Consultancy Services to Develop a Renewable Energy-based Off-grid Electrification Master Plan for Remote Islands of Vanuatu along the Example of Four Islands

(Project Number 81195891; GIZ Contract number: 13.9022.8-001.00)

Report 2: Site Visit and Survey Report: Ability and Willingness to Pay for Electricity and Estimated Electricity Demand for Emae, Makira, Mataso and Aneityum Islands

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Prepared for

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1. Introduction

This report has been prepared for the Government of Vanuatu and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH under "Consultancy Services to Develop a Renewable Energy-based Off-grid Electrification Master Plan for Remote Islands of Vanuatu along the Example of Four Islands" (GIZ project 81195891). It is one of a series of reports being prepared for this project:

1	Inception Report	Completed 8 April 2016
2	Site Visit and Survey Report	This report
3	Renewable Energy Resources and Prioritized Renewable Energy Projects and Technologies for the Islands of Emae, Makira, Mataso and Aneityum	Completed 12 June
4	Preliminary Technical Design of Potential Renewable Energy Projects for the Selected Islands	Forthcoming: mid-June
5	Financing Requirements & Mechanisms and Recommended Business & Institutional Models	Forthcoming: mid-June
6	Renewable Energy Electrification Master Plan and Project Final Report	Draft: mid-June Final: late June

This report covers items 4.4-4.6 of the Scope of Work, to: a) make site visits to the selected islands and conduct a preliminary assessment of the renewable energy potential and energy needs of communities; b) conduct household income generation and willingness to pay surveys for the communities on the selected islands; and c) conduct an electricity demand assessment for the selected islands based on the community needs and potential income generating activities.

Preliminary lists of reference materials and those contacted during the consultancy are included in the Inception Report and a final list will be in the final project report. This report includes only those met during the trips to the four islands selected by the Government of Vanuatu for visits.

2. Survey Design, delivery and Analysis

Purpose of the Survey

The islands for this project were chosen by the Government of Vanuatu (GoV) to be representative of most rural areas in Vanuatu in that they largely operate in the subsistence economy with cash availability often very variable and limited. A primary requirement in determining the type of electrification to be undertaken for these remote areas is that the local populace: a) specifically places a high priority on receiving the services to be provided in order to improve their economic productivity or enhance their quality of life; b) has —and is willing to pay — the cash necessary to at least cover the Operation and Maintenance (O&M) costs of the electrical system to be installed; c) the sources of the cash flow available in the community can be expected to be continuing and sufficient to cover the O&M cost of the electricity system for the long term; and d) that the type of electrical supply system installed is the most cost effective for the geography of the community and its types of electricity usage and is flexible enough to affordably continue to meet the electricity needs of the majority of households for at least twenty years.

The primary purpose of the household survey and site visits is to allow the team to better understand the sources and relative amounts of cash available to households in the community that are available to cover the cost of electricity, the specific priorities of households for electricity usage — primarily indicated by the amount they are willing to pay for electrical services — and the geography of the community as it affects access to the renewable energy resource and the cost of installation and maintenance of an electrical supply system. In particular the survey was designed to provide the following specific information:

- The relative levels of each source of cash income for each household to help determine the type of income sources currently available to the community
- The relative levels of each type of cash expenditure for each household to help determine what other costs the household have that may take priority over electricity payments
- The priorities of each household for their use of electricity to help understand the initial electrical load and its potential for growth
- The amount per month that the household is willing to pay for electricity services – the most important indicator of the priority of the community for electricity services
- The percentage of households with mobile phone service from each carrier that can be used to make payments and access external support services
- The electrical services that are already present in the household that operate on renewable energy such as lighting from solar lanterns or recycled solar equipment.
- What approaches to making payments for electrical services are acceptable to the household

Income and expenditure figures are difficult to obtain accurately under the best of conditions since most rural families have variable incomes and expenditures because their income sources are strongly affected by external factors such as weather conditions, access to transport and the availability of support services such as a fuel supplies and equipment repair services. Also, sales and purchases are not particularly important to the household since cash exchanges are not the main means of subsistence so they are typically not recorded, bank accounts not used and transactions are easily forgotten. However the relative amounts of cash flowing in each of the different sectors

usually is remembered and the survey results can be expected to provide a good indicator of how each sector fits into the household economy in terms of relative income and expenditures.

For best results a survey of this type is usually carried out by a field team that visits each household, interviews household members and fills in the survey forms in the presence of household members based on their responses. In the case of this survey, the resources (particularly time) were insufficient to follow the ideal survey approach. For most villages it was possible to have a collective meeting of representatives from the majority of households to explain the survey components and to answer obvious questions, but filling out the forms had to be done by the respondents and collection of the survey forms had to be carried out by the local Island Secretary with little opportunity to clarify survey components that were not well understood by the respondents or to correct areas of the survey that were not filled in properly. As a result, as many as 20% of the completed forms received from most communities had unusable responses in some sections due to incomplete responses or responses that had sections where the respondent failed to use the answer formats needed to maintain statistical consistency with the entries of the other respondents. However, in general the survey is considered generally sufficient to provide an overview of the relative importance of the various sources of access to cash for payments, availability of mobile phones for making payments and communicating maintenance needs, user priorities for electrical services and good information regarding the amount of that limited cash that households are willing to pay for those services.

Design of the Survey

The survey design is a compromise between ease of completion by the respondents and simplicity and accuracy of data entry for statistical analysis. Questions were prepared that required the respondents to either enter a clearly identifiable number or check off the best answer by using a multiple-choice question. Written answers or explanations by respondents were limited to listing exceptions to the check-off lists given in the questions.

The demographics of the households are of interest since different age groups use electricity somewhat differently and the number of persons in the households also affects usage. Both to get the respondents started with an easily answerable question and to obtain demographic data, the first section asks for the name, age and sex of each permanent household member. Clearly the number of persons living in a household has an effect on electricity usage and needs to be considered although it is not a strong determinant of usage. Although there is no expectation that respondents will have access to a detailed record of income and expenditures on a monthly basis, in the case of income and expenditure amounts, a twelve month series was used rather than a single annual lump sum. That allows the respondent to consider seasonal changes in income and expenditures such as a reduction in fishing income during the cyclone season due to rough seas and increased expenditures for food and clothing around holidays such as Independence Day and Christmas. Indeed, many responses did show higher expenditures at Christmas and other major holidays and changing income according to the seasons.

To assess the priority the household has for services, two questions provide indicators. The first is a two-part question that asks how much the household would be willing to pay for basic lighting services with the second asking how much they would be willing to pay for an installation that covers video in addition to basic lighting. This indicates both the approximate level of payment that can be made and indicates that the respondent realizes that additional services will cost additional money. The second priority related question includes a list of common uses of electricity that was provided with check boxes for five levels of priority ranging from “don’t need” to “very important”.

This is used to help understand which services are most desired by households and which are not important. Surprisingly, lighting was often not listed as essential, presumably because most of the households already have access to some form of solar lighting and adding more capacity to the lighting system is not as high a priority as adding other services such as video and radio usage. Most households did show a range of priorities for the services listed though a few just checked the highest priority boxes for all services.

In addition to the listed services, there were spaces where five uses for electricity that were not already listed could be filled in as specifically desired by the household. Common priorities added in those sections were sewing machines, power tools, small kitchen appliances such as blenders and tea pots, water pumps, and music players/sound systems.

Questions were asked about their current use of solar electricity for the household in order to determine what type, if any, of solar lighting system was already in use and its general usage patterns.

Because the mobile phone system may become the primary access point for payments and support services, multiple-choice questions were asked about the household's access to and use of mobile phone services. As expected, most villages have a high percentage (generally over 90%) of households with mobile phone services from the two carriers (Digicel and TVL) with many subscribing to both through the use of dual SIM card phones.

The final question refers to how people would prefer to pay the cost of the services provided. The choices included very frequent small payments (an approach similar to that often used for kerosene lighting where a bottle is brought to a shop for refilling every day or two), weekly payments, monthly payments and prepayments. For one island, a common write-in payment method was "Custom Economy" payments which means providing agricultural, fisheries or other locally available products or services as payment for electricity instead of cash (such as is being done in some solar electrification in the Solomon Islands). Although cash income is irregular, with different incomes expected in different times of the year, the great majority of respondents chose monthly payments as their preference.

The survey form is attached (Annex 1). It was translated to Bislama (Annex 2) and during the initial visit to the communities, sufficient Bislama forms were provided for all households on each island. Mostly the forms were provided by the team at the time of the initial village visits with completed forms collected by the relevant Island Secretary the following week and delivered to Port Vila through various means after collection. About half the completed forms were received before the team left Port Vila in April 2016 but the rest had to be scanned and provided by electronic means for later analysis with some forms from the more remote villages of Aneityum not arriving until just before the second visit to the islands in late May.

3. Travel Schedules to the Four Selected Islands

As required by the terms of reference, two trips were scheduled to each of the four islands. The travel was completed as shown in Table 2.1 below:

Table 2.1: Travel to Selected Islands: April & May 2016

Consultant	Island	Dates
Herbert Wade	Emae	11-12,-14-15 April
	Mataso & Makira	13 April
	Aneityum	19-21 April
John Salong	Emae	11-12, 14-15 April
	Mataso & Makira	13 April
	Aneityum	19-28 April
Peter Johnston & John Salong	Mataso & Makira	20 May
	Emae	21 May
	Aneityum	24-26 May

During the April travel to Emae and its neighboring islands of Mataso and Makira, the consultants were accompanied by Mr Uwe Mades of GIZ. The small islands of Mataso and Makira were both visited on a single day-trip using a small boat based on Emae, the largest of the three islands. As there are no roads on Aneityum, on the initial visit in April to that island, the national consultant, John Salong, stayed for an extended period to allow sufficient time to visit each community by boat or on foot, interview people in each community, distribute survey forms in the national language (Bislama) and instruct village leaders and household representatives in the completion of the forms. A follow-up visit was made in May by the team leader and the local consultant to clarify and confirm earlier responses and collect additional data that was needed.

Survey Analysis

Because each village is quite different from the others, the analysis was not done on an island-wide basis but on an individual village basis. The survey forms from each village were scanned and manually entered for separate analysis into individual worksheets of a large Excel spread sheet.

While the first section lists the permanent household members with names, sex and ages to help identify the data source if there were problems with the completed form and to help understand household demographics, the information (other than number of persons in each household) was not used in the analysis as its focus is on the types of services desired overall by the household and their collective ability and willingness to pay for those services. The household size clustered around four to five persons and ranged from 1 person to 10 persons per household.

The sections on cash income and cash expenditures are merely estimated values. Monthly estimates were requested since many income sources vary by season and expenditures tend to increase during major holiday seasons. In many cases, the forms were filled in with the same value for each month while in others seasonal variations were considered. A few respondents failed to include income amounts, just checking off their sources of income. Most respondents provided estimated amounts for monthly expenditures though the listed expenditures tended to exceed income for much of the population, something that is very common with income and expenditure surveys – the pain of paying seems easier to remember than the pleasure of being paid. However, there also remain some one-time costs associated with recovery from Cyclone Pam in March 2015 that may have increased expenditures over income just for this time period.

The important information from these sections are the relative amounts, not absolute vatu amounts, so that the types of income and types of expenditures can be ranked in importance. That information is very useful in estimating possible productive (income generating) uses of electricity and the likelihood of demand growth over time.

In the survey form, two levels of electrification were listed with one the respondent's willingness to pay for basic lighting, radio and phone charging services and the second for those same services plus sufficient electricity to provide 4 hours of video operation per day. With few exceptions, willingness to pay increased with increased service provision showing an understanding of the requirement for increased payment for increased services – a concept that has sometimes not been understood with earlier projects installing solar PV systems since all village installations carried out were identical for each household. In those projects, the same fixed fee for all installed units was collected.

While the range of acceptable payment tended to be wide, in most villages the average value and the median value were similar indicating that those amounts would be considered reasonable payments by at least half of the households and the distribution of acceptable costs was continuous with little outlier data that was very high or very low relative to the rest of the respondents. At this point, it is not possible to give a formal estimate of the cost of providing services at various levels, but based on the experience in other countries of the Pacific, the O&M cost of basic lighting through solar home systems (SHS)[1] tends to be on the order of USD 10 per month and goes up in a mostly linear fashion for added demand and increasing services. For mini-grids, according to their use patterns and type, costs have ranged from over USD 2.00 per kWh down to about USD 1.50 per kWh with a lot of the O&M cost dependent on the quality of batteries, their usage patterns and their accessibility. Mini-grid kWh costs tend to decline as their size goes up with a crossover in cost between solar home systems and mini-grids somewhere around 2 kWh per day of energy delivery per household, with a somewhat higher kWh level for particularly remote sites where access by mini-grid technical support personnel is even more expensive than usual for remote islands. For schools and offices, solar delivery costs are generally lower than the same services provided in homes since home use tends to be heaviest after dark and depends heavily on energy stored in the batteries. Office and school use tends to be heaviest during the day when the sun is still shining so batteries are generally not as stressed nor do they need as much capacity per unit of energy delivered to loads.

