

Title: Conservation strategies based on local perception of forest ecosystem services

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ABSTRACT

Historically, cattle expansion has been a leading cause of deforestation in the Guanacaste Province, Costa Rica. The Payments for Ecosystem Services (PES) policies were implemented in the late 1990s and successfully increased forest area in Costa Rica; however, the economic incentives provided by this program are insufficient compared to farming profits to continue recruiting new participation in these policies. For increased advancements, it is therefore imperative for alternative and complementary strategies to be identified and implemented. The objective of this study is, therefore, to identify complementary incentive packages for cattle producers to promote forest conservation in Guanacaste. To find alternative approaches, cattle ranchers' perceptions on ecosystem services, motivations for deforestation, and conservation goals were surveyed. Statistical approaches relating motivational factors were conducted and comparisons to other related literature studies were completed. These analyses can be used as a starting point for identifying gaps in knowledge and required adaptations to economic legislation both in the province, and in similar areas in other provinces.

Introduction

In recent years, there have been countless approaches to the economic valuation of ecosystem services, and evaluation strategies, such as the SEEA framework or WAVES program, have garnered increased attention (UN, 2014). The attribution of economic value to the benefits derived from the environment is increasingly becoming an important instrument for the elaboration of policies related to conservation (UN, 2014). New markets, or ways to integrate the largely intangible services provided by natural systems, have been developed recently as potential solutions to the undervaluation of natural landscapes and the incentivization of

destroying ecologically sensitive areas. One such market, which has become standard across many countries, is the payments for ecosystem services (PES) (Robalino & Pfaff, 2013). This particular approach utilizes an economic instrument where a tangible agreement between the suppliers and consumers of environmental services is created to ensure the sustainability and long-term continuity of the supply of quality services (Daily et al., 2009). The driving theory behind these transactions is that users who benefit from environmental services pay for their provision, thereby internalizing the costs of generating these services and correcting for market distortions which exclude natural capital (MA, 2005; Engel et al., 2008, Sukhdev et al. 2010).

The design of specific PES programs are varied and largely based on the needs, context, and application of the particular environment where they are utilized. Some programs compensate for the cost incurred in avoided actions (eg, not deforesting) and others pay for the induction of actions (i.e. planting trees) (see Porras et al., 2008; Lambin et al., 2014); however, in both designs there are agents who pay for the services, and others who provide the service. Individuals or collective groups can serve in both capacities, from a single farmer to a large industry or collective management association (Lambin et al., 2014). The type and scale of the environmental services involved must also be defined by the PES program. For example, if there are no direct users of the services, regulatory or supporting services including nutrient cycling, decomposition, soil formation, or climate regulation may be defined as the purpose for the PES agreement. In this context, demand formation is necessary through public actions and mechanisms to allow users to access suppliers (e.g., carbon credit markets; Farley & Costanza, 2010). For Paglia et al. (2005), the purpose of a PES is related to compensating land owners for the environmental services that an area provides.

Historically, cattle expansion and livestock production has been considered to be one of the major driving forces behind tropical deforestation in Central and South America (Castillo et al., 2014). The impacts of the deforestation involve serious environmental damages, including: the release of a large quantity of carbon dioxide into the atmosphere, climatic changes, hydrologic cycle alteration, soil degradation, alteration of the structure and dynamics of the communities, and the extinction of innumerable species; in short, severe reductions in the supply and quality of ecosystem services. In Costa Rica, the historical records show that economic incentives for expanding the cattle industry began in 1957, to increase exports to the United States. In a single decade (1963-1973), the pasture areas expanded by 62%, with the centre of ranching located in the province of Guanacaste (Mc Dande 1994). By 1972, Guanacaste accounted for over 40% of all cattle production in Costa Rica (Ibraham et al., 2000), and this led to severe environmental

damage and the reduction of many of the services that the ecosystems once provided. The government of Costa Rica recognized the environmental concerns that it faced, in part due to the cattle ranching, but also due to road expansion and cattle production (Zbinden & Lee 2005). Costa Rica was, therefore, one of the countries that pioneered payments for ecosystem services in 1997 to mitigate some of the historic deforestation and degradation that occurred between 1950 and 1990 (Robilino & Pfaff, 2013).

