MUNICIPAL ENERGY PLAN
PHIKKAL RURAL MUNICIPALITY
Sindhuli, Province Number 3

A final report submitted to:
Renewable Energy for Rural Livelihood (RERL)
Khumaltar,Lalitpur

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EXECUTIVE SUMMARY

Key words: MEP, Clean Energy, RETs.

A. GENERAL BACKGROUND

The main goal of the Municipal Energy Plan (MEP) is to create a planning process for accelerating the dissemination of clean energy technologies at municipal level, contributing to development goals at national and local level. The overall objective of the MEP of Phikkal Rural Municipality is to identify the most suitable option or a mix of options to provide clean cooking and lighting solution for a municipality to meet not only the immediate demand but also future needs attaining at least Tier 3 as defined by SEforALL and national policies of Government of Nepal.

The focus of MEPs is to expand clean energy service provision through coordination of implementation. Primary data were collected from ward level and the estimation of energy consumptions are based on primary and secondary information from Water and Energy Commission Secretariat (WECS), Alternative Energy Promotion Center (AEPC), Central Bureau of Statistics (CBS) etc. Limitations to the study include a general lack of recent disaggregated data of Phikkal Rural Municipality especially those relating to renewable energy. The entire MEP is primarily focused on residential sector energy planning and projection and limited focus on service and community sector.

B. GEOGRAPHY OF PHIKKAL RURAL MUNICIPALITY

Phikkal Rural Municipality lies in Sindhuli District of Province 3. It lies within the geographical location of 27.24°N and 86.28°E. The municipality was formed by six old Village Development Committee (VDCs) - Mahadev Dada, pokhari, Khola Gau, Khansang, Solpathana, Ratnawati. It has population of 16,968 (CBS, 2011) and covers an area of 186 Square Kilometer. In the east of Phikkal Rural Municipality lies Sunkoshi Rural Municipality, in west lies Golanjar and Tinpatan Rural Municipality, in north lies Okhaldunga district and Ramechhap district and eventually in south lies Dudhouli municipality and Udayapur district.

C. MEP PREPARATION PROCESS

The MEP 9 step planning process has been followed during the preparation process. An initial desk study was followed by secondary data collection and compilation. Primary data was collected from ward level and secondary data was collected from various relevant institutions. The MEP task force at the municipality, facilitated by AEPC/RERL was responsible for coordination at municipal level to ensure local input into the process. A planning workshop was held in Phikkal Rural Municipality to share the outcomes from the data analysis and the scenario development. The feedbacks have been incorporated into this planning document.

D. SCENARIO DEVELOPMENT

The energy model developed is based on end-use energy accounting model from bottom-up approach. Simple accounting framework, excel software and LEEP software have been used for modeling. While preparing energy model for MEP firstly we have collected data regarding availability of resources, existing technologies and devices for energy end use, number of households using different technologies, demographic status. Then data have been disaggregated through different possible ways and for five years projection input parameters have been set for cooking and lightening end use. Here four different scenarios have been developed for analysis viz; Business As Usual (BAU), Low intervention Scenario, Mid Intervention Scenario and High Intervention Scenario for five years. After planning workshop at Rural Municipality, final plan has been made based on low intervention Scenario.

E. MUNICIPAL ENERGY SITUATION

a. Energy Demand Assessment:

Energy consumption in Phikkal Rural Municipality is mainly on residential sector. The main source of energy is fuel wood, electricity, biogas, fossil fuels and some part by other renewable energy sources. Energy demand in Phikkal Rural Municipality is assumed to grow annually along with the increment in number of households and commercial enterprises.

b. Energy Resource Assessment

National grid:

Phikkal Rural Municipality is not connected to national grid but 45% of total household is connected to Pico/ Micro hydropower and others are depend up solar home system. Rural Municipality is planning to extend NEA National grid in all its wards within 5 year of time. Further study is being conducted jointly by NEA and RM for extension of NEA grid within its boundary.

Solar:

Phikkal Rural Municipality has good potentiality for solar energy; according to SWERA report, Phikkal Rural Municipality has the 5.212 kWh/m2 /day annual direct solar radiation and 4.296 kWh/m2 /day annual global solar radiations. Similarly the solar energy can be used for heating application and for water pumping also. Thus to meet the demand of electricity in community and institutional sector, solar energy will be good resources. Utility scale solar plant can be developed and can be connected to national grid.

Biomass:

The main source of energy in the Rural Municipality is fuel wood and is generally supply from forest area. The total area of forest land in Phikkal Rural Municipality is 103.46 square kilometer, including community, government owned, and lease private forests.

Biogas:

Most of the people are dependent on agricultural base and have cattle in their home and annual dung production potential of the Rural Municipality 44378.16 MT from cattle. So there is huge potential for biogas generation.

F. IMPLEMENTATION PLAN

The implementation plan for Phikkal Rural Municipality is made by using bottom up approach from ward level to municipality level and having concrete model for planning the energy plan in the coming years. The plan includes the technology option and delivery mechanism for different regions of Phikkal Rural Municipality. The implementation plan for Phikkal Rural Municipality has been mentioned below. The overall activities of MEP are categorized in eight different sectors.

- Household level lighting and use of electrical appliances
- NEA grid extension
- Household level cooking
- Community level lighting & endues
- Project inventory and Pipeline development
- Service & small industry level
- Capacity development Activities

Activities	Year Target					Total
	Y1	Y2	Y3	Y4	Y5	
Households level (Lightning& EA)						
SHS (100 W.) for HH without NEA Connection distance greater than 2000m	489	489	489	244	244	1954
Solar Mini grid	2	2	2	2	2	10
Micro Hydro Grid Upgradation						
LED Promotion (Buy One and Get One Free)	1245	1245	830	415	415	4150
Households level (Cooking)						
Biogas (no. and cubic meter)	178	178	178	178	178	889
ICS (Wood Stove /Pellet/ Briquette/Rice Husk) in no	613	613	613	613	613	3064
Community level						
ISPS in Educational Institute (no. & KW)	1	2	1			4
ISPS in Health Center (no. & kW)	1	1				2
ISPS in Ward Office						0
ISPS in other community center (no.& kW)						0
Solar Street Lamp (no.& KW)	120	120	120	120	120	600
Special energy access program for DAG	1	1	1	2	1	6
Project Inventory and Pipe line development Activities						
Feasibility study Solar PV-Irrigation and Drinking Water Projects	2	2	2			6
Pre-Feasibility of Mini/Micro Hydro		1				1
Feasibility and Detail Engineering Design for Mini Hydro			1			1
Study on Business Opportunity Assessment	1					1
Feasibility study of Institutional & Commercial Biogas Plant including Municipal Waste		1				1

Production ,Service & Industry Level						
Lift Irrigation & Drinking Water-solar			2	2	2	6
Poultry & Animal Husbandry	1	1	2	1	1	6
other MSMEs	6	6	6	6	6	30
Capacity Development Activities						
Institutional Set up of Energy Section in Municipality	1					1
Awareness program on Transformational Energy Access(Localizing local, National and SDG) and Energy Efficiency	1	2	1	1	1	6
Training on implementation of Energy projects-(MEP, Policy, Activity and program design, implementation modality, ToR and specification prep, evaluation of projects, procurements and after sales service)		1				1
Training to implementing stakeholders (Ward office, School, Health post, Tole Sudhar Samiti,FUG etc) on energy, climate change issues and management				1		1
Training on partnership/business model to companies, NGOs, CBOs, private firms, cooperatives, banks, clubs etc for Clean energy technologies/projects		1				1
Training on energy resource conservation including GESI groups	1				1	2
Training on operation, maintenance and management and after sales service of clean energy technologies				1		1
Training on database management & software of energy projects/local, provincial and federal level program)		1				1
Training on Monitoring and Quality Assurance (MQA) of energy projects					1	1

G. FINANCING REQUIREMENTS

The financial plan of Phikkal MEP has been made based on Annual budget of Municipality and Renewable energy subsidy policy with target to reach Tier 3 level of Energy supply.

Activities	Cost	% of Total Cost
Households level (Lightning& EA)	24,848,000.00	30.74
Micro hydro grid Upgradation	1,037,500.00	1.28
Households level (Cooking)	20,844,000.00	25.79
Community level Lightning	16,600,000.00	20.54
Project Inventory and Pipe line development Activities	4,000,000.00	4.95
Service & Industry Level	6,900,000.00	8.54
Capacity Development Activities	6,600,000.00	8.17
Grand Total	80,829,500.00	

The Sector wise cost of above mentioned activities is given below.

Funding Agency	Amount	Percentage
GoN Subsidy*	94,058,000.00	37.06
Municipality Support	80,829,500.00	31.85
Private Sector	60,025,000.00	23.65
Users equity	18,900,000.00	7.45
Total	253,812,500.00	100.00

H. RECOMMENDATION

- Although the BAT analysis for Phikkal shows need of SHS installation in HHs but the RM is planning for extension of NEA National Grid to all its HHs hence the tier 3 status of Phikkal Rural Municipality cannot be reached without extension of NEA and up gradation of micro- hydropower.
- The municipality has high potential of biogas hence for clean cooking energy biogas should be promoted in rural area where as in urban areas electrical cooking should be promoted.
- There is high potential for bio-pallet from forest residue hence pellet making industry should be piloted and promoted.
- A detail engineering study for mini hydro and solar farming and its grid connection is needed.
- Most of the agricultural land is not irrigated hence solar/grid pump irrigation system should be promoted.

* GoN Subsidy will be provided as per availability of budget in AEPC.

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ACRONYMS AND ABBREVIATIONS

AEPC	:	Alternative Energy Promotion Center
BAT	:	Best Available Technology
BAU	:	Business As Usual
CBOs	:	Community Based Organizations
CBS	:	Central Bureau of Statistics
CCS4ALL	:	Clean Cooking Solution for all
CDMA	:	Code Division Multiple Access
DCEP	:	District Climate and Energy Plan
DDC	:	District Development Committees
DEECCS	:	District Environment, Energy and Climate Change Sections
DWSS	:	Department of Water Supply and Sewage
EO	:	Executive Officer
FGD	:	Focused Group Discussion
FM	:	Frequency Modulation
FUG	:	Forest User Groups
GESI	:	Gender Equality and Social Inclusion
GI	:	Galvanized Iron
GIS	:	Geographic Information System
GJ	:	Giga Joule
GoN	:	Government of Nepal
GPS	:	Global Positioning System
GSI	:	Gender and Social Inclusion
GSM	:	Global System of Mobile
GTF	:	Global Tracking Framework
HHs	:	Households
ICS	:	Improved Cook stoves
ICS	:	Improved Cooking Stove
INPS	:	Integrated Nepal Power System
ISPS	:	Institutional Solar Photovoltaic System
IWM	:	Improved Water Mills
KII	:	Key Informant Interview
KVA	:	Kilo Volt Ampere
kWh	:	Kilo Watt hour
LCC	:	Life Cycle Cost
LED	:	Light Emitting Diodes
LGOA	:	Local Government Operation Act
LPG	:	Liquefied Petroleum Gas
MEP	:	Municipal Energy Plan
MJ	:	Mega Joule
MoE	:	Ministry of Energy
MoEIWR	:	Ministry of Energy, Irrigation and Water Resource
MOU	:	Memorandum of Understanding
MQA	:	Monitoring and Quality Assurance
MSMEs	:	Mini, Small and Medium Enterprises

MTF	:	Multi-Tier Framework
MW	:	Mega Watt
NEA	:	Nepal Electricity Authority
NGOs	:	Non-Government Organizations
NPC	:	National Planning Commission
NRREP	:	National Rural and Renewable Energy Programme
ODF	:	Open Defecation Free
OJTs	:	On the Job Training
PV	:	Photo Voltaic
PVPS	:	Photo Voltaic Pumping System
RCC	:	Reinforced Concrete Cement
RE	:	Renewable Energy
REDP	:	Rural Energy Development Programme
RERL	:	Renewable Energy for Rural Livelihood
RETs	:	Renewable Energy Technologies
SDGs	:	Sustainable Energy Goal
SEforALL	:	Sustainable Energy for All
SHS	:	Solar Home System
SIM	:	Subscriber Identification Module
TJ	:	Tera Joule
ToR	:	Terms of Reference
TRC	:	Total Resource Cost
TV	:	Television
UNDP	:	United Nation Development Programme
VDC	:	Village Development Committee
V-SAT	:	Very Small Aperture Terminal
WECS	:	Water and Energy Commission Secretariat

CHAPTER 1: INTRODUCTION

1.1 Background

In Nepal, firewood is the predominant energy carrier with 75% of the population using solid biomass (firewood, cattle-dung or agro-waste) as primary fuel (CCS4ALL, 2016). The use of traditional fuel wood is inefficient (10% efficiency), unsustainable and possesses a threat to environment leading in massive forest degradation. The government of Nepal is promoting grid and off-grid energy sources to meet the energy demands. The grid energy has problems of long lines and hence there is a challenge in maintaining the quality of electricity supplied. Whereas the off-grid energy mainly prefers on distributed generation following the worldwide trend of "produce where consumed". This trend has led almost 18% of rural people still lack of electricity access (GTF, 2017) and even those with access have quality and reliability issues. Moreover, only 26% people have access to clean cooking and technologies for cooking (GTF, 2017). Accelerating energy access in non-electrified regions requires strategic planning that would take into account geographical location, infrastructural and socio-economic conditions and best available technology for rural electrification to meet their current demand as well as future needs.

