Nuevo Sistema de Abastecimiento de Agua en Ipetí-Emberá

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PROJECT INDEX

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1. EXECUTIVE SUMMARY

This internship focuses on the assessment of the current water and irrigation system for a rural farm community. We worked with with Patronato de Nutrición, a non-government organization that seeks to alleviate poverty and malnourishment in rural communities throughout Panamá. They do this through the establishment of sustainable production farms that help enhance community organization, participation, and implement sustainable farming techniques. We worked on one of these farms, namely La Granja Ipetí-Emberá. Ipetí-Emberá is located in the eastern part of the province of Panamá, in the district of Chepo.

Due to an extreme flooding event last November, the existing aqueduct system that provides water to the community was significantly damaged. Since then, the community and La Granja have been forced to collect water by hand from the Ipetí River, for all their daily needs. Not only is this a time and labor intensive activity, but the water provided by the river is not clean, resulting in many cases of illness throughout the village. Water security has cas in maan exhe village71

of creating a sustainable water system for La Granja and aid in the maintenance and expansion of their production, and although there are some risks which could result in negative outcomes for the community of La Granja, the PVP project has many opportunities for the farm, including increased pig production, increased crop yields, empowerment among the community, and increased economic standing, to name a few. By ensuring proper water and soil evaluation pr

5. BUDGET

Purpose	Number	Unit Cost ($)	Total Cost ($)
Bus Round Trip Tickets	6	10	60
2 mosquito nets	2	5	10
		Total Amount =	**$80**

6. INTRODUCTION AND BACKGROUND

Water security, or the presence of a sustainable, reliable, and sufficient source of water for daily needs, is fundamental to the health and well-being of any community worldwide. In many cases, this issue is more than simply the pursuit of quality water, but 2involvestheneeds or daccessto tater a4.7(ny cpoorr)omm i]TJT*.0009 Tc.00442Tw[(worldw strug5.98(g

sustainable farm supported by Patronato de Nutrición de Panamá, is not an exception. Since the inundation, they rely on a gasoline water pumping system, which is expensive and insufficient in providing the necessary amount of water to sustain the livestock and crops (Docamo 5 Feb. 2009; Ehrman 2009).

The interdependency of water security and food security is not a new phenomenon; worldwide, water supply impacts large to small scale food production (UNDP 2009). Water supply is a limiting factor for the cultivation of numerous crops in La Granja, from hardy subsistence crops (yucca and otoe) to those that are valued most commercially (i.e. tomatoes, onions, and peppers). Thus, the current lack of sufficient amounts of water affects both the nutritional and economic needs of the farm community.

Broadly speaking, our task is to provide water to La Granja, enough water so that they can sustain the crops and animals being raised there; this task includes exploring possible ways of repairing the current system, as well as alternative solutions for the implementation of a new system. In many rural areas and places of poverty throughout the world, alternative methods for water access have been applied. These alternatives constitute more affordable, reliable, and clean ways to supply these communities with the water they so desperately need. Alternatives include rainwater collection, fog collection, non-conventional energy pumps such as hydraulic, windmill, photovoltaic-powered (IETC 1998). We hypothesize that both relocating the water infrastructure to the Ipetí River or a groundwater source, in addition to utilizing an alternative energy method such as solar energy will provide a more reliable and cost effective way to provide water to La Granja and the community in the long run.

7. OBJECTIVES

The main goal throughout this project has been to *find a way to bring water to the farm efficiently and through a cost-effective method*. However, because the process was dependent on community involvement, and the findings of each stage of the process

directed the subsequent steps, the specific objectives shifted throughout project. Therefore, the text below outlines our initial and subsequent objectives.

7.1 Initial Objectives

- Evaluate the current damage (from the flood) to the aqueduct system
- Research and evaluate solutions or alternatives for the farm's/community's aqueduct system
- Present results to the farm/community as a usable resource

7.2 Subsequent Objectives

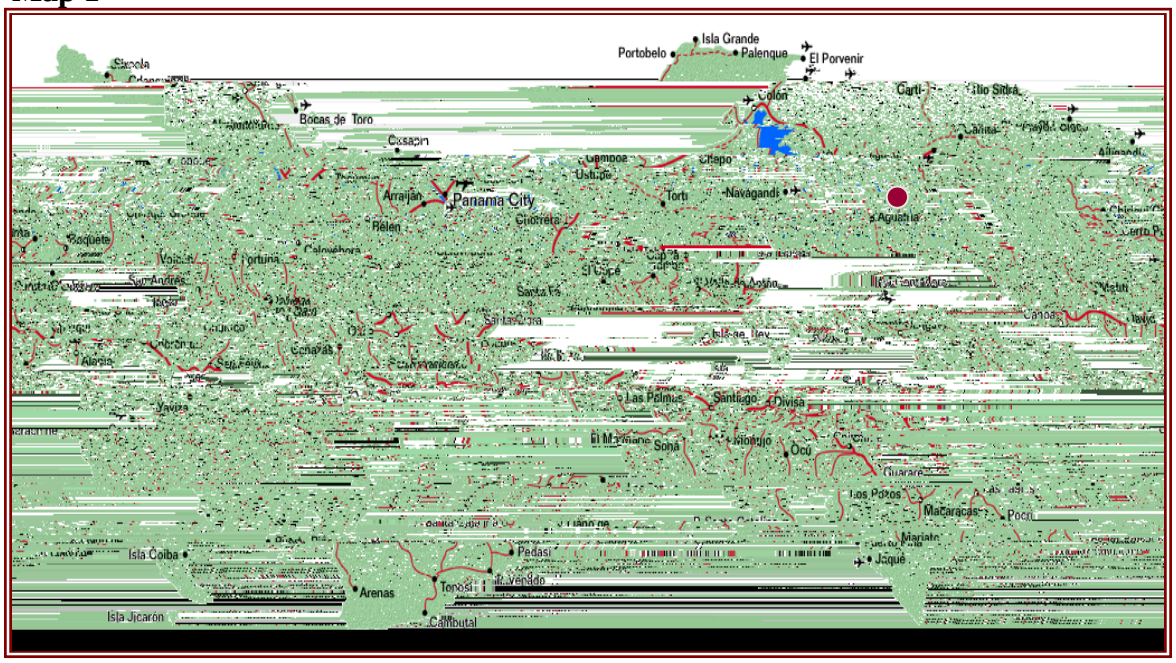
- Select the water system alternative/solution that would best serve La Granja
- Analyze this method in terms of costs and benefits, both socially and environmentally
- Specific Objectives stemming from the selection of the best alternative:
    - Provide a secure and sustainable source of water for the future of the farm
    - Improve health and economic situations caused by lack of sufficient water (food security and income)
    - Provide sufficient water for all crops on the farm
    - Enable the desired expansion of livestock production
    - Create community empowerment amongst members of the farm
    - Create a project that can be used as a replicable model, in the future, for the rest of the Ipetí-Emberá community, or other communities in Panamá and Central America

