PROMOTING FOREST CONSERVATION IN THE PERUVIAN AMAZON: A STAKEHOLDER ANALYSIS OF INCENTIVE MECHANISMS

by

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Abstract

The Madre de Dios region of Peru is significant for its wealth of biodiversity and natural resources that sustain the local economy and provide ecosystem services. Current demand for extractive land uses (e.g., gold mining) favors land conversion over conservation, leading to questions about how to sustain this ecosystem. The purpose of this study was to understand the relationship between landholder preferences for land use and evaluate the potential to motivate landholders to support forest conservation.

Using secondary data from a household survey of 400 landholders, we examined relationships between landholder characteristics and willingness to conserve for cash and services (e.g., healthcare, education). Additionally, respondents ranked preferences for these services. The population was generally not well-educated and lacked health insurance and bank accounts. Most landholders expressed a willingness to participate in forest conservation in exchange for payments (78%) and for services (76%). Of the three main types of livelihoods examined, farmers ranked education and health insurance higher than Brazil nut harvesters. Wood harvesters did not differ significantly in their preferences.

Landholders demonstrated very little practical differences in their preferences for services indicating that the potential for successful forest conservation programs in the region exists, despite the increased demand for extractive land uses. Although financial payments are common tools used to promote conservation, the high preferences for health insurance and education indicate that social outcomes may be an effective inducement for conservation programs. However, additional research is required to understand factors that influence participation in such programs.

1. Primary Purpose

The Madre de Dios region of Peru is a significant biodiversity conservation area with a wealth of natural resources that sustain the local economy, provide ecosystem services and house several endangered species. There are currently three protected natural areas that aid in the conservation of these natural resources, but face imminent threats from local human activities. The Department of Madre De Dios is included in the Peruvian Amazon and houses at least a quarter of the world's terrestrial species, with countless species still yet to be identified (Webster, 2012). The forests within this region are also comprised of tropical, old growth trees that sequester a quarter of the world's carbon while contributing to 15% of land based photosynthesis (Kirkby, Guidice-Granados, Day et al, 2010; Webster, 2012).

This area is extremely important for biodiversity, but it is also inhabited by thousands of people who use the land in ways that promote land conversion over conservation, simultaneously threatening biodiversity. These land uses are ecotourism, logging, mining, farming and Brazil nut harvesting. Excluding ecotourism, which shows potential to be an alternative form of land use which could protect forests from further deforestation (Kirkby, Guidice-Granados, Day et al, 2010), and well managed Brazil nut harvesting, which requires a healthy tropical forest to be successful (Fraser, 2013), these land uses imperil the ecosystems of the region. Pressure from mining and logging is extremely high given the demand for natural resources. The rise in gold mining, for example, is reflective of the increase in market demand (Swenson, Carter, Domec et al, 2011). Gold mining causes mass deforestation at an alarming rate while also leaving behind pollutants and toxic chemicals (Butler, 2012). While mining is the leader in deforestation, logging and the harvesting of crops such as the Brazil nut also leave behind a fragmented landscape. With inadequate regulations and enforcement, the need for more holistic land management is crucial (Hajek, Ventresca, Scriven et al, 2011). This is especially true considering the current incentive structure favors land conversion over land conservation.

The question remains then, how can the sustainability and conservation of the region be enhanced? A possible answer would be to use incentives to bridge the gap between sustainability and conservation and current land uses. The success of incentive programs would depend on the willingness of the people of Madre de Dios to engage in conservation given the current demand for these natural resource products. The success of incentives as tools for conservation can be based on the Value Transfer Mechanism (VTM). Ideally, incentives target the changing of behaviors and do not pay people for activities that they were already going to do (McClenathan, 2013). There are four main forms in which values can be transferred to create an incentive for conservation: cash, services, productive assets, and access to credit; each having advantages, disadvantages, and all requiring they are appropriate for the community (McClenathan, 2013).

The purpose of this research is to understand concession holder preferences and determine whether or not incentives would be the proper tool to promote conservation

while maintaining livelihoods. The independent variables will be defined as land uses and demographics and the dependent variables will be defined as preferences for incentives. The objectives of this paper are to assess technical needs and abilities, demographics, and land uses. Questions targeted in the data will include willingness to conserve based on cash versus services, length of contract, and ranking of various services. Background information of the area and comparable incentive programs are important to this study to help understand the relationship between demographics and preferences. A thorough literature review examines several comparable studies that visit these very issues, but have gone on to implement incentive programs. Background on the environmental degradation of economic activities and current infrastructure in the community should also be addressed. The population of Madre de Dios has already made a significant pledge towards a forest based economy, by setting aside over 80% of their territory as Protected Areas and sustainable logging concessions (Oliveira, Soares-Filho, and Alexandrino, et al 2013). Therefore, it is possible that incentives would be well received and would create significant local goodwill on which to continue building a vision for Madre de Dios where biodiversity and economic needs can co-exist (Hajek, Ventresca, Scriven et al, 2011). The objective of this paper is not to prescribe an incentive program for the Madre de Dios region of Peru, but rather to focus on intensive data analysis to uncover potential indicators for natural resource conservation in this region. However, based on the findings and coupled with further research, there is potential to prescribe an incentive program could achieve a sustainable level of local natural resource conservation.

2. Background

Located in southeastern Peru (Figure 1), Madre de Dios was established in December of 1912 and consists of three provinces: Tambopata, Manu, and Tahuamanu. The area is known for it's natural beauty and natural resources. The Ministry of the Environment and several other government organizations have created three main reserves to protect and strengthen the environmental management. These natural reserves are shown in Figure 2. Tambopata National Reserve (TNR) covers 274,690 hectares and contains an immeasurable wealth of biodiversity including over 600 species of birds, 205 species of fish, and 169 species of mammals (UNEP 2013). Bahuaja Sonene National Park is over one thousand hectares in size and protects the only tropical humid savanna in Peru, as well as species such as the maned wolf, *Chrysocyon brachyurus*, giant anteater, *Myrmecophaga tridactyla,* and the harpy eagle, *Harpia harpyja* (UNEP 2013). Manu National Park (MNP) is the largest protected natural area in Peru, spanning 1.5 million hectares, and has been claimed as one of the best wildlife destinations in the Amazon (UNEP 2013). MNP has been declared as a Natural World Heritage Site by UNESCO, and is inhabited by a variety of native communities and Amazonian peoples (Peru Travel Guide, go2peru.com)

http://www.peru4youtours.com/aboutperu.php

Fig 1. Madre de Dios is located in Southeast Peru and borders Brazil and Bolivia.

http://www.icfcanada.org/lacc.shtml

Fig 2. Manu National Park, Tambopata National Reserve, Bahuaja Sonene National Park , as well as several other conservation areas make up a large portion of the land within Madre de Dios.

The regions in and around the Protected Natural Areas are also inhabited by local people and migrant workers who utilize the land in ways that potentially jeopardize the fragile ecosystems of the area. While Madre de Dios has one of the smallest populations in

Peru, the latest census reported 102,174 inhabitants, the pressure from deforestation and natural resource extraction can still be felt, particularly the local gold mining, logging, farming and brazil nut harvesting (Hajek, Ventresca, Scriven, et al, 2011).