Respondents' priorities for electrical services were ranked from 1 (very important) to 5 (not needed). Average and median values were calculated and they are considered the best indicator of priority for the community. This is important since the type of usage will largely dictate the type of installation required. It is noted that in a number of responses, the household indicated that every usage listed was a number 1 priority – but it is also the case that in the majority of those instances the respondent's willingness to pay was far below the cost of the services listed as high priority, so it will be important not to place too high a relevance on priority of service unless there is the disposable income necessary to pay for those services.

Mobile phone service was available to around 90% of the island households with TVL having more individual customers than Digicel but most households have a dual SIM phone and SIM cards for both carriers since coverage is often spotty and some places have better reception from TVL and others from Digicel.

Because of the widespread distribution of solar lanterns and small solar lighting units, almost all households surveyed currently have access to at least minimal solar lights with some having permanent lighting installations using recycled solar panels and boat or car batteries. Those that

[1] When this report was written, analysis undertaken for forthcoming reports 3 and 4 on *Renewable Energy Resources and Prioritized Renewable Energy Projects and Technologies for the Islands* and *Preliminary Technical Design of Potential Renewable Energy Projects for the Selected Islands* respectively clearly indicated solar PV as the appropriate technology for each of these specific islands.

indicate that their solar lights are practical for outdoor walking can be considered to be using solar lanterns while those that have the ability to move the lights from room to room but not to be portable for walking can be considered to have larger, more permanent solar installations that are not a single unit solar lantern. If the solar cannot be moved from room to room, it is expected to be one that depends on a larger recycled or purchased solar panel charging an automobile or boat battery and wired to a light in the building.

4. Discussion of the Survey Results

Site Visit and Survey Report: Emae

The island of Emae (coordinates 17°4'S 168°24'E) is in Shefa province, in the Shepherd group of islands, north of the capital Port Vila. Maunga Lasi is the highest peak at 644 m, forming the northern rim of the (mostly) underwater volcano of Makira. Its rim also includes the nearby islands of Makira and Mataso. Emae is about 10 km long and up to 5 km wide, with an area of 32 km^2. The island and its main villages are shown in Figure 4.1. The Area Council headquarters is at Tabakoro village in the island's center.

Mostly mountainous, the island is covered with thick vegetation except where cleared for habitation and gardens. Villages are interconnected by unpaved tracks cleared of vegetation but generally passable only by four-wheel drive vehicles. Scheduled aircraft typically fly three days a week but sea transport to other islands is irregular, mostly by small private boats with limited capacity, and therefore quite costly.

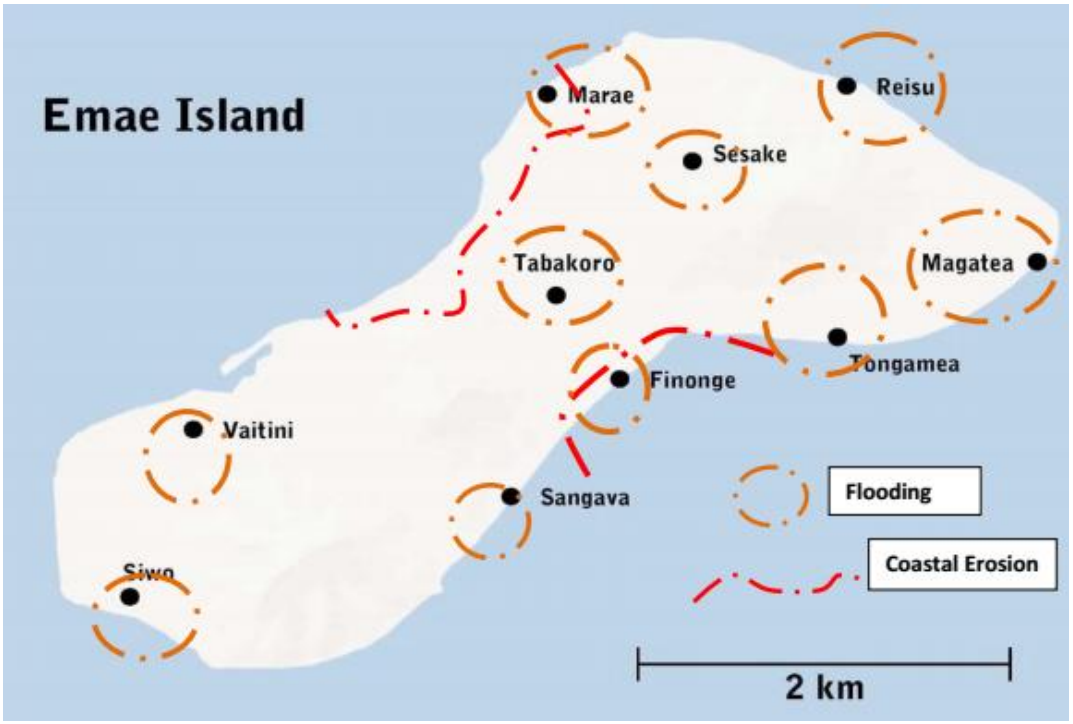


Figure 4.1: Emae and its Main Villages
Source: Tropical Cyclone Pam Summary: Emae Island Assessment Report March 2015**)**

Emae is rugged (Figure 4.2) with the population of over 900 spread throughout the island, mostly along the coast, about equally distributed between the north and south of the island. There is no electricity supply but nearly all households have small solar lanterns. Some public facilities such as the secondary school have larger solar systems, there are several small PV systems for fish freezing and a few households have small Chinese-made petrol-fueled generators.

Figure 4.2: Emae Island from Makira (Photo: John Salong, May 2016)

The populations of the villages in the villages surveyed by the Cyclone Pam assessment team in March 2015 are summarized in Table 3.1 below, which shows a population of 906 with 199 households, although with some villages uncounted. Every village was visited by the GIZ study team.

The populations of the villages in the villages surveyed by the Cyclone Pam assessment team in March 2015 are summarized in Table 4.1 below, which shows a population of 906 in 199 households, with some villages uncounted. Except for Finonge, the uncounted villages were not visited by the team though some of their households may have been included in the survey as outliers of nearby communities.

Table 4.1: Emae Population and Households

North Emae	Population	Households	Comments
Siwo	b	4	Also airport, Presbyterian church & nakamal. TVL & Digicel communications towers
Vaitini	46	4	Church, nakamal
Marae	138	27	Presbyterian church, aid post, community hall, store. Also TVL & Digicel towers
Sulua & Tabakoro	72	16	Presbyterian church, store, nakamal
Sasake	128	30	Presbyterian church, store, nakamal
Savuti	41	9	Presbyterian church, health centre
Vaima	16	3	One store
Reisu	10	3	Includes church & nakamal
South Emae	**Population**	**Households**	**Comments**
Sangave	250	52	1 pre-School building, 3 church houses, 4 community nakamals, 7 local store houses
Finonge Putuai Lemputa Vaima			
Tongamea	145	40	Two church buildings, 2 nakamals and 2 local store houses
Makatea	42	11	Two church buildings, 2 nakamals and 1 local store house
Total	187	51	

The population counted in March 2015 after the cyclone, though incomplete, was about 21% higher than the 750 at the time of the last national census in late 2009. The principal economic activity is subsistence agriculture and sea harvesting with exports of kava (Piper methysticum) and bêche-de-mer (a type of sea slug popular in Chinese cuisine). Access to the island is by air with the unpaved airport located near Siwo on the eastern coast. Two hour access from North Efate by small boat is possible in good weather and some fish are exported to the Port Vila market when small boat access is practical. The GDP of the island is estimated to be around USD 450. There is very limited tourism mostly based on dives on a WWII wreck at Cook's Reef just north of Emae and there is very little tourism infrastructure with two basic bungalows and a dining/meeting area in Marae on the northern coast.

Unlike surrounding islands populated by Melanesians, it is considered a Polynesian outlier though the island is well integrated into Melanesian culture and traditions. The island's local language, also called Emae, is in the Futunic language family which is the language family of most of the Polynesian outliers. North Efate, one of the other languages of Vanuatu, is used as a second language. Many of the islanders have migrated to Port Vila. Perhaps due to this Polynesian heritage, villages seem to be more compact and are often regularly laid out in rectangular blocks as is usually seen in Polynesia and quite unlike those on Tanna in southern Vanuatu where homes are typically widely scattered without a clear underlying pattern.

The survey results for the communities assessed on Emae are summarized in the following pages.

Sangava, Emae Island

Source: Google Earth

The largest village on Emae, Sangava is compact and well laid out for a mini-grid installation. However, the income and expenditure survey indicates a low priority for electrification with only lights, radio and phone chargers having top priority for the village as a whole. Also the willingness to pay is very low relative to the average O&M cost of a grid connection which is likely to be on the order of 3,000 Vt per month (using about 0.7 kWh/day) or more. Based on the survey, pico-solar systems can provide the high priority services to the bulk of the homes and SHS can provide the extended services that some households desire. At this time a mini-grid is not recommended.

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
51	234	300 Vt/Month	500 Vt/Month

High Priority Services*	Lights	Radio	Phone Charger
Priority	1.12	1.61	1.47

Other Services Desired	Electric tools, blender, toaster, iron, sound system, fish finder welder

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day	Acceptable Payment Approaches
7% Digicel 16% TVL 67% Both 90% TOTAL	94%	76%	6.9	Monthly 100% Prepaid 14%

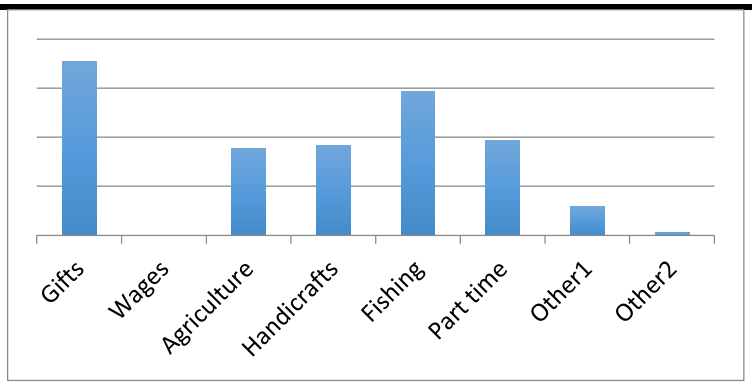
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Sangava, Emae Island

SOURCES OF CASH INCOME

Relative averages over a year

(Entire Village)

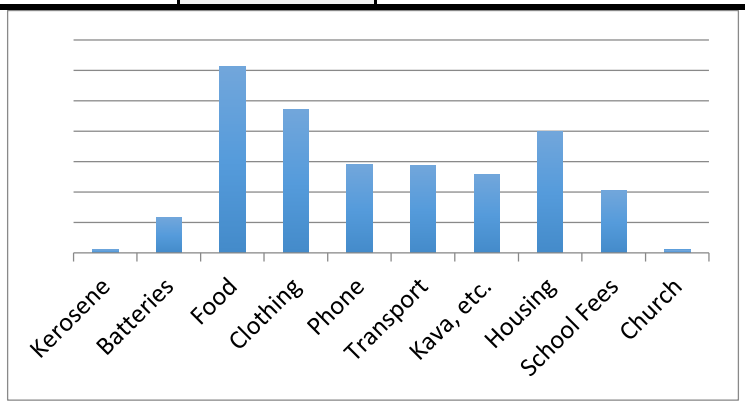


Median	2138 Vt/mo/HH	Average	2418 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

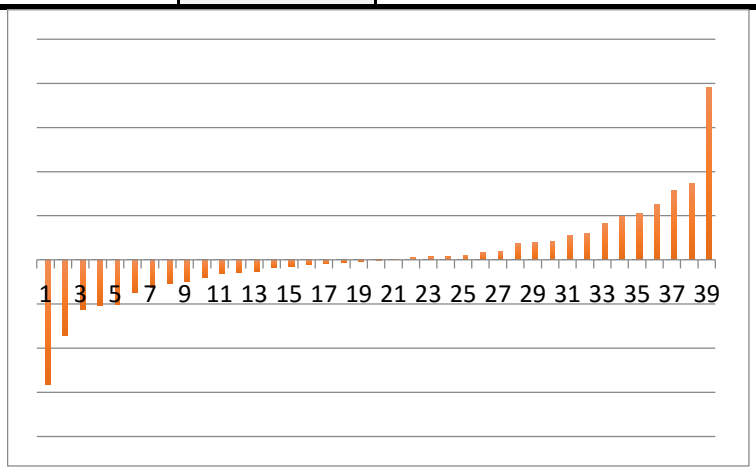


Median	1807 Vt/mo	Average	2407 Vt/mo

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	4749 Vt/mo	Median	-25 Vt/mo	Average	122 Vt/mo

Note: 39 usable responses out of the 51 households

Tongamea, Emae Island

Although the priority for extended electricity services is high in Tongamea, the acceptable payment is lower than the cost of operating anything but basic lights, radio and phone-charger. A mini-grid is technically reasonable in this relatively compact and easy-to-wire village but whether the populace will pay the cost of mini-grid services for the desired multiple appliances needs to be confirmed before preparing a design for a village mini-grid system. The decision as to whether to install a mini-grid or SHS should be made by the village based on cost and with full knowledge of the advantages and disadvantages of each technology. All the services requested can be provided by either mini-grid or a properly sized SHS on each house

