

# The Causes, Effects and Alternatives to Deforestation in the Rural Community of Aguas Claras



## Las Causas, Efectos y Alternativas a la Deforestación en la Comunidad Rural de Aguas Claras

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## 1. Executive Summary

### 1.1 In English

Fondo Peregrino- Panama is a branch of the U. S. A. based Peregrine Fund, a non-governmental organisation dedicated to the conservation of birds of prey through conservation and captive release programs as well as environmental education programs. Fondo Peregrino- Panama specialises in the conservation and captive breeding of the Harpy Eagle, Panama's endangered national bird. In order to help ensure the survival of the Harpies once released into the wild, the Fondo Peregrino has educational programs specifically designed for the areas around where the birds are released, to reduce the chances of the birds being hunted.

Harpy Eagles are top predators dependent on large, intact forests, so one of their primary threats is habitat loss. With the goal of examining the reasons Harpy habitat is being degraded and how further degradation can be prevented, this project targeted the causes, effects and alternatives to deforestation in rural Panama.

We studied these themes in the rural community of Aguas Claras because of its proximity to Parque Nacional Soberanía, which is the initial release area for the Harpies that FPP raises in captivity. It is important not only to understand the actual causes and effects of deforestation in Aguas Claras, but also the opinions and the level of awareness of the residents on these topics. To gather this information, we surveyed Aguas Claras as comprehensively as possible. Furthermore, we investigated alternative land uses to deforestation by interviewing NGOs and experts working in this field. It is also important to educate the people in communities like Aguas Claras, so a presentation on the importance of intact forests was created and given in the community, which will be repeated in other rural communities in the future.

In general, we found that Aguas Claras is not necessarily representative of most rural communities in Central America, because of its location between Parque Soberanía and large cattle pastures and foreign-owned plantations. It is therefore unlikely that the agricultural frontier is expanding in Aguas Claras the way it is elsewhere. We also found that environmental awareness is quite high in Aguas Claras, perhaps more so than in other similar communities because of its exposure to information from NGOs and Canal and Park authorities. Although community members were mostly aware of the importance of the forests and the causes and effects of deforestation, they were less aware of possible alternatives or solutions to the problems they saw.

In our research on alternatives, the one we found most viable was small-scale agroforestry and simple integration of trees into pastures, because of the minimal capital investment or need for outside help. In terms of larger-scale NGO efforts, the potential for greater, tangible results was higher, but most of the more impactful results required either substantial investments or ongoing outside help. We feel that for the most long-term and widespread impacts would require infrastructural changes in terms of land titling and usage

## 1.2 En Español

Fondo Peregrino Panamá es la rama panameña del Peregrine Fund, una organización no gubernamental internacional sin fines de lucro. Su misión es de conservar las aves rapaces en la naturaleza a través de la restauración de especies, la conservación de hábitat y la educación ambiental para el público. Específicamente, el programa en Panamá se dedica a la protección del Águila Arpía. El programa consiste de la crianza en cautiverio y la reintroducción de Águilas. El Parque Nacional Soberanía es un de los lugares donde las aves son liberadas.

El Águila Arpía es un depredador tope, y necesita largas áreas de hábitat. Su hábitat consiste de bosques intactos con árboles bastante altos para sus nidos, de 20 a 40 metros. La pérdida del hábitat es la amenaza la más importante que tiene el Arpía, y eso ocurra por la deforestación y la fragmentación del bosque. Es por eso que nosotras investigamos las causas, efectos y alternativas a la deforestación.

Hemos hecho nuestras investigaciones en la comunidad rural de Aguas Claras, ubicada en el corregimiento de Santa Rosa en la provincia de Colón. Esta comunidad es sobre la frontera del Parque Nacional Soberanía, y también es en la Cuenca del Canal de Panamá. Queremos saber lo que pasa en esta comunidad acerca de las actividades que causan la deforestación, y también las opiniones de la población sobre este tema. Para hacer esto, hicimos un sondeo en la comunidad. Para encontrar alternativas a la deforestación, hablábamos con ONGs y otros expertos para conocer los proyectos que se hacen ahora en Panamá.

Aprendimos que Aguas Claras no es necesariamente un ejemplo representativo de la mayoría de las comunidades en Centroamérica por su ubicación entre el Parque Soberanía y grandes potreros y plantaciones con dueños de afuera. Por eso, no es probable que hay una expansión de la frontera agrícola en Aguas Claras como otros lugares en Centroamérica. Encontramos también que los conocimientos ambientales en Aguas Claras son bastante altos, quizás más altos que en comunidades similares por su exposición a informaciones de ONGs, el ACP y ANAM. Los miembros de la comunidad son mayoritariamente conscientes de la importancia del bosque y de las causas y efectos de la deforestación, pero estaban menos conscientes de alternativas posibles o de soluciones a los problemas que tienen.

Nuestras investigaciones nos muestran que sistemas agroforestales son las mejores alternativas porque necesitan poco dinero y ayuda de afuera, y tiene beneficios ambientales tan como social. El ayuda de ONGs tendrá efectos más pronunciados pero necesitan más dinero y ayuda de afuera. Los cambios que hicieron impactos mejores están cambios gubernamentales sobre título de terreno y usaje.

## **2. Introduction and Background**

### 2.1 Fondo Peregrino

Fondo Peregrino Panama is the Panamanian branch of the U.S.-based Peregrine Fund, a non-governmental organisation focused on the conservation of birds of prey. The Panamanian branch more specifically addresses the plea of the Harpy Eagle, Panama's national bird. Through conservation efforts including a captive breeding program and an environmental education program, the Fondo Peregrino is reintroducing populations of Harpy Eagles to areas of Panama and Central America where populations have severely declined or been extirpated. Although the range of this bird once extended from Mexico to the north of Argentina, Panama now has the last remaining wild populations in Central America (Fondo Peregrino 2006).

Harpies bred in the Fondo Peregrino's captive breeding program are raised in captivity, and once they are able to live independently, are fitted with radio transmitters and released into Parque Nacional Soberanía. It is there that they learn to live on their own and capture prey. Once they have "outgrown" Soberanía, they are recaptured and transported to areas with larger remaining habitats than what can be found in Soberanía, to Belize, Bocas del Toro or the Darién.

Educational programs, as the Neotropical Environmental Education Program (NEEP) employed by the FPP, are helping to achieve their goal of conserving natural populations

of birds of prey. For example, NEEP helps improve people's perceptions on Harpies and other birds of prey by demonstrating their importance in food chains as environmental regulators, and easing people out of the negative stigma attached to the Harpy for its curiosity, mistaken for a desire to attack, that too often leads to it being hunted.

The Harpy Eagle, as a top predator, is intrinsically more vulnerable to extinction than links lower down on the food chain (Borrvall et al. 2000). They require a large home range, so rely on large, intact tropical forests for survival, with emergent trees in which to build their nests, along with enough prey such as monkeys and sloths to provide their diet. Due to the rapid rate of deforestation in Central America, habitat loss is their main threat. For this reason, the FPP wishes to include deforestation as a topic in their educational and research programs.

## 2.2 Tropical Deforestation

The primary cause of deforestation in Central America is the expansion of the agricultural frontier by small-scale agricultors (Southgate 1990, FAO 2005). With the reduction in prices of raw agricultural products internationally, there is increasing pressure for poor rural agricultors to expand their land and increase production. This can have many negative consequences on the environment and consequently on harvests, reducing the long-term viability of this solution as a supplement to income.

The term deforestation can be interpreted and defined in different ways, which vary according to how much degradation must be done to a forest before it is considered deforested. The definition used by UN agencies is “the temporary or permanent clearance of forest for agriculture or other purposes” (Grainger 1993). This definition centres around the concept of land use change, and does not include degradation caused by selective logging. Selective harvest of forest resources is the second most important impact on tropical forests, but is treated as separate from deforestation in this understanding (Grainger 1993). On the other hand, deforestation could be interpreted as any kind degradation experienced by a forest. For the purposes of this paper, deforestation will be understood as degradation of a forest to the point where the integrity of the original forest is no longer intact. In this context, integrity refers to the functionality of ecosystem services and the renewability of the forest.

According to the United Nations Food and Agriculture Organization (FAO), the most recent assessment of global rate of deforestation is approximately 13 million hectares per year (FAO 2005). At the same time, the net loss of forest has decreased since the last assessment, from 8.9 million to 7.3 million hectares lost per year (FAO 2005). This decrease in net loss is due to forest planting, natural expansion of forests and landscape restoration. Some regions of the world, such as Europe even experienced net gains of forested land, but Central America is still experiencing a net loss. In the previous decade, the annual forest loss in Central America was 971 000 hectares, corresponding to a loss of 1.2% of forest cover (FAO 2000). In Panama, this number was 52 000 hectares, or

1.6%. Forest loss in Panama can therefore be considered significant, and substantial investigation of the causes, effects and alternatives to deforestation is warranted.

