Before and After Study on Renewable Energy Installation in Rural Community

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Introduction

-About **1 billion people** live without modern electricity (UN, 2017)

⇒National Rural Development Policy

RE, especially Solar home systems (SHSs) in remote villages

However,

- a fair number of the rural electrification projects have been observed to be **unsustainable** (e.g., Urmee T, 2016)

- **little evidence** of direct impact on income generation or economic growth from RE (World Bank, 2008, Mishra T, 2016)

Objectives

Study on the impacts in villagers' Quality of Life (QOL) "**before and after**" their electrification (under the support of JATIP, 2016-)

- *Following the same household*
- *Direct comparison with a small statistics*

Final goal

-Find suitable system (hardware and software) of rural electrification

=>Assessment to Rural Development Policy

Methodology : before-after survey

RE installation

Demographic Characteristics

Quality of Life

External Condition

Environmental and Socio-Economic Condition

- Transportation
- School/Hospital
- National Income

- Background Information
- Satisfaction Level
- Psychological Well-Being and Symptoms
- Physical Health
- Social Relations
- Income
- Activities of Daily Living
- Personal (family) Properties and Daily Life Pattern

Electricity Demand, Affordability

Wisconsin QOL indicators

Q2 : SATISFACTION LEVEL

Q2.1	Very dissatisfied	Moderately dissatisfied	Neither satisfied or dissatisfied	Moderately satisfied	Very satisfied
How satisfied or dissatisfied are you with the way you spend your time?	□	□	□	□	□
	Not at all important	Slightly important	Moderately important	Very important	Extremely important
How important?	□	□	□	□	□
	Very dissatisfied	Moderately dissatisfied	Neither satisfied or dissatisfied	Moderately satisfied	Very satisfied
How satisfied or dissatisfied are you when you are alone?	□	□	□	□	□
	Not at all important	Slightly important	Moderately important	Very important	Extremely important
How important?	□	□	□	□	□
	Very dissatisfied	Moderately dissatisfied	Neither satisfied or dissatisfied	Moderately satisfied	Very satisfied
How satisfied or dissatisfied are you with your housing?	□	□	□	□	□
	Not at all important	Slightly important	Moderately important	Very important	Extremely important
How important?	□	□	□	□	□
	Very dissatisfied	Moderately dissatisfied	Neither satisfied or dissatisfied	Moderately satisfied	Very satisfied

Where we are studying?

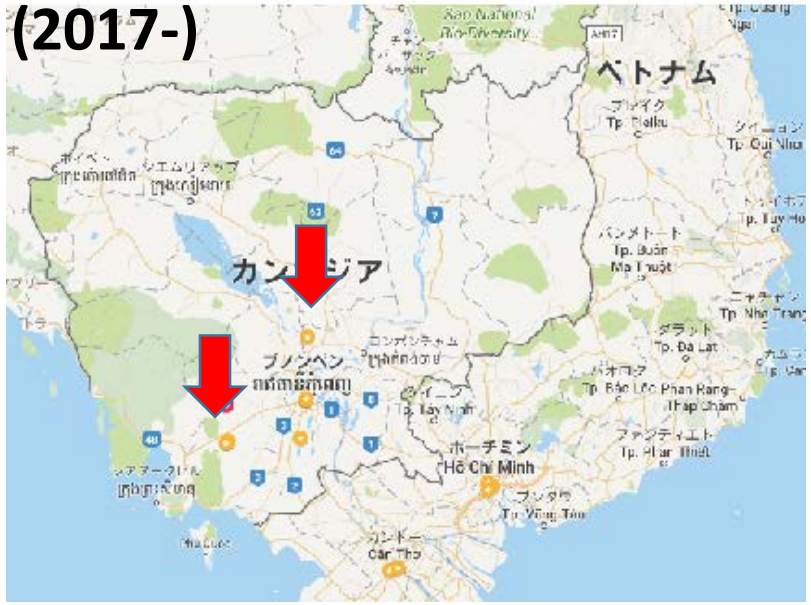
Sarawak, Malaysia (2016-)

Electrification ratio : 100% population (2016) WDI

Some villages, especially in Borneo island, still stay in off-grid condition.

SHS, Grid extension

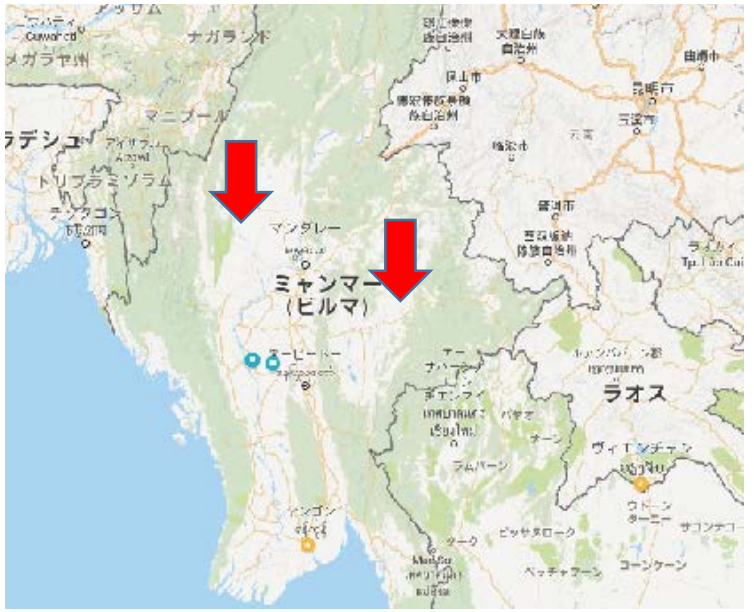
Near Phnom Penh, Cambodia (2017-)



Electrification ratio : 50% population (2016) WDI

SHS (solar lantern), Grid extension

Magway, Myanmar (2017-)



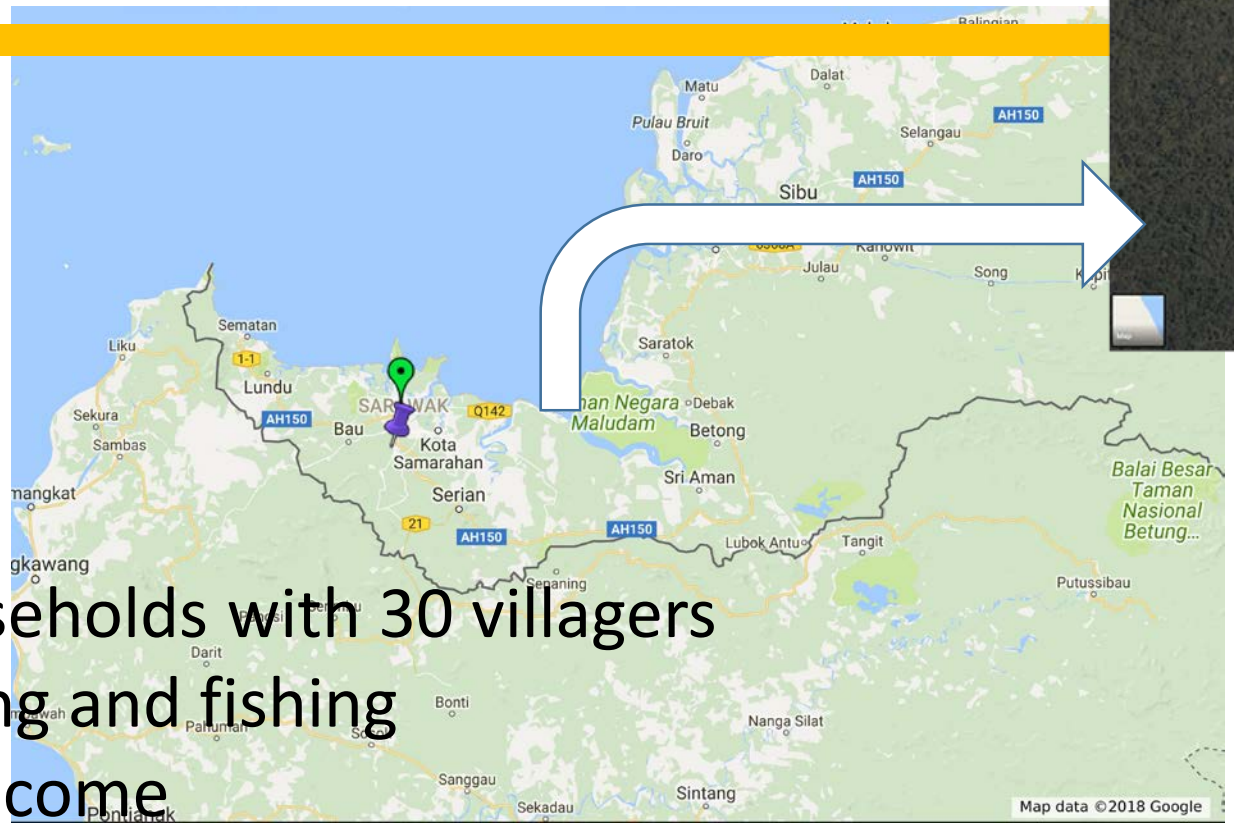
Electrification ratio : 57% population (2016) WDI

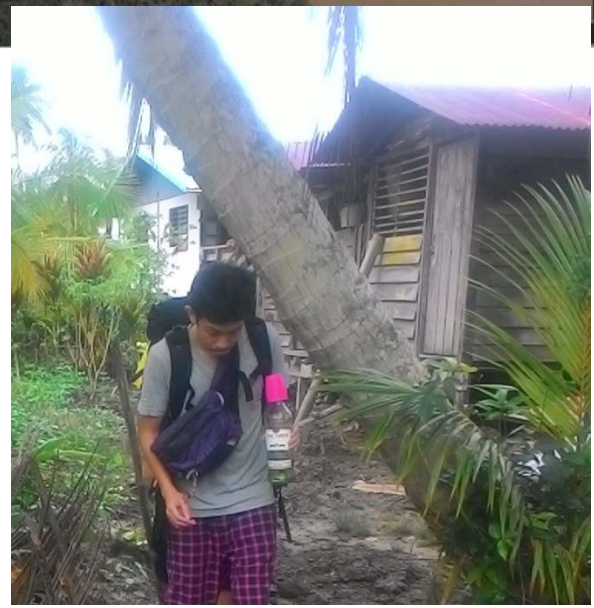
Hybrid mini-grid, Grid extension

Sites survey: Sarawak

major tribe in rural Sarawak: **Iban**

Kampung Sungai Merah





1. 5 households with 30 villagers
2. Farming and fishing
3. Low income
3. **Willing to pay for electricity**