According to Sanchez-Azofeifa et al. (2007), the PES in Costa Rica was based on three laws: the 1995 Environment Law (balanced and ecologically driven environment), 1996 Forestry Law (rational use of all natural resources and prohibits land cover change in forests), and 1998 Biodiversity Law (promote the conservation and rational use of biodiversity resources). The program has provided payments to thousands of farmers and forest owners for the purposes of reforestation, forest conservation, and sustainable forest management activities (Zbinden & Lee 2005). Given the increase in forest cover in provinces like Guanacaste from 23.6% to 40% during 1985 to 2005 (Calvo-Alvarado et al. 2009), the PES program has been touted as a fundamental component to the reduction in deforestation and conservation of remaining tracts of natural land (Sanchez-Azofeifa et al. 2007); however, this is called into question due to the fact that PES contracts represent only 12% of total natural forest area of Guanacaste (Calvo-Alvarado et al. 2009). Additionally, other empirical research indicates that the impact on the annual deforestation rate was less than 0.2%, with the Forest Law providing much more concrete evidence for reducing deforestation in this era (Robino & Pfaff, 2013). The payments program in Costa Rica also has the problem of having a disproportionate amount of large land holdings despite being promoted as a way to assist the poorest farmers (Bosselmann & Lund, 2013; Ross, 2016).

The uncertainty surrounding both the effectiveness and relevance of payment for ecosystem services, especially in the Costa Rican context, provided the motivation for this study. Our objective is, therefore, to assess the local opinions about both environmental conservation as a whole and the ecosystem services that the forest provides. From there, we will assess the current perceptions and buy-in surrounding the payments for ecosystem services policy in the Guanacaste Province of Costa Rica. This will provide a basis to determine the current effectiveness of the program, and identify if additional information needs to be gathered to find ways to either strengthen the policy to attract more local support, or suggest alternatives to the policy if it is considered ineffective.

Methods

Study Area

The Guanacaste Province is located in the northwest portion of Costa Rica and has an area of 10,140 km² (Figure 1). The landscape is dominated by a seasonally dry tropical forest, with a 6-month dry season (Nov-May), and a rainy season (May-Nov) (Stansifer et al., 2017). The population of the province was just over 325,000 in 2011, with the capital city of Liberia housing over 25% of the province's citizens (INEC, 2011). The rural portion of Guanacaste is divided into various land holdings, and overall experienced land use intensification and the transformation of cattle raising between 1950 and 1980 (Augelli, 1989). The Costa Rican economy has seen stable growth since 2010, with the main traditional exports of coffee, sugar, beef, and bananas still accounting for large portions of the overall revenue (CIA, 2017). The economy has also experienced an increase in diversification with industrial exports, tourism, and foreign investment becoming key components of the country's GDP (CIA, 2017). The Guanacaste Province continues to focus on cattle ranching, however, with over 50% of the farms raising cattle and the average farm size more than double the national average (Guanacaste: 0.54 km², national: 0.26 km²) (Censo Nacional Agropecuario de Costa Rica, 2015).

Data and Analysis

To achieve our objective of understanding rancher's perceptions about incentives for forest conservation, we sent out 30 questionnaires to ranchers in Guanacaste, Costa Rica. The producers were randomly sampled and included different districts and rancher types to gather a broad view of the thoughts on the conservation processes. The surveys were distributed over 17 different districts in the province, and included 11 different (self-identified), rural occupational streams. Questionnaires were iteratively created, tested, and improved, and were then distributed by a single interviewer in the final format between December 2016 and January 2017. The interviewer was controlled for consistency purposes so that the explanation and any associated error in distributing the surveys was common across all samples. Additionally, the survey administrator was a leader within the Guanacaste ranching community, improving the rate of response then by using another methodology. The questionnaire consisted of 13 - multi-part open and close-ended questions. The first part of the survey focused on sociological information relating to the rancher characterization (Appendix 1). The second section dealt with the

importance and prioritization of ecosystem services and conservation as a whole, and the final section dealt with the perspective on the advantages, disadvantages and importance of the incentives programs currently in place.