2.1 Mineral Extraction: Gold

One of the fastest growing and detrimental local land uses is the mining of gold. Gold mining, which has been occurring in Peru for decades, now produces nearly 70% of the country's gold (Swenson, Carter, Domec et al, 2011). Even with a large mass of acreage set aside for protected land and areas that require miners to formally register and present environmental impact statements, Madre de Dios still experiences high numbers of illegal mining due to a lack of law enforcement and infrastructure (Swenson, Carter, Domec et al, 2011). This problem is exacerbated by record high gold prices. While the exact monetary figures of gold mining are difficult to quantify, it is clear that it is a practice which a large portion of the population rely on for income (Webster, 2012). A majority of illegal miners are among the poorest of the community (Swenson, Carter, Domec et al, 2011) and have migrated to the area in hopes of making upwards $100 in one days work, a high figure in a country where $100 per month is minimum wage (Frazer, 2009). These demographics make targeting miners with non-cash incentives difficult. Mining practices also rely on mercury to extract gold (Gardner, 2012), which is as difficult to control as the influx of miners themselves. The mercury used is toxic and its affects can be seen in every level of the food chain, even in humans. Potentially, controlling the import of mercury could aid in the control of illegal mining (Gardner, 2012).

While the monetary trail of gold mining is hard to follow, the path of deforestation and environmental impacts is not. The dense jungle and river systems within the Peruvian Amazon make deforestation impacts difficult to monitor in person, but the increased use of satellite imagery has allowed researchers to see the fragmented landscapes due to mining (Swenson, Carter, Domec et al, 2011). Deforestation is occurring at nearly 2000 hectares a year (Fraser, 2011). River edges and forested areas alike are being excavated by machinery that can clear a football sized area of land in a few, short hours (Fraser, 2011). While a majority of the mining is taking place on the outskirts on the protected areas, some is making its way into the reserves, further threatening the biota with a loss of habitat.

Sheer loss of habitat is not the only threat that mining places on the environment within Madre de Dios, the mercury used in the extraction process has detrimental effects on wildlife and humans. The small flecks of gold obtained after blasting away sand and gravel with hoses are removed by creating an amalgam with liquid mercury, which is mixed directly by hand (Fraser, 2009). The mercury is then released into the waterways and atmosphere when processed by buyers and sellers to remove its excess (Gardner, 2012). Similar to other metallic toxins, it accumulates in the food chain and has been found in high concentrations in fish that local people consume (Fraser 2011). The unhealthy levels of mercury can cause brain and kidney damage and possibly many other effects that

have yet to be documented (Gardner, 2012). While some locals seem to be aware of the danger, many continue to support the illegal influx on the metal and disregard health concerns (Gardner, 2012). The lawlessness and poor land management surrounding gold mining radiates through other forms of land use including logging and agriculture which also have difficulty using the land in a sustainable way.

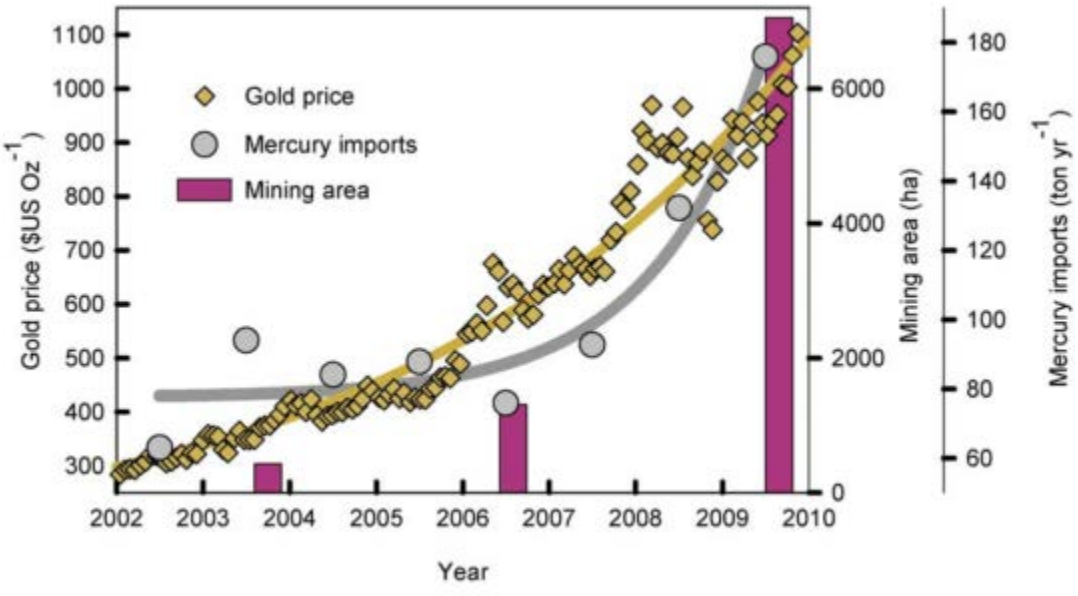

Fig. 3. Gold mining in the Peruvian Amazon; global prices, deforestation, and mercury import. *Source:* Swensen et a. 2011.
Increased mining area reflects the almost linear increase in gold prices as well as increased mercury imports.

2.2 Logging

Peru's logging industry has been growing for decades and subsequently contributes to a large portion of the region's economy. In 1975, an original forestry law came into place that laid out a system of both small and large contracts for logging operators (Smith, Colan, Sabogal et al 2006). These contracts had several restrictions and because of this, many loggers chose smaller contracts over the large contracts that could last well over ten years. This still holds true today as many landholders circumvent the law and acquire multiple small contracts (Smith, Colan, Sabogal et all 2006). The acres within these small contracts are considered large enough to return a profit (Superintendencia Forestal, 2001). Contracts between communities or private landowners are referred to as informal logging operations. In contrast to formal logging which follows harvest restrictions and strategic planning of roads and forest access, informal logging tends to target only the most profitable trees while leaving behind a mosaic of patches throughout the forest (Soriano, Kainers, Staudhammerb et al, 2011).

A new forest regime was created in 2002 to address some of the major issues of the timber extraction business. This included the designation of 25 million hectares for permanent timber management as well as a more transparent system of buying concessions (Smith, Colan, Sabogal et al, 2006). Logging practices were still authorized and approved by Forest Management Plan and an Annual Operational Plan. In addition to these regulations, if a concession owner's logging practices were deemed sustainable their fees (area-based taxes) could be reduced (Smith, Colan, Sabogal et al, 2006). While the new regime showed promise of improving the timber industry, it could not single handedly alter the behaviors of all people in the area. Informal logging has become the norm and is seen as justifiable and safe (Smith, Colan, Sabogal et al, 2006). The logging industry has similar issues to that of mining, "Governance failures that have promoted norms inconsistent with good management are government's perceived lack of interest in long-term timber management, inconsistent forestry laws, perceived discrimination against the timber sector, and ineffective law enforcement," (Smith, Colan, Sabogal et al, 2006 pg. 2) Unfortunately, under the new regime illegal logging has increased (Torres, 2003).

The rise in illegal logging is especially detrimental to the conservation of the forested lands within the Peruvian Amazon. Sanctioned forest extraction activities, those that are formal and regulated, show less deforestation than unmanaged timber extraction (Oliveira, Asner, Knapp et al, 2007). Limiting logging to authorized annual harvest areas also promotes long-term sustainability by protecting timber volumes, biodiversity and ecological processes in unlogged areas (Snook et al., 2002). Timber extraction businesses and conservation would both succeed if the government increased the effort to promote long-term forest management.

Another initiative that is benefiting the logging industry is multiple-use forest harvesting. Multiple-use forest harvesting integrates management for diverse products such as timber, non-timber forest products, and environmental services (Smith and Scherr, 2003; Garca-Fernandez et al., 2008; Guariguata et al., 2010). Multiple-use forest harvesting aims to incentivize landowners to protect the standing forests on their land while also enabling them to use beneficial harvesting methods and make a profit from several activities (Soriano, Kainer, Staudhammer et al, 2011). A successful example of this is the combination of Brazil nut harvesting and selective logging. The logging has no effect on the Brazil nuts and the densities of tree species increases with logging (Soriano, Kainer, Staudhammer et al, 2011). This method of incentivizing landowners to conserve forested land is not without issues and similar to mining and crop harvesting, requires reformed land policies.