The expansion of the agricultural frontier by small farmers is the greatest cause of deforestation in the developing tropics (Southgate 1990, FAO 2005). Before the 1970s, deforestation was inherently linked with the idea of progress, and viewed as an entirely positive phenomenon (Southgate 1998). Nature and intact forests were widely viewed as useless, wild landscapes waiting to be tamed. This conceptualization can still be seen today, embodied in governmental land policies that award land tenure based on the social utility that land is providing. As intact forests do not usually fulfill a recognized social utility, in many cases the most efficient and reliable way to assert land claims is to deforest land and convert it to pasture or agricultural fields (Southgate 1990, 1998). However, in the past 30 years, attitudes have changed dramatically, and international concern has mounted regarding the rate and global consequences of deforestation, especially in the tropics (Grainger 1993). In Central America, the reasons for the expansion of the agricultural frontier are numerous. Population growth is an important factor, as rapidly growing populations put increasing pressure on land and resources (Ehrhardt-Martinez 1998). But that is not the whole picture: property rights also play a major role, as secure land tenure is more likely to lead to conservation of private natural resources, whereas insecure land title will incite users to deforest in an attempt to claim property of the land (Mendelsohn 1994). Furthermore, new roads, weak governmental institutions, economic growth and poverty reduction, technological change, agricultural

markets, foreign debt and national income can all affect deforestation in poorly understood ways (Angelsen and Kaimowitz 1999).

As for the effects of deforestation, the removal of primary forest has an impact on many different ecosystem services, most of which would in some way negatively affect agricultural production. Forests play an important role in water regulation and filtration, especially in countries such as Panama, with quite pronounced wet and dry seasons, keeping there from being too much water during the wet season or too little during the dry season. In Aguas Claras specifically, due to its location in the Panama Canal watershed its role in preventing excessive sedimentation and providing water for the Canal is essential. The forest also provides a host of benefits to soil quality: it prevents erosion, which keeps the fertile soil from washing away with the rain, the roots keep the soil from compacting, with the help of both the leaves in the trees and leaf litter, which reduce the impact of rain on the soil as a compacting agent. The leaves also increase the amount of organic matter in the soil, augmenting fertility. The forest is also a climatic regulator, locally by cleaning the air and providing shade, and globally for its Carbon sequestration abilities. It also provides a buffer from strong winds. The forest as a habitat for animals is a mixed blessing for farmers, as some eat agricultural crops. On the plus side, they provide game for hunting (though there are usually regulations against hunting in National Parks). Economically, the forest's ecosystem services reduce maintenance costs for agricultural activities, and have the potential of generating economic activity in the form of ecotourism.

### 3. Goals and Objectives

The overarching goal of this internship was to find viable alternatives to deforestation for small rural agricultors in an attempt to reduce habitat loss for the Harpy Eagle, which at the same time reduces environmental degradation and therefore improves overall conditions for agricultors. Thus, our project aimed to find out through surveys conducted with residents of Aguas Claras, a small rural village near Parque Nacional Soberania, what the main causes of deforestation were in their area and what are their principal land uses, and assess their level of knowledge on issues related to deforestation and its effects on the environment. With this knowledge, combined with further research on alternatives to deforestation, we were able to design a power point presentation catering to the level of knowledge demonstrated in Aguas Claras, educating the residents about the causes and effects of deforestation, as well as providing them with information and suggestions of economically viable alternatives. This relates to Fondo Peregrino's mandate of habitat protection, as alternative land uses can decrease pressure to further encroach upon intact forests. Because of Aguas Claras' proximity to the location of release of the Fondo Peregrino's captively bred Harpy Eagles, the Harpies are sensitive to activities taking place in the Park. Though it is illegal to extract resources, whether they be flora or fauna, from National Parks, it is known that there are people who still do use the resources in the park for firewood, building materials and hunting. In a community like Aguas Claras, which is sandwiched between Parque Soberania and predominantly foreign-owned teak plantations and reforestation projects, it is theorized that there is a higher use of Park resources than could normally be expected, because of a lack of other options, with most

residents owning only the land immediately surrounding their homes. Therefore, our goal is to recommend to the residents of Aguas Claras alternatives to extracting wood resources from Parque Soberania that will ideally be economically beneficial, reduce negative impacts on the environment, and preserve the integrity of Parque Soberania.

In short, the objectives of this project are:

- To design and conduct a survey in Aguas Claras to learn about their perspectives on deforestation and their uses of land and forest products.
- To conduct literary research on the primary causes and effects of deforestation for use in our presentation for Aguas Claras.
- To interview representatives of NGOs concerned with land use, conservation and deforestation issues to find out what organized alternatives exist, and what may be applicable to the situation in Aguas Claras.
- Develop a Power Point presentation on the causes, effects and alternatives to deforestation for use by the Fondo Peregrino as an educational tool.

- Present the Power Point in Aguas Claras along with before-and-after knowledge testing questions in order to assess the effectiveness of the presentation as an educational tool.

#### **4. Study Site**

##### Aguas Claras

The community of Aguas Claras is on the border of Soberania National Park, in the Panama Canal watershed (see Appendix 1). It consists of 19 houses, 2 of which have been abandoned, so essentially 17 households. It is in the district of Santa Rosa, which in 1990 had a population of 533 (ANAM 1999). Situated in a rural area, over 40% of the economically active population cited agricultural production as their principal economic activity (ANAM 1999). In Aguas Claras, subsistence agriculture, farmhands and working on nearby teak plantations and reforestation projects were the main occupations. Most households own only the land immediately surrounding their homes, with a few exceptions, where larger amounts of land are owned elsewhere. Space is limited due to the proximity to the Park and to the plantations, preventing expansion. The majority of households (11) are centered around a small church, schoolhouse and public meeting house, with the remaining 6 stretching across an approximately hour-long walk away from the main area of the community. These last 6 houses are only accessible on foot, with no road access. Aguas Claras is equipped with electrical wires and fuse boxes, but

the electricity is not connected, so there are no lights or televisions and no phones, except for a few residents who own cellular phones. The population of Aguas Claras consisted of children under 12, adults between approximately 25 and 45, and elderly residents over the age of 60. The school has 9 students, and the teacher serves as the liaison to the Fondo Peregrino. The Fondo Peregrino has been working with this community for several years, both conducting surveys and giving educational presentations on the importance of birds of prey, top predators, and food chains. Given their proximity to the Panama Canal and to Soberania Park, the community is also familiar with their relation to the Panama Canal watershed and with regulations prohibiting the extraction of resources from the park.

## **5. Methodology**

### 5.1 Field Methods

In order to assess what would be viable alternatives to deforestation, we first needed to determine what were its causes in our study site, and then find out about existing alternatives in order to cater them to this situation. To do this, we first conducted a survey, and second, interviewed representatives of NGOs working on projects pertinent to this cause.

The survey was elaborated to be conducted in Aguas Claras, consisting of 25 questions whose answers would inform us of respondents' level of knowledge on environmental

issues, land use and wood use practices, and their opinions on reforestation activities in their area. For a copy of the Survey, see Appendix 3. Three schoolchildren were recruited as “tour guides,” who took us to each house in Aguas Claras. Their guidance allowed us to ensure that we had interviewed one representative from each household in the village, except for two households who refused to respond. We ensured that respondents lived in the house where they were found, such that there would be no double counts. The questions were posed orally by one researcher, while the other wrote down the answers given. Surveys were conducted on March 9<sup>th</sup> and 10<sup>th</sup>, 2007.

Literary research was conducted along with interviews with individuals involved in environmental and social development projects in Panama in order to learn about alternatives to deforestation that are currently being used. Most interviews were conducted with representatives of NGOs, but experts in certain fields were also consulted. This was with the dual purpose of compiling relevant information found into an educational presentation that was given in Aguas Claras, and to present to Fondo Peregrino with a comprehensive assessment of projects being done by NGOs to avoid deforestation and reduce habitat loss. We used a rough template when interviewing NGOs, first finding out what activities they are doing that relate to deforestation or habitat conservation, what conditions needed to be met in order for their program to work, how they select the communities they work in, and if the project could potentially be done in a place like Aguas Claras, with or without outside help.

An educational power point presentation was elaborated and presented in Aguas Claras. It taught about the causes of deforestation and some of the damaging environmental effects it can have, and consequently the negative impact on farming. It also suggested methods to reduce the rate of deforestation, primarily by getting wood from other sources, and talked about some initiatives being taken by NGOs and private enterprises. The presentation was followed by a movie, which was advertised as an incentive for people to attend and as thanks to those who did attend.

To go along with the presentation, 10 true or false questions were put together to test knowledge of attendees to the presentation before and after listening to it, to see how much they learned. See Appendix 5 for the questions. The questions were posed both before and after the presentation, and respondents wrote down “si”, “no”, or “no se” to each question.

## 5.2 Ethics

In accordance with McGill University’s code of ethics, we ensured that survey respondents consented to the use of the information they provided us for academic purposes. Given the informal nature of the survey and the casual subject matter of the questions being asked, we felt that oral consent was sufficient in this context. Having written consent was unnecessary, and may have deterred some respondents as they may have expected much more prying questions to have been asked as a result. We introduced the Fondo Peregrino and ourselves and explained the purpose of the survey, ensured that

respondents knew it was voluntary, and we did not ask for or use respondents' names. See Appendix 2 for the outline of the introduction that was said prior to each survey.

