Project Concept Proposal - Draft

Project Name: Households Efficient Stone Made Woodstoves in Rombo and Hai District, Kilimanjaro, Tanzania

1.0 Project Objectives and Background

1.1 Overall objective

This project aim at improving thermal performance of the woodfuel stoves in rural areas of Kilimanjaro Region located in the northern part of Tanzania. The project activity focus on replacing the three stone fire places (with efficiency of 10 – 15 percent) with improved and efficient firewood stoves (efficient of more than 60%). This will result in reduced woodfuels consumption, avoided carbon dioxide emission and indoor air pollution, reduced workload to women and children and conserved forest resources. Other benefits are income generation opportunities especially to village technicians. The project activities are designed to start with small models that can be replicated in the same project location i.e. Kilimanjaro region.

The project activities will relate to construction of the efficient stoves and imparting knowledge on proper management of woodfuels.

1.2 Background of the project area

Tanzania is located in Eastern Africa between longitude 290 and 410 East and Latitude 10 and 120 South. Tanzania with a surface area of 945,087 Km^2, is bordering with the Indian Ocean to the East, Mozambique, Malawi and Zambia to the South, Democratic Republic of Congo, Rwanda and Burundi to the west and Uganda and Kenya to the North. According to 2002 census, Tanzania has a population of about 35.3 million people with a growth rate of 2%. It is still the poorest country in the world with annual GDP of USD10.7 billion in 2003 and a per capita income of USD 280. The GDP in real terms grew at 6.7 percent in 2004. The increase in growth rate was mainly attributed to dept relief, increase in agriculture products, tourism, minerals and communication.

Tanzania is rich in renewable and non- renewable energy resources but is a least consumer of modern energy at about 70kgoe per capita. Annual per capita electricity consumption stands at 84 kwh and overall per capital annual energy consumption is about 700 kgoe (MEM 2002). The quantitative distributions of the different energy carries to the energy balance are; biomass fuels 90%, petroleum 8%, electricity 1.2% and other less than 1%.

Kilimanjaro is one of the 26 regions in Tanzania. It is located in the northern part of the country (Figure 1). Kilimanjaro region covers 13,209 km2 and is bordered to the North and East by Kenya, to the South by the Tanga Region, to the Southwest by the Manyara Region, and to the West by the Arusha Region. Kilimanjaro is home to Mount Kilimanjaro. Moshi is the capital of the region, the region comprises six Districts: Moshi Urban, Moshi Rural, Hai, Same, Rombo and Mwanga. According to the National population and housing census, the region has

297,439 households, and 1,381,149 residents, 667,865 among whom are males and 713, 284 females with growth rate of 1.6 (URT, 2002).

Hai and Rombo Districts are located along slopes of Mount Kilimanjaro in northern part of the region (Figure 2). Chagga and Pare are the dominant tribe living in this area and they traditionally practice agroforest in small home gardens of about 0.5 ha. Indigenous languages are commonly spoken in the villages, although national language Kiswahili is widely understood. Agriculture, livestock keeping and dairy farming are the main economic activities. Hai and Rombo districts have an area of 2,112 km2 and 1,442 km2 respectively. Hai has a population of about 259,958 and 58,056 households with an average size of 4.5 while Rombo district has a population of about 246, 479 and 50,123 households with average size of 4.9 (Tanzania National Census, 2002). The area borders a water catchment forest of about 139,832 ha.

Population density is so high 2.9% people per square kilometer so is the demand for firewood which is 2.4 million m^3 per year. The high population density and lack of enough land for agriculture and tree growing cause enormous pressure on catchments forest for firewood and other wood products. Just like in many areas of the country women are the victims of the situation and as result they are forced to encroach forest or else they walk several kilometers (10km) away to look for firewood.

The project site face many other problems like water shortage, decreased land productivity, loss of biodiversity, disturbed ecosystem which are directly linked with unsustainable use of tree resources and climate change impacts. A study carried out by OECD in 2003 revealed that the impact of climate change has significantly affected mountain Kilimanjaro glacier which has decreased from 4.2 km^2 in 1976 to 2.5 km^2 in 2000 and there is intensified fire risk and subsequent impacts on biodiversity and ecosystem. Also, according to annual daily rainfall records from Lyamungo Coffee Research Institute, the annual precipitation has decreased by 150mm from 1937 to 2000. Poverty levels is also increasing as it was revealed on study carried out by TaTEDO in 2005, which found that fall of coffee price in the world market has substantially suppressed economy of Kilimanjaro. As a result the income level of low class is around 297 USD per year. This shows that immediate action has to be undertaken.

The efficient stoves proposed in this project add value on indigenous technology that uses indigenous fuel resources and materials. The technology has been practiced in same villages and shown to have high potential to contribute in reducing fuelwood consumption, indoor air pollution and greenhouse gas emissions. Phase one of the project will involve 10 villages of Rombo and Hai districts (each District 5 villages). The villages to be involved are Shimbi Kati, Maharo, Kitasha, Mengwe and Mamsera for Rombo district and Nronga, Kisereni, Mkuu Sinde, Uduru and Mkweseko for Hai District.

The proposed project sites have other energy alternatives such as electricity and kerosene. The average electricity connection fee is 240,000 Tshs (240 USD), electricity tariffs 115 Tshs (0.115 USD) per unit and services charge of 1,700Tshs

(1.7 USD) per month. However, kerosene is imported and its price is about 1000Tshs (1 USD) per liter which is unaffordable for most households.