Source: Google Earth

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
32	154	1000	1250

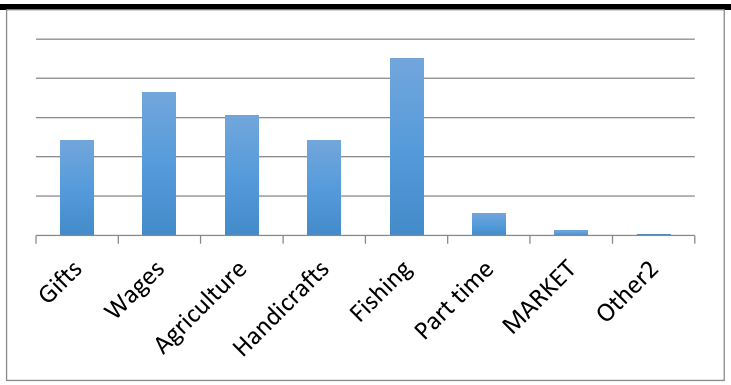
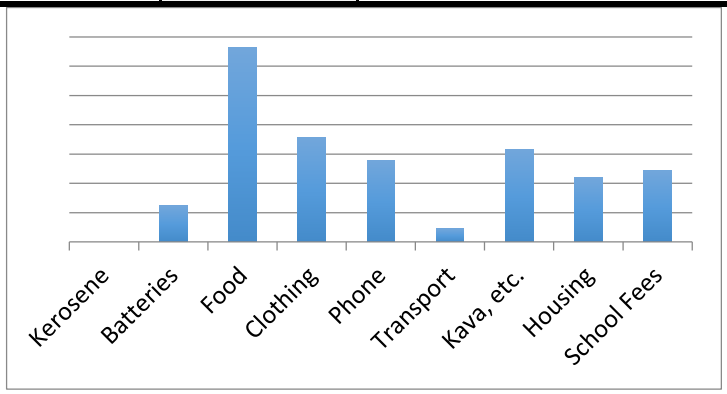
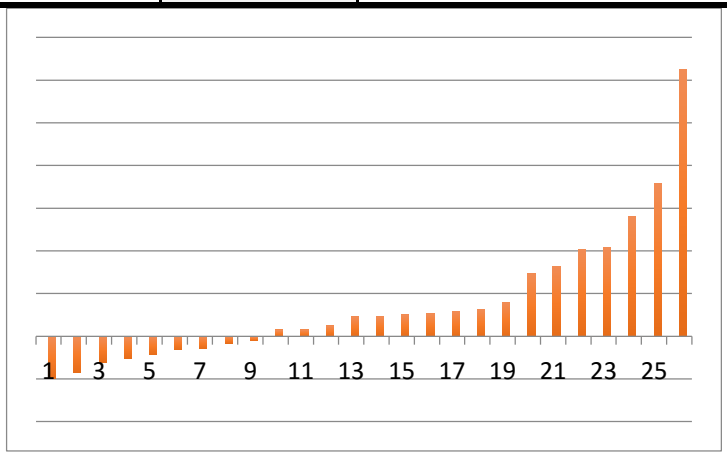
High Priority Services*	Lights	Radio	Video	Phone Charger	Freezer	Washer
Priority	1.13	1.38	1.56	1.13	1.66	1.91

Other Services Desired	Power tools, Sound System, Iron, Blender, Electric pot

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
22% DIGICEL 47% TVL 25% BOTH 94% TOTAL	94%	94%	6	Monthly 81% Prepayment 50%

*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Tongamea, Emae Island

SOURCES OF CASH INCOME **Relative averages for one year** **(entire village)**					
Median	6417 Vt/mo/HH		Average	10702 Vt/mo/HH	
CASH EXPENDITURES BY CATEGORY **Relative averages for one year** **(entire village)**					
Median	4758 Vt/mo/HH		Average	6845 Vt/mo/HH	
DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD **Relative averages for one month** **(per household)**					
Total Village	100203 Vt/mo	Median	2279 Vt/mo/HH	Average	3854 Vt/mo/HH

Fineonge, Emae Island

The dispersed nature of Fineonge makes SHS the first choice for electricity production for households. Also the high priority services desired by the households are easily met by basic SHS. Those households that want extended services can have larger SHS to provide the needed energy.

Source: Google Earth

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
23	89	500	1000
High Priority Services*	Lights	Radio	Phone Charger
Priority	1.52	1.52	1.65
Other Services Desired	Water Pump		

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
Digicel 22% TVL 4% BOTH 52% Total 78%	87%	43%	4.7	Prepayment 52% Monthly Payment 48%

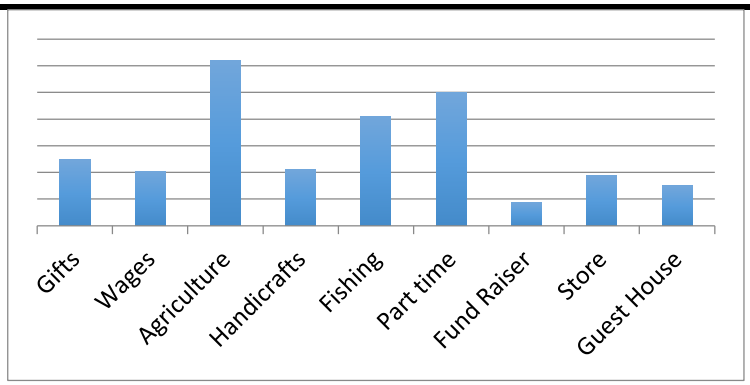
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Fineonge, Emae Island

SOURCES OF CASH INCOME

Relative averages for one year

(entire village)

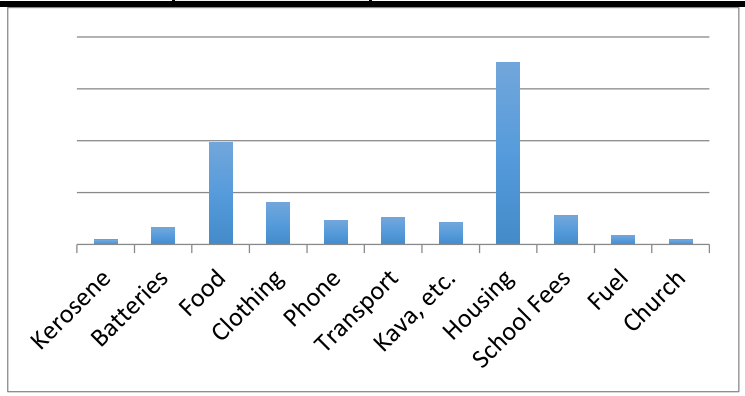


Median	5242 Vt/mo/HH	Average	8695 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

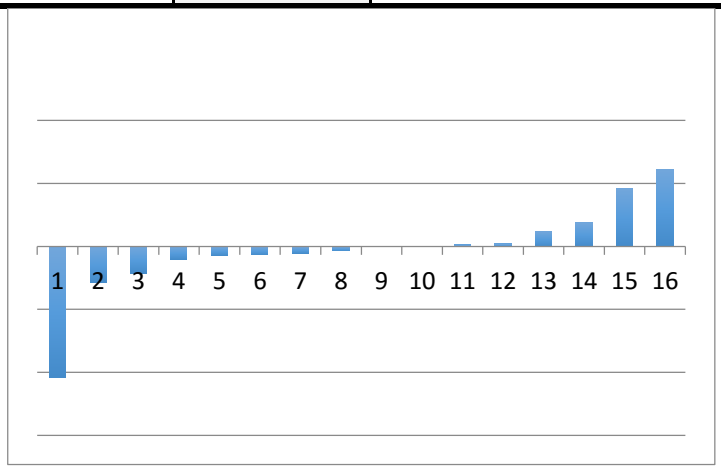


Median	5496 Vt/mo/HH	Average	7338 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total	-9424 Vt/mo	Median	-381 Vt/mo/HH	Average	-589 Vt/mo/HH

Sasake, Emae Island

e

Sasake is a reasonable candidate for a mini-grid with sufficient disposable income to afford basic services and the use of some larger appliances and tools. A mini-grid to power the central group of homes should be considered with some SHS for outlier homes that would be expensive to connect to the main min-grid.

Source: Google Earth

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
22	96	1000 Vt/Month	2500 Vt/Month

High Priority Services*	Lights	Radio	Video	Phone Charger	Freezer	Fridge
Priority	1.32	1.18	1.55	1.14	1.73	1.86

Other Services Desired	Power Tools

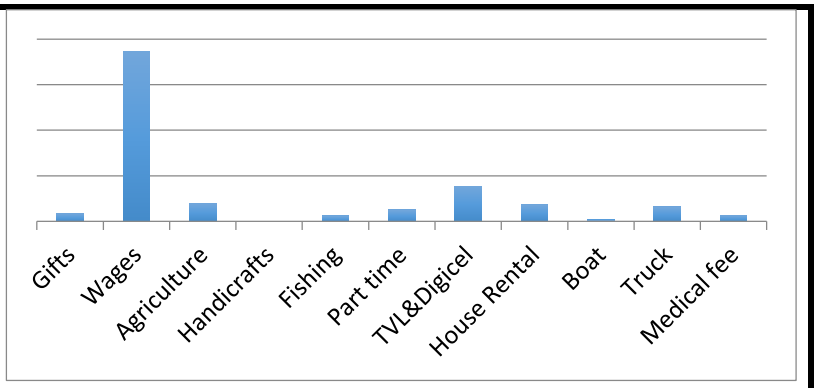
Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
Digicel 9% TVL 9% Both 82%	95%	77%	4	Prepayment = 5% Pay Quarterly = 5% Pay Monthly = 90%

*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Sasake, Emae Island

SOURCES OF CASH INCOME

Relative averages for one year

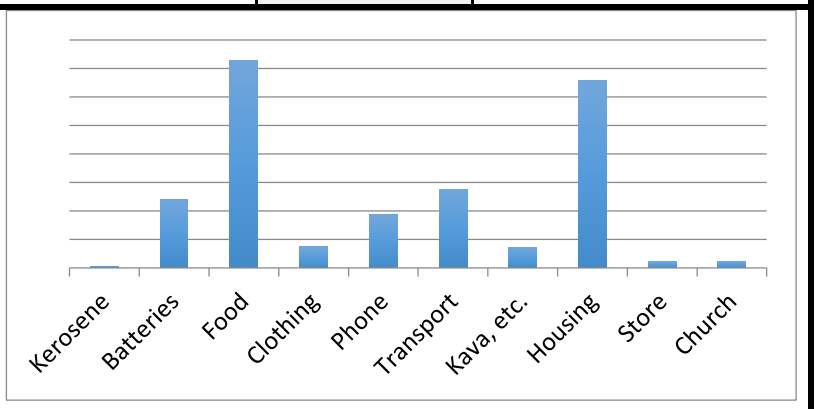


Median	4910 Vt/mo/HH	Average	14650 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

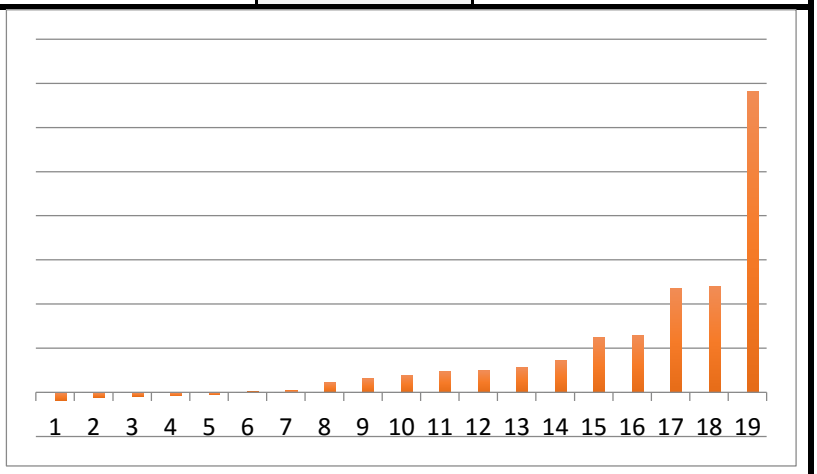


Median	2131 Vt/mo/HH	Average	8671Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	168253 Vt/mo	Median	3935 Vt/mo/HH	Average	8855 Vt/mo/HH

Marae, Emae Island

Marae has some potential for diving tourism with a WWII American warship wreck at nearby Cook's Reef. A small facility with three bungalows, a dining room and a shower/toilet has been constructed but there is no electricity other than small solar lights that are connected to a solar charged vehicle battery used to keep the path from the bungalows to the cooking room and the toilet/shower building. The village is reasonably compact and should be considered for a mini-grid. Some outliers may be better served with SHS

Source: Google Earth

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)		Median Acceptable Payment (Lighting+additional Services)
22	121	1000 Vt/month		1250 Vt/month
High Priority Services*	Lights	Radio		Phone Charger
Priority	1.05	1.27		1.50
Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
95%	95%	32%	7	Monthly 73% Prepayment 32%