## **6. Results**

### 6.1 Survey Results

For full survey results see Appendix 5. Results found that there was a high level of environmental knowledge in Aguas Claras. In terms of uses of wood, the main use was for firewood, followed by building materials. According to the survey results, the principal way in which land use has changed is that the soil is less productive (see Figure 1).

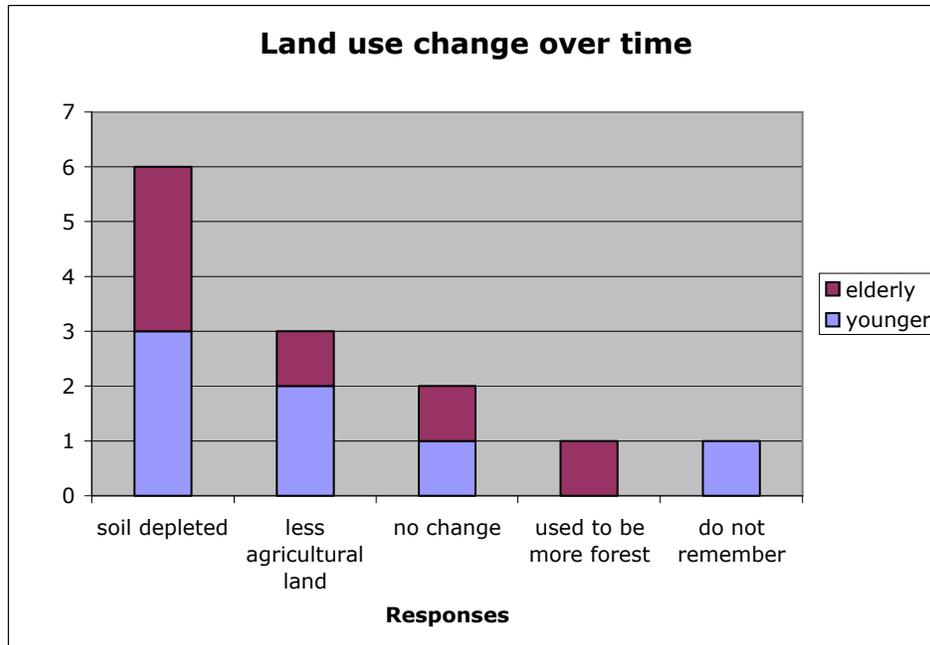


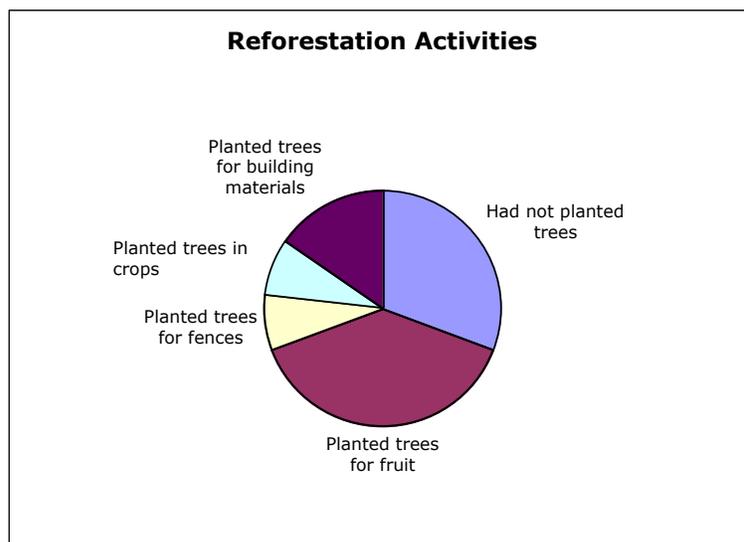
Figure 1: Perceptions in Aguas Claras of change in land use over time.

Most residents own only the lots around their houses. When asked where they get the wood from, most (7) claimed that they gather or cut it from their own property, with a few others (4) saying that they get teak from plantations, either donated by the owner, purchased, or from what is left behind after harvesting. A few respondents (4) admitted outright that people do use wood from Parque Soberania, but several more deflected responsibility by saying it used to be a problem, but not anymore (3), that people take dead wood only (1), or that it's only a problem elsewhere, not in Aguas Claras (1). When asked about the importance of Parque Soberania, and whether or not it presented an inconvenience, 8 said it didn't, 1 said it did, and 5 claimed it didn't but lamented that they used to be able to use the resources there, but were now forbidden, and it has become more difficult to get by as a result. As for its importance, only 2 respondents did not know why protected parks are important, and the rest listed reasons such as that it was

better for the animals (3), good for the canal (3), and not as hot with the forest nearby (2). Fully 10 respondents knew, when asked about the relationship of the park to the Canal, that it is important because of their location in the watershed.

Survey respondents all expressed that they enjoy having Harpy Eagles living nearby, though 2 expressed concern that it might attack their hens.

Tree planting activities varied between residents of Aguas Claras, as depicted in Figure 2.



*Figure 2: Reasons given for reforestation activities by residents of Aguas Claras.*

2 of the respondents who had not planted any trees on their land had planted for plantation projects. There are several reforestation projects located in the outskirts of Aguas Claras, with 5 respondents who work or have worked on them at some point. There was a generally negative opinion towards them, with many respondents saying that though it provides some work, it doesn't pay well and it doesn't produce any food. Asked

about monocultures, there was quite a sweeping trend towards dislike of teak plantations (8 respondents), with respondents citing that they dry up rivers and render the soil infertile. Several (7) said it is better to plant a variety of crops, with 4 specifically citing fruit trees. There was less knowledge about non-native species. 2 respondents saw no problem with planting non-native species, 1 said it depends if they adapt, 1 said native species are better but they grow more slowly. A few others didn't know, or thought it was probably a bad idea to plant non-native species.

On the topic of deforestation, 5 respondents gave answers that indicate they don't find it worrisome, either saying it wasn't a problem or a big issue (3), that it's a problem in general, but not so much in Aguas Claras (2). 3 respondents indicated that it was bad. Asked about the causes of deforestation, 3 said deforestation is caused by people cutting trees to sell (1 mentioned it is now prohibited), or (3) for pastures and land clearing. Only one respondent saw no causes of deforestation, and 3 saw a connection between education and awareness and deforestation. As for the effects of deforestation, 1 said deforestation is bad for the animals, 3 said it gets hotter without trees, 1 added there is less shade, and 1 respondent said it was bad for the soil and water.

The final question on the survey asked what the respondent's ideal use of their land would be. 3 female respondents said that fruit trees and subsistence crops on their lots would be ideal. 3 male respondents echoed the desire for subsistence crops, though not specifically mentioning fruits, and 2 expressed a desire for machines to help with labour.

## 6.2 Results of Effectiveness of Educational Presentation

There were 16 people present at the educational presentation in Aguas Claras, including the schoolteacher. 9 of them were the schoolchildren, between the ages of 6 and 11, and 6 were local adults who wished to hear the presentation (5 women and 1 man). 13 attendees responded to our before-and-after presentation evaluation questions, with 8 children and 5 adults responding.

Between the before and after test, 24 answers were changed correctly, while 15 answers were correct the first time, but were changed to a wrong answer for the second test. 16 answers were wrong the first time, and remained so for the second test. There were not enough test subjects to allow for statistical tests on the significance level of the amount learned or if there was a significant difference between what was learned by adults versus children. On average, however, adults correctly changed 1.6 answers after the presentation, while children correctly changed 1.875. Adults only had on average 0.6 questions wrong after the presentation, but the children had an average of 3.625 questions wrong after the presentation. Among the adults, only 1 question was incorrectly changed, but 14 answers were incorrectly changed and only 15 correctly changed among the children.

## **7. Discussion**

### 7.1 Discussion of Survey Results

The survey provided us with interesting results that gave us an idea of the state of things in Aguas Claras. There was a higher level of environmental knowledge than expected. This is likely contributed to by the fact that the Fondo Peregrino has had educational visits to Aguas Claras in the past that the residents may have learned from. There also seemed to be evidence of visits from the ACP (Autoridad del Canal de Panama), since so many knew of the relation between the forest and the Canal. There was also evidence of the influence of ANAM (Autoridad Nacional del Ambiente), since residents generally knew quite clearly that they weren't supposed to extract wood from the forest or hunt there.

Being a very poor, small agricultural village with no electricity, and therefore no stoves, be they electric or gas powered, it made sense that firewood for cooking was the main use of wood in Aguas Claras. Most houses were small and built out of cinderblocks and wood, with wooden furniture, so building materials follows logically as the second most common use of wood.

Land ownership seemed rather unofficial in the community, with most people owning only the lots around their houses. Land tenure was difficult to establish, as people referred to land as belonging to them even when they had no legal title to it. Most respondents did not know the exact number of hectares, and could not even provide an

estimate. In terms of land use changes over time in Aguas Claras, people seemed to have different interpretations of this question- some responded based on the quantity of each type of land use, and others responded based on quality of agricultural land. Despite this confusion, the overarching trend was that the situation had gotten worse. The majority of responses indicated either lower soil fertility or less agricultural land, and no one said that fertility had improved. Overall, people seemed to feel they were in a rather dire situation where the soil doesn't provide, and there was a desire to change that and improve the situation.

