our research reveals how the first farms in Manola were established in the

1990s with the arrival of pioneer families who typically appropriated between 50 and 140 ha of virgin forest⁸. For poor farmers clearing forests is a way of obtaining fertile land using only their own labour. Given low capital availability and abundant land, slash-and-burn maximizes labour cost-effectiveness, while ensuring food self-sufficiency (see also Malmidier, 2004). However, once the land has been cultivated for about three years, soil fertility rapidly declines while weed competition increases, resulting in diminishing crop yields. As restoring the soil's fertility would require a long fallow period (about 15-20 years), crop areas are then usually converted into pastures, while new plots of forest are cleared for crops thereby expanding the farm's agricultural area. These typical land use dynamics lead to gradually shifting production systems and related land use patterns at the farm and landscape level as is respectively shown diagrammatically in Figure 1 and Figure 2.

[FIGURE 1 ABOUT HERE]

[FIGURE 2 ABOUT HERE]

Figure 1 and Figure 2 show that once new settlers (*multiple crops production system*) manage to accumulate sufficient capital through casual off-farm wage-working and seasonal migration to Costa Rica (mainly during the coffee harvest), they usually start investing in cattle in order to exploit their growing pasture areas, leading to a *multiple crops and livestock production system*. As the herd size grows over time and demands more labour, farmers increasingly give up labour-intensive crop cultivation and further convert forest into pasture, usually by passing through a crop phase (*multiple crops and livestock with temporary employees*), eventually leading to a production system which is increasingly geared towards livestock specialization.

⁸ At that time the forested land in this area was considered to be free of rights. Any actor could freely take possession of any non-privately appropriated tract of land and secure de facto rights to it through clearing the borders of the area, building a house and clearing some forest plots for agricultural purposes.

This sequence corresponds to the ‘typical trajectory’ in Figure 1. In line with this, our interviews clearly indicate that farmers perceive forests as strategic land reserves for future agricultural and cattle production, possibly after bequeathing to their children. Apart from wood extraction for heating and construction, they report little benefit from forests. Therefore, although most farms in the Manola area are still covered by large tracts of forest (on average about 50% of total area), the specialization in livestock will probably continue, resulting in an ever-increasing conversion of farms’ forests into pasture, and eventually in the search for additional land in neighbouring areas. These dynamics have also been observed in earlier-colonized neighbouring areas (Larson, 2010; Vérant, 2013).

Farmers’ motivations to pursue cattle-based specialization draw on a combination of factors, grounded in and, at the same time, grounding the dominant extensive cattle pathway. Firstly, our technical-economic analysis⁹ shows that the relative abundance of ‘idle’ forested land and the lack of capital makes labour the main constraining production factor. Figure 3a displays the monthly labour demand for each of the main production systems, together with the available on-farm family labour¹⁰. It clearly shows that for most production systems labour needs are close to or even surpass on-farm labour availability. It also shows that implementing cattle-based production implies hiring temporary workers, mainly employed for pasture maintenance. Farmers’ limited access to financial capital reduces their capacity to hire non-family labour. Under current price conditions cattle production, even if representing the lowest output per unit of land, clearly offers the highest return per unit of labour (see Figures

⁹ Calculations are based on the following basic principles (Dufumier, 1996; Apollin and Eberhardt, 1999): (1) Gross Product (GP) = Production * Market Price (all products are valued at a local market price, or the equivalent purchase price in case of products for own consumption); (2) Value Added (VA) = GP – (yearly depreciation of machinery, tools and farm infrastructure) – (inputs costs); (3) Family Agricultural Income = VA – (payment of interest for financial capital) – (land rent) – (taxes) – (non-family labour costs) + subsidies (e.g. PES). For detailed calculations of all these indicators, please refer to Lindtner (2014).

¹⁰ The graph displays the two most common levels of available labour equivalents in the area.

3b and 3c), making it an attractive production strategy for this area. Moreover, cattle are easy to move around and represent a means of saving that is easy to mobilize, especially in regions where markets are distant and difficult to access (Maldidier, 2004). As such, farmers tend to opt for production systems geared towards cattle, while limited labour and financial capital constrain the pace of land use conversion, which explains why we still observe a relative abundance of on-farm forests.

