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Sustainable Community Development Projectplan

Small Scale Community Biogas plant and SDGs learning centre for Kailash village in Bajhang District, Nepal

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The thesis work concentrates on the opportunity to make a sustainable development project in the Far Western Region of Nepal. This area is facing many environment and development problems. High poverty rate, lack of education, distant rural settlement are making life difficult for those who live in this area.

Kailash village in Bajhang district of The Far Western Region (FWR) is one of the poorest areas on Nepal and the idea of changes living conditions by building community biogas plant and learning centre for UN Sustainable Development Goals is the way to lessen the problems what people are facing each day. Education and lending a helping hand for those who live in vulnerable situation gives hopes and opportunity to rise from poverty trap.

This thesis work explains how to make a project plan proposal for NGO's to applying a grant or loan for the project, and gives an example of how the proposal should look alike.

Keywords	Community, sustainability, development, poverty reduction, biogas plant, UN SDGs

Contents

Abbreviations

CO_2	Carbon dioxide
CC	Climate Change
FWR	The Far Western Region
GDP	Gross domestic product
HDI	Human Development Index
H_2	Hydrogen
H_2S	Hydrogen Sulfide
KWh	Kilo Watt Hours
LPG	Liquefied petroleum gas
MDGs	Millennium Development Goals
MEDEP	Micro Enterprise Development Programme
NGO	Non-Governmental Organisation
UN	United Nation
SDGs	Sustainable Development Goals
PV	Photovoltaic
UNDP	United Nation Development Programme
UNFCO	United Nations field coordination office

Terminology

Term	Explanation
Anaerobic digestion	Biological process in the absence of oxygen, where microorganisms break down biodegradable material
Basic human needs	In general, basic human needs includes these: clean drinking water, clothing and shelter, sanitation, education, food and healthcare
Climate change	Change of weather patterns which can be statistically distributed for an extended period.
Deforestation	Removal of a forest and converted to a non-forest use
Extreme poverty	In 1995 UN defined it as “a condition characterized by severe deprivation of basic human needs.” Also, known as earning below the international poverty line of $1.25/day
Fuel wood	Wood used as a fuel, such as firewood, chips, pellets, sawdust, charcoal, and sheets.
Global warming	Part of the climate change, where global surface temperature rise from the normal temperature. This is statistically distributed for an extended period.
Greenhouse gas	Certain gasses that absorb and emit radiation within the thermal infrared range in an atmosphere.
Indoor air pollution	Part of the indoor air quality where the quality is affected by certain gases, such as carbon monoxide, volatile organic compounds, particulate.
Open deification	A practice where people are defecating outside using the ground as a toilet.
Slurry	A semi-liquid mixture, in this work its waste from biogas plant
Water stress	Occurs when water demand exceeds the maximum amount during a certain period or poor restricts of its use.

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1 Introduction

This thesis is a project plan proposal, designed for Non-Governmental Organisation (NGO's. It describes generally about what a project plan is, why it is needed and who it is for. This thesis work provides the general guideline the implementing a project plan for Kailash village in Bajhang District of the Far Western Region of Nepal (FWR). The thesis discusses generally about problems in FWR and give more detailed information about Kailash situation. This work explains how these problems could be tackled with biogas plant and teaching households about the United Nations(UN) Sustainable Development Goals (SDGs) and by adopting the views of SDGs they can improve their standard of living.

The aim of this thesis was not to concentrate on only one household but on a dwellers complex, where multiple household live next to each other. Project plan proposal is situated in Kailash village, where small scale community biogas plant is built for 48 households and SDGs learning centre will provide education and knowledge platform for these households. For one single person, a community biogas plant comes cheaper than individual biogas plant. Working as a community strengthens the connection with the dwellers and improves community development. Thus, community development is one part of this thesis. The thesis explains what community development is and why it is good for communities. Quite often in rural areas, especially in FWR of Nepal, dwellers are living far away of from the bigger cities, and lack of education making people more vulnerable for poverty in a place where the poverty rate is already extremely high. As mentioned earlier, the UN has new SDGs which have been design to help everyone and especially those who are categorised vulnerable or are already at the bottom of the Human Development Index (HDI). These people are lacking the basic human needs and are more likely to stay in poverty generation after generation. Thus, educating people of the basic principles what these SDGs are and how they can be implemented to their own life, will give these dwellers a better change to rise from poverty. Combining a community biogas plant, which gives light, cooking gas and sanitation, with education of SDGs will benefit these people better than just building a biogas plant or just teaching SDGs.

In summary, this thesis explains what the project plan is, who it is for, and how an example of project plan would be done in the Kailash village in Nepal.

2 Project plan – model

Putting it to a simple sentence; project plan is a formal document designed to guide both project execution and project control. Project plan is the most important document when starting any project, it helps to make a project successful and tells the project activities along a timeline. It answers to the following question (techipedia, 2017):

- **Why?** - why is this project made and which are the task related to the project?
- **What? –** What is the focus or product and what activities are required to make this project successful?
- **Who? –** Who is charge of the project, who takes apart in the project and what are their priorities and responsibilities during this project? How everything is organized?
- **When? –** What are the milestones and the preside time for the project schedule

2.1 Project description

The fame work for this project is to build a sustainable community development centre, which could help people rise from poverty by means of a community biogas plant, sustainable agriculture and a SDGs learning centre in the Far Western Region of Nepal.

The United Nation Development programme (UNDP) works toward a long-term recovery framework which emphasizes resilience. The framework providing renewable energy alternatives for the most vulnerable people, building a culture of disaster risk awareness, and helping to ensure all reconstruction is done with a better approach (UNDP, 2015). UNDP launched the Micro Enterprise Development Programme (MEDEP) in 1998 together with the Government of Nepal. The aim is poverty alleviation though micro enterprise development.
This project will cover the main ideas of UNDP and their framework for sustainable development in Nepal. Key topics are sustainable development of the rural community, improved agriculture development, and building a learning centre for people learning about Rural development, eradicating poverty, water and sanitation, sustainable

consumption and production, biodiversity and ecosystem, waste management, climate change, energy, gender equality and women's empowerment and health, sustainable agriculture, and food security and nutrition (UNDP, 2015).

2.2 Example of the project plan

Example of the structure guidelines for a Project plan proposal. This demonstrates what is needed to be considered and what the plan should contain:

Priority area:	This area is for top issues what the prioritizes project address
Strategic Planning	• Background and Justification • Short and long term goals • List of priorities • Development policies • Clear idea of project • Timeline • Need Assessment report • Plot survey • Mission Statement • Missions Statement in the future • Performance measures
Goal:	Broad statement of hope to accomplish related to this priority area.
Objectives	• Development objectives • Immediate objectives Describes the objectives that this project is using in the short term. These Objectives should be "SMART" S- Specific M - Measurable A- Appropriate R - Realistic T - Time-based

Project Sustainability	• Explanation of what is project sustainability. What indicators must be taken an account? • Programme process supporting sustainability • Guidelines for ensuring project sustainability • Establishing standard indicators of sustainability • Establishing standard indicators of sustainability
Energy and waste management	• Demand and state of energy • State of waste treatment • Improved methods of energy and waste management
Project Description and financing	• Methodology • Main finding of the other field case studies • Implementation • Supervision • Evaluation • Microfinance • Natural resource management • Limitation of Project • Assessment of Project cost • Key risk and mitigation measures
Anticipated Results	Describe the direct, and measurable results of the project activity. (example: documents, an agreement or policy, number of participants.)

3 UN sustainable Development goals and justification for SDGs learning centre

Sustainable Development Goals also known as SDGs of the 2030 Agenda for Sustainable Development, which came to action on 1 January 2016, with new 17 goals. These SDGs are also known as a Global Goals, whose purpose is to end all forms of poverty, fight inequalities, ensure no one is left behind and tackle climate change

What makes these SDGs different from the Millennium Development Goals (MDGs) is that they call everyone to take an action, poor, middle-come and rich countries to promote prosperity and protecting the planet at the same time. The 17 SDGs has 169 targets, which have scopes and framework to address the root causes of poverty and build a universal development strategy that works for every person. Goals cover the three dimensions of sustainable development: Environmental protection, social inclusion and economic growth. What makes these new SDGs even more different from MDGs is that these goals are universal and apply to all countries and not only developing countries. The core is a strong focus on means of implementation, capacity-building and technology, data and institutions, and the mobilization of financial resources (UN, 2017). It is important to implement and teach people about the SDGs, and here are some statistics why it is so important.

Here are just some examples that MDGs managed achieve by 2015:

- 1.9 billion people living on less than $ 1.25 a day reduced to 836 million between 1990 to 2015
- primary school enrolment rose from 83% in 2002 to 91% in 2015
- Around 2/3 of developing countries manage to achieve gender equality in primary education sector
- The past 25 year till 2015, child mortality rate dropped by more than half
- The maternal morality ration has fallen by nearly half
- Around 2.6 billion people gained access to improved drinking water since 1990 (the guardian, 2015).

These are just some of the goals that MDGs have managed to achieve, and the SDGs is assumed to achieve even more results on the poverty and environmental problems. Figure 1 on the next page, illustrates the 17 new goals of sustainable development.

Figure 1: UN sustainable development goals of the 2030 agenda for Sustainable Development (UN,2017)

Due to a complicated and long agenda plan, SDGs are explained in short simple sentences to give the basic understanding on the goals that the UN wants to achieve by 2030.

