The Economic Impacts of PNDS Infrastructure Projects
June 2016

National Program for Village Development

The Economic Impacts of PNDS Infrastructure Projects

A study prepared for the Ministry of State Administration and the

Ministry for Planning and Strategic Investment,

Government of Timor Leste

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Executive Summary

The Ministry of State Administration and the Ministry for Planning and Strategic Investment in the Government of Timor Leste (GOTL) launched the Programa Nasional Dezenvolvimentu Suku (PNDS, or National Program for Village Development) in 2013-2014 with block grants to 30 sukus that funded 75 community-planned and implemented infrastructure projects. With the completion of the 2016 cycle, a total of 1014 small infrastructure projects will be completed across all 272 sukus in Timor Leste.

Under the guidance of the PNDS Secretariat, a consultant was engaged in 2016 to conduct an economic impact analysis of projects constructed by communities under the block grants. Five municipalities were selected, and projects building new clean water systems, roads, bridges and irrigation systems completed through 2015 were evaluated.[1] A total of 53 projects were identified in the PNDS Database (37 clean water systems, 5 road projects, 7 bridges and 4 irrigation projects) and all of these were included in the evaluation.

Working together with The Asia Foundation (TAF) and their local NGO partners, a large-scale quantitative survey was completed of 1110 beneficiaries of the 53 projects. Clean water, road and bridge surveys focused on estimating time savings per household, and monetizing the value of time saved using the average rural wage rate. Beneficiaries of the irrigation projects were surveyed on agricultural production and sales before and after the project. In addition, a team from the Secretariat conducted a complementary study by interviewing beneficiaries in thirteen of the clean water projects to gain a better understanding of the nature and extent of livelihoods activities resulting from the water projects. Based on the survey results, the value of benefits from the projects are estimated over ten years (the life of the projects), and an estimated Internal Rate of Return (IRR) is calculated for each type of investment.

The impact of roads and bridges constructed under PNDS has the least clear results. While the value of estimated stream of benefits over time is less than the investment cost (-1% IRR), 82% of beneficiaries for bridges and 59% of beneficiaries for roads said they were <u>satisfied or very satisfied</u> with the project results. This indicates that estimating the value of time saved from the project is perhaps not the best way to evaluate the impact of these projects and does not accurately capture their real value to beneficiaries. It is recommended to undertake a more detailed review of the small (but growing) number of these projects to identify the problems, systematically correct any technical issues and determine the most appropriate evaluation strategy.

The impact of PNDS irrigation projects is very positive, with a 72% IRR (12% is the typical benchmark for a successful investment). Unsurprisingly, 96% of beneficiaries are satisfied or very satisfied with the results of the projects. Overall production of padi, corn and vegetables has increased dramatically, and vegetable sales are pushing a 500% increase in revenues.

> *Farmers using PNDS irrigation systems have increased vegetable production by 400%, and their total sales from padi, corn and vegetables are <u>six times</u> what they were pre-irrigation.*

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[1] These four categories of projects are most likely to have direct economic benefits. Rehabilitation projects were not targeted in the sample because of the difficulty in assessing the impact of repairs compared to a new investment.

The results from clean water projects are the highest of all the project categories reviewed (37 out of

> **More than 100 households in the 37 water projects save 4+ hours every day by improved access to water.**

53 total projects). The IRR is calculated at 133%. Moreover, the separate survey[2] conducted by the Secretariat indicated that fully 40% of beneficiaries are using improved access to water to raise their incomes, either directly (for example, growing and selling vegetables or investing in animals for sale) or indirectly (for example, using their time saved to make and/or sell things

in their communities). Another 31% were growing vegetables for own consumption. Clearly, the clean water projects are very valuable to communities when measured from a variety of perspectives.

> **In a smaller survey of clean water beneficiaries, 40% of respondents reported increasing incomes from access to water, and another 31% are growing vegetables only for family consumption.**

At the same time, only 74% were satisfied or very satisfied with the project results, which was thought to be relatively low for projects yielding such high rates of return. A detailed review of beneficiary satisfaction looked for projects where more than half of beneficiaries were dissatisfied, and found five problem projects. On the other side, ten clean water projects counted 90% or more beneficiaries as satisfied or very satisfied.

Table 12. Summary IRRs

	Clean Water	Roads & Bridges	Irrigation	Total
Total Investment	$626,972	$235,781	$55,589	$918,342
Investment Weight	0.68	0.26	0.06	1.00
IRR by Category & Overall	133%	-1%	72%	**95%**

The IRRs for the projects are summarized in Table 12. If each IRR by project category is weighted by the proportion of the total investment, the average IRR for these projects is 95%. This result is dominated by the very high returns on clean water projects combined with the fact that 68% of total investment is in clean water – this was strong enough to overcome the slightly negative return on investments in roads and bridges.

Recommendations for livelihoods support under PNDS follow two main principles. First, ask beneficiaries, especially those who are already building on projects to increase incomes, what support they would find valuable. Second, since neither the Ministry of State Administration nor the Ministry for Planning and Strategic Investment have specialized skills in agriculture or livelihoods development, it is strongly recommended to leverage their extensive decentralized facilitation network (PNDS' key strength) and work together with the relevant agencies, projects and NGOs to deliver these services to beneficiaries. A selection of specific opportunities is also listed.

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[2] This was a test on developing qualitative research capacity within the PNDS Secretariat, and while the results provide useful indicators, the sample size is too small to be considered valid across the entire project.

Introduction

The Programa Nasional Dezenvolvimentu Suku (PNDS, or National Program for Village Development) is administered by the Ministry of State Administration and the Ministry for Planning and Strategic Investment in the Government of Timor Leste (GOTL). PNDS enables villages to prioritize their local infrastructure needs and to construct projects through the provision of block grants (maximum $50,000 per subproject). In addition to the block grants, the GOTL provides technical and social facilitation assistance to build village-level organizational and implementation capacity.

Seventy-five projects were completed under the Pilot in 2013-14, and when the projects funded under Phase III are completed, they will total 1014 projects. Sukus can participate in more than one round of grant funding, and PNDS has now covered all 442 sukus with the 2016 grant cycle. Table 1 below outlines the implementation phasing.

Table 1. PNDS project implementation

	2013-14 Pilot	2013-14 Phase I	2014-15 Phase II	2015-16 Phase III	Total
Number of Suku	30	149	91	202	472[3]
Number of Projects	75	335	219	385	1014

What is being built?

The breakdown of project activities is shown in Figure 1. The project menu initially included Community Halls under the category "Building" in addition to projects such as the rehabilitation of schools and health centers. Community halls were removed from the menu at the end of Phase I, which is reflected in the sharp drop in the overall number of building projects after Phase I (see Figure 1 below).