There was an overall sentiment of shortage of both land and wood in Aguas Claras. We sensed that some responses were being modified slightly for our ears, since we were foreign researchers who, though we claimed to have no association with ANAM or any government body, could very well have in respondents' eyes. Though most respondents claimed not to get wood from Soberania, and instead scrape it together from their own property or even purchase it, we got the impression that residents of Aguas Claras felt quite restricted to a small, mostly insufficient space. Several respondents probably use wood from the forest, but they seem to do so reluctantly, being aware of the consequences of if they are caught: heavy fines from ANAM. Once again reflective of the likelihood of biased answers towards us researchers was the fact that many respondents claimed Parque Soberania did not present an inconvenience to them, but adding statements about how it's a shame they can no longer use the resources there. Respondents appeared to give the answer they believed was being searched for (no), rather than an honest opinion. The park was only created in 1980, so especially for the

residents that have been living in Aguas Claras since before 1980, it was an adjustment to make from having been able to use whatever resources they desired beforehand, to being expressly forbidden once the park was established. Despite all the strict regulations about not using resources from the park, responses to why they think protected parks are important showed relative indifference, except for respondents who made a link between the forest and keeping the area cooler and with more shade: things that directly affect their well-being.

The fact that almost all respondents knew about the connection between the Panama Canal and Parque Soberania is indicative of ACP presence. Knowledge about the Harpy Eagle was indicative of Fondo Peregrino presence. The two respondents who were concerned that Harpies may eat their chickens were reassured during surveying that Harpies do not eat chickens, but this belief demonstrates the bias people sometimes have against birds of prey, or animals in general that they do not know very much about, and base their assumptions on popular belief or on extrapolations from behaviours they have seen these animals exhibit.

Most residents of Aguas Claras had at some point planted trees, though a few of them only on plantation projects. This was a positive result, which indicated some sort of a desire to take into their own hands the production of a scarce resource (wood) that is normally taken for granted as growing in the wild. This type of tree planting seemed to differ extraordinarily, by their perspectives, from tree plantation projects. Most people had a negative opinion of plantation projects, either because they appeared useless in that

they didn't produce anything useful like food, or because they only create a few low-paying jobs and then both the money and the products produced leave the community along with the absentee owners. The answers to our question about monocultures further allowed us to extrapolate a general dislike of plantations, with many respondents indicating a blatant dislike of teak plantations, and the majority of responses indicating that it was better to plant a variety of species. There was less knowledge about non-native species, with teak usually as the exception. These results are indicative of knowledge acquired from working on the land for many years and making conclusions about what seem like good practices through doing them year after year, and not from learning academically about agriculture and therefore having less knowledge about the origins of their crop species.

As for the causes and effects of deforestation, in general there was more knowledge about the causes, rather than the effects of deforestation. This makes sense, because it is easy to see the direct causes when they know themselves their uses of wood, while it may not always be obvious exactly why it is that a hill is eroding more this year than last, for example. There also tended to be a perception that deforestation was not a problem in their area. This is likely in large part due to the presence of a large National Park in their backyards (literally), and the fact that agriculture and land clearing has always been a part of their lives here, and it is perhaps not apparent that the land they are growing their crops on used to be jungle.

There appeared to be a gradient of environmental knowledge between men and women, and younger respondents versus elderly respondents. There were not, however, enough survey respondents to allow us to conduct statistical tests on the demographic trends, so they are qualitative observations. Elderly men apparently knew the very most out of the respondents, followed by elderly women and younger male respondents, who had approximately equivalent levels of knowledge, and those who knew the least were the younger women. Though it is likely the elderly respondents have less education than the younger ones, they in general have far more experience on the land and have been around long enough to observe cause and effect, and how land use changes have affected other environmental factors. Between the men and the women, there is the possibility that men have more education, but it is also likely that the men spend a lot more time on the land and have a more intimate relationship with the changes that take place on it. Other differences between men and women were found in our survey question asking what they would do with their land if they could do anything at all. Most women thought fruit trees on their lot would be the best use, suggesting women spend more time at home, while men tended to have answers more centered on varied subsistence crops, sometimes citing a desire for more labour or for machinery on their farms.

A notable result was that overall, survey subjects were far more centered on taking care of subsistence needs than farming for the purpose of selling their produce. Many respondents expressed that if farmers only harvested for subsistence, there would be many fewer problems. They claimed this would help increase fallow time and consequently soil productivity. There was overall an emphasis on the importance of

cultivable land for subsistence, and any ecosystem services which promote this land use. Many respondents spoke of less fertile soil now than there used to be, and several understood the link with slash and burn practices and reduced fallow time as well as trying to get too much out of the land when people try to sell produce in addition to their subsistence growing, but nobody seemed to have a solution for this problem, other than wishing their neighbours would change mindsets and stop selling their products. The residents of Aguas Claras would likely welcome educational efforts which would teach them about more efficient farming techniques or ways to maintain soil fertility, because this seemed to be the predominant worry for them.

## 7.2 Discussion of Effectiveness of Educational Presentation

Though the sample size was very small, so it is difficult to gauge the usefulness of the presentation in terms of knowledge learned since there were not enough respondents to be able to conduct statistical tests, it seems the test- or simply the subject matter in the presentation, was too easy for the adults and too difficult or confusing for the children. Whether or not to extrapolate that this would be the case in other communities a tough question, given that Aguas Claras seems to be a rather unrepresentative case of a rural community, with higher than expected environmental knowledge. Some questions also related to subject matter covered in former Fondo Peregrino presentations in the community, suggesting that these topics would be more likely to be new information in communities new to the Fondo Peregrino.

The amount of answers incorrectly changed by children after the presentation suggests that it went over their heads or was confusing. One question that many got wrong asked if deforestation is when you plant trees. We theorise that our pronunciation of the words 'deforestation' and 'reforestation' in our imperfect Spanish could have affected these results.

Though relatively few new question answers were learned by the adults tested, it is possible that some of the answers they put the first time around were suspicions they had, and they were confirmed by our presentation. Seeing as the residents of Aguas Claras have prior experience working with the Fondo Peregrino, they presumably consider the FPP a reliable source, and trust that the information given by them is reliable.

### 7.3 Limitations and Obstacles

Though the project overall went well, there are always unforeseen and unavoidable obstacles, which in this case were in the form of scheduling conflicts, language barriers and the bias of being a foreign researcher, and the representativeness of our study site.

Firstly, scheduling was a problem, both for our visit to Aguas Claras to conduct the survey, and for our return to present the power point and movie. Due to unforeseen conflicts with other academic obligations, last minute changes had to be made on both occasions, but because of the lack of telephones in the community it was difficult to reschedule, and in the first instance the community was unaware that we would be

arriving on a different date. Contact via cell phone with the schoolteacher mitigated the problem of scheduling the second time it became an issue.

Seeing as we are both foreign researchers, there were also potentially issues arising because of language barriers and the fact that we are strangers. During surveying, our phrasing and pronunciation of the questions could have made it difficult for respondents to understand them. Furthermore, our limited Spanish abilities sometimes made it difficult to fully understand the responses we were given, potentially skewing our results. The fact that we are foreign researchers could have also skewed results, because even though we explained that we were not with ANAM or Soberania Park Authority or any sort of government agency, it at times seemed respondents were providing us the answers they assumed we were looking for (i.e. people don't use the wood from Soberania, deforestation is bad, etc.).

An obstacle to the application of this study in other contexts is that Aguas Claras, though a very interesting case study, we believe is fairly non-representative of other villages. Because of its location right next to Soberania, sandwiched with teak plantations, they do not have much land to deforest, even if they wanted to. The primary cause of deforestation in Central America is the expansion of the agricultural frontier, but that doesn't appear to be the cause in this situation. Furthermore, we believe there to be a higher level of environmental knowledge in Aguas Claras than many other villages because of prior involvement with Fondo Peregrino's educational program, as well as influence of the ACP and ANAM due to its location in the Canal watershed, next to

Soberania. So though the adults in the village had very high scores on our before-and-after presentation evaluation, the same results may not be seen in other villages.

In Aguas Claras, we felt the absentee owners of teak plantations seemed a more appropriate target for environmental education than the villagers themselves, as our survey results and literary research showed that the teak plantations were a far more substantial cause of environmental degradation than were the small agricultors in the area.

On a more humbling note, it is also tempting to want to fix as many problems as you can, but it was necessary for us to remind ourselves of time and resource constraints, and that given those, you may not be able to change the whole world, but perhaps you can tweak a small part of it.

## **8. Alternatives to Deforestation**

### 8.1 Results of interviews

In the context of exploring alternative land use strategies to current and widespread slash and burn agricultural expansion, interviews and other types of investigation were conducted. In this manner, a variety of efforts and options currently underway in Panama were examined. We met with NGOs (Non Governmental Organizations), consulted experts and visited government agencies.