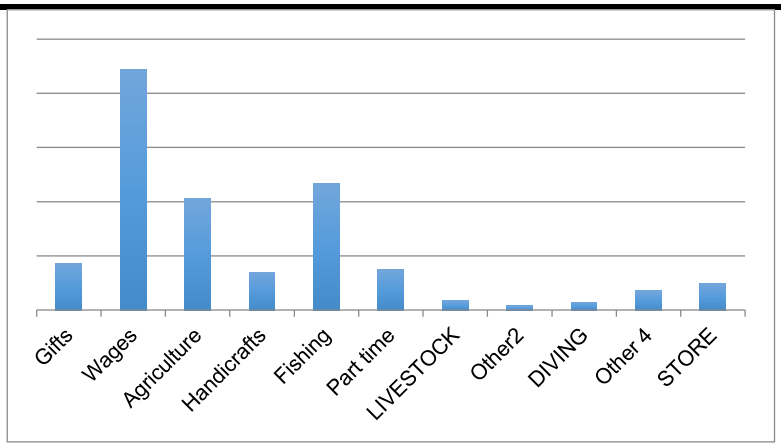
*With a median priority of 2.0 or higher on a scale of 1 (highest priority) to 5

Marae, Emae Island

SOURCES OF CASH INCOME

Relative averages for one year

(entire village)

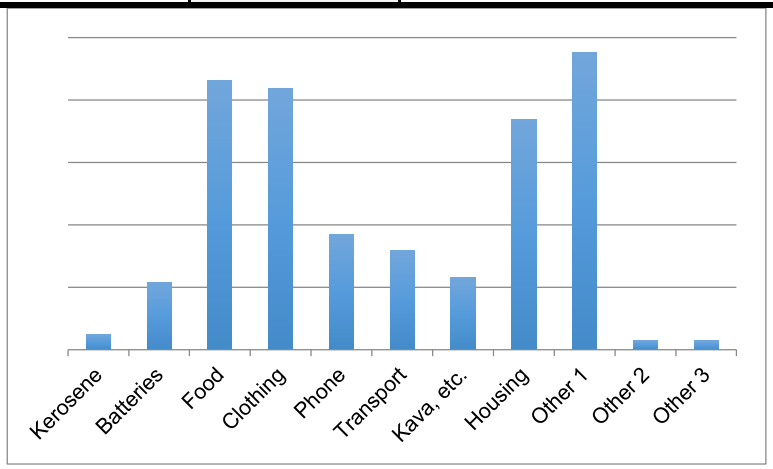


Median	3692 Vt/mo/HH	Average	5175 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

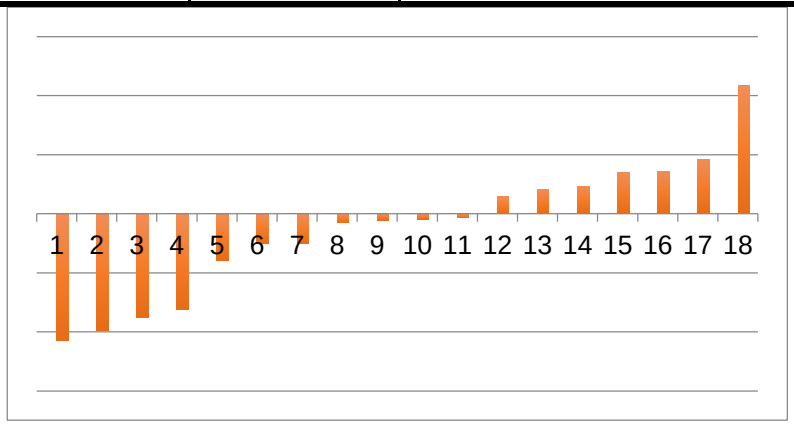


Median	3942 Vt/mo/HH	Average	4826 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	-20163 Vt/mo	Median	-504 Vt/mo/HH	Average	-1120 Vt/mo/HH

Vaitini, Emae Island

Vaitini is quite spread out and with a very low acceptable payment and low priority for all but lights and radio, making pico-solar the best choice for most households and SHS the best choice for the few that can afford extended services

Source: Google Earth

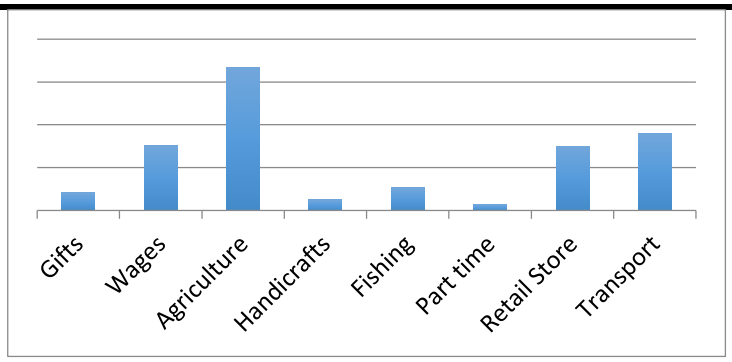
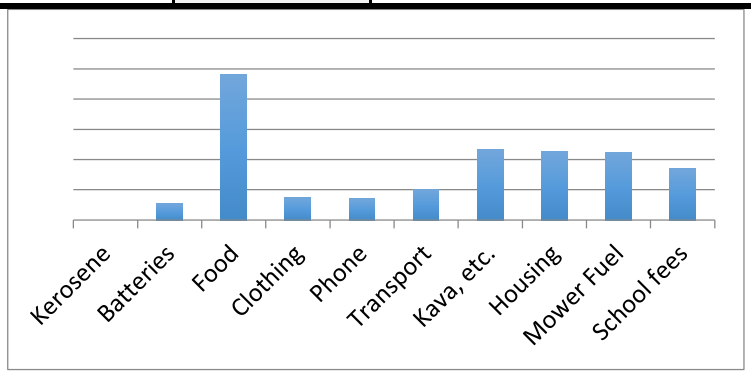
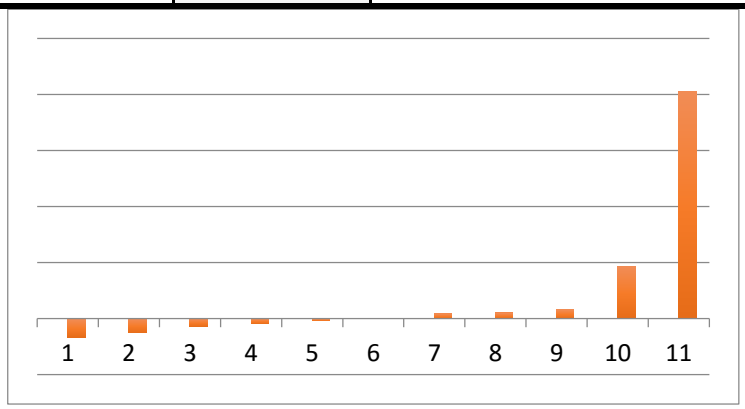
HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
12	46	100	150

High Priority Services*	Lights	Radio
Priority	1.33	1.75
Other Services Desired	Water Pump, Toaster	

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
TVL 42% Both 58% TOTAL 100%	100%	92%	7.5	Prepayment (8%) Monthly (92%)

*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Vaitini, Emae Island

SOURCES OF CASH INCOME **Relative averages for one year** **(entire village)**					
Median	**14367 Vt/mo/HH**		**Average**	**5083 Vt/mo/HH**	
CASH EXPENDITURES BY CATEGORY **Relative averages for one year** **(entire village)**					
Median	**7279 Vt/mo/HH**		**Average**	**6186 Vt/mo/HH**	
DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD **Relative averages for one month** **(per household)**					
Total	**89997 Vt/mo**	**Median**	**-25 Vt/mo/HH**	**Average**	**8182 Vt/mo/HH**

Tabakoro, Emae Island

Tabakoro is sufficiently compact to be practical for a mini-grid but it is questionable economically since the capacity of the village to pay for more than very basic services does not seem to be present. Pico-solar and SHS are considerably more cost effective when only basic services serve the majority of user needs with larger SHS or micro-grids installed in those households or businesses that require more capacity.

Source: Google Earth

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
10	52	1000 Vt/Month	1200 Vt/month

High Priority Services*	Lights	Radio	Phone Charger
Priority	1.0	1.4	1.2

Other Services Desired	None listed

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
100	100	100	10	Monthly Payments 100%

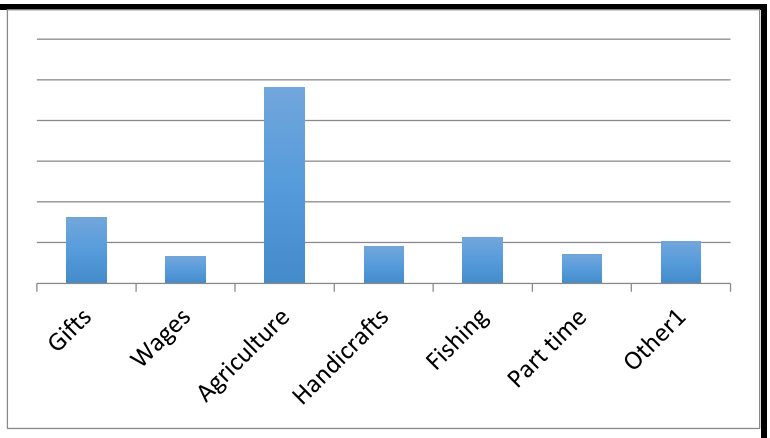
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Tabakoro, Emae Island

SOURCES OF CASH INCOME

Relative averages for one year

(entire village)

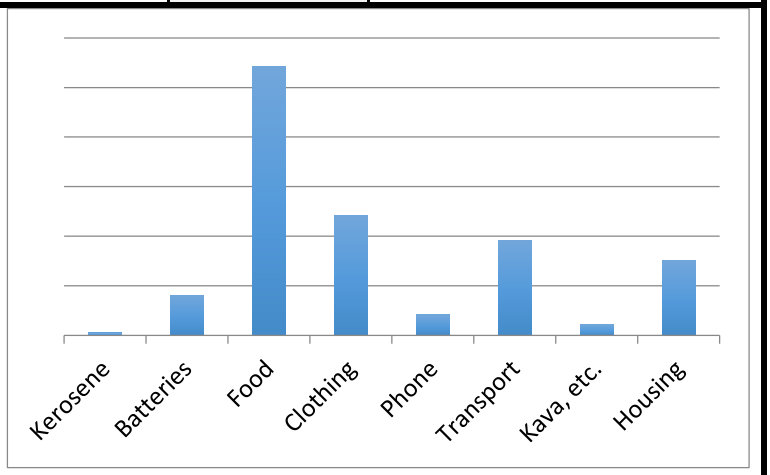


Median	938 Vt/mo/HH	Average	903 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

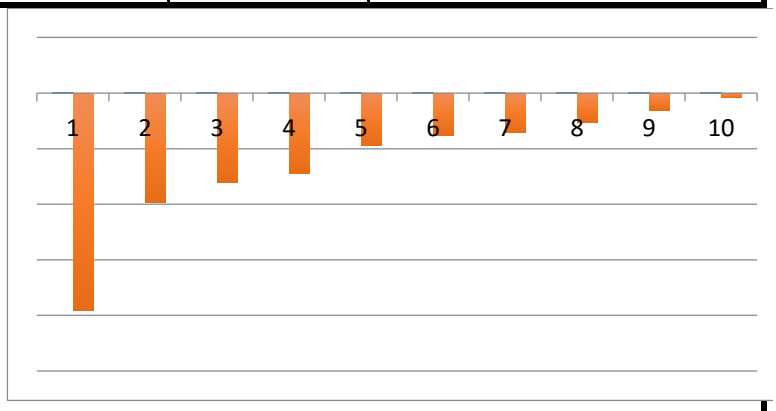


Median	1696 Vt/mo/HH	Average	2128 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



VillageTotal	-12256 Vt/mo	Median	-852 Vt/mo/HH	Average	-1226 Vt/mo/HH

Makatea, Emae Island

The low density of the village combined with the low acceptable cost of services make a mini-grid a poor economic choice for Makatea. A combination of pico-solar and SHS for the households is recommended.

