Amazon Partnerships Foundation
Evaluation of Water Catchment Programs, Summer 2011

Abstract: *This report evaluates an Amazon Partnerships Foundation project providing rainwater catchment systems to indigenous communities in the Amazon rainforest in Ecuador. The evaluation, which is based primarily on a survey of 35 families in three communities, sought to learn how the program had impacted respondents' health and happiness and whether it had empowered communities. Quality of project implementation was also assessed. A statistically significant difference was found in health outcomes of program participants: after the program, participants had less diarrhea. Participants' happiness was proxied by satisfaction with the tanks; most repondents reported that they were very satisfied. Changes in empowerment were unable to be measured.*

Background

Amazon Partnerships

Amazon Partnerships Foundation (APF) was founded in 2009 to help indigenous communities in the Amazon protect the rainforest, find strategies to confront climate change and promote the conservation values of their culture. APF is built on a participatory model of development work in which communities take an active role in their own development; communities propose projects and take part in their planning and execution. APF provides small grants to fund these projects, and teaches community leaders how to manage them and monitor their implementation. The organization holds meetings and workshops with community members, teaching them how to sustain the results of projects over the long-term.

APF first began working in three communities: Palma Amazónica, Campana Cocha, and San Pedro Auca Parti, where a U.S. based community health organization, Global Pediatric Alliance, had provided funding for rainwater catchment systems. When Global Pediatric Alliance closed its Ecuador program, the organization transferred responsibility to APF to help communities finish implementation of these projects (1). This evaluation is largely based upon a survey APF designed to evaluate these early rainwater catchment projects. APF's survey attempted to ascertain how its rainwater catchment program had accomplished the organization's goals to improve respondents' health and happiness and empower communities. How well projects had been implemented was also assessed, in an effort to improve project management in the future.

Pie Chart 1. Families' Primary Reason for Requesting the Project

Distance 16%
Laundry Project 21%
Lack of Clean Water 63%
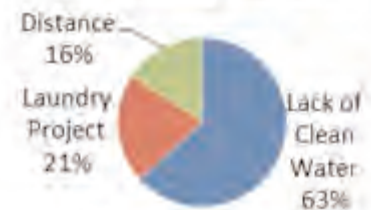
Source: APF

Why Rainwater Catchment?

According to survey results, the main reason most respondents—63 percent—wanted rainwater tanks was because they lacked clean water (see Pie Chart 1). Rivers and streams, the main sources of water in the Amazon, are very polluted; this was demonstrated in APF's previous analyses of the water quality in two communities similar to those surveyed, Isla Apaay and Shiwa Yacu. In those analyses, the

(1) Because the original project goals were defined by Global Pediatric Alliance and focused exclusively on health, the project did not incorporate conservation activities or indicators that have been incorporated in subsequent rainwater catchment, reforestation, and organic agriculture projects.

Table 1. Average Levels of Bacteria in Rivers		
Name of River	Average units of E.coli/100 mL water	Average units of bacteria/100 mL
River Napo	500	1315
River Arajuno	700	920
River Tacota	1415	1800
River Shiquipino	1110	3465

Source: APF

water from four rivers was tested: Rio Napo, Rio Arajuno, Rio Tacota and Rio Shiquipino. Rio Napo is a source of water for the communities in this survey. In all rivers, the level of E.coli and general bacteria was found to be far above the levels the EPA and WHO consider acceptable for clean water (see Table 1). In Rio Napo, for example, the average level of E.coli in water was 500 units for every 100 mL of water and 1315 units of bacteria/100 mL. These numbers are far above the EPA's standard of 200 units of bacteria, and the WHO's standard of 0 units of E.coli. Two hundred units of bacteria is related to approximately 8 gastrointestinal illnesses per 1000 users of river water.

In addition to water being dirty, its location is also often a problem in communities. The survey revealed that water sources—a river or stream, for example—are an average of 235 meters from homes. In in-depth interviews, respondents reported that they had to go to the river twice a day during the dry season to get water. Ramon Aguinda, a community member of Campana Cocha, told interviewers it takes his family an average of ten minutes to go to the river, fill up buckets with water, and return.