[FIGURE 3 ABOUT HERE]

Secondly, as some farmers may climb the social ladder by becoming ranchers (production systems 3 and 4) and as no viable alternatives are currently envisaged, the ongoing transformation of land into pasture for cattle development is largely perceived – also by smaller farmers – as the desirable ‘moral landscape’ (Setten, 2004) offering a promising path towards the desired social identity of the successful, productive *finquero*. Despite an increasing local awareness of the detrimental ecological consequences of deforestation, peasant ideas of progress and development are still largely related to the conquest of the ‘savage and unproductive’ forest to make it arable and eventually to convert it into a large farm with pasture full of cattle (see also Larson, 2010; Van Hecken et al, 2015b). Large *finquero* cattle-breeders also manage a broad social network and hold preferential positions in a society where inherited vertical patron-client relations, based on control over land and capital/cattle, still largely prevail.

While the above sketched description of the typical evolution of farming systems might give the impression that they evolve in homogenous and unidirectional ways, in practice these changes occur at different paces and in complex manners, depending on specific differences between farmers. As shown in Figure 1, this also means that a snapshot at a specific point in

time reveals the co-existence of different production systems alongside each other, including but not limited to the four production systems presented in Figure 2¹¹. For example, our diagnosis reveals that a crucial element influencing a farm's pace of development relates to its degree of geographic isolation or accessibility and the influence this has in terms of labour availability (see adapted trajectories, Figure 1). Families who arrived after the initial colonization period were forced to appropriate land in the geographically less accessible areas of the area, with difficult access to local infrastructure (e.g. markets, schools). This often pressures part of the family – usually wife and children – to migrate to the urban municipal centre, thus increasing household expenses and further reducing available on-farm labour availability. This, in turn, means a constraint of the growth potential of the farm both in terms of herd size and cultivated area, usually also implying a slow-down in the rate of conversion of forests into agricultural/pasture land (see Figure 1, bottom).

Other important factors that lead to divergence from the typical trajectory are related to differences in farmers' capital endowments, unexpected shocks (e.g. health problems leading to treatment funded by the sale of cattle), inheritance issues, and situations of local conflict (mostly related to land issues). These limiting events are often a substantial impediment to the capitalization process, and in the most severe cases can even result in the sale of the farm (cf. adapted trajectories, Figure 1). As land systematically tends to be cheaper further into isolated regions of the agrarian frontier, there is always the temptation to sell a 'failed' farm in a more established zone to successful farmers and then start again by buying more, and cheaper, land. Currently in Manola this particular trajectory is mainly followed by younger farmers who, after having inherited a plot of land considered too small for establishing a sustainable farm, decide to sell and move into the frontier. Their original land is sold to local farmers wanting

¹¹ In this article we only present the main historical trajectories. The original analysis provides a more detailed description of additional trajectories that can be found in the area (see Lindtner, 2014).

to expand or to newcomers from other regions who possess sufficient capital to buy several farms at once, thus allowing them to implement further livestock specialization.

4. Can Financial Incentives for Forest Protection Alter the Cattle-Based Development Pathway?

Our diagnosis shows that the territory is composed of different types of evolving farming systems that together crystallize into a dominant cattle-oriented territorial pathway. Our analysis clearly suggests that motivation is not merely an individual attribute but is socially instituted in this pathway which generates particular opportunities and constraints, as well as guiding ideas and habits that ‘work’ within, and are partially created by, these pathways. On the basis of these empirical insights we now discuss whether the current intervention of forest-related financial incentives, aimed at the promotion of sustainable farm plans, offers any possibility of sustainably altering farmers’ motivations and pro-environmental action in this context.