At recent times, there is an increasing awareness that access to modern energy services is fundamental to sustainable development. The realization underpins the formulation of Sustainable Development Goal (SDG); which calls for achieving universal access to reliable, affordable and modern energy services by 2030 including Sustainable Energy for All (SEforALL) initiative. **Sustainable Energy for All (SEforALL) is an International Organization working with leaders in government, the private sector and civil society to drive further, faster action toward achievement of Sustainable Development Goal 7, which calls for universal access to sustainable energy by 2030, and the Paris Climate Agreement, which calls for reducing greenhouse gas emissions to limit climate warming to below 2 degrees Celsius.** Nepal has also joined other members of United Nations in adopting Sustainable Development Goals (SDGs), also referred as Agenda 2030. The Government of Nepal (GoN) has established an institutional framework and reinforced its commitment towards attaining SDGs by integrating it into 14th Periodic Plan. Also, National Planning Commission has set national targets for each of the 17 SDGs including SDG 7. National Planning commission Of Nepal has developed status and roadmap: 2016-2030 to achieve SDG targets. As per it, NPC has set targets in time line of 2019, 2022, 2025 and 2030 keeping 2015 as base year.

Table 1: SDG 7- Ensure access to affordable, reliable, sustainable and modern energy for all

Targets and indicators	2015	2019	2022	2025	2030
Target 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services					
7.1.1 Proportion of population with access to electricity	74	80.7	85.7	90.7	99
7.1.2 Proportion of population with primary reliance on clean fuels and technology					
1 Households using solid fuel as primary source of energy for cooking (%)	74.7	65	55	45	30
2 People using liquid petroleum gas (LPG) for cooking and heating	18	23.6	27.8	32	39
3 Electricity consumption (KWh per capita)	80	230	542	1077	1500
Target 7.2 By 2030, Increase substantially the share of renewable energy in the global energy mix					
7.2.1 Renewable energy share in the total final energy consumption	11.9	22.1	29.7	37.3	50
7.2.1.1 Installed capacity of hydropower (MW)	782	2301	5417	10260	15000
Target 7.3 By 2030, double the global rate of improvement in energy efficiency					
7.3.1.3 Higher efficiency appliances (in residential & Commercial)(%)	10	15	30	40	60
7.3.1.4 Electric vehicles in public transport systems (%)	1	5	20	35	50

Source: Nepal: Sustainable Development Goals, Status and Roadmap 2016:2030, NPC (2018)

Moreover, GoN accords high priority for the promotion of Renewable Energy Technologies (RETs) in its periodic development plans as access to, and use of, RE is a national priority. In its Rural Energy Policy, the GoN envisages decentralized development of renewable energy for rural electrification and improvement of livelihood. The current constitution has kept "Renewable Energy" with high priority.

In this context, it is found essential to institutionalize and create a sense of ownership among the locals for the promotion of clean energy technologies at local level- household, community and production sectors. As per the current situation in which governance structure of Nepal is evolving, the local government authorities are preparing annual and five yearly plans. The annual plans support the local authorities to address important issues while utilizing the locally available resources for social and economic enhancement of local people. Likewise, the annual plan helps local government to identify bottleneck of development and distribute local resources equally by keeping in mind the goals and targets set by provincial and central government with regards to different national and global agenda. Furthermore, the Local Governance Operation Act (LGOA), 2074 has clearly provided mandates to promote renewable energy relate policies, technologies and other functions related to small hydro projects. The concept of Municipal Energy Plan came up to facilitate the local authorities to include energy related programs in their annual and periodic plans.

1.2 Rationale

MEP is a key document that shows how the municipalities will address energy development at municipal level whilst acknowledging government vision for universal access to clean, affordable and reliable energy, climate change impacts and incorporating gender equality and social inclusion based on Low Cost Option and Best Available Technology analysis. It has provided an inventory of municipal energy resources to identify the most appropriate actions, opportunities and intervention techniques to access the Clean Energy Technologies.

1.3 Municipal Energy Plan

Earlier, District development committee : Energy environment and climate change section was responsible for all energy development related activities in the district and provided technical and financial assistance to rural communities to plan and implement renewable energy projects with support from Alternative Energy Promotion Center(AEPC) and its programmes. However, The Nepal Electricity Authority (NEA) was responsible for the national electricity grid Integrated Nepal Power System (INPS). The procedures in practice for system expansion particularly the distribution network followed by NEA is influenced by different factors, making grid extension unpredictable and continuously creates uncertainty amongst both old and proposed distributed generation systems; repercussion of ambiguities often results on duplication of activities and wastage of resources while a large area still do not have access to electricity. After the promulgation of constitution of Nepal in 2016, the development and implementation of energy projects including management of distribution system of NEA grid came under the responsibility of Municipality.

To address this issue, with support from AEPC/RERL, Municipality has taken an initiative to prepare Municipal Energy Plan (MEP) based on grid and off-grid solutions followed by criteria for Best Available Technology (BAT) to provide policy makers and planners from public, private and development sectors to assess and compare the level of energy access at the Ward level. The specific task focuses on consideration of ward level geographical, infrastructural and socio-economic conditions by developing a Geographic Information Systems (GIS) based methodology to develop planning system including BAT. It is expected that the methodology developed will help to identify a technology or an optimal mix of different options, ranging from individual solar home system (SHS), community level mini grids to grid extension in a particular area. These activities are expected to improve planning accuracy and reduce the wastage of time and resources. The MEP will come in use after it will be endorsed by municipal board and will be the basis on which the energy related activities will be incorporated in annual and periodic plans.

1.4 Objective of MEP

The main objective of the Municipal Energy Plan (MEP) is to identify the most suitable option or a mix of options to provide clean cooking and lighting solution to meet not only the immediate demand but also future needs attaining at least Tier 3 as defined by SEforALL and national policies of Government of Nepal.
The specific objectives of Municipal Energy Plan (MEP) are as follows

- Socio economic development of local level through promotion of clean energy
- Accessibility of clean and reliable cooking and lighting energy solutions in Phikkal Rural Municipality to ensure all the households have energy access of at least Tier 3

- Promote and develop community/institutional/commercial renewable energy projects such as Mini/Micro Hydro, PVPS, ISPS, Solar wind hybrid, Solar Mini-grid, Large biogas and waste to energy, Solar street lamp etc. at local level
- Economic development of local level through promotion of clean energy based MSMEs
- Develop a baseline to allocate adequate amount of budget with timeline for promotion and development of RETs

1.5 Scope of MEP

This MEP report maps municipal energy resources, providing a suitable basis for making decisions on most appropriate actions and interventions necessary for accessing clean energy technologies. The focus of MEP is to expand coordination among stakeholders for provision of clean energy services to all, contributing to climate change mitigation and adaptation.
Some of the specific scopes of the MEP are:

- Access and analyze energy supply and consumption patterns in the municipality supported by data disaggregated by gender and caste/ethnicity
- Identify potential of clean energy sources and associated technologies based on climatic, geographical, and socio-economic variations
- Identify current and potential stakeholders in the clean energy and interconnected sectors and analyze their capacity in terms of ability to implement MEP
- Prepare integrated clean energy development and management plan including divisions of responsibility and specific activities of stakeholders
- Provide tentative financial requirements for identified/proposed plan and suggest ways of finance (grant/ credit), funding mechanisms
- Provide a monitoring and evaluation plan for the implementation of MEP including effectiveness of MEP.

1.6 Limitations of the Study

MEP is the first dynamic document in sector of municipal energy planning. Some of the limitations of this report are

- Household level survey has not been considered. Data collected from Key Informant Interview (KII) at ward level is considered.
- Data from CBS (2011) for household and population is used because of unavailability of recent baseline data.
- Large scale industries and transportation sector is not included in MEP
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2.3 Overview of Phikkal Rural Municipality

2.3.1 Phikkal Rural Municipality

Phikkal Rural Municipality lies in Sindhuli District of Province 3. It lies within the geographical location of 27.24°N and 86.28°E. The municipality was formed by six old Village Development Committee (VDCs) - Mahadev Dada, Pokhari, Khola Gau, Khansang, Solpathana, Ratnawati. It has population of 16,968 (CBS, 2011) and covers an area of 186 Square Kilometer. In the east of Phikkal Rural Municipality lies Sunkoshi Rural

Municipality, in west lies Golanjar and Tinpatan Rural Municipality, in north lies Okhaldunga district and Ramechhap district and eventually in south lies Dudhouli municipality and Udayapur district.

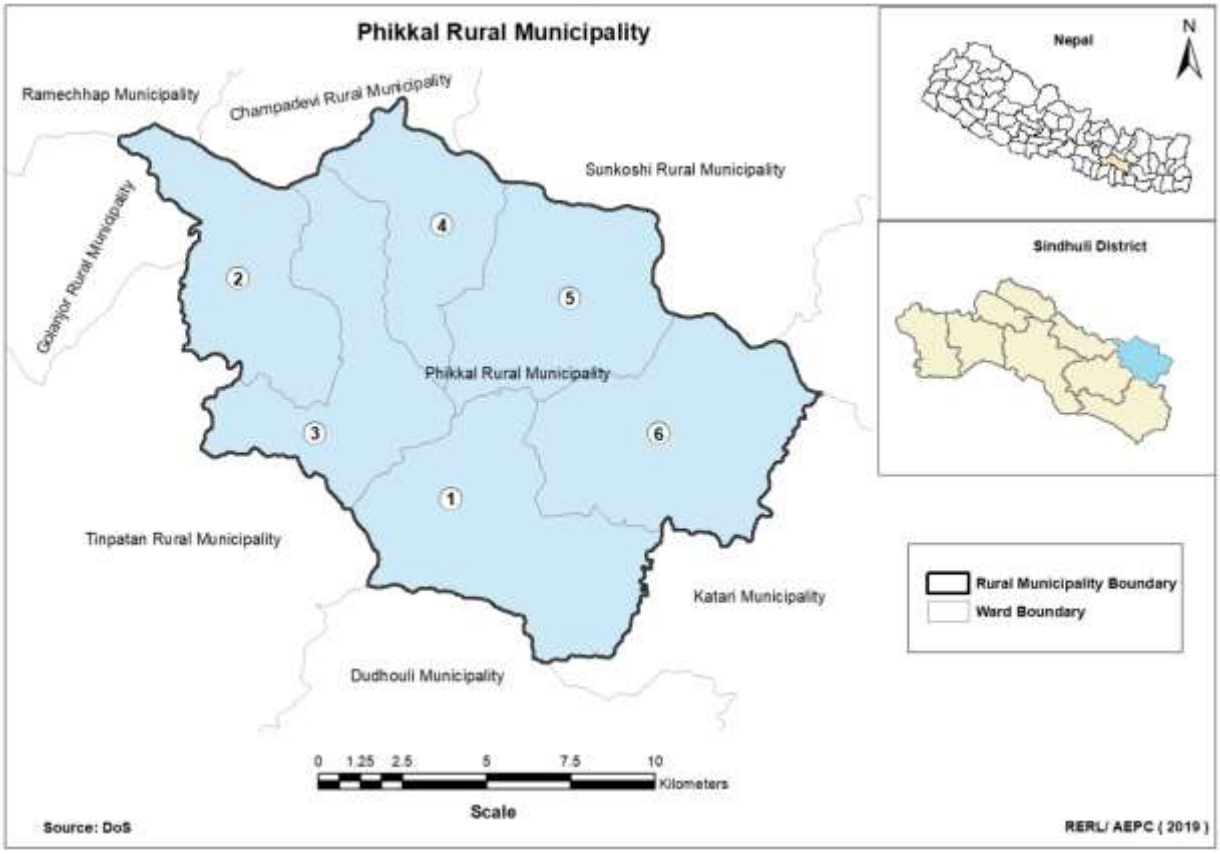

Figure 1: Map of Phikkal Rural Municipality

2.3.2 Land use

The land-use of Phikkal Rural Municipality is dominated by forest area covering 56% followed by agricultural land (31%) out of which only 6% is irrigated while 94% is yet to be irrigated. Only land near the river is irrigated through canal irrigation. This is followed by Pasture land (4%) and Barren land (6%) (Table 2).The pasture land consists of 4% which usually used for grazing the livestock while 6% of the total area is covered by barren land where there is no settlement or agricultural production.

Major River of Phikkal Rural Municipality is Sunkoshi. Waksu khola, Sakhar khola, Jau khola, Sau khola, are the major rivulets for irrigation purpose and hydropower generation. There are 12 water springs emerging from forest which are beneficial from drinking water purpose.

Table 2: Land-use of Phikkal Rural Municipality

Wards	Area (Sq. Km)	Forest	Agricultural			Barren	Residential	Pasture
			Irrigated	Non Irrigated	Total			
1	40	21.60	1.52	13.68	14.88	2.00	1.12	0.40
2	26	14.92	0.42	7.98	8.40	1.12	0.54	1.02
3	29	18.84	0.41	7.85	8.26	0.73	0.65	0.53
4	23	11.50	0.32	6.10	6.59	2.76	1.00	1.15
5	31	18.60	0.37	6.99	7.56	1.55	0.79	2.50
6	35	18.00	0.59	11.13	11.88	2.00	0.82	2.30
Total	**184**	**103.46**	**3.63**	**53.73**	**57.57**	**10.16**	**4.92**	**7.9**

2.3.3 Population

Based on field survey, the total households in Rural Municipality is 4,150 and population is 23,370 (Males 47% and Females 53%). The population density (Map in Annex) of area is 127 per sq. km; maximum population is laying in the wards 1, 2, and 3. The total number of households in each ward is given in figure 3.