Table 1: Goals the UN wants to achiever by 2030 (UN, 2017)

SDGs	Agenda of goal
Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forest, combat densification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

- UN Sustainable Development Goal Knowledge platform 2015

3.1 Sustainable development and the Human Development Index (HDI)

Sustainable development purpose is to meet the needs of the present and ensure future generations to meet their own needs. To achieve sustainable development, is to combine the three core elements: social inclusion, economic growth and environmental protection. To achieve the requirement for sustainable development it is indispensable to eradicate poverty in its all dimensions and forms (UN, 2017). SDGs aim is to eradicate extreme poverty everywhere around the world. When talking about poverty, it is often only defined by one-dimensional measured, such as income. It is important to understand what is poverty and how it can be measure correctly to get as realistic results as possible. For example, a person in Finland might live in income poverty but does not lack basic human needs, but a person living in Nepal might lack of basic human needs and suffer from income poverty at the same time. Thus, it is important to understand the intensity of person's deprivation. One dimensional measures do not reveal the true depth of poverty. The use of HDI gives a more comprehensive picture of the poverty in different countries, revealing who is poor and why the person is poor. HDI is measured by three main dimensions, health, education and standard of living. These are divided into ten different indicators, and poverty measures are then divided on intensity of poverty and headcount ratio. Using HDI helps to understand countries poverty level in different areas and sub-groups of people in these areas (OPHI, 2017). MPI is explain in more detail in the figure 2 diagram of MPI.

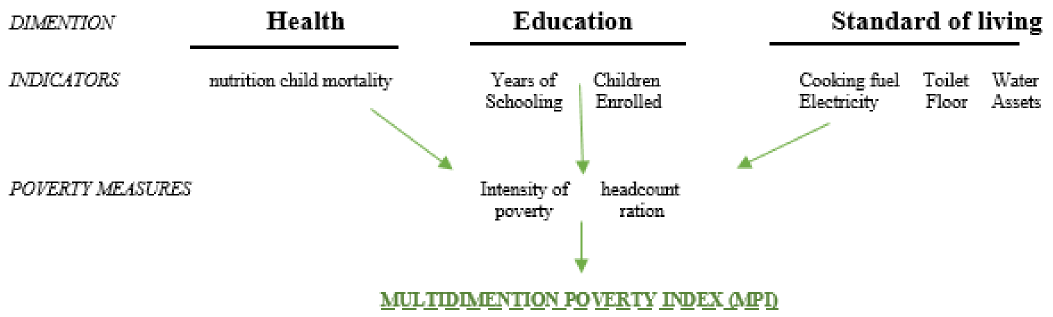

Figure 2:HDI explanation of dimensions (OPHI, 2013)

HDI in the Far Western mountain and hill region is distressing from 0.386 to 0.466 respectively, whereas Nepal's average HDI is 0.509 (UNFCO, 2011)

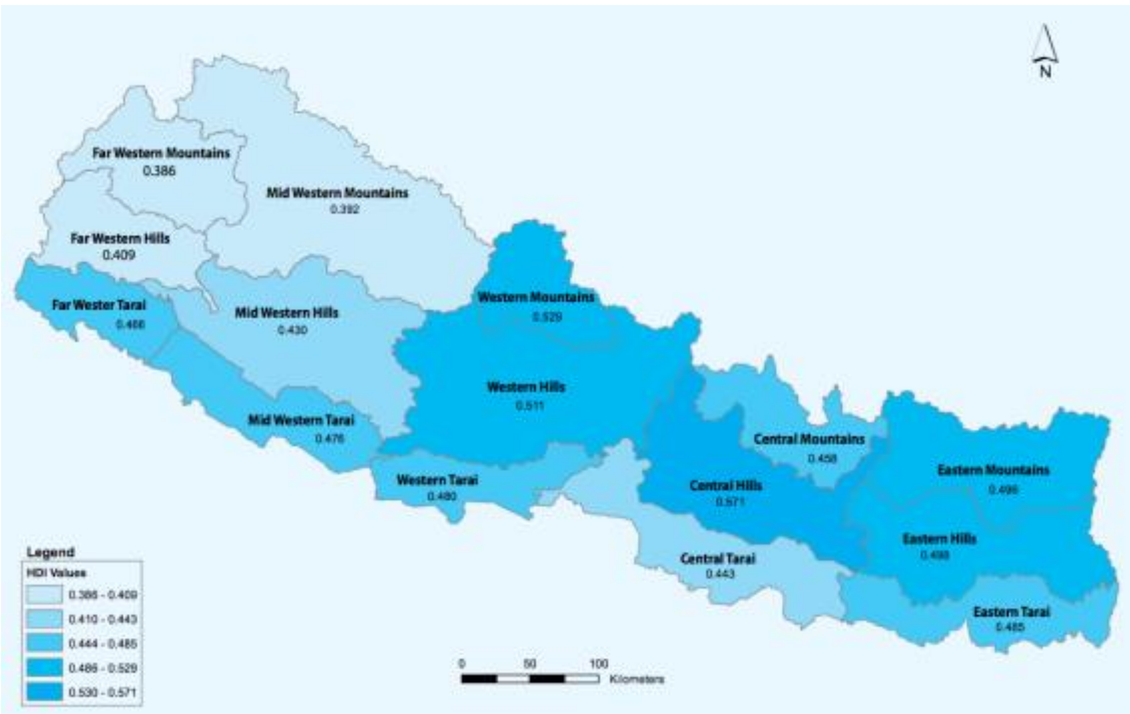

Figure 3: Human development index % (UNDP,2014)

3.1.1 How rising of HDI will help Far Western rural region

As explained earlier, the Far Western Region scored lowest HDI in all Nepal. This is primary due to low scores for education, life expectancy, and in general lows scores in all three detentions. When scores are higher, the region is more likely to have reduce of poverty and higher life expectancy, higher change to finish the education and higher per capita income (UNDP,2015).

When implementing SDGs to communities, it will give an opportunity to make better choses in the development field. More of this will be discussed on the chapter 2.6 SDGs learning centre.

4 Community development

In this project, it is important to understand the definition of community development. It is vital to make this project to be successful. Understanding and implementing good and easy development plans to the community, helps communities gain benefits from project work.

The aim of community development is to gather community members together and take collective action and generate a solution for the problems with grassroots level. To make rural communities to work, it is vital to maintain adequate infrastructure, enhancing business and economic opportunities, have access to services and communities to have a rethinking asset. Communities must have a comprehensive agenda to help dwellers gain better access to services and information. When approaching community development developers usually face five main challenges when implementing: new improvements; coping with perceptions, changing the role of government, greater recognition of community values, fostering community confidence and new forms of participation (Jim Cavay,2011).

4.1 Benefits of community development

Good community works, when locals use assets in new ways, mobilize existing skills, work cooperatively, put innovative ideas into action, and improve networks. When planning a project work on improving rural communities, it is important to build enthusiasm and confidence of the community people, challenge overall community attitudes and perceptions and build relationships with inside and outside key individuals (Jim Cavay, 2011).

Implementing works shops to change existing skills, changing innovative ideas into action, teaching sustainable agriculture and climate change effects on Nepal helps dwellers to make good sustainable changes in their life and helps poorer people to rise from poverty.

4.2 Rural settlement

Rural settlements are permanent living areas which most of the time concentrate on agriculture, forestry, fishery and mining. There are many types of settlements but most commons settlements are compact, semi-compact, helmeted, and dispersed/ scattered settlements. In compact settlements, the dwellings are concentrated in one central site, where the inhabitants are living in close proximately for each other raging from a cluster of thirty to hundreds of dwellings of different size, functions and forms. In semi-compact settlements, the dwellings are not very closely compacted and covers more area than the compact settlement. Hamleted Settlement are spread over the area and often lack of main or central settlement. In dispersed settlements, the inhabitants live in scattered in the cultivated fields in isolated dwellings (Smriti Chand, 2016).

4.2.1 Settlement patterns

Settlements patterns are made for citing shape of the settlement according to housing formation. There are four main settlement patterns, Linear, Nucleated, dispersed and Isolated. Figure 4 shows how each settlement pattern should look (3D geography, 2017).

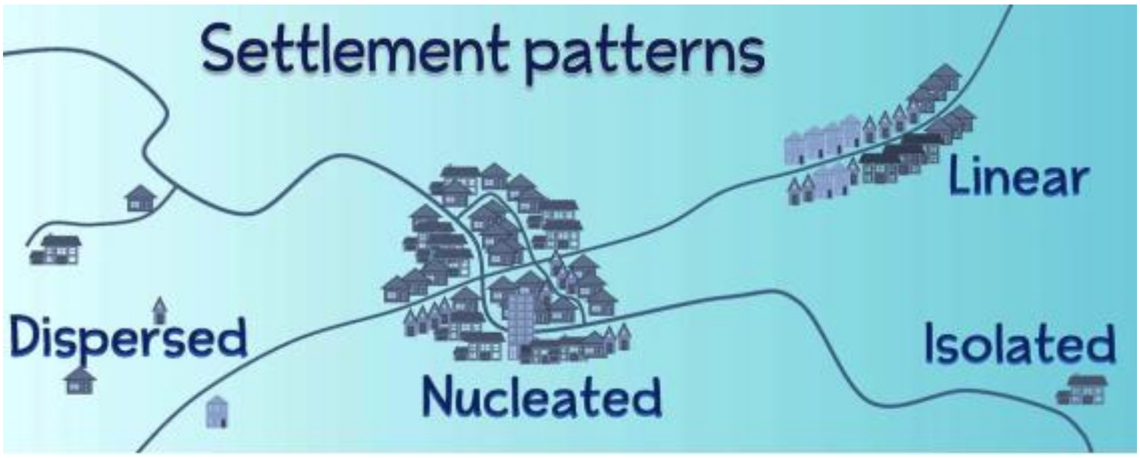

Figure 4:Settlements patterns according to their type. (3D geography, 2017)

4.2.2 Relevance of settlement types to the project plan

Knowing the settlement types and patterns makes designing of the biogas plant possible when implementing a community biogas plant whose aim is to maximise the help for as many dwellers as possible.

To maximise the benefits for community biogas plant, isolated or dispersed settlements are not ideal for the plant, because the piping system cost would rise when dwellers are far away from each other. Minimizing the installing cost of piping lines, the ideal dwelling type is a nucleated or linear settlement where dwellings are adjoined.