   Agrees to collect 30 RM/m/house for battery replacement

Installed SHS in Kampung Sungai Merah

5 SHS systems have been installed in **Feb. 2017**.

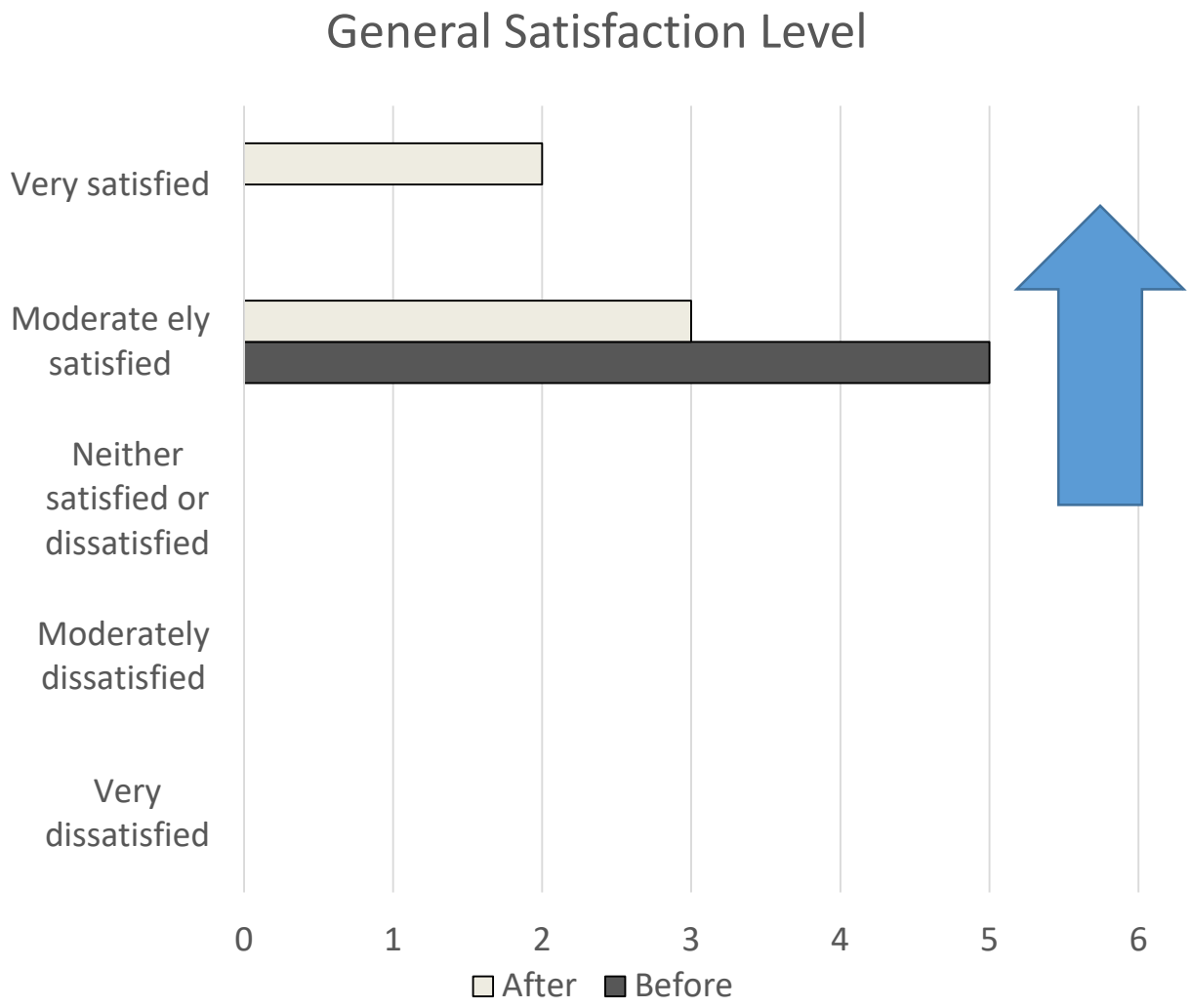
~6,000 USD / 5 systems

Item	Unit Specifications
PV Panel	305W, V_{mpp} = 37.8 V, I_{mpp} = 8.34A, V_{oc} = 45V, I_{sc} = 8.85 A
Battery	AGM sealed lead-acid battery, 12V, 150Ah
Inverter	Stand-alone type, 200W, Input: 12/24 V, 20/10 A_{max} Output; 230V 50Hz
Solar charge controller	PWM-type 12/24 V, 20/10 A

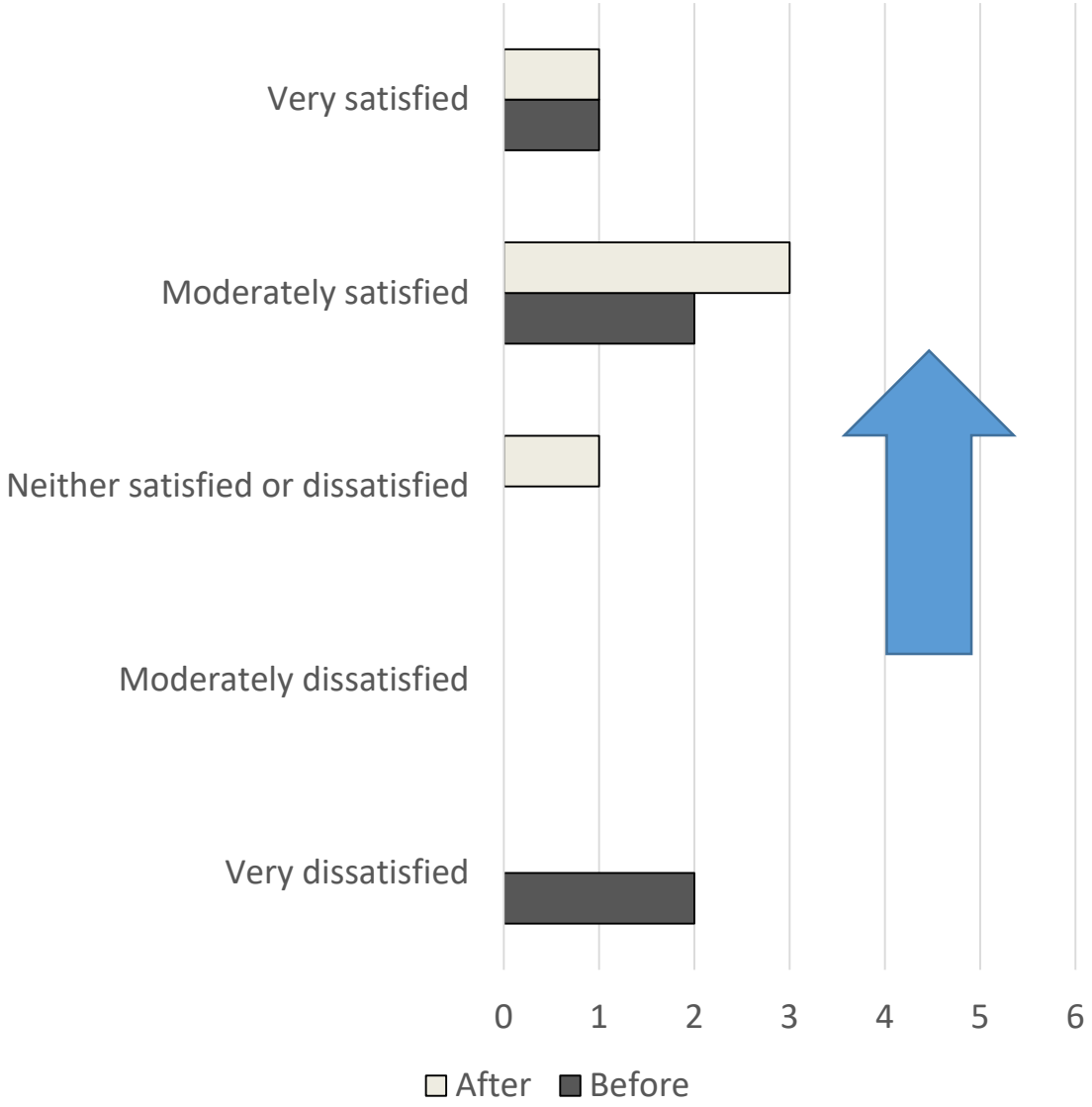
UM and JASTIP budget

Feb. 2017

After installation (Kampung Sg. Merah, 2018)