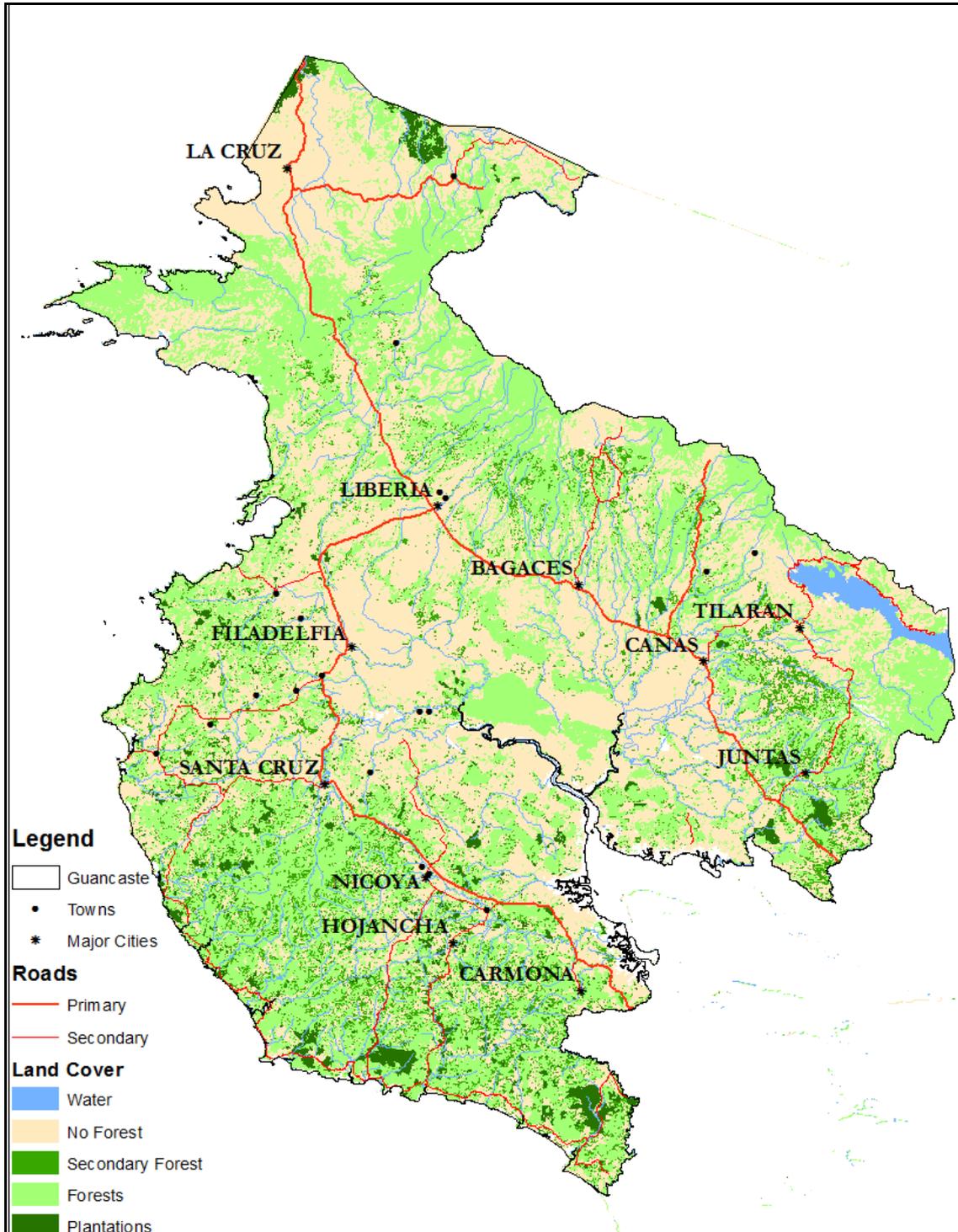


Figure 1. Guanacaste Province of Costa Rica which includes a number of land cover types, various towns, and cattle ranching as a primary economic driver.

The frequency of the responses was analyzed for commonalities and significant differences. Rancher location and characterization were used as potential difference moderators for differences in the perceptions and prioritization of conservation. The number of surveys was considered sufficient as a representative section of the ranching producers in the province. These results are then compared against other social perception studies conducted in other areas of the country to determine where Guanacaste fits against the national PES perspective.