During field survey it was found that 95% people are literate with 97% male and 93% female literate population. This was analyzed assessing the capacity of people to understand different level of promotion materials and ability to read and write.

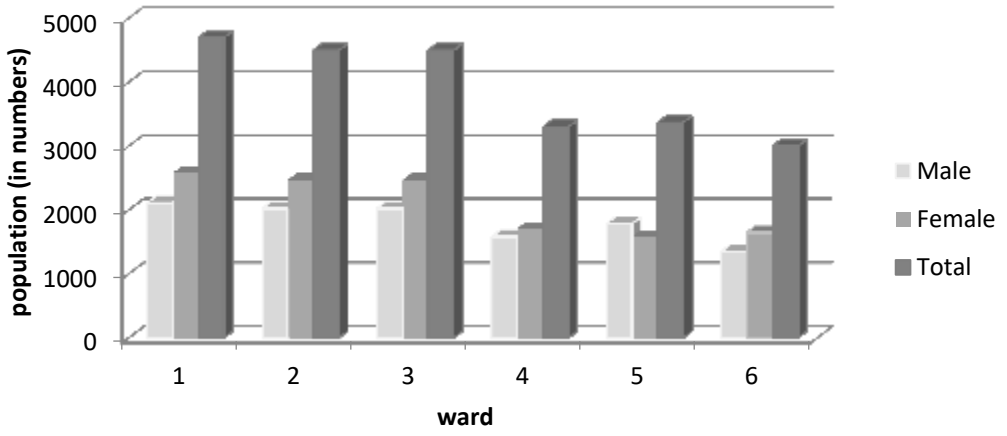

Figure 2: Population by Ward

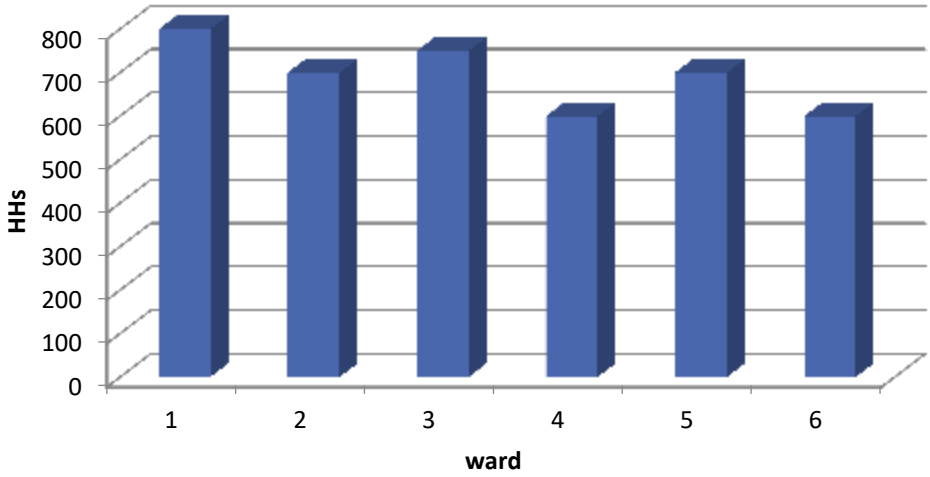

Figure 3: Number of Households by Ward

2.3.4 Infrastructures

Types of houses

During field survey, it was found that 82% of the houses are temporary houses with walls made up of stone and mud and roofed with either GI sheets or tiles While, 17% of them have permanent walls made up of brick, stone and cement; roofed with galvanized iron (GI) sheet .Remaining 1% of them are RCC building. The status of types of houses in each ward is shown in figure 4.

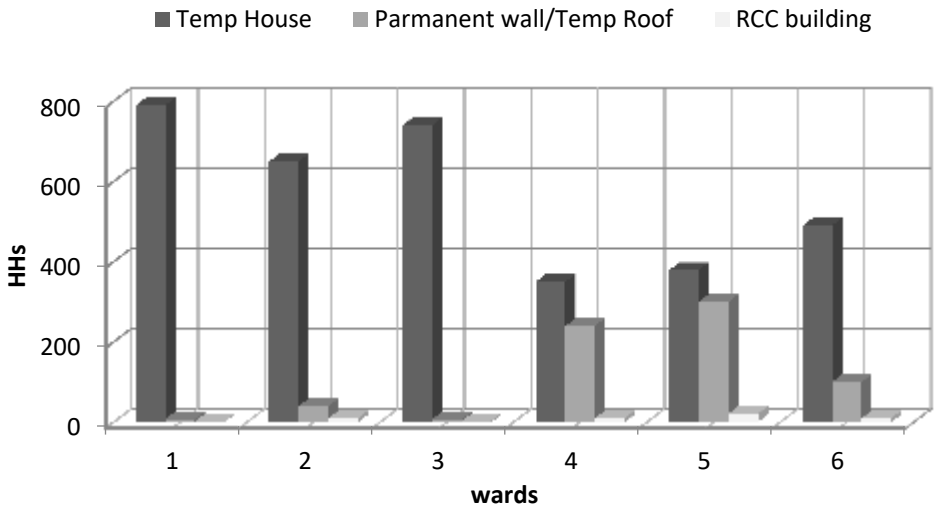

Figure 4: Types of Houses by ward

Road Network

The total road network in Phikkal Rural Municipality is 350 km including black topped (km), gravel (15.5 km) and muddy (334.5 km). Ward 2, ward 3, ward 4, ward 5 and ward 6 had black top road of 1 km, 1.75 km, 7 km, 4 km and 2 km respectively which is Mid Hill highway. Likewise, the entire roads that connect to Mid Hill highway through the wards are muddy, usually used for transportation of goods.

More than half of the people, 86% used water from community tap for drinking purpose while, only 7% of the population have access to private tap. Few of the households fetched water from mul (7%) for drinking purpose.

Phikkal Rural Municipality was declared as Open Defecation Free (ODF) in 2013 (DWSS, 2018) however 8 households of ward 1 and 20 household in ward no 2 had no access to toilet yet. Most of the houses i.e. 97% had permanent toilets with pans and 2% had temporary toilets.

Phikkal Rural Municipality need to conduct different awareness programs on waste management and this was well reflected in rural municipality as 43% of them households managed their wastes inside compound and 3% used disposal sites However, 20% and 13% of house hold still disposed their waste on public road and randomly respectively.

Institutions

Education & Heath Care

There are 42 basic schools, 12 higher secondary schools, 6 health posts (in each ward) in Phikkal Rural Municipality.

Commercial

There are 1 Commercial bank, 10 Micro financial institutes and 14 cooperative in Phikkal Rural Municipality.

Communication

Most of the ward has one or more communications options: CDMA, GSM mobile or V-SAT telephones. The Rural Municipality has easy access to various national television channels. There is internet access to government offices and NGOs located in Rural Municipality. Rural Municipality has service of few private internet service providers also. Mobile phones have also become a good source of internet recently. Most people have a mobile phone equipped with one or more SIM cards.

CHAPTER 2: METHODOLOGY

2.1 Steps of MEP

The general steps included in MEP process are:

Step 1: Identify Stakeholders- who generates, controls the sale of, sells or uses energy

- Utility- NEA and other distributed Generators
- Government: Municipality office, decision making representation from local agencies- support from local leaders, confidence in the process, increase participation, interest and quality
- Community business- large energy users
- NGOs- have knowledge and history of different sectors
- Residents- have power of the people, input on resident's reaction and support from communities
- Champion- Energy Leader

Step 2. Establish Leadership Team

- Team that can make decisions, direct the funding resources and promote the project
- Municipality office and Ward representative
- Few active advocates for transparency
- Full time/Part time coordinator
- Volunteers

Step 3. Develop Energy Vision

- Identify top priorities
- Increase and ensure reliability
- Optimization of needs and demands
- Minimize environmental impacts
- Diversify supply
- Use of local resources
- Strengthen local economic development
- Identify and Prepare local workforce- technical, operational, private companies, sellers, consultants, experts, etc.

Step 4. Develop Energy Baseline

- Team and Stakeholders involved in baseline
- Sector analysis
- Define Scope of Baseline- details
- Clearly define methodology for measuring baseline so that future measurements can be verified
- Involve and use local organization and data

Step 5. Develop Specific Goals

- Consists of an event or sequence of events
- Discussion on best ideas

- Use of skilled facilitator
- Define community driven specifics- how much of the goal will be met by solar, energy efficiency? How much from municipal sources and how many from private sector?
- A Champion may be required
- Brainstorming- freethinking apart from subsidy and other sources

Step 6. Evaluate and Rank Programs

- Develop ranking system for cost-effective programs using the baseline, vision and ideas
- All information available
- Methodology to evaluate the program is available
- Correction of measures
- Use of Total Resource Cost (TRC) and Best Available Technology (BAT)

Step 7. Funding Source

- Secure financial commitment and support
- Identify alternative funding sources- Municipality/Ward budget, grant, loan or other external sources
- Partnership sources and methods

Step 8. Compile and Finalize the Plan

- Summarize the process, consolidate the information and make it publicly available
- Endorsement from Municipal Council and use the document for policy, decision making and annual budgeting
- Present current and future program development
- Schedule reporting, progress, review and documentation
- Promote Green or Other initiatives to support the long-term acceptance of the plan

Step 9. Monitoring and Evaluation

- Monitoring and Evaluation of the implemented activities in participation of AEPC

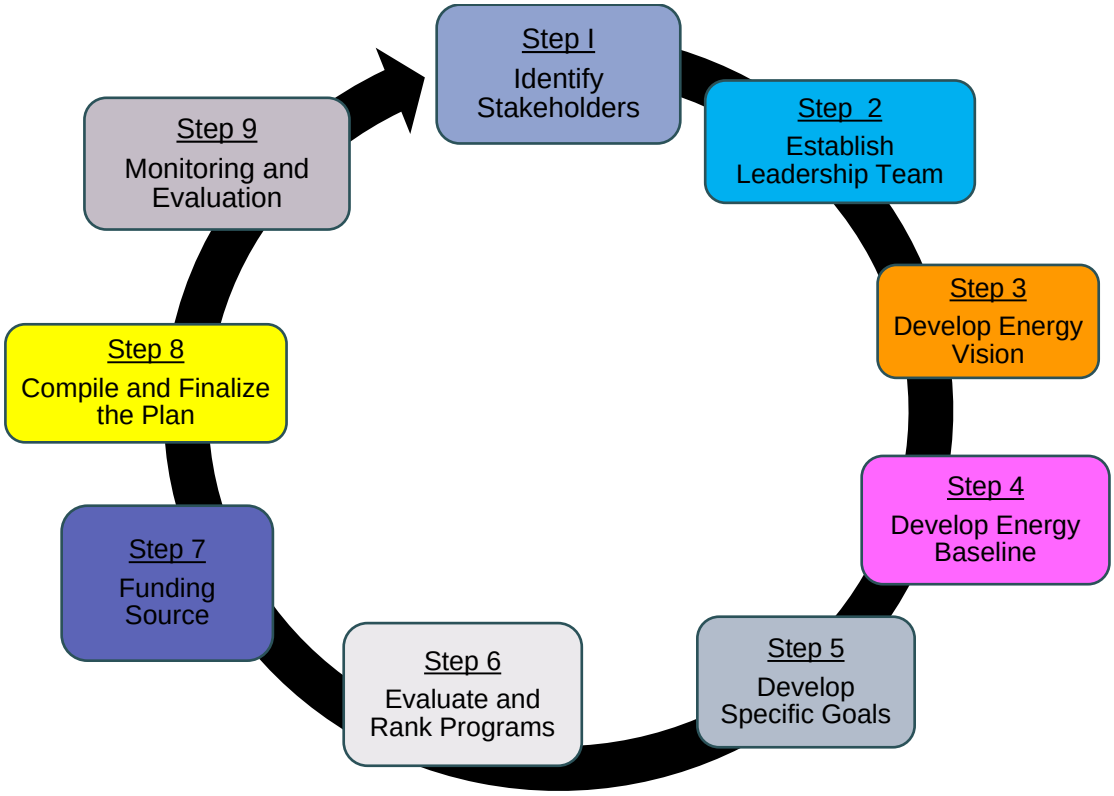

Figure 5: Steps involved in Municipal Energy Planning

2.2 MEP Flow-Chart

The Municipal Energy Planning consists of series of steps starting from desk study to endorsement of MEP from respective municipal council. Each of the steps are described shortly below:

Desk Study:
All the available data and information related to the municipality were reviewed. The relevant information was collected from NEA and from the profiles of municipalities, CBS reports, WECS, AEPC, MoE, etc. From these data, the stakeholders were identified and sample size for data was determined. After this, Rapid Assessment sheet and checklists were designed. Likewise, GIS based energy situation maps were prepared.

First Interaction:
First interaction was organized at the municipality where all the relevant stakeholders including Mayor, EO and Ward Chairs are provided orientation on MEP process; also, the GIS based maps prepared from desk study were presented. These maps and data were verified and other secondary information required was also collected during discussion. A Task Force was formed among the members of municipality which develops energy vision for the municipality. A discussion session was held to discuss on required sample size for data collection, identification of stakeholders, KIIs, rapid assessment sheet and checklists and field plan. A draft MOU was shared.

Review of Information:
Few amendments on MOU as suggested by workshop were made. The data gaps were rectified based on the secondary information collected in discussion session. And eventually, decisions were made on field plan to finalize the field visit and tools like GPS device are arranged based upon requirement.