In many development projects, biogas plant is built for single family and not for a dwelling complex. Installing a community biogas plant will cost more, but for a single person the installing cost goes down. This is explained more detail on the *table 2. On page 2.*

4.3 Sustainable agriculture

Sustainable Agriculture in simple terms is the production of food using farming techniques that protect, health, communities, animal welfare and the environment. The key is to produce food without compromising future of generations (CCF, 2017).

5 Case study – Nepal

5.1 Background and justification

Nepal is breathtakingly beautiful country with Terai, hill and mountain sites, but at the same time it is one of the most vulnerable countries in the world with natural disaster and the effect of climate change. Nepal is a host for 10 percent of the world's glacial lakes, and is in a high seismic hazard zone, where over 80 percent of the Nepalese are facing high risk from natural hazards such as, floods, landslides, fires, hailstorms and windstorms. Nepal is ranked fourth in global scale of vulnerability to the impact of climate change, and the threat of climate change has a huge impact on livelihoods and GDP. Climate change is posing a serious threat to people in Nepal, especially people living in mountain communities. Thus, a slight change in climatic condition could have a major impact on the lives of Nepalese and their livelihood, where nearly 70 percent of population depends on agriculture (UNDP, 2015).

5.2 The Far Western Region of Nepal

The Far Western Region (FWR) in Nepal comprises two zones, the Mahkali and Seti covering a total 19, 539 km^2. Far Western Region has nine districts and is located in a remote area making the region challenging to develop. Demanding topography causes limited access to services and limits the opportunities to increase services in this region. As much as 49 percent of the Himalayan districts and 44 percent of the Far Western Hills live below the poverty line. Development faces difficulties due to a complex socio-economic structure with outspread caste and gender discrimination. Customs, religion and culture classes of the traditional system making the great impact on development (UNFCO, 2011).

Figure 5: The War Western Region of Nepal (UNFCO, 2011)

According to UN field coordination office (UNFCO), Major challenges are caste and gender-based discrimination, high seasonal migration to India and lack of employment. The Kamaiya/ Haliya system and bonded labour causes socio-economic exploitation. Low literacy rate, limited access to quality education and insufficient school facilities increase widespread child labour and generation poverty. Lack of basic health services and high malnutrition cause high maternal and infant mortality rates. Poor infrastructure across the districts and transport facilities makes people to relay heavenly on porters and mules. Demanding topography is prone to natural disaster such as forest fires, landslides and floods makes together with poor infrastructure across the district agricultural productivity be low. Insufficient irrigating system and limited markets and production opportunities causes further harm on agricultural productivity (UNFCO, 2011).

5.2.1 Kailash village

Kailash is a small village in the Bajhang District of FWR. It belongs to Seti zone. Kailash is one of the poorest villages in the Bajhang district, where the main income comes from the agricultural sector. In Kailash, major of the households lack basic household resources. Main source of fuel for cooking comes from the firewood, only 36 of the household have some form of toilet, and the main fuel for lightning comes from the three source: kerosene with 90 household, solar with 66 household and unknown source with 181 household. Annex.1 gives more detail picture about the household statistics in Kailash.

Table 2 shows the common source of fuel, household sizes and sanitation facilities. There is no biogas plant in the village and only portions of the households use solar as their fuel of lightning. To make a long-lasting change on the village, which lack of most basic elements, it is important to think how to approach the solution.
Building a small-scale community biogas plant will improve situation on cooking, lightning and sanitation (Government of Nepal, 2011).

Table 2: Household statistics on Kailash village (Government of Nepal, 2011)

Total household	339
Population	1911
Absentee population	202
Absentee household	100
Average household size	5.74
Main drinking water source	
tap/piped water	142
Uncovered well/Kuwa	138
Main fuel for cooking	337
Wood/firewood	2
other	
Fuel used for lightning	
Kerosene	90
Solar	66
Other	181
Household by type of toilet	
Without toilet	301
Flush toilet	12
Ordinary toilet	24

Majority of the villages in Kailash belong to Thakuri caste, which are generally known work as a farmer or landlord. Even though the Thakuri caste is known for their royal family heritage, modern Thakuri living in Kailash live under poverty line and are far from the old nobility caste. Poverty and farming culture could explain the reason for low literacy rate and lack of secondary and higher education. With these, problems on multidimensional poverty and lack of modern household system increase the depth of the poverty and generational poverty.

To ensure household getting better quality of life and stop the generational poverty, education centre is vital for households to make better choses and reach better options in live. This is not enough to stop the problems, but combining this to the biogas plant will solve majority of the problems cost by multidimensional poverty.

Table 3: General education level in Kailash village (Government of Nepal, 2011)

Average age population	
0-19	1046
20-29	287
Male population aged 5 years and above by literacy rate	68.18 %
Female population aged 5 years and above by literacy status	43.07 %
Male population that have completed the educational level of	
Beginner	69
Primary (1-5)	247
Lower secondary (6-8)	110
Secondary (9-10)	75
S.L.C & equiv.	49
Intermediate & equiv.	29
Graduate & equiv.	10
	0
Female population that have completed the educational level of	
Beginner	70
Primary (1-5)	213
Lower secondary (6-8)	75
Secondary (9-10)	43
S.L.C & equiv.	21
Intermediate & equiv.	17
Graduate & equiv.	1
Male population aged 5-25 years by school attendance	1020
Currently going to school	833
Not currently going to school	175
Attendance not stated	20
Female population aged 5-25 years by school attendance	1141

Currently going to school	775
Not currently going to school	332
Attendance not stated	34

6 Small scale community biogas plant case study implementation for Kailash

Bioenergy

The definition of Bioenergy in Oxford English Dictionary is "*Energy for industrial and domestic use derived from biofuels or other plant or animal sources".* (oxford dictionary, 2010)

The use of bio-based energy is one solution to decrease the amount of generated greenhouse gas emissions and the use of fossil fuels. It provides national energy security, since bio-based waste is present everywhere where the households are. As seen on the figure 6, biogas plant has three beneficial elements for the environment and the households. Biogas plant reduce CH4 emission by using manure as a source of fuel. Biogas plant produce gas, what households can use as a fuel for cooking and lightning. This will stop the harmful gases rise to the atmosphere and reduce the deforestation. Bio-slurry is the left over from the biogas production and can substitute chemical fertilizers and reduce the soil, water and air pollution.

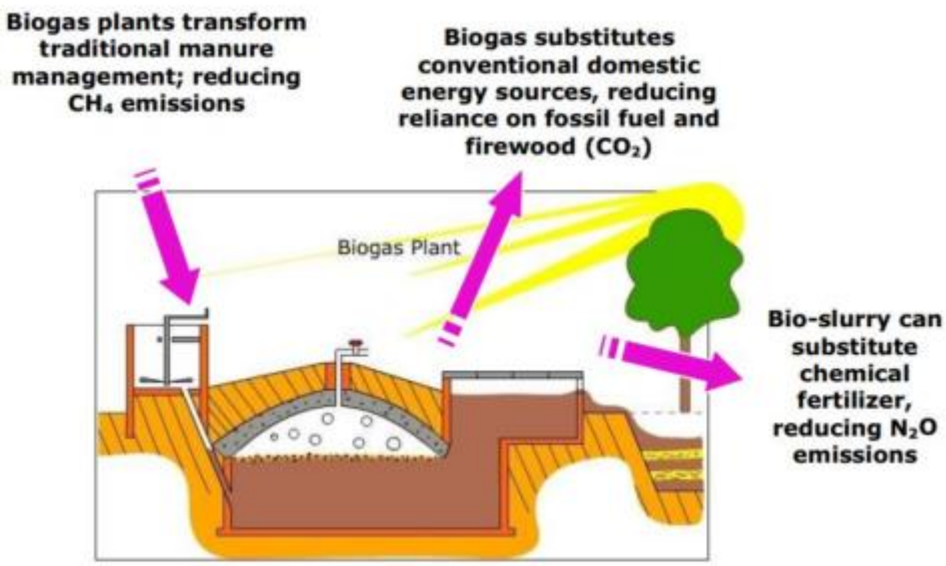

Figure 6: Explanation of why biogas plant is good (eawag,2010)

Biogas is one of the renewable energy resource and is generated through of an anaerobic digestion of organic material process. These organic materials come from human and animal waste, agro-industrial waste, crop residue and other biomass materials. Biomass energy is obtained from the waste materials mentioned above and contains methane, carbon dioxide, nitrogen, hydrogen sulphide and other components. (George Otim, 2010)

Table 4. Composition of biogas (George Otim, 2010)

Composition of biogas	Percentage	Properties and Remarks
Methane	55-70	Main source of energy, lighter than air and has ignition temperature of approximately 700°c with specific gravity of 0.86 and a flame factor of 11.1. Its flammability in air is 6-25%(safer than other gasoline)
Carbon dioxide	30-45	Green gas. Use for photosynthesis
Nitrogen, hydrogen sulphide and others	1-5	

Methane is the main source of from anaerobic digestion of manure and has a great negative environmental impact on groundwater contamination and air pollution. An average just one cow's dung and urine can produce around 3.0 kwh of electricity and eliminates methane release to the air, which is 21 times more damaging than carbon dioxide. (George Otim, 2010)

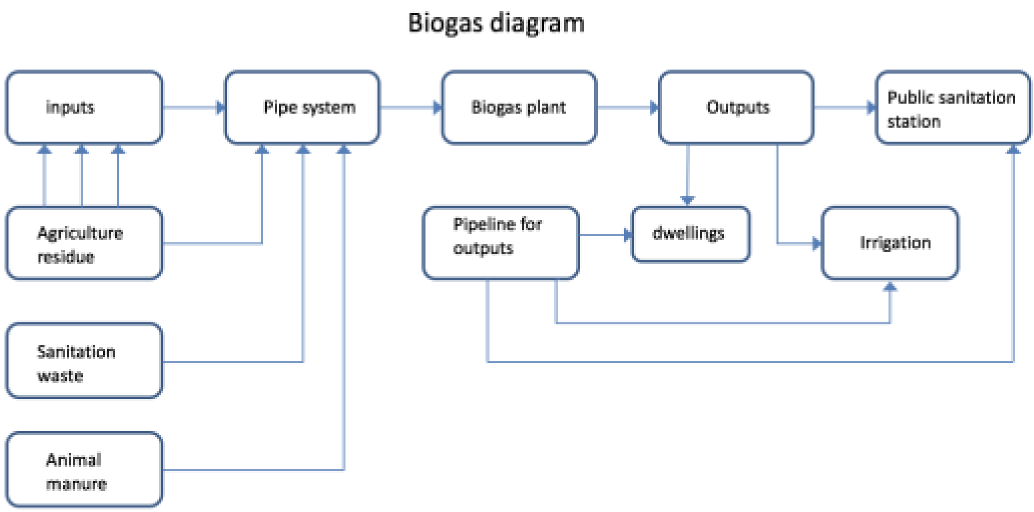

Figure 7: Material flow on the biogas plant

For example, in Kailas, roughly 90 percent of the villagers use open deification causing many environment and health problems. Reducing the deification problem, when building a biogas plant, community toilets should be build and connected to the biogas tank.