- Provide the community with a clean, potable source of water

8. STUDY SITE

Our study site is located in Ipetí-Emberá (Map 1) in the district of Chepo, in eastern Panamá. We are working specifically with La Granja in Ipetí-Emberá that was implemented and is supported by Patronato de Nutrición de Panamá. Although this is the general study site, given the objectives and goals of our project, work occurred in the village, along the Ipetí River, in the nearby mountains and hills, and in offices of businesses and organizations in Panamá City.

Map 1



9. METHODS

Throughout the project, we followed an adaptive methodology due to the continuously changing communal process. Although specific tactics and procedures were undertaken, three fundamental principles shaped the entire process. These principles are the maintenance of complete transparency throughout the process, community involvement and participation throughout all decision-making and planning, and community understanding of the technology and project. These tactics emphasize the fundamental

principles included in McGill's Code of Ethics, emphasizing the three guiding principles of power, equity, and respect. More specifically before any decision was made or any specific action undertaken (e.g. a field evaluation on the farm by a company), the results

9.2 Community Participation

The community is an integral part of the success and completion of this project. The people themselves possess the best knowledge about Ipetí-Emberá, and their input throughout this entire process will be very important in determining the direction and soundness of our project. First, we conducted several interviews with people from the community, specifically elders, in order to best understand the history of water pipeline and aqueduct systems within their village. We used interviews to access the traditional ecology knowledge of the community, such as knowledge of flooding and drought events. To find individuals possessing the necessary knowledge, we used the snowball sampling technique, asking one person about other people who may be helpful to our research, and so on. In addition, we ensured that all interviews were informal, and acquired verbal consent at the before each interview has begun. Another aspect of community participation throughout the projec

10. RESULTS

10.1 Damage Assessment

We evaluated the state of the current aqueduct system, consisting of a pipeline running from a rapid-moving stream at the top of a nearby mountain to the village. Since the fall flooding event, members of the community had no true account of what the state of the system currently was, prior to our evaluation. The aqueduct system stretches through steep, thickly forested mountain passes, and is not easily accessible, thus, no one had viewed the system in months.

There were 17 locations where there were damages to the system, and the total length of damaged pipes that required replacement was 440 meters (this number includes only the pipes in zones of damage). Figure 1 displays several different zones of damage. There were areas where pipes extended, mid-air, over creeks and streams (Figure 1: Damage #4). The force of the water washing through these streams, during the inundation, broke these pipes completely. There were also areas where previously buried pipes had been exposed by soil erosion (Figure 1: Damage #6), and the pipes were either washed away or remained exposed and vulnerable to future erosion or inundation events. Finally, there were zones of damage where trees or branches fell onto pipes leading to severe bending or complete breaks along the pipeline (Figure 1: Damage #16).

Figure 1: Examples of zones of damage:

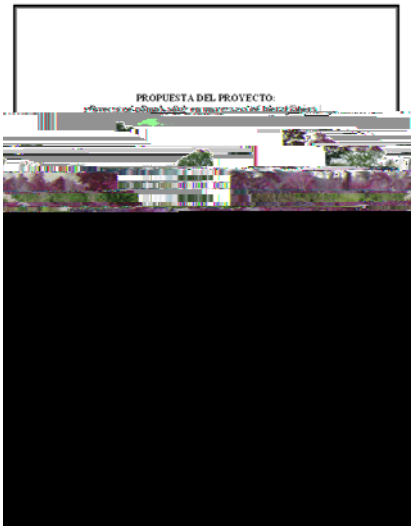
Damage #4 Damage #6 Damage #16

In addition to areas of damage along the pipeline, there was also immense damage at the summit of the aqueduct system, where the reservoir once was located. When we arrived

at the reservoir, there was nothing left except for a litter of broken trees, branches, and heaps of boulders and sand. The concrete holding reservoir was completely destroyed, and without the explanation from our guide, we may never have had a clue that it had once been present. We also viewed the proposed location for the new reservoir, if the system was to be repaired, nearby the site of the old reservoir. In order to construct this, 88 meters of *additional* pipes would be needed to connect with the former pipeline.

Perhaps the most important aspect of th

maximal capacity when the sky is completely covered (PASS Interview 2009). If given the minimal, but appropriate maintenance, the PVP system can be very reliable (Short & Oldach 2003), and its component



both the previous year's flooding events and the resulting social implications. Furthermore, the document goes on to overview the most important observations from the evaluation of damages to the aqueduct system. By utilizing images of the damages caused by erosion and weathering, the proposal seeks to gain awareness of the severity of the problem with the existing infrastructure and the real need for this specific development project in Ipetí-Emberá.