Source: Google Earth

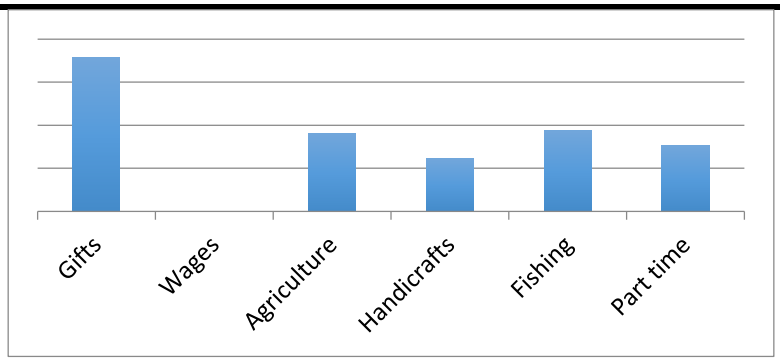
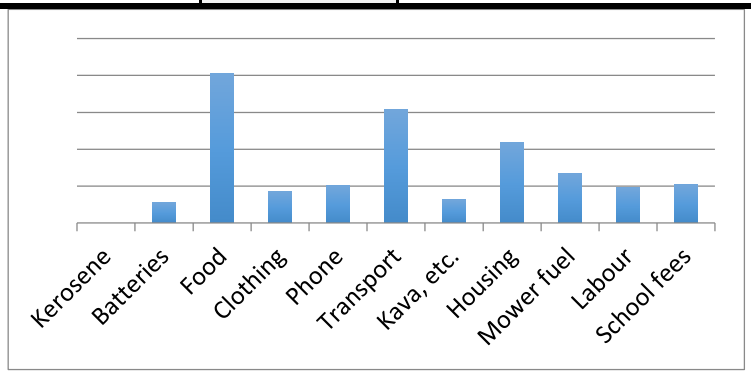
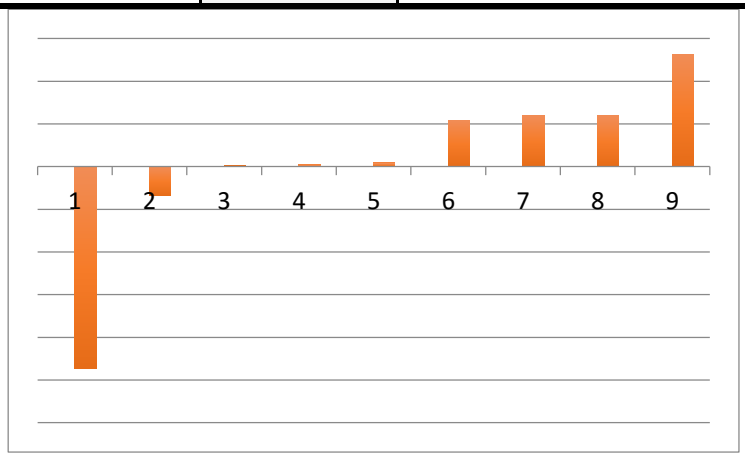
HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
10	43	400	650

High Priority Services*	Lights	Radio	Phone Charger
Priority	1.4	1.4	1.3
Other Services Desired	None listed		

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
Digicel 10% TVL 50% Both 30% TOTAL 90%	90%	90%	4.7	Monthly 90% Prepayment 10%

*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Makatea, Emae Island

SOURCES OF CASH INCOME **Relative averages for one year** **(entire village)**					
Median	**5083 Vt/mo/HH**		**Average**	**5288 Vt/mo/HH**	
CASH EXPENDITURES BY CATEGORY **Relative averages for one year** **(entire village)**					
Median	**3663 Vt/mo/HH**		**Average**	**5104 Vt/mo/HH**	
DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD **Relative averages for one month** **(per household)**					
Total Village	**1656 Vt/mo**	**Median**	**173 Vt/mo/HH**	**Average**	**184 Vt/mo/HH**

Reisu Village, Emae

Although Reisu only has four households, the houses are close together and could be powered from a mini-grid but in general the low payment that is acceptable and relatively low priority placed on electrical services indicates that SHS specific to the needs of each household will be a more economically acceptable choice and can easily meet the stated needs of the village.

Source: Google Earth

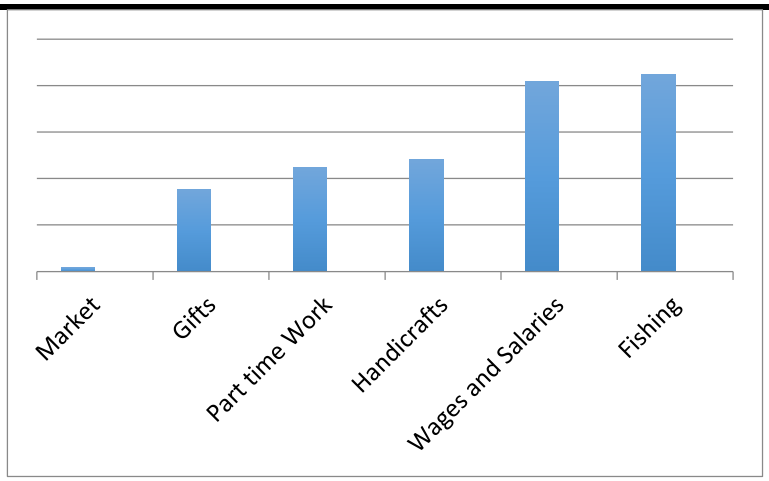
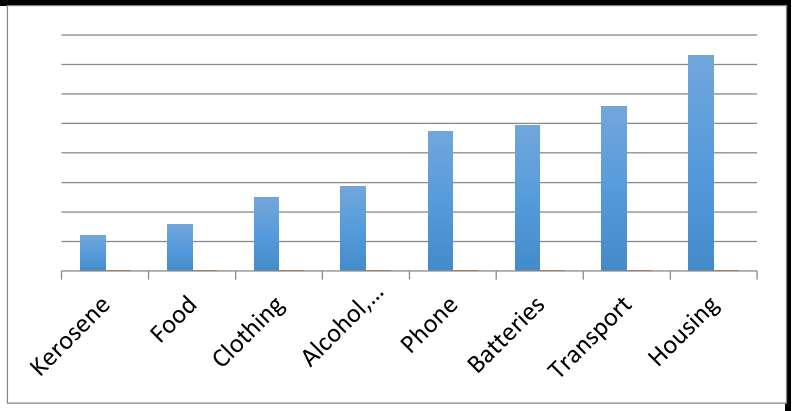
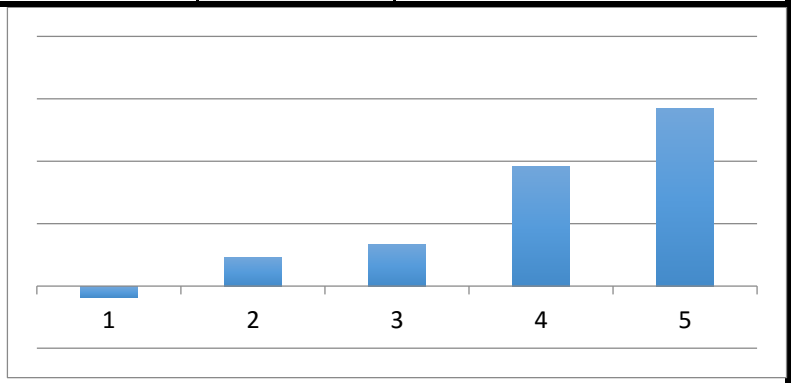
HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
4	16	750	1000

	Lights	Radio	Video	Phone Charger
Priority	Only the phone charging service had an average priority of 2.5, all other services were lower in group priority. One Household requested power for a sewing machine			

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
100%	100%	25%	7.2	Monthly 50% Prepayment 50%

*With a median priority of 2.5 or higher on a scale of 1 (highest priority) to 5

Risu, Emae Island

SOURCES OF CASH INCOME **Relative averages for one year** **(entire village)**					
Median	**9713 Vt/mo/HH**		**Average**	**9946 Vt/mo/HH**	
CASH EXPENDITURES BY CATEGORY **Relative averages for one year** **(entire village)**					
Median	**5865 Vt/mo/HH**		**Average**	**6379 Vt/mo/HH**	
DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD **Relative averages for one month** **(per household)**					
Total	**14266 Vt/mo**	**Median**	**2819 Vt/mo/HH**	**Average**	**3566 Vt/mo/HH**

Siwo, Emae Island

NO USEFUL SATELLITE VIEW AVAILABLE

Siwo village is at the edge of the unpaved airstrip on the eastern end of Emae. The houses are scattered and of traditional construction. The dominant sources of income are salaries and fishing. The installation of SHS of the size needed by each household is seen as the most economically and technically reasonable option for this village.

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
4	26	1000 Vt/Month	1500 Vt/Month

High Priority Services*	Lights	Radio	Fridge	Phone Charger	Freezer
Priority	1.25	1.5	1.75	1.25	1.75

Other Services Desired	Water pump

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
DIGICEL TVL 100% BOTH	100%	100%	7	Every day or two Weekly Monthly

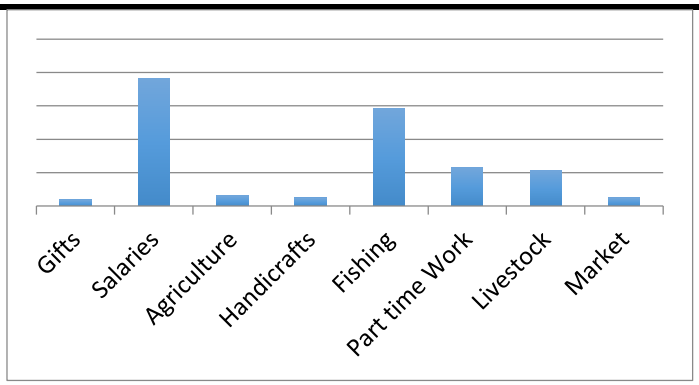
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Siwo, Emae Island

SOURCES OF CASH INCOME

Relative averages for one year

(entire village)

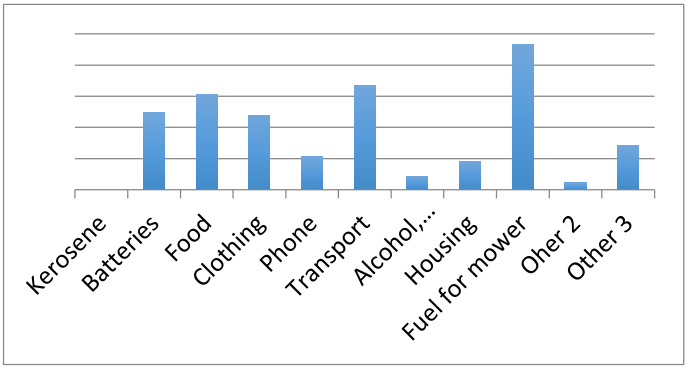


Median	11,333 Vt/mo/HH	Average	13,056 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

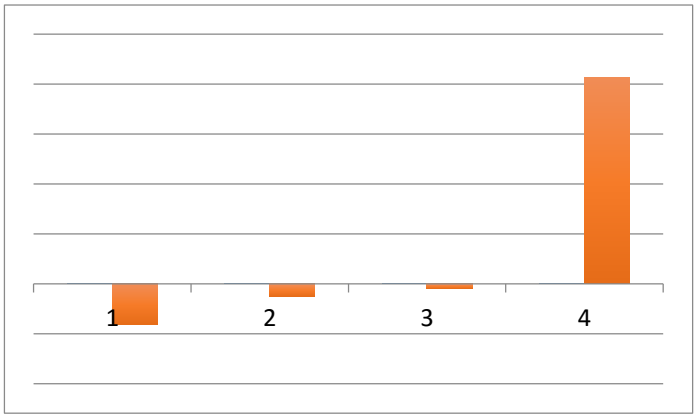


Median	9046 Vt/mo/HH	Average	9315 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	14967 Vt/mo	Median	-825 Vt/mo/HH	Average	3742 Vt/mo/HH

Site Visit and Survey Report: Mataso

Figure 4.3: Mataso Island
Source: Google Earth. Image from 2009

Mataso island has a single village, Na'asang, with 111 people in 12 households (March 2015). All houses and kitchens were destroyed by Cyclone Pam, as were the primary school and aid post. The bulk of the island is made up of two steep peaks with a small valley at just above sea level between them. The village is located in that valley and has little access to land for agriculture and, since the passage of Cyclone Pam few intact trees. Though it is over a year since Pam, the village remains a conglomeration of tents, temporary metal housing and the few permanent structures that remained.

Figure 4.4 Approaching Mataso Island from Efate (Photo: Peter Johnston, May 2016)

Figure 4.5: Mataso Island, Na'asang village in background (Photo: John Salong, May 2016)

Na'asang Village, Mataso Island

Source Google Earth (2009)

Although the village is compact and it would be relatively easy to install a distribution grid, the limited resources and low household requirements for electricity services make it unlikely that a mini-grid system can be economically reasonable. Also, access to the island requires several hours travel in a small boat and it would be very costly to deliver the major components of the grid and associated solar system and also to provide access for the external support services needed to keep it operating properly. Pico-solar or small SHS appear to be the best general approach with larger SHS installed for specific higher loads such as freezers or pumps. Note that the satellite photo was taken before PAM and the current village is even more compact.