2.3 Brazil Nut Harvesting

The Brazil nut is a key economic species for Peruvian landowners due to its presence in the international trade market (Ortiz, 2002). It should be made clear that the

Brazil nut has the capability to promote forest conservation due to the fact that Brazil nuts only thrive in natural forests (Evans, 2013). According to a study done by the Center for International Forestry Research, plantations of brazil nut trees have not been as successful as natural, old growth forests. However, many landowners who harvest Brazil nuts commercially also remove other species of trees in logging operations. As mentioned above, this multiple-use logging can be sustainable when done properly. However it also has the capacity to remove large patches of forest as harvesters clear the trees to access the crop trees (Evans, 2013). Similar to the other land uses, mining and logging, there is a lack of enforcement, especially in property rights. Brazil nut harvesters report multiple instances of having trees stolen from their concessions and even Brazil nut trees being cut down in vandalism (Fraser, 2013). There is also a high occurrence of overlap between agriculture concessions and concessions for nut harvesting. This most likely happens because harvesters feel that they are not receiving enough income from the nuts and therefore choose to clear land for farming (Fraser, 2013). Brazil nut harvesters would benefit from technical assistance in the process of harvesting and processing the nuts and this could potentially incentivize them to maintain their forests for the well being of the Brazil nut trees (Evans, 2013).

2.4 Farming and Agriculture

The harvesting of Brazil nuts is a successful non-timber forest product and contributes a substantial amount to the economy of southeastern Peru, however it is not always the most feasible do to access to markets and proper harvesting methods (Phyhala, Brown, Adger 2006). A much more common land use is agriculture and farming of both crops and livestock. According to the Peruvian Ministry of Agriculture, 30% of the country's working population is employed in the agriculture sector. This is in part due to the wide variety of climates that allow various species of crops to thrive. Peru has the most varieties of potatoes as well as wild corn species, fruits, and medicinal plants. Crops of national important include Coffee, potatoes, rice, cotton, asparagus and sugar. Common livestock found in Peru are sheep, poultry, cattle and pigs. The same trends can be seen in Madre de Dios where over 40% of the Madre de Dios occupies about 40% of the economically active population (Oliveira, Soares-Filho, Alexandrino 2011).

While farming makes up nearly half of the livelihoods for the people of Madre de Dios, most agricultural activities are run by small landowners (Oliveira, Soares-Filho, Alexandrino 2011). This is due to the rural setting of the area and therefore agricultural production in Madre de Dios is mainly non industrial and requires manually cultivating and harvesting crops for the subsistence consumption by the farmers and their families. The crops and livestock are also sold primarily to the local markets with easiest access (Oliveira, Soares-Filho, Alexandrino 2011). Small, landowner based farming also means that the farms are laid out in a patchwork across the land and their impacts on the environment are

difficult to quantify. These impacts include but are not limited to erosion, loss of organic material in the soil, deforestation, and chemical imbalances in streams and rivers due to the influx of livestock waste (All and Terms, 2013). The government faces similar management and policy enforcement difficulties as logging and mining and struggles to mitigate and address the effects of land conversion for agriculture on the ecosystem (Chavez, Perz 2012). Livestock and crop productions systems should be managed as ecosystems based on environmental costs and benefits and the important ecological interactions between the human based land use and the natural environment (Robertson, Swinton 2005). Thus, managing for multiple services and outcomes could reduce the environmental footprint of agriculture. This type of management may require public education and the use of incentives that reward environmental stewardship. Further incentive recommendations are addressed in the following section.

2.5 Incentivizing a Community

It is clear that the Amazon, and more specifically the Peruvian Amazon, has incredible environmental value. The present struggle is that this value has not taken precedence over the land uses that threaten it. Environmental organizations and NGO's including REDD have therefore made an attempt to reveal this value by means of incentives (Wolman, 2004) via Value Transfer Mechanisms (VTM).

2.5.1 Cash

Cash is the most direct VTM and can be appropriate when considering payment for ecosystem services that have an identifiable value (McClanathan, 2013). An example of an identifiable value would be water sources that provide clean drinking water for a community. The value of the clean water is identifiable, or recognizable, to the community. This is a common method for many private organizations including The Nature Conservancy, Conservation International, and World Wildlife Fund when private concessions are purchased from landowners to be set aside as a reserve (Wolman, 2004). Cash payment has limited potential, especially in areas where the community does not respect the legitimacy of the reserve (Hajek, Ventresca, Scriven et al, 2011). Often time's cash payments are connected to another form of VTM, such as services to promote behavior change and not dependency on payment.

2.5.2 Services and Productive Assets

Services and productive assets use payments other than cash to incentivize a behavior change. An example of alternative economic activity would be educating and enabling a land owner to grow a crop that reduces erosion but is also able to harvested for a supplemental income (McClanathan, 2013), an example would the harvesting of Brazil nuts.

The success of this mechanism would be reflective of the landowners' willingness to change current land management practices.

Services aim to benefit the people of the area in two separate ways: income and non-income improving services (McClanathan, 2013). A disadvantage to these methods is that non-income services require a community to value services such as education and health as they do resources with dollar value (Wolman, 2004). Conditionalities such as these can be seen in income-improving services as well when all members of a community would not benefit equally from a service (Hajek, Ventresca, Scricven et al, 2011).

A successful example of services as a VTM was completed by conservation International de Brazil by funding a research station with acreage to grow and regenerate native tree species (Schwartsman and Zimmerman, 2005). The local community benefits from the research station with employment, training in harvesting techniques, as well as administrative and technical support for other business opportunities (Schwartzman and Zimmerman, 2005). This alternative form of land use was successful as an incentive because local indigenous peoples were able to see the value.

2.5.3 Access to Credit

The final method of value transfer, access to credit, has potential but is not without challenges and is appropriate only in certain situations. Members of a community need to show motivation to have credit (McClanathan, 2013). A successful example of a credit scheme was introduced in Brazil due to poor land uses polluting the headwaters and riparian areas in Xingu Reserve. A successful stakeholders meeting involving ranchers, agriculturists, environmentalists and indigenous peoples was held and all agreed to restore the watershed by seeking subsidized official credit for the landowners (Schwartzman and Zimmerman, 2005). If credit is not seen as an incentive, the VTM will fail. As briefly laid out, VTM's require many questions to be researched and asked about a community to determine the appropriate means of engaging them in conservation.

There is still knowledge and experience that remains to be gained about conservation incentives in order to achieve the most success. The management of property rights, economic alternatives, and the linking of development benefits with conservation will be essential (Schwartzman and Zimmerman, 2005). As stated by a REDD initiative, incentives require a bottom-up approach because the future of this diverse region in the Peruvian Amazon rests in the hands of local people (Hajek, Ventresca, Scriven et al, 2011). A middle ground between financial gains of the community and the NGO's and governing agencies will have to be met. Clearly, the diversity of conservation strategies that have arisen in recent years is a beneficial development. There is not a one-size-fits-all approach to conservation, given the different demands of both land-owners and conservation organizations (Wolman, 2004).

In summary, it is apparent that the unique and biologically sensitive Madre de Dios region of Peru shows signs of impact from the variety of land uses of its inhabitants. Certain impacts are proving far more detrimental than others, but ultimately, varying incentive programs to alter land use would be beneficial. The purpose of this research is to understand how the preferences of concession holders will influence their willingness to engage in conservation through incentives. The influence of demographics, namely the inhabitant's level of education, on type of livelihood, and owning services such as health care, bank accounts and communication devices, will have a direct effect on the willingness to conserve their land/concession land based on various incentive programs. In addition, the inhabitant's type of livelihood in combination with their choice of concession length will have a direct effect on their willingness to conserve land for certain services. However, additional research is needed to understand the context in which local inhabitants interact and encounter the NGO's in these host communities.