The proposal then shifts focus from background and current information to the rationale behind the submission of this specific project. In order to justify the selection of a photovoltaic pump system, we present a main goal and several specific objectives in the pursuit of the broader goal. These objectives overlap closely with those mentioned above and used within the entire internship process. They are the following (in Spanish):

Objetivos

A. Solucionar los problemas económicos y de salud causados por la falta de agua (producción de La Granja :seguridad alimentaría, ingreso)
   A1. Proporcionar una cantidad de agua suficiente para el mantenimiento y crecimiento de cosechas (especialmente hortalizas como tomates y ajo)
   A2. Proporcionar una cantidad de agua suficiente para el desarrollo y expansión de la producción de puercos y pollos
B. Solucionar los problemas causados por la falta de agua limpia y potable (consumo humano)
   B1. Mejorar la salud, de todos los miembros
   B2. En particular, mejorar la salud de los niños, que constituyen el grupo más vulnerable. Esto tendrá efectos positivos en cascada, sobre su desarrollo social, como la habilidad de ir a la escuela y aprender, y físico (crecimiento adecuado. También, afecta su capacidad de asistir con las actividades de las familias.
C. Asegurar que La Granja tenga un sistema de abastecimiento de agua durable y seguro para el futuro
D. Instigar la independencia y el *empoderamiento* de las familias de La Granja por medio de incluirlas en el proceso y en la implementación del proyecto
   D1. Asegurarse que los miembros de La Granja tengan el conocimiento y la capacidad necesarios pa


Water Quality
Community Understanding
Capacity To Repair Damages
Maintenance

relatively quick, once the necessary soil and aquifer evaluations have been made. The budget is a significant sum ($6,461.25), but is not unfeasible, especially since the only real cost to the construction of this type of system is the initial start-up (construction) costs. The proposal then concludes with our personal vision of the project, its potential strengths and weaknesses, and the ways in which we plan on tackling these issues. The central idea is the value of community involvement throughout the process and the potential empowerment and ownership this can create within La Granja. These ideas will be fleshed out more thoroughly in the sections that follow, but for the complete proposal, refer to Appendix 16.7.

11. DISCUSSION

11.1 Analyses of Proposed Plan

Before the implementation of a PVP system, we felt that it must be analyzed for both its ecological and socio-economic impacts. In order to do so we conducted an ecosystem services assessment and then a social sustainability assessment.

11.11 Ecosystem Services Assessment

**some material in this section, 11.11, comes from Ecosystem Services Assessment Project of our internship in GEOG 404, 2009.

Before creating a project such as this, it is important to assess the credibility, legitimacy, and relevance of the entire process and outcome. In terms of credibility, the project is headed by Patronato de la Nutrición (NGO) which has been involved in the farm community for several years. Not only that, but Patronato has accomplished many

projects similar to this one. For example, in Chiriqui, a solar powered well-pump system was installed to provide water to a rural farm community and has been functioning for over seven years (Patronato de Nutrición 2008). In addition to the credibility due to NGO participation, we, personally, have throughout

Prior to undertaking any actions or construction, an assessment of ecosystem services this project *depends on* and those that it *impacts* must be completed.

The construction of this well system depends on several key ecosystem services:

Category of Service	Ecosystem Service	Description
Provisioning	Freshwater	Ground water supply for consumption and use by people
Regulating	Water Regulation	Recharge of the water: rainfall and subsurface runoff (infiltration) (quantity and timing) Under laid by the surrounding vegetation cover and land use (physical scale: from farm to watershed)
Regulating	Water Purification	Filtration, purification, detoxification of groundwater

This project also has important impacts on key ecosystem services:

Category of Service	Ecosystem Service	Description
Provisioning	Freshwater	Ground water supply for consumption and use by people and its availability.
Provisioning	Food Production	This project defines the amount of crops and livestock that the farm community is able to produce. For example, with more water they can grow tomatoes and peppers, which now cannot grow because of lack of water.
Provisioning	Health/General Well-being	With more water, *cleaner* water, the community will not only have sufficient quantities of food and a balanced diet, but they will also have a clean, portable water source. This greatly affects the maintenance of health in within the farm community
Regulating	Water Regulation	Recharge capacity of groundwater source and nearby rivers. The Ipetí River is very close to the farm and presumably, where we would construct the well. If too much water was drawn from this well, the discharge may reach a level that exceeds the recharge of both the groundwater flows and the nearby Ipetí River.
Regulating	Water Purification	Filtration, purification, detoxification of groundwater
Regulating	Pollination	Pollination of crops by insects and animals is affected by land-use.
Cultural	Cultural Connection	The indigenous community's connection to nature (spiritual) They feel that forest provide water from the mountains.

As is evident by the tables above, this project depends on and affects many different aspects of the ecosystems. Temporal scales and geographical scales must be taken into

3. Natural water purification is the only sustai

Ecosystem Service	Community Dependence	Recent Trends*	Strength of Impact of Driver
1. Freshwater (Ground water)	Absent/low	Neutral	Driver = Technological change **High**
2. Water (Ground water)			

integrated to the impact category of the cost-benefit analysis, as both approaches strengthen each other by using different perspectives.

CRITERIUM 1: Positive and Negative Impacts

Positive Impacts:

The expected and potential positive impacts of the project are very much linked to the central goal and to the objectives enunciated in the result section, but they will be discussed in more detail below.

i. Reliable and sufficient water supply for the farm

Increased production

The construction of a PVP system could provide the farm community with a relatively quick and easy way (a few weeks) to reestablish water supply, with an increased capacity, and an enhanced reliability and future water security. This would benefit the farm through the improved irrigation capacity for crops and livestock. Moreover, it would allow them to not only recover past years' yields (i.e. before the pipeline system was broken), but to sustain and even increase it over time. This is part of the farm's and Patronato de Nutrición's plan, as they wish to increase their pigsty, currently holding seven individuals, to 20 individuals. A7sn3

Increase food security

Because of this increase in quantity, diversity, and sustainability of their food production, and because of an increased purchasing power due to additional income, their access to food supplement (i.e. purchased, to supplement in terms of variety as well as during periods of lower production) increases. Therefore, the food security of the families of La Granja could dramatically increase. This signifies that the quantity and quality dietary needs would be met in a more sustainable fashion, and they are less vulnerable to weather, insects, or potential destructive events

well, because they would not attend school hungry. Additionally, they could be more able to help their parents in their productive tasks on the farm or at home. Lastly, by being less prone to sickness due to improved health, the children would require less care from the parents, which could also favor the overall household well-being and productivity.