Three years into the second phase of the PES project we observe that so far all participants have maintained the forests under contract (see Table 1). This may give the impression that the project has been successful in promoting on-farm forest protection. However, an assessment of the PES project against our diagnosis cautions against jumping to such conclusions. While we are aware that the performance of PES does not necessarily hinge on a complete coverage of the opportunity costs of economically more attractive land uses (Kosoy et al., 2007; Muradian et al., 2010), our findings show that the project payment is particularly low as it only covers about 20% of the annual per hectare income created by the locally more attractive pasture alternative and less than 7% of the income generated by staple crops such as beans or rice (see Figure 3b). From an economic perspective it is then unlikely that the current

payment would be high enough to trigger long-term changes in farmers' land uses. This is also confirmed by our interviews in which all participants typically reported that:

[T]he amount they pay me is really insignificant, I'm grateful, but I feel we're doing them [the NGO] a favour. Producing beans or maize obviously would give me a much higher income. If they want to convince us to enrol our forests in a future project, they'll definitely have to pay us more (interview farmer, 18/07/2014).

In light of this type of claim, it initially seems somewhat puzzling that farmers have participated in this project at all. In answer all respondents refer to the importance of forests in providing water thus motivating them to protect strategically located on-farm forest. Also, the growing presence of conservation NGOs has generated new locally adopted discourses that stress the importance of forests for the provision of global goods such as clean air and biodiversity. Respondents typically stated that 'a community without forests would be ugly and unpleasant to live in', and would undermine the potential for developing ecotourism projects.

While these stated reasons are certainly credible, our AS analysis allows us to go beyond common discourse and helps us explain why they are unlikely to translate into significant and long-lasting changes in farmer practices. AS enables us to assess remaining forest patches not as independent and disconnected elements but as part of broader production systems evolving within specific historical trajectories. As stated above, the current pace of deforestation in the area is mainly limited by labour and capital constraints. We also explained how the local NGO was predisposed to select participants on the basis of established relationships as well as a minimum requirement of 10 hectares of on-farm forest thus excluding farmers who recently

arrived in the region and those who have small farms with the majority of their forest already transformed into fields for crops and pasture.

Relating Table 1 data to our analysis of agrarian change in Manola enables us to better understand the rationale behind the dynamics of forested plots within the PES project. Table 1 shows that many project participants (6 out of 14) belong to an '*adapted multiple crops and livestock production (with off-farm labour)*' system. Farmers belonging to this production system are located in relatively isolated areas, are mainly constrained by limited labour availability and are therefore typically prevented from increasing their livestock in the near future. For these farmers it makes sense to include all on-farm forest plots under a fixed-term payment contract, potentially later continuing with livestock specialization. A second group of farmers (6 out of 14) are those belonging to the '*multiple crops and livestock*' or the '*specialized in livestock with temporary employees*' production systems. Since participants were free to choose which plots and how much forest to enrol under the five-year contract, it is not surprising that these farmers did not include some forest plots - typically the ones adjacent to current production areas¹². These farmers could continue their usual farming practices as described above, while temporarily 'protecting' forests that were not actually going to be disturbed, at least not in the foreseeable future (see Hartshorn et al., 2005 for similar findings in Costa Rica). Lastly, some project participants (2 out of 14) belong to the '*multiple crops*' system. These farmers are characterized by a very low level of financial capital and the absence of cattle even if they have pasture. For diverse reasons – recent arrival to the region, inheritance issues – they have been stuck in the initial phase of the typical farm evolution and, thanks to seasonal international migration, have not been obliged to sell and permanently migrate towards the pioneer front. For these farmers, who lack the necessary financial capital to start the typical trajectory, it makes sense to put all their remaining forests

¹² This is often referred to as the 'self-selecting nature of voluntary participation' (see e.g. Wünscher et al., 2008: 822).

under contract as a strategy to access financial capital. Overall participants chose to include plots of forests that in the short term have almost no opportunity cost. This finding was confirmed in all our interviews where farmers typically stated that:

I was going to protect these forests [under the PES contract] anyway. I have been protecting them for the past twenty years [...] You really think that the little money they're offering me is the reason why I'm protecting these forests? (interview farmer, 27/07/2014).