Figure 7 and 8 demonstrate how the community toilets can be benefit on biogas plant.

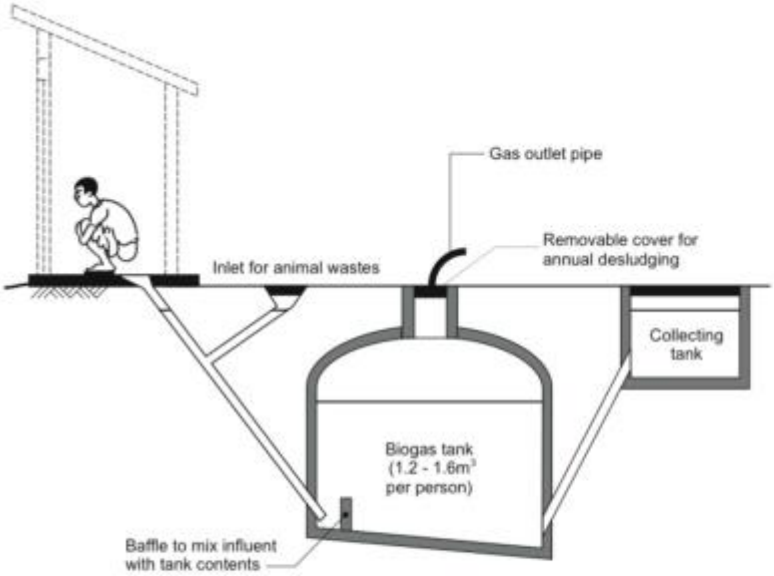

Figure 8: Biogas plant using human faecal matter and animal manure as a source of waste (Eawag,2010)

Kailash has a high poverty rate and running cost of a biogas plant is very low US$ 0.25 with a life of 20 to 30 years does not affect negatively to the household's budget. Instead biogas plant promotes sustainability and helps households to save money (George Otim, 2010).

6.1 Determine the plant size

When determine the plant size, it is important to take account is the fuel demand, amount of the people using the plant, the expected hydraulic retention time of the material in the biogas system and the average daily feed stock.

According to the Himalaya Time, 20 m^3 biogas plant cost around 400 000 to 500 000 NPRs (US$ 3897,65 to US$ 4872,06), Thus the 70 m^3 biogas plant cost between 13 US$ 641.775 to US$ 17 052.21 (Madan Wagle, 2016).

Table 5: Biogas plant capacity, feedstock and cost

Plant capacity m^3	Daily feedstock	Daily water	Cost

	(Kilogram)	(Litre)	(US$)
70	694.65	694.65	13 641.775 to 17 052.21

The biogas plant consists five main components: Inlet tank, digester vessel, dome, outlet chamber and compost pits.
692.65 kg of daily feedstock and 692.65 kg of daily water is mixed in the inlet tank and the slurry is discharged to the digestion (digester vessel). This phase last on average of 35 days where organic matter is breakdown in the absence of oxygen, producing methane, carbon dioxide and traces of other gases. These gases are collected in the dome and the digested slurry flows to the outlet thank though the manhole. The gas is supplied from the dome though the pipeline to gas stoves and lamps. The slurry flows through the overflow opening in the outlet tank to the compost pit, where it can be used as a fertilizer (United State Forces, 2011).

6.2 Calculation

Due to the size of villages, village must be divided on smaller sectors to calculate size of the biogas plant. In General, rural settlement type in hill and mountain area is linear or nuclear, making this biogas plant production easier due to the shorter and the straighter gas piping system.

The biogas plant can produce enough gas for 48 households, but cost of the plant will rise due to gas pipe installation. This is still more cost effective, than having multiple small one household biogas plant due to complicated infrastructure, where access to the village must be done by using caravans, where mules carry materials for the biogas plant.

Even though the total amount of the household in Kailash is 339, according to the Government of Nepal survey study in Bajhang Districts, shows that only 239 households were currently living in the village.

Current amount of household: 239

Approx. 1709 people in the village

(Mean value of the animals in mountain per agricultural household (FAO,2010))

3.9 cattle per household

2.1 buffalo per household

5.6 goats per household

1.5 pig per household

7.7 poultry per household

5.7 people per household

Average household size is 5.74, assuming, that 10 out of 48 households fill the mean value of animals, the size of the plant can be calculated using 10 households producing the methane gas.

Figure 9, shows the main feedstock sources, daily manure yield, and the gas yield. Calculation are based on these feedstock sources combined with mean value of the animals per agricultural household.

animal species/ feed material	daily manure yield			fresh-manure solids		liveweight	C/N	gas yield	
	manure		urine	DM	ODM			range	average
	[kg/d]	[%$_{fw}$]	[%$_{fw}$]	[%]	[%]	[kg]	[-]	[l/kg ODM]	
cattle manure	8	5	4 - 5	16	13	135 - 800	10 - 25	150 - 350	250
buffalo manure	12	5	4 - 5	14	12	340 - 420	20		
pig manure	2	2	3	16	12	30 - 75	9 - 13	340 - 550	450
sheep/goat droppings	1	3	1 - 2	30	20	30 - 100	30	100 - 310	200
chicken manure	0.08	4.5	-	25	17	1.5 - 2	5 - 8	310 - 620	460
human excreta	0.5	1	2	20	15	50 - 80	8		
corn straw	-	-	-	80	73	-	30 - 65	350 - 480	410
water hyacinths	-	-	-	7	5	-	20 - 30	300 - 350	325
vegetable residues	-	-	-	12	10	-	35	300 - 400	350
fresh grass	-	-	-	24	21	-	12	280 - 550	410

Figure 9: main feedstock source for biogas plant (Chagumaira, Isaiah,2011)

Gas production

∑ x per 10 households

∑cattle = 10 household x 3.9 cattle

= 10 x 3.9

= 39 cattle

∑ Buffalo = 10 household x 2.1 buffalo

= 10x2.1

=21 Buffalo

∑Goat= 10 household x 5.6 goat

=10 x 5.6

=56 goat

∑ pig= 10 household x 1.5 pig

= 10 x 1.5

= 15 Pig

∑ poultry= 10 household x 7.7 poultry

= 10 x 7.7

= 77 poultry

∑ Human= 10 household x 5.74 human

= 10 x 5.74

~57 human

Yield production

Cattle yield 250 l per head day of gas (Yield cattle = ∑ cattle x 250 l)

= 250 x 39

= **9750 l**

Buffalo yield 250 l per head day of gas (Yield buffalo = ∑ buffalo x 250 l)

= 250 x 21

= 5250 l/d

Goat yield 200 l per head day of gas (Yield goat = ∑ goat x 250 l)

= 200 x 56

=11 200 l/d

Pig yield 450 l per head day of gas (Yield pig = ∑ pig x 450 l)

= 450 x 15

= 6750 l/d

Poultry yield 460 l per head day of gas (Yield poultry = ∑ poultry x 460 l)

= 460 x 77

= 35 420 l/d

Humans yield 40 l per head per day of gas (Yield human = ∑ human x 40 l)

= 10 x 40 l

= 400 l/d

Total yield = 9750 + 5250 + 11 2250 + 6750 + 35 420 + 400

= 68 820 l/d

= 2868 l/hr

Gas Usage

Due to lack of accurate data of the energy usage of the village, a biogas plant size calculation has been adapted from Debvikilum community case study, consisting 8 people (Chagumaira, Isaiah, 2011).

Calculation of gas demand used information from Debvikilum case study, where total gas demand for everyday activities (cooking and lightning) per community of 8 was 2000 L/d (Chagumaira, Isaiah, 2011).

Usage (per person) = 2000 ÷ 8 = 250 l/d

Usage (total) = 57 x 250

= 14 250 l /d

= 594 l/hr

Estimated gas production is 4.8 times bigger than gas usage in 10 household. Therefore, more households can be connected to the gas pipeline. There is enough gas for 48 households all together.
Extra houses added to the gas pipeline gives the total demand of gas is 2 849 l/hr

Usage (48 household) = 273.5 x 250

= 68 375 l/d

= **2 849 l/hr**

This way the gas production 2 867.5 L/hr is equal to estimated gas usage 2 849 L/hr, therefore it will be effective to add extra household on the gas pipeline

Gas Storage Capacity

Using the Debvikilum community case study, gas consumption for community was 470 L/h, adapting this value for consumption to this case study, maximum consumption can be calculated based on same techniques as gas usage.