Figure 1. PNDS project type by phase
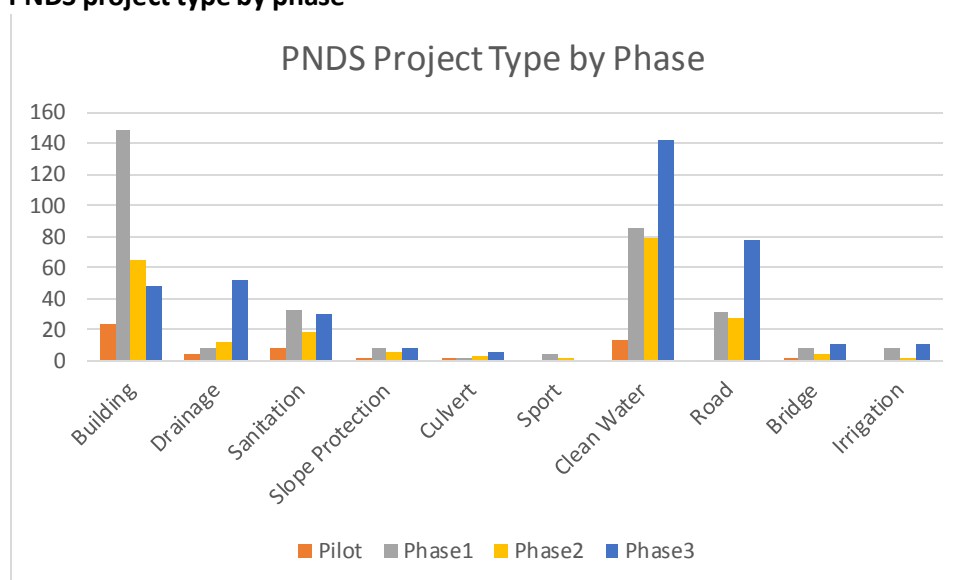
Clean water remains the top priority for communities, and the number of proposals for this increased sharply in Phase III. The demand for roads (including both road repairs and new roads) is also increasing, together with drainage projects. The importance communities place on roads would be

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[3] The total participating sukus is 442. Thirty suku from the pilot have received multiple project rounds.

more accurately reflected through a more detailed analysis of projects to determine to what extent drainage, slope protection and culvert projects are related to road preservation.

Study Objectives and Design

Five municipalities were selected by the PNDS Secretariat for study as part of a technical evaluation and an economic impact analysis:[4] Aileu, Covalima, Ermera, Liquica and Viqueque. The projects for the economic impact analysis were limited to clean water systems, roads, bridges and irrigation systems only.

The study was a joint product of the PNDS Secretariat, the PNDS Support Program and The Asia Foundation. The PNDS Secretariat provided the overall umbrella for the work. A smaller team within the Secretariat coordinated activities and the participation of field facilitators at the municipal, posto and suku levels, as well as conducting the supplementary qualitative survey.[5]   The PNDS Support Program contracted the lead consultant and provided operational support at all levels.[6] As part of its PNDS monitoring program for the Secretariat, The Asia Foundation (TAF) organized and implemented the quantitative surveys working with their NGO partners under the TRAIN program in the five municipalities.[7]   The consultant and the Secretariat team worked with TAF to tailor the survey questionnaires[8] to the Timorese environment. Three instruments were developed, one each for clean water and irrigation, and one for roads and bridges combined. The survey enumerators completed three days of training with TAF staff and the consultant in the capital, Dili, including test interviews. Individual surveys were completed in the field on electronic tablets, which were downloaded into TAF's servers. Once all surveys were completed, TAF staff consolidated the data sets and provided them to the consultant for analysis.[9]

The main objective of the economic impact study is to quantify the value of the PNDS small infrastructure projects over a period of time to the communities which built them. A straightforward but relatively narrow measurement is used, with all results expressed in a monetary value. The value of the projects over time can then be compared to the costs of the investments by calculating a rate of return which will provide information to the GOTL on the relative efficiency of the investments, and their economic value to the communities.[10]

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[4] The two studies were conducted independently under the direction of different consultants.

[5] The economic impact study was conducted under the direction of Mrs. Dulce Guterres Junior, National Director, Programa Nasionál Dezenvolvimentu Suku (PNDS), with supervision by Mr. Rosito Guterres. The PNDS Secretariat implementation team consisted of Olderico Lopes, Bartolomeu Tilman, and Fortunato Amaral. Finally, none of this work could have succeeded without the active support of the PNDS field facilitators in the municipalities, postos and sukus.

[6] The PNDS Support Program is funded by Australian AID and implemented by Cardno Emerging Markets. Melinda Mousaco, Dulche da Cunha and Alvaro Ribeiro were all central to the study implementation, and members of the Facilitation Support Team provided invaluable insight and guidance during the field operations.

[7] Satorino Amaral, Carmenesa Soares and Joaquina da Silva Pinto were the key and very capable counterparts who took on this task at TAF.

[8] The Timorese surveys were based on standard World Bank CDD impact surveys used in a number of countries.

[9] While the study was a collaboration among partners, the analysis, conclusions and recommendations contained in this paper are the views of the consultant. The consultant offers her sincere thanks for their excellent efforts, support, and good humor, without which this report could not have been prepared.

[10] Additional surveys were also conducted with labor paid from PNDS project funds and with businesses which provided goods and services in order to estimate the benefits from PNDS cash infusions. However, there are a

A secondary objective of the study is to provide information to the GOTL that will help them design and implement a pilot livelihoods program being considered for PNDS. What lessons can be learned from current beneficiary experience with the infrastructure projects that will help the Government provide effective support to selected community livelihoods activities?

Methodology

The study uses a sampling model to estimate the values of the types of projects selected. A key operational principle is to ensure the data are systematically conservative so that the resulting analyses do not over-estimate the actual results, and the calculated rates of return can be considered a minimum estimate.

Study Methodology

The general methodology for estimating a project's rate of return is to survey a sample of beneficiaries for each project to develop average values for the responses. The sample should be sufficiently large for variations in responses to balance out, and outliers (unexplained very high and very low values) are typically discarded. The averages are then applied to the overall population of project beneficiaries. The process is illustrated in Figure 2 below.

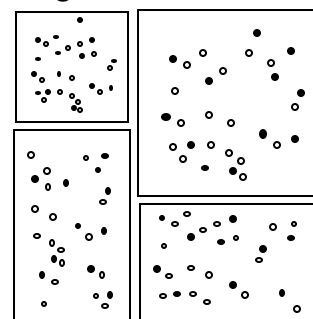**Figure 2. Sampling in one aldeia**
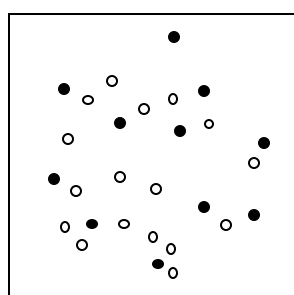
Suppose Figure 2 represents beneficiaries of a clean water project. In the figure, the black dots represent project beneficiaries who were surveyed, and the circles represent those other project users who were not surveyed. All survey responses for all clean water projects (Figure 3) are calculated, averaged, and the averages are applied to all project beneficiaries – both the black dots and the circles – in all the target clean water projects.