As such, the current payments are unlikely to lead to much behavioural change. Respondents reported that they had used project payments to invest in practices that were very much part of their usual production strategies (Table 1). Families who cultivate staple crops used the payments to satisfy basic needs such as the purchase of medicines, sugar and staple foods. Only a few have been able to use the money to try alternative activities promoted via the NGO-supported sustainable management plans, such as the cultivation of *raicilla*. As shown in the Table, farmers practicing a livestock system have mainly used the money to invest in cattle-related expenditure such as fences, improving and expanding pastures, or additional cattle (7 of 14 farmer households). Payments alleviated some of the commonly experienced capital constraints and supported farmers in their endeavours towards aspirational livestock specialization. These findings prompted the NGOs to critically reflect on the selection criteria for future participants (cf. selection bias), as well as to question their initial decontextualized technical assumptions about the need for and the possibility of intensified production in order to release pressure on the remaining forests. These assumptions are based on overly simplistic and erroneous ideas that attribute deforestation to farmers' cultural backwardness and their lack of technical know-how (see also Larson, 2010) rather than on an informed analysis of the multiple factors and motivations that underlie why farmers do what they do.

In summary, our case study suggests that the PES project alone is not enough to break with historically evolved practices, embedded in particular production logics and socio-cultural contexts. Instead of shifting farmers to alternative development pathways, in some cases payments paradoxically might even have stimulated and accelerated future deforestation. Indeed, the intervention did not challenge the conditioning factors of the current pathway that generate a strong economic and social rationale to continue expanding cattle production. The rationale is founded in associated cultural views and habits such as moral landscape, social status of cattle ranchers, etc.

5. Conclusion

Territorial dynamics are more than the simple sum of individual decision-making processes implemented within independent farms. They are rather the result of the historically built rules and norms, social structure, culture and worldviews which characterize broader rural societies, and are supported by particular macro-economic policies and ensuing market and price structures. Throughout this article we have argued that research on the long-term impact of policy interventions on human behaviour should recognize that human motivation is socially constructed (Vatn and Vedeld, 2012). This does not deny the existence of strategic action, but rather suggests that individual motivation and actions are both constrained and enabled by the broader development pathways in which they are embedded. Understanding this dynamic interplay between agency and structure means that we should move beyond the purely bio-physical or economic considerations of human-environment challenges to encompass broader and often previously unacknowledged socio-institutional, political and knowledge-based dimensions of interventions (German et al., 2010).

In line with Hiedanpää and Bromley (2014:182), this is the fundamental reason why one should not expect a significant impact from the simple introduction of PES, since:

Human behavior is deeply habituated – and for good reasons – on the basis of long experience with what seems to work (Quellette and Wood, 1998). Only when confronted by startling doubt and surprise do individuals stop and reassess what they are doing – and why they are doing it (Bromley, 2006). This matter of deep habituation is fundamental to any supposition that scattered individuals out in remote areas can be easily dislodged by PES schemes from a lifetime – perhaps of several generations of predecessors – of habituated behaviors with respect to their natural surroundings.

Habits and motivations are not mere automatic unreflective reactions, nor just a matter of inherited cultural practices; they are contingent on or jointly determined by the structural features of the environment (Hiedanpää and Bromley, 2014; Vatn and Vedeld, 2012). They are generated and sustained out of the perceived ‘realities’ in which they work. Logically, this implies that instituting new environmental habits means ‘both the agent and the decision environment must be changed’ (Hiedanpää and Bromley, 2014:183-4). One cannot assume that offering fixed-term payments is sufficient to promote a lasting change in structurally entrenched rationalities and habits nor that the challenge is reduced to finding the ‘right’ exchange prices for a PES mechanism to work.

Payments could however provide a spur for changing perspectives and rationalities and, if accompanied by broader structural changes, could become part of a change dynamic that redefines the emerging pathways in novel directions. Only if payments are sufficiently

integrated within broader approaches that address the multiple causes of deforestation at different scales, could they possibly support changes in cognitive perceptions and farmer rationalities and ‘crowd-in’ new mental habits and motivations geared towards a changed culture of forestry (Geist and Lambin, 2002; Vatn and Vedeld, 2012; Hiedanpää and Bromley, 2014). This would require socio-institutional transformations that enable the creation of new pathways with redefined opportunities and constraints, ranging from changes in relative prices through re-regulation of global value chains and national fiscal policies to more local initiatives related to the promotion of alternative strategies based on, for example, community-based ecotourism or cacao production.