What are Rainwater Tanks?

Rainwater tanks, which hold up to 500 gallons of water, are placed directly next to houses. Gutters, attached to the roofs of houses, collect rainwater and funnel it into the tanks. The tanks are sealed to prevent breeding of mosquitos, which spread dengue and malaria, and fitted with mesh to filter out most debris. As a result, water from rainwater tanks is much cleaner than river water; in analyses conducted by APF in Campana Cocha, water in rainwater tanks

used by project participants was found to have between 4 and 3,107 units of bacteria and 1 to 240 untils of E.coli, far less than in river water. If the rainwater tanks are cleaned with soap or detergent and liquid bleach and treated with appropriate amounts of lemon or chlorine, which APF teaches project participants do do during project workshops, the water is even cleaner. When treated in previous analyses by APF, the water in rainwater tanks in Campana Cocha was found to have between 46 to 100 percent less bacteria.

Methodology

Data for this report was obtained from surveys of 35 participants in the first three rainwater tank projects undertaken by APF, between 2008 and 2009. Specifically, the Foundation surveyed half of all project participants in three communities: 5 respondents and one pre-test family in Palma Amazonica, 14 respondents in San Pedro de Auca Parti, and 15 respondents in Campana Cocha. Survey participants were selected nonrandomly, by convenience sampling. This was due to difficulties in arranging interviews in advance with families chosen at random (community members often lacked regular phone access and reception) as well as the fact that many families lived in areas that were not easily accessible. Interviewers were directed to homes by a community member, and those families that were at home were interviewed.

A pre-test for the survey was developed after consultation with the Executive Director, Mary Fifield, and Nelly Tanguila, a teacher in Palma Amazonica. The pre-test was given to only one family in Palma Amazonica, given time constraints and a relatively small sample of project participants from which to draw.

Surveys were conducted in communities during a period of six weeks in June-July, 2011, by Alia Waly, a graduate student from Duke University in-

terning at APF, and Elizabeth Glass, a Peace Corps Volunteer working at the organization. In two communities, Palma Amazonica and Campana Cocha, a community leader assisted interpreting from Kichwa to Spanish during the interviews.

Data were also obtained from several in-depth interviews with community members and previous data collected by APF on water quality and implementation effectiveness.

Data Analysis

It is notoriously difficult to establish causation—that impacts on participants' lives can be attributed to a program or project—and impossible without a control group or baseline data with which post-project results can be compared. Thus, the analysis of this survey, which lacks baseline data and a control group, is not attempting to prove that the water tank program caused changes in participants' health, happiness, and community empowerment—the impacts which the program was interested in. It analyzes associations and trends in the data using Kruskal Wallis tests, chi-squared tests, and correlations.

Validity Concerns

Internal Validity

There are a number of concerns regarding the validity of the survey data collected for this report. It was sometimes difficult to obtain answers from survey respondents because the surveys were administered in Spanish, a language not all indigenous people speak. An interpreter was often needed, and it was impossible to check the accuracy of translations. The interpreter could have changed responses, or included his/her own opinion in responses. Since the interpreters were from the community (not impartial) this posed a real threat to the survey findings' validity. In addition, communities did not know or trust the interviewers, which might have made them reluctant to truthfully answer questions on personal topics, like income.

Other internal validity concerns with the survey included the Hawthorne effect—the program participants were aware they were being evaluated and could have changed their responses to those they perceived were desired by APF. In addition, since participants self-selected into the rainwater tank program, characteristics of participants could be driving the results seen—it is impossible to know whether this was the case without a control. A control would also rule out historical threats to validity—that the survey's results were a reflection of other events that occurred between initiation of the rainwater tank program and outcomes of interest, or that they were the result of natural changes that would have occurred in absence of the rainwater tank program.

Another threat to internal validity of the survey can be found in its use of retrospective questions. Retrospective questions were used to better estimate the association between the project and outcomes, and to compensate for a lack of baseline data; nonetheless, there are clear validity concerns in relying on people's memory to approximate changes in outcomes.