3. Methods

The original research survey was funded by the InterAmerican Development Bank in order to gather information as a part of a larger project exploring the design of a regional economic development fund. The survey targeted 400 households in Madre de Dios and was overseen by NGO Nature Services Peru. The survey was designed by Josh Donlan and his team by using previous research and literature to target information about the various livelihoods in the area. The interviews were administered by trained locals and the research team via face-to-face interviews. The results were then coded and after thorough investigation there were three main questions left to be tested: Are they willing? How willing (contract length)? What do they want based on what they already have?

A flowchart was created to depict the exploration of relationships between the variables (Figure 4)

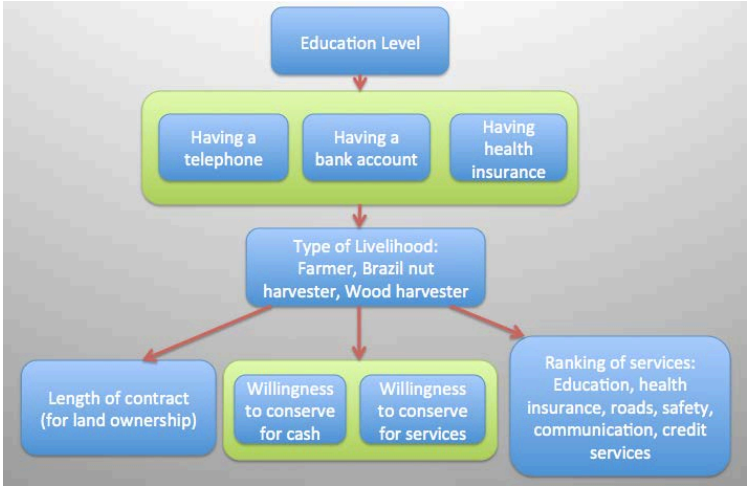

Fig. 4. Framework for analyzing the education level of the respondents.

From there I examined the relationships between levels of education and having a variety of amenities as indicators of wealth and to answer the question, "What do they have?" Next, I looked into the association between education and type of livelihood. Livelihood was then compared with length of contract (to maintain forest) to determine "How willing are they to conserve". The next relationship examined answered the question "Are they willing to conserve," based on cash and service incentives. Finally, the rankings of services (from most to least important on a scale of 1-6) were investigated against the three livelihoods to determine "What they want".

To explore the relationships between education and having certain amenities (e.g., bank account, telephone, health insurance) I conducted chi-square analysis. I used residual analysis to determine the relationships between landowner type and behavior (i.e. the cells of the chi-square table) that contributed to a statistically significant result. I standardized and adjusted these residuals so that they could be interpreted as z-scores (Sorice, Kreuter, Wilcox, Fox, 2013). Adjusted standardized residuals greater than 1.96 indicate that the number of observations in a cell was significantly greater than the expected number, whereas residuals less than -1.96 indicates that the number of observations was significantly less than expected (Sorice, Kreuter, Wilcox, Fox, 2013). I also used this method to explore the relationships between livelihood and education, livelihood and willingness to conserve, and livelihood and length of contract.

To explore the relationship between livelihood and rankings of services, I conducted a one-way analysis of variance (ANOVA) to determine whether there were any significant differences between the means of two or more unrelated groups. Assumptions that held true for our data were that the dependent variable must be continuous (rankings), independent variable must be categorical (livelihood), no significant outliers occurred and

there was approximately normal distribution. A Tukey HSD post-hoc analysis was chosen to determine which specific groups differed from one another within the cells.

4. Results:

4.1 Education

To understand the relationship between education and having amenities and education and livelihood, I first examined the frequency of each level of education: elementary, high school, technical, and university. I found that 40% of respondents had an elementary level of education, 46% had a high school education, 10% had a technical level of education and 4% had a university level of education.

4.1.1Education and Amenities

The first relationship examined was between education level and having a bank account (Table 1A). Most respondents with either an elementary (87%) or a high school (81%) education level do not have a bank account ($X^2_{(3)} = 24.38$, $p = .000$). In contrast, more respondents with either a technical (42%) or a university (86%) level of education had bank accounts than expected. The second relationship we examined was between education level and having a telephone (Table 1B). Regardless of education level, most respondents do have a telephone ($X^2_{(3)} = 14.85$, $p = .002$) . More respondents than expected with an elementary education did not have a telephone (37%) and all respondents with a university level of education did have a telephone (100%), more than expected. The third relationship we examined was between education level and having health insurance (Table 1C). Most respondents regardless of their level of education did not have health insurance ($X^2_{(3)} = 5.52$, $p = .137$).

Table 1A. Relationship between the four levels of education and having a bank account. Cell numbers are given as row percentages within the education level for answering either, "Yes" or "No." $X^2_{(3)} = 24.38$, $p < 0.001$, $n = 386$

Education Level	Yes (%)	No (%)
Elementary	12 ↓	87 ↑
High School	19 ↓	81 ↑
Technical	42 ↑	58 ↓
University	47 ↑	53 ↓

↓Adjusted Standardized Residual <-1.96, the number of observations in this cell is less than expected.

↑Adjusted Standardized Residual >1.96, the number of observations in this cell is greater than expected.

Table 1B. Relationship between the four levels of education and having a telephone. Cell numbers are given as row percentages within the education level for answering either, "Yes" or "No." $X^2_{(3)} = 14.85$, p = .002, n = 387

Education level	Yes (%)	No (%)
Elementary	62 ↓	38 ↑
High School	76	24
Technical	76	24
University	100 ↑	0 ↓

↓ Adjusted Standardized Residual ≤1.96, the number of observations in this cell is less than expected.
↑ Adjusted Standardized Residual >1.96, the number of observations in this cell is greater than expected.

Table 1C. Relationship between the four levels of education and having health insurance. Cell numbers are given as row percentages within the education level for answering either, "Yes" or "No." $X^2_{(3)} = 5.52$, p = .137, n = 387

Education Level	Yes (%)	No (%)
Elementary	40	60
High School	36	64
Technical	40	60
University	67 ↑	33 ↓

↓ Adjusted Standardized Residual ≤1.96, the number of observations in this cell is less than expected.
↑ Adjusted Standardized Residual >1.96, the number of observations in this cell is greater than expected.

4.1.2 Education and Livelihood

Prior to examining this relationship, we first calculated the frequencies for each other three livelihoods: 76% farmers, 13% wood harvesters, and 11% Brazil nut harvesters (figure 5). Results from the chi-square analysis indicated that wood harvesters were more likely than expected to have a university level of education and farmers were less likely than expected to have a university level of education ($X^2_{(6)} = 21.12$, p = .002). Brazil nut harvesters had the lowest proportion of individuals with a university degree (6%) (Table 2).