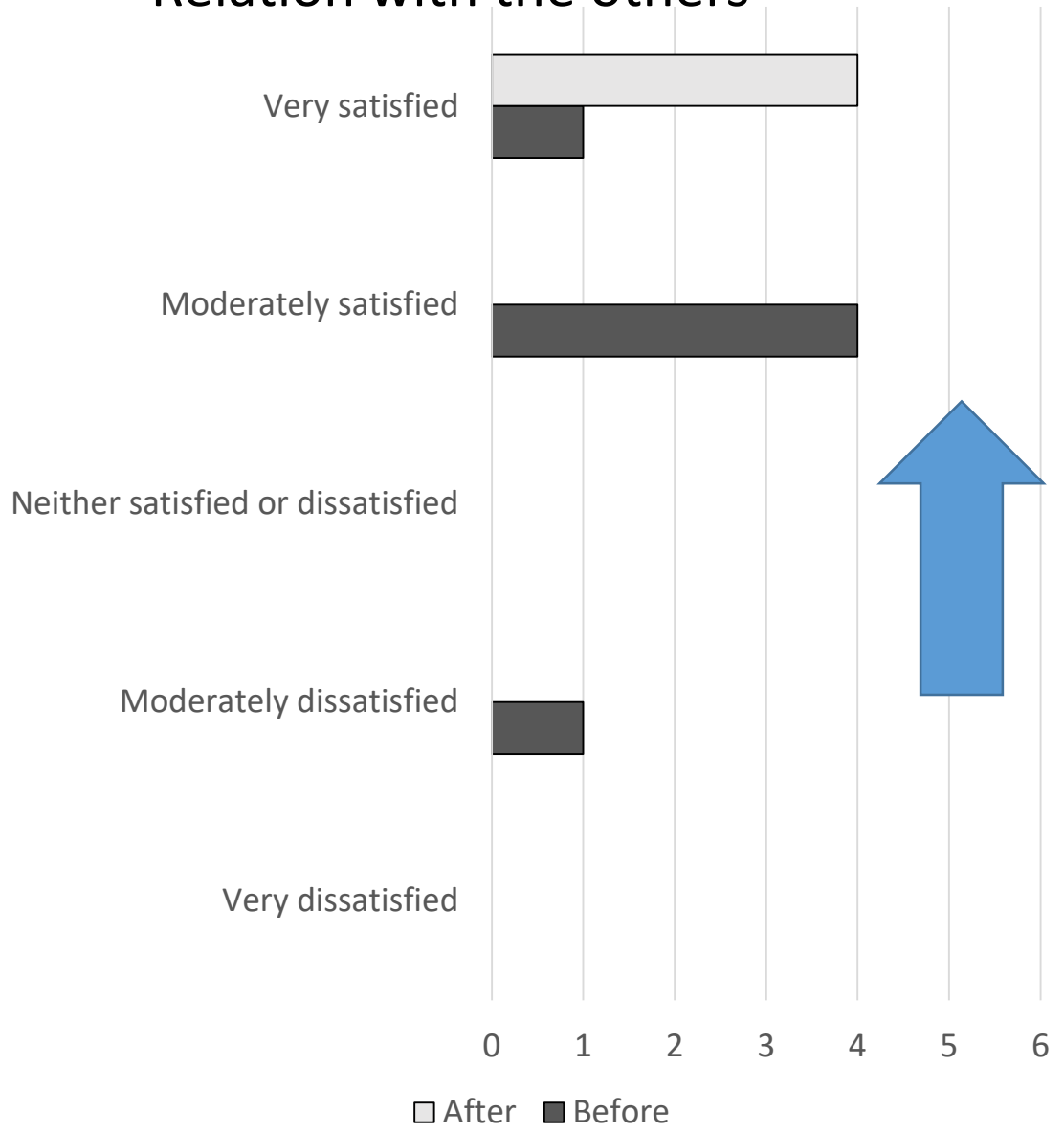


Income Satisfaction Level

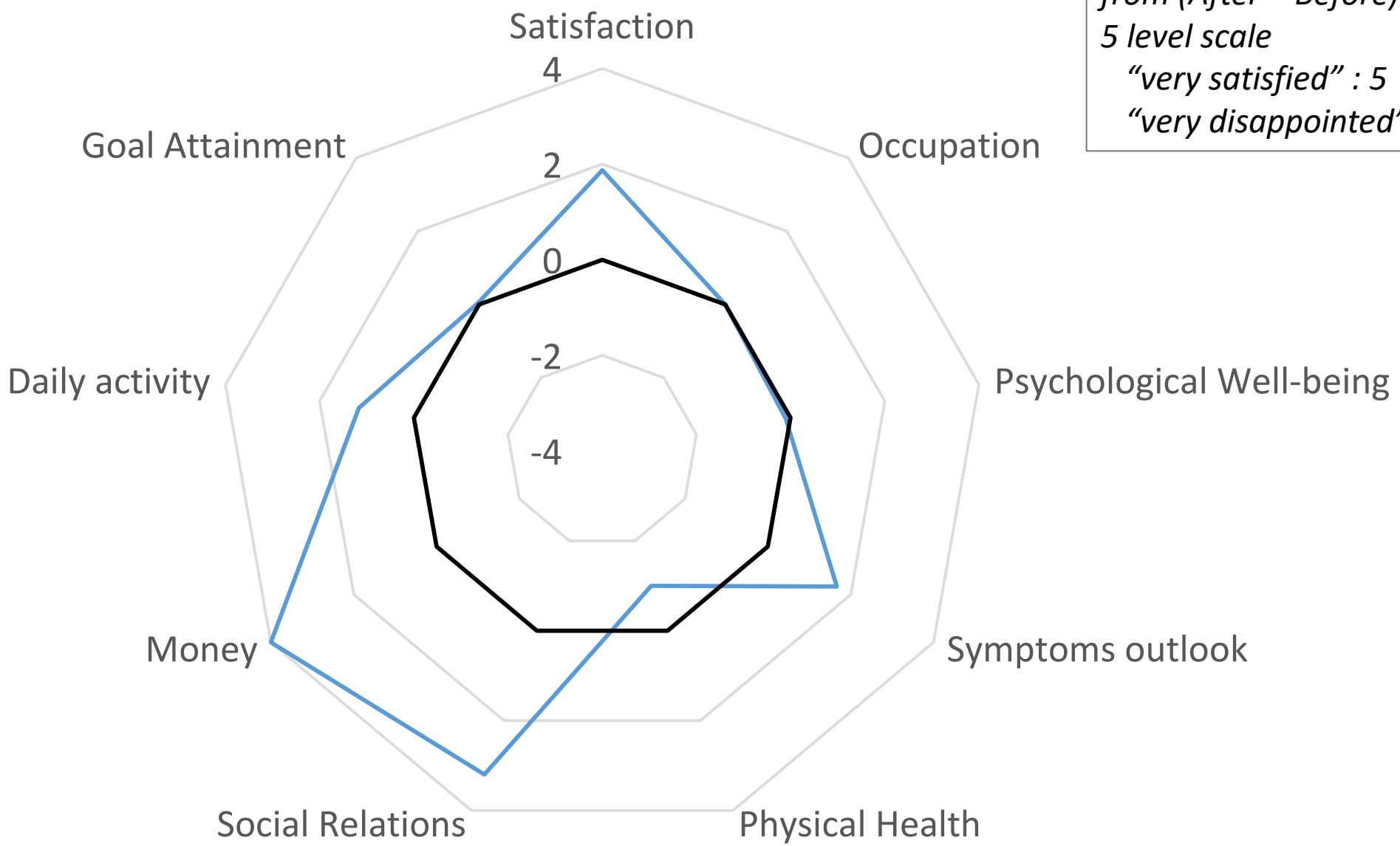


average 500 RM

Relation with the others



Before and After



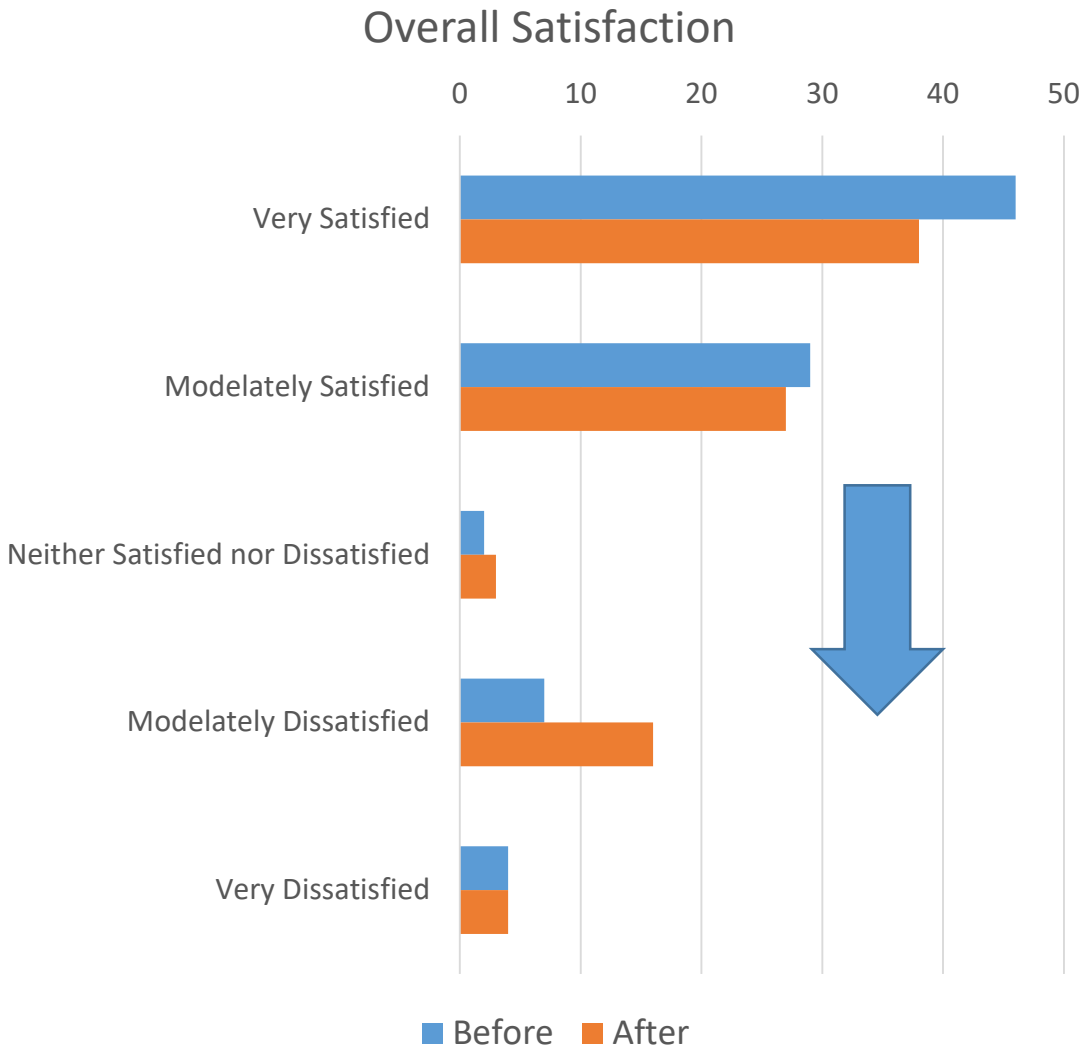
Average of sub questions from (After – Before)
5 level scale
"very satisfied" : 5
"very disappointed" : 1

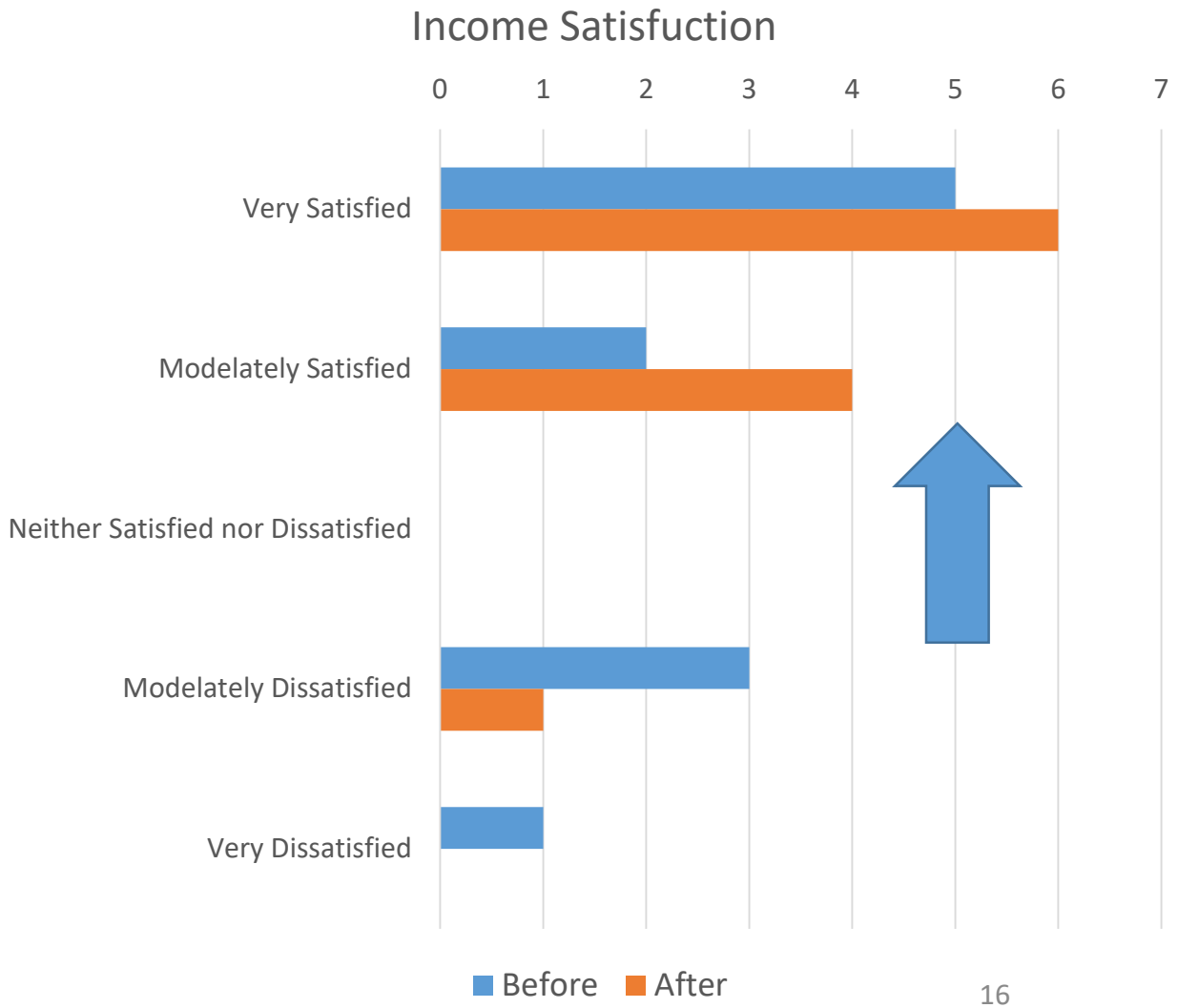
Menangkin (before grid connection, 2016)

Grid power has been extended in 2017.
Interview was done in July 2018.