External Validity

This study also has problems with external validity. Since the sample size is so small, it is difficult to generate statistically significant results, let alone extrapolate the data to other indigenous populations.

Findings

Community Demographics

Palma Amazonica (PA)

Families in PA were the least educated of the three communities surveyed. Female head of households had received an average of 4 years of education, and male head of households, 6 (See Table 2). This data is further supported by interviewer observations; it was more challenging to conduct surveys with this community than with the relatively more edu-

Table 2. Average Demographic Characteristics by Indigenous Community*

Demographic Characteristics	Palma Amazonica	San Pedro	Campana Cocha
Number of People per Household	5.40	4.93	6.87
Length of Time in Community (in years)	16.80	11.36	23.87
Educational Attainment of Female Head of Household (in years)	4.00	7.79	7.07
Educational Attainment of Male Head of Household (in years)	5.80	7.79	8.86
Average Income in dollars	$112.00	$132.31	$96.33
Receiving Government Support	80.00%	93.33%	86.67%
Receiving a Majority of Income from their Land	80.00%	71.43%	80.00%
Occupation, males			
Agriculture	100.00%	28.57%	64.29%
Canoe	0.00%	35.71%	0.00%
Construction	0.00%	14.29%	0.00%
Teaching	0.00%	0.00%	35.71%
Other	0.00%	21.43%	0.00%
Total	100.00%	100.00%	100.00%
Occupation, females			
Agriculture	100.00%	25.00%	60.00%
Housewife	0.00%	41.67%	40.00%
Other	0.00%	33.33%	0.00%
Total	100.00%	100.00%	100.00%

*Data from Summer 2011 Survey, including 5 respondents from Palma Amazonica, 14 respondents from San Pedro de Auca Parti and 15 respondents from Campana Cocha.

cated families in San Pedro and Campana Cocha. More translations to Kichwa and explanations of questions were necessary.

PA was the smallest community; however, of all the families surveyed, its families were the most dispersed and difficult to reach. The community relies on agriculture for income, and average income in PA was reported to be $112. However, the incomes reported for all communities are very rough estimates of families' earnings; most heads of families lacked steady employment, and their monthly income was very variable.

Campana Cocha (CC)

CC appears to be the most well-established community, with families reporting an average length of time of 24 years in the community. Average income in CC was the lowest of the three communities surveyed, at $96. The majority of men surveyed, nearly 65 percent, stated that their occupation was agriculture. 35 percent of males surveyed were teachers at the local school. 60 percent of females were employed in agriculture, while 40 percent were housewives. CC had the largest number of people per household, at nearly 7 people. The educational attainment of males was the highest of communities surveyed, at nearly 9 years   4

on average. Females had an average of 7 years of schooling.
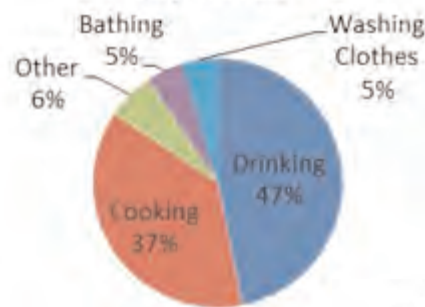
San Pedro de Auca Parti(SP)

SP does not appear to rely as heavily on agriculture as PA or CC; only 28 percent of males and 25 percent of females surveyed work in agriculture. This seems to account for the fact that only 71 percent of respondents in the community reported receiving a majority of income from their land—the lowest of all communities surveyed. 35 percent of male respondents reported working as canoe drivers; 15 percent of males were employed in construction, and over 20 percent had other jobs, like carpentry. 41 percent of women were housewives in SP, and 33 percent held other jobs, like working in the cabanas, an ecotourism project in the community. Average income in the community was the highest of all communities surveyed, at \$132.

On average, educational attainment for male and female head of households was similar—around 7 years of schooling.