Results

Based on the surveys that were distributed to 30 random individuals in the Guanacaste agriculture industry, we found that the majority of respondents work primarily in growing livestock (Figure 2). Ranching alone accounts for more than half of the respondents, and growing feed for cattle resolve an additional 14%, for a total of 3/4 of the farming in Guanacaste related to cattle. The next largest industry is associated with forestry, accounting for nine percent of the respondents, both through deforestation and reforestation. The farm size distribution was skewed towards the smaller holdings, with most landowners only owning a single farm. The employee size was equally distributed between a single employee to those that had more than 7; however, all landowners employed fewer than 10 people (Figure 3).

Overall, there was a consensus that the environment is important and there should be consideration for its conservation. The reasons for this importance varied between respondents, but in general, the majority of the people surveyed agreed that either water or air quality was the most critical aspect. Following those, climate change mitigation and protecting natural areas for future generations were considered the most important (Figure 4), each accounting for approximately 10% of the conservation reasons mentioned.

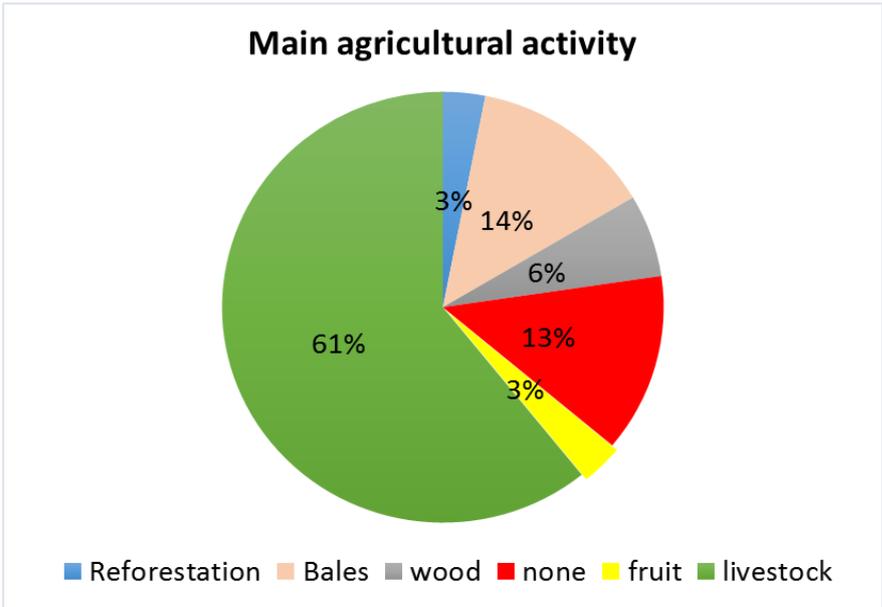


Figure 2. The distribution of survey respondents by employment type in the Guanacaste province. Over 3/4 of the respondents deal in industries related to either livestock and the use of forest land.

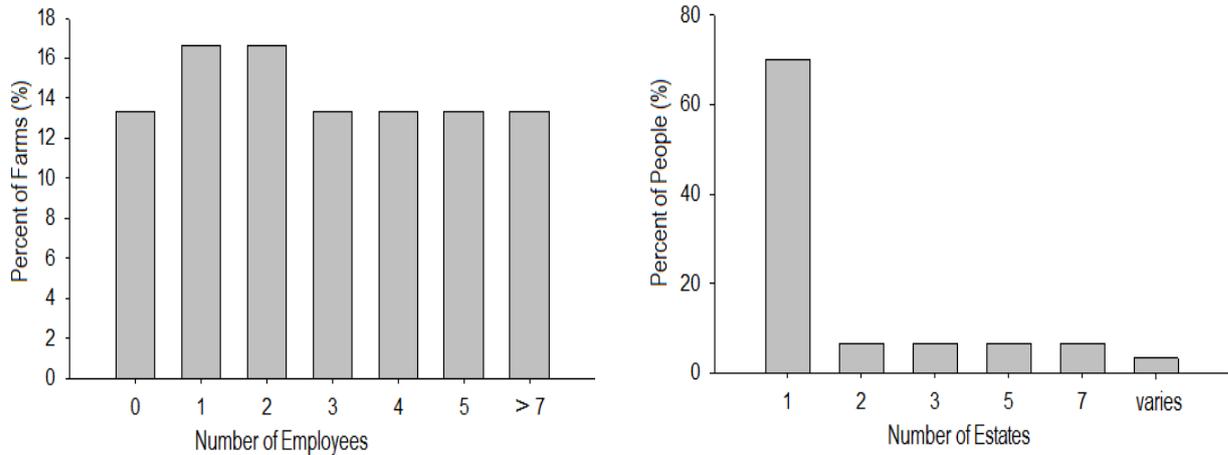


Figure 3. The demographic information about the survey respondents according to the number of people employed by each landowner (left) and the number of holdings owned by each owner (right).