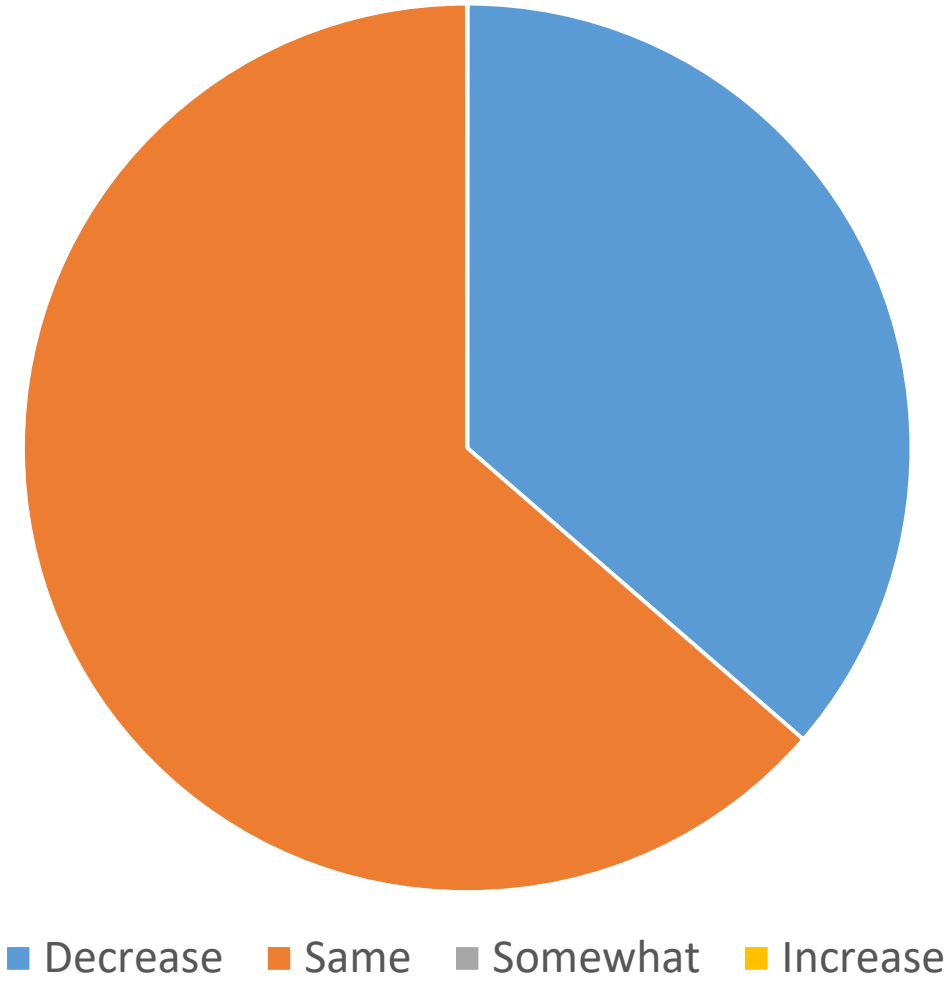
After (2018) 11 households interviewed

Result

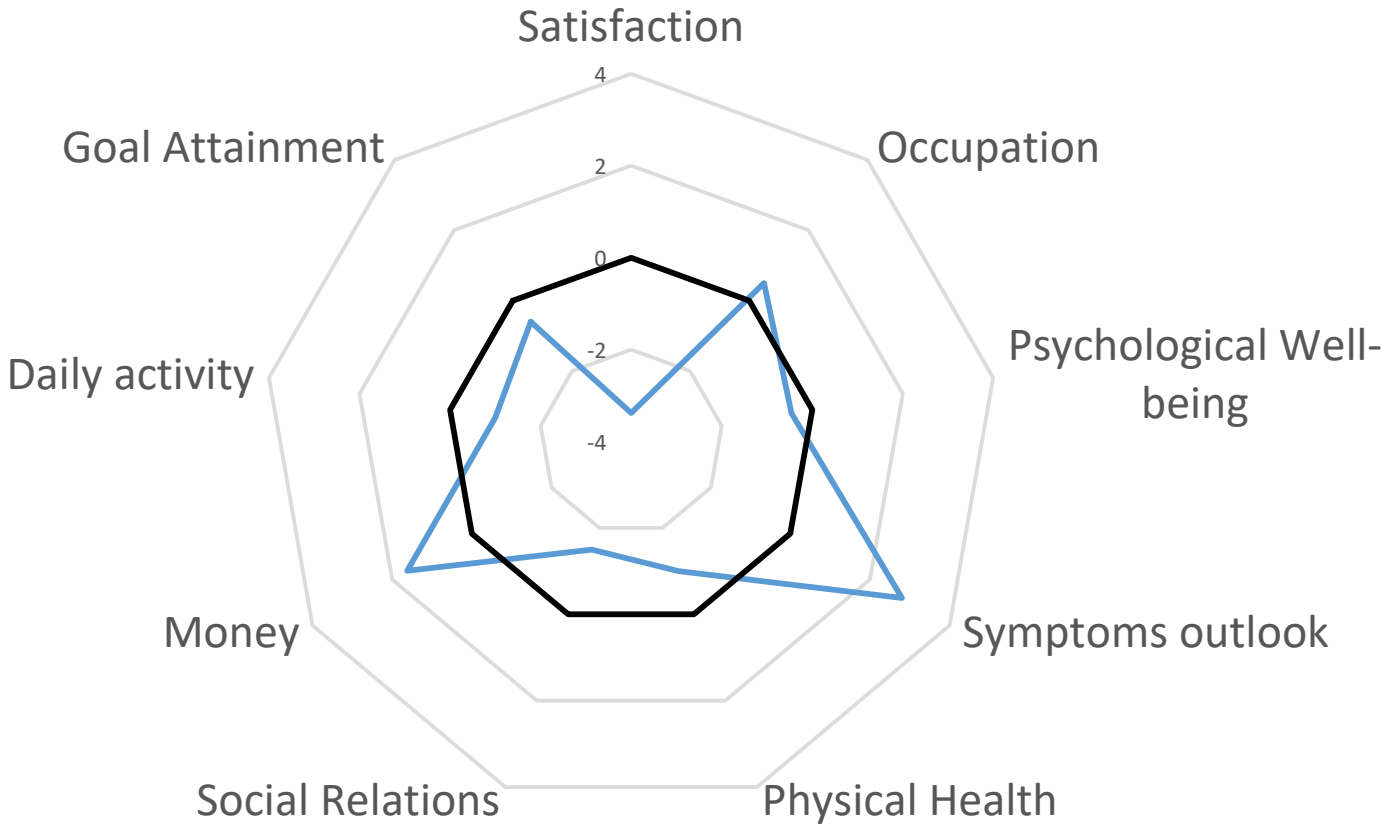

Overall Satisfaction
0
10
20
30
40
50
Very Satisfied
Modelately Satisfied
Neither Satisfied nor Dissatisfied
Modelately Dissatisfied
Very Dissatisfied
Before
After


Income Satisfuction
0
1
2
3
4
5
6
7
Very Satisfied
Modelately Satisfied
Neither Satisfied nor Dissatisfied
Modelately Dissatisfied
Very Dissatisfied
Before
After

Income



Before and After



Interview summary: Kpg. Sg. Merah

Interview with 5 households, (April 2016, July 2018)

1. Installed 5 SHSs (October, 2017)
2. After the installation of SHSs,

   positive : Social relations and Money condition

   negative (slightly) : Physical Health(?)
4. Saving fuel cost: 94 RM/m (in average, ~23 USD)
5. Purchased TV, cell phone, refrigerator (doesn’t work…)

Interview summary : Menangkin

Interview with 11 households, (April 2016, July 2018)

1. Grind Extension (2017)
2. After the grid extension,

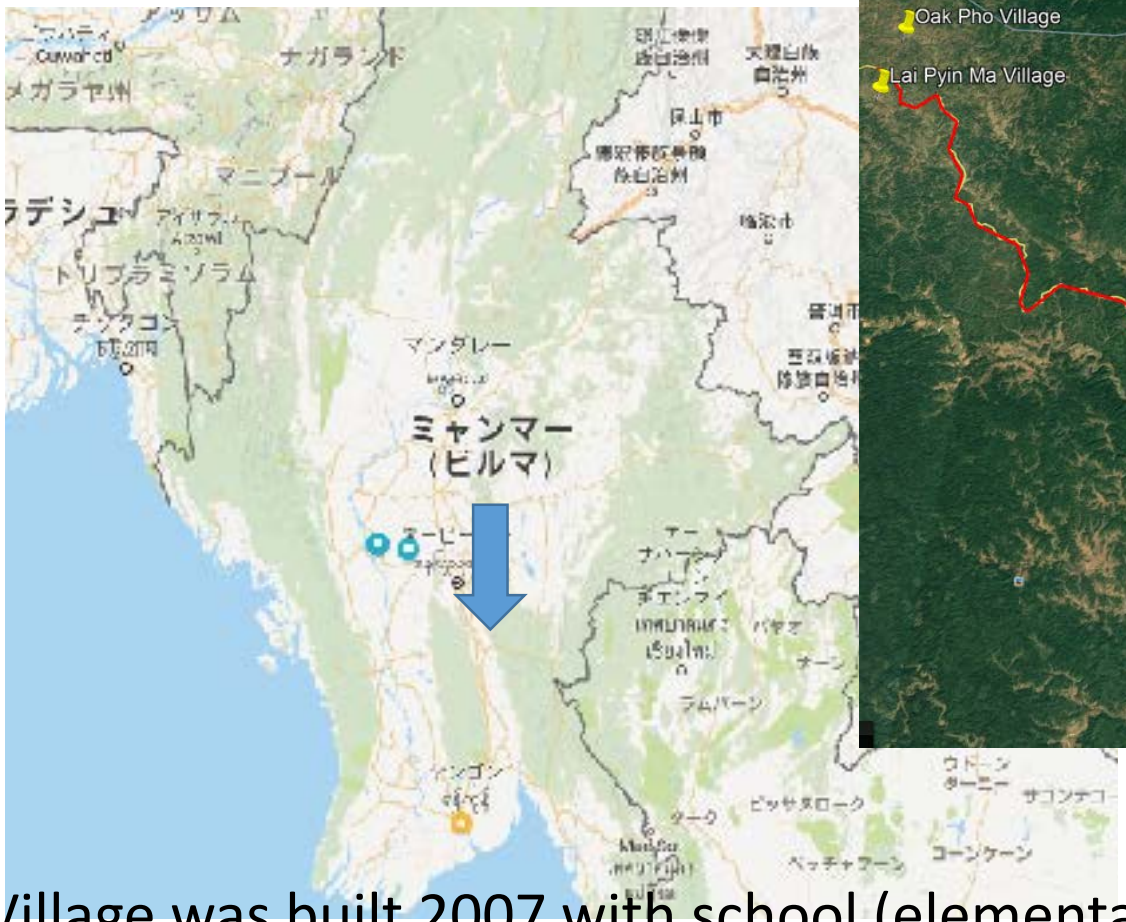
   positive : Outlook, Money condition

   negative : Significance in Satisfaction level

4. Income : ~150 RM/m => ~70 RM/m
5. Complain: Too low power limit for “free of charge”

   => Too expensive

Myanmar case : Oak Pho Village mini-grid project



Interviewed 1 village, 25 villagers

- Village was built 2007 with school (elementary, branch of middle school), temple
- ~400 Houses, population ~ 2,000
- Road construction : 2012
- **Mini-grid installation : 2017.07**

Installed system

- 20 kW(solar) + 30 kW(Diesel) (Backup System)
  - 260 Wp Polycrystalline Solar Panel : 80
  - MPPT Charge Controller : 4
  - Pure Sine Wave Inverter 6 kW : 6
  - Generator (30 KVA 415 V 3P4W 50 Hz : 1
  - Deep Cycle Lead Acid Battery, 48V 2000AH : 1
- Main distribution line
- Installed 2017, 07
- Budget : about 200k USD, 60% government, 20% community, 20% company (Talent and Technology Co., Ltd)

Installed system cont.