We have shown that the AS approach is a useful conceptual-methodological approach that can help us uncover and assess the emergence of particular development pathways and their consequent changed opportunities for individual livelihood trajectories at varied spatial-temporal scales. This approach paves the way for better-informed appraisals of the underlying reasons and motivations for *why farmers do what they do*. It also allows for deeper and more systematic reflection on the expected impact of interventions, such as PES, that attempt to change these motivations and habits. This should help us avoid one-size-fits-all panacea solutions by directing our attention to the particularities and the diversity within the local social framework as well as the wider social-institutional factors that underlie specific human-environment problems.

Table 1. Land characteristics of farm households participating in PES (n=14): Indio-Maíz Biological Reserve buffer zone, Nicaragua

Farm HH*	Production System**	Total farm area (ha)	Forest area under contract (ha)	Forest area not under contract (ha)	Cultivation area (ha)	Pasture area (ha)	Access to other farm?	Investment plan	Investment plan implementation
1	2	128.9	100.0	22.0	2.9	4.0	yes	pigs	failed
2 (P)	2b	44.8	30.1	0	5.9	8.7	yes	pigs	failed
3	2b	37.4	18.9	0	3.7	14.8	yes	livestock	failed
4	2b	45.5	29.3	0	6.2	10.0	yes	livestock	average
5 (P)	2b	33.1	12.1	0	5.8	15.2	yes	livestock	good
6 (P)	2b	43.3	28.2	2.4	9.1	3.5	yes	cacao	average
7 (P)	2	39.5	28.2	4.8	6.5	0	yes	pigs	failed
8	1	33.6	21.7	0	11.9	0	no	<i>raicilla</i>	good
9	2	219.5	100.0	28.6	29.9	61.1	no	livestock	n.a.
10 (P)	2b	34.2	22.4	0	2.0	9.8	yes	livestock	average
11	4	49.7	29.2	0	4.2	16.4	yes	<i>raicilla</i>	good
12	4	27.3	11.0	0	6.0	10.3	no	livestock	n.a.
13	1	20.1	13.3	0	3.9	2.9	no	selling clothes	n.a.
14 (P)	2	39.8	24.0	0	7.7	8.2	yes	livestock	n.a.
Total		796.5	468.3	57.8	105.5	164.9			
Mean		56.9	33.5	4.1	7.5	11.8			

* Households (HH) indicated with '(P)' also participated in the 2006-2009 pilot phase

** Production systems: 1 = Multiple crops / 2 = Multiple crops and livestock / 2b = Adapted multiple crops and livestock (with off-farm labour) / 3 = Multiple crops and livestock with temporary employees / 4 = Specialized in livestock with temporary employees

Figure 1. Evolution of coexistin

g production systems in the Indio-Maíz Biological Reserve buffer zone, Nicaragua 1990-2015

Figure 2. Evolving farm production systems and land use changes: Indio-Maíz Biological Reserve buffer zone, Nicaragua

Figure 3. Labour and land productivity, and labour constraints for production systems in the Indio-Maíz Biological Reserve buffer zone, Nicaragua