Second Interaction:
The MOU was signed between AEPC and municipality. Enumerators were recruited and provided with orientation and trainings for data collection and use of GPS device. Relevant stakeholders including NEA were consulted.

Data Collection:
At ward level, enumerators were deployed in field. They collect geo coded data, energy use status and potential source, information on production and services, photographs from field survey through KII, FGD, institutions, etc.

Data Processing:
The data entry and data verification were completed. Different tools for data analysis and relevant model analysis was done and the municipal energy baseline draft report was prepared.

Energy Demand Calculation:
From the field visit data, municipal energy baseline assessment was done. Municipal energy demand forecast was prepared using different relevant software and GIS based mapping.

Demand Supply Analysis:
Different approaches like BAT, TRC, and LCC analysis were used for selection of technology in non-electrified area. Clean cooking technologies were selected. Based on the demand and demand forecast, municipal grid upgrade plan was devised. The solutions to meet the demand of MSMEs and community services were sought.

Specific Goal Setting and Ranking of Projects:
At municipal level, specific goals were set for wards and municipality. Based on the funding source available and after consultation with local stakeholders, projects was prioritized afterward level consultation.

Draft Report:
Ward level and municipal level draft report were prepared after demand supply analysis and energy expert consultation.

Review of Draft Report:
The draft report was shared with municipality, AEPC and line agencies for review

Final Draft Report:
The comments from different stakeholders were incorporated in the draft and a final MEP was prepared.

Endorsement of MEP from Municipal Council:
The MEP was then endorsed from rural municipal council.

Implementation, Monitoring and Evaluation:
Continuous monitoring of the report and adjustments will be made in the energy dashboard. Technical assistance as required will be provided for the implementation of ideas mentioned in the MEP.

Form, Formats and GPS:

The forms, formats and required checklists were prepared by RERL MEP team by consulting the municipal stakeholders. The checklists were field tested before finalizing. The enumerators, of Phikkal Rural Municipality and Engineers hired by RERL were trained provided with relevant training on dealing with the key informants to collect information and also in the usage of GPS device to collect the GPS coordinates of transformers, clusters, ISPS and other important indicators.

CHAPTER 3: MUNICIPAL ENERGY SITUATION

3.1 Present Energy Use Pattern

The energy use pattern of Phikkal Rural Municipality also follows the pattern of the national energy use situation. The energy use of Phikkal Rural Municipality is dominated by biomass (98.99% of total energy use) followed by LP gas (0.53%), electricity and biogas. The overall energy pattern is given in figure 6.

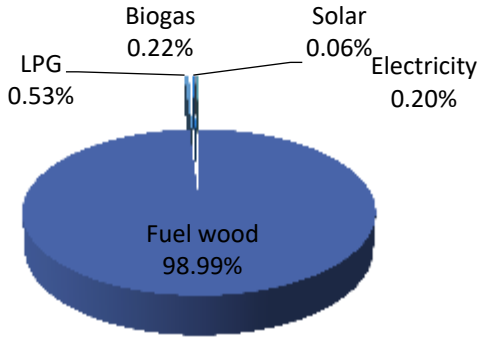

Figure 6: Present Energy Use Pattern of Phikkal Rural Municipality

3.2 Lighting

3.2.1 Electrification Status

There is no National Grid in the Rural Municipality. However, about 45% of the households have been electrified through micro/ Pico- hydropower. Rest of them is using solar home system for electricity excess, most of solar home systems, are 10-20 watt peak which were donated by government as the place of Earthquake affected area, are not sufficient enough for lighting too. The electrified household pays the bill based on per flat tariff basis to community electrification systems. Not even single household of ward no -5 has excess to grid electricity as there is a not sufficient resource to generate hydroelectricity.

Table 3: Electrification Status of Phikkal Rural Municipality

Ward	HHs	HHs connected to Pico/Micro Hydropower	HHs not connected to Pico/Micro-Hydropower	% Electrified Pico/Micro Hydropower
1	800	211	589	26%
2	700	550	150	79%
3	750	321	429	43%
4	600	400	200	67%
5	700	0	700	0%
6	600	390	210	65%
Total	**4150**	**1872**	**2278**	**47%**

Phikkal Rural Municipality is supplied electricity from 14 pico/micro – hydropower systems having capacity ranges from 2kw to 36 kw. Total Capacity of hydropower including all Pico/Micro hydropower is 158 Kw which electrified 45% of total house hold.

3.2.2 Tier Level Classification

Access to electricity is measured based on technology neutral multi-tier standards attributes. The multitier framework (MTF) is a new methodology for measuring energy access along a continuum of five different tiers, based on an evaluation of seven dimensions of service quality including affordability and reliability. MTF redefines energy access from the traditional binary count to a multi-dimensional definition as "the ability to avail energy that is adequate, available when needed, reliable, of good quality, convenient, affordable, legal, healthy and safe for all required energy services". That is, having an electricity connection does not necessarily mean having access to electricity under the new definition, which also takes into account other aspects, as for example reliability and affordability. Energy access is measured in the tiered-spectrum, from Tier 0 (no access) to Tier 5 (the highest level of access). The detail of MTF is given in figure below

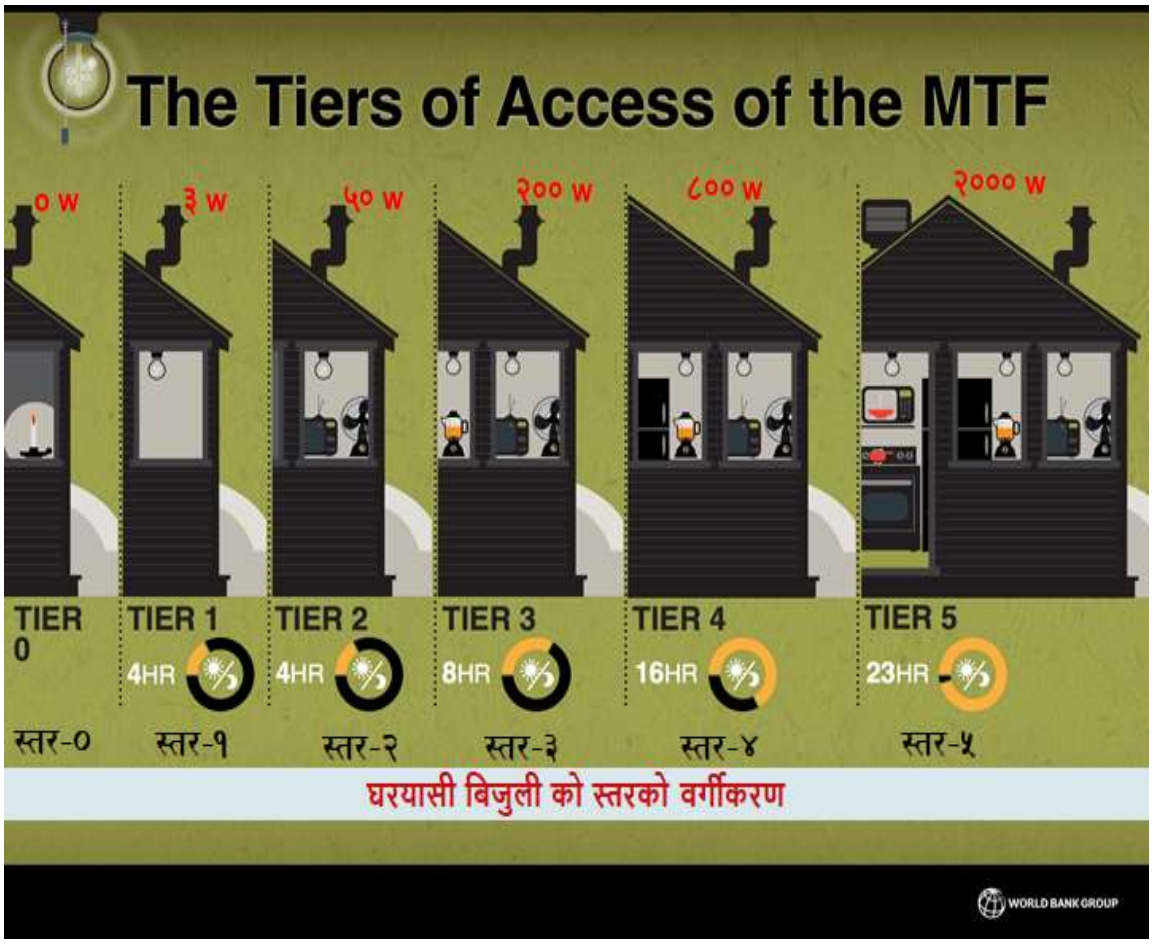

Figure 7 Tier of access of MTF

On analysis of data, it is found that all the house hold lie below Tier3 because micro hydro powers and solar systems supplied the power below 200 watt per house hold. Among them, 41% of total house hold excess electricity of Teir-2 and rest of them have excess of Tier-1

The ward wise Tier level is given in figure and table below.

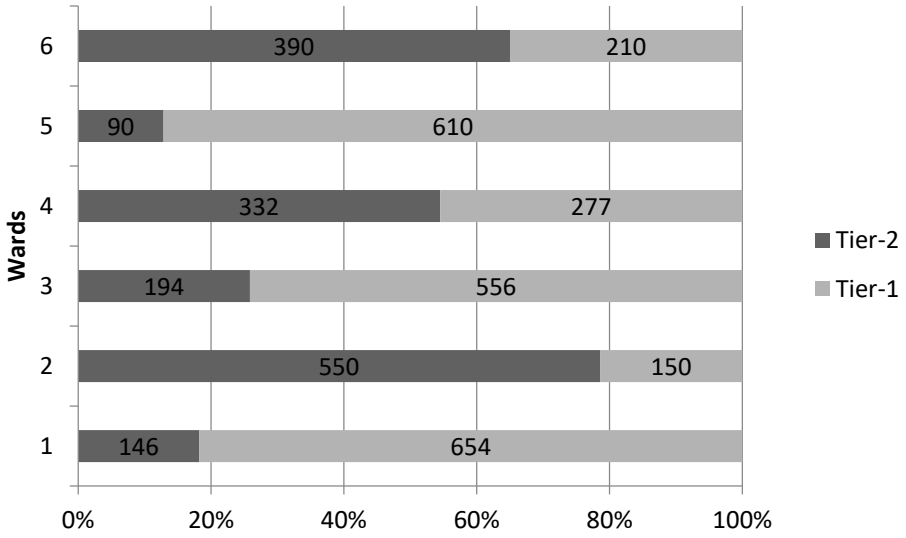

Figure 8: Electricity Tier Status by Ward

Table 4: Electricity Tier Status by Wards

Wards	Tier-2	% of Tier-2	Tier-1	% of Tier-1
1	146	18%	654	82%
2	550	79%	150	21%
3	194	26%	556	74%
4	332	55%	277	45%
5	90	13%	610	87%
6	390	65%	210	35%
Total	1702	43%	2457	57%

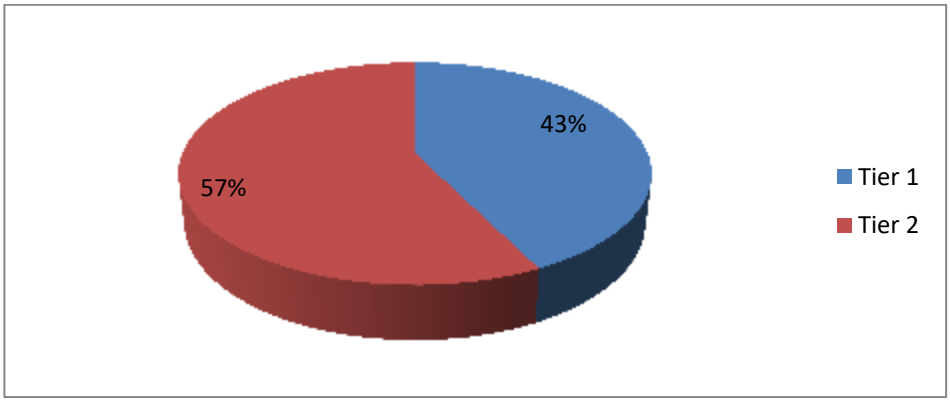

Figure 9: Overall Tier Status (Electricity) of Phikkal Rural Municipality

3.2.3 Priority of Electrical Applications

Besides lighting, mobile, is in first priority used in almost all household in average of 2-3 mobile per household, is used as the major communicative medium in this Rural Municipality. As mobile is easily charged by small capacity of solar homes hence its dominant is high. Beside mobile, other appliances use is very limited because lack of sufficient electricity. TV user account only 11% of total household. Only 1% (50 HHs in ward-2, 10 HHs in ward -4 and 3HHs in ward-3) of total house hold are using rice cooker.