- 10W Street light, 220VAC 50Hz : 18
- Service wire For Water Pump, school, monetary : 4
- Smart card type single phase prepaid meter, 220V, 50Hz, 1(6)A
  - Power limit
  - 1100 Watt : 10 + 158, 2200 Watt : 10, 3300 Watt : 4, 4400 Watt : 2, 6600 Watt : 2
- **Installed 120 HHs (not all houses)**
- **Price : 500 (0.37 USD) MMK/kWh**

20 kW Solar Plant

Power House

30 kW Diesel Generator

Controller, Inverter, Battery

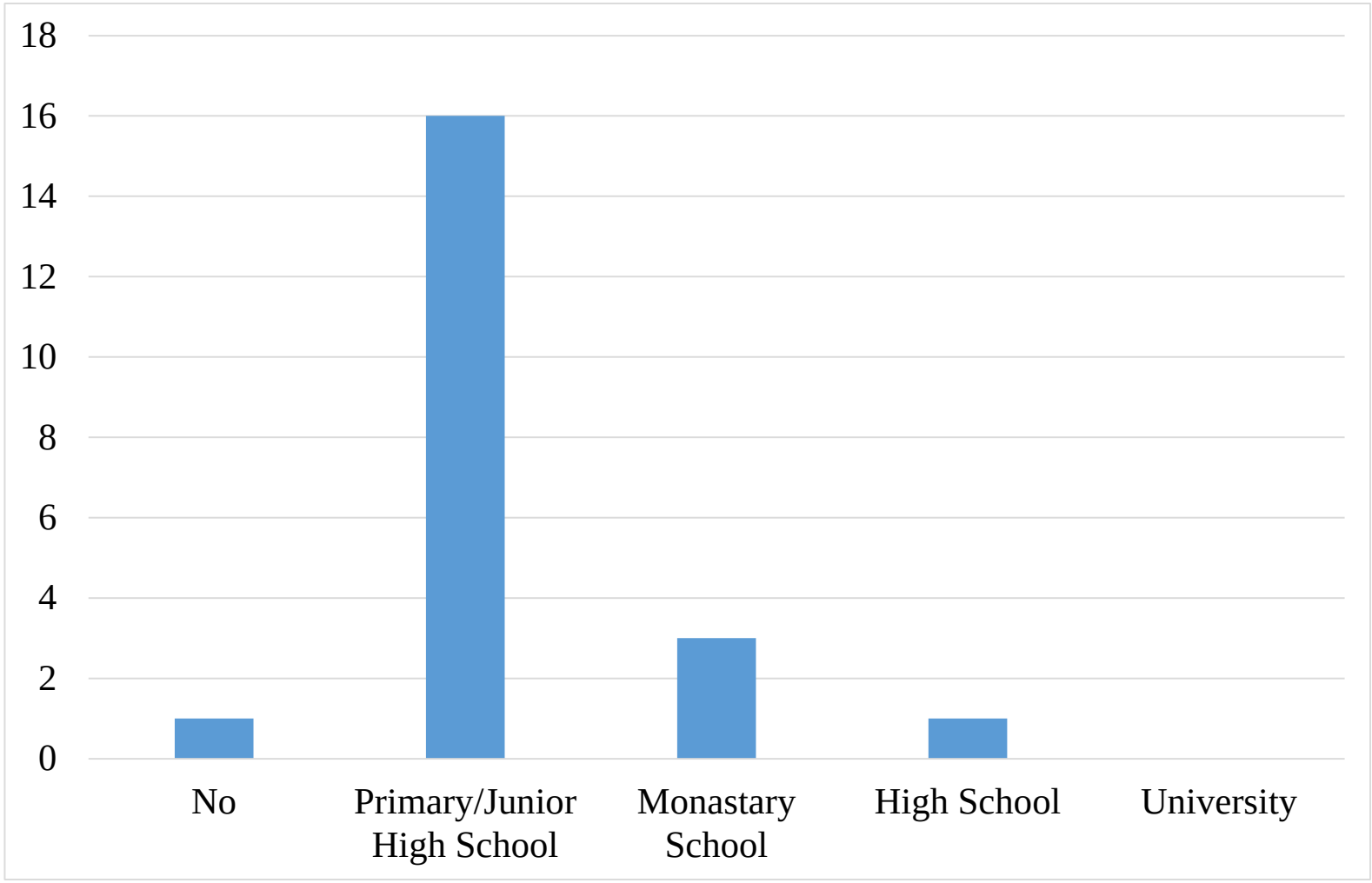
Distribution Line

Prepaid Meter,
Switch CB

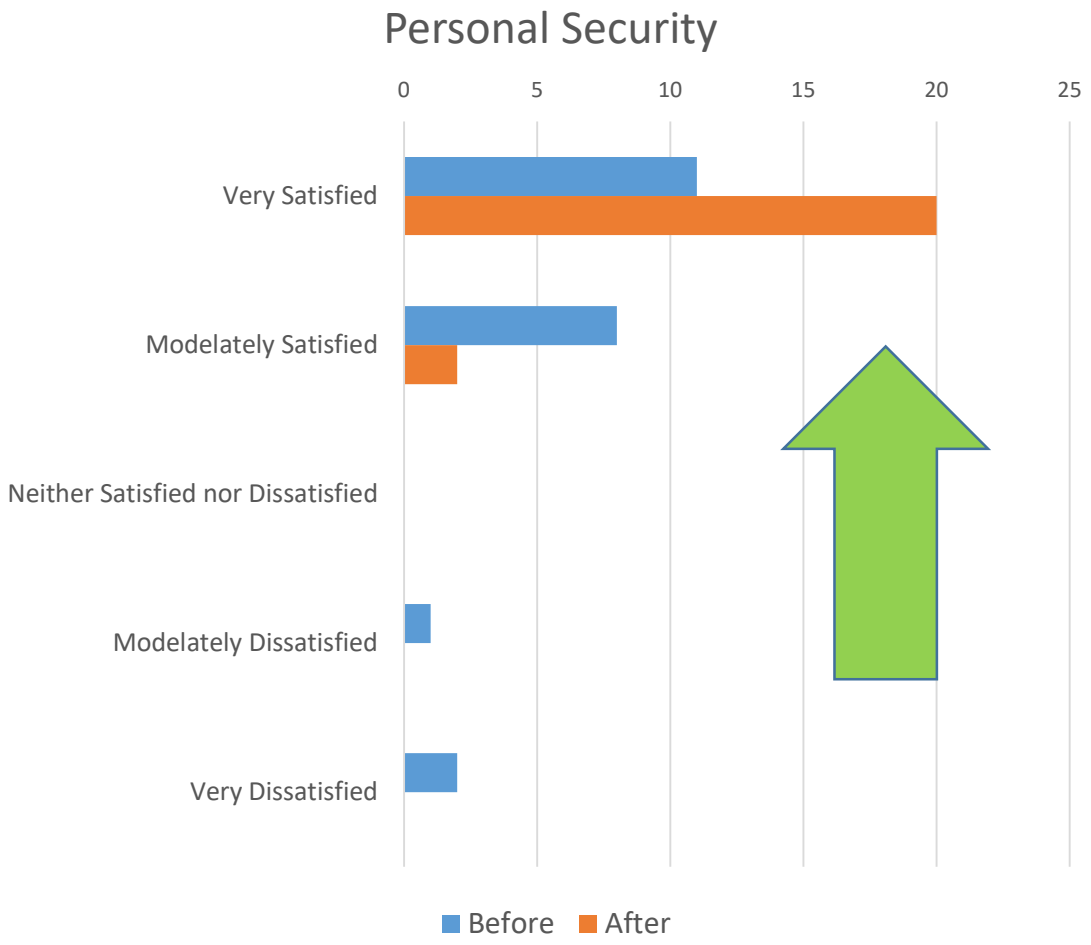
Interview sessions in Oak Pho

- 2017/11/12: 18 households (include 3 without mini-grid)
- 2018/10/20: 35 households (include 5 without mini-grid)
  - 2018 without mini-grid data is used as “Before” installation
- Age from 24 to 76, male/female ~50/50
- >90% low level education