### 8.1.1 Agroforestry: a Happy Compromise

Agroforestry refers to practices that integrate trees with agricultural crops (Schroth et al. eds 2004). Agroforestry has the potential to reduce deforestation for agriculture and decrease forest degradation by relieving pressure on surrounding forests (Schroth et al. eds 2004). However, Fischer (2002) has found that the implementation of agroforestry projects in Panama only minimally reduced the extent of slash and burn practices. Agroforestry techniques can take very varied forms, from externally supported intercropping efforts to the planting of fruit trees on individual plots of land. The requirements in terms of outside expertise and funding vary accordingly, but potentially can be quite minimal. This is a reason that some forms of agroforestry are highly generalisable, as it is often possible for poor individuals to plant trees that will improve their standard of living by providing fruit, fuel wood or construction wood, without the need for outside support (Fischer and Vasseur 2002). Agroforestry is particularly interesting because it addresses two major concerns: environmental and societal well-being. Agroforestry has the potential to provide socioeconomic advantages to rural poor, largely because it is labour intensive, while producing environmental benefits such as reduced soil erosion, increased soil fertility, and improved quality and quantity of water sources (Fischer and Vasseur 2002). Still, agroforestry faces challenges. For example, profitable agroforestry techniques can attract practitioners to a forested area in order to convert primary forest to these agroforestry systems (Angelsen and Kaimowitz 2002).

### 8.1.2. Reforesting with Plantations: Good Trees and Bad Trees

Often, there is great difficulty in developing projects that provide both ecological and social benefits. One option that can resolve this conflict is plantation projects, because they provide income and jobs while maintaining, at least in the relatively short term, forest cover. Forest plantations are a significant source of reforestation, and of the 130 million ha of plantations worldwide, more than 50% are located in the tropics (Kraenzel et al. 2003). However, there is a wide range of plantation types. In Panama, teak monocultures make up a considerable percentage of all plantations (Simmons 2002), but other kinds of reforestation projects, like polyculture with native species and community-managed projects should be considered as well.

Teak (*Tectonis grandis*) is an exotic species in Panama, but its cultivation has been encouraged through government incentives and it is now a frequently planted species of tree in the country. Its popularity stems from its rapid growth rate and high market value as exported timber. However, there are many reasons to be critical of this type of reforestation, even though it is commonly supported by ANAM and by government incentives. Ecologically, teak is very problematic when planted in extensive monocultures. Furthermore, any monoculture is inherently more vulnerable to disease (Sayer 1991). Futuro Forestal, a German-based reforestation investment company, has apparently solved this problem by planting teak in smaller areas surrounded by other kinds of trees (Futuro Forestal, oral communication, 2007). At the same time, teak has been shown to have appreciable carbon storage capacity (Kraenzel et al. 2003), making

teak plantations potential beneficiaries of carbon sequestration projects. On top of its ecological complications, teak does not tend to be very beneficial socially. In our personal research, we found that a large percentage of rural inhabitants in Aguas Claras have very low opinion of teak. Reasons cited were that it dried out soil and nearby water sources, and that the money produced by teak plantations does not stay in the community. In effect, teak plantations tend to be owned by foreigners and are centered on an export economy. Furthermore, they are labour-extensive and so do not employ many locals. These environmental and social problems have led us to conclude that teak plantations are not a very desirable solution for forest conservation and human development at a local level. In Aguas Claras, there are presently a number of plantations composed largely of teak and certain other species, such as pine, which is also exotic. These plantations are foreign-owned and place pressure on locals by limiting their access to land. We therefore would not recommend more teak plantation as a solution in the area.

Forest Stewardship Counsel (FSC) is an organization that certifies sustainable forestry (FSC, oral communication, 2007). Part of their current work involves supporting a community managed, mixed native species forestry project in the Darien (FSC, oral communication, 2007). This system is beneficial socially because it will provide income and jobs directly to locals. Simultaneously, it is ecologically less detrimental to the environment than many other forms of timber harvest because it involves selectively and sustainably harvesting timber from an already existing forest without over-harvesting any particular species. Expertise on how to extract forest resources in a less damaging and more sustainable manner has in fact greatly improved, and a large body of knowledge

now exists on the subject (Southgate 1998). These systems create direct incentive for the users to maintain the forest resources, so they may continue to make use of them. This type of operation requires a fair amount of outside resources, mostly in the form of technical expertise, knowledge and financial investment. A further difficulty is a general lack of a domestic market for certified forestry products (FSC, oral communication, 2007).

Futuro Forestal is an example of a FSC-certified forestry company that is based on foreign investment. The land is sold to the investors and is managed by the company for 25 years. Selective logging is done after 10, 13 and 25 years. When the contract is up, the investors have the option to renew it, but can equally chose to use the land as they wish. Although this company is very environmentally conscious and socially sensitive, we do not see this as generally applicable strategy because of the numerous complications that arise with foreign land ownership, and the uncertainty of what will happen to the land after 25 years.

On a more local level, it is possible to develop agreements to create and manage a plantation funded by individuals or groups wishing to neutralize their carbon emissions. Funding can be channelled through Kyoto accord structure or through independent organizations like Carbon Care (A. Senikas, oral communication, 2007). An example of this small small-scale carbon sequestration project is being implemented by PFSS student interns, who are creating a plantation of native species in an indigenous community in

order to compensate for the carbon emitted by the travel of students and teachers between Panama and Canada (A. Senikas, oral communication, 2007).

### 8.1.3. Re-envisioning Parks and Protected Areas: Protecting People Too

Panama has an extensive system of National Parks and other protected areas which help maintain a national forest cover of 44.91% (ANAM 2003). Roughly 10% of the country's area is composed of national parks (ANAM 2003), and much of the country is protected in some way (see Figure 3).



*Figure 3: Location and extent of nationally protected areas in Panama (ANAM)*

When looking at rural social development, it is important to distinguish between “traditional” National Parks, which are strictly for conservation and recreation purposes and where use for any other purpose is forbidden, and Managed Resource Protected Areas (IUCN 2007). This latter category of protection does not exclude subsistence use by original residents of the area, and is much more useful for purposes of social and economic development. One example of this type of management in Panama is Parque

Nacional Chagres. The Nature Conservancy is managing of this park through funding from a cancellation of debt (or “debt-for-nature swap”) program with the US government (TNC, oral communication 2007). The mandate of TNC is to reconcile habitat protection while enhancing the well-being of local people, by integrating economic growth and environmental protection (Southgate 1998). In this case, the needs of the communities within the park are being met while still preserving natural resources. This is the definition of sustainable use of resources, which TNC is living up to by promoting sustainable agricultural and silvopastoral (the co-management of cattle and trees) systems (TNC, oral communication, 2007).

Another way of interpreting protected areas is through the concept of eco-tourism. In this strategy, the goal is to preserve natural resources as they can attract paying visitors, and these funds can be used to maintain the resources. However, the actual utility of eco-tourism, in terms both of ecological benefit and economic returns to local communities, has been put into question (Southgate 1998). The APPC (Asociación Panamericana para la Conservación) is an organization that wishes to further explore tourism as a basis for conserving the forest. Their goal is to convert an abandoned military area into a recreational park, typifying the concept that you can conserve forest through use: in this case by making it a desirable and profitable tourist destination. This type of use is not directly beneficial to the original residents of the area, and so the organization hopes to help poor local communities in other ways, such as through the construction of children’s playgrounds (APPC, personal communication, 2007).

#### 8.1.4. Agricultural Intensification and Increased Efficiency: Removing the Need to Remove Trees

One argument for the protection of forests calls for the increased production on agricultural land in order to decrease the need to further deforest for agricultural purposes (Southgate 1998). The theory is that if agricultural production were more efficient, that is, produced higher yields, less forest would need to be cleared to make way for farms and pasture. One NGO that is applying this logic in Panama is CREA (Conservation Research Education Action). Although primarily interested in habitat destruction, this organization is dedicated to ending the cycle of environmental degradation and rural poverty. By disseminating information to youth groups and farmers, they are hoping both to influence the decision makers of the present and future. CREA is currently working to suggest alternative means of existence to farmers who employ inefficient and environmentally damaging techniques (CREA, oral communication, 2007). As part of this campaign, they are advocating practices like diversified cropping, planting along hill contour, row cropping, soil conservation with plant barriers and silvopastures. These techniques can make land up to twenty five times as productive as shifting cultivation, meaning that the same land can be used for much longer without moving on to a newly cleared area. These strategies are usually more labour intensive and require little technological inputs. These characteristics would suggest they are not the type of general yield-increasing technologies that would increase pressure on forest frontiers by making agriculture more profitable (Angelsen and Kaimowitz 1999). Still, CREA has come up against difficulties: lack of funding outside certain development “hotspots” (like the Canal Watershed,

indigenous communities, etc), transport problems and contradictory policies in different government agencies. For example, although ANAM is attempting to promote forest conservation, the National Bank still gives loans based on the utility which the land is fulfilling. The fact that intact forests are not considered to fulfill social utility is a problem that the next approach addresses.