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
36	124	500 Vt/Month	600 Vt/Month

High Priority Services*	Lights	Phone Charger
Priority	1.64	1.36
Other Services Desired	Fan, Spotlight	

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
7% Digicel 16% TVL 67% Both 90% TOTAL	04%	76%	6.9	Monthly 100% Prepaid 14%

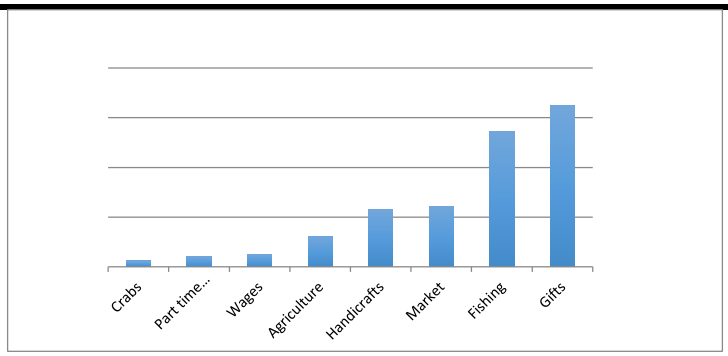
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Na'asang Village, Mataso Island

SOURCES OF CASH INCOME

Relative averages over a year

(Entire Village)

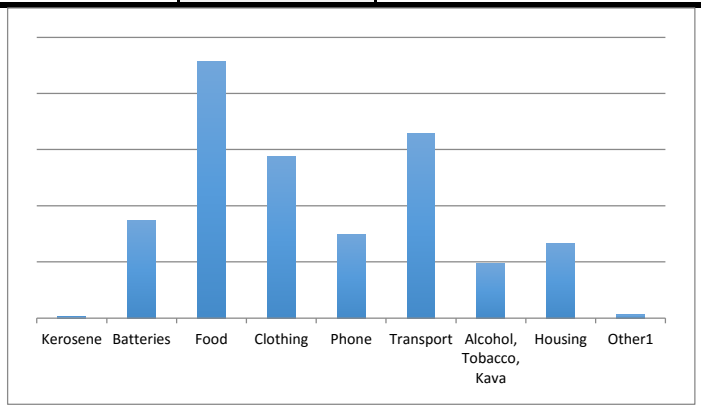


Median	2500 Vt/mo/HH	Average	2733 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

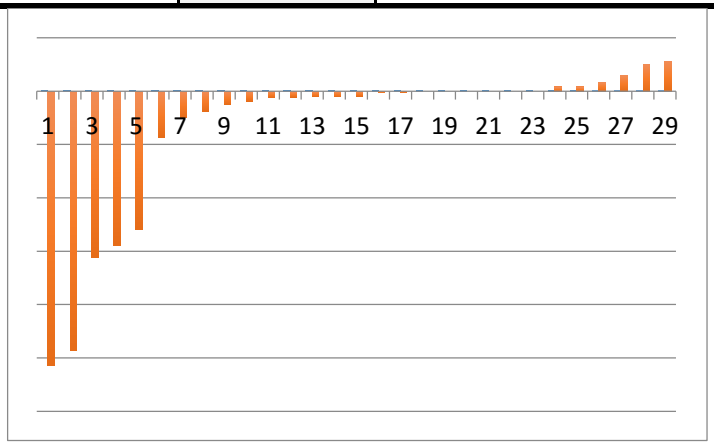


Median	2000 Vt/mo/HH	Average	2570 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	-39363 Vt/mo/HH	Median	-183 Vt/mo/HH	Average	-1357 Vt/mo/HH

Site Visit and Survey Report: Malakoto village, Makira

Makira lies between the islands of Emae and Mataso in the Shepherd group. It is the central peak of the submerged caldera that includes Emae and Mataso as part of its rim. The island population in 2009 was 109 and 93 persons lived in the households surveyed by the team in 2016. Most of the island has steep slopes rising directly from the ocean with an area of low, relatively flat, land at the north end. It is on that tongue of low land that the village is located. A long wide white coral sand beach curves around the north western coast. Access is by sea only, there is no air strip. The team's travel between Mataso and Makira was about one hour by small boat in fairly rough seas with another hour to get to Emae. Resources are limited but with more good garden area than Mataso. The island has its primary input of cash in the form of wages and salaries to employees of government and non-government public organizations. Subsistence fishing and farming is the primary occupation of most of the rest of the population.

Figure 4.6: Makira Island
Source: Google Earth. Image from 2009

Makira has a single village, Malakoto (also known as Malakaf) with 31 households. The population in early 2016 was 135, compared to 132 in 1999 (census) and 106 in 2009 (census). During both visits, village men and young men were busy with building reconstruction. The village is very neat with many homes repaired since the cyclone and gardens are clearly recovering from the cyclone. Digicel and TVL mobile phone reception is from towers on Emae to the north, so reception can be intermittent and poor. Most households have solar lanterns and one fisherman has a small solar-powered freezer capable of keeping about 80 kg of fish frozen for up to four days without sunshine. The majority of people from the island (about 350) have migrated to Efate.

Figure 4.7: Approaching Makira Island (Photo: Peter Johnston, May 2016)

Malakoto Village, Makira Island

Source Google Earth (2009)

Although Makira Island was also severely damaged by cyclone Pam, the island has relatively few temporary buildings remaining and most of the damage to surviving structures has been repaired. The village is relatively compact and could be considered for a grid but most of the population have quite low incomes and that causes their stated willingness to pay for additional electricity to be about half the real cost of operating even a basic SHS installation. Also since the highest priority services are lighting, radio and phone charging, pico-solar or a small SHS can provide those services at much lower cost than a mini-grid. The few households willing and able to pay the cost of a higher level of service can opt for a larger SHS sized to fit their needs.

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)		Median Acceptable Payment (Lighting+additional Services)
17	93	500 Vt/Month		500 Vt/Month
High Priority Services*	Lights	Radio		Phone Charger
Priority	1.64	1.88		1.59
Other Services Desired	Portable Speaker, electric pot,			
Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
0% Digicel 23% TVL 71% Both 94% TOTAL	94%	81%	4.9	Monthly 47% Prepaid 65%

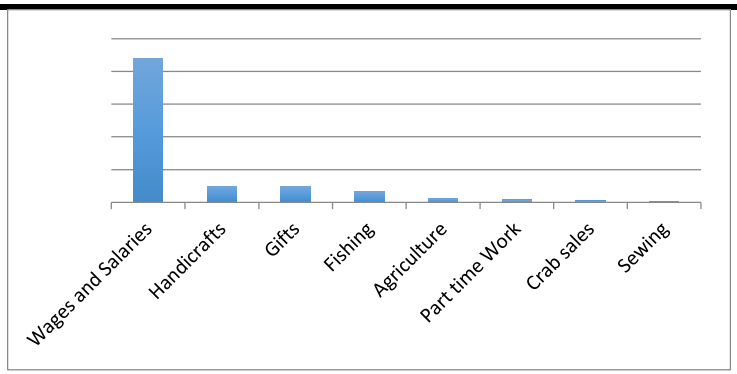
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Malakoto Village, Makira Island

SOURCES OF CASH INCOME

Relative averages over a year

(Entire Village)

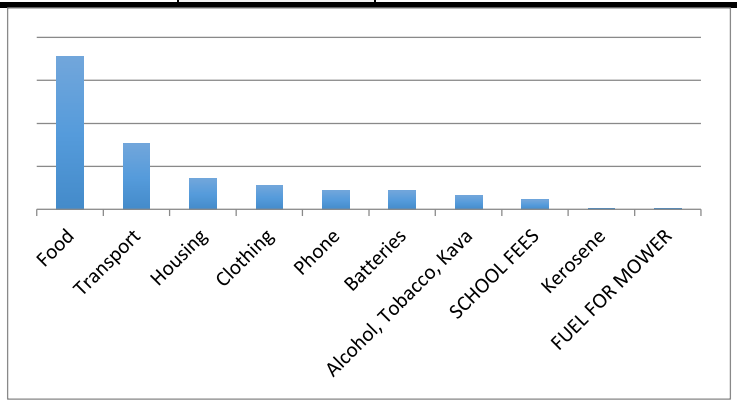


Median	**1242 Vt/mo/HH**	**Average**	**7107 Vt/mo/HH**

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(entire village)

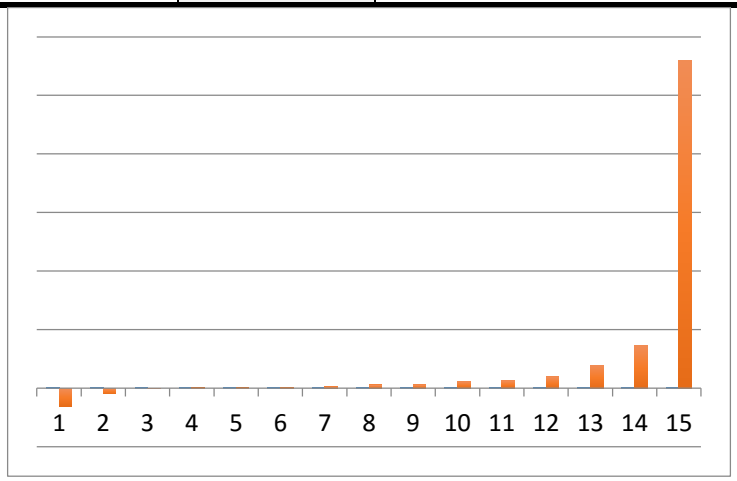


Median	1027 Vt/mo/HH	Average	2646 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	**69034 Vt/mo/HH**	**Median**	**550 Vt/mo/HH**	**Average**	**4602 Vt/mo/HH**

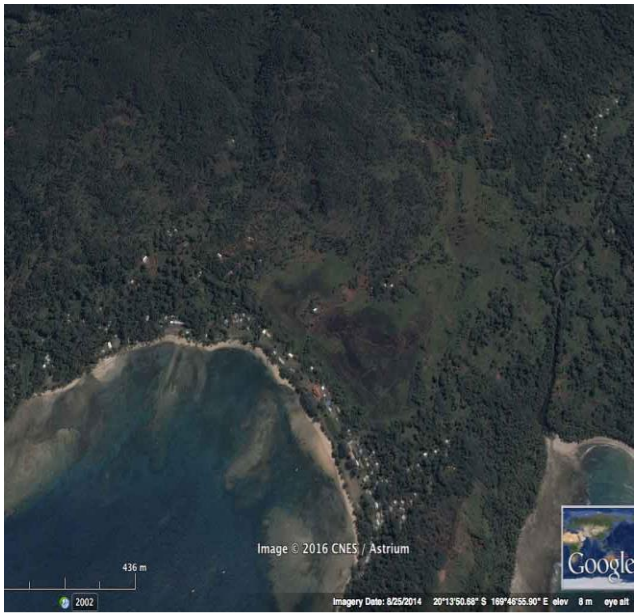
Site Visit and Survey Report: Aneityum

Aneityum (Anatom in French) is the southernmost island of Vanuatu (excluding the Matthew and Hunter Islands, which are disputed with New Caledonia). Its southeastern cape, Nétchan Néganneaing, is the southernmost point of land in Vanuatu. The island is 159.2 km^2 in land area, rising to an elevation of 852 m at Mount Inrerow Atamein. The largest village is Anelcauhat (also known as Anelghowhat), on the south side. The island had a population of 915 at the time of the last national census in 2009. It is served by Anatom Airport, an unpaved airstrip on a small island to its south west, Iñec (or Inyeug), also called "Mystery Island" for the benefit of the cruise ship passengers that visit. There are several flights per week from Port Vila, usually via Tanna.

The Anelcauhat area has 177 households and a population of 776 or 60% of the island's total, with the more densely populated central portion of Anelcauhat having 153 hh, 669 people and 52% of the island population. With no roads connecting villages, the usual mode of travel is on foot on cross country or beach tracks (6-8 hours and permission of land owners) and small boat (1-2 hours). There are plans for the construction of roads connecting the three main villages but the cost of construction is high – particularly due to the several bridges needed to span valleys – and it appears unlikely that there will be roads for vehicular transport for many years. Fortunately the distance between villages is not great, a few hours walking or less by boat, and there is significant commerce between villages. The gardens of Port Patrick are a major input to the food supply of Anelcauhat (and a major input of cash to Port Patrick).

Figure 4.8: Aneityum Island
Source: Google Earth. Image from 2014 (pre-Cyclone Pam)

Anelcauhat Village, Aneityum Island



Anelcauhat village is a long string of homes and government or commercial facilities spread along several km of beach. It is the village on Aneityum with the largest cash economy because of the frequent visits of cruise ships whose passengers spend a day visiting the many attractions set up by the Anelcauhat residents on nearby Mystery Island. Because the village is long and narrow, it is recommended that electrification be divided into two, and possibly three village segments each with its own separate mini-grid located with the generation near the center of each segment. Some outlier homes will still need to be provided with SHS.