Education level

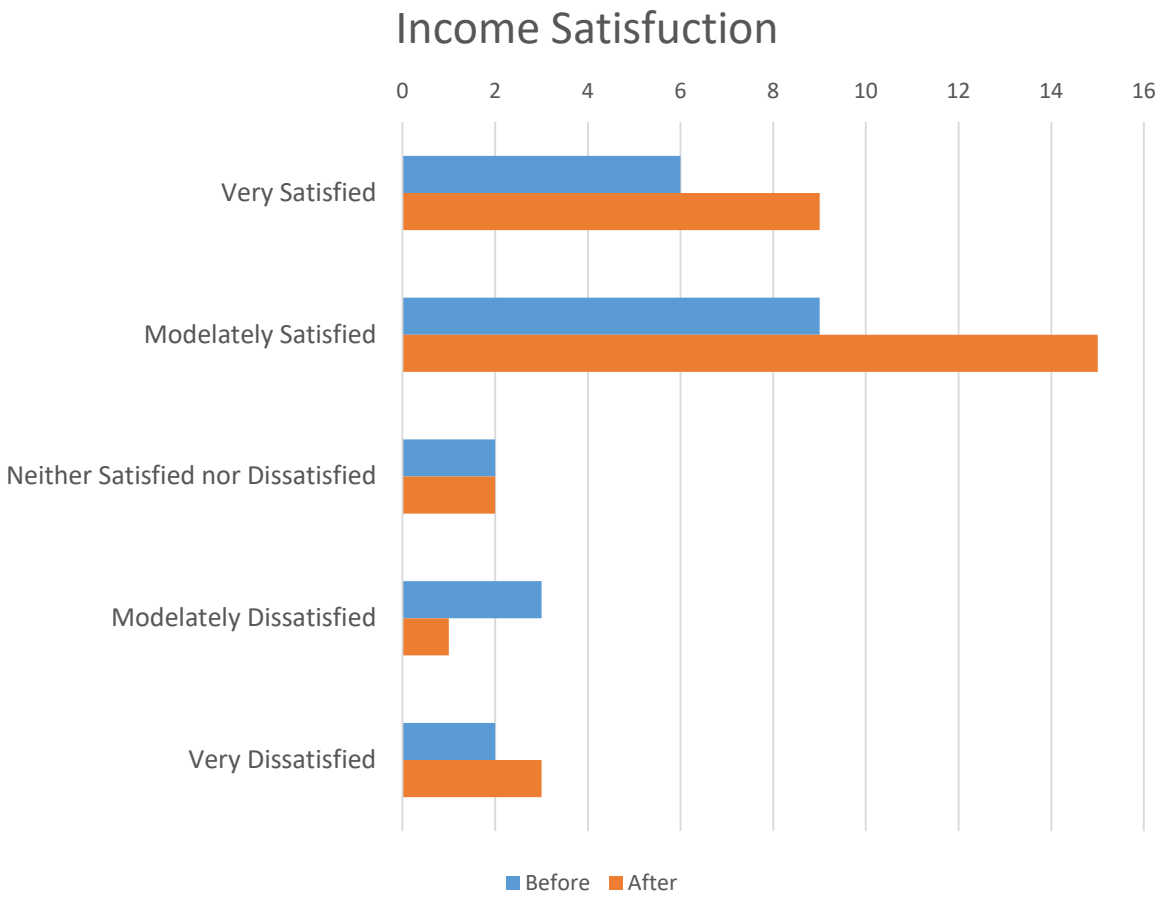


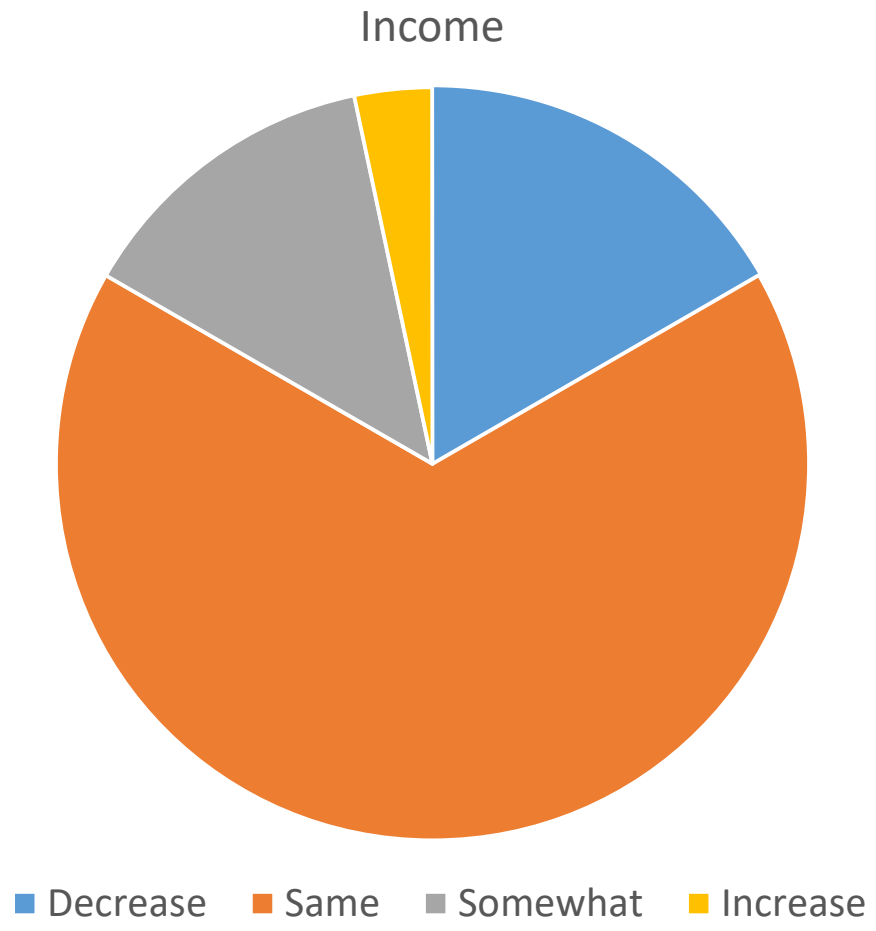
Satisfaction level, Oak Pho



- all villagers are satisfied with their lives and very happy with the mini-grid system (even out from the service)

Income





- Positive 16%、Negative 17%
- Monthly income (average): 58,000 => 115,000 Kyat (37 =>73 USD)
- Electricity charge: 4 USD/m (av.)

Oak Pho Results

Positive effect

- Satisfaction level, Psychological well-being,

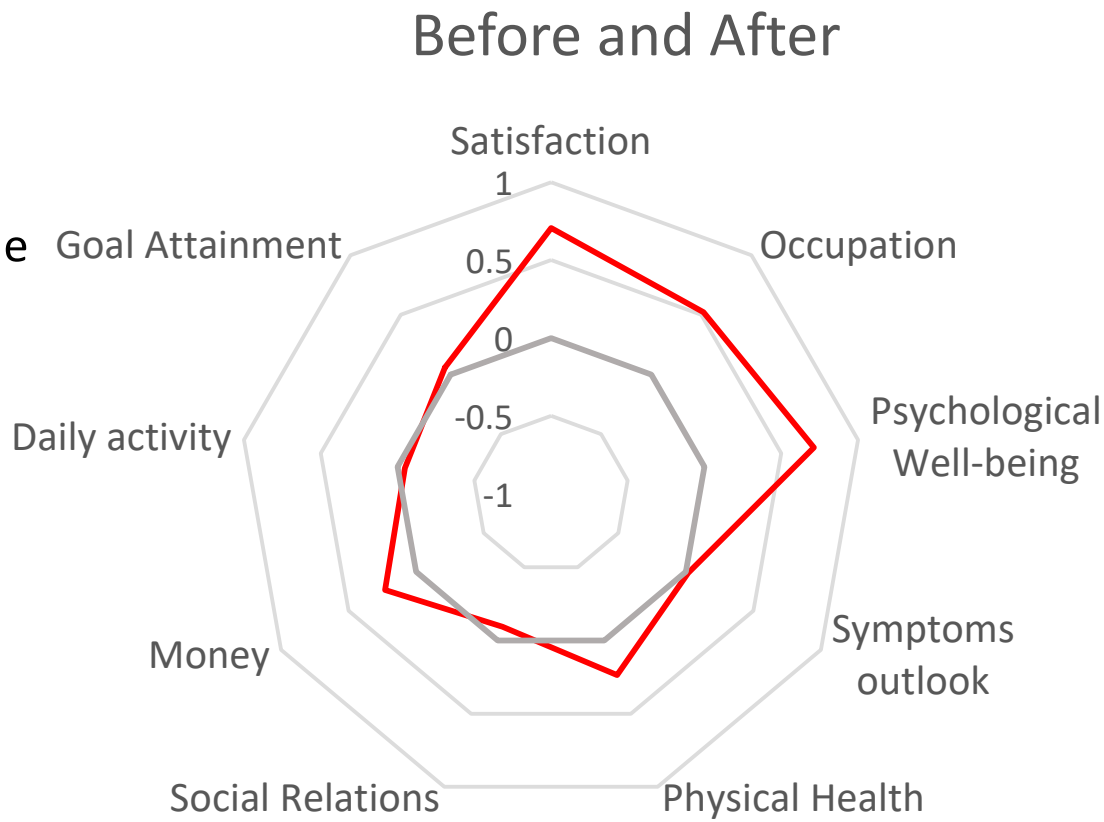
Income

- Although, their average income become almost double (73 USD/m), they do not feel so.
- Due to an expensive electricity charge, they only purchase 4 USD/m (15 kwh + free of charge base ??).

Negative effect

- So far, no significant negative effects

The installation has just been finished…



Summary

- The mini-grid system gives positive effect in General Satisfaction level and Income condition, especially Personal security.
- However, the price of electricity is very high, most of villagers use only few hours in a day.
  - Rich houses can use more power and get more income.
  - Most of them earn to use more power, but have no plan for business use.
- Since the system includes street light installation, even villagers without grid connection feel very happy with the system.

Background Information

Prey Thom, Reaksmey Samaki Commune, Aoral, Kampong Speu Province, Cambodia

- Village consisted of 6 block, total around 435 families with 2,097 of population (> 1,118 females).
- All those Households got solar lanterns around 2014 (~3 years past)
- Donor : Panasonic CSR
- Local collaborative organization : Life With Dignity (LWD)
  - Maintain and instruction

Installed solar lantern system in Prey Thom

Item	Specifications
PV Panel	50 W (?)
Solar Lantern	?W LED
Battery	????
USB outlet	2 ports
	2(or 3) solar lantern system installed per house

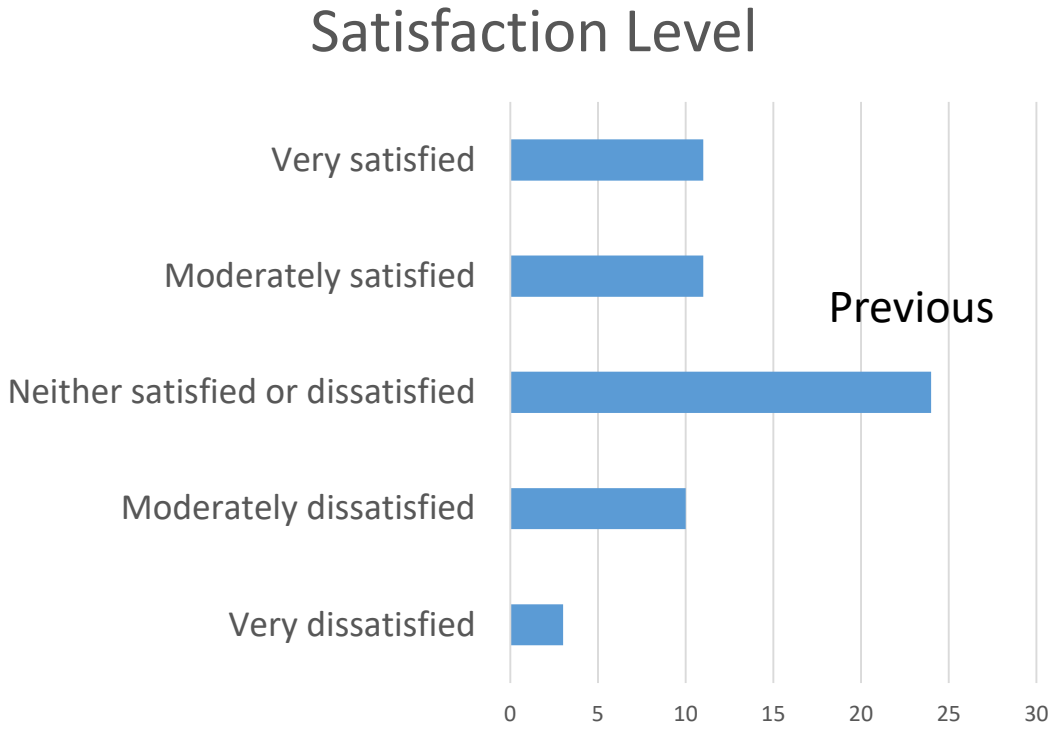
- Some photos

Some villagers installed additional PV panel(s)