#### 8.1.5. Avoided Deforestation and Payment for Ecosystem Services: Paying People not to Pollute

One emerging area in the domain of forest conservation is the field of payments for avoided deforestation and for ecosystem services. Many of these schemes arise in the context of the Kyoto Accord, which established a global Carbon exchange market. The idea is that Carbon emitters, generally industrial polluters from richer countries, would provide monetary compensation to landowners to not cut down standing forests. This option is appealing because in theory it would provide rural people with a secure income. The reason such a system is needed is because currently there are incentives for reforestation that could create a situation where it is economically favourable for landowners to cut down existing forests to then replant. This is a counterproductive strategy, as primary forests sequester more carbon than plantations (Kraenzel et al. 2003), and many plantation types that are environmentally degrading (such as teak monocultures) are still considered reforestation projects that can receive compensation. There are, however, many challenges and limitations involved. Whether or not avoided deforestation will develop as a significant alternative route is currently being investigated

by student interns from McGill University (M. Boileau, oral communication, 2007). The success of this alternative depends on the strength of local institutions like ANAM, which is poor in Panama. For that reason it has been suggested that decentralization would be preferable, with third party NGOs taking responsibility for projects. Land tenure systems in Panama are also an impediment to avoided deforestation, because rural people currently have incentives to convert forest to pasture or agriculture, as that will secure them a certain amount of entitlement to the land, as in the eyes of the government they will be fulfilling a social utility with the land (Southgate 1990, 1998). Payments for avoided deforestation fit in a larger discussion of payments for ecological services (PES), which are compensation mechanisms by which service providers are paid by service users (FAO 2003). Despite its lofty goals of conservation and development, sustainable development and sustainable use of natural resources, this paradigm is riddled with uncertainties, such as how to identify the beneficiaries, how to calculate the amount of compensation, and how to successfully design and execute PES schemes (FAO 2003). Again, a solid legal foundation and competent regulatory institutions are necessary.

## 8.2 Discussion of Feasibility of Possible Alternatives in Aguas Claras

In all cases, we attempted to assess the potential applicability of each scenario to Aguas Claras, to see how feasible such a system would be in that community and other rural areas.

### 8.2.1. Agroforestry

Of the agroforestry techniques that can be implemented with minimal amounts of external support, many would be well suited to the context of Aguas Claras. Live fences are already extensively used, and have the potential to further provide benefits such as erosion control, soil conservation, fruit and shade for cattle. Home gardens and individual fruit trees on family plots also require little inputs of time and resources to establish, and can be seen throughout the village. However, many residents claimed that fruit trees would be a desirable alternative for them, implying that there is some reason that is impeding them from having the quantity of fruit trees they desire. Speculatively, such impediments might consist of a lack of access to seeds or conversely, lack of knowledge concerning how to plant or care for fruit trees. Other more formal agroforestry systems could be possible in Aguas Claras with some form of outside technical support. These projects would need to expand institutional infrastructure and foster the development of civil society in order to be successful (Southgate 1998). There is reason to believe that Aguas Claras would be a good candidate for these projects as it is within the Canal watershed and adjacent to a protected area, both factors that make it a critical area in which to promote sustainable land use practices (A. Fischer, oral communication, 2007).

### 8.2.2. Plantations

Other than Soberania Park, there is no primary forest surrounding Aguas Claras, so any FSC certified forestry project would have to consist of a reforested plantation, and not the

kind of extractive enterprise being managed by the community in the Darien. Such a plantation would require a large amount of land, and there are only a few community members who own sizable portions of land. Furthermore, due to poor road conditions, it would be difficult to transport timber products, even if a market could be found. Also, there must be sufficient capital to invest in getting certified. However, it is not a completely impossible alternative if the market price for teak drops or if teak becomes less desirable for any other reason (for example, change in governmental policy) and plantation owners begin seeking profitable options that tap the kind of niche market that certified timber does.

### 8.2.3 Protected areas

Parque Soberania is managed as a IUCN-Category 2 protected area, which excludes the exploitation or occupation of the park (IUCN). Hunting and resource extraction of any kind is formally forbidden. This type of park management faces many challenges, summarized as the “perils of parks” argument (Schwartzman 2000). Often, conflicts arise when locals are excluded from using the area’s resources. In Aguas Claras this is clearly a problem, although there have been no public confrontations, and park officials describe the relationship between the community and the park as “good” (ANAM 1999).

However, enforcement of the regulations is poor, and it seems that park resources are still being used clandestinely, albeit quite possibly in small and diminishing amounts. This means that the supposed integrity of the park is not being maintained in reality. Despite this, it would take considerable political influence in order to have the

management of Soberania Park altered to include the well-being of the residents of Aguas Claras, or to have Aguas Claras re-zoned to be eligible for the sustainable agriculture programs TNC employs. The likelihood of an outside organization wishing to accomplish a eco-tourism development project in the region of Aguas Claras is not high, given that there aren't any intact forest stands outside the park. The poor quality of the roads would also make transportation difficult.

#### 8.2.4 Agricultural Intensification and Improved Efficiency

There is definite potential to this approach in Aguas Claras. Improved agricultural efficiency and increased crop production would certainly raise the well-being of the residents. However, it remains to be seen if this would change the situation in terms of rates of local deforestation, because it is unclear to what extent people in Aguas Claras clearing land for agricultural expansion. A more long term or in depth study would be needed to discover if agricultural land is growing the edges of the community, because in the central region all available land (i.e. land outside the park) has already been transformed to pastures, plantations and fields.

#### 8.2.5. Avoided Deforestation and Payment for Ecosystem Services

The reason this is a potentially interesting alternative for the residents of Aguas Claras is because of the strong incentive on the part of the Panama Canal Authorities to conserve forest cover in the canal watershed, as canal operations are strongly dependent on water

resources and erosion control provisioned by the surrounding forests. However, payments for ecological services are at the moment only in the initial stages of planning and development and are not likely to provide any short-term solutions. If and when this system becomes established, then the town of Aguas Claras could become a good candidate for this kind of project.

## **9. Conclusions and Recommendations**

There are different levels at which the problem of deforestation in Central America can be approached. There are strategies that individual, small-scale farmers can adopt that are better for the environment and their personal well-being, with little or no input from external sources. Fruit trees, home gardens and live fences are all small scale agroforestry practices that are already quite widespread. In our estimation, these actions are the most promising at this scale as they are beneficial both to the well-being of the individuals and to the local environment because of the provision of wood and sometimes fruits, and the erosion control and other ecosystem services provided by trees. They also require the least amount of capital investment or outside help, making them an attractive option for agricultors.

Then there are larger projects that necessitate expertise, capital and setting up by outside organisations, like NGOs or other groups of individuals. This is where organizations like FPP and the other NGOs that we learned about have the greatest potential to make a

difference. The reason that this level of action is often effective at achieving tangible results is that energies can be focused on a specific location or problem, without having to go through inefficient bureaucracies. However, energies are not necessarily directed at the most pressing places or issues, as projects must fit within the particular NGO's mandate and resources. It is also not a comprehensive level at which to solve problems, as changes in one location will not necessarily be applied to all other regions. The need for NGO-level solutions is more an indication of the failings of local government to adequately tackle these problems and provide solutions for the population as a whole. In the long term, comprehensive progress can realistically only be accomplished with sweeping institutional and infrastructural changes. The rural campesinos who are the largest agents of deforestation are acting in response to external pressures, and their behaviours will only be altered significantly if those pressures change.