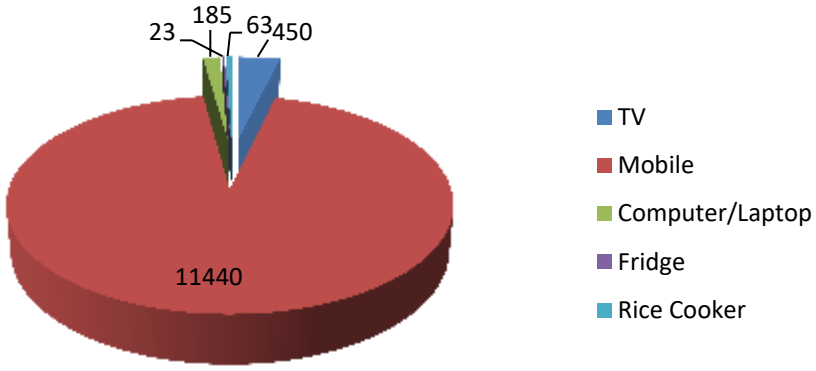

Figure 10: Number of electrical appliances

3.3 Cooking

3.3.1 Sources of Cooking

95% of the houses use firewood as the primary source of fuel for cooking purpose for both household and livestock cooking. LPG cylinders are dominant over 4% of the households whereas only 1% HHs has biogas installed. According to field survey, most of wards have highest number of houses using firewood because of their remoteness to the access of LPG supply. The maximum distance to the nearest LPG depot is found to be 80 km (Sindhuli) whereas the average distance from all wards to the nearest LPG depot is 30 km. Ward-2, ward-5 and ward-6 have maximum user of LPG cylinder. The minimum average distance to the LPG depot in this ward is 6 km. Ward-1 and ward -3 has minimum LPG cylinder users due to remoteness. In spite of high potential of domestic biogas there is only low penetration of biogas plant.

Table 5 Source of Cooking Energy of Phikkal Rural Municipality

Ward	Source of Cooking		
	Firewood	Biogas	LPG
1	784	0	16
2	650	0	50
3	741	0	9
4	535	15	50
5	690	0	10
6	550	0	50
Total	**3950**	**15**	**185**

3.3.2 Tier Level Classification for Cooking

After analysis it was found that 95% of the total households are below level three. The ward wise status of cooking in tier level is given in table 6.

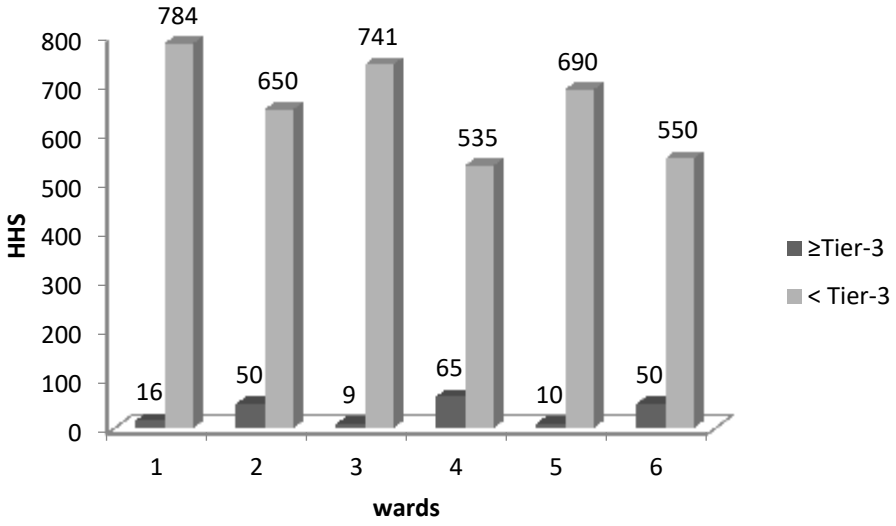

Figure 11: Cooking Tier Status by Ward

Table 6 Cooking Tier status by ward

Wards	≥Tier-3	%≥Tier-3	< Tier-3	% < Tier-3
1	16	2%	784	98%
2	50	7%	650	93%
3	9	1%	741	99%
4	65	11%	535	89%
5	10	1%	690	99%
6	50	8%	550	92%
Total	200	5%	3950	95%

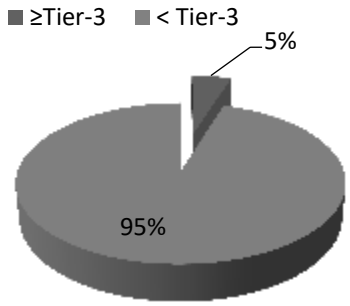

Figure 12: Over all Tier Status of ward (Cooking)

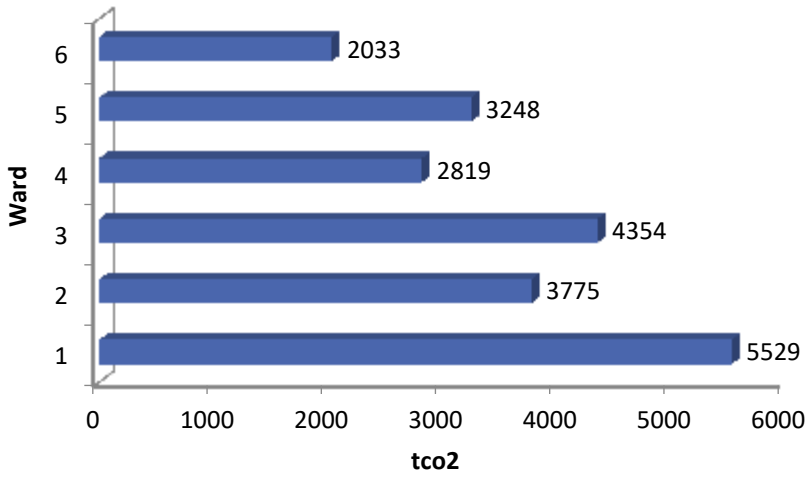

Figure 13: Carbon Emission by Ward

3.4 Status of Renewable Energy Technologies (RETs) installed

In spite of having high potential for RETs installation, the field survey show low installation of RETs in Rural Municipality. The number of different RETs installed is shown in figure below. There was high number of ICS installed but most of them were destroyed and are not in existence.

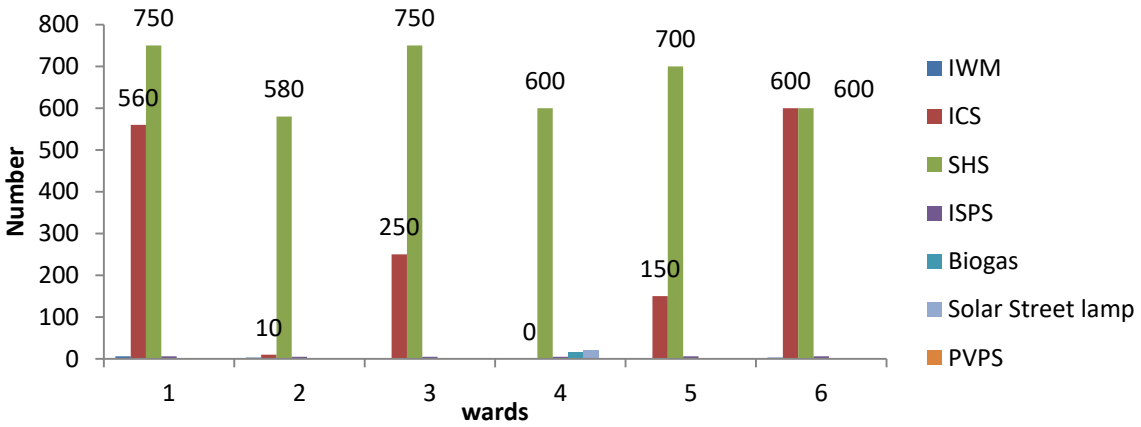

Figure 14: RETs installation by ward

3.5 Potential Energy Source in Rural Municipality

This Rural Municipality has high potential to develop Solar Energy Project, mini and small hydro projects. The potential for bio gas installation is also high. The Rural Municipality does not have enough wind for commercial wind production. The potential map of solar is given in annex. As per National Planning Commission's Study and analysis of optimal distributed generation for access to grid electricity for All in Five Years with Participation from local level Government, one mega watt hydropower project is feasible in the Rural Municipality in Waksu Khola. The Rural Municipality has also good potentiality for briquette and pallet making. The ward wise potentiality of domestic biogas installation is given in figure 15.

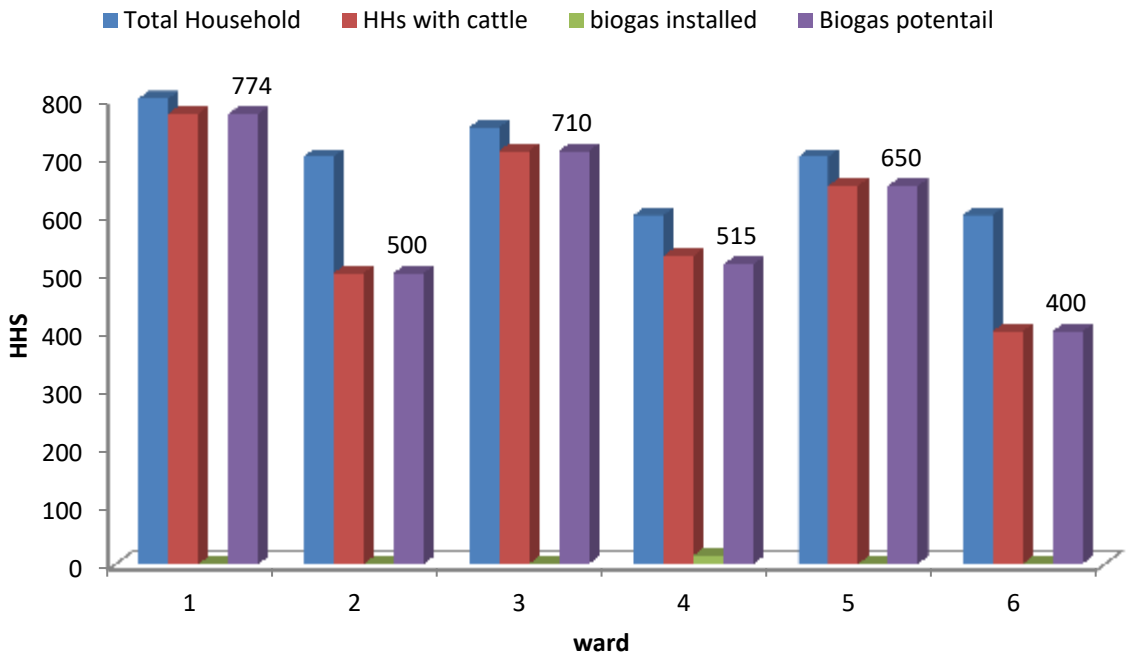

Figure 15: Biogas Potential by Ward

3.6 Municipal Energy Scenario Development/Demand Projection

3.6.1 Introduction

Energy consumption data for residential sector has been collected and projected for five years with various scenarios. For the projection of various scenarios population, population growth rate and household growth rate have been used to get approximate outcome of forecasting. Energy consumption data of Phikkal Rural Municipality has been collected by primary survey for residential sector. As the Rural Municipality is electrified by Pico/Micro-Hydropower, the need to electricity to reach Tier 3 level has been calculated and for cooking solution, business as usual (BAU) and different intervention scenario has been projected.

3.6.2 Present Electricity consumption

The present annual electricity consumption on ward level is given in figure 16.

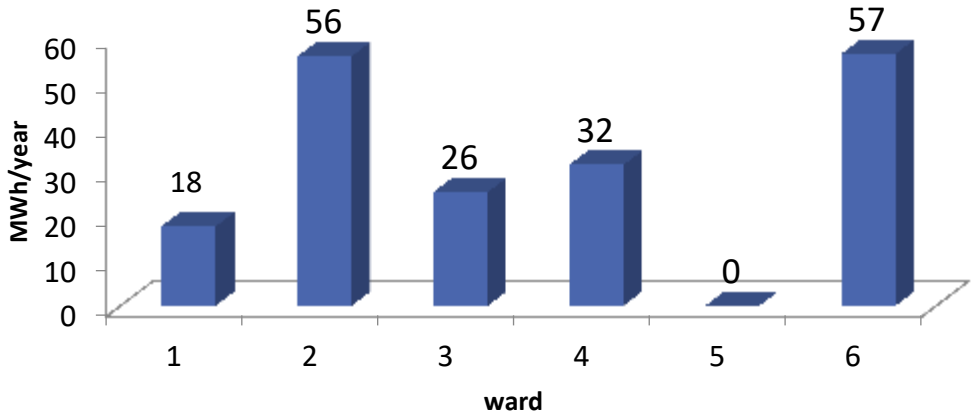

Figure 16: ward wise yearly consumption of electricity (Mwh/year)

3.6.3 Cooking energy solution

3.6.3.1 Energy demand in Business as usual (BAU) scenario

The BAU Scenario in next five year for cooking energy is given in figure 17. The basic assumption for BAU scenario is that in next period of time the uses of different cooking RETs by HHs will be the same as of base year. 2019 is considered as base year.

Table 7: BAU Scenario for cooking energy

Scenario: Business as usual (BAU) Scenario	**Yearly house hold distribution**					
Years	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Electric Cooking	-	-	-	-	-	-
Biogas	15	15	15	16	16	17
LPG	185	187	189	192	194	196
Wood	3950	3996	4043	4090	4138	4187

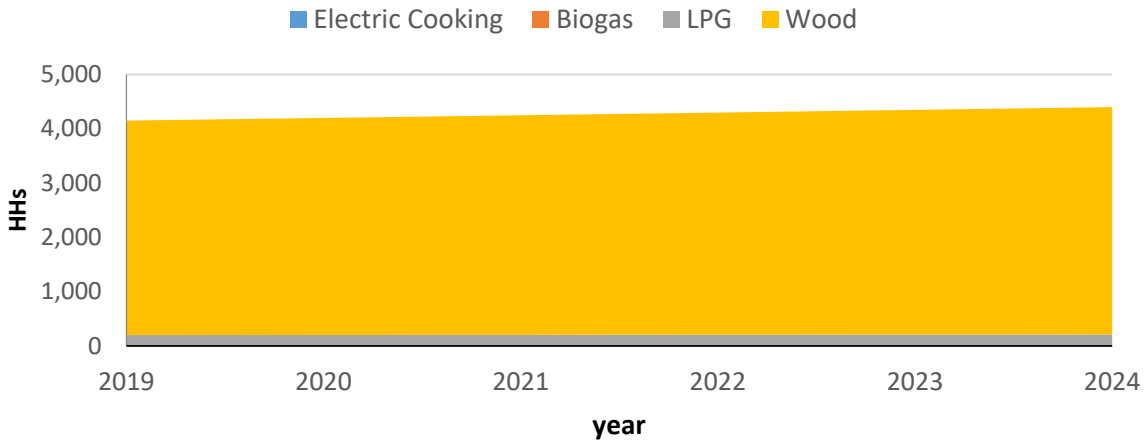

Figure 17: BA U Scenario

3.6.3.2 Low Intervention Scenario

The basic assumption for low intervention scenario is that at the end of five year 0.14 % of total households will be using electric cooking, 20.17% biogas, 1.18% LPG and 78.51% biomass for cooking. This is assumed based on the economic status of HHs and biogas potential of the Rural Municipality. The total demand for cooking in HH is given in figure 18.