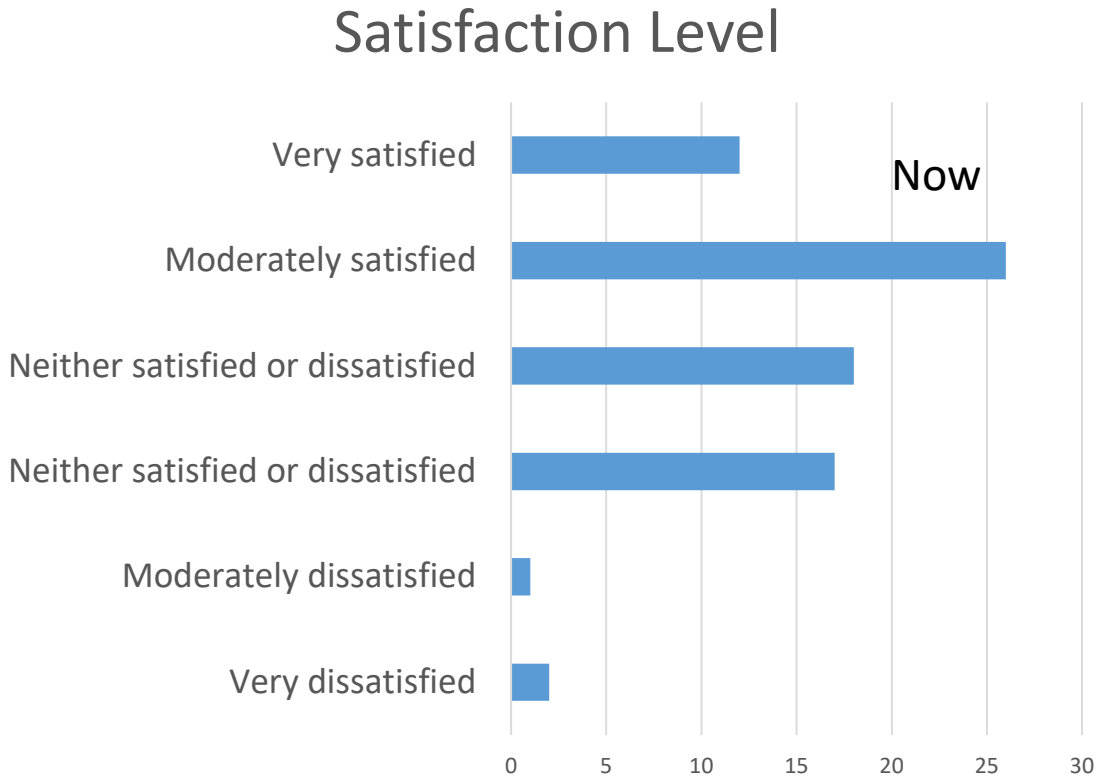
Result (background information)

- 59 villagers (families)
- Age : 20-40: 25, >40: 34, male: 11, female: 48
- Education: None: 25, Primary: 32, junior or hi-school :2
- Occupation: Farming: 34, Paid work: 4, Housewife: 21

General Satisfaction Level

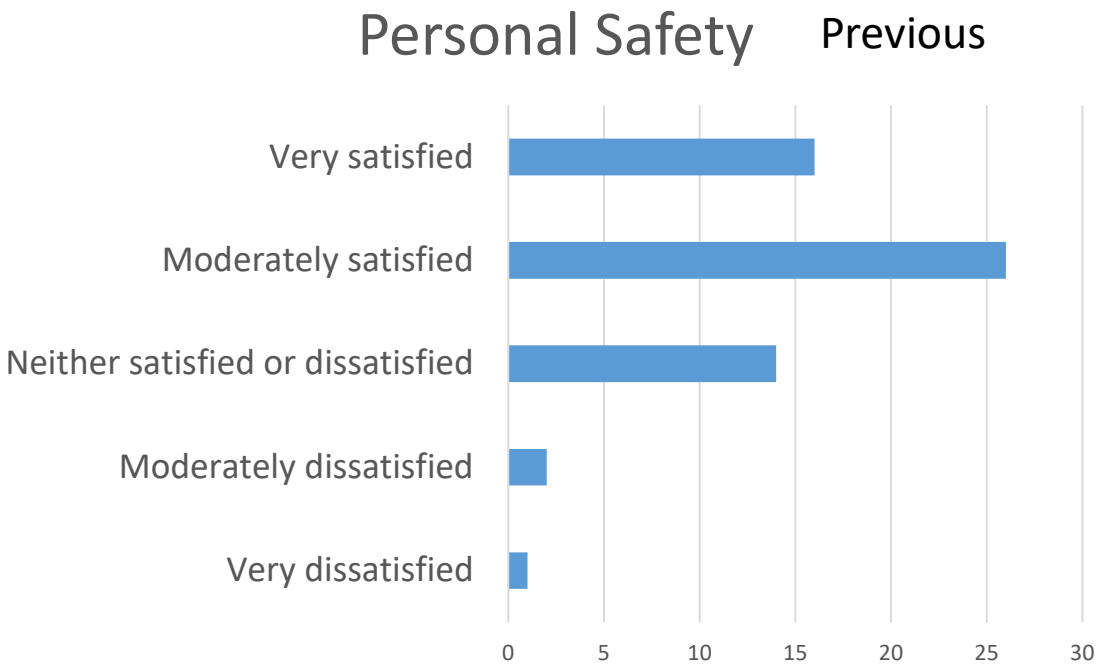


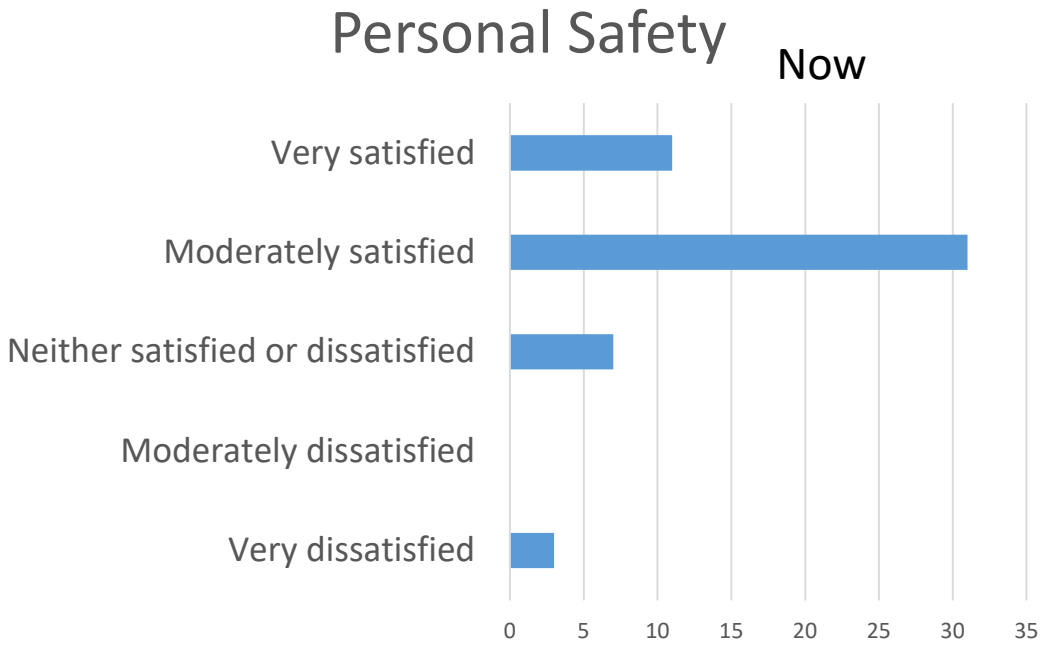
40% satisfied



54% satisfied

Personal Security

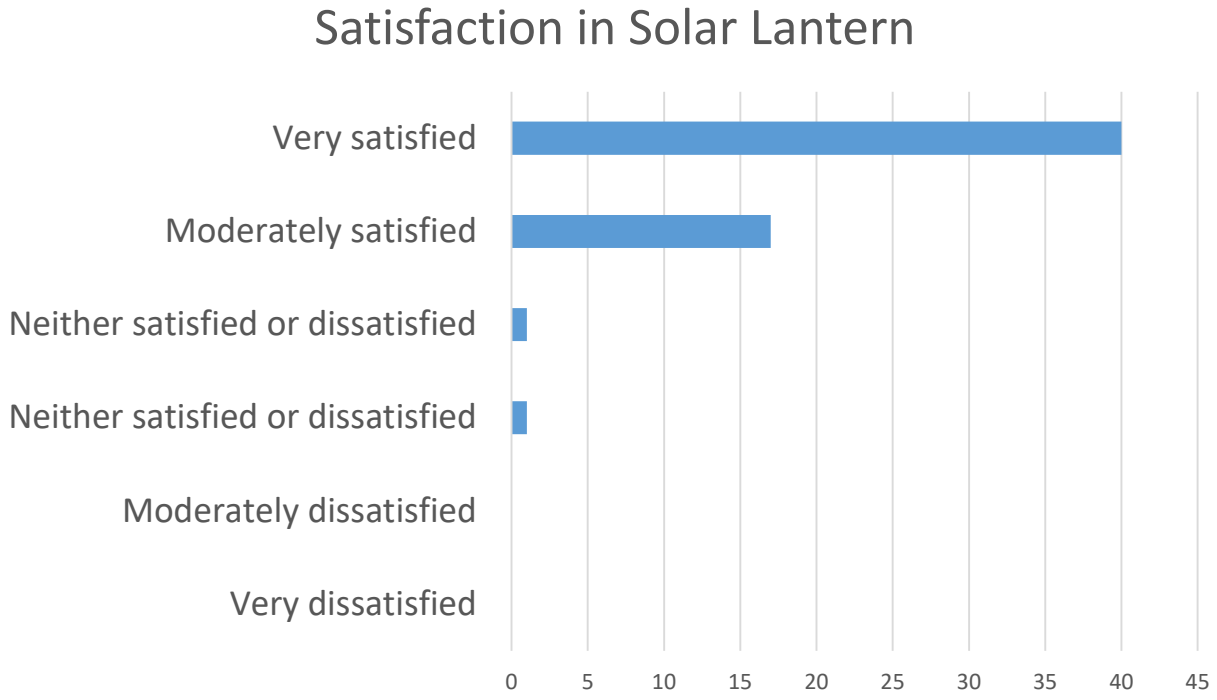


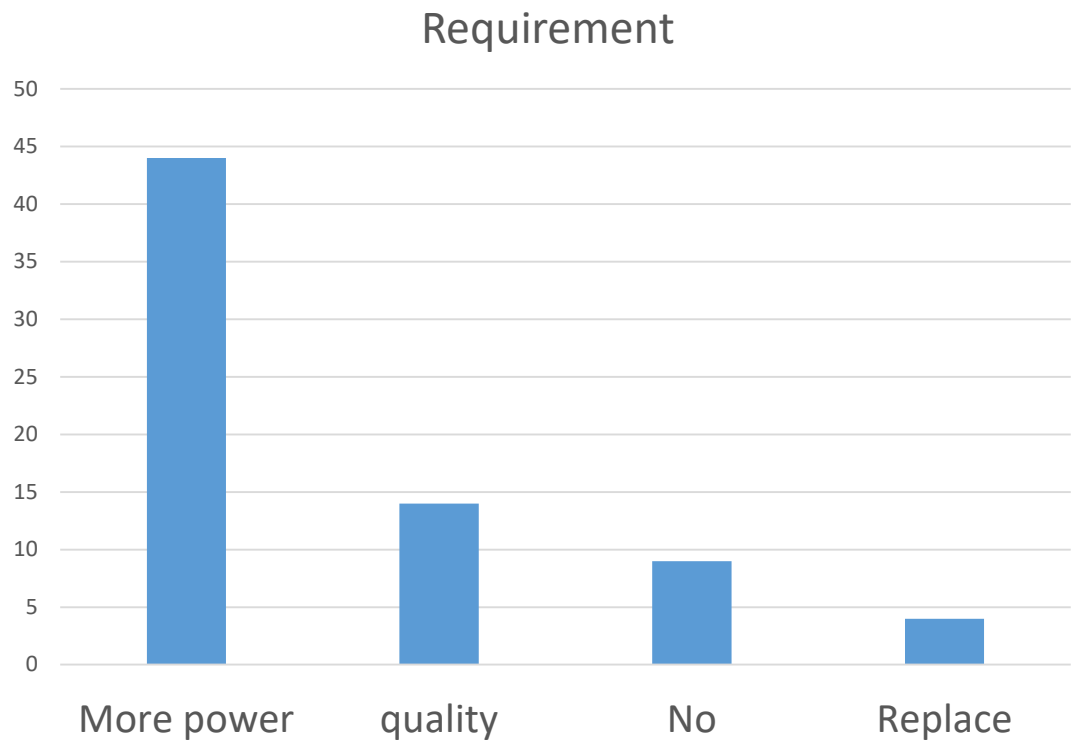


Very satisfied: decreased
Moderately satisfied: increased

71% satisfied (seems improved)