Figure 3. Averaging all target locations

For clean water, roads and bridges, twenty beneficiaries were selected and surveyed for each project, with a minimum requirement of ten surveys per project[11]. Irrigation projects typically have a smaller number of direct beneficiaries, and the target survey number is ten-to-fifteen beneficiaries. The strategy for selecting individual survey respondents for the various category types is detailed in Annex 2.

The survey calculates the value of the projects for beneficiaries today (this year), and based on this value, a stream of benefits is calculated extending ten years into the future – consistent with the typical lifespan of small infrastructure projects[12]. Because infrastructure is expected to decline in efficiency over time, the resulting stream of value will also decline; the value stream is calculated here to decline by ten percent every year. The actual cost of the projects and the declining ten-year value stream are used to calculate an internal rate of return (IRR). A benchmark IRR of 12% is typically used for development investments: if a project has an IRR greater than 12% it

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number of gaps and inconsistencies in the results, and the consultant recommends a follow up study to better determine the local impacts of PNDS cash circulation.

[11] Projects with less than ten surveys are not considered valid, and would be deleted from the study sample. All projects met this minimum requirement, and most met the target number.

[12] The PNDS Secretariat team found a number of clean water projects in their sample which were a combination of rehabilitation and new project expansion. The Xefe Aldeias reported that the old systems were built by IOM about 10 years ago – confirming the assumption of a 10-year lifespan for clean water projects.

is considered good value, and if a project has an IRR less than 12%, it should be carefully considered. If the IRR is less than 12%, it is possible for the investment to be justified based on other criteria, for example, other measures of value, the investment benefits certain disadvantaged groups, redresses inequalities, etc.

Sampling Methodology

The economic analysis also limited its target projects to those which were completed during the pilot, phase I and phase II to ensure that the projects were fully completed and communities were benefitting from their services. Finally, the economic analysis limited its target projects to new construction only, as the value of rehabilitation is more difficult to estimate.

Based on these criteria, the PNDS database of 1014 subprojects was sorted and searched, and 53 subprojects were identified in the five municipalities that met all the criteria listed above. These are listed below in Table 2 by type and location. See Annex 1 for additional details on the projects.

Table 2: 100% sample of infrastructure projects

	Clean Water	Roads	Bridges	Irrigation	Total Projects
Aileu	4	0	3	1	8
Covalima	5	2	0	2	9
Ermera	21	1	4	0	26
Liquica	1	1	0	0	2
Viqueque	6	1	0	1	8
Total	37	5	7	4	53

Supplementary Qualitative Study

In addition to the quantitative surveys, an exploratory qualitative survey and analysis was conducted by a team from the PNDS Secretariat. The consultant worked with the Secretariat team to develop a range of useful qualitative research topics, and one topic was selected to develop and test a practical research process that could be managed in the future by the Secretariat. The team chose to examine how beneficiaries of clean water projects allocate their resources (water, labor, financial, etc.) both before and after access to clean water.

The team visited a subset of 13 clean water projects[13] in three municipalities (Covalima, Viqueque and Ermera) with varying degrees of remoteness[14]. Due to the small team size and the test nature of the research, beneficiary surveys were limited to five respondents from each project. The key results were coded and analyzed, and while the very small sample size means they cannot be used to accurately reflect all beneficiary behavior, they provide useful indicators and usefully supplement the results of the larger quantitative surveys.

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[13] Fifteen aldeias were targeted, but one project was rehabilitation and the team was unable to visit a second aldeia due to its extremely remote location and rain experienced during the field study.

[14] PNDS follows the GOTL's classification for each aldeia as not remote, remote, very remote or extremely remote, and uses this as input for calculating the cost of project implement under the block grant.

Economic Impacts of PNDS Roads and Bridges

Figure 4. Survey locations for roads and bridges
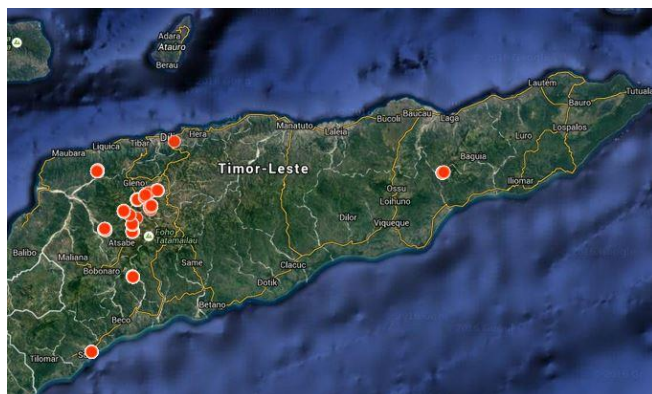
251 respondents (115 men, 136 women) were surveyed, representing a reported 1,066 project beneficiaries. The value of PNDS investments totaled $235,781. Prior to the survey, the enumerators consulted with the suku facilitators to determine a destination common to all project beneficiaries (for example, a market, health center, etc.) that required the use of the project road or bridge. Beneficiaries were surveyed on the time it took them to reach the common destination before and after the project, during both the dry season and the rainy season. The average time savings was valued at the rural wage rate[15] and a ten-year value stream was calculated.

Rate of Return

In the consolidated category of roads and bridges, the average time savings is relatively small (around 30 minutes per week) compared to the size of the investment: returns from time savings over ten years are less than the cost of the investments. When the time saving data from roads and bridges are evaluated separately, roads provide greater benefits than bridges although neither provides time savings over ten years that equals the cost of the investment. The value streams for both types of projects are calculated at one trip per household per week to the common destination (consistent with a most conservative estimate), and when the travel rate is doubled to two trips per week, the return on investment in roads increases to 8%. While this is well above zero, it is still below the benchmark 12%.

Beneficiary Satisfaction

However, up to 34% of combined respondents had upgraded their mode of transportation, i.e. from foot to motorbike or microlet, which is generally a benefit and indicates more efficient transport. Moreover, beneficiary satisfaction levels are relatively high (59% overall) for projects which don't measure significant economic impact, and this was surprising. The breakdown of beneficiary satisfaction for both men and women, and for roads and bridges is detailed in Table 3 below.