Consumption (Max) = 470 ÷ 8 x 273.5

=15 384 l/hr

Consumption yield is calculated by maximum usage minus production. This way the maximum decrease in gas can be calculated.

Consumption yield = 15 384.4 - 2849

= 12 535 l/hr

The gas is consumed by the rate for 3 hours, where the volume of gas storage can be calculated.

Volume (gas storage) =12 535.4 x 3

= 37 606 l

When calculating the size of the biogas plant, the fluctuation should be taken account by multiplying consumption yield by safety factor of 1.25, to ensure adequate gas consumption increase by 25 %

Volume (gas) = 37 606.2 x 1.25

= 47 008 l

Sludge Storage Capacity

Cattle produce 8 kg per head per day of manure.

Quantity (Cattle)= ∑ cattle x 8 kg

= 39 x 8

=312 l/d

Buffalo produce 12 kg per head per day of manure.

Quantity (Buffalo) = ∑ Buffalo x 12 kg

= 21 x 12

=252 l/d

Goat produce 1 kg per head per day of manure.

Quantity (Goat) = ∑ Goat x 1kg

=56 x 1

= 56 l/d

Pig produce 2 kg per head per day of manure.

Quantity (Pig) = ∑ Pig x 2 kg

= 15 x 2

= 30 l/d

Poultry produce 0.08 kg per head per day of manure.

Quantity (Poultry) = ∑ Poultry x 0.08 kg

= 77 x 0.08

= 6.2 l/d

Human produce 0.5 kg per head per day of manure.

Quantity (human) = ∑ Human x 0.5 kg

= 57 x 0.5

= 29 l/d

Quantity (total) = 312 + 252 + 56 + 30 + 6.2 +29

= 696 l/d

Manure is stored in the tank for the next 80 days; thus, the quantity must be multiplied by 80 to get the final volume of sludge in the tank.

Volume (Sludge) = 694.65 x 80

= 54 772 l

Volume of Tank

The volume of the tank is calculated by added together the volume of gas and volume of sludge.

Volume (total) = Volume (gas) + Volume (Sludge)

= 37 606.2 + 54 772

= 92 378 L

Assuming, that there will be some differences of the household animal sizes and not all the households will use the new system, the realistic percent of the use and size should be around 75 %. Thus, calculating the adjusted volume is used to calculate the size of the biogas plant.

Volume (adjusted) = 92 378.2 x 0.75

= 69 294 L

To know the size of the biogas plant, the radius of the chamber is calculated by using the adjusted volume.

Radius(r) of the camber:

69 294= 69.3m3

69.3 =$(2*r^3\pi)/3$

r = 3.2 m

Volume of Compensation Task (CT):

Volume of compensation tank is calculated to allow an excess gas produce without excessive pressure, thus the volume in both chamber is the same.

Volume (gas) = 47 007.75 L = Volume (CT)

Volume (CT) = 47 007.75 L x 75 %

Volume (CT) = 35 255.8 L

≈ 35 m^3

Radius (r) of CT:

35 =$(2*r^3\pi)/3$

r ≈ 2.6 m

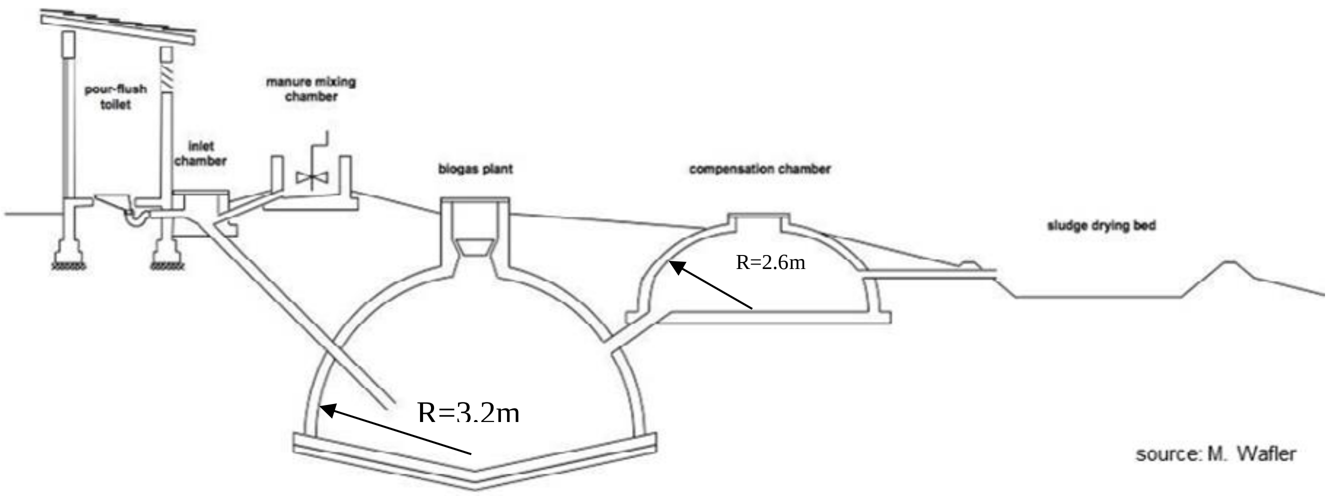

Figure 10: How the radius on main chamber and compensation tanks is measured (Chagumaira, Isaiah,2011)

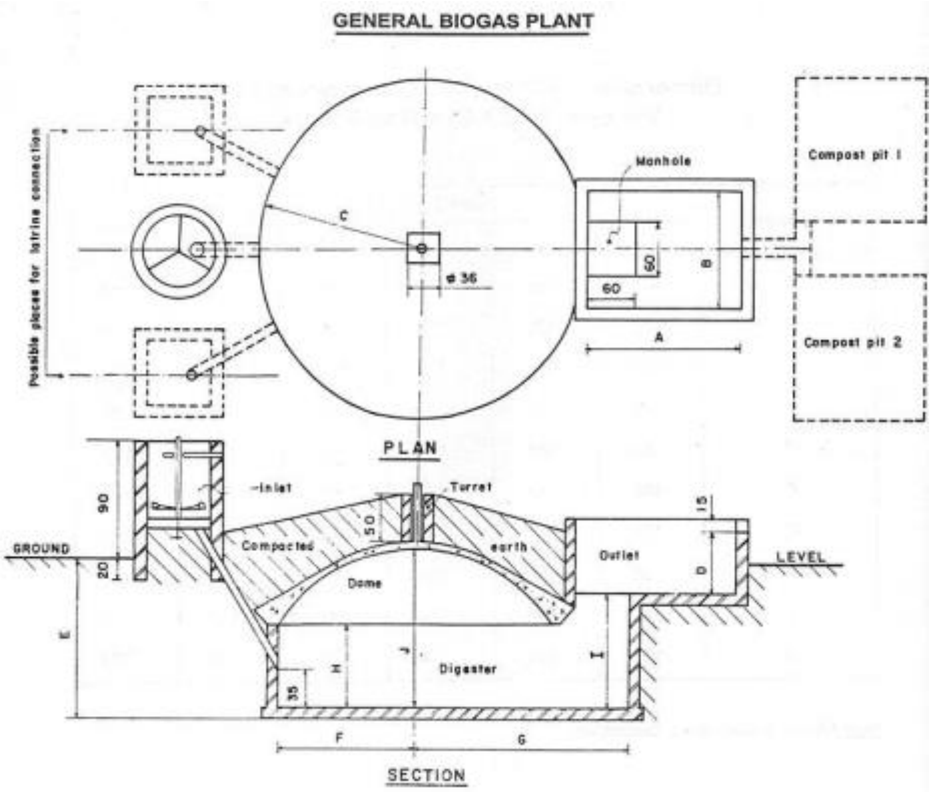

Figure 11:Detailed picture of the general biogas plant (United State Forces, 2011)

6.3 Construction Materials

It is important to use quality materials, otherwise the quality of the plant will be poor even though the skilled labour and right design are excellent. Table 5. Gives the list of construction materials used on general biogas plant.

Table 6: List of materials and building labour (United State Forces, 2011)

Particular	**Unit**	**70m^3**
1.Building materials:		
Bricks	Piece	9800
Sand	Bag	420
Gravel	Bag	245
Cement	Bag	119
6 mm rod	Metre	340
paint	Litre	14

2. Building labour		
Skilled labour	Days	15
Unskilled labour	Days	55
3. Pipes & appliances:		
vert. mixer device	Piece	-
hor. mixer device	Piece	1
inlet pipe	Piece	2
dome gas pipe	Piece	1
GI pipe	Piece	24
Socket	Piece	6
Elbow	Piece	12
Tee	Piece	5
Union	Piece	1
Nipple	Piece	6
Main gas valve	Piece	1
Water drain	Piece	1
Rubber hose	Metre	2
Gas stove	Piece	2
Gas lamp	Piece	3
Teflon tape	Roll	4
In case of stone masonry		
3 extra bags of cement		

When selecting construction site, it is important to find the optimal site for plant and take account the following points.

- Plant should be placed in a sunny site to keep the digester near 35 degree Celsius
- Plants edge should be at least two meters away from the nearest house or structure to avoid any potential damage during construction and maintenance.
- Plant should be placed at least 10 meters away from water areas, just as surface water, groundwater, wells or other water bodies to protect water from potential pollution.

- Designing the ideal place for plant, the plant should be built on near to household, raw feedstock supplies and water station used for plant.
- If possible, gas pipes length should be kept short to decrease the risk of gas leaks which can occurs when pipeline has number of joints.

6.4 Benefits of small scale community biogas plant

Less time and workload

It is mostly women and girls who do the most labour and spend time collecting firewood and cooking. Women in rural areas will be spared the burden and time up to two hours daily. The reduction in domestic workload increases the opportunities for education, for other social activities and for empowering women.