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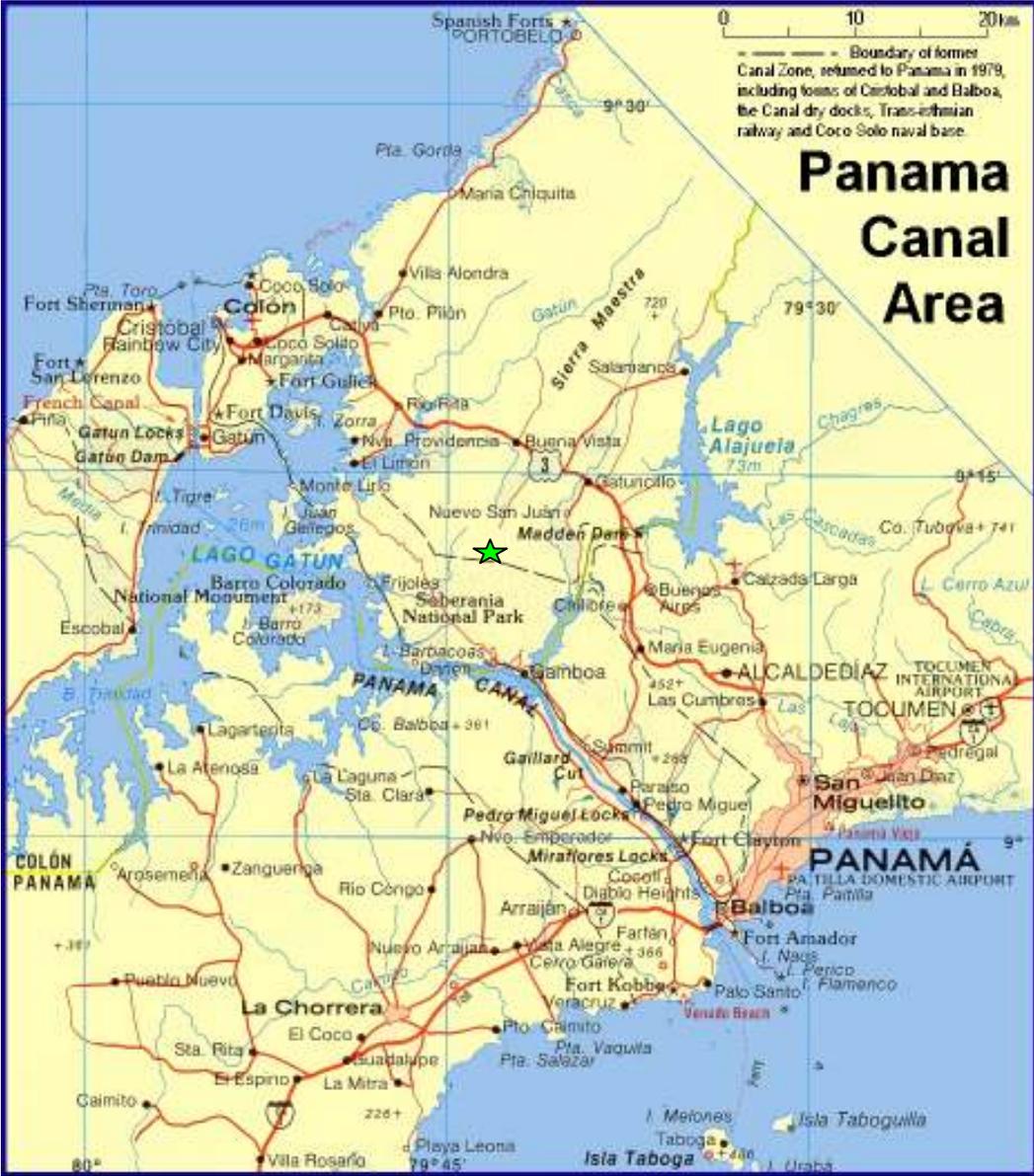
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Appendix 1: Location of Aguas Claras



## **Appendix 2: Introduction to Survey**

Hola, somos Zena y Erika, somos estudiantes de la universidad de McGill en Canada y estamos haciendo una pasantia con el Fondo Peregrino. Sabe algo acerca de esta organización? Queremos hacer un proyecto en esta región sobre la deforestación y como se relaciona con el Águila Arpía. Sabemos que la deforestación puede tener efectos sobre el ambiente, el suelo, agua y el Águila Arpía. Este sondeo es para saber su opinión acerca las causas de la deforestación, para tratar de encontrar alternativas apropiadas. Además de esta encuesta, vamos a recopilar mas información también, y en abril vamos a regresar con miembros de Fondo Peregrino para dar una presentación sobre lo que aprendimos. Quisiera saber si podemos hacerle algunas preguntas. Es voluntario (no tiene que responder si no quiere), y es confidencial (no necesitamos usar su nombre). Nigun parte de nuestro trabajo va a ser utilizado para agencia gubernamental.

Es de acuerdo? Es un buen momento para usted? Cuando podemos regresar?

Usted vive aquí? Es esta su casa?

Appendix 3: Survey



**Encuesta sobre las causas y efectos de la deforestación y usos del suelo**

1. ¿A que se dedica usted o su esposo?  
\_\_\_\_\_
  
2. ¿Cuántas personas viven en esta casa? \_\_\_\_\_
  
3. ¿Hace cuánto tiempo vive aquí? \_\_\_\_\_
  
4. ¿Vivía alguno de sus familiares aquí antes que usted? \_\_\_\_\_  
\_\_\_\_\_
  
5. ¿Es usted dueño del terreno? \_\_\_\_\_  
Sí: ¿Cuánto? \_\_\_\_\_  
No: ¿Hace uso de la tierra? \_\_\_\_\_
  
6. ¿En que forma utiliza este terreno? ¿Cuánto de cada tipo?  
agricultura (que tipo) \_\_\_\_\_ cuanto \_\_\_\_\_ bosque\_\_ cuanto \_\_\_\_\_  
huerto\_\_ cuanto \_\_\_\_\_ potrero\_\_ cuanto \_\_\_\_\_  
otra \_\_\_\_\_ cuanto \_\_\_\_\_
  
7. ¿Cómo ha cambiado el uso del suelo desde que usted (o sus padres) están aquí?  
(por ejemplo, había más o menos bosque intacto?)  
\_\_\_\_\_
  
8. ¿Que hace con la madera?  
leña para cocinar \_\_\_\_\_ cercas \_\_\_\_\_  
muebles \_\_\_\_\_ material de construcción \_\_\_\_\_  
otra \_\_\_\_\_
  
9. ¿De dónde proviene la madera? \_\_\_\_\_  
Cada cuánto tiempo la busca? \_\_\_\_\_
  
10. ¿Ha plantado o replantado árboles alguna vez? \_\_\_\_\_  
¿Porqué? \_\_\_\_\_  
¿Hace cuánto? \_\_\_\_\_

11. ¿Le causa algún inconveniente el Parque Nacional Soberanía? \_\_\_\_\_  
(Le gusta el parque? Quería usar los recursos en el parque?)

12. ¿Qué piensa es la importancia del bosque intacto o del bosque protegido como Soberanía? \_\_\_\_\_  
\_\_\_\_\_

13. ¿Cree usted que hay una relación entre el bosque de Aguas Claras y el Canal?  
\_\_\_\_\_

14. ¿Cree usted que hay gente que usa la madera del parque? \_\_\_\_\_  
Sabe para qué? \_\_\_\_\_

15. ¿Ha visto alguna Águila Arpía? \_\_\_\_\_  
Le gusta que haya Águilas cerca de aquí? \_\_\_\_\_  
Sabe acerca del programa de liberación de Fondo Peregrino? \_\_\_\_\_

16. ¿Qué tipo de hábitat piensa usted que es el mejor para el Águila Arpía?

\_\_\_\_\_

¿Cree usted que este hábitat se encuentra aquí en Aguas Claras o en Soberanía?  
\_\_\_\_\_

17. ¿Piensa usted que las Águilas Arpías y los humanos pueden convivir en el mismo lugar?  
\_\_\_\_\_

18. ¿Sabe algo acerca de los proyectos de reforestación? \_\_\_\_\_  
\_\_\_\_\_

19. ¿Qué piensa usted de los proyectos en los alrededores?  
\_\_\_\_\_  
\_\_\_\_\_

20. ¿Que piensa usted de los monocultivos, eso es, plantar solamente un tipo de árbol en un área?

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¿Piensa que hay efectos negativos?

---

21. ¿Cual es su opinion sobre la plantación de especies de árboles no nativas?

---

---

22. ¿Piensa que la deforestación es un problema?

---

¿En esta región? \_\_\_\_\_

¿En general? \_\_\_\_\_

23. ¿En su opinion, cuales son las principales causas de la deforestación?

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24. ¿En su opinion, cuáles son los efectos de la deforestación?

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25. ¿Si pudiera hacer lo que quisiera con el terreno que haría?

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Preguntas y/o comentarios?

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## Appendix 4: Survey Results, per Question

### Survey conducted in Aguas Claras, March 9-10, 2007

- Of the 19 houses in Aguas Claras, 3 were uninhabited and 2 households refused to respond to the survey.
- In total, 14 households had a representative respond to our survey.

In questions where there seemed to be a notable difference in the responses given between men and women, or between elderly respondents and younger respondents, the answers have been sorted in such a manner. Where respondents gave irrelevant responses to questions or when a question was not asked, it is indicated by NA.

#### **General demographics:**

Of 14 respondents, 7 were men and 7 were women.

Of the 7 women: 3 were over the age of 60, and 4 were under the age of 60.

Of the 7 men: 4 were over the age of 60, and 3 were under the age of 60.

1. As the main source of income/subsistence in their household,  
5 responded machetero (land clearing).  
5 responded agriculture.  
2 responded reforestation labourer.  
1 responded taking care of the house and president of parent's association.  
1 responded lawyer and pasture owner.  
1 responded working with horses.  
There is some overlap due to respondents who listed two of these as their job.
2. The average number of people living in a house in Aguas Claras was 3.5.  
Elderly men interviewed had lowest number of inhabitants in their households, with an average of 2 per household.
3. The average time spent living in Aguas Claras was 32 years.  
Among the elderly, average time spent was 45.6 years.  
Among younger respondents, average time spent was 20.1 years.
4. 3 of the younger respondents had relatives living in Aguas Claras before they arrived, 4 did not. Of respondents who did not, the families originated from locations such as Costa Baja and Colon.  
2 of the elderly respondents had relatives living in Aguas Claras before their arrival, while 3 did not.  
2 NA
- 5 & 6. 8 of the respondents owned only the lot around their home.  
3 of the respondents owned agricultural land and forest: 5 ha, 40 ha, 50 ha.  
3 of the respondents owned pasture between 50 and 100 ha.