Beneficiaries are somewhat happier with bridges than with roads, with 82% of all respondents satisfied or very satisfied for bridges, compared to 59% for roads. Satisfaction with roads was the same for men and women, while somewhat more men were happy (86%) with the results of bridges than were women (59%). Considering the lack of saving in travel time, it was natural to question why respondents weren't more dissatisfied with the project results. After double-checking with a number of respondents, many said they were happy with the outcome because trucks could now enter their villages during harvest time, their ability to utilize vehicles meant they could increase the volume of goods carried [16] and the journey was safer, all of which have positive economic value. This highlights the limitations of using a single definition of value (savings in routine travel time) to calculate the rate

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[15] There are no reliable statistics on rural wages in Timor Leste, but information from the Ministry of Agriculture, Forestry and Fisheries (MAFF) put the rural wage rate at $5 per day.

[16] Respondents noted that travel on a difficult road by foot can actually be *faster* than by vehicle, but the volume of goods that can be carried in a vehicle is larger.

of return without considering alternative valuations, and the issue is discussed further in the section on conclusions and recommendations.

Table 3. Beneficiary satisfaction with roads & bridges

Roads

	Men		Women		Total	%
Very dissatisfied	5	10%	13	22%	18	16%
Dissatisfied	13	25%	11	19%	24	22%
Neither S nor D	3	6%	0	0%	3	3%
Satisfied	20	39%	32	54%	52	47%
Very satisfied	10	20%	3	5%	13	12%
Total	51		59		110	

Bridges

	Men		Women		Total	%
Very dissatisfied	0	0%	3	4%	3	2%
Dissatisfied	7	11%	9	12%	16	11%
Neither S nor D	2	3%	4	5%	6	4%
Satisfied	42	66%	36	47%	78	55%
Very satisfied	13	20%	25	32%	38	27%
Total	64		77		141	

Disabilities

Finally, the enumerators asked respondents if any household members had a disability, and if yes, if they benefited from the road or bridge project. A surprising 28% reported a disability in their household, which is nearly double the WHO's global estimate of 15% of the general population.[17] From those who responded yes, 83% said those with the disability benefited from project. The main benefit cited was easier access to transportation so they could reach services (especially health services) when needed.

Economic Impacts of PNDS Irrigation

Four completed irrigation projects were listed in PNDS's Management Information System (MIS) for the five target municipalities through Phase II. Three of these projects were operational, and one very small project had no water and no beneficiaries could be identified.[18] The total PNDS investment in the four irrigation systems was $55,589.

Fifty-one respondents (30 men, 21 women) were surveyed on their

Figure 5. Survey locations for irrigation

agricultural production and sales before and after the project, representing a reported 143 beneficiary

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[17] This result may be a reflection of Timor Leste's recent history of conflict. This is worth exploring further together with relevant agencies.

[18] This project cost $3,866 and was funded from the remainder of the grant the community received to build a clean water system.

households.[19] The reported number of beneficiary households presented a problem for the analysis: the number was thought to be far too large for three modestly-sized irrigation systems.[20] A total number of beneficiary households is required to calculate the total value of the investment, and because the number was thought to be unrealistic, the analysis used *only the responses from the respondents* to calculate the total value stream – the most conservative estimate that could be fully justified.[21]

The analysis starts with the farmers' total sales of padi, corn and vegetables before and after the investment in irrigation. Based on aggregate volumes and reported sales values, a rough price per kilogram was estimated for padi, corn and vegetables. This was later applied to the reported production volumes in order to obtain a total value of production before and after (see Table 5 and Table 6 below).

Table 4. Sales before and after PNDS irrigation

	Before PNDS			After PNDS		
	Total Annual Sales	# farmers	Avg sales per farmer	Total Annual Sales	# farmers	Avg sales per farmer
PADI sales	740	8	93	1,560	8	195
CORN sales	534	6	89	474	5	95
VEGETABLE sales	425	6	71	8,155	11	741
Total	$1,699		$252	$10,189		$1,031

The small number of respondents (and beneficiaries) makes it difficult to generalize across the entire PNDS project, but there are several interesting points that can be seen from Table 4 on sales and Table 5 on production. First, farmers reported they increased padi production by 38%, yet they doubled their padi sales. Second, corn production and sales present a very different picture. Farmers said they nearly doubled corn production with irrigation but they *reduced* their sales, keeping more for own consumption. From these two points, farmers are observed to generally prefer to sell padi and keep corn for their own consumption. The third point is the huge increase in vegetable production and sales, from $425 to more than $8,000, with the number of farmers selling vegetables increasing from six to eleven. Overall, total sales for the beneficiaries is <u>six times</u> what it was before the irrigation investment.

Table 5. Total agricultural production (KG) before and after

	Before PNDS			After PNDS			
	Total Annual Production KG	# farmers	Average production per farmer	Total Annual Production KG	% ch	# farmers	Average production per farmer
PADI	28,368	29	978	39,057	+38%	40	976
CORN	1,269	9	141	2,479	+95%	8	310
VEGETABLES	925	6	154	4,636	+401%	11	421

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[19] Responses from one survey were discarded because the respondent did not use the irrigation system for growing crops, only for watering animals.

[20] This number could be the total number of households in the three aldeias.

[21] The three operational projects had 51 respondents, and most projects this size are estimated to have between 10-20 direct beneficiary households – 51 was likely to be close to the actual total.

Table 6. Value of total production before and after

	Before PNDS	After PNDS	$ Change
PADI	25,749	35,451	9,702
CORN	673	1,315	642
VEGETABLES	1,749	8,769	7,020
Total	$28,172	$45,537	$17,364

Rate of Return

For the 51 surveyed households only, irrigation projects yield an IRR of 72%. When this is compared to the benchmark 12% for a worthwhile investment, PNDS irrigation systems clearly qualify as very valuable investments.

Beneficiary Satisfaction

Not surprisingly, 96% of respondents were satisfied or very satisfied with the irrigation projects, with men farmers being somewhat more enthusiastic (100%) than women farmers (91%). Both of the dissatisfied farmers stated there was inadequate water in the system to meet all their needs.