Source Google Earth (2009)

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
52	246	2000	3000

High Priority Services*	Lights	Phone Charger
Priority	1.33	1.54
Other Services Desired	Power tools, shell polishers, sewing machines, electric cooker, electric fry pan, fan, computer, water pump	

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
TVL 53% Both 35% Digicel 4% Total 92%	69%	31%	4.9	Weekly 4% Prepay 8% Monthly 84% Custom Economy 18%

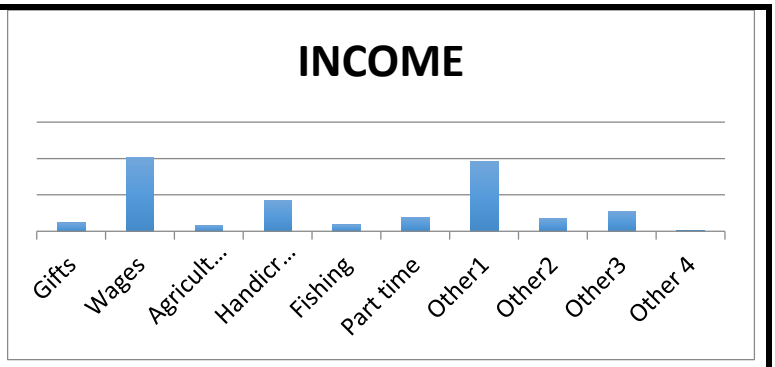
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Anelcauhat Village, Aneityum Island

SOURCES OF CASH INCOME

Relative averages over a year

(Entire Village)

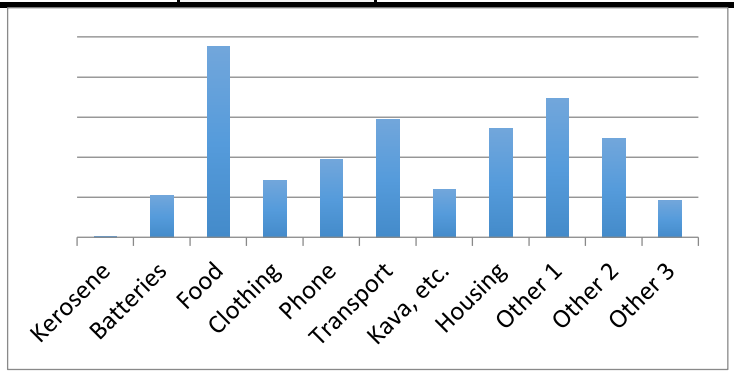


Median	33000 Vt/mo/HH	Average	56590 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(Entire Village)

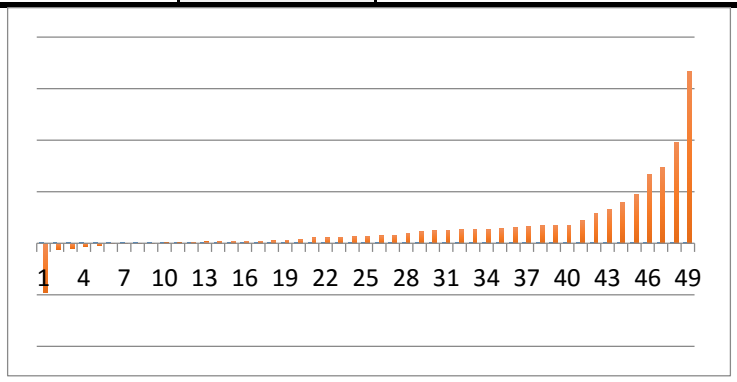


Median	8963 Vt/mo/HH	Average	18357 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	1515754 Vt/mo	Median	13921 Vt/mo/HH	Average	30934 Vt/mo/HH

Umetch Village, Aneityum Island

Umetch was not seriously damaged by Cyclone Pam and there are few signs of the passage of the cyclone remaining. The village is reasonably compact, though long and narrow. If a mini-grid were located to feed the village in its central area, losses in the side extensions to the rest of the village should not be a problem provided wire sizing is done properly. However, there are concerns about the village's willingness to pay the cost of O&M for a mini-grid relative to the lower cost of SHS for the modest energy delivery needed to meet the overall priorities for services. The village layout is good for SHS with most houses having an open, unshaded court area suitable for pole mounted SHS panels.

Source Google Earth (2009)

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
28	139	500	1000

High Priority Services*	Lights	Phone Charger
Priority	1.18	1.79
Other Services Desired	No other services listed	

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
Digicel 3% TVL 54% Both 18% Total 75%	50%	32%	5.1	Monthly 75% Custom Economy 50% Prepayment 11%

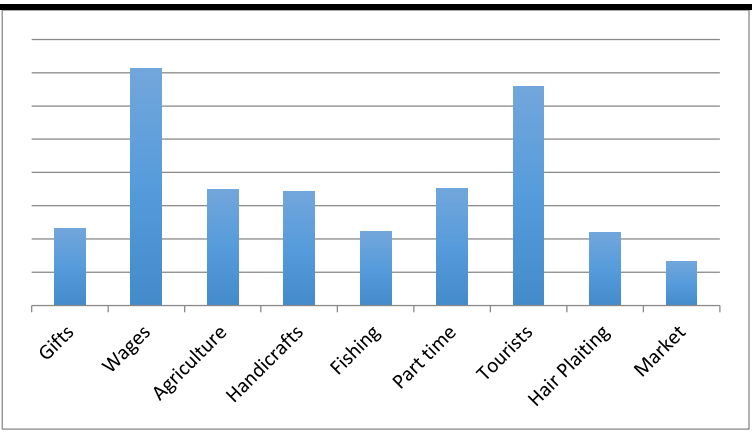
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Umetch, Aneityum Island

SOURCES OF CASH INCOME

Relative averages over a year

(Entire Village)

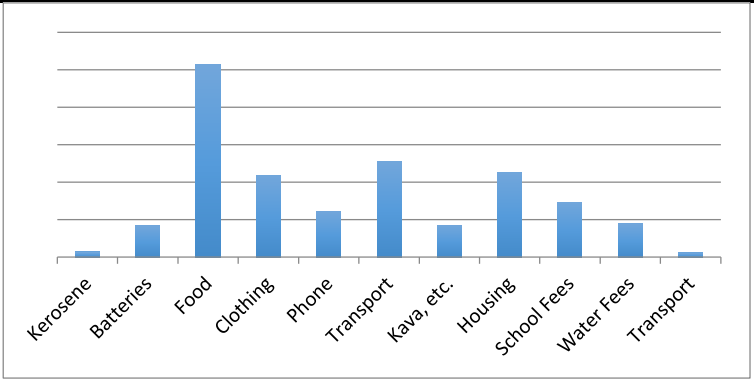


Median	13917 Vt/mo/HH	Average	19858 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(Entire Village)

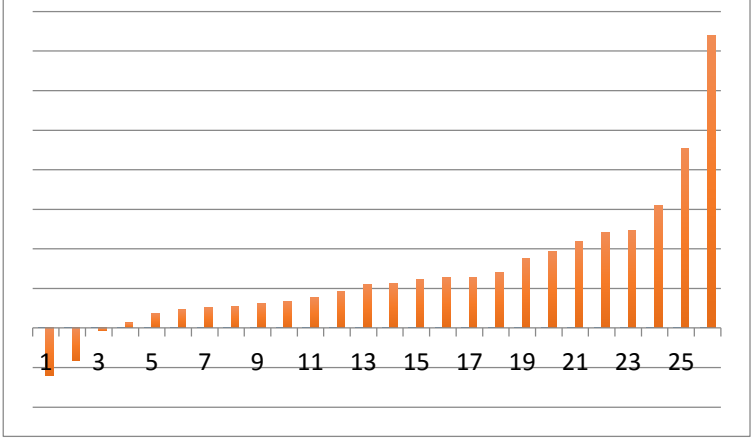


Median	3985 Vt/mo/HH	Average	6080 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	361080 Vt/mo	Median	927 Vt/mo/HH	Average	1157 Vt/mo/HH

Port Patrick Village, Aneityum Island

Source: Google Earth

Port Patrick is a very spread out village on the north coast opposite the island from the other large village of Anelcauhat. There are no roads between villages but there are walking tracks and the trip by boat when seas are calm is only a few hours. Port Patrick is the agricultural center for Anetiyum and much of the food that is purchased by the residents of Anelcauhat comes from Port Patrick so the money from tourism made by the Anelcauhat residents also supports Port Patrick. The willingness to pay and the priority for services seen in Port Patrick fits small to medium sized SHS very well as does the low density of homes in the village.

HH Surveyed	Population Surveyed	Median Acceptable Payment (Basic Lighting Services)	Median Acceptable Payment (Lighting+additional Services)
19	102	1250	2750

High Priority Services*	Lights	Radio	Phone Charger
Priority	1.21	1.53	2.0
Other Services Desired	Aqua Culture, Electric tools, laptop, water pump		

Percentage of HH with mobile coverage	Percentage of HH with some type of solar lighting	Percentage with portable solar lights	Average hours of solar lighting per day.	Acceptable Payment Approaches
Digicel 21% TVL 16% Both 37% Total 74%	68%	53%	5.4	Month 58% Prepayment 32% Custom Economy 26%

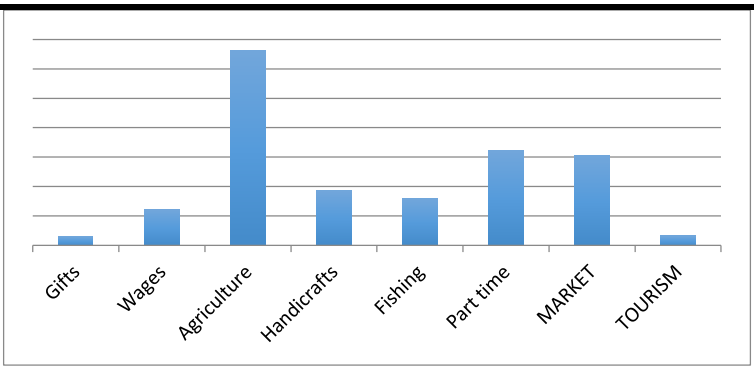
*With a median priority of 2.0 or higher on a scale of 1 (essential) to 5 (not needed)

Port Patrick, Aneityum Island

SOURCES OF CASH INCOME

Relative averages over a year

(Entire Village)

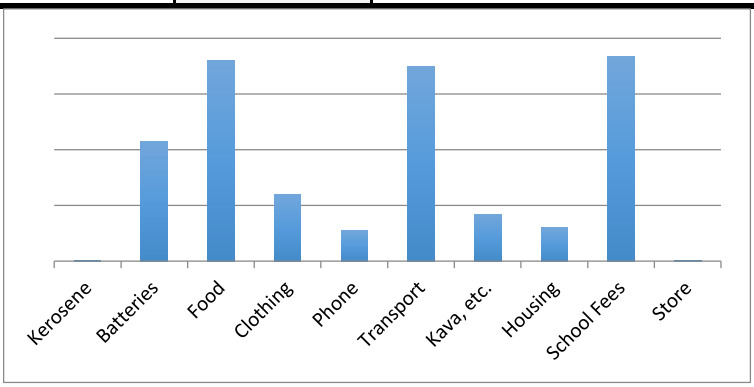


Median	10979 Vt/mo/HH	Average	17983 Vt/mo/HH

CASH EXPENDITURES BY CATEGORY

Relative averages for one year

(Entire Village)

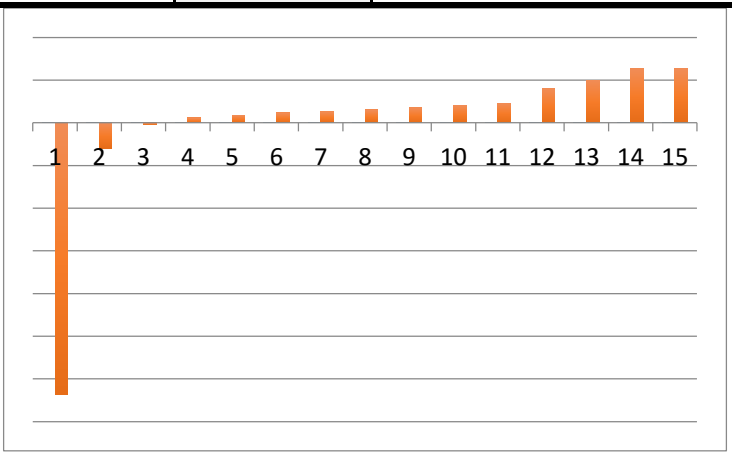


Median	4505 Vt/mo/HH	Average	24110 Vt/mo/HH

DISTRIBUTION OF DISPOSABLE INCOME BY HOUSEHOLD

Relative averages for one month

(per household)



Total Village	-5993 Vt/mo	Median	6021 Vt/mo/HH	Average	-400 Vt/mo/HH

Mystery Island, Anetiyum, Island

Figure 4.9: Mystery Island, Aneityum

Source Google Earth (2009)

Mystery island lies a few hundred meters to the south of the village of Anelcauhat. It has no permanent habitants but is the main source of income for Anelcauhat as well as the site of the unpaved airport connecting Aneityum to Tanna and Port Vila. Most importantly, it is where around two 2000 passenger Carnival line cruise ships per week off-load their passengers to spend the day visiting food and handicraft stalls that were set up early in the morning by the local sellers, getting massages and hair plaiting, drinking kava, going fishing or diving, sampling local food and kava or just lying around on the beaches and enjoying the sand and the sea. The Caribbean cruise ship line will join Carnival in visiting Mystery Island next year, so the passenger visits may about double. A second pier for offloading transfer boats was completed in May to reduce passenger transfer time and to allow for the increased traffic. One permanent building already has solar electricity but the rest of the buildings, business stalls and other facilities are not permanently connected to an electric power source, nor is the small airport terminal building. The site is considered a good candidate for a mini-grid to provide an electrical supply when cruise ships are anchored at Mystery Island. Besides electrification, the use of solar power is itself something of an attraction for the visitors. In the few days between cruise ship visits, the power could be used to make ice from collected rainwater – always in demand for cooling drinks and for preserving fish for sale or later use – with the proceeds from the sale of the ice covering some of the cost of O&M for the solar with the rest coming from its use on cruise ship arrival days. Of all the electrification proposed under this project, a mini-grid on Mystery Island probably has the most potential for economically productive use.