References

1. Adhikari, B. and Agrawal, A. (2013) Understanding the social and ecological outcomes of PES projects: a review and an analysis, *Conservation and Society* 11: 359-374.
2. Apollin, F. and Eberhardt, C. (1999) *Análisis y diagnóstico de los sistemas de producción en el medio rural: Guía metodológica*, CAMAREN-CICDA-RURALTER.
3. Bastiaensen, J., Marchetti, P., Mendoza, R. and F. Pérez (2013) After the Nicaraguan Non-Payment Crisis: Alternatives to Microfinance Narcissism, *Development and Change* 44(4): 861-885.
4. Bastiaensen, J., Merlet, P., Craps, M., De Herdt, T., Flores, S., Huybrechs, F., Mendoza, R., Steel, G. and Van Hecken, G. (2015) Making sense of territorial pathways to rural development: a proposal for a normative and analytical framework. Discussion Paper 2015:04. Institute of Development Policy and Management (IOB), University of Antwerp, Antwerp.
5. Bowles, S. (2008) Policies designed for self-interested citizens may undermine ‘the moral sentiments’: evidence from economic experiments, *Science* 320: 1605-1609.
6. Brossier, J. (1987) Système et système de production. Note sur les concepts. *Cahiers des sciences humaines* 23: 377-390.
7. Büscher, B. (2014) Selling Success: Constructing Value in Conservation and Development, *World Development* 57: 79-90.
8. Cardenas, J.C., Stranlund, J. and Willis, C. (2000) Local Environmental Control and Institutional Crowding-Out. *World Development* 28(10) : 1719-1733.
9. Cleaver, F. (2005) The Inequality of Social Capital and the Reproduction of Chronic Poverty. *World Development* 33(6): 893-906.

10. Cleaver, F. (2012) *Development through bricolage: rethinking institutions for natural resource management*, Routledge, Abingdon, Oxon.
11. Cochet, H. (2011) *L'agriculture comparée*, Quae Editions.
12. Cochet, H. (2012) The systeme agraire concept in francophone peasant studies. *Geoforum*, 43(1): 128-136.
13. Cochet, H., Devienne, S. and Dufumier, M. (2007) L'agriculture comparée, une discipline de synthèse? *Économie rurale. Agricultures, alimentations, territoires* 297-298: 99-112.
14. Cote, M. and Nightingale, A.J. (2012) Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research, *Progress in Human Geography* 36(4): 475–489.
15. de Haan, L. and Zoomers, A. (2005) Exploring the frontier of livelihoods research. *Development and Change* 36(1): 27-47.
16. Dufumier, M. (1996) *Les projets de développement agricole: Manuel d'expertise*: KARTHALA Editions.
17. Ezzine-de-Blas, D., Corbera, E. and Lapeyre, R. (this issue) Crowding-in or crowding-out? A conceptual framework to understand motivations in payments for ecosystem services.
18. Fazey, I., Wise, R.M., Lyon, C., Câmpeanu, C., Moug, P. and Davies, T.E. (2015) Past and future adaptation pathways. *Climate and Development* 8(1): 26-44.
19. Ferraro, P.J. and Kiss, A. (2002) Direct payments for biodiversity conservation, *Science* 298: 1718-1719.
20. Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005) Adaptive governance of social-ecological systems, *Annual Review of Environment and Resources* 3: 441–473.
21. Geist, H.J. and Lambin, E.F. (2002) Proximate causes and underlying driving forces of tropical deforestation, *BioScience* 52(2): 143-150.

22. German, L., J.J. Ramisch and R. Verma (Eds.) *Beyond the Biophysical. Knowledge, Culture, and Power in Agriculture and Natural Resource Management*. Springer, Dordrecht-Heidelberg-London-New York.
23. Gneezy, U. and Rustichini, A. (2000) Pay enough or don't pay at all, *Quarterly Journal of Economics* 115(3): 791-810.
24. Hartshorn, G., Ferraro, P., Spergel, B. and Sills, E. (2005) *Evaluation of the World Bank-GEF Ecomarkets Project in Costa Rica*, Durham, North Carolina State University.
25. Hayes, T. (2012) Payment for ecosystem services, sustained behavioural change, and adaptive management: Peasant perspectives in the Colombian Andes. *Environmental Conservation* 39(2): 144-153.
26. Hiedanpää, J. and Bromley, D.W. (2014) Payments for ecosystem services: durable habits, dubious nudges, and doubtful efficacy, *Journal of Institutional Economics* 10(2): 175–195.
27. Hukkinen, J.I. (2014) Model of the social-ecological system depends on model of the mind: Contrasting information-processing and embodied views of cognition, *Ecological Economics* 99: 100-109.
28. Jouve, P. (1988) Quelques réflexions sur la spécificité et l'identification des systèmes agraires. *Les cahiers de la recherche développement* 20: 5-16.
29. Kits, G.J., Adamowicz, W.L. and Boxall, P.C. (2014) Do conservation auctions crowd out voluntary environmentally friendly activities? *Ecological Economics* 105: 118-123.
30. Kosoy, N. and Corbera, E. (2010) Payments for ecosystem services as commodity fetishism, *Ecological Economics* 69(6): 1228-1236.