Table 8: Energy Demand in Low Intervention Scenario

Low intervention Scenario: cooking				
Yearly house hold distribution (%)				
Year	**Electric Cooking**	**Biogas**	**LPG**	**Wood**
2019	0.00%	0.36%	4.46%	95.18%
2020	2.86%	4.51%	4.46%	91.69%

2021	0.06%	8.56%	3.10%	88.28%
2022	0.08%	12.52%	2.45%	84.95%
2023	0.11%	16.39%	1.81%	81.69%
2024	0.14%	20.17%	1.18%	78.51%

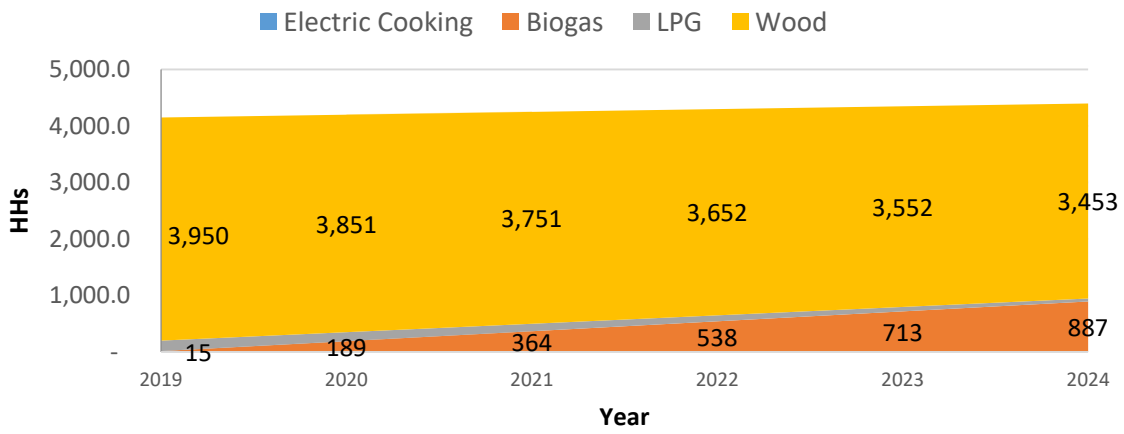

Figure 18: Low Intervention Scenario: cooking

3.6.3.3 Mid Intervention Scenario

The basic assumption for mid intervention scenario is that at the end of five year 0.7 % of total households will be using electric cooking, 40.3% biogas, 4.2% LPG and 54.8% uses biomass for cooking. This assumption is based on economic status of HHs of Phikkal, Biogas potential. It is assumed that due to policy intervention there will be no increase in LPG users rather the HHs using firewood will switch to Biogas.

Table 9: Mid Intervention Scenario: cooking

Mid- intervention Scenario: cooking	**Yearly house hold distribution (%)**					
Years	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Electric Cooking	-	0.1%	0.3%	0.4%	0.5%	0.7%
Biogas	0.4%	8.7%	16.9%	24.9%	32.7%	40.3%
LPG	4.5%	4.4%	4.4%	4.3%	4.3%	4.2%
Wood	95.2%	86.7%	78.5%	70.4%	62.5%	54.8%

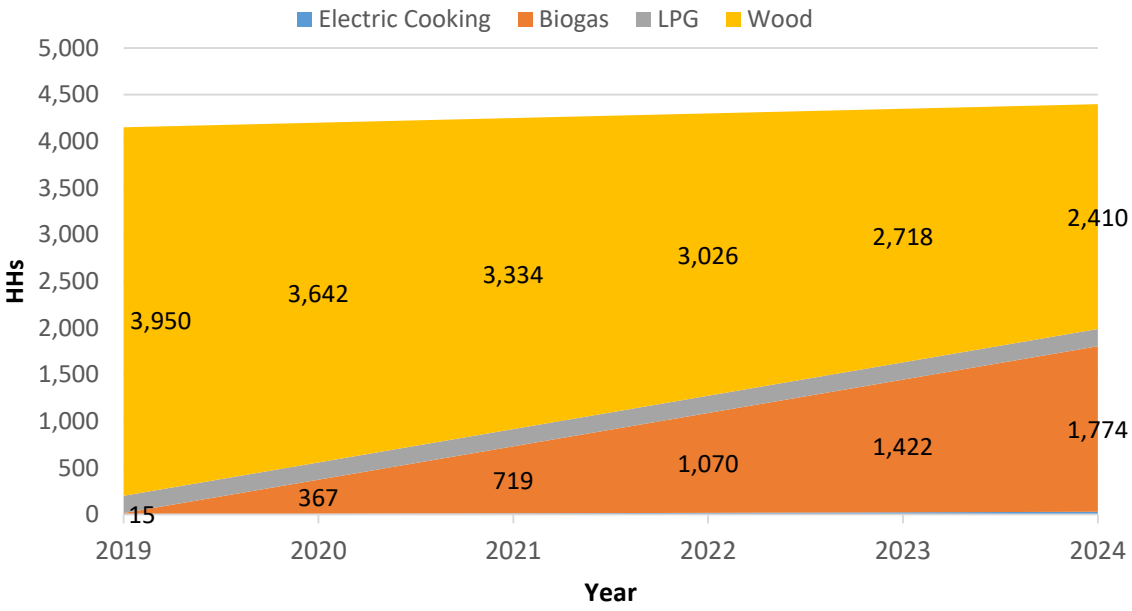

Figure 19: Mid Intervention Scenario: Cooking

3.6.3.4 High Intervention Scenario

The basic assumption for high intervention scenario is that at the end of five year 1.32 % of total households will be using electric cooking, 80.70% biogas, 3.80% LPG and 14.19% biomass for cooking. This assumption is based on economic status of HHs of phikkal, Biogas potential. It is assumed that due to high policy intervention the users of LPG will decrease and biogas will be promoted to its highest potential. The total demand for cooking is given in figure 20.

Table 10: High Intervention Scenario: cooking

High-intervention Scenario: cooking	**Yearly house hold distribution**					
Years	2019	2020	2021	2022	2023	2024
Electric Cooking	0.00%	0.28%	0.55%	0.81%	1.07%	1.32%
Biogas	0.36%	17.19%	33.62%	49.67%	65.36%	80.70%
LPG	4.46%	4.32%	4.18%	4.05%	3.92%	3.80%
Wood	95.18%	78.22%	61.65%	45.46%	29.65%	14.19%

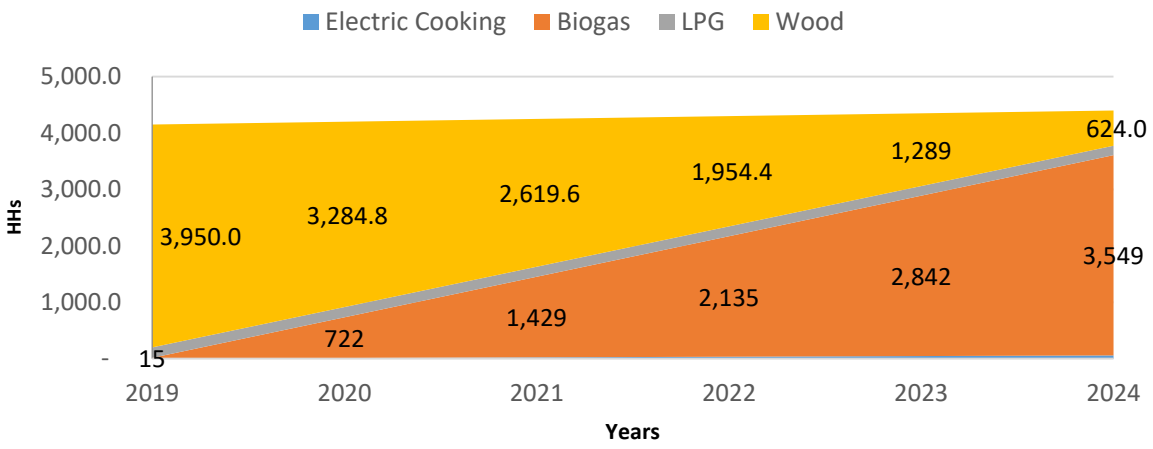

Figure 20: High Intervention Scenario: cooking

After interaction, it was decided to adopt low intervention scenario.

Chapter 4: MEP Implementation Plan

4.1 Introduction

Municipal Energy Plan is a five year periodic plan of Rural Municipality for the intervention of clean energy technologies meeting the objective of implementing the most suitable option or a mix of options to provide clean cooking and lighting solution for a selected location to meet not only the immediate demand but also future needs attaining at least Tier 3 as defined by SEforALL and national policies of Government of Nepal, reducing carbon emission and mainstreaming GESI issues. The implementation plans are generally based on government plan and policies related to renewable energy, gender and social inclusion, and carbon issues. The implementation plan is prepared on ward level.

4.2 Existing Policies and Plans to implement proposed plan

Local Government Operation Act 2017, Rural Energy Policy 2006, Renewable Energy Subsidy policy 2013, Smokeless kitchen by 2017, Fourteen National Plan, Sustainable Development Goal (SDG) 2030 and other similar policies might be the basis for implementation. Proposed plan for various technology options and strategy must be checked to implement through these policies and hence some of these have been discussed below.

4.3 Income Situation

From field survey it is revealed that more than 96 % of total population has inadequate income for accessing clean energy technologies. 1 % of total population has adequate income hence can support new energy intervention by their own.

4.4 Financial Accessibility for energy harvesting

One consequence of the above-mentioned “income inadequacy” is the suitability of “Energy Financing” in this Rural Municipality. An indicator of financial accessibility is the average number of people served by a bank branch. Additionally, there is a provision that D-class licensed institutions (microcredit) which can disburse up to Rs. 100,000 per committee member to ultra-poor and people with low income, to run small enterprises or businesses against group guarantee and up to Rs. 300,000 per group member against acceptable collateral. Besides, a maximum of Rs. 60,000 per family can be made available as microcredit for the use of Solar Home Systems (SHS) and/or Biogas plant as renewable energy technologies.
The recently released budget reveals that 2.02of the total budget allocation is related to energy it implicates that the Rural Municipality is going to allocate energy related projects in Municipal Annual Plan. In addition to this there is big chunk of money already committed to support climate change, energy and other key climate sensitive sectors from central and provincial government. As revealed through the field survey there are few agencies, organization and private sectors which are capable of designing energy related program and also provide support services.

4.5 Capacity Development

The capacity assessment and capacity development plans should be reflected according to the delivery mechanism envisioned in the project document and the capacity of the Municipality to implement along with the on-going program. AEPC should support Municipality to develop a well-defined program implementation modality where by most of the energy services are contracted out to the competent parties following its own guidelines and financial norms, discipline. All human and other required resources are also included in their contractual agreement. While AEPC has the mandate to facilitate implementation, technical advice, monitors progress and report back to the AEPC. To materialize the coordination and synergy between programs and for effective implementation of the MEP some mechanisms involving the key stakeholders has to be devised at the municipal and ward level.

4.6 Summary Detail Implementation Plan

The implementation plan is made by using bottom up approach from ward level to municipality level and having concrete model for planning the energy plan in the coming years. The plan includes the technology option and delivery mechanism for different regions of Municipality. The implementation plan for Municipality has been mentioned below. The overall activities of MEP are categorized in seven different sectors.