Ecosystem services, however, have been identified as an area that the respondents did not consider important or did not think about at all. Of the ecosystem services in the survey, four (air quality, water quality, biodiversity, and climate regulation) were considered essential by the majority of respondents. An additional four (cattle production, agricultural production, groundwater recharge, and a feeling of belonging) were considered either important or essential by the majority of respondents. The remaining 14 services were considered unimportant by the majority of people who completed the survey (Table 1). It is worth noting that the environmental

services, including provisioning services (i.e. food, wood, biodiversity), regulatory services (i.e. flood regulation and erosion control), and cultural services (i.e. tourism and scenic beauty), are considered among the lowest rated reasons to protect areas. There is a mixed level of perceived importance for each of these services, but overwhelmingly tourism, aesthetics, and flood control are considered some of the most unimportant ecosystem services in the area (Table 1). These services are also not considered to be of benefit to the natural environment as a whole, based on the responses received.

When moving into the views on payments for ecosystem services, it is important to note that only four of the respondents were actually part of the PES program. There was a consensus among all farmers that without economic incentives they would not participate of the PES programs. The response about the program was 48% negative, 34.5% positive, and 13% indifferent. Among the "positive" attitudes, reasons for being part of the program included that the farmer had too much land, or that the land was unusable for ranching to begin with, and this accounted for over 20% of the responses. The negative response to the program was overwhelmingly because of the limited payment per hectare, with this reason accounting for over 43% of the opinions of all respondents (Table 2). Overall, the general understanding is that the payments are not sufficient enough to attract additional investment into the program (Table 2).

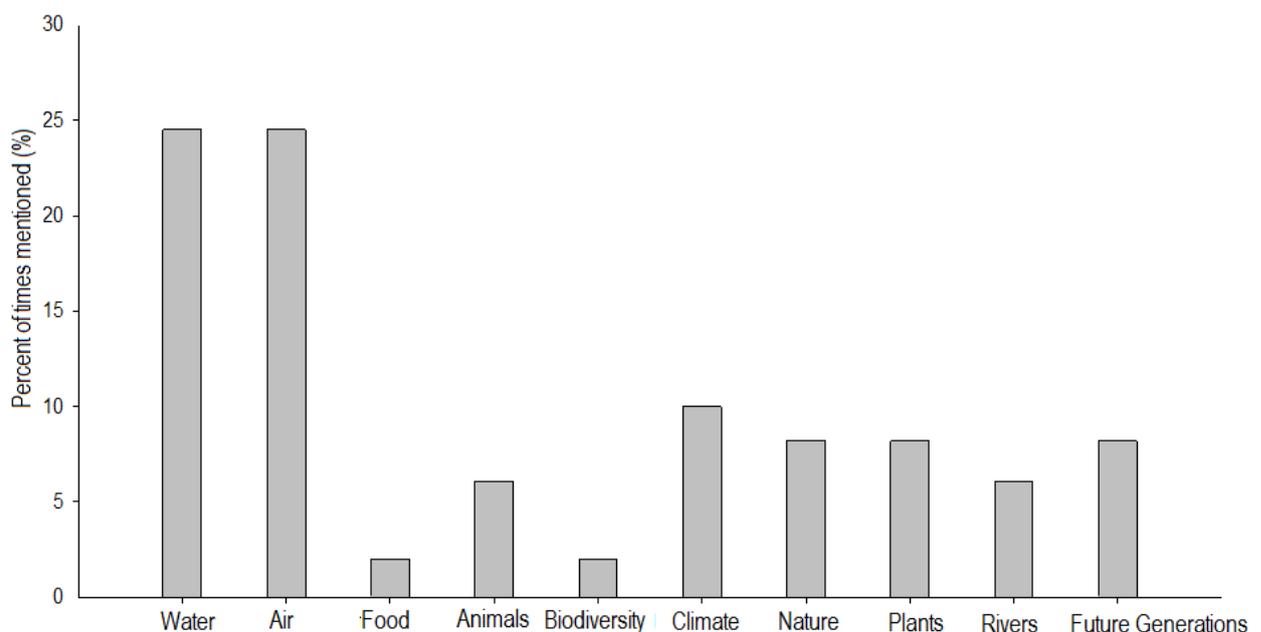


Figure 4. Perceptions about the important reasons to conserve the environment. All respondents recognize the importance of environmental protection, though the reasons vary among different people.