Implementation Findings

To assess how well APF had implemented its rainwater tank projects, the survey focused on the organization's trainings. (While the projects were on-going, APF regularly monitored their progress--so other elements of implementation have already been evaluated). Questions attempted to gauge whether respondents had learned what was expected from trainings, and whether they were satisfied with such trainings.

Tank Usage

Survey findings showed that trainings on rainwater tank usage were largely effective; all 35 families reported actively using the rainwater tanks, and they primarily use them as instructed. Findings also showed that most families lack clean water during the dry season (which usually lasts from December to 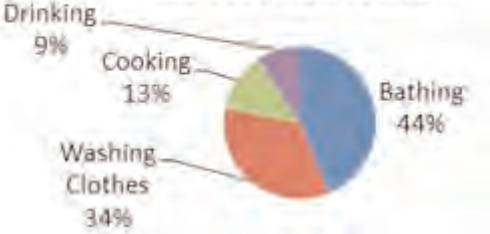April in the Oriente, where the Amazon is located) and that some families may not purify river water that they drink, though they purify water from their rainwater tanks.

Pie Chart 3. Uses of Other Water Sources in Rainy Season

- Drinking 9%
- Cooking 13%
- Bathing 44%
- Washing Clothes 34%

During the dry season, most project participants use rainwater tanks for drinking (47 percent) or cooking (37 percent), as instructed (see pie chart 2). During the rainy season, families also use the rainwater tanks for drinking and cooking, more than bathing or washing clothes (see bar graph 1).
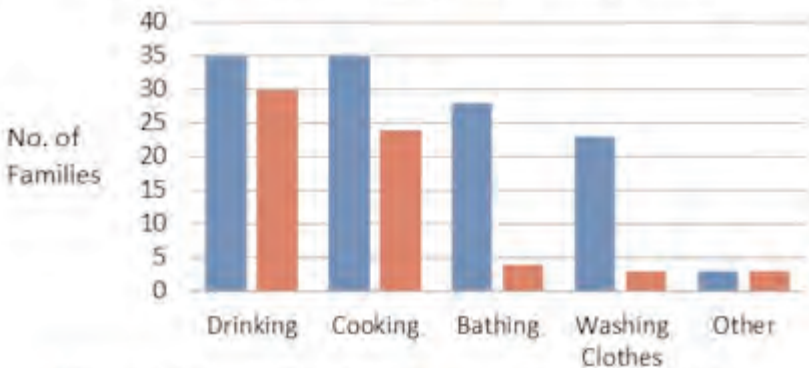
Nearly all families use other sources of water in the dry season, other than the rainwater tank. Over half use them for cooking and drinking (see bar graph 1). 24 families, or nearly 70 percent, use water from other sources several times a week or once a day in the dry season.

During the rainy season, 57 percent of families use only the rainwater tanks for water. All families

Pie Chart 2. Water Tank Uses in Dry Season

- Bathing 5%
- Other 6%
- Washing Clothes 5%
- Drinking 47%
- Cooking 37%

Bar Graph 1. Water Tank Uses Rainy/Dry Seasons

No. of Families

■ Water Tank Uses in Rainy Season ■ Water Tank Uses in Dry Season

that used other sources of water in the rainy season used them at least once a week--most (two-thirds) once a day. However, only 9 percent and 13 percent of families used other water sources for drinking and cooking, respectively (see Pie Chart 3). Thus, during the rainy season, survey data show the rainwater tank was enough for most families' cooking and drinking needs. In-depth interviews further reinforced this. Ramon Aguinda, for example, reported that when it rained, water from rainwater tanks was usually sufficient for drinking and cooking for one week. He added that while tank water was sufficient for his family's cooking and drinking needs during the rainy season, during the dry season there was not enough.

Sixty percent of survey respondents reported washing their rainwater tanks once every two weeks, as instructed, or even more frequently. Nearly 75 percent of families purify water as instructed, most with chlorine (22 families) or lemon (6 families). There was a statistically significant difference among the three communities that were surveyed and whether they purified water or not, at the 5 percent significance level. All but one family in both San Pedro de Auca Parti and Palma Amazonica purified water, but only 53 percent of families in Campana Cocha did. More research should be done to discover why this was the case. In addition, research should be done to substantiate the finding from several in-depth interviews in Campana Cocha and Palma Amazonica that some families are not purifying water from the river, though they may purify water from the rainwater tank.