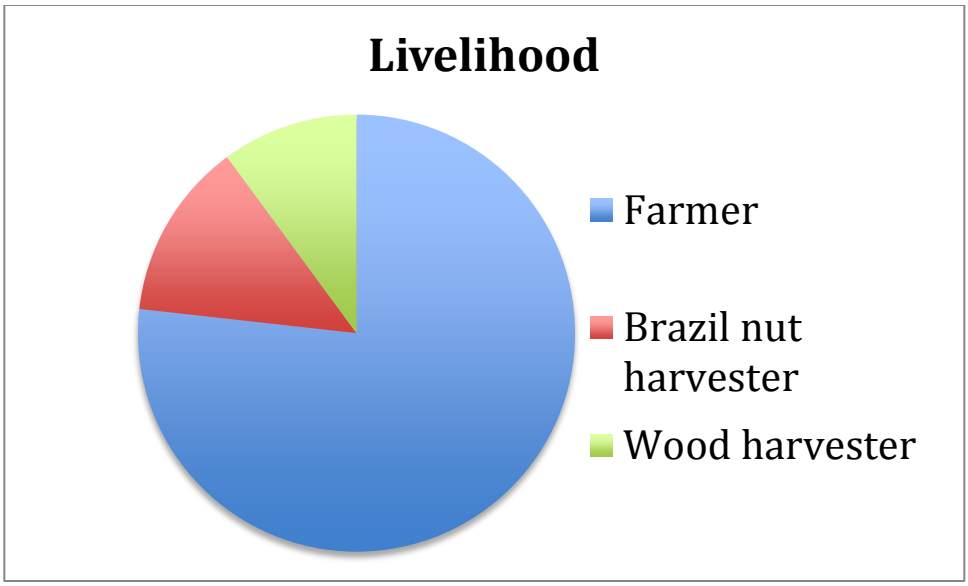

Fig. 5.

Table 2 Relationship between the four levels of education and the three types of livelihood. Cell numbers are given as row percentages within the education level. $X^2_{(6)} = 21.12$, $p = .002$, $n = 390$

Education Level	Farmer (%)	Brazil Nut Harvester (%)	Wood Harvester (%)
Elementary	77	15	7
High School	79	12	9
Technical	63 ↓	16	21 ↑
University	53 ↓	7	40 ↑

↓ Adjusted Standardized Residual <-1.96, the number of observations in this cell is less than expected.

↑ Adjusted Standardized Residual >1.96, the number of observations in this cell is greater than expected.

4.2 Livelihood

4.2.1 Livelihood and Length of Contract

The question in the survey asked landholders to choose between four lengths of contract: 1 year, 1-5 years, 5-10 years, or 10-20 years. The contract applies to a parcel of land, which the landholder would privately own and manage for conservation purposes for a designated amount of time. Most respondents (45%) chose a contract length of 1-5 years. Very few (7%) chose 5-10 years and an equal percentage (~25%) chose either 1 year or 10-20 years. The chi-square analysis showed that there was no statistically significant relationship between livelihood and length of contract ($X^2_{(6)} = 6.32$, $p = .388$).

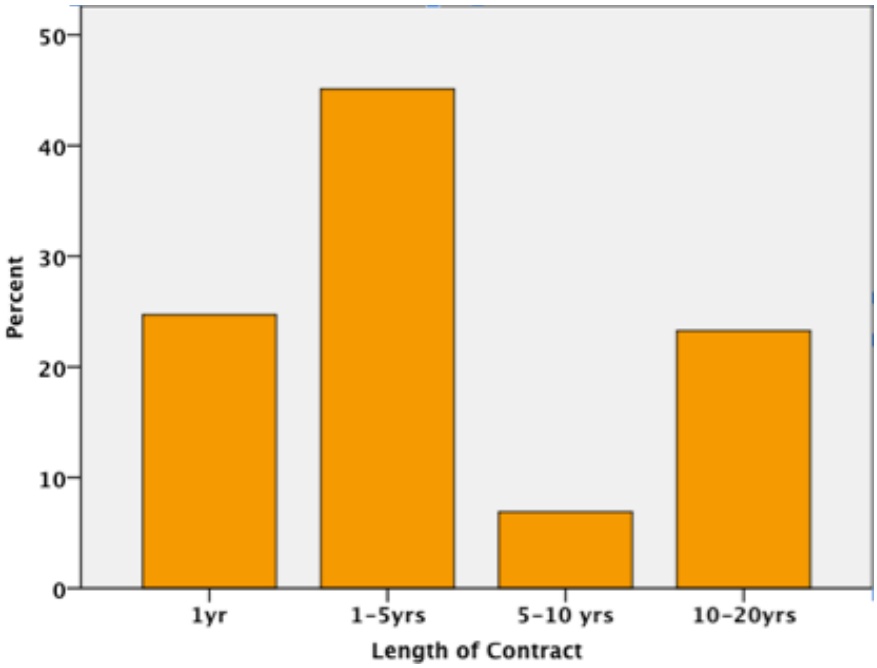

Fig. 6. The percentage at which respondents chose one of the four contract lengths

4.2.2 Livelihood and Willingness to Conserve

Respondents were asked yes or no questions about their willingness to conserve (maintain forest) for cash and willingness to conserve for services. First we examined the relationship between livelihood and conserving for a cash incentive. A majority of respondents answered yes (79%). However, more farmers than expected (24%) said no to the cash incentive and more Brazil nut harvesters (94%) said yes ($X^2_{(2)} = 12.41$, $p = .002$) (Table 3A). Second, most landholders answered "Yes" (76%) to services, but there was no statistically significant difference in responses by livelihood ($X^2_{(2)} = 3.63$, $p = .162$) (Table 3B).

Table 3A Distribution of responses to willingness to conserve for cash. Cell numbers are row percentages within livelihood type. $X^2_{(2)} = 12.41$, $p = .002$, $n = 392$

Livelihood	**Yes (%)**	**No (%)**
Farmer	75 ↓	25 ↑
Brazil Nut Harvester	94 ↑	6 ↓
Wood Harvester	90	10

↓Adjusted Standardized Residual <-1.96, the number of observations in this cell is less than expected.
↑Adjusted Standardized Residual >1.96, the number of observations in this cell is greater than expected.

Table 3B Distribution of responses to willingness to conserve for services. Cell numbers are row percentages within livelihood type. $X^2_{(2)} = 3.63$, p = .162, n = 394

Livelihood	Yes (%)	No (%)
Farmer	78	22
Brazil Nut Harvester	67	33
Wood Harvester	76	24

↓ Adjusted Standardized Residual ≤1.96, the number of observations in this cell is less than expected.
↑ Adjusted Standardized Residual >1.96, the number of observations in this cell is greater than expected.

4.2.3 Livelihood and Ranking of services

4.2.3.1 Livelihood and Ranking of Communication

A one-way ANOVA was used to test for differences among the three types of livelihood. Preferences for how roads were ranked in importance did not differ significantly across the three livelihoods, $F_{(2, 360)} = 1.385$, $p = .252$. Tukey post-hoc comparisons of the three groups indicate that the Farmer group ($M = 3.57$, 95% CI [3.41, 3.73]) did not give significantly higher preference rankings than the Brazil Nut Harvester group ($M = 3.31$, 95% CI [2.79, 3.84]), $p = .561$, or the Wood Harvester group ($M = 3.22$, 95% CI [2.76, 3.69]), $p = .561$. Comparisons between the Brazil Nut Harvester and Wood Harvester group were also not significant, p = .958

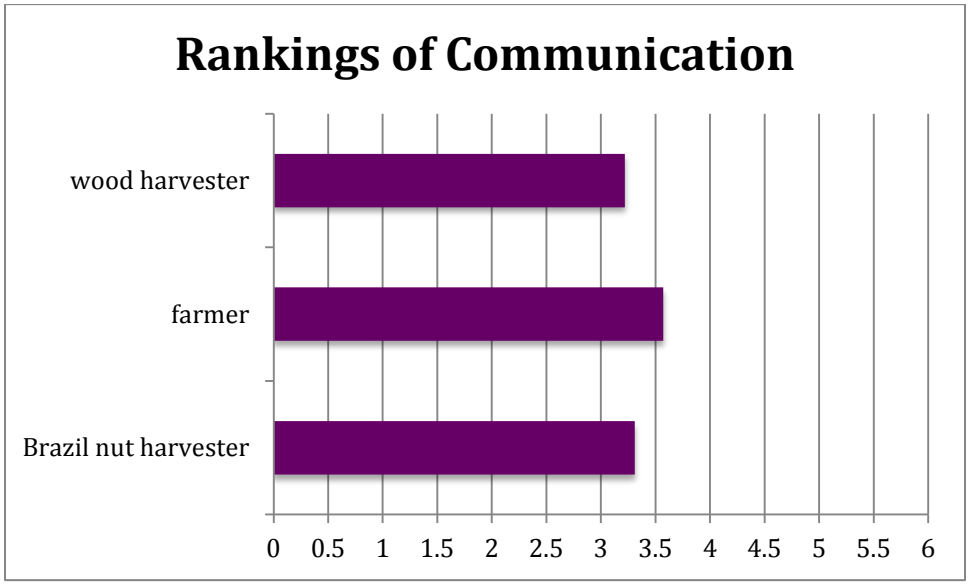

Fig. 7. Mean ranking of importance of communication on a scale of 1 (most important) to 6 (least important).