It appears evident, from this discussion, how many self-reinforcing feedbacks may arise from the underlying increase in quantity and reliability of water supply to the farm, such as the positive effect on health which in turn would positively affect the productivity on the farm.

ii. Reliable and potable water supply for the household

The farm community could benefit from the PVP system through direct water access for household use (drinking, cooking, washing, etc.), given that the households are connected with the pipes. If the water quality is found to be mediocre but maintains the same cleanliness present in the Ipetí River, a direct household water supply coming from the PVP system could still entail a few positive impacts, such as time savings from not having to fetch the water daily. However, if the water in the aquifer is pronounced potable, it could provide, for the first time, officially drinkable water to members of Ipetí (Potvin, 2009 from informal interview). The positive impacts would be numerous. Most importantly, it would result in dramatic health benefits. Improved health of adults would have cascading positives repercussions, such as increased productivity on the farm and at home, which could lead to further income increments. Additionally, there would most likely be mental benefits, from the mere fact of being more physically healthy and having

enhanced water security. In turn, this would help the entire economic situation of the farm community. Many effects, for both adults and children, would, in fact, be very similar to the ones already discussed above under the section *Health benefits* for water supply for the farm, such as reduced stress from having a secured access to water.

Moreover, many women would not need to fetch their household water in buckets from the Ipetí River. This gain in time could signify more time allotted to more productive

Replicable model

Given successful outcomes, the project could serve as a replicable model for the greater community of Ipetí, as well as for other communities throughout Panamá and Central America. The PVP system possesses the prerequisites for such a widespread use, since it is relatively inexpensive, accessible and durable if the proper maintenance is accomplished, which is minimal (Kaunmuang 2001).

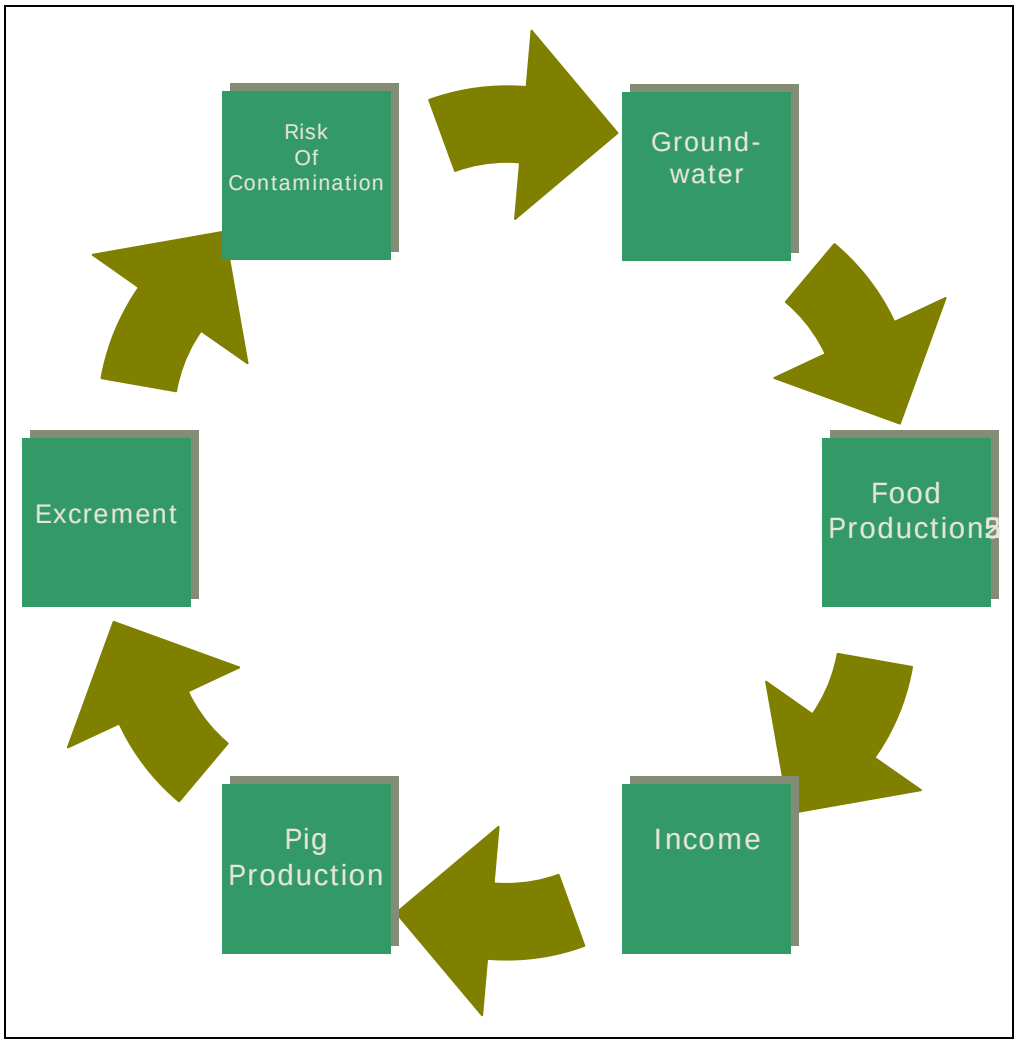
Negative Impacts:

i. Health risks

One of the major risks in undertaking this project is a risk to the health of the people living in this community through their direct consumption of the water and the irrigation of their crops. There are several factors that must be taken into account in order to ensure water quality: presence of pesticides, insecticides, fungicides, herbicides, pig manure (pathogens), heavy metals, fertilizers, nitrogen and phosphorus loading (from fertilizers, manure, etc), and nearby industry (Johnson & Kross 1990). The presence of these anthropogenic and natural contaminants negatively affects groundwater quality and therefore poses health risks to those consuming this water. Also, we must note that many groundwater and aquifer systems have intrinsic susceptibility to contamination due to their hydrogeologic characteristics (Ray & O'Dell 1993). Given the recent trends in the maintenance and preservation of the Tierra Colectiva and beyond (Potvin et al. 2007), more and more, land conversion to agriculture, deforestation, development, and encroachment by external players are increasing the input of abovementioned chemicals

an organic fertilizer spread thinly throughout a large area, which they currently do not do. This would reduce the concentration of manure in and near pig ranches, and decrease their need for synthetic fertilizers. Ultimately, the use of manure as a fertilizer could decrease contamination potential of the soil and their groundwater source. Additionally, Catherine Potvin, during the 2009 symposium presentation, commented that manure can be converted to easily usable biofuel, producing an energy source. The latter could serve to power some type of water purifier mechanism or system which could prove necessary if the aquifer water quality is insufficient for direct consumption. Such a system may be relatively cheap and efficient, which renders it a considerable option (this information learned from the symposium presentation, question and answer period).