31. Kosoy, N., Martinez-Tuna, M., Muradian, R. and Martinez-Alier, J. (2007) Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America, *Ecological Economics* 61: 446-455.
32. Larson, A. (2001) *Rainforest conservation and grassroots development: If ever the Twain shall meet? Peasant colonists and forest conversion in the Nicaraguan rainforest*. Ph.D. Dissertation. Berkeley, University of California.
33. Larson, A. (2010) The “Demonization” of Rainforest Migrants, or: What Conservation Means to Poor Colonist Farmers, in: German, L., J.J. Ramisch and R. Verma (Eds.) *Beyond the Biophysical. Knowledge, Culture, and Power in Agriculture and Natural Resource Management*. Springer, Dordrecht-Heidelberg-London-New York, pp. 49-71.
34. Leach, M., Mearns, R. and Scoones, I. (1999) Environmental entitlements: Dynamics and institutions in community-based natural resource management, *World Development* 27(2): 225–247.
35. Leach, M., Scoones, I. and Stirling, A. (2010) *Dynamic Sustainabilities. Technology, Environment, Social Justice*, Earthscan, London and Washington D.C.
36. Lindtner, M. (2014) La influencia de pagos por servicios ambientales sobre las decisiones de uso de tierra de los productores agropecuarios en la frontera agrícola nicaragüense – El caso de las comunidades a lo largo del río Manola en Río San Juan, Nicaragua. Master Thesis Agrismundus, SupAgro, Montpellier.
37. Liu, J., Dietz, T., Carpenter, S. R., Alberti, M., Folke, C., Moran, E., . . . Lubchenco, J. (2007) Complexity of coupled human and natural systems. *Science*, 317(5844), 1513-1516.
38. Maldidier, C. (2004) Agricultural pioneer fronts, the crest of a far-reaching wave. The social and spatial dimension of lowland colonization in Nicaragua, in: Babin, D. (ed.) *Beyond tropical deforestation. From Tropical Deforestation to Forest Cover*

Dynamics and Forest Development. UNESCO CIRAD, Montpellier, France, pp.185-192.

39. Ministerio del Ambiente y los Recursos Naturales (MARENA) (2015) Reserva de Biosfera del Sureste de Nicaragua. Gobierno de la Republica de Nicaragua, Nicaragua.
40. Martin, A., Gross-Camp, N., Kebede, B., McGuire, S. and Munyarukaza, J. (2014) Whose environmental justice? Exploring local and global perspectives in a payments for ecosystem services scheme in Rwanda, *Geoforum* 54: 167-177.
41. Mazoyer, M. and Roudart, L. (2005) *A History of World Agriculture: From the Neolithic Age to Current Crisis*. Monthly Review Press, New York.
42. McAfee, K. (1999) Selling nature to save it? Biodiversity and green developmentalism, *Environment and Planning D: Society and Space* 17(2): 133–154.
43. Milne, S. and Adams, W.M. (2012) Market masquerades: uncovering the politics of community-level payments for environmental services in Cambodia, *Development and Change* 43: 133-158.
44. Muradian, R., Corbera, E., Pascual, U., Kosoy, N. and May, P. (2010) Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services, *Ecological Economics* 69(6): 1202–1208.
45. Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., de Blas, D.E., Farley, J., Froger, G., Garcia-Frapolli, E., Gómez-Baggethun, E., Gowdy, J., Kosoy, N., Le Coq, J. f., Leroy, P., May, P., Méral, P., Mibielli, P., Norgaard, R., Ozkaynak, B., Pascual, U., Pengue, W., Perez, M., Pesche, D., Pirard, R., Ramos-Martin, J., Rival, L., Saenz, F., Van Hecken, G., Vatn, A., Vira, B. and Urama, K. (2013) Payments for Ecosystem Services and the fatal attraction of win-win solutions, *Conservation Letters* 6(4): 274-279.