Cooking with biogas is faster and easier than cooking with charcoal or firewood. With charcoal, a person must wait for the coals to get hot and manage the flame. With gas, the stove does not take much time to heat, it is ready to use right away. And once the mealtime is over, there is no black soot on the stove to clean.

The time saved from collecting firewood, cooking and cleaning soot from the kitchen can be on average, 2-3 hours a day per household.

Benefits of biogas plant:

Examples of improvements that a biogas plant can provide.

Improvement of health and sanitary condition:

- Reduction of pathogenic capacity
- Reduction of disease transmission
- Improvement on nutritional patterns
- No indoor air pollution

Education and culture sector:

- Provides light to families making it possible for them to be active at night by reading, writing, and studying
- More free time for women and children who used to spend hours to collecting fire wood, and can now enjoy free time and attend school
- Gives more time for women to devote more time to children

Distribution of Income:

- Possibility to sell leftover biogas and fertilizers
- No more buying firewood
- No more buying fertilizers
- More money to buy necessary tools and improved seeds for farming

Environmental benefits:

- Reduction of deforestation
- Reduction of greenhouse gases
- Reduction of soil and water pollution from toxic fertilizers (energypedia, 2016)

Below, the table 7 compares bioenergy, hydro, solar and wind power to each other and explains why bioenergy is the best solution for the people living in multidimensional poverty.

Table 7: Comparison of renewable energy resources (Catina Weste,2017),(Windindustry,2017),(Greenelecyticity Guide, 2017)

Solution	Bioenergy	Hydropower	Solar power	Wind power
Initial investment	- relatively low (cost variates depending on the size and the materials used on the plant. Can be used for community and one family use	- high (impossible to invest only with small community or one family)	- high (solar panel has high investment costs but solar cookers are less expensive)	- high (impossible to invest only with small community or one family)
Repayment time	- Less than a year, but this also depends on the type of the biogas plant	- multiple years	- multiple years	- multiple years
Resources at the site	- leftover food - animal manure	-Dependent of the rivers. Cannot be	- Depends on the sun.	- Wind power is depending on the

	- human faeces -Agricultural residues	used in the areas where rivers are faraway.	Seasonal changes will affect the use of solar power	wind patterns on the area. No point to build a wind power to place with no wind
Infrastructure	- plastic and gas pipe lines	- electricity grid and battery technology needed	- unless used for heating, electricity grid and battery technology needed	- electricity grid and battery technology needed
Maintenance and use	- spare parts are quite easy to get - use of the biogas is easy, most of the problems an expert is not needed	- spare parts can be too costly and hard to get - an expert is needed for maintaining the equipment	- spare parts can be too costly and hard to get	- spare parts can be costly and hard to get - an expert is needed for maintaining the equipment
Other uses than energy	- fertilizer - reduces the amount of waste - heat	- none	- heat	- none
Space required	- a little (for single family -only for the tank) Community use, depending on the gas demand	- takes a lot space and that way energy is not in immediate use	- depending on the volume might take a lot of space	- takes much space and that way energy is not in immediate use

Climate Change

Biogas is an environmentally friendly fuel, although it contains CO_2, water vapour, H_2, H_2S and siloxane contaminants.

Biogas production from biomass is carbon dioxide neutral and does not emit additional greenhouse gases into the atmosphere Unlike fossil fuel combustion. The most common energy source of Kailash is burning wood based fuels such as charcoal and firewood.

Gas reduces the greenhouse gas emissions and decreases climate change unlike fire wood, which increases the climate change.

Energy produced with biogas produces only about 5 % of greenhouse gases compared to the same amount of energy produced with firewood. Cooking with biogas reduce the energy consumption and gives light to households without needing to use fossil fuels for electricity.

Decreasing firewood use also slows down deforestation and soil degradation. Cutting down woods for energy is destroying forests in Kailash, and deforestation is a noted problem. Trees also bind released CO_2 (TDBP,2017)

Changing to biogas also increases awareness of environmental impacts, alternative energy sources and climate change.

6.5 Rooftop rainwater harvesting

The FWR is quite different with its monsoon seasons, whereas 85 % of the Nepal get its monsoon rains during the summer season, in FWR rainiest season is during the winter time. During this time, vaporized westerlies wind comes from Mediterranean Sea bringing the rainfall to the region.

During the summer time, the hot wind blows from Thar Desert of India causing many epidemic outburst. Thus, it is important to prevent epidemics to speared and collect enough rainwater during the dry seasons (My Nepal My Pride, 2010).

Rooftop rainwater harvesting is a method of collecting rainwater during the rainfall and store it for the dry season. Lack of drinking water causes problems on the FWR and it is essential to household to have a sufficient and safe drinking water supply though the year. Common reason for not having available access to drinking water is lack of electricity, too expensive water supply system or remote area lacking suitable infrastructure. Lack of clean drinking water has a significant impact on livelihood improvement and health. This will increase the risk of multidimensional poverty and staying in poverty trap.

Rooftop rainwater harvesting provides a local and quick access on the drinking water source on households, community biogas plant and irrigation system. Rainwater harvesting is cheap and easy way to collect water for the dry months and does not need difficult technical inputs when building it. Materials can be collected on locally and labor can be used to constructing the jars, reducing the cost even lower. On average, household spends US$ 3.5 and 6 hours per year on maintenance. The cost of the

harvesting system can be keep down due to simple three basic elements needed for system to work: a collection area, a conveyance system, and storage facilities. The roof of the house is used as a collecting area, where the rainwater runs down to conveyance system which consist of gutters or pipes that deliver rainwater to the storage facility.
Rooftop rainwater harvesting system can be seen on the figure 11, where: 1 is a collecting area, 2 is a conveyance system and 3 is the storage facility also known as a jar (TECA, 2012).

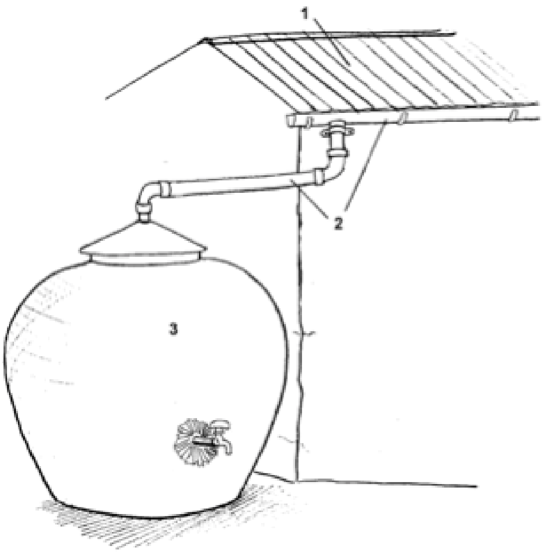

Figure 12: Rooftop rainwater harvesting (UNICEF, 2012)

The financial cost of rainwater harvesting jar of 2000 litre and gutter system cost between NRS. 6000 to NRS.8 500 (US$ 80 – 110). The cost depends on the delivery fees which includes distance of the construction site to the road network, number of jars installed, the size of the jar, and construction materials (ICIMOD,2006)
Main benefits of the harvesting system have direct link to an improvement on health conditions, better hygiene practices, and household time saving on average 6.4 hour per day in water fetching, which usually women and girls are doing. This leaves time for women to reproductive activities, such as cooking, taking care of the children, cleaning, and income generating activities. This also gives more time for management and social activities, as training and studying (TECA, 2012).

Table 8: List of materials(ICIMOD,2006)

Material for rainwater harvesting 2 000 litres jar for 48 households	Cost NPRs

Cement	113 968
Sand and aggregate	7 866
Chicken wire mesh (m)	103 542
Metal jar cover	27 253
Agricultural paint	10 426
Plastic sheet/mosquito screen	7 432
Polyethylene, pipes, reducer	117 478
Nail, clamps, pipe elbows, other materials	17 859
Brass tap, socket, seal tap	17 343
24 skilled mason workers 2 days/house (96 days all together)	57 600
Transportation on mule caravans 1 day (mule caravan)	714 1

7 Sustainable agriculture implementation for local dwellers

Nepal is vulnerable to Climate Change (CC) and have already seen some changes in weather patterns, where two stable states of the monsoon can become chaotic. This means that the monsoon could come drier or more wet monsoon. One of the biggest problems that Nepal is facing with CC is the glacial melt on the mountain area that can cause an outbreak of devastating floods. One which is affecting mainly agriculture is increasing water stress. Nepalese agriculture is depending on water sources from snow, ice and glacial melt, which are changing due to climate change. A change in monsoon seasons will affect the production of crops; seasonal agriculture is depending on unchangeable weather patterns and in the worst case of the case, the whole harvest might be affected due to a change in the weather. Thus, it is important to make sure to adapt to climate change and start producing crops that are suitable for changes and ensure food security (Ryan Bartlett, 2010).

Benefits of sustainable agriculture are listed below:

- Environmental preservation
- Protection of Public Health

- Upholding animal welfare
- Sustaining vibrant communities

Figure 9 gives the indication on how CC could affect temperature, precipitation and runoffs in Nepal and highlights the importance of taking action in the agricultural sector.

Temperature	• Significant rise in temperature: ➢ 0.5 to 2.0 °C by 2030 ➢ 1.3 to 3.8 °C by 2060 ➢ 1.8 to 5.8 °C by 2090 • Increase in the number of days and nights considered hot by current climate standards • Highest temperature increases during the months of June to August and at higher elevations
Precipitation	• Wide range of mean annual precipitation changes: ➢ -34 to +22% by the 2030s ➢ -36 to +67% by the 2060s ➢ -43 to 80% by the 2090s • Increase in monsoon rainfall towards the end of the century: ➢ -14 to 40% by the 2030s ➢ -40 to +143% by the 2060s ➢ -52 to +135% by the 2090s
Runoff	• Higher downstream flows in the short term, but lower downstream flows in the long term due to retreating glaciers and snowmelt and ice-melt • Shift from snow to rain in winter months • Increased extreme events, including floods, droughts and GLOFs

Figure 13: Anticipated changes in climate change on Nepal in coming decades, (Ryan Bartlett,2010)

When thinking of maximizing sustainable agriculture, the following should be considered:

- Genetically improved crops, trees and livestock, increase the productivity, nutritional values, resilience to stress and efficiency of resource use.
- Focusing on natural resources and ecosystem productivities offers an opportunity to reverse environmental degradation
- Climate-smart agriculture focus farmers and other resource users to adopt and mitigate options suitable for them
- Improved health and nutrition education emphasize dietary diversity which is important for poor consumers
- Nurturing diversity ensure to maximize food security, nutrient rich crop and resilient farming and productivity. (CGAR strategy, 2016)

Implementing sustainable agriculture enables farmers to adapt to climate change and lessens the risk of food shortage and famine.