4.2.3.2 Livelihood and Ranking of Education

To examine the different rankings of education among the three livelihoods a one-way ANOVA was used. Rankings for education differed slightly among the groups, $F_{(2, 371)}$

=6.635, p = .001. Tukey post-hoc comparisons showed that the difference occurred between Farmers (M = 2.50, 95% CI [2.34, 2.76]) and Brazil nut harvesters (M = 3.40, 95% CI [2.86, 3.94]), p = .001. There was no difference between Farmers and Wood harvesters (M = 2.63, 95% CI [2.19, 3.07]), p = .867. There was only marginal significant difference between Brazil nut harvesters and Wood harvesters, p = .054.

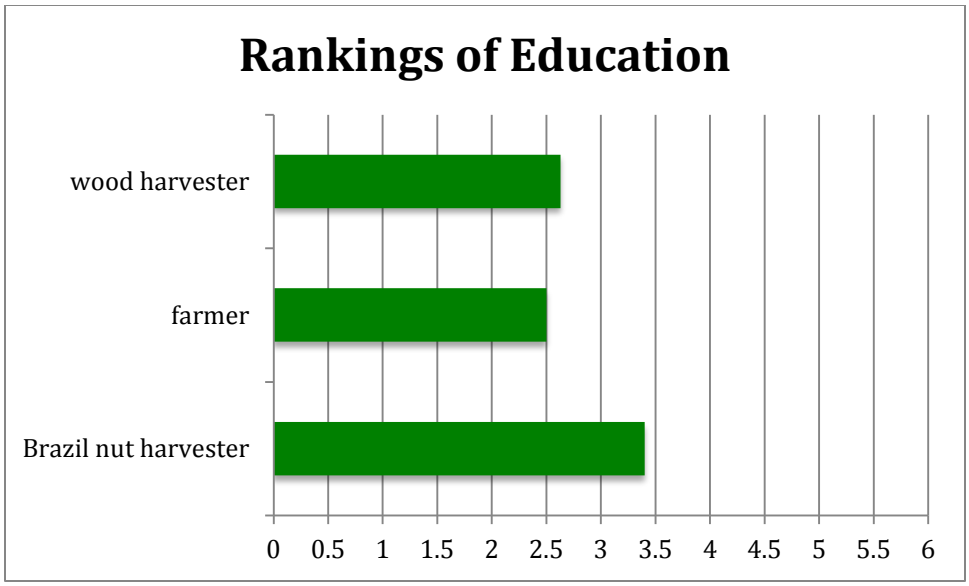

Fig. 8. Mean ranking of importance of education on a scale of 1 (most important) to 6 (least important).

4.2.3.3 Livelihood and Ranking of Roads

According the one-way ANOVA, there was a significant difference among the three livelihoods $F_{(2, 369)}$ =7.795, p = .000. A tukey post-hoc indicated that the difference occurred between Brazil nut harvesters (M = 3.59, 95% CI [3.07, 4.11]) and farmers (M = 4.52, 95% CI [4.43, 4.69]), p = .001. There was no difference between the farmers and wood harvesters (M = 3.97, 95% CI [3.44, 4.51]), p = .097, or the wood harvesters and Brazil nut harvesters, p = .509.

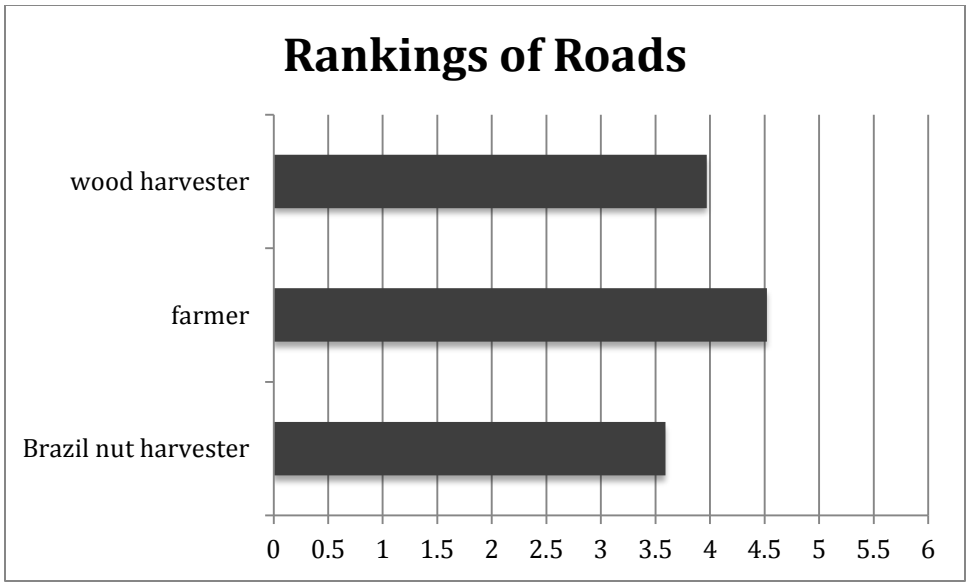

Fig. 9. Mean ranking of importance of roads on a scale of 1 (most important) to 6 (least important).

4.2.3.4 Livelihood and Ranking of Safety

Similar to the significant differences in the ranking of roads, the results of the service, safety were also significant $F_{(2, 366)} = 4.968$, $p = .007$. The differences occurred again between Farmers ($M = 4.18$, 95% CI [4.02, 4.34]) and Brazil nut harvesters ($M = 4.47$, 95% CI [3.07, 3.88]), p = .010. There were no significant differences between Farmers and Wood harvesters ($M = 3.81$, 95% CI [3.22, 4.39]), p = .285, of between Wood harvesters and Brazil nut harvesters, p = .570.

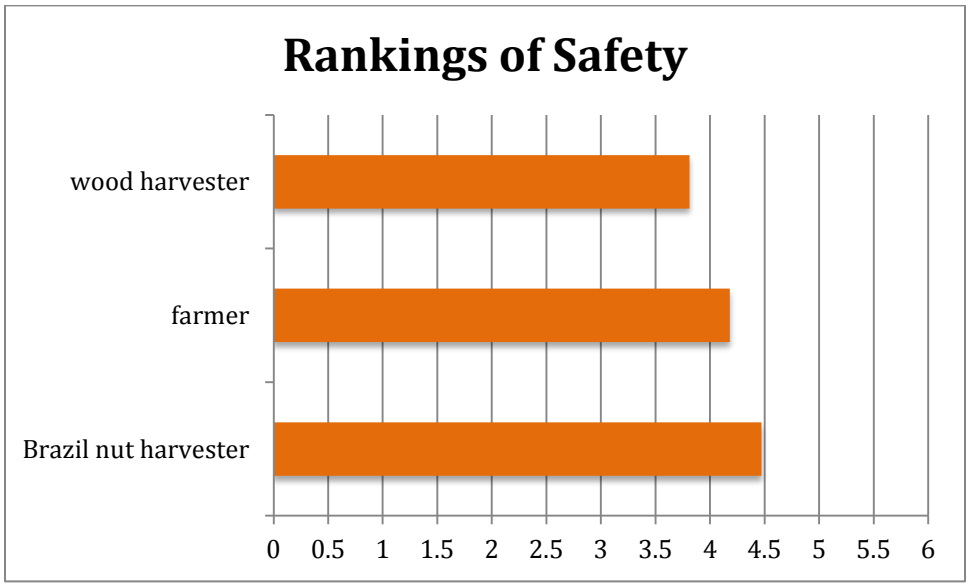

Fig. 10. Mean ranking of importance of safety on a scale of 1 (most important) to 6 (least important).