46. Narloch, U., Pascual, U. and Drucker, A. (2012) Collective action dynamics under external rewards: experimental insights from Andean farming communities. *World Development* 40: 2096–2107.
47. Nygren, A. (2000) Development discourses and peasant-forest relations: Natural resource utilization as a social process. *Development and Change* 31(1): 11–34.
48. Nygren, A. (2004) Contested Lands and Incompatible Images: The Political Ecology of Struggles Over Resources in Nicaragua's Indio-Maíz Reserve. *Society and Natural Resources* 17: 189–205.
49. Pagiola, S., Arcenas, A. and Platais, G. (2005) Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date, *World Development* 33(2): 237-253.
50. Pattanayak, S.K., Wunder, S. and Ferraro, P.J. (2010) Show me the money: do payments supply environmental services in developing countries? *Review of Environmental Economics and Policy* 4(2): 254-274.
51. Rabella, J. (1995) Aproximación a la historia de Río San Juan. Solidaridad Internacional, Managua, Nicaragua.
52. Ribot, J.C. and Peluso, N.L. (2003) A Theory of Access. *Rural Sociology* 68(2): 153–181.
53. Rizzo, D., Marraccini, E., Lardon, S., Rapey, H., Debolini, M., Benoit, M. and Thenail, C. (2013) Farming systems designing landscapes: land management units at the interface between agronomy and geography. *Geografisk Tidsskrift-Danish Journal of Geography* 113(2): 71-86.
54. Rode, J., Gómez-Baggethun, E. and Krause, T. (2014) Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence, *Ecological Economics* 109: 80–92.

55. Schomers, S. and Matzdorf, B. (2013) Payments for ecosystem services: a review and comparison of developing and industrialised countries, *Ecosystem Services* 6: 16–30.
56. Scoones, I. and Wolmer, W. (2002) *Pathways of Change in Africa. Crops, Livestock and Livelihoods in Mali, Ethiopia and Zimbabwe*. James Currey, Oxford.
57. Setten, G. (2004) The habitus, the rule and the moral landscape. *Cultural geographies* 11(4): 389-415.
58. Van Hecken, G. and Bastiaensen, J. (2010a) Payments for ecosystem services: justified or not? A political view, *Environmental Science & Policy* 13(8): 785-792.
59. Van Hecken, G. and Bastiaensen, J. (2010b) Payments for ecosystem services in Nicaragua: do market-based approaches work?, *Development and Change* 41: 421–444.
60. Van Hecken, G., Bastiaensen, J. and Vásquez, W.F. (2012) The Viability of Local Payments for Watershed Services: Empirical Evidence from Matiguás, Nicaragua, *Ecological Economics* 74: 169-176.
61. Van Hecken, G., Bastiaensen, J. and Windey, C. (2015a) Towards a power-sensitive and socially-informed analysis of payments for ecosystem services (PES): Addressing the gaps in the current debate. *Ecological Economics* 120: 117-125.
62. Van Hecken, G., Bastiaensen, J. and Huybrechs, F. (2015b) What’s in a name? Epistemic perspectives and Payments for Ecosystem Services policies in Nicaragua, *Geoforum* 63: 55-66.
63. Vatn, A. and Vedeld, P. (2012) Fit, Interplay, and Scale: A Diagnosis, *Ecology and Society* 17(4), 12.
64. Vérant, S. (2013) Analyse-diagnostic de l’agriculture familiale dans un contexte de développement d’une grande entreprise agro-industrielle. Municipalité de El Castillo, Nicaragua. Agro Paris Tech.

65. Wunder, S. (2005) Payments for environmental services: some nuts and bolts, *CIFOR Occasional Paper* 42, CIFOR, Jakarta, Indonesia.
66. Wunder, S. (2015) Revisiting the concept of payments for environmental services, *Ecological Economics* 117: 234-243.
67. Wünscher, T., Engel, S. and Wunder, S. (2008) Spatial targeting of payments for environmental services: a tool for boosting conservation benefits, *Ecological Economics* 65: 822-833.