5. Conclusions

The selected islands provide a variety of village types that cover a range of cash access from under an average of USD 10 per month per household in Tebakoro to over USD 500 per month in Anelcauhat. Village geography ranges from compact and laid out in well-defined blocks and pathways to dispersed, random housing. Access to urban centers ranges from flights several times a week to hours of walking or boating between the area transport hub and the village. The desire of communities for electrical services ranges from very little to very strong. For all the villages, it will be costly to get the technicians and equipment to the electrification sites and carry out the electrification. Carrying out electrification of the four islands comprising this project will be a good test for both the various rural electrification technologies being used and the institutional structure that is developed for rural electrification.

Based solely on the site visits and survey, a mix of RE technologies for electrification are recommended for each village. All villages have a wide range of income levels and it is clear from the surveys that basic pico-solar kits will suffice for affordable basic electric services. In villages proposed for mini-grids, there are always outlier houses that may want and get better (or cheaper) service from a SHS as well as eliminating the substantial cost of a grid extension. Therefore all villages are expected to have households that are best served by SHS and pico-solar installations though the main form of electrification may be mini-grids or SHS. (For more detail on the village electrification design process please see Report 3 on Renewable Energy Resources and Prioritized RE Options and Report 4 on Preliminary Technical Design.)

Table 5.1: Proposed Mix of Electrification Installations Based on Site Visits and Survey

EMAE ISLAND VILLAGES	Mini-Grid	SHS	Pico-solar
Sangava	QUESTIONABLE		
Tongamea	QUESTIONABLE		
Fineonge			
Sasake			
Marae			
Vaitini			
Tabakoro	QUESTIONABLE		
Makatea			
Reisu			
Siwo			
MATASO ISLAND			
Na'asang			
MAKIRA ISLAND			
Makatoto Village			
ANEITYUM			
Anelcauhat			
Umetch	QUESTIONABLE		
Port Patrick			
Mystery Island (Iñec or Inyeug)			

Annex 1: Survey Form (English)

LOCATION_____

MEMBERS OF THE HOUSEHOLD (do not count persons who will only reside in the household temporarily)

1. Name_____Age_____Sex_____
2. Name_____Age_____Sex_____
3. Name_____Age_____Sex_____
4. Name_____Age_____Sex_____
5. Name_____Age_____Sex_____
6. Name_____Age_____Sex_____
7. Name_____Age_____Sex_____
8. Name_____Age_____Sex_____
9. Name_____Age_____Sex_____
10. Name_____Age_____Sex_____

CASH INCOME SOURCES (estimate the income from each source for each month of the year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gifts received												
Wages and salaries												
Agriculture												
Handicrafts												
Fishing												
Part time work												
Other_____												
Other_____												
Other_____												
Other_____												

HOUSEHOLD EXPENDITURES OF CASH (Include only estimated CASH expenditures, not barter or in-kind)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kerosene (for lighting)												
Batteries (for lights, radios, or other battery operated equipment)												
Food purchases												
Clothing purchases												
Mobile phone payment												
Transport cost (includes fuel purchased for boats)												
Alcohol, tobacco, kava												
Housing (including repairs and purchase of items for use in the house but not including batteries or kerosene)												
Other cash payments _____												
Other cash payments _____												
Other cash payments _____												

How much is the household willing to pay in cash each month to have access to enough electricity for good quality lighting, radio use and phone charging? _____

How much would the household be willing to pay each month for electricity to operate good quality lighting, radio use, phone charging and to operate a video player for about four hours a week? _____

Please show below how important you feel each of the listed electrical services is to your household by putting an X in the box showing the level of importance of each service. If a service important to your household is not listed, please name the service by writing its name in one of the "Other" boxes.

	Very Important to have	Important for the household	Ok but not essential	Not very important	No need at all
Electric lights					
Radio					
Video					
Refrigerator					
Freezer					
Washing machine					
Phone charger					
Other _____					
Other _____					

Does someone in your household have a mobile phone (Yes or No)_____

If Yes, what company provides the mobile phone service (DIGICEL or TVL) _____

If someone in your household has a mobile phone, how is it charged (put an X in the box that is correct)?

Solar charger	
Charged by a shopkeeper	
Community charging location	
Charged by a battery in a boat, tractor, truck or car	
Other_____ _____	

If there is a fee for charging, how much does it cost to charge the phone? _____

Does your household have a solar powered portable lantern or other solar lighting unit? (Yes or No) _____ (if No, skip the following questions about solar powered lighting)

Do you use the light every day? (Yes or no)_____

About how many hours a day do you use the light? (if less than 1 hour per day write "less than 1")_____

Can the light be easily moved from room to room (Yes or No)? _____

If yes, is it a light that can be taken outside for walking at night? (Yes or no)_____

If your household accepts electrical services, which of the following approaches to payment would you prefer (put an X by each one you feel is a suitable way for your household to pay for electrical services):

Pay a small amount every day or two	
Pay by the week	
Pay by the month	
Pay in advance when you have the money	
OTHER MODE OF PAYMENT _____	

Annex 2: Survey Form (Bislama)

PLES (Velej mo Aelan)_____

OL MAN MO WOMAN WE OLI STAP KAKAE TUGETA LONG HAOS IA OLTAEM (no kaontem olgeta we oli kam stap lo haos smol taem nomo afta aot bakegen)

1. Nem_____ Hamas yia____ M/F_____(krossem wan mo lego emia we i stret)
2. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
3. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
4. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
5. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
6. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
7. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
8. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
9. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)
10. Nem _____ Hamas yia ____ M/F_____(krossem wan mo lego emia we i stret)

YUFALA ISTAP KASEM MANI BLONG LIVING BLONG YUFALA OLSEM WANEM? (tingbaot mo raetem daon hamas mani ikam insaed long haos long ol difdifren aktiviti long wan wan manis long wan wan yia)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ol gift blo fren o famle												
Ol wejes mo salari												
Akrikalja												
Handikraft												
Fishing												
Part taem wok												
Nara_____												
Nara_____												
Nara_____												
Nara_____												

HAMAS MANI YU SPENDEM LONG OL SAMTING IA LONG OL MANIS IA? (Tingbaot mo raetem daon CASH be ino ol exjenses o valiu blong kastom ekonomi)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kerosene (blong laet)												
Battery (blo laet, redio, o torch laet o nara ekwipmen)												
Kakae we yu peim												
Klos we yu peim												
Mobael phone mo credit												
Transport (kaontem tu benzin mo oil blong boat)												
Alcohol, tobacco, kava												
Haos materiel (kaontem ripea mo ol ting blong haos be no kaontem battery mo fuel)												

Ol nara payment lo cash _____												
Ol nara payment lo cash _____												
Ol nara payment lo cash _____												

Hamas cash mani yufala i willing blong peim long wan wan manis blong kasem inaf electricity blong gat gud kwaliti lighting, redio yus mo blong chargem ol phone?_____

_____

Hamas cash mani yufala i willing blong peim long wan wan manis blong kasem inaf electricity blong gat gud kwaliti lighting, redio yus , chargem ol phone mo mekem video player i wok blong 4 hours long wan week? _____

Plis yu putum wan mak long bokis blong showem impotense blong ol elektrikel services long haoshol blong yu. Sipos service hemi important long haoshol blong yu be ino stap long list, plis raetem daon service ia long wan box andanit we oli markem "nara"

	Hemi impoten tumas blong mas gat	Emi impoten blong haoshol	Ok be i oraet sipos i nogat	Ino impoten	Ino nidim nating
Electric laet					
Redio					
Video					
Refrijereta					
Friza					
Washing masin					
Phone Charger					
Nara _____					
Nara _____					

Igat wan long ol memba blong haoshol ia we igat mobile phone? (Yes or No)_____

Sipos yes, wanem kampani i givim service ia? (DIGICEL or TVL)_____

Sipos I kat wan mobile phone lo haos ia, yufala I stap chargem olsem wanem ?

Solar charger	
Chargem lo wan store	
Community charging location	
Chargem wetem battery blong boat, tractor, truck or car	
Nara source (Talem) _____ _____	

Sipos I kat fee blong chargem phone, talem hamas ?_____

Haoshol ia i gat wan solar light or sam narafala solar unit ? (Yes or No) _____ (Sipos ' No', plis skipim (Yes or no)_____

Light blong solar ia i save last kasem hamas hour lo wan day? (Sipos emi less than 1 hour lo wan dei, plis writem "ino bitim 1")_____

Emi isi blong muvum light lo wan rum igo long narafala rum ? (Yes or No)? _____

Sipos 'yes' man i save karem light igo aotsaed blong wokbaot long night ?(Yes or no)_____

Sipos haoshol blong yu i akseptem ol electrical servis, which one long ol fasin blong payment ia nao mbae yu wantem usum? (putum wan X lo bokis we yu luksave se hemi stret wei we haoshold blong yu i wantem peim servis blong elektrisiti):

Peim smol amaont evri dei o tu dei	
Peim evri week	
Peim evri manis	
Peim taem yu gat mani bifo yu usum olsem prepaid	
OL NARA WEI BLONG PEIMENT _____	

Annex 3: Key People Met During the Site Visits

i) MATASO ISLAND

John Matasing (Chief, Na'asang village), the only village on the island)

John Simi, resident of Mataso and boat driver

Efron Jimmie, Chair, Community Development Committee

Walter Marcel, Secretary Community Development Committee

Robson Firiam, resident of Mataso

Margaret Royal, women's representative (and several women)

ii) MAKIRA ISLAND

Ishmael Robert (Chief's representative, Malakoto village, the only village on the island)

Tonkin Billy, fisherman (with PV system for fish freezing)

Robson Langises, Area Secretary

iii) Emae Island *

Jack Timakuramata (Chief, Sangava village)

Samuel R Tapangatoroa (Chief, Sesake village)

Harry Kalo Tisomorimata (Chief, Marea village)

David William (Chief, Siwo village)

Divaedini (Chief, Vaitini village)

Masamori (Chief, Tabakoro)

Maltonga (Chief, Makatea village

Berry (paster, Sasake village)

David Roy Maipu (Chief, Tongamea village)

Losu (Chief, Vinange village)

Kalsong Varatialiu (Chief, Sasake village)

Davidainimata Roroneo (Chief, Sangava village)

Mariko Shem Marikovisi (Chairman of Area Council & Chief, Siwo village)

Christopher Daniel Matariki (Area Secretary)

Werearu (Chief, Raysu village)

Matisangava (Chief, Tabakoro village)

Matariteya Graham Ben (Chief, Finonge village)

Ian Sini (Principal, Nofo Secondary School)

Other men and women who did not identify themselves

* Villages have multiple chiefs; some chiefs provided only their titles, not names

iv) ANEITYUM ISLAND

Jack Keitadi (Secretary of Island Council of Chiefs)

Frank Inhat (Chair of Council of Chiefs)

Reuben Neriam (Area Secretary)

John Karubi (Provincial Councillor)

Alfred Yakam (elder of Anelcauhat village)

Chief Simon Nijina (Anelcauhat village)

Paster Isaac Manukyaha (Chair of Port Patrick School)

Kennery Todominic (village health worker, Umech village)

Balmath Stuart (Headmaster of Port Patrick School)

Ben Makoya (Headmaster of Anelcauhat Primary School)

Ms Reni Mark (Acting principal, Teruja School)

James Silas (Chair, Keamu Cooperative Society)

Barry Nangia (Secretary of MITHL – Mystery Islands Tourism Holdings Ltd)

Joel Rawai (fisherman, Anelcauhat village)

Chief Clement (Umeth Village)

Francois Wanieg - Board member of Mystery Island Tourism Holdings Limited (MITHL)

Richard Willie - Board member of Mystery Island Tourism Holdings Limited

Robert Nasawari Manyo - Board member of Mystery Island Tourism Holdings Limited

Henry Naumeta

James Nakao

Keith Yayo Stanley

Kenneth Keith (Owner/manager, Kenneth Bungalows)

Other men and women who did not identify themselves

Annex 4: List of Documentation Consulted

This annex lists only documentation used for this report.

FAO, 2001	FAO 2000 Forest Resource Assessment Vanuatu Country Report, Department of Forests (March); http://www.fao.org/docrep/006/ad672e/ad672e18.htm
GoV VNPO, 2011	2009 National Population and Housing Census: Analytical Report Volume 2 (http://www.vnso.gov.vu/images/PublicDocuments/Census/2009/2009 Census Analytical Report - Vol2.pdf
GoV, 2007	Census of Agriculture 2007 Vanuatu; http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Reports/VAN_ENG_REP_2007.pdf
GoV, 2013	Vanuatu Forest Policy: 2013-2023; http://theredddesk.org/sites/default/files/vanuatu_forest_policy_2013-2023.pdf
GoV, 2015	Emae Island Assessment Report (TC Pam Summary)
GoV, 2015	Mataso Island Assessment Report (TC Pam Summary)