Figure 3 Cyclical relationship between the use of underground water, food production, income, pork production, manure production and risk of contamination of ground water



ii. Socio-cultural

Potential negative impacts of the project, although uncertain, could stem out of social frictions between the farm members and the rest of the community of Ipetí-Emberá. On the one hand, the construction of a water infrastructure solely for the use of La Granja may be seen as a form of segregation from the rest of the community, which we personally sensed while working in the field; and, according to another McGill intern in the community, this separation is already perceived by certain community members (Julie Ray PFSS 2009). This, in fact, contrasts with cultural conceptualizations of the community that are centered on *sharing* water systems, the costs as well as the benefits. Conversely, the benefits of the PVP project will be almost exclusively directed to the members of La Granja, and not to the greater community. This could be seen as an indicator for socio-cultural rupture. In addition, it could conceivably lead to jealousy from the part of certain members of the community, especially in the case of a very successful project which includes household access to potable water.

As a result, the project may be expected to create an inequality gap between the farm and the greater community, and this could impede

Beyond the social relations between the community and the farm community, there are

relatively speaking, worse off then before. This, once again, highlights the importance of community understanding and ability to maintain the PVP technology.

In addition, by constructing a PVP system in this farm community, there is a risk to the strength and presence of several Emberá cultural beliefs and associated behaviors. The Emberá believe that the mountains and forests safeguard freshwater and abundance of

have the adverse effect of obliging more labor-input on the farm, most of whom may be women and children.

iv. Maintenance

Despite the minimal maintenance requirements of modern PVP systems, lack of or insufficient maintenance has been repeatedly identified as a source of failure for many of the PVP systems installed, notably in Thailand (Short & Oldach 2003). The use of a foreign and complex technology itself has been associated to failures of similar projects (Ibid.).

Finally, a distinction must be raised between the likeliness of the positive and negative impacts outlined above. Most of the positive impacts identified are likely possibilities, strongly supported by empirical evidence and logical reasoning; e.g. how increased water supply can be expected to increase the production capacity of La Granja. Contrastingly, many of the potential negative impacts identified are extremely hypothetical, and their likeliness does not appear as certain; e.g. the creation of an equality gap between the farm and the rest of Ipetí-Emberá which could disintegrate the social cohesion of the community. This is not to say that these potential negative impacts should be neglected, but rather to prevent the reader from simply counting the number of positive and negative impacts possible, since both their importance and likeliness differ greatly and do not allow direct comparison.

CRITERIUM 2: Efficiency, cost-effectiveness

The cost-effectiveness of the proposed PVP project is clearly higher than any other alternative we have been looking at, especially in the long run. With the data available, we could estimate the total monetary cost

that institution may at some point not be actively supporting La Granja anymore. This extremely plausible given that one of their stipulated goals is to eventually ‘set free’ the supported farms when they are judged self-su

First, the PVP technology is ideal in that it requires minimal maintenance that is easily understood and can be easily completed. With very little training, the members of La Granja will be capable of maintaining *their* water system *themselves*. The only aspect that may not be in their control is the actual repairing or replacement of components; this, however, may take up to 15 years (Gonzalez 2009).

In addition, the farm community will be a part of the process and construction of the project. For example, they will build the concrete tank (5000 gallon capacity) that will serve as the reservoir for water pumped from the well using solar energy. This integration into the planning and implementation of the project helps mitigating several of the risks of non-commitment and lack of ownership of this project, risks that have tendencies to lead to poor maintenance and breaks in system components.

In terms of empowerment, by ensuring that the farm community is always informed, and formulates final decisions with Patronato de Nutrición, they feel not only included but important to the project plan. Furthermore, by incorporating them into the process and always explaining to them why certain decisions are proposed and the impacts these decisions have, the people will better understand how and why the system works. They understand and see the benefits of the project and decision-making go directly to their needs. These benefits are clearly defined, tangible, and well understood, and therefore, the community has strong incentives to maintain and care for the results of the project, namely the PVP system. The fact that it is a relatively small group of people probably

could facilitate the development of such stewardship behaviors for the PVP project, because fewer people are involved, thus avoiding the problems of neglect and loss of sense of responsibility arising with large scale common properties. Nevertheless, this

becomes an increasingly important step. If water quality is very poor, then the completion and success of our project may be compromised. That being said, the original goal of the project, communicated to us by Patronato de Nutrición, is to find water for the farm, not necessarily potable water for human consumption. If the water quality is sufficient for crop cultivation and livestock, then the PVP system can still be a positive, successful project. Utilizing the system for human use is a secondary objective, but we personally feel it could create enormous benefits, as outlined in sections above, for the community.

13. RECOMMENDATIONS

If the system encounters funding and is

system. Finally, over the years, if an increased production on the farm allows more income generation, some capital may want to be gradually put aside, in order to constitute a photovoltaic water pump fund that could allow the members of La Granja being able to finance themselves reparation or replacement of components.

14. CONCLUSION

We believe that this project coincides with goals of Patronato de Nutrición by providing La Granja with a tool for a more sustainable future. This project has the potential to provide the farm community with a sustainable and reliable source of water. This water security would allow for improved health, economic benefits, as well as enhanced social well-being, which impact every aspect of their lives. As outlined throughout our social sustainability assessment, there are numerous possible benefits and opportunities that result from this project. Specifically, it will allow for the expansion of pig production, possible manure fertilizer throughout the farm, increased yields of crops for export (specifically highly valuable crops such as tomatoes and peppers). Also, this creates an opportunity for the families of the farm to have a reliable, potable water source in their homes for their daily lives. Furthermore, by having increased income from the increased crop yields, the families can have greater opportunities for education by being able to send their children to school and undergo night courses themselves. Ultimately, we hope that with the support from Patronato de Nutrición, , along with the achievement of the specific benefits above, this photovoltaic water pump system (PVP) will eventually create independence and empowerment among the nine families constituting the farm.