8 SDGs learning centre for Kailash households

The idea of a SDGs learning centre for local dwellers is to improve their chance of rising from poverty, make them to choose a better sustainable option for their everyday lives. This is one of the most difficult implementations to succeed in, due to people's attitude and willingness to change their learned habits.

It is important to do this in the right way and to make sure that the dwellers can participate in each steps of the education process. Ideally, teachers should be from Nepal, making sure that there will not be any problems with the language barrier and having a local might makes the message easier to grasp than If it was an outsider. Other matters that need to be considered are tone and manner of teaching; education should be interesting and something that villagers will listen to. It is easier to take new changes to the heart if people can see what benefits they would gain from these changes. Preparing for the meeting should be done well beforehand and let the dwellers know what the topics of each lesson are. Having a separate place for children during the meeting will increase the chance that more people are coming, when they do not need to leave their children at home. Teaching should contain discussions, group work and other activities where dwellers can work together and think of the ideas that could be beneficial for them.

8.1 Timetable and methods of teaching

Period of teaching:

- goal per 2 months
- 1 lesson taught each week
- lesson time is 2 hours
- all together roughly 3 years of teaching

Five teachers are teaching in different days on the same topic. This will guarantee that everyone can come to the lessons in each week and the size of the lessons stays relevantly small.

Teaching method:

- First months is teaching about the goals and have a general discussion about the topic
- Second months concentrates on group works and different activities related to the month's topic

Method of teaching must be planned according to the literacy rate. When giving a group works and other activities, it is important to take account that not all dwellers knows how to read and/or write.

9 Example of the project plan – Nepal

9.1 project plan

This project is designed for organisations to make a long-term development project in the Kailash village, Far Western Region of Nepal. The purpose is to make rural villages sustainable in the field of agriculture, food distribution and skill management. Lack of education, global warming and poverty makes villagers even more vulnerable for human and environmental changes. Implementing a sustainable development project is a key to make sure that the people living in poverty have an opportunity to escape from the poverty trap.

The aim is to implement this project work for those dwellers who are lacking electricity and cooking gas. These dwellers are generally in a more vulnerable situation and may not be able to have finances to have electricity, cooking gas or send their children to school. At the end of the project, the dwellers have a basic needs and better quality of life. Also, educating and teaching the right methods of, for example farming will increase their production, and the knowledge gained can be spread to others in the area. An ideal goal for the dwellers is to teach others about sustainability, help to build biogas plants to other dwelling areas.

9.2 The project activity

The project activity is to implement sustainable community development in rural Far Western Region of Nepal. Aim is to build small scale community biogas plant to small rural village community combining with the education centre for UN sustainable development goals (SDGs). The project activity will replace chemical fertilizers by using a bio-slurry from biogas plant. Activity will replace the non-renewable energy resource just as firewood or fossil fuels to methane gas produced from the plant, thus reducing the greenhouse emissions (GHG).
The project activity will educate communities about the UN SDGs and teach how this will improve their quality of life. Aim is to reduce multidimensional poverty and break the cycle of generational poverty. (UNFCCC,2014)

The main activities under the project include:

- Support communities to recycle and use renewable energy resources as their main energy source.
- Assisting and train how to build, maintenance and repair biogas plant
- Carry out long term learning SDGs education centre, where local learn about the goals and how these goals can be implemented in their life.
- Motivate to including SDGs to their lifestyle by encourage how these changes will improve their life and reduce the general poverty.

Project works sustainable development benefits attributed for this project:

- Reduce GHG, deforestation, soil erosion, loss of biodiversity, poverty, lack of education and time spend on fuel collection
- Improve living conditions, health, nutrition, education, agriculture production, improve fertilizer quality and sanitary conditions

Location of project activity
Federal Democratic Republic of Nepal

Region/State/Province
The Far Western Region

City/Town/Community
Kailash village

Physical/Geographical location

Location is inside of the Far Western Region

28^0N-16^0N, 83^0N-23.1^0N

Technologies and/or measures

Project type: sustainable development project

Technical Description of the project activity

Technologies used in the proposed project are rooftop rainwater harvesting, biogas stoves and lamps that are fed by biogas digester, weather resistance crops production, and sustainable irrigation.

Rooftop rainwater harvesting is used to give water to irrigation and biogas plant, extra water can be used on other household activities. Due to low rainfall in the Far Western Development region, rainwater harvesting is beneficial in dry seasons. Harvesting only needs three main elements: a collecting area which is the roof of the house, a conveyance consisting pipes or gutters that delivers rainwater falling from rooftops to storage facilities, and storage facilities which are certain type of jars installed on the ground.

Biogas digester have a capacity to hold sludge and gas up to 70 m^3. The biogas plant includes basic technical design components: inlet, gas outlet, gas storage dome, digester, and outlet. The feedstock consists agriculture waste, bio waste from households, human excreta with water and cattle manure.

Weather resistance crops are modified to sustained drought and harsh weather conditions. Using bio-slurry will increase the soils fertility and increase the growth. Sustainable irrigation is to design to use less water and concentrate the maximum water consumption (UNFCCC,2014).

Duration of project activity

The start date of the project will be taken into action when all the agreement has been done and work will start.

Expected operational lifetime of project activity

In biogas plants, the operational lifetime is 20 years, but during its lifetime plant needs maintenance.

Crediting period of project activity/ type of crediting period

Renewable

Start date of crediting period

Start date will start on registration of the project work

Length of crediting period

The duration of the crediting period of this project is 3 years.

9.2.1 Strategic planning

Direction and lifespan	The project will make a considerable progress in the future. When educated dwellers can teach other dwelling areas about sustainability, biogas plants and importance to change old habits to new ones The project will continue after the official work has been done by organizations
Short term and long term goal	**Short term goal:** to help immediately for those who the project is planned for and to make sure that the education is understood and dwellers are ready to implement them to their everyday life **Long term goal:** To spread the knowledge of SDG to a wider area of rural sites. Dwellers teaching each other and educating others about the development benefits.
List of priorities	• Teaching and making sure dwellers understands how to build, maintenance and repair biogas plant • Making sure that the knowledge will be passed on to other dwellers in the rural area. • Reduce poverty

	• Empower women • Raise the awareness of nutrient balance diet • Educating dwellers of global warming and how to adopt the changes
Develop policies	Development policies are done according to the UN 's and Nepalese governments terms
Clear idea of project	• Reduce poverty in the Kailash village • SDG education • Sustainable agriculture • Biogas plant
Need assessment report	Need assessment report is done before starting the project Done at the same time with the plot survey

Plot survey	Plot survey is the first task that must be done when starting this project work. **Plot survey should contain the followings:** • Geometrical location, seasonal pattern, temperature change during the seasons • Ownerships of land and the land sizes • Irrigation method • Chemicals used in agriculture • Crops types and seasonal production • Road infrastructure • Quantity of dwellings • Sanitation facilities and open defecation • Main source of fuels • Health, nutrient balance and life expectancy • Literacy rate and years of education • HDI plot
Mission statement	• The target groups are poor dwellings with no lights or cooking gas • The problems with HDI will be minimised in all sectors • The project is future focus
Mission statement in the future	• Dwellings living under poverty are now self-sufficient and have constant access to lights, cooking gas, clean drinking water and sanitation stations • Quality of life has risen and dwellers are living a healthy life

	• Children in poor families can complete their education • Nutrient balanced diet is possible for all because of sustainable agriculture • No stigma against the poor families, religion or sex

9.3 Goals

The goal on this project plan is to fulfil the missions to reduce the following:

- inadequate network of electricity by building a biogas plant
- inadequate agriculture production by teaching SDGs and by investing in quality seeds and tools
- inadequate skills and knowledge of sustainability development by teaching SDGs
- pre-existing beliefs on gender equality which have a negative effect on income, health and poverty reduction by teaching SDGs
- inadequate sanitation facilities – by teaching SDGs and by building a common sanitation facility which is connected to the biogas plant

9.4 Objectives

9.4.1 Development objectives

- Reduction of waste: organic waste using a biogas plant, non-organic by recycling and reuse
- Traditional firewood replaced by a biogas plant
- No more indoor air pollution: reduction of health problems
- All children from the project dwellings will complete their primary school education
- Gender equality, women's empowerment
- Reduce the risk of deaths under the age of five by having a good nutrient balance diet and clean drinking water

9.4.2 Immediate objectives

- After building a sanitation facility connected to a biogas plant, open deification will end
- The finished biogas plant will give fuel for cooking stove, stopping the air pollution, increase of deforestation and waiting time for fuel to be ready.

9.5 Energy and waste management

9.5.1 Demand and state of energy

The organic waste management problem is reduced when the biogas plant uses it for making electricity. At same time, it will cut down the CO^2 and methane gas which would be otherwise released to the air. Energy demand is cut down to an availability to use waste to produce electricity.

The only problem in waste production remains the non-organic waste, such as plastic, metals, chemicals and other products which can be very damaging for the environment.