Respondent Satisfaction

Over 75 percent of respondents reported attending all or most project meetings. APF implementation records confirm these findings. Of those project participants that did not attend all meetings, 14 percent cited the meeting time as the reason for their absence, while 6 percent cited work, and 3 percent cited other reasons (see pie chart pull-out).

All respondents reported enjoying the project meetings. Most--over 70 percent--because it enabled them to listen and learn how to use their rainwater tanks. Some respondents also reported liking the meetings because they believed in the cause of the project (20 percent) or because meetings allowed them to socialize with other members of the community (5 percent).

A majority of respondents--over 65 percent-- had no recommendation on how to improve the proj-

Bar Graph 2. What Families Would Do if Their Tank Broke

ect meetings. Of those 12 participants that did have a recommendation, 8 reported wanting more meetings. Three survey respondents wanted more practice during meetings (ex. practice purifying water, etc.). Despite the fact that 14 percent of project participants reported the meeting time as preventing their attendance, only one participant recommended having different times for meetings (for ex. later in the day) so that more people would be able to attend. In in-depth interviews, both Ramon Aguinda and Nelly Tanguila reported that the most interesting aspect of meetings was seeing that though water appeared to be clean, it was polluted (from microbes). Aguinda also said he liked meetings because they included practical activities, not just theory.

Impact Findings
Happiness

Questions attempting to directly elicit whether participants' lives had improved or happiness increased because of the project were ineffective. It

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was difficult for respondents to think retrospectively about abstract concepts like happiness. Proxies for happiness, like rainwater tank satisfaction, however, were much more effective in eliciting valid responses. Eighty-six percent of project participants reported that they were very satisfied with their rainwater tanks, and 14 percent reported that they were "a little satisfied." No participants reported that they were unsatisfied.

Another indication that participants valued their rainwater tanks was that nearly 25 families reported that they would buy a new tank if their tank broke; 10 families reported that they would try to repair it. Only 30 percent, or 11 families, reported that they would revert to old water sources (see bar graph 2).

Empowerment of Communities

The proxy used for community empowerment was community organization. Questions attempting to elicit whether community organization had changed as a result of the project were ineffective, however; like happiness, the conception of organization was too vague for participants and it was difficult to answer retrospectively. Since no other proxy for organization was used in the survey, and in-depth interviews also proved ineffective at measuring organization, community empowerment was unable to be assessed by this evaluation.

Health

Data show that the rainwater tanks' cleaner water could have led to better health outcomes. 31

Table 3. Diarrhea Incidence Before and After the Tanks, by Community[*][†]						
	Campana Cocha		Palma Amazonica		San Pedro	
Before the Tanks	f	%	f	%	f	%
A lot	8	53.33%	2	33.33%	4	28.57%
A little	7	46.67%	3	50.00%	10	71.43%
Rarely	0	0.00%	1	16.67%	0	0.00%
Total	15	100.00%	6	100.00%	14	100.00%
After the Tanks						
A lot	0	0.00%	0	0.00%	0	0.00%
A little	7	46.67%	2	33.33%	7	50.00%
Rarely	8	53.33%	4	66.67%	7	50.00%
Total	15	100.00%	6	100.00%	14	100.00%

[*]Data from Summer 2011 Survey.
[†]All numbers were statistically significant at the 10 percent level according to a Fisher's exact test.

families out of 35 reported having less diarrhea after getting a rainwater tank than before it, going from "a lot" of diarrhea to "a little" or "rare" diarrhea(see Table 3). This finding was statistically significant at the 10 percent level. A difference among communities on diarrhea incidence was not found, with the Kruskal Wallis test reporting p-values above ten percent significance levels.

This study also found a strong positive correlation (of .4) between gaining health outcomes and purifying water. This relationship was significant at the 5 percent level. This finding was not surprising, but it does underline the importance of water purification.