4.2.3.5 Livelihood and Ranking of Health Insurance

The one-way ANOVA showed significant differences in the ranking of health insurance $F_{(2, 374)} = 4.517$, $p = .012$. The Tukey post-hoc indicated that the differences which did occur between farmers ($M = 2.15$, 95% CI [2.00, 2.31]) and Brazil nut harvesters ($M = 2.69$, 95% CI [2.14, 3.24]) were only marginal, $p = .063$. There was also marginal difference between wood harvesters ($M = 2.71$, 95% CI [2.17, 3.25]) and farmers, $p = .066$.

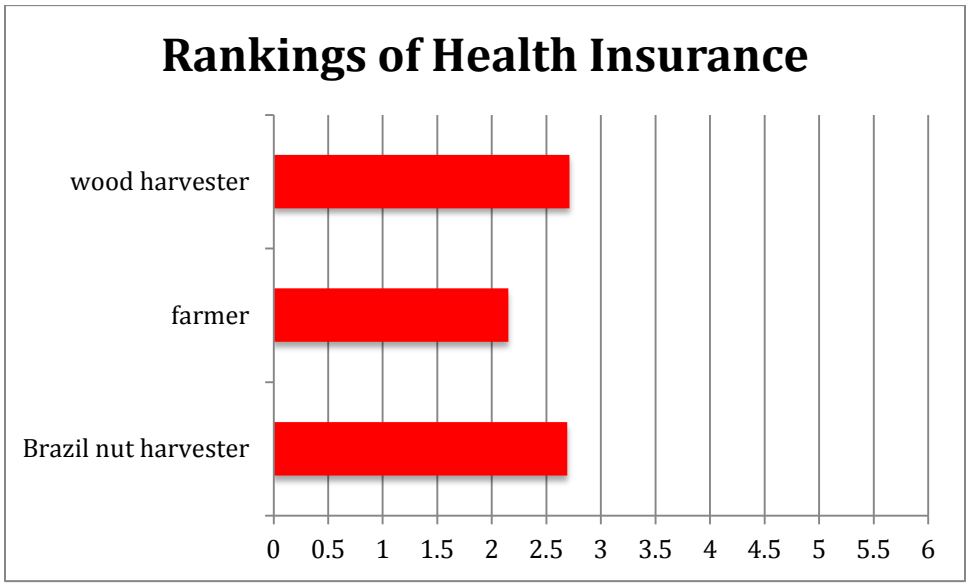

Fig. 11. Mean ranking of importance of health insurance on a scale of 1 (most important) to 6 (least important).

4.2.3.6 Livelihood and Ranking of Credit Services

The one-way ANOVA showed no significant differences among the three types of livelihood and their rankings of credit services $F_{(2, 372)} = 2.494$, $p = .447$. Due to the lack of significant difference, the Tukey post-hoc showed no significance in any of the cells.

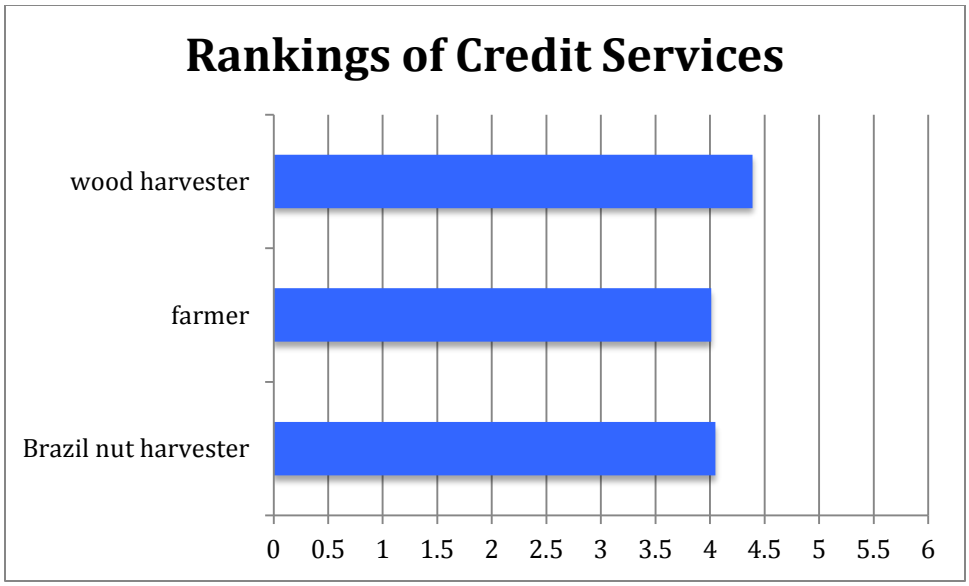

Fig. 12. Mean ranking of importance of credit services on a scale of 1 (most important) to 6 (least important).

Table 4.

Table 4A. Results of post-hoc tests show the distribution of locations within the cells where significant differences were indicated by analysis. Depicts the relationships between the three livelihoods: F = farmer, W = wood harvester, BN = Brazil nut harvester and three of the service rankings.

Livelihoods	**Communication**	**Education**	**Roads**
F and W	.334	.867	.097
F and BN	.561	.001*	.001*
W and BN	.958	.054**	.509
One-way ANOVA	$F_{(2, 360)}$=1.385, p = .252	$F_{(2, 371)}$= 6.635, p = .001.	$F_{(2, 369)}$ =7.795, p = .000

*Indicates where significant differences occurred in Tukey post-hoc

**Indicates where marginally significant differences occurred in Tukey post-hoc

Table 4B. Results of post-hoc tests show the distribution of locations within the cells where significant differences were indicated by the analysis. Depicts the relationship between the three livelihoods: F = farmer, W = wood harvester, BN = Brazil nut harvester and the other three service rankings.

Livelihoods	Safety	Health Insurance	Credit Services
F and W	.285	.066**□	.413
F and BN	.001*	.063**	.993
W and BN	.570	.998	.668
One-way ANOVA	$F_{(2, 366)}$ =4.968, p = .007	$F_{(2, 374)}$ =4.517, p = .012	$F_{(2, 372)}$ = 2.494, p = .447

*□Indicates where significant differences occurred in Tukey post-hoc

**□Indicates where marginal significant differences occurred in Tukey post-hoc

5. Discussion:

Based on the results, I found that regardless of education level or type of livelihood, most respondents (average of 77.5%) were willing to conserve. I also found that most people do not have health insurance or an education level above high school; these two services (health insurance and education) were also ranked highest most frequently. In addition to this information, I found that while 76% of the population was farmers, 13% were Brazil nut harvesters, and 10% were wood harvesters, there was often minimal practical difference between the three variables in terms of how they ranked the various services. Where there was a difference, it most often occurred between Brazil nut harvesters and farmers. The wood harvesters were not significantly different than the farmers or Brazil nut harvesters.