Table 7. Beneficiary satisfaction with irrigation

	Men	%	Women	%
very dissatisfied	0	0%	1	5%
dissatisfied	0	0%	1	5%
neither S nor D	0	0%	0	0%
satisfied	21	70%	10	48%
very satisfied	9	30%	9	43%
Total	30		21	

Economic Impacts of PNDS Clean Water Systems

Figure 6. Survey locations for clean water systems
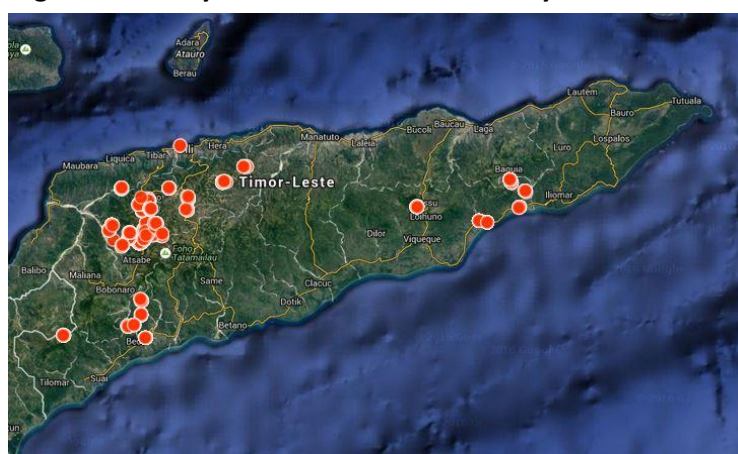
A total of 38 clean water systems in the target municipalities were identified in the PNDS MIS through Phase II. Two adjacent projects in the same aldeia in Viqueque were difficult for both respondents and enumerators to distinguish,[22] so they were consolidated into a single project for the purpose of this analysis, making a total of 37 projects. Three of the projects were later identified as being a combination of rehabilitation and system expansion, which will have smaller measurable effects than a newly constructed project. The survey results for these projects were retained in the sample because a) it

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[22] The same number of beneficiary households (903) was listed for both projects, reinforcing the probability that this was likely the total number of households in the aldeia, and supporting the decision to combine the two projects.

was not possible to distinguish the beneficiaries of the expansion vs. rehab portions of the projects, and b) minimizing the benefits from the project would be consistent with a most conservative estimate. The total PNDS investment in the 37 clean water projects was $626,972.

808 respondents (387 men, 421 women) were interviewed representing 5,214 reported beneficiaries for the 37 projects. The surveys asked beneficiaries primarily about the time required to collect water, the distance traveled, and household consumption of water. These were supplemented by more detailed interviews with 51 beneficiaries in a subset of 13 projects, focusing on how they utilized their available resources both before and after the investments. The results showed a range of important benefits from these investments, summarized in Table 8 below.

Table 8. Household changes in water management

increased water consumption per household per day: 16 liters*

decrease in distance traveled per household per day: 939 meters

average time saved carrying water per household per day: 45 minutes

*This should be considered a minimum estimate for reasons clarified below, with the actual increase larger than 16 liters.

The data on time saved carrying water was the key element in the analysis of the economic impact. Based on the responses summarized in Table 9, access to water remains a significant challenge for households in rural Timor Leste. If we apply the average responses from the surveys to all 5,214 beneficiaries of the 37 clean water projects, more than 100 households are now saving *four or more hours every day* by accessing clean water in their aldeia, and almost a third of all beneficiaries are saving an hour or more.

Table 9. Time saved not carrying water

	# Respondents	% Respondents	All Beneficiaries
Households saving 1 up to 2 hours each day	124	15%	800
Households saving 2 up to 3 hours each day	51	6%	329
Households saving 3 up to 4 hours each day	47	6%	303
Households saving 4 or more hours each day	18	2%	116
Total	240	29%	1,549

The quantitative survey also yielded a perplexing result: roughly 25% of respondents reported *consuming less water now* than before the clean water project, yet they were satisfied or very satisfied with the project. Beneficiaries typically <u>increase</u> water consumption after these investments, and the team was concerned by this unusual result. Follow up discussions with enumerators and respondents quickly revealed the source of the data problem. Beneficiaries know how much water they carry and use every day from a distant water source because it is typically carried in a fixed number of plastic *jerigan.* However, once a water distribution point is built near their house, most reported bathing and washing clothes at the distribution point, and carrying a limited amount of water back to the house for household consumption. They didn't know how much water they were actually using, but they were *carrying* less water home. Based on this information, the decision was made to adjust these responses as follows: a) if the reported volume of water consumed decreased after the investment, and b) if the respondent was satisfied or very satisfied with the project, then the current consumption was increased to match the pre-project consumption level. If the respondent was dissatisfied or very dissatisfied with the project, the number was left as reported. The team felt this was a realistic

adjustment, more closely reflected the real situation, and would still be consistent with estimating the most conservative result (actual consumption was likely higher now).

Rate of Return

The rate of return for clean water projects was calculated on the information on time savings provided by the 808 respondents in the quantitative survey, using the same strategy as for roads and bridges. The time saved by each household was averaged and applied to all clean water beneficiaries. The value of the time was monetized by using the rural wage rate, and the value stream ten years forward was estimated by discounting the future value stream by ten percent year-on-year. Based on this, PNDS clean water projects have an IRR of 133%, greatly exceeding any minimum investment criteria.

The limitations of using a single indicator (time saved) to estimate economic value have already been highlighted. Just as the value of roads and bridges might be underestimated by using this narrow measure, is it possible this very high rate of return is overly optimistic by focusing on this one aspect? The results obtained from the more limited qualitative study of the subset of 13 clean projects can add information on whether this is unrealistic or a fair indicator. From the sample of 52 respondents (4 men, 48 women), **40%** were increasing their cash incomes based on their improved access to water.

Table 10. Economic activities related to access to water

	# Respondents	%
number of households with positive economic impact	21	40%
directly from access to water (growing & selling vegetables, raising animals for sale)	19	37%
indirectly from access to water (extended kiosk hours, making & selling snacks)	8	15%

Six respondents (12%) were using water directly in addition to utilizing their new time for indirect activities (this is why the total for direct and indirect is greater than 40%). An additional **31%** are growing vegetables for own consumption only, which is either saving economic resources (no longer purchasing vegetables) and/or increasing vegetable consumption (and likely improving nutrition). These indicators show that communities are eager to increase incomes and are creative in using the resources available to them. This supports the high rate of return on PNDS clean water projects.

The researchers initially assumed that communities nearer to established towns would be more likely to generate income from access to water, and were surprised when the qualitative survey data painted a very different picture: *nearly all* (20 out of 21) of the income generating activities linked to clean water came from remote, very remote and extremely remote areas. One possible explanation for this result is that there is pent-up demand for all types of goods in remote areas and difficult access to supplies, with ready buyers waiting for sellers.

Beneficiary Satisfaction

Patterns of beneficiary satisfaction are somewhat more complex for clean water. Overall, 70% of beneficiaries are satisfied or very satisfied with the clean water projects, while 26% are dissatisfied or very dissatisfied, with men and women holding roughly similar views (see Table 11).

Table 11. Beneficiary satisfaction for clean water

	Men	M (%)	Women	W (%)	ALL	ALL (%)
Very dissatisfied or dissatisfied	97	25%	112	27%	209	26%
Neither Satisfied nor Dissatisfied	13	3%	19	5%	32	4%
Very satisfied or satisfied	277	72%	290	69%	567	70%

While distance to the water tap is possibly one logical explanation for satisfaction or dissatisfaction, the individual project data were examined more closely to see if additional information could be extracted. Two specific questions were asked:

1. How many projects have more than 50% of beneficiaries unhappy with the project result? Five projects (13%) fall into this category, accounting for 35% of all unhappy votes.