Table 1: *Perceptions about the value of conserving ecosystem services. Air and water quality are considered overwhelmingly the most important things to protect, with provisioning, regulatory, and cultural services receiving a mixed or negative response.*

	Type of Ecosystem Service	Percent who think ES is Essential	Percent who think ES is Important	Percent who think ES is NOT Important
Essential	Quality and Quantity of Water	90%	10%	0%
	Air Quality	73%	27%	0%
	Biodiversity	67%	30%	3%
	Climate Regulation and Climate Change	67%	23%	10%
Important	Feeling of Belonging	7%	53%	40%
	Cattle Production	37%	23%	40%
	Groundwater Recharge	13%	47%	37%
	Agriculture Production	17%	40%	43%
Not Important	Temperature Regulation	3%	43%	53%
	Precipitation Regulation	0%	43%	57%
	Soil Quality	3%	40%	57%
	Hunting/Fishing for food	0%	40%	60%
	Tourism	7%	30%	63%
	Erosion Protection	7%	23%	70%
	Hunting/Fishing for recreation	0%	23%	77%
	Flood regulation	0%	23%	77%
	Aesthetics	7%	13%	80%
	Fruits for food	0%	17%	83%
	Honey/Natural Medicines	3%	10%	87%
	Wood for fuel and construction	0%	10%	90%
Firewood	3%	7%	90%	
Artisanal materials	0%	3%	97%	

Table 2. *Perceptions regarding farmers' views of the payments for ecosystem programs and why they think the program is good, bad, or irrelevant.*

Opinion (N=30)	Reason for opinion	Percent of Respondents (%)
Positive	Being paid for space that is unused	8.6
	The pay is good	4.3
	To be in a negotiation position	4.3
	To maintain the forest	4.3
	Have a large amount of land	13
Negative	Payment is insufficient	43.5
	Difficult to access and payment is insufficient	4.3
Indifferent	Not interested	8.7
	Do not have forest	4.3

Discussion

With a sample size of 30 people, this survey is insufficient to make overarching conclusions about the PES program, the ranching opinions in Guanacaste, or the opinions in Costa Rica. That being said, this study does fall in line with other research that has been conducted in the last decade which assessed the payments program. The small farm size, and the importance placed on the monetary compensation agrees with a study done by Ross (2016). The study found that while large land titles could be motivated by non-financial incentives, this did not hold true for small and medium farms, where increased financial incentive related to increased participation (Ross, 2016). Other research indicates that factors, such as undesirable fallow land and high slope, increase participation in these types of programs (Lansing 2017). Additionally, wealthier farms where the owners have less to do with the actual agriculture (i.e. also have a salaried job) have been found to also be more likely to enroll in a PES program within Costa Rica (Lansing 2017).

While there has been research on the characteristics of the landowners and types of farms that become enrolled in PES in Costa Rica, this study is unique in that attempted to understand how the ranchers think about not only the program, but the environment that they interact with. The concerns were brought forward by a private stakeholder, and this study was a way to test whether this problem needed more study. Given the consistent results about the lack of favor for the program despite the interest in the environment, and the consistency relating to the economics of the program, this issue most certainly needs to be investigated more fully. The lack of profitability from the program has been explicitly explored, where PSA's pay a maximum of \$42 USD/ha, while cattle ranching can easily pay double or triple per hectare (Robilino & Pfaff, 2013).

Non-essential ecosystem services, according to the survey respondents, directly relate to those services which are not explicitly paid for through the government or incentive programs (e.g. inundation regulation or soil protection). Vignola et al. (2010) argue that the perception of farmers in Costa Rica regarding the importance of forest conservation for soil protection is associated with cognitive and socioeconomic aspects. Owners of small areas are less aware of the need to conserve the soil and generally have less formalized education (Vignola et al. 2010). Farmers who live in highly affected areas, however, tend to place more importance on this service, and respond more favorably to soil conservation programs (Vignola et al. 2010). In our study, the majority of the interviewed have only one property with one or two employees, which

would provide consistency between our results and the socio-economic factors suggested by Vignola et al. The lack of awareness surrounding these types of supporting services found with forest conservation and the demographic distribution of the respondents is consistent with the aforementioned study.