- Household level lighting and use of electrical appliances
- NEA grid up gradation
- Household level cooking
- Community level lighting & endues
- Project inventory and Pipeline development
- Service & small industry level
- Capacity development Activities

The category wise detail activity plan is given below

Table 11 Activities plan of Phikkal Rural Municipality

Activities	Ward						Total	Remarks
	1	2	3	4	5	6		
Households level (Lightning& EA)								
SHS (100 W.) for HH without NEA Connection distance greater than 2000m	479	150	315	200	700	110	1954	
Solar Minigrid	1		2			2	5	
Micro Hydro grid Upgradation								
LED Promotion (Buy One and Get One Free)	800	700	750	600	700	600	4150	
Households level (Cooking)								
Biogas (no. and cubic meter)	194	125	178	129	163	100	889	
ICS (Wood Stove /Pellet/ Briquette/Rice Husk) in no	591	525	564	406	528	450	3064	
Community level								
ISPS in Educational Institute (no. & KW)	2	1	1				4	
ISPS in Health Center (no. & kW)			1	1			2	
ISPS in Ward Office							0	
ISPS in other community center (no.& kW)							0	
Solar Street Lamp (no.& KW)	100	100	100	100	100	100	600	
Special energy access program for DAG	1	1	1	1	1	1	6	
Project Inventory and Pipe line development Activities								
Feasibility study Solar PV-Irrigation and Drinking Water Projects	1	1	1	1	1	1	6	
Pre-Feasibility of Mini/Micro Hydro							1	
Feasibility and Detail Engineering Design for Mini Hydro							1	
Study on Business Opportunity Assessment							1	
Feasibility study of Institutional & Commercial Biogas Plant including Municipal Waste							1	

Production ,Service & Industry Level								
Lift Irrigation & Drinking Water-solar	1	1	1	1	1	1	6	
Poultry & Animal Husbandry	1	1	1	1	1	1	6	
other MSMEs	5	5	5	5	5	5	30	
Capacity Development Activities								
Institutional Set up of Energy Section in Rural Municipality							1	
Awareness program on Transformational Energy Access(Localizing local, National and SDG) and Energy Efficiency	1	1	1	1	1	1	6	
Training on implementation of Energy projects-(MEP, Policy, Activity and program design implementation modality, ToR and specification prep, evaluation of projects, procurements and after sales service)							1	
Training to implementing stakeholders (Ward office, School, Health post, Tole Sudhar Samiti,FUG etc) on energy, climate change issues and management							2	
Training on partnership/business model to companies, NGOs,CBOs, private firms, cooperatives, banks, clubs etc for Clean energy technologies/projects							1	
Training on energy resource conservation including GESI groups							2	
Training on operation, maintenance and management and after sales service of clean energy technologies							1	
Training on database management & software of energy projects/local, provincial and federal level program)							1	
Training on Monitoring and Quality Assurance (MQA) of energy projects							1	

4.7 Yearly Breakdown of MEP

The yearly breakdown of activities for five year is given in table12

Table 12: Yearly breakdown of activities for five year

Activities	Year Target					Total
	Y1	Y2	Y3	Y4	Y5	
Households level (Lightning& EA)						
SHS (100 W.) for HH without NEA Connection distance greater than 2000m	489	489	489	244	244	1954
Solar Minigrid	2	2	2	2	2	10
Micro Hydro grid Upgradation						
LED Promotion (Buy One and Get One Free)	1245	1245	830	415	415	4150
Households level (Cooking)						
Biogas (no. and cubic meter)	178	178	178	178	178	889
ICS (Wood Stove /Pellet/ Briquette/Rice Husk) in no	613	613	613	613	613	3064
Community level						
ISPS in Educational Institute (no. & KW)	1	2	1			4
ISPS in Health Center (no. & kW)	1	1				2
ISPS in Ward Office						0
ISPS in other community center (no.& kW)						0
Solar Street Lamp (no.& KW)	120	120	120	120	120	600
Special energy access program for DAG	1	1	1	2	1	6
Project Inventory and Pipe line developmentActivities						
Feasibility study Solar PV-Irrigation and Drinking Water Projects	2	2	2			6
Pre-Feasibility of Mini/Micro Hydro		1				1
Feasibility and Detail Engineering Design for Mini Hydro			1			1
Study on Business Opportunity Assessment	1					1
Feasibility study of Institutional & Commercial Biogas Plant including Municipal Waste		1				1

Production ,Service & Industry Level						
Lift Irrigation & Drinking Water-solar			2	2	2	6
Poultry & Animal Husbandry	1	1	2	1	1	6
other MSMEs	6	6	6	6	6	30
Capacity Development Activities						
Institutional Set up of Energy Section in Rural Municipality	1					1
Awareness program on Transformational Energy Access(Localizing local, National and SDG) and Energy Efficiency	1	2	1	1	1	6
Training on implementation of Energy projects-(MEP, Policy, Activity and program design implementation modality, ToR and specification prep, evaluation of projects, procurements and after sales service)		1				1
Training to implementing stakeholders (Ward office, School, Health post, Tole Sudhar Samiti,FUG etc) on energy, climate change issues and management				1		1
Training on partnership/business model to companies, NGOs,CBOs, private firms, cooperatives, banks, clubs etc for Clean energy technologies/projects		1				1
Training on energy resource conservation including GESI groups	1				1	2
Training on operation, maintenance and management and after sales service of clean energy technologies				1		1
Training on database management & software of energy projects/local, provincial and federal level program)		1				1
Training on Monitoring and Quality Assurance (MQA) of energy projects					1	1

4.8 Financial Plan

The financial plan of Phikkal Rural Municipality MEP has been made based on Annual budget of Rural Municipality and Renewable energy subsidy policy with target to reach Tier 3 level of Energy supply.
The Sector wise cost of above mentioned activities is given in table13.

Table 13: Sector- wise cost of activities

Activities	Cost	% of Total Cost
Households level (Lightning& EA)	24,848,000.00	30.74
NEA grid Upgradation	1,037,500.00	1.28
Households level (Cooking)	20,844,000.00	25.79
Community level Lightning	16,600,000.00	20.54
Project Inventory and Pipe line development Activities	4,000,000.00	4.95
Service & Industry Level	6,900,000.00	8.54
Capacity Development Activities	6,600,000.00	8.17
Grand Total	80,829,500.00	100

It is assumed that the cost of activities will be covered by Nepal Government's subsidy, Rural Municipality, private sector and users' equity. The share of these components is given in table 14.

Table 14 Summary of five year budget Plan of Municipality

Funding Agency	Amount	Percentage
AEPC Subsidy	94,058,000.00	37.06
Municipality Support	80,829,500.00	31.85
Private Sector	60,025,000.00	23.65
Users equity	18,900,000.00	7.45
Total	253,812,500.00	100.00

Chapter 5: Conclusion and Recommendation

5.1 Conclusion

- Current status shows that traditional cook stoves are the leading cooking technology employed in the Rural Municipality followed by LPG, and Mud ICS.
- Similarly, in the case of lighting technology, 45% of the households are using Pico/Micro- Hydropower, however, rest are using solar system of 10-20 watt peak.
- New technologies for the municipality would be ICS, Biogas, and Electrical Cooking, Solar for irrigation and community use in order to meet the objective of reducing GHGs emission and energy consumption.
- Energy use pattern shows the dominance of biomass with 99 % share followed by LPG 0.53%, electricity 0.2% and biogas 0.2%.
- Main potential sources seem to be biogas with ICS and electrical stove for cooking and solar for irrigation and community service.
- There is potentiality of Mini hydro and solar farming which can be connected to national grid.

- To promote the clean energy technology as per MEP plan has estimated the amount required NPR 51,899,250.00; 52,459,250.00; 56,045,500.00; 47,054,250.00 and 46,354,250.00 in Year 1, 2, 3, 4, and 5 respectively.
- Possible financial sources for the above mentioned investment plan are Central Government, Provincial Government, INGOs, NGOs, private sector etc.

5.2 Recommendation

- Although the BAT analysis for Phikkal shows need of SHS installation in HHs but the RM is planning for extension of NEA National Grid to all its HHs hence the tier 3 status of Phikkal Rural Municipality cannot be reached without extension of NEA and up gradation of micro- hydropower, Hence coordination between Rural Municipality and NEA is needed
- There is high potential of biogas hence for clean cooking energy biogas should be promoted in rural area where as in urban areas electrical cooking should be promoted.
- There is high potential for bio pallet from forest residue hence pellet making industry should be piloted and promoted.
- A detail engineering study for Mini Hydro and solar farming and its grid connection is needed.
- Most of the agricultural land is not irrigated hence solar/grid pump irrigation system should be promoted.
- There are not dedicated technical section/staffs responsible for development of clean energy in the Rural Municipality hence a separate section dedicated to energy

should be established and the capacity of Rural Municipality for promotion and development of clean energy should be enhanced.

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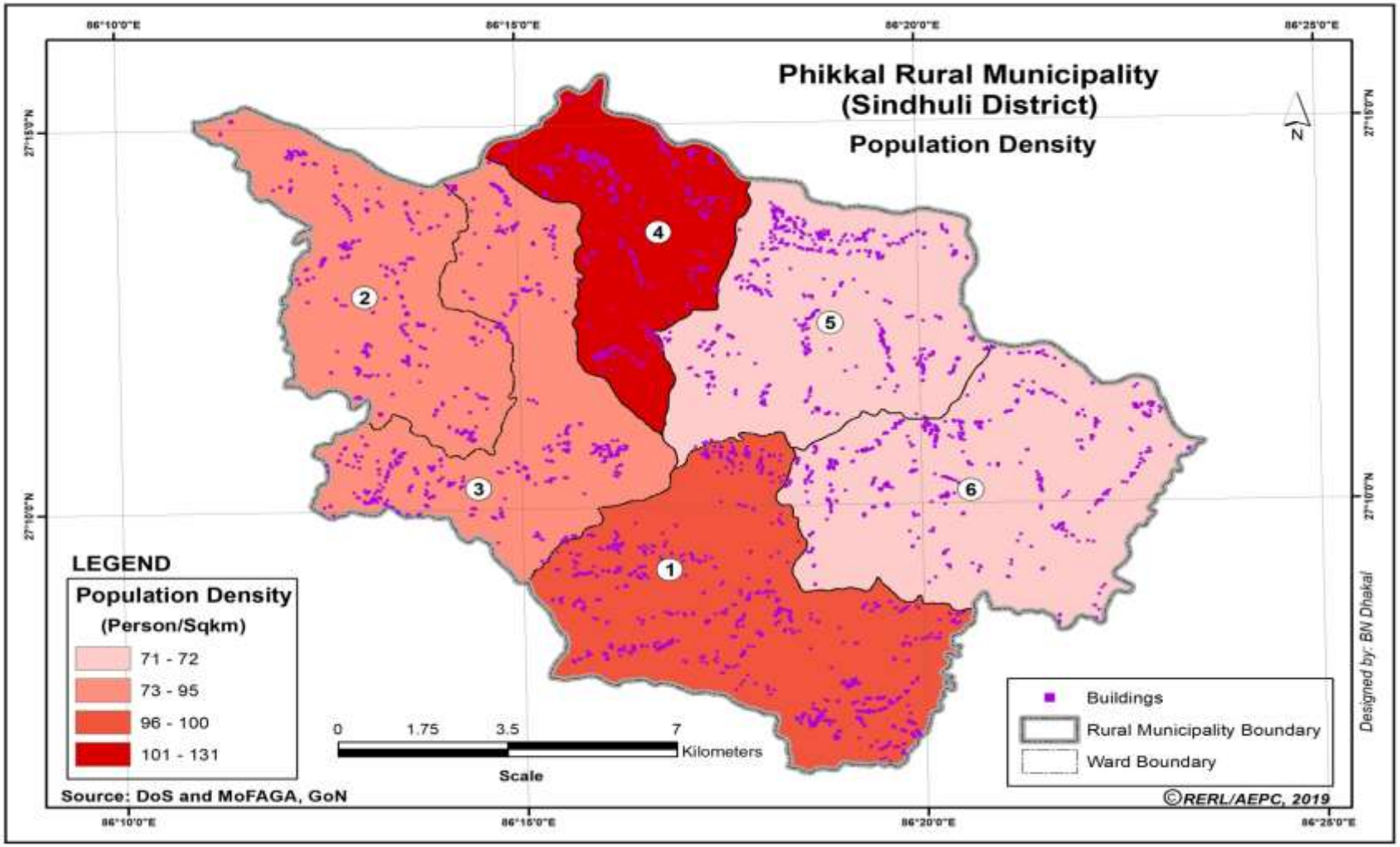
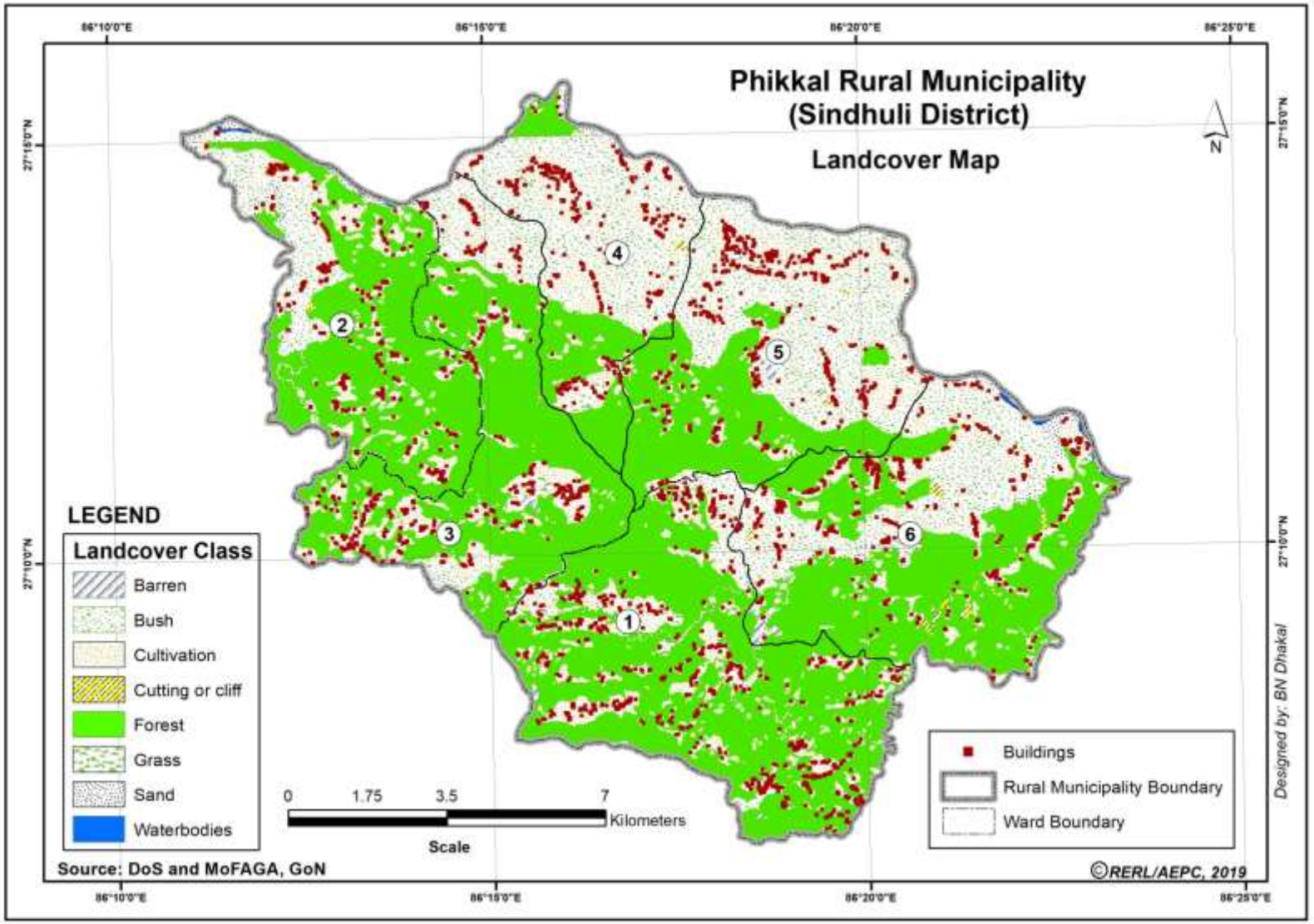
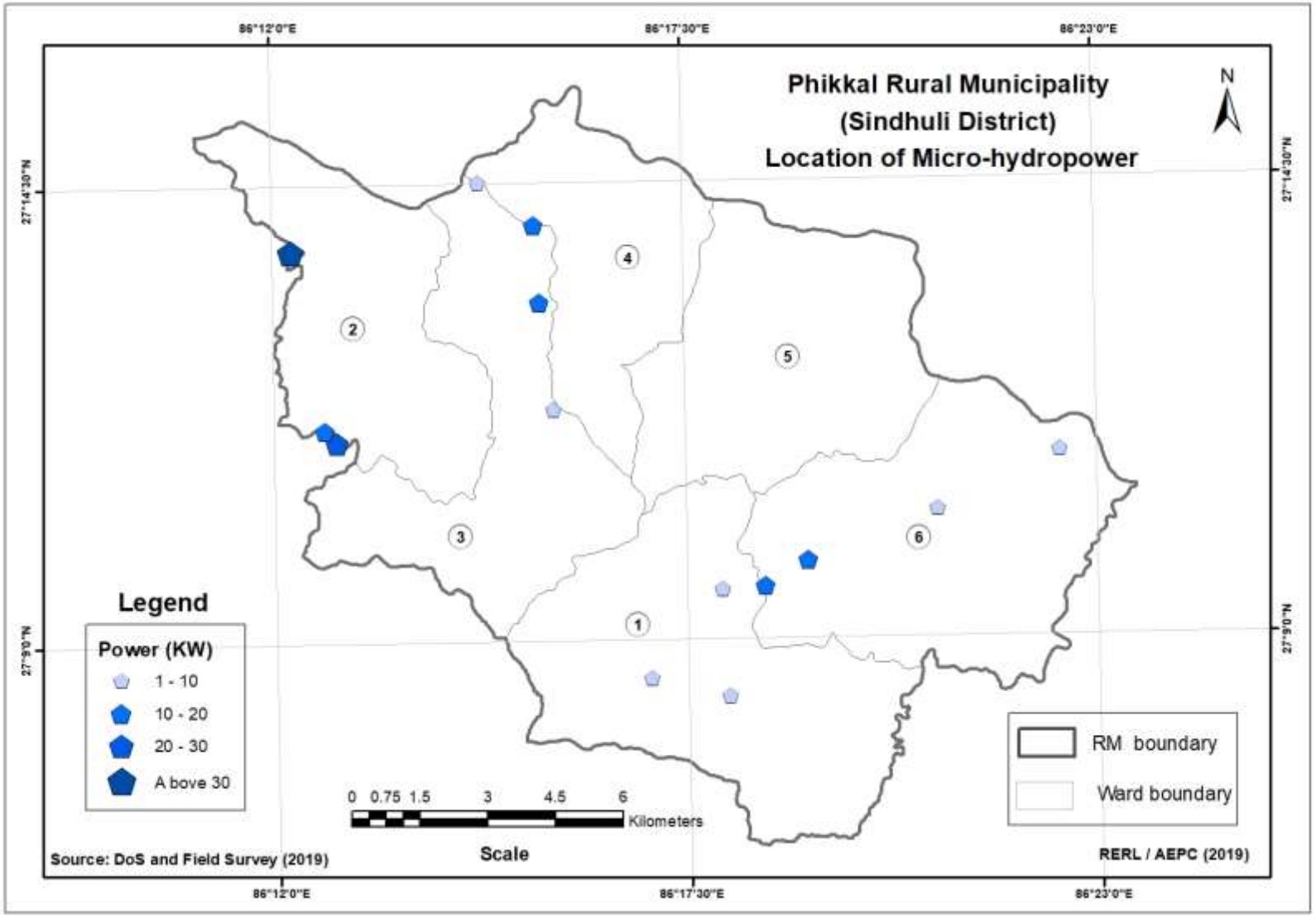
ANNEXES