2. How many projects have 90% or more beneficiaries happy with the project result? Ten projects (27%) fall into this category, accounting for 37% of all happy votes.

These results indicate that there are a limited number of problem projects where beneficiary dissatisfaction is concentrated, and that better-performing projects have a larger proportion of satisfied beneficiaries dispersed across the project area. This is consistent with the team's field experience, in which several barely- or non-functioning projects were visited and beneficiaries were widely disappointed. The beneficiary satisfaction data for the individual projects is contained in Annex 3.

Conclusions

The results from the surveys fall into two categories: very clear, and less clear.

The high rates of return on clean water systems (133%) makes them very valuable investments for rural communities. The high returns on clean water based solely on daily time savings are reinforced by the supplemental study that found 40% of respondents were increasing cash incomes either directly or indirectly as a result of better access to water. Most of those were growing and selling vegetables or investing in animals for future sale (direct) or were using their newly-freed time to produce and/or sell goods demanded in their communities. The 31% increase in gardens for own consumption strengthens these results even further, as they free up cash resources or increase vegetable consumption. It was very encouraging to see that income generation from clean water was most successful in remote communities and was not dependent on access to larger town markets.

The high rate of return on irrigation (72%) based on the value of production before and after also makes it a clear winner. Several respondents noted they now had fish ponds as well, indicating beneficiaries are finding additional, creative ways to use these investments to generate more income.

The results of the surveys for roads and bridges are less clear. The initial numbers on travel time saved show that the value of time saved over ten years is less than the cost of the investments. This might be a reflection of quality problems with new roads identified in the technical audit. However, it's also possible that using this single dimension for valuing roads and bridges is highlighting the limitation of the standard measurement strategy, and underestimating their true value to communities. The number of road and bridge projects up to now has been very limited (this study included a 100% sample of 12 projects), although the number increases in Phase III and will likely increase in the future. It is strongly suggested to do a more detailed review and analysis of the underlying issues with road construction – from the technical, social and economic perspectives. Do the problems lie in

prioritization, planning, facilitation, implementation, operations and maintenance, or elsewhere? The PNDS Technical Audit Evaluation June 2016 (Draft) indicates that there are technical challenges with opening new roads, and low time savings may be a reflection of this. However, other CDD programs in similar environments successfully build new roads (for example PNPM Indonesia), and it is unclear why these are not yet good investments for PNDS. This is an excellent opportunity to find the problems and develop solutions.

Table 12. Summary IRRs

	Clean Water	Roads & Bridges	Irrigation	Total
Total Investment	$626,972	$235,781	$55,589	$918,342
Investment Weight	0.68	0.26	0.06	1.00
IRR by Category & Overall	133%	-1%	72%	95%

The IRRs for the projects are summarized in Table 12. If each IRR by project category is weighted by the proportion of the total investment, the average IRR for these projects is 95%. This result is dominated by the very high returns on clean water projects combined with the fact that 68% of total investment is in clean water – this was strong enough to overcome the slightly negative return on investments in roads and bridges.

The study also highlights a few administrative issues that could easily be corrected and will improve future analysis. The small number of projects included in this review means that each project and respondent data can be closely reviewed for inconsistencies, but this will become increasingly difficult in the future as the numbers grow. It is recommended to:

- Improve project descriptions to make it very clear what is rehabilitation and what is new. This is particularly important for clean water systems, one of the largest categories in PNDS.
- Improve the accuracy of beneficiary numbers on projects. Facilitators need to carefully assess who will and who will not benefit from individual projects, and the total number of households in an aldeia is often not the appropriate number. This is especially important for clean water and irrigation.

Recommendations for Livelihoods Development

The GOTL is considering allocating additional funds specifically for livelihoods support, but does not yet have a clear strategy for implementing this. It is recommended to first leverage income generating activities that are already being started by communities as a result of PNDS investments.

Two guiding principles are recommended. First, ask beneficiaries (especially those who are already leveraging PNDS investments) what they would value in terms of support and capacity building (not cash or in-kind grants). Start with what is already happening, and look for ways to strengthen it.

Second, neither the Ministry of State Administration and the Ministry for Planning and Strategic Investment have extensive expertise in agriculture or rural development, and care should be taken to work together with relevant agencies, organizations and the private sector to leverage suitable linkages. The potentially huge value of PNDS lies in its facilitators and their ability to network effectively around the country. No other organization has this capacity, and it should be a key part of the foundation for any livelihoods work. In view of the encouraging results from PNDS clean water

and irrigation projects, a good first step might be to work with DFAT's Tomak project in MAFF to develop some sensible, concrete options in agriculture.

- Those planting gardens reported that good quality seeds, inputs and information are difficult to obtain outside Dili. How could PNDS support this in a way that is sustainable? Can groups be supported to develop nurseries for good quality seedlings? How can PNDS work with the private sector and MAFF to do this?
- No one in the qualitative study produced or used compost to improve the productivity of their gardens, except for the occasional collection of animal manure if they found it nearby. Are there opportunities to work with NGOs with agricultural skills to build capacity to produce and sell compost? This could be an especially valuable activity in coffee growing areas that need to maintain organic standards.
- Fish ponds are a natural pairing with clean water and irrigation projects. Some of these are happening spontaneously, but all could benefit from building management capacity.
- Develop strategies for building groups (especially women) to develop saving & credit groups to support members' needs. There is an excellent example in Viqueque (Uatu Lari) of a group coming together on their own and growing rapidly. They should be supported, and opportunities given to other communities to replicate their success.
- Group development also facilitates the development of livelihoods skills, both general (such as basic budgeting principles) and technical (improving animal health and productivity).