We acknowledge the fact that there are some risks involved in undertaking this type of project, namely, the risk of breakdown and more importantly the resulting inability to repair or replace broken components (Short & Oldach 2003). The most common reason for failure in PVP systems is the lack of basic maintenance because of inadequate basic information and commitment (ibid). For this reason, we plan to ensure that all maintenance requirements are understood and undertaken. In order to achieve this, we believe in community involvement throughout the process, community understanding of the technology and project, and complete transparency, which has been the case throughout this assessment and will be the case throughout the establishment of the project. Furthermore, by following the abovementioned steps, the farm community will be able to feel a personal connection to this project and a sense of ownership; thus, they will have a strong commitment to the maintenance and success of the new technology. The relatively small scale of the project also tackles the risk of non-commitment and poor maintenance, specifically because the community involved is only a group of thirty-two people; they see the benefits and results of the work put into the farm, directly.

There may be many examples of the failure of PVP systems, but there are also many success stories. For example, one of Patronato de Nutrición's established farms in the Chiriqui province underwent a similar PVP project about seven years ago, which has proven successful to this day. Taking necessary precautions and undergoing risk-aversion tactics with the farm community, we believe this project can be extremely successful and a worthwhile endeavor.

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2006. Protocol for Research in Panamá's

16. APPENDIX

16.1 Complete Damage Assessment

Damages to the Existing Water System: Damages along the Pipeline

Damage Number	Details	Length of pipe replacement (m)
1	Pipe extends over huge ravine. Cables and pipes located high up in the air. Pressure of the water broke pipes. This is the point which connects the whole system to the village	**80 meters** (approximated because of enormity and difficulty of this location)
2	Large ravine filled with soil; foliage growing in the soil. Many trees seem to have broken and been carried down the ravine by the flood. Slope of about 25 degrees.	**45 meters**
3	Very narrow ravine; lots of earth. A small amount of rock exposed. You cannot locate the pipe on the right side of ravine (totally covered with earth).	**6.77 meters**
4	Located in the pasture, with much earth exposed. Originally the pipes were buried, but now completely exposed. 2 to 3 meters of erosion.	**13 meters**
5	In the pasture, with much earth exposed. Originally, the pipes were buried, but now exposed. Not broken, but damaged.	**3.22 meters**
6	Broke at the joint. Pipe extends across ravine. Bent on the right side, and broke at the left side of the joint. Was once a tiny stream, but now 2 ft wide.	**8 meters**
7	Left side seems to be broken. Below the pipe is just rock, no more boulders left. Ave boulder diameter = 30-50cm. Tiny stream of water (3cm). 10 ft height of ravine.	**14.38 meters**
8	The entire pipe that is exposed was once completely buried underground. Natural stream in the center (3m of pipe not buried). 4-5 meter height of ravine.	**47 meters** (ground to ground) **33 meters** (damage to damage)
9	This pipe was in the air, supported by	**24.46 meters**

16.2 DOCAMO, MARISIN INTERVIEW

We interviewed the daughter of Juvenal, Marisin, who is the financial secretary of La Granja, on April 20th, 2009

- They feed the pigs with yucca in the moment, because they do not really have anything else to feed them
- This year, not much will be sold out of the farm, mainly for consumption
- Little yucca was produced this year
- They keep all the money made out of the sales of the farm in a bank account
- They would be selling tomatoes and peppers, but there was no water
- Sometimes they grow rice on the farm
- 9 families, 32 persons, 18 adults, on the farm
- Contract with Bonifacio, the real owner of the land of the farm
- Nance fruit, cuilantro
- Canawalia, achiote
- Organic bean produced
- 3 types of soils:
    - Toca: hard white not good
    - Tierra colorada: red, for yucca
    - Tierrra negra: good, for rice

16.3 DOCAMO, JUVENAL INTERVIEWS

We interviewed Juvenal Docamo, an important member of the farm and the president of the water system of the community, several times:

On March 28th, 2009

- Ministerio de Salud contributed to the first aqueduct system
- Administered collectively by the community
- Emberá vision of the water: take care of the mountains and the trees, that provide the clear water
- Tierra Colectiva (TC): wanted education
- Government said that if they grouped as a community, they could provide infrastructure
- An Emberá cannot sell the land, there is no property
    - All of it is managed collectively
- The chiefs do not want the Patronato to be in control of the money
- The farm is still part of TC
- The forest supplies the animals, seed it as a ganaderia, of which they must take care

On February 5th, 2009

- 4 times a pipeline system
- The last one, 120.000.$, 4 months, 18 men

- The 1st: flooding of the river
- The 2nd one was a steal pipe, it still broke, because of flooding again
- The 3rd first dried, then broke
- Right now a gasoline pump
- Last year's summer: no rain in March, April
- The community was founded in 1970

16.4 PACHO INTERVIEW

We interviewed an elder from La Granja on February 4th, 2009.
Summary [translated notes]

- todo el pueblo trabajaba en la construccion del aqueducto[the existing system].
- 10 to 20 people per day
- There was a contract with the town, whereby all families in the community contributed to the construction in some way.
-

16.6 PASS S.A. MEETING/INTERVIEW

We had a meeting/interview with Calletano Gonzalez (PASS S.A. técnico) on March 16, 2009.

Cuestionario para las companías de paneles solares:

1. Puede describer el tipo de sistema que su compañía provee para los sistemas de posos y bombas alimentados por paneles solares ? En cuanto tiempo se puede efectuar la instalación ?
2.