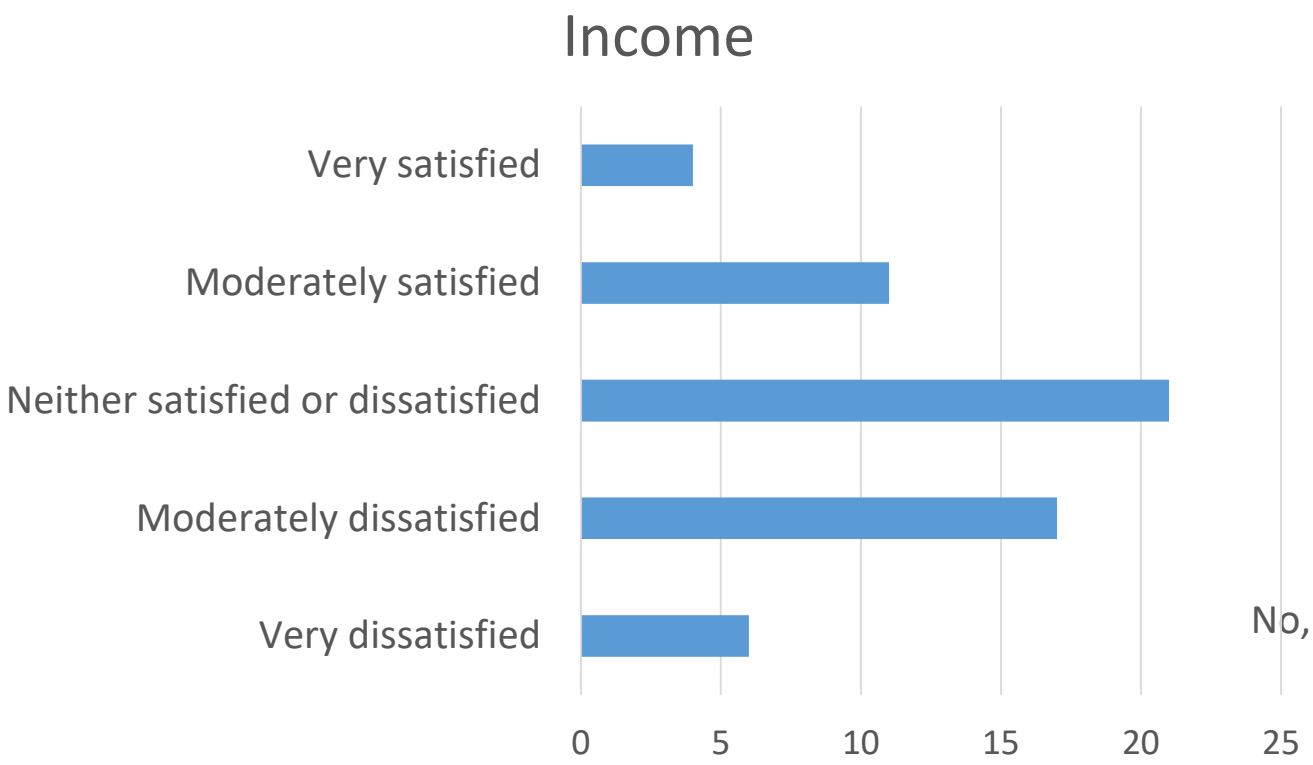
Satisfaction of solar lantern and requirement

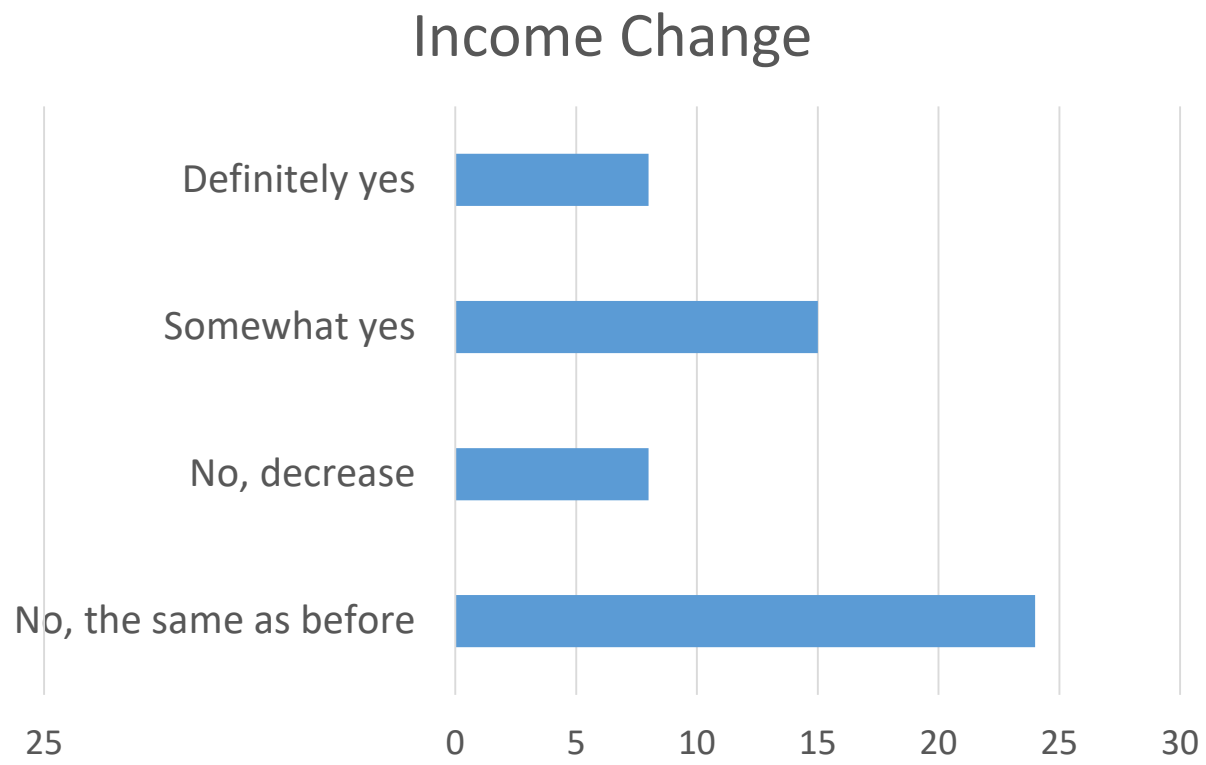




92% satisfied

Income



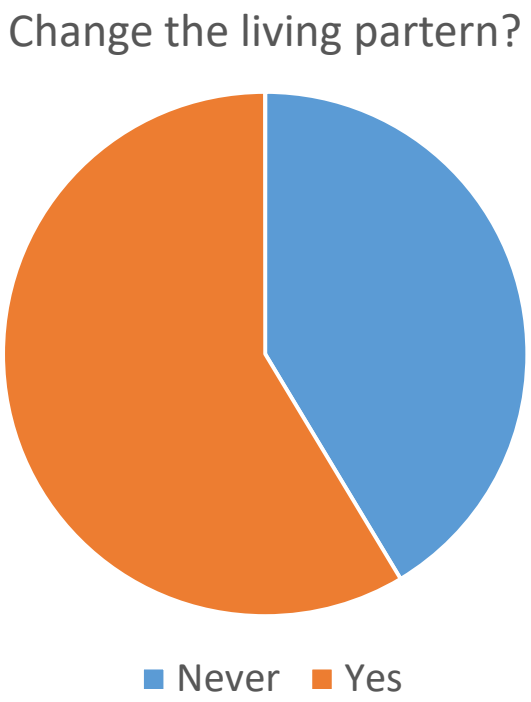


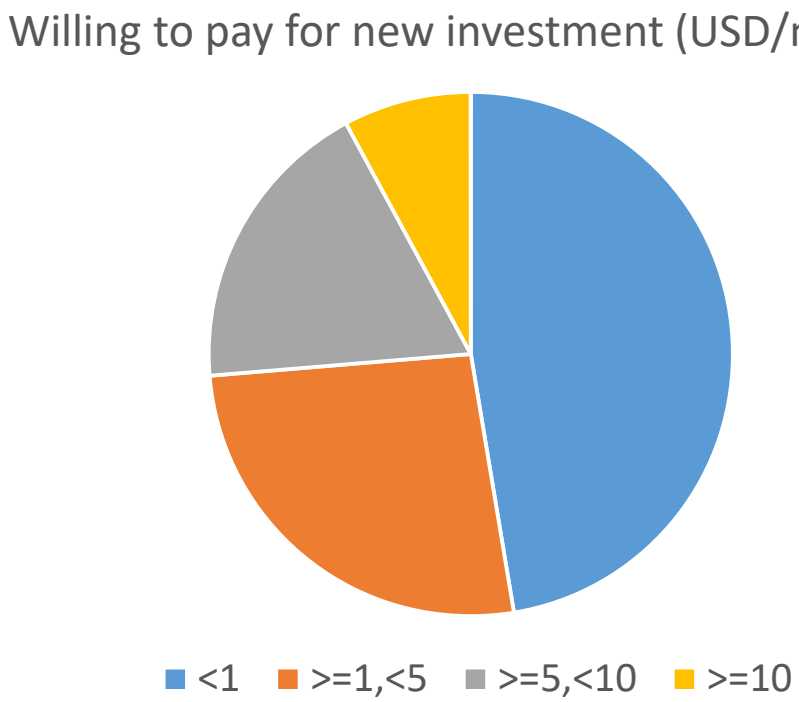
25% satisfied: very low level…

39% positive

Income Average: 81.9 USD/month

Daily Pattern and willing for investment





Not so much changed by solar lantern, because they had some kind of lights (i.e. battery charging system) .

They want more power, but no money and willing.

Interview result : solar lantern

- The general satisfaction level became improved (14% up) than before.
- The personal safety level also became better.
- Their incomes slightly increased, but still low satisfaction level
- Villagers satisfied solar lantern system and wishing to increase PV power
  - We observed several houses put additional PV panel or changed original panel to large ones.
  - A few solar lantern system have been broken.

Summary

-Solar Lantern gave a slight positive impact but most of villagers do n ot satisfied their living condition.

-SHS gives positive impact on social relations and saves fuel cost.

-mini-grid system gives positive impact significantly.

-Expensive electricity cost by a grid extension gives negative impact s on Satisfaction level and Income

We observed short term effect: SHS shows better cost performance and satisfaction…

Should observe long term impacts (education, business activity,

health condition)