Overall, this case study exemplifies that there is a disconnect between the well-intentioned government programs, and the survey respondents' realities. Having a sufficient profit margin is more important than environmental conservation, unless areas are under direct threat, and this needs to be addressed if the current programs want to be sustainable over the long-term. The general consensus found throughout the responses gathered indicates that there is an issue that can be addressed through additional surveys to ranchers across the country. Our results can serve as a pilot study which clearly indicates that by consulting with the ranchers and farmers who use the PES programs, and those who do not, gaps in the legislation and education surrounding environment can be identified. The environment is clearly important, however, to reach more people and continue to recruit new land to incentive based programs, the private, academic, and legislative bodies would be well served by working together. Through the collaboration of multiple parties, more comprehensive and relevant policies and incentives can be created. Additional studies should be conducted in other provinces to assess whether there is a spatial, education, or economic bias. This information would prove very useful for designing education programs that are tailored to the needs in each region, and to provide appropriate regulatory controls in areas where it is necessary.

Conclusions

Based on the surveys that were distributed throughout Guanacaste and the overwhelmingly consistent responses that were received, we can conclude that the farmers of Guanacaste believe that conserving the environment is important, especially for water and air quality. The value of ecosystem services is not something that is appreciated by those who were surveyed, and the payments for ecosystem services were insufficient to continue to receive buy-in from farmers. The pay is too little to offset what would be gained by converting useable farm and pastureland, and therefore only unusable or extra land was put into the programs. These responses are important, as they indicate that there may be a disconnection between the program intent and how PES programs are perceived by ranchers. Given this, it is important to initiate additional consultations with a wide variety of land owners across Guanacaste and Costa

Rica. Further information provided by the farmers can give insight into the effectiveness of PES programs and education surrounding the environments, help policy makers to understand gaps between legislation and reality, and help to develop a more relevant set of incentives and restrictions which can help ranchers work in conjunction with their environment while not damaging it irrevocably.

References

- Assessment, M. E. (2005). Millennium ecosystem assessment. *Ecosystems and Human Well-Being: Biodiversity Synthesis, Published by World Resources Institute, Washington, DC.*
- Augelli, J. (1989). Modernization of Costa Rica's Beef Cattle Economy: 1950-1985. *Journal of Cultural Geography*. 9(2): 77-90.
- Bower, K. M. (2014). Water supply and sanitation of Costa Rica. *Environmental earth sciences*, 71(1), 107-123.
- Calvo-Alvarado, J., McLennan, B., Sánchez-Azofeifa, A., & Garvin, T. (2009). Deforestation and forest restoration in Guanacaste, Costa Rica: Putting conservation policies in context. *Forest Ecology and Management*, 258(6), 931-940.
- Carpenter, S. R., Mooney, H. A., Agard, J., Capistrano, D., DeFries, R. S., Díaz, S., ... & Perrings, C. (2009). Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences*, 106(5), 1305-1312.
- Castillo A., Quesada, M., Rodriguez, F., Anaya, F.C., Galicia, C., Monge, F., ... & Sanchez-Azofeifa, A. (2014). Tropical Dry Forests in Latin America: Analyzing the History of Land Use and Present Socio-Ecological Struggles. In *Tropical Dry Forests in the America: Ecology, Conservation, and Management*. Eds. Sanchez-Azofeifa, A., Powers, J., Fernandes, G.W., and Quesada M. Boca Raton, FL: CRC Press Taylor and Francis Group.
- Costanza, R., & Folke, C. (1997). Valuing ecosystem services with efficiency, fairness and sustainability as goals. *Nature's services: Societal dependence on natural ecosystems*, 49-70.
- Censo Nacional Agropecuario: Resultados Generales (2015). Instituto Nacional de Estadística y Censos. Primera edición. San José. Costa Rica. INEC, 2015. 146 p. ISBN: 978-9968-683-96-8.
- Daily, G. (1997). *Nature's services: societal dependence on natural ecosystems*. Island Press.