Notes concerning interview:

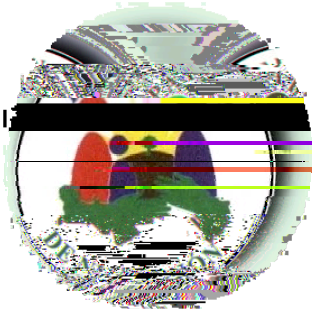
- PASS is the company that built the well-solar panel system in Chiriquí with Patronato. They seem to have extensive experience and knowledge in the domain (there were many books with pictures)
- The size of the pump is 1.25, but it can be adjusted to different sizes of pipes.
- The day we went, it was very cloudy, but the interviewee told us a solar panel could still work at about 50% of its capacity (5 gallons/minute, 10 with no clouds) with such sky conditions.

16.7 Formal Funding Proposal

PROPUESTA DEL PROYECTO:
Proyecto de Bomba Solar en una granja de Ipetí-Emberá

Por:
Vincent Hamann Benoit
Cayleigh Eckhardt
Universidad de McGill

Presentado a:
Patronato del Servicio
Nacional de Nutrición



Índice

VISIÓN GENERAL DEL PROYECTO

Este proyecto pretende reestablecer un abastecimiento de agua seguro para una granja de Ipetí-Emberá, en el distrito de Chepo en la provincia de Panamá. Consiste específicamente en la perforación de un pozo y en la instalación de un sistema de bomba y paneles solares. En efecto, después de muchas visitas en la comunidad y en La Granja, y de un análisis de costos y beneficios de las diferentes alternativas, este sistema aparece como la opción más factible y durable para arreglar la falta de agua en La Granja.

INFORMACIÓN ANTECEDENTE

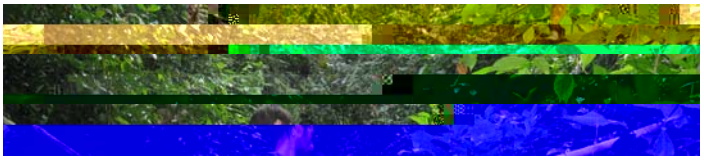
Patronato de Nutrición

El Patronato del Servicio Nacional de n es una organización no gubernamental, que fue establecida en 1990 (Patronato de Nutrición, 2008). Tiene la meta de "contribuir a disminuir los índices de pobreza y pobreza extrema en las áreas rurales de nuestro país [Panamá] y por ende, la desnutrición infantil, a través del desarrollo e implementación del Programa de Granjas de Producción Sostenible", que hoy en día abarca 318 granjas (Ibíd.). Específicamente, ayuda a los agricultores a organizarse y capacitarse para que sean capaces de producir los alimentos suficientes para una buena nutrición, mientras se generan excedentes de producción para sostener una fuente de ingreso (Ibíd.). Con este fin, la organización fomenta métodos de manejo racional de los recursos y servicios ecológicos y humanos, enfocando el desarrollo sostenible, y persiguiendo el autoabastecimiento y la sostenibilidad de las granjas (Ibíd.).

La Granja de Ipetí-Emberá

En 2003, La Granja de Ipetí-Emberá fue establecida en el ámbito del Programa de Granjas de Producción Sostenible del Patronato de Nutrición, incluyendo nueve familias de la comunidad de Ipetí-Emberá que sufrían de pobreza extrema y de desnutrición. Desde su creación, La Granja y El Patronato de Nutrición han trabajado sobre la diversificación de la producción, integrando los diferentes componentes del sistema, para rendirle más sostenible. Por consiguiente, han extendido la variedad y cantidad de cosechas y pecuarios producidos en La Granja. Además, el Patronato de Nutrición está aportando los conocimientos y las técnicas necesarias para empezar, sostener y desarrollar las actividad

autosuficientes en el futuro. Cada año, pueden producir yuca, ñame, otoe, ñampi, maíz, arroz, fríjoles, plátanos, papayas, tomates, ajo, pimientos, culantro, pollo y puerco, con



3. Dañados en lugares de impactos con árboles que cayeron (Foto 8 & 9)

Foto 8

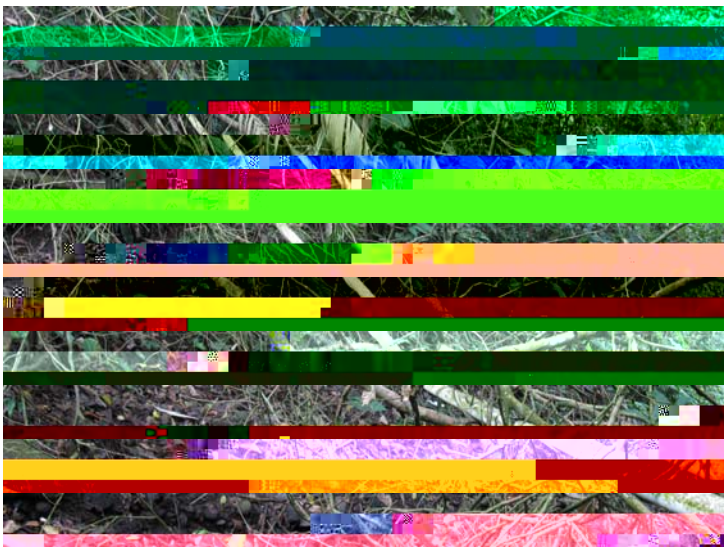
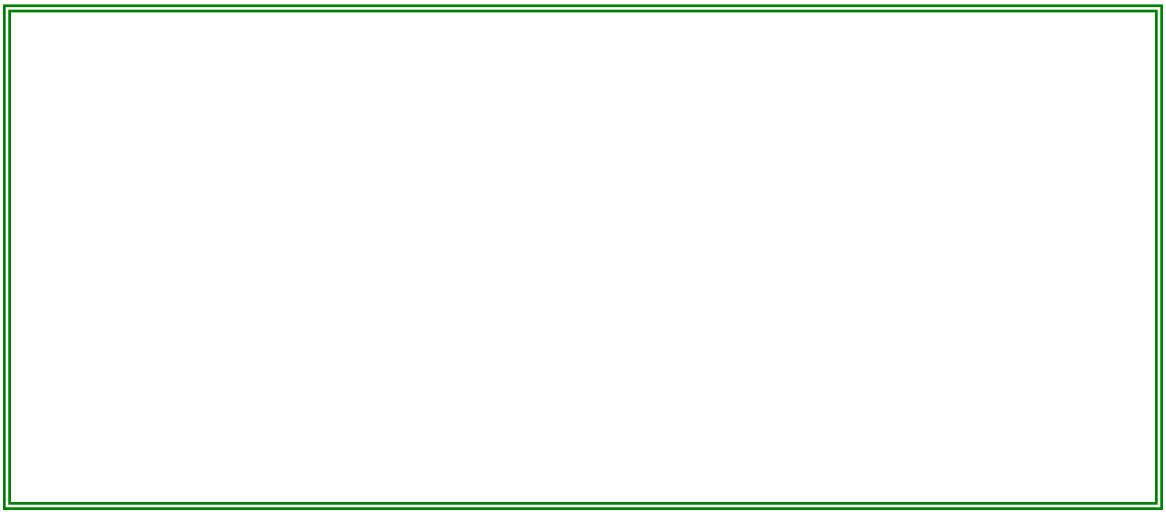