9.5.2 State of waste treatment

In general waste treatment is lacking most parts in Nepal. The lack of waste treatment centres makes rural communities to burn their waste, which usually contains a high amount plastic and other harmful substances which are dangerous to the environment and the humans. The main sources of plastic come from product packaging and plastic bags.

9.5.3 Improved methods of energy and waste management

Energy and waste management can be improved in parts by using the biogas plant and educating people on SDGs. Combining these will dramatically degrease the waste problems and at the same time dwellers will gain electricity, fuel for cooking and a good source of fertilizers. Recycling and reusing non-organic waste reduce waste impact on the environment, and it is the only solution for rural areas because the municipal waste management is impossible in most parts.

10 Project description and financing

Methodology	A guide for project work structure is done by starting with surveys of needs and problems that the project is going to face and change. The second step is to start implementing the results on action. The size and location of dwellings gives on idea of the size of the biogas plant and investment costs. Maintenance and repairing cost are staying generally low and will not make major changes to the budget.
Supervision	The purpose is to hire all workers from local places. NGOs will be overseeing the supervision.
Evaluation	The project plan is evaluated by NGO's and changes will be made to the part that need to be edited.
Infrastructure	Underlining foundation or basic framework for this project work
Natural resource management	• All the work is done under the Environmental laws of the UN and the Nepal Government • All the materials are local and recyclable materials later used as much as possible • Main source of material is plastic
Limitation of the project	• Lack of participants for SDG education lectures • Not sufficient founding • Lack of local materials and impossible road infrastructure conditions • Project timing: not during the busiest crop seasons nor during the festival time.
Assessment of the project cost	Estimated project cost covers founding, salary, microfinance, loans and grants. Other cost that are needed to be considered are production costs, running costs, lifetime of plants, and an average cost of a biogas plant.

	Biogas plant production cost includes all expenses and lost income. The following factors are determined by production cost: • Model of the biogas plant – dimensions and size, connection to utilization facilities. • Price of the materials. This varies by quality and quantity • Wages and labor input • Purchasing cost of land - If the land is not owned by the dwellers • Material transportation cost – this depends on the area; More hill/mountain, more expensive the transportation is Total product cost varies but on average, the cost of the biogas plant is between 50 to 75 US$ /m^3 capacity, of which the digester cost is around 35 to 40 per cent. This cost does not include land, which increases the total cost of the biogas plant. A Community plant generally cost less than a small family plant, but the cost for the gas distribution increase when the size of the plant becomes larger. It is important to include the running cost in the estimated project cost. The running cost should include repair, maintenance, and operation. In this project plan proposal, the idea is to teach dwellers to operate, repair and maintain the biogas plant, in which case the running costs are staying relevantly low. Community biogas plants have a high-water consumption which in some cases might increase the total cost of the plant. FWR has monsoon seasons and in generally have rainy days, which makes a possible to use a rooftop water harvesting system to collect the water to biogas plant (Energypedia, 2016). • **Grant application for the cost of SDGs teachers and biogas plant** • Salary is paid for a local trained SDGs teacher, where the average salary per month is 32 133 NPR or US$ 313,11 (Salary explorer,2017) • 70 m^3 Biogas plant cost between US$ 13 641.775 to 17 052.21 (energypedia,2016)

	• Rooftop rainwater harvesting with 2 000 litre jar cost between US$ 80 to US$ 110 (ICIMOD,2006)

Material for rainwater harvesting 2 000 litres jar for 48 households	Cost NPRs
Cement	113 968
Sand and aggregate	7 866
Chicken wire mesh (m)	103 542
Metal jar cover	27 253
Agricultural paint	10 426
Plastic sheet/mosquito screen	7 432
Polyethylene, pipes, reducer	117 478
Nail, clamps, pipe elbows, other materials	17 859
Brass tap, socket, seal tap	17 343
24 skilled mason workers 2 days/house (96 days all together)	57 600
Transportation on mule caravans 1 day (mule caravan)	714 1
Known cost together:	481 481 NRPs or US$ 4664

Total cost for 2000 litre rooftop rainwater harvesting jar per household is US$ 97

Due to lack of material cost available, known material, transportation and labour cost has been calculated below (EWB 2013, the economic times 2015, Nepaliads 2017).

Building material and labour cost for biogas plant	Cost (NPRs)

	Bricks 1st quality 9800 bricks: 186 200 Sand 420 bags: 504 000 Gravel 245 bags: Free Cement 119 bags: 757 755 Skilled labour x 5, 15 days: 45 000 Transportation on truck (one way): 15 000 Transportation on mule caravans (One week travelling time): max. 5 000 Known cost together: 1 512 955 NPRs or **US$14 647,60**

Bricks 1st quality	9800 bricks	186 200
Sand	420 bags	504 000
Gravel	245 bags	Free
Cement	119 bags	757 755
Skilled labour x 5	15 days	45 000
Transportation on truck (one way)		15 000
Transportation on mule caravans (One week travelling time)		max. 5 000
Known cost together:		1 512 955 NPRs or **US$14 647,60**

If the total cost of biogas plant is US$ 17 052.21, and know material, labour and transportation cost is US$14 647,60, rest of the material cost (Pipes & appliances cost) will be **US$ 2 404.61**

Material cost variates depending on the quantity, quality, distance where the materials need to transport and market fluctuation.

Estimated total cost of the project work:

70 m^3 biogas plant total cost US$ 17 052

3-year teaching job with 5 teachers cost US$ 56 360

48 rooftop rainwater harvesting cost US$ 4664

Total cost of biogas plant, SDGs teaching and rooftop rainwater harvesting:

US$ 78 076

Key risks and mitigation measures	Monitoring risk includes the following: • tracking identified risk • evaluate risk process effectiveness throughout the project

	Key risk and mitigation measures will be done with a chart and demonstration pictures. This is done to help to understand and track the risks factors.

11 Conclusion

The Biogas plant has a great positive affect on household life. It will give opportunities that might be lost without biogas providing light and cooking gas. Risks of indoor air pollution are reduced and open deification can be limited by building public sanitation facilities. This especially helps small children under the age of five to stay heathier without suffering a severe health risk caused by faecal contamination.
Biogas plant produce 2 868 litres per day and the demand for the gas for all 48 household is 2 849 litres per day, making the biogas plant efficient to build. 70 m^3 biogas plant is perfect for the community household and the total cost of the biogas plant is US$ 17 052, this means that the cost per household is US$ 355.25.
Rooftop rainwater harvesting is cheap and good way to collect water for later use. It is relevantly cheap, only US$ 97 per household. The water collected to the jar can be used in the biogas plant, household activities and as an irrigation water on agricultural sector.
Adopting sustainable agriculture and changing the crop production to gene manipulated seeds, more sustainable irrigation and a good source of fertilizer produced from the biogas will help farmers to adopt the climate change before it is too late.

The SDG learning centre will help dwellers to change their old habits to better more sustainable use. Teaching about the importance of a nutrient-balanced diet, positive results of equality and education will help families to rise from poverty. These changes are going to be difficult to implement, and making sure that the households will change their view of the world is going to be extra hard, but it will pay off in the long run. The Aim is to change at least 80 percent of the household views, thus the education will last three years. In general, it is difficult to change the minds of the people, even them knowing how much they can gain from the change.

End results aim is that the household can live self-sufficient life, future generation will have an opportunity to finish their secondary education and encourage to apply for higher education. If the results are positive and major chances can be seen on the poverty reduction, improvements on quality of live, project should continue that every household on the Kailash village has access to sanitation facilities, cook with biogas and can have lightning from gas lamps. This means that four more 70 m^3 biogas plant should be build giving the total cost of biogas plants US$ 68 208.

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Annex 1.

Total household	339
Ownerships of house	
Owned	336
Other	3
Type of foundation of the house	
Mod bonded (Bricks/Stone)	335
Other	
Roof of the house ¨	
Tile/Slate	261
Other	
Main source of drinking water	
Tap/piped water	142
Covered well/kuwa	14
Uncovered well/kuwa	138
Spout water	43
Not Stated	2
Fuel used for cooking	
Wood/firewood	337
Other	2
Fuel used for lightning	
Kerosene	90
Solar	66
Other	181
Not stated	2
Household by type of toilet	
Without toilet	301
Flush toilet	12
Ordinary toilet	24
Not stated	2
Absentee population and household	
Absent household	100
Total absent population	202
Absent male	142

Absent female	60

Population and average household size	
Total	1911
Male	917
Female	994
Average household size	5.74
Sex Ratio	92.25
Population by 10 years' age group	
00-9	543
10-19	503
20-29	287
30-39	209
40-49	150
50-59	97
60-69	89

70+	36
Population by caste/ethnicity	
Chhetree	469
Kami	193
Damai/Dholi	39
Thakuri	1100
Sarki	109
Other	1
Male population aged 5 years and above by literacy status	
Can read &write	542
Can read only	55
Can’t read &write	198
Literacy rate	68.18
Female population aged 5 years and above by literacy status	
Can read &write	379
Can read only	63
Can’t read &write	438
Literacy rate	43.07

Male population that have completed the	
educational level of	69
Beginner	247
Primary (1-5)	110
Lower secondary (6-8)	75
Secondary (9-10)	49
S.L.C & equiv.	29
Intermediate & equiv.	10
Graduate & equiv.	0
Post Graduate equiv. & above	0
Other	0
Non-Formal education	0
Level not stated	2
Female population that have completed the educational level of	

Beginner	70
Primary (1-5)	213
Lower secondary (6-8)	75
Secondary (9-10)	43
S.L.C & equiv.	21
Intermediate & equiv.	17
Graduate & equiv.	1
Post Graduate equiv. & above	0
Other	0
Non-Formal education	0
Level not stated	0
Male population aged 5-25 years by school attendance	1020
Currently going to school	833
Not currently going to school	175
Attendance not stated	20
Female population aged 5-25 years by school attendance	1141
Currently going to school	775
Not currently going to school	332
Attendance not stated	34