- Daily, G. C., Polasky, S., Goldstein, J., Kareiva, P. M., Mooney, H. A., Pejchar, L., Ricketts, T. H., Salzman, J. & Shallenberger, R. (2009). Ecosystem services in decision making: time to deliver. *Frontiers in Ecology and the Environment*, 7(1), 21-28.
- Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological economics*, 65(4), 663-674.
- Farley, J., & Costanza, R. (2010). Payments for ecosystem services: from local to global. *Ecological Economics*, 69(11), 2060-2068.
- Ibrahim, M., Abarca, S., & Flores, O. S. C. A. R. (2000). Geographical synthesis of data on Costa Rica pastures and their potential for improvement. *Quantifying sustainable Development: The future of tropical economics. Eds*, 423-446.
- Instituto Nacional de Estadística Y Censo. (2011). Población total por sexo, total de viviendas por ocupación y promedio de ocupantes según provincia, cantón y distrito. *Censos 2011*.
- Lambin, E. F., Meyfroidt, P., Rueda, X., Blackman, A., Börner, J., Cerutti, P. O., Dietsch, T., Jungmann, L. & Walker, N. F. (2014). Effectiveness and synergies of policy instruments for land use governance in tropical regions. *Global Environmental Change*, 28, 129-140.
- Lansing, D.M. (2017). Understanding Smallholder Participation in Payments for Ecosystem Services: the Case of Costa Rica. *Human Ecology*. 45: 77-87.
- McDade, L. A. (1994). *La Selva: ecology and natural history of a neotropical rain forest*. University of Chicago Press.
- Milder, J., Scherr, S., & Bracer, C. (2010). Trends and future potential of payment for ecosystem services to alleviate rural poverty in developing countries. *Ecology and Society*, 15(2).
- Niemelä, J., Saarela, S. R., Söderman, T., Kopperoinen, L., Yli-Pelkonen, V., Väre, S., & Kotze, D. J. (2010). Using the ecosystem services approach for better planning and conservation of urban green spaces: a Finland case study. *Biodiversity and Conservation*, 19(11), 3225-3243.
- Ross C. T. Sliding-scale environmental science payments and non-financial incentives: Results of a survey of landowner interest in Costa Rica. *Ecological Economics*. 130: 252-262.
- Pagiola, S. (2008). Payments for environmental services in Costa Rica. *Ecological economics*, 65(4), 712-724.

- Pagiola, S., Arcenas, A., & Platais, G. (2005). Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. *World development*, 33(2), 237-253.
- Porras, E., & Dekker, R. (2008). An inventory control system for spare parts at a refinery: An empirical comparison of different re-order point methods. *European Journal of Operational Research*, 184(1), 101-132.
- Robilino, J. & Pfaff, A. (2013). Ecopayments and Deforestation in Costa Rica: A Nationwide Analysis of PSA's Initial Years. *Land Economics*. 89(3): 432-448.
- Sánchez-Azofeifa, G. A., Pfaff, A., Robalino, J. A., & Boomhower, J. P. (2007). Costa Rica's payment for environmental services program: intention, implementation, and impact. *Conservation biology*, 21(5), 1165-1173.
- Stansifer C.L., Elbow, G.S., Karnes, T.L., & Parker, F.D. (2017). Costa Rica. *Encyclopedia Britannica*. Retrieved from: <https://www.britannica.com/place/Costa-Rica>.
- Sukhdev, P., Wittmer, H., Schröter-Schlaack, C., Nesshöver, C., Bishop, J., ten Brink, P., Gundimeda, H., Kumar, & Simmons, B. (2010). The economics of ecosystems and biodiversity: mainstreaming the economics of nature: a synthesis of the approach, conclusions and recommendations of TEEB. *European Communities*.
- United Nations (2014). System of Environmental-Economic Accounting 2012 - Central Framework. ISBN: 987-92-1-161563-0.
- Vignola, R., Koellner, T., Scholz, R. W., & McDaniels, T. L. (2010). Decision-making by farmers regarding ecosystem services: factors affecting soil conservation efforts in Costa Rica. *Land Use Policy*, 27(4), 1132-1142.
- Wunder, S. (2007). The efficiency of payments for environmental services in tropical conservation. *Conservation biology*, 21(1), 48-58.
- Zbinden, S., & Lee, D. R. (2005). Paying for environmental services: an analysis of participation in Costa Rica's PSA program. *World development*, 33(2), 255-272.