Foto 9

También observamos el lugar de la fuente de agua arriba en la montaña, cuyo depósito de concreto fue completamente destruido por la fuerza del corriente y la caída de árboles grandes (Foto 7). La construcción de un

Por consiguiente, hemos hecho un estudio de factibilidad para diferentes opciones, como, por ejemplo, sistemas de bombas funcionando con el viento (IETC 1998, Organización Panamericana de la Salud et al., 1997). Opinamos que la opción más apropiada, en cuanto a las condiciones físicas del área, de los recursos de la comunidad, y por razones de



adecuado. También, afecta su capacidad de asistir con las actividades de las familias.

G. Asegurar que La Granja tenga un sistema de abastecimiento de agua durable y seguro para el futuro
H. Instigar la independencia y el *empoderamiento* de las familias de La Granja por medio de incluirlas en el proceso y en la implementación del proyecto
   D1. Asegurarse que los miembros de La Granja tengan el conocimiento y la capacidad necesarios para el mantenimiento del nuevo sistema (Ej. la limpieza necesaria; manera, frecuencia). Este objetivo se logra, entre otros, por la entrega a La Granja de una hoja informativa sobre el sistema, con indicaciones y recomendaciones precisas para su uso y mantenimiento.
I. Establecer un modelo replicable de sistema sostenible y exitoso de abastecimiento de agua para la comunidad de Ipetí-Emberá y otros lugares en Panamá y Centro América

PLAN DE TRABAJO

Tiempo de efectuación

TRABAJO	EFECTUACIÓN	TIEMPO NECESARIO
Evaluación del terreno (suelo y agua)	Dirección Nacional Ingeniería y Riesgo	29-30 de Abril de 2009
Perforación del pozo	Patronato de Nutrición	2-3 días

PRESUPUESTO

TÍTULO	DESCRIPCIÓN	COSTO ($)
Bomba PS 200	Hecho por PASS	**1,300.00**
Controlador PS 200	Hecho por PASS	**520.00**
Sensor del tanque	Hecho por PASS	**75.00**
Módulo solar de 50 watt	Número de paneles; Hecho por PASS	**420.00**
Kit accesorios para la instalación	Hecho por PASS	**250.00**
Mano de obra para la instalación	Hecho por PASS	**200.00**
Estructura para panel solar	Hecho por PASS	**300.00**
Transporte	1-2 días; Hecho por PASS.	**200.00**
ITBM (impuesto)	Por PASS.	**216.25**

Evaluación del terreno (suelo y agua)	Hecho por Dirección Nacional Ingeniería y Riesgo	**200.00?**
Perforación de pozo	DNIR	**~580.00 to 720.00**
Construcción del tanque	Capacidad de 5000 galones ; Hecho por la Granja	**800.00?**
	TOTAL	**$6,461.25**

VISIÓN PERSONAL DEL PROYECTO

Opinamos que este proyecto se inscribe en la visión y los objetivos del Patronato de Nutrición, proporcionando La Granja con una herramienta para un futuro sostenible. En efecto, este proyecto pretende establecer una fuente fiable y sostenible de agua para la comunidad de La Granja. Este acceso seguro a agua resultaría en beneficios económicos, y en una salud y en un bienestar social mejorados, impactando positivamente todos los aspectos de su vida. A la larga, esperamos que este proyecto de bomba solar, con el soporte del Patronato de Nutrición, contribuya a la autosuficiencia y al *empoderamiento* de la comunidad de La Granja.

Reconocemos que este tipo de proyecto supone algunos riesgos, a saber la posibilidad que un componente del sistema se dañe, y más importante la consiguiente incapacidad de la comunidad de repararlo o cambiarlo (Short & Oldach 2003). Sin embargo, el origen más común de daño es la falta de mantenimiento básico (Ej. Limpieza de los insectos), por falta de entendimiento del sistema, y de compromiso (Ibíd.). Para evitar eso, nos aseguramos que el funcionamiento del sistema y sus necesidades de mantenimiento están entendidos por la comunidad de La Granja. A fin de lograr esto, creemos en la integración de sus miembros en todo el proceso, en su entendimiento de la tecnología y del proyecto, y en una transparencia completa, lo que fue practicado durante la evaluación, y que será aplicada durante el establecimiento del proyecto. Todos estos elementos favorecen sentimientos de conexión personal y de propiedad entre los miembros de La Granja y el proyecto; por eso, tendrán un compromiso fuerte al mantenimiento y al éxito del proyecto. La pequeña escala del proyecto, 32 personas, igualmente enfrenta estos riesgos; sentarán directamente los beneficios de su compromiso y del mantenimiento propio del sistema.

Aunque hay algunos ejemplos de proyectos de bombas solares que no funcionaron a lo larga, también hay muchos casos que fueron exitosos (Ibíd.). Por ejemplo, un proyecto similar de bomba solar fue establecido en una granja apoyada por el Patronato de