A possible cause of the results of the service rankings analysis could be that Brazil nut harvesters face different obstacles than the other two livelihoods. For example, a major threat to Brazil nut harvesters is illegal logging and farming on their concessions (Bosques Amazonicos, 2013). Farmers and wood harvesters also ranked safety lower (less important than other services) than Brazil nut harvesters, conceivably indicating the occurrence of theft on their concessions. Brazil nut harvesters also had the lowest proportion of people who had a university level of education. Analysis comparing education and health insurance also showed that those with a university degree were the most likely to have health insurance. This could contribute to why health insurance and education, while still highly ranked by Brazil nut harvesters, were slightly less than the wood harvesters and farmers.

Another significant difference that occurred was in the ranking of roads. The InterOceanic Highway, which connects Peru to Brazil and crosses several large rivers, was officially completed in 2011 (United Nations). Since it's completion, an increase in illegal immigrants has been reported, and subsequently an increase in illegal hunting, farming,

logging and mining (Bosques Amazonicos). Roads were most frequently ranked least important, possibly revealing negative attitudes towards their presence. Farmers, however, did not feel as negatively about the roads. This could be due to the fact that a large portion of farming in Southeast Peru is sustenance farming (Oliveira, Soares-Filho, Alexandrino 2011), while most logging and Brazil nut harvesting operations involve the transport of the product. Sustenance farming refers to families who mainly cultivate for the purposes of supporting their own family and not selling products to market.

While roads, health, education, and safety differed slightly among the groups, communication and credit services did not and the results of their analyses showed no noticeable patterns. A report by the United Nations stated that while many urban parts of Southeast Peru have experienced gains in education and health care development, most of the rural areas have not (Vasquez, 2011, p. 4):

> "The quality of services, like health and education, remains a challenge. This is particularly true among the poor, who tend to get a considerably lower quality of services than the rest of the population. It is the poor population living in rural or remote areas that is directly or indirectly affected by extractive industry projects."

The report also states that there remains a large poverty gap between those living in and around cities and those living in rural areas. Poverty rates in rural areas are over six times higher than in urban areas (CEPAL, 2009). However disregarding the lack of education, as shown by the chi-square analysis of education and having a telephone, a majority of the respondents do have a telephone. From this I infer that the services were ranked in terms of services, or amenities, the respondents lacked but still valued.

Communication was not highly ranked, and the means of the three livelihoods fell around a ranking of fourth in importance. Telephones rapidly grew in commonality from 1990 to 2000, especially in the lower socioeconomic levels (Bernstein, 2000). Support from the Supervising Agency for Telecommunications Private Sector Investment (OSIPTEL) and an Andean satellite system also aided in the development of telecommunication. Because of this, I inferred that communication was ranked lower because more respondents already had adequate methods of communicating.

The other service lacking significance in ranking, credit services, showed difficulty to analyze. I first compared the low ranking to the respondent's lack of bank accounts. This is assuming that the credit services are referring to those used in micro financing and involving the transfer of credit instead of direct cash for purchases/rewards. However, there is also the possibility that credit services could be environmental credit development such as watershed management and carbon sequestration. Due to this information gap, it is premature to suggest explanations to respondents' answers to the question.

Considering the strong influences from destructive land uses such as intense, and often illegal, logging and mining, it was unanticipated to find an overwhelmingly positive response to conservation. Also unforeseen was the lack of significance between the various

livelihoods and their willingness to conserve. Brazil nut harvesters showed the only significant difference when willing to conserve for cash (94%). This could be explained by the fact that Brazil nut trees require forests to thrive (Evans, 2013). Brazil nut harvesters could be overwhelmingly willing to conserve because it is what they already do within their concessions. After researching current conservation initiatives in the area it became apparent that there are currently over 85,000 hectares of land already set aside by REDD initiatives (Vasques, 2011). With this much land currently under conservation efforts, it is possible that some of the concession holders were already in a program and therefore obviously willing to conserve. REDD is also currently providing certification in forest management to increase wood harvesters' profits, in exchange for commitment to forest conservation (Bosques Amazonicos, 2013). According to McClanathan (2013), this would be described as an income-improving service, and further evidence of current incentive programs already in existence that could have potentially influenced their willingness to conserve.

There are, however, limitations to my assumptions. For example, the respondents were only categorized into three types of livelihoods and cash was not included in the rankings of services. Therefore, we cannot conclude that the entire population would be willing to conserve. The three livelihoods that were targeted have also been targeted by REDD initiatives and therefore may have already had some experience with conservation initiatives and may have benefitted. Because cash was not ranked, it is not possible to reason that cash would be a successful, or unsuccessful, incentive, especially relative to other VTM's. While direct cash transfers can have an array of positive effects on the recipient, from increased household assets, increased revenue, and decreased hunger and stress, it is not possible to predict how a person will spend the money (Haushofer, Shapiro 2013). For this reason, most cash transfers are conditional or targeted at specific groups of individuals (Haushofer, Shapiro 2013). In a department such as Madre de Dios where the economy is being stimulated by mining and logging, it is difficult to predict how cash would be ranked when some people are well above the poverty level due to illegal gains from extractive practices. It is possible that a cash incentive would not persuade them if it does not pay them more than their alternative sources of income.

In order to design an incentive program that would benefit the stakeholders in Madre de Dios, the most appropriate non-monetary target would be health insurance and education, based on the results from the rankings of services and the lack of both services regardless of land-holder type. This would mean choosing services and productive assets as incentive methods. As mentioned, it is not within the realm of this research to suggest cash as a potentially successful incentive due to the lack of information on this subject. There is, however adequate research to support the proposal of incentives targeting education and health insurance. The Peruvian Government has also recognized this gap and is prioritizing the training and mobilization of human resources, especially in science, technology and innovation, so that Peru becomes a country with more to offer than natural

resources alone (Vasquez, 2011). There is also potential to use education as an incentive in ways other than classical schooling (McClanathan, 2013). As mentioned, the Brazil nut harvesters ranked safety higher than the other livelihoods. For example, Brazil nut harvesters could be educated on how to best prevent theft or illegal activities on their concessions. Catering to the various needs of different landholders and stakeholders is key to a successful incentive program (Vasquez 2011). Considering the positive response to conservation in general, there is room to speculate that despite differing needs, Madre de Dios is a community where its inhabitants see the positive benefits of conservation.

6. Limitations of the data:

This data was designed to gather information about the livelihoods in Madre de Dios and despite the large number of face-to-face interviews and survey questions limitations still exist. A wealth of demographic information still remains to be understood and gathered about the communities and their current services such as health insurance, health care, and available education. It must also be noted that while the population was overwhelmingly willing to conserve, willingness does not directly equate to behavior. It is also not known where cash would fall amongst the ranking of services. With these limitations in mind, it is possible to suggest and strive for further research in an attempt to address these issues. A more in-depth survey could be more intensely directed at the livelihoods and the demographics behind them. For example, it would be beneficial to examine other livelihoods such as mining and tourism as they are also a large component to the economy. From there one could look into income, where/how the population acquires an education, and other current services either provided by NGO's or the government. Obstacles facing the population were briefly addressed in this survey; however better organization could provide answers that would help better prescribe a successful incentive program.

7. Conclusion:

This study provided insight into the preferences and livelihoods in an area where conservation efforts are striving to evolve and keep pace with the extractive land uses that threaten the existence of the natural resources on which they depend. Madre de Dios is a prime model to study the viewpoints of various concession holders and how their willingness to conserve could be directed as a method of forest conservation. Based on the results of the study it is clear that the respondents are willing to conserve and although the proportion of the three livelihoods is different, their rankings of services such as health and education are not. Therefore, in an effort to further motivate these key stakeholders into conservatory action, a successful incentive program would target these two services.

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