Annex 1. List of infrastructure projects and locations

| Study ID	Muni-cipio	Postu	Suku	Aldeia	Remoteness*	Suco_SubProject_ID	Type	Actual Expend.	# Beneficiary Households
1020105015	Aileu	Aileu Vila	Lahae	Lahae	R	5A478234EEB841E99EF E8913ACA158BB	Irrigation	18,595.70	16
1020101013	Aileu	Aileu Vila	Aisimou	Aituhularan	N	CB7246EB6291468A8F0 D5102ABAC90E1	Clean Water	14,421.10	65
1020102013	Aileu	Aileu Vila	Bandudato	Dudato	N	4A6E3278E3654C52A22 6436571E1BF7F	Clean Water	16,850.95	38
2020302013	Aileu	Remexio	Tulataqueo	Roluli	V	DDE3D6EE48BE4CD8AE CFA52EA7233FEE	Clean Water	42,417.60	98
2020305013	Aileu	Remexio	Fadabloco	Lequica	R	1382929C40544582810 A3098F807834C	Clean Water	39,500.00	248
P020107012	Aileu	Aileu Vila	Hoholau	Saharai	R	178FBDAE60884F319A9 7063DE98A2616	Bridge	18,976.50	144
1020108012	Aileu	Aileu Vila	Seloi Malere	Tatatihi	N	E2230B43071E43C1BF2 F93CDFA568CB7	Bridge	22,585.49	57
1070111012	Aileu	Aileu Vila	Suco Liurai (Aileu Vila)	Laclo	R	2304A401784A487EBBC 313E80B953E5F	Bridge	22,012.50	130
1050101015	Covalima	Fatululik	Fatululik	Beco	V	0DDF6E75F0BE43D68D 5C0D36B1C33C1A	Irrigation	3,865.50	52
2050503015	Covalima	Suai	Suailoro	Acar Laran	N	8A3181626C544E2EA2A F3DAFFC4EB2DA	Irrigation	21,609.70	127
2050504014	Covalima	Suai	Camenaca	Fatuisin	N	5311D7B90B1C43EAB6 D7E57506DECD69	Road	9,960.98	200
1050707014	Covalima	Zumalai	Ucecai	Ledula	E	3BE3ED7B359A49D69A 7A94A9653DCB8E	Road	25,760.00	85
2050501013	Covalima	Suai	Beco	Gala	R	A8DA923DA28540F2BB B459E53449EB92	Clean Water	16,155.20	76
1050702013	Covalima	Zumalai	Zulo	Zulo Tas	V	6212D785183E448AB36 61648EE9DF35C	Clean Water	7,632.40	45
1050704013	Covalima	Zumalai	Fatuleto	Nala Op	V	BABEB9FD31B34E4EA91 4B32FEA54B027	Clean Water	11,809.92	165
1050705013	Covalima	Zumalai	Mape	Daro/Polo	V	2A7656A8D4BA4CD2B9 8FA6D7F1408C1A	Clean Water	43,346.70	72
1050708013	Covalima	Zumalai	Tashilin	Galitas	V	FA48E1F25B964D0F8F6 EA0DBB7E166E8	Clean Water	23,596.45	180

1070505024	Ermera	Hatolia	Leimeacriac	Lequiama	V	93118F277B5E46C3A51D55A3F6A24316	Road	12,658.00	370
P070106013	Ermera	Railaco	Railaco Leten	Tuileco	R	12A2772E70304E18A2C5BEB8585D4190	Clean Water	6,948.75	43
1070204013	Ermera	Ermera	Mirtutu	Apido	N	EEA8839738F34FFEB369B04A2B4347F2	Clean Water	21,181.25	85
1070205013	Ermera	Ermera	Lequimea	Titihar	R	ABC9FB34A58D4252B67DDA70BE4A4E18	Clean Water	13,352.75	144
P070206013	Ermera	Ermera	Humboe		N	7CF7FE36C6B34DD1A5834E70514F6B9A	Clean Water	23,725.00	136
1070207013	Ermera	Ermera	Riheu	Gomohei	N	E55D0A411DA7437A9FADFBAE4B4C5589	Clean Water	8,656.60	76
2070301013	Ermera	Letefoho	Dururai	Assui Craic	V	AB22A26A263C40DE997EFF6A40A4F7E5	Clean Water	20,432.70	80
2070301023	Ermera	Letefoho	Dururai	Renomata	V	D2E64710D2AC4634B4CF54C0BB7043AD	Clean Water	13,684.80	100
2070302013	Ermera	Letefoho	Haupu	Raepusa	R	650D88D61CAE47B0BAED7EA2F3E8F171	Clean Water	18,398.45	399
2070302023	Ermera	Letefoho	Haupu	Riatoni	R	AA6ABF23B84047628A62299396BBBC3E2	Clean Water	11,858.25	629
2070302033	Ermera	Letefoho	Haupu	Duhoho	R	D922DD5565D04E02A6CDAE93F518D1EE	Clean Water	10,095.00	353
2070303023	Ermera	Letefoho	Lauana	Raebou Soli	V	99B17B6A79734E58B5CB63A0C99115BC	Clean Water	9,531.50	33
2070304013	Ermera	Letefoho	Catrai-Criac	Manturai	V	E7BBCD77A7364E9487940F15AEAFD01B	Clean Water	20,559.75	74
2070305023	Ermera	Letefoho	Catrai-Leten	Merigue	V	1E64E14E37A0407C9AB50C85C92CEC29	Clean Water	14,164.10	120
2070306013	Ermera	Letefoho	Goulolo	Goulala	R	DA32D5B5495C419C996D9C3661A2E986	Clean Water	12,740.00	77
2070307023	Ermera	Letefoho	Eraulo	Goulala	R	E86D4117ADBE4527AACDABEAD0534EEC	Clean Water	9,203.00	28
1070501013	Ermera	Hatolia	Leimea Sorimbalu	Brughou	E	6F499170612347648A21CAC85E58EACB	Clean Water	13,244.70	80
1070501023	Ermera	Hatolia	Leimea Sorimbalu	Leodato	E	F8B6E49FBB5A41ABB282BBC755123A8C	Clean Water	15,939.75	82
1070502013	Ermera	Hatolia	Coliate-Leotelo	Manucati	V	636A004B9A3E49C1BA3C24490658B02A	Clean Water	14,915.25	456
1070504013	Ermera	Hatolia	Ailelo	Santa Cruz	V	672031B34CA4496FAA9B41A90E4C8114	Clean Water	8,914.50	48