7. When asked how land use has changed, most respondents claimed the soil quality has decreased since their arrival in Aguas Claras.

Of the younger respondents:

3 said the soil has been depleted- more acidic, use of non-biodegradable fertilizers, shorter fallow time, trees not growing as tall.

2 said there used to be more agricultural land.

1 said land use has not changed.

1 said they didn't remember.

Of the elderly respondents:

1 said there used to be more forest, so now they've protected what's left.

2 said the soil quality has decreased, and is less productive.

1 said erosion has become a problem and the soil quality has decreased.

1 said it has remained the same.

1 said there is less agricultural land.

1 NA.

8. This question asked what the main uses of wood are. It was sometimes dropped because the answers were fairly uniform and obvious:

All 10 of the respondents to whom this question was posed answered that they use wood for firewood for cooking. Most also said that they used it for the construction of their house or furniture.

4 NA

9. Respondents were asked where they get their wood from. *Refer to question 14 for more on this.*

7 said the wood is collected or cut from their property.

2 said the wood was purchased teak.

1 said it is a present from Ivan Foster, a plantation owner, for working on his plantation.

1 said that they use teak that has been left behind from harvesting.

1 said it is gathered from the wild- mostly wood dried from lightning.

1 said the wood is taken from land clearing.

1 said the wood is from cutting down trees.

1 respondent added that you now need permits to cut down the trees even on your own property.

10. When asked if they had ever planted or replanted trees,

2 responded that they had planted teak or acacia in order to use it for building materials.

5 responded that they had planted some trees in their lot, mostly for fruit – only 1 of these said that it was to sell the fruits.

1 responded that they had planted trees for fences (cercas vivas).

1 responded that they had planted trees on their agricultural land.

2 responded that they had not, only for work on the plantations.

2 responded that they had not.

1 NA.

*In total:* 9 yes, 4 no

**11 & 12.** They were also asked what they think the importance of protected forests is, or why they think protected forests exist.

5 gave answers that suggested that the park presented an inconvenience, despite claiming that it didn't really, citing reasons such as that they can't use the resources there, though they used to be able to, and that insects eat their agricultural crops, or that now they need to buy food for lack of other options.

1 answered that the park presents an inconvenience, and it's there to provide work for the park rangers.

8 answered that the park presented no inconvenience.

Regarding the importance of protected forests,

2 respondents didn't know why parks are important.

3 said it's important for the animals.

2 said they'd been told (by the government) that it was important for the canal.

1 said it's important for the trees and the canal.

2 said that it's not as hot with the forest there.

4 NA.

**13.** When asked what the relationship was between the forest in Soberania Park and Aguas Claras, and the Panama Canal,

10 answered that the forest keeps the canal from drying up.

1 answered that there was a relation, but didn't know what it was.

1 answered there is a relationship because Aguas Claras is nearby.

1 answered there is no relationship because it's far away, and that only the Park is important for the Canal, not Aguas Claras.

1 NA.

**14.** Respondents were asked if they believe that people use wood from Soberania Park.

This question was posed in as un-accusatory a manner as possible such that respondents would not feel pinpointed.

3 answered yes.

1 answered yes, people cut the trees illegally.

3 answered people used to use it a lot more, but not anymore. Some added it was a shame they could not use this resource.

1 answered dead wood only.

1 answered maybe.

1 answered no, not here, only in other places.

2 answered no.

2 NA.

**15.** When asked if they'd ever seen a Harpy Eagle in Aguas Claras,

13 said yes.

1 said no.

Do they like it that the Harpy lives in this area?

5 said yes.

3 said yes, it's very pretty, or their children love them.

2 said yes, it does no harm.

2 said yes, it does no harm, but expressed concern about it eating their hens.

1 said maybe, don't know (hadn't seen any).

1 NA.

Asked if they knew about the Fondo Peregrino's captive release program,

4 said yes.

3 said no.

3 said a little bit.

4 NA.

When respondents did not know about the program, it was briefly explained to them.

**16 & 17.** These questions dealt with knowledge about the Harpy Eagle. Respondents were first asked what habitat people thought was best for the Harpy and if that kind of a habitat exists in Soberania or Aguas Claras. They were further asked if respondents believed Harpies and humans could coexist in the same place.

For the first question,

12 answered tall trees or forest, and that this habitat can be found in the area.

1 answered they didn't know what kind of habitat was best.

1 NA.

For the second,

9 answered that it seems Harpies and people can coexist

5 NA

**18, 19, 20 & 21.** Respondents were asked if they knew anything about reforestation projects, and those that are in the surrounding areas. Related to this, they were further asked what their opinion was on monocultures (and if they had any negative effects), and what their opinion was on planting non-native species.

There is some overlap in instances where more than one of the answers was listed.

Reforestation projects and those in the area:

7 said they knew about reforestation projects.

5 respondents work or worked in reforestation projects.

3 said they didn't know about reforestation projects.

2 respondents further commented that most plantations are owned from the outside, so the money doesn't get back to the community.

1 respondent added that they are good to have in areas with little wood and no jobs.

4 said that it provides jobs, but it doesn't produce anything (fruit, crops, etc.).

3 said it's better to produce food crops.

1 said that plantations are good because they reduce the burden on the forest for wood.

1 commented that the forest is closer because of plantations

Regarding monocultures,

8 respondents said that teak plantations are bad, citing reasons such as that it keeps you from being able to plant anything on that soil afterward, dries the rivers, acidifies the soil, etc.

7 said it's better to plant a mix of species, with 4 specifically citing fruit trees as a better option.

1 said it depends what is planted.

1 claimed there were more insects with monocultures.

2 respondents weren't sure, and supposed that it could be alright.

1 said they didn't know.

Regarding non-native species,

1 said it's better to plant native trees but that they grow slower.

1 said they don't know of any other than teak, the use of which they dislike.

2 said there are no problems with planting non-native species.

1 said if the species adapts, it's ok.

2 said they didn't know.

1 said they didn't know, but doesn't seem like a good idea.

1 did not know of any tree species, and when told of plantations with non-native species, said it makes good wood.

**22, 23 & 24.** These questions asked if respondents found deforestation to be a problem, either in that region or in general. The question was often rephrased so as not to be as leading, and simply asked what their opinion was on deforestation. Respondents were further asked what they believed to be the main causes and effects of deforestation.

Is deforestation a problem?

2 said it's not a problem or it doesn't do any harm, but that too much would be bad.

1 said deforestation is not a big issue, but it's sometimes a problem in this region.

2 said more a problem in general, less here.

2 said deforestation is a problem.

1 said its bad.

1 said reforestation was better.

5 NA.

Causes?

Some respondents answered more than one of the following options

3 said deforestation is caused by people cutting trees to sell (1 mentioned it is now prohibited).

1 said people don't have money so they cut down trees for pastures.

1 didn't see any causes of deforestation .

2 said land clearing was a cause of deforestation.

3 said a lack of education or awareness was a cause of deforestation.

1 said immigration and intensive cattle production were causes of deforestation.

4 NA.

Effects?

Some respondents answered more than one of the following options.

1 said deforestation is bad for the animals.

3 said it gets hotter without trees.

2 said it dries out the rivers.

1 said there is less shade.

1 said it's bad for the soil and the water.

1 said they now know it's bad to cut near rivers.

6 NA.

1 added that deforestation is prohibited here.

**25.** This question asked what people would do with their land if they could do whatever they wanted.

women

3 said fruit trees and subsistence crops.

1 said to cut, plant and clean land.

1 said crops (rice, beans, corn).

1 said depends on earth, aquatic rice would be good and vegetables.

1 NA.

men

1 said crops (yuca, guineos, fruit).

1 said he's lacking labor.

3 said subsistence food (animals, pork, chickens, rice, corn, ñame).

2 said they could do more with machines (but there are problems with machines as well).

## Appendix 5: Questions asked Before and After Educational Presentation

### Evaluación de la charla La Importancia del Bosque Intacto

1. Las Águilas Arpías no atacan a la gente.

SI NO NO SE

2. Las Águilas Arpías comen gallinas.

SI NO NO SE

3. Los árboles ayudan a prevenir la erosión del suelo.

SI NO NO SE

4. El bosque seca los ríos.

SI NO NO SE

5. Deforestación es cuando se plantan árboles.

SI NO NO SE

6. Es fácil reforestar un bosque primario después de la desertificación.

SI NO NO SE

7. Es bueno para el suelo plantar monocultivos de Teca.

SI NO NO SE

8. Si siembra árboles, puede vender la madera en caso de que su cultivo falle.

SI NO NO SE

9. Es posible mantener el bosque intacto y al mismo tiempo usar recursos forestales de otras fuentes.

SI NO NO SE

10. Algunas ONGs o empresas ofrecen programas que pueden ayudar a la gente y mantener el bosque en buenas condiciones.

SI NO NO SE

**Appendix 6: Days of Work**

39 days were spent on this project.

5 days were in the field.