Correlations with Project Outcomes

This study also attempted to learn whether certain characteristics of participants were associated with better project outcomes—more consistent rainwater tank cleaning, etc.

Of the correlations performed between program participant characteristics: salary, level of education of female and male heads of household, number of family members, and tank value (measured by satisfaction with the rainwater tank and willingness to pay for a tank if it broke) none were statistically significant, except one: there is a positive, statistically significant relationship between number of family members and cleaning the rainwater tank as recommended, every 2 weeks. The correlation, at .5, is

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fairly strong. This finding, however, is not very practically significant—cleaning every two weeks was just one of many dimensions upon which program success was measured, and number of family members was not correlated with any of these other dimensions. Nonetheless, research in the future should attempt to substantiate this finding, and identify other associations between project outcomes and participant characteristics.

Recommendations

Project Recommendations
1. Teach about boiling water from the RIVER or rainwater tank, in addition to lemon and chlorine usage. More research should be done to substantiate the finding from in-depth interviews that many families don't purify water from the river, even if they purify water from rainwater tanks. Nevertheless, emphasizing purifying river water is easy, and this should be implemented into trainings as soon as possible.

2. Emphasize conserving water in the rainy season, so that families have water in the dry season. Most families lack clean water during the dry season; this problem could be somewhat alleviated if families conserved some water from the rainy season for the dry season. More research should be done to assess whether families would have enough water during the rainy season to do this, and how the water could be conserved.

Monitoring and Evaluation/ Survey Recommendations
3. Set Targets for knowledge acquisition and health, happiness and empowerment outcomes. Without targets on health, happiness and empowerment outcomes, it was difficult to assess how successful the water tank program was for APF. Targets would enable the organization to work more deliberately toward outcomes and evaluate its progress over time.

See Appendix A for an example.

4. Conduct a baseline survey of each family at the first project meeting. The survey should collect baseline information on outcomes of interest to the organization, like health. This would greatly increase the validity of survey findings and avoid having to ask respondents retrospective questions (which are difficult for them to answer and not as valid).

5. Develop an indicator to measure empowerment. Survey respondents and the subjects of in-depth interviews all found it difficult to assess the level of organization in their community, let alone whether it had changed because of the water tank project. APF needs to do one of the following to be able to assess its empowerment impact: 1) develop a clearer conception of organization to pose to respondents 2) develop a different way to measure organization (not through surveys or interviews) or 3) develop a different indicator for measuring empowerment.

6. In future surveys, avoid "Why" questions and do more pre-tests. In the Kichwa culture, people are not used to thinking abstractly about things like happiness and organization and it was difficult for many respondents to answer "Why?" about these kinds of topics. These kinds of questions should be utilitzed in in-depth interviews, when interviewers can probe respondents on their answers--not in surveys. This lesson could have been learned in pre-testing, had more pre-tests been performed. In the future, more are recommended.

Conclusion

APF's survey in Campana Cocha, San Pedro de Acaparte, and Palma Amazonica has shown that the organization implemented its rainwater tank program well--a majority of respondents learned what was expected from trainings and enjoyed them. The project was also associated with increased health and happiness outcomes of communities that participated; program participants reported less diarrhea after the

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program, significant at the 10 percent level, and a majority of repondents reported highly valuing their rainwater tanks. Changes in empowerment were unable to be measured by this study. It is hoped that future evaluations by APF will succeed in measuring empowerment and fill the other gaps in knowledge this evaluation has identified, as well.

APPENDIX A. Example of APF Targets

APF Results and Targets

Results	Targets for 2011
Improving the Health and Happiness of program participants.	
1. Clean water	(A) 80 percent of participants purifying their tank water
	(B) 90 percent of participants purifying water from other sources that they drink
	(C) 90 percent of participants cleaning tanks twice a month
2. Increasing sanitation knowledge	(A) Include at least two trainings on sanitation in every project cycle.
	(B) 70 percent of participants understand what microbes are
Empowering communities	
1. Provide project management skills	(A) 80 percent of participants understanding the project cycle