1070505013	Ermera	Hatolia	Leimeacriac	Hatupae	V	10B4DB47560E4D18A8 AF881D48A5D12B	Clean Water	12,714.75	50
1070506013	Ermera	Hatolia	Samara	Raeluli	V	78800E2919B84F5EBDF A2226EE75DD64	Clean Water	13,873.75	60
1070209012	Ermera	Ermera	Raimerhei	Nazare	R	2F0B3A3780DF4229859 A64E03962FFAD	Bridge	12,222.50	53
2070303012	Ermera	Letefoho	Lauana	Alosai	V	17C14D4AC2D342BDB9 F5BF58578BDEA6	Bridge	$19,695.25	65
2070305012	Ermera	Letefoho	Catrai-Leten	Lutumou	V	EE56009DB4414587ABF DC5194EDC2ECB	Bridge	11,885.50	89
2070307012	Ermera	Letefoho	Eraulo	Olopana	R	074EEBC293724F3E867 C6D85B4ECC142	Bridge	8,791.25	94
2080207014	Liquica	Liquica	Leoteala	Caimegoluli	V	E19F44126A0546F5BC5 3CA82A554C259	Road	24,276.05	82
2080106013	Liquica	Liquica	Acumano	Siscoelema	V	E9175A35DB614CF3862 FB6A9E5DB351F	Clean Water	18,639.75	179
1130103025	Viqueque	Uato Carbau	Uani Uma	Boro - Bohae	R	18DBFA63A5234679B75 D416BF0E53729	Irrigation	11,518.25	343
2130301014	Viqueque	Uato Lari	Macadique	Bobulita	V	DEC68C89661842B0918 389029F63C5D4	Road	46,894.20	120
1130102013	Viqueque	Uato Carbau	Irabin de Cima	Tetumori	E	CCB82FA40F5A4A2CA89 DA0A4958B97E4	Clean Water	2,573.35	171
1130103013	Viqueque	Uato Carbau	Uani Uma	Osso-Mali	E	C9086673E43940B3882 EEABB166BDA7D	Clean Water	14,037.55	43
1130105013	Viqueque	Uato Carbau	Bahatata	Tatadere	E	F752B549BB3046A3BCB 089D95916CCB3	Clean Water	14,330.50	168
1130207013	Viqueque	Ossu	Loi-Humo	Lia Uai Oli	N	6269E15EFE46456EAAE 21C10986057C9	Clean Water	1,701.35	70
2130305013	Viqueque	Uato Lari	Babulo	Beli	V	4BBDD00C52544E13B9 45A327C49DE7F4	Clean Water	13,325.50	171
2130306013	Viqueque	Uato Lari	Afaloicai (Uatu Lari)	Uaicai	V	455E7BE6826141DA9F9 395DDE139064A	Clean Water	20,455.20	903
2130306023	Viqueque	Uato Lari	Afaloicai (Uatu Lari)	Uaicai	V	766930E9BE0940B79D0 F600FDAA0C64C	Clean Water	16,021.85	903

*N=Not Remote; R=Remote; V=Very Remote; E=Extremely Remote

Annex 2. Selection criteria for quantitative survey respondents

Roads
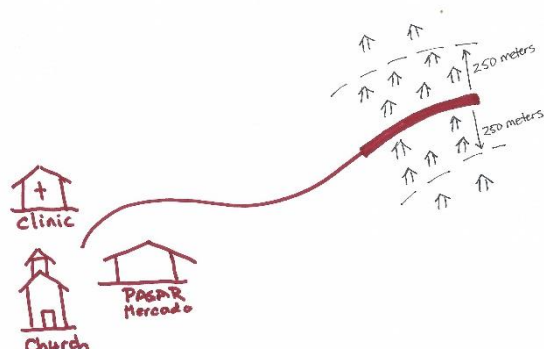
Total: 5 projects

Respondents (each project): 20 households

Target: All residents who live within 250 meters of the new road, and who use it to reach the common destination.

Methodology: choose a single common destination for all respondents in the aldeia, and compare travel times to the common destination before and after the project, during rainy season and dry season.

Bridges

Total: 7 projects

Respondents (each project): 20 households

Target: All residents who live within 1 kilometer of the new bridge, and who must use it to reach the common destination. In the illustration, those on the south and east side of the river would not be eligible respondents.

Methodology: choose a single common destination for all respondents in the aldeia, and compare travel times to the common destination before and after the project, during rainy season and dry season.
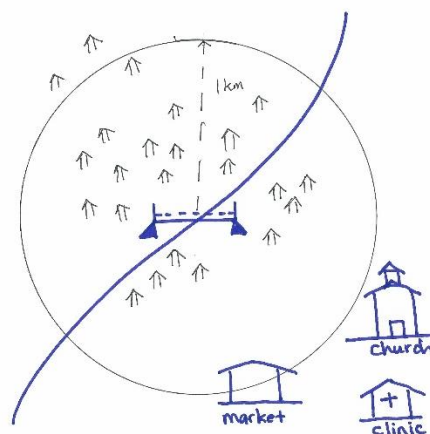
Clean Water
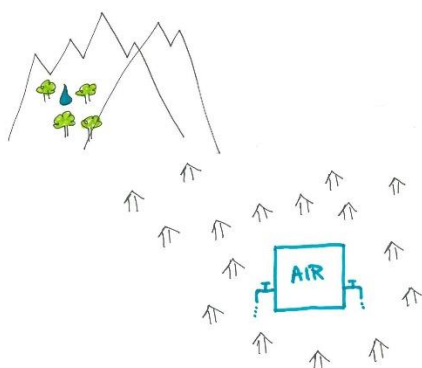
Total: 38 projects (37 after consolidation)

Respondents (each project): 20 households

Target: All residents who use water from the clean water project.

Methodology: Compare the time needed daily to get water before and after the project.
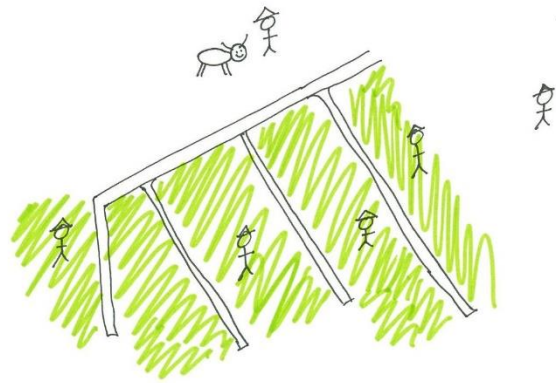
Irrigation

Total: 4 projects

Respondents (each project):   10 people (more if possible)

Target: All farmers who use the water from the project to water fields.

Methodology: Compare agricultural production and sales before and after the project.

Annex 3. Beneficiary satisfaction for all clean water projects

Project Study ID	Satisfied and Very Satisfied	Neither Satisfied nor Dissatisfied	Dissatisfied and Very Dissatisfied	% DISSATISFIED
	70%	4%	26%	
ALL	567	32	209	
2050501013	0	0	18	100%
1050702013	3	1	14	82%
1050704013	4	0	17	81%
1130105013	5	1	13	72%
2130305013	7	0	12	63%
1070505013	10	3	9	47%
2130306013	12	0	9	43%
1130103013	6	0	4	40%
2070302013	12	1	6	33%
1050708013	14	0	7	33%
2070301013	11	0	5	31%
1130207013	11	0	5	31%
2080206013	14	0	6	30%
2070307023	13	2	5	28%
2070303023	13	1	5	28%
1070501013	11	1	4	27%
1020101013	14	2	5	26%
1130102013	27	0	9	25%
2070306013	14	3	4	22%
2070304013	18	0	5	22%
2070305023	15	1	4	21%
2070302023	15	1	4	21%
2070301023	17	0	4	19%
1070504013	14	2	3	18%
1070207013	18	0	3	14%
P070106013	19	0	3	14%
1070501023	21	1	3	13%
P070206013	19	3	2	10%
2020302013	20	0	2	9%
1070506013	17	1	1	6%
2070302033	21	1	1	5%
1070502013	26	4	1	4%
1070204013	26	0	1	4%
2020305013	27	0	1	4%
1070205013	14	0	0	0%
1050705013	20	0	0	0%
1020102013	19	3	0	0%

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