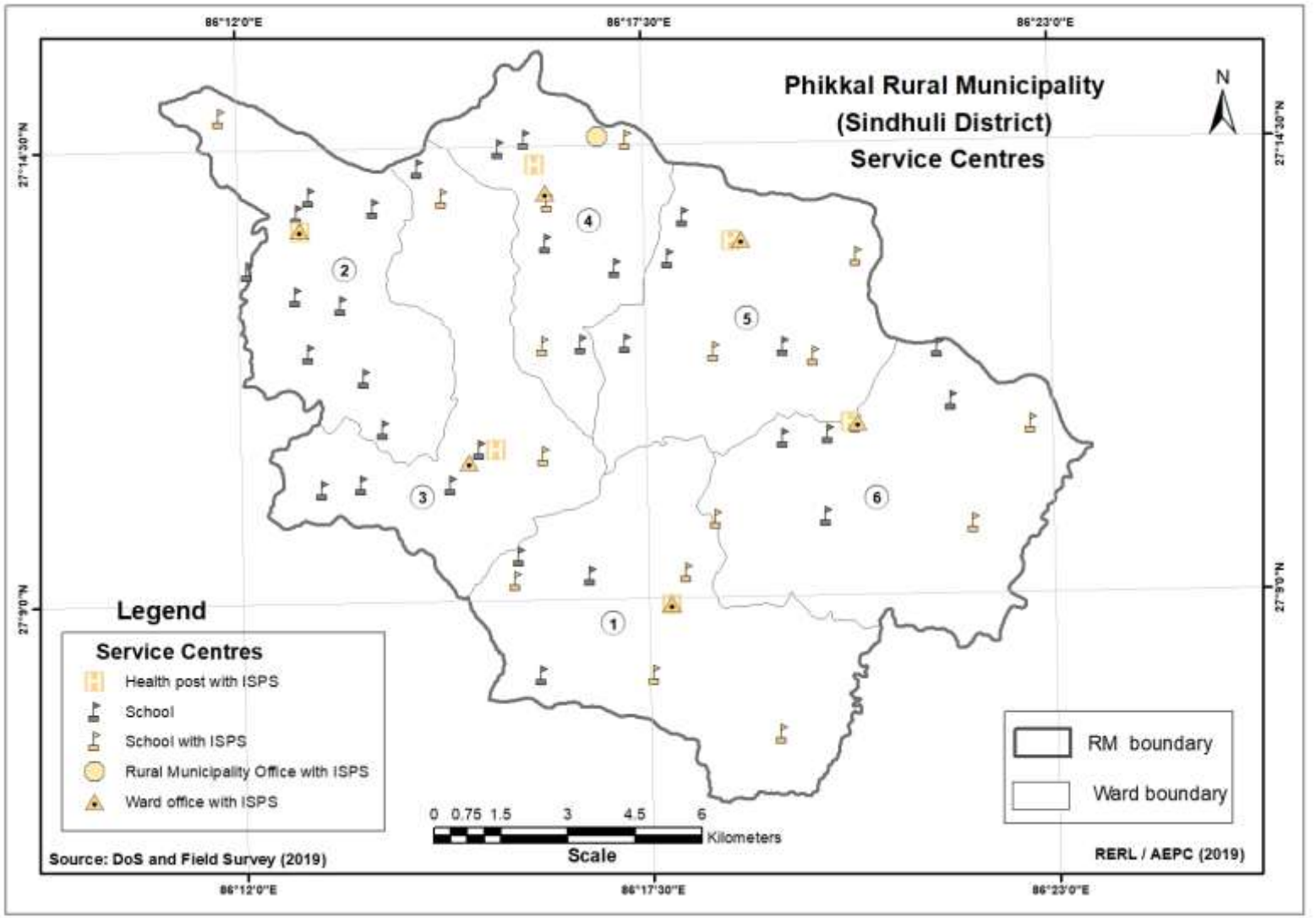
Annex 1 : Population Density Map of Phikkal Rural Municipality



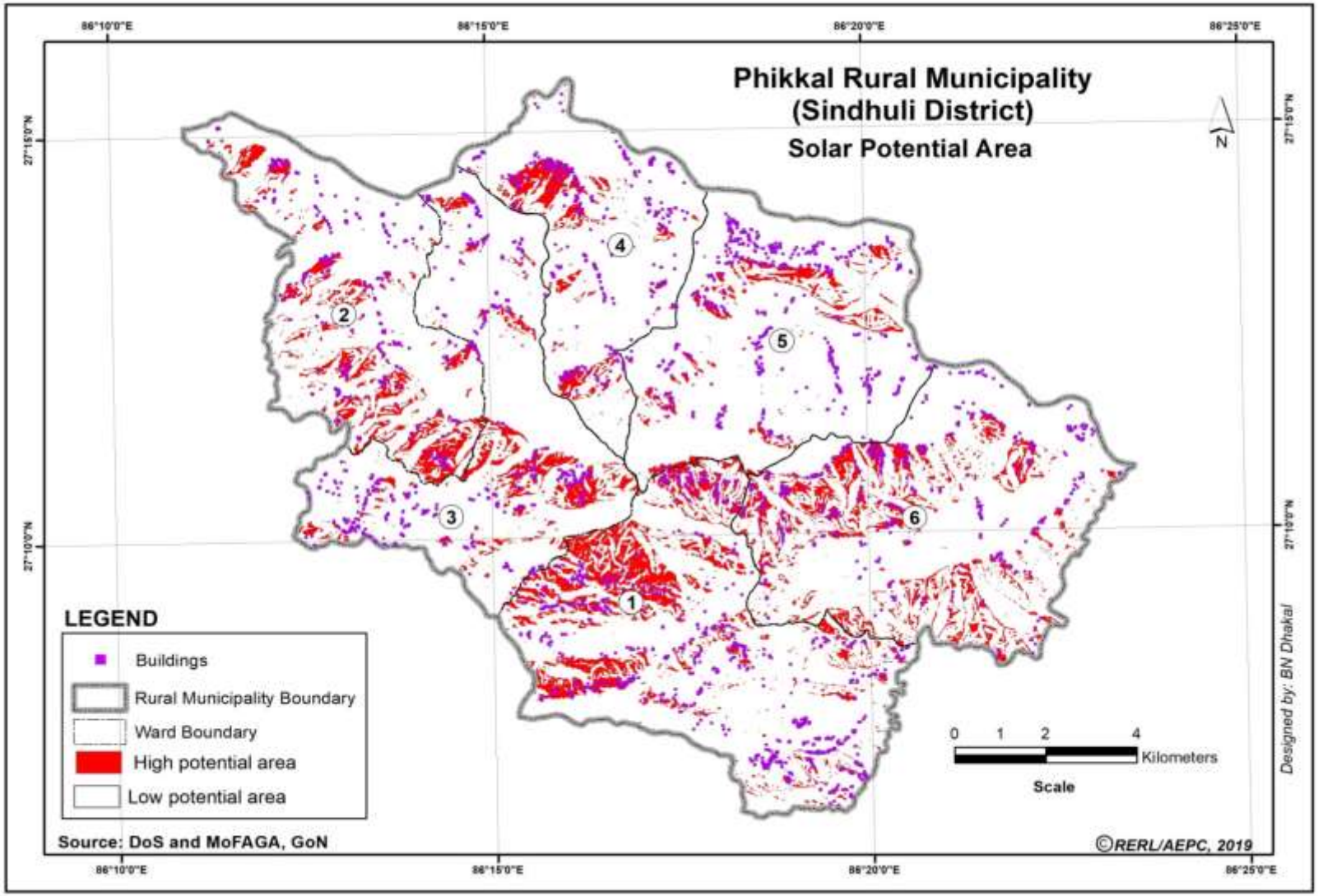
Annex 2: Landuse Map of Phikkal Rural Municipality



Annex 3: Hydropower Location



Annex 4: Location of service centres



Annex 5: Solar Potential MAP