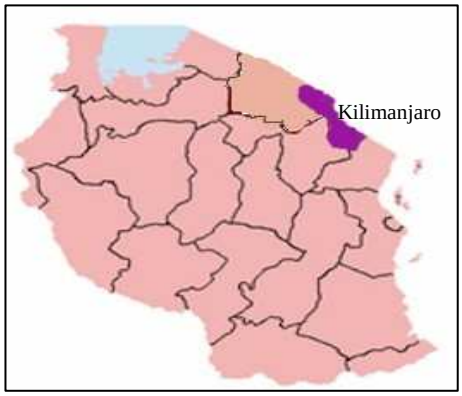


Figure1: Tanzani

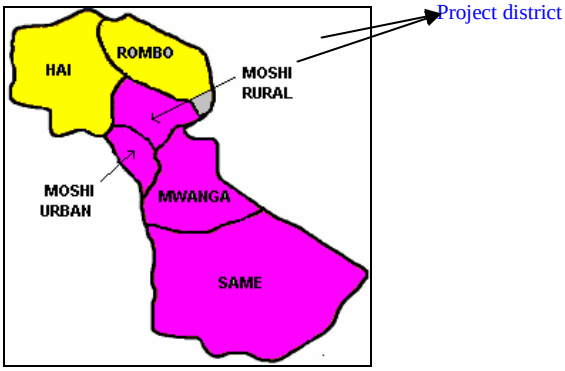


Figure 2: Kilimanjaro Region showing Hai and Rombo district

2.0 Project description

The project activity will start with 6,000 households in which efficient firewood stoves will be installed. Design of the stoves will be adapted considering preferences from women who are the main users of the technology. For instance, women have reported to prefer stoves with two to three cooking fireplaces rather than single fire place (TaTEDO field monitoring report, 2004). The number of installation will be monitored and emission reduction calculated on this basis. The project activity is modular that will be replicated to more households in the same project area.

Installation of the efficient stoves will be done by village technicians who will be trained on how to construct and repair the stoves where necessary. The beneficiary households will contribute labour and construction materials such as water, bricks and sand. The project will contribute 80 % of the cost for 6,000 stoves which will be constructed in the first round. This fund will be revolving funds. i.e. will be recovered and used to install more stoves in other households. Fig 3 shown examples of the efficient stone made stove technology.

Figure 3: Efficient stone made stove technology

2.1 Technical Details and Performance of Efficient Stone Made Stove

The proposed stove is made up of insulating materials, which prevent heat loss and raise heat content inside the firing chamber. This has positive implication in reducing emissions, cooking time and improving forest regeneration and conservation, due to reduced fuelwood consumption.

Combustion chamber is aligned with high temperature resistance bricks which also have insulation properties to prevent heat energy loss through conduction (figure 4).

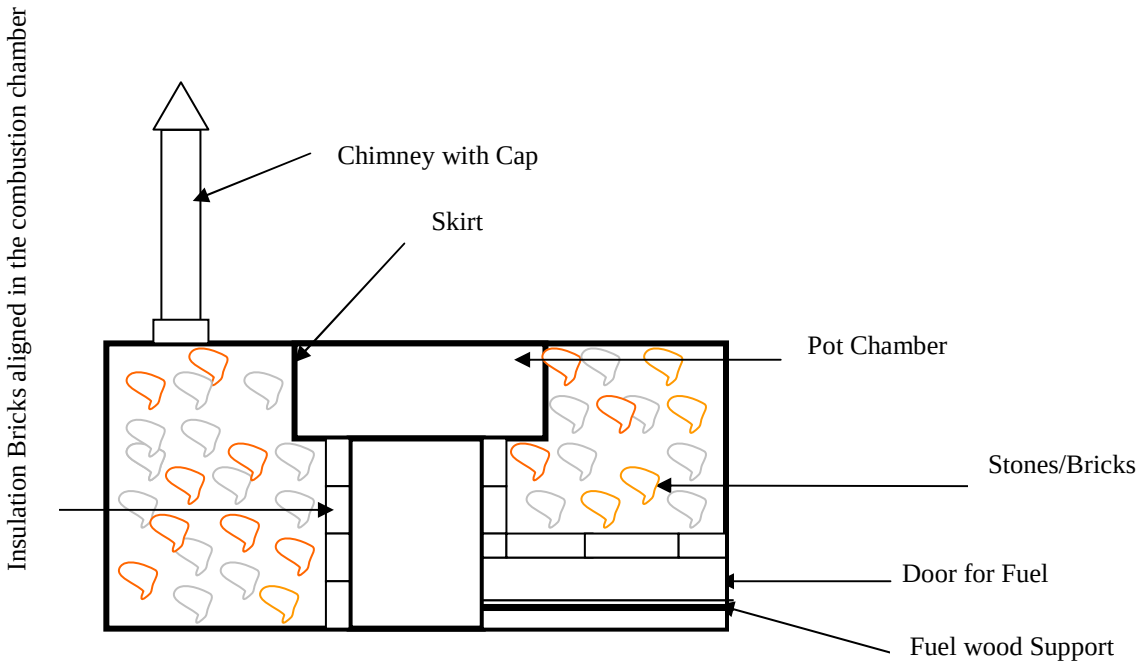


Figure 4: Sectional View of Stone Made Single Pot Firewood Stove

Design parameters for the fuel wood stove such as distance from base of the fire to the cooking pot 1.5x (figure 5)), size of combustion chamber (x) and air gap (gap between side of pot and the wall) is determined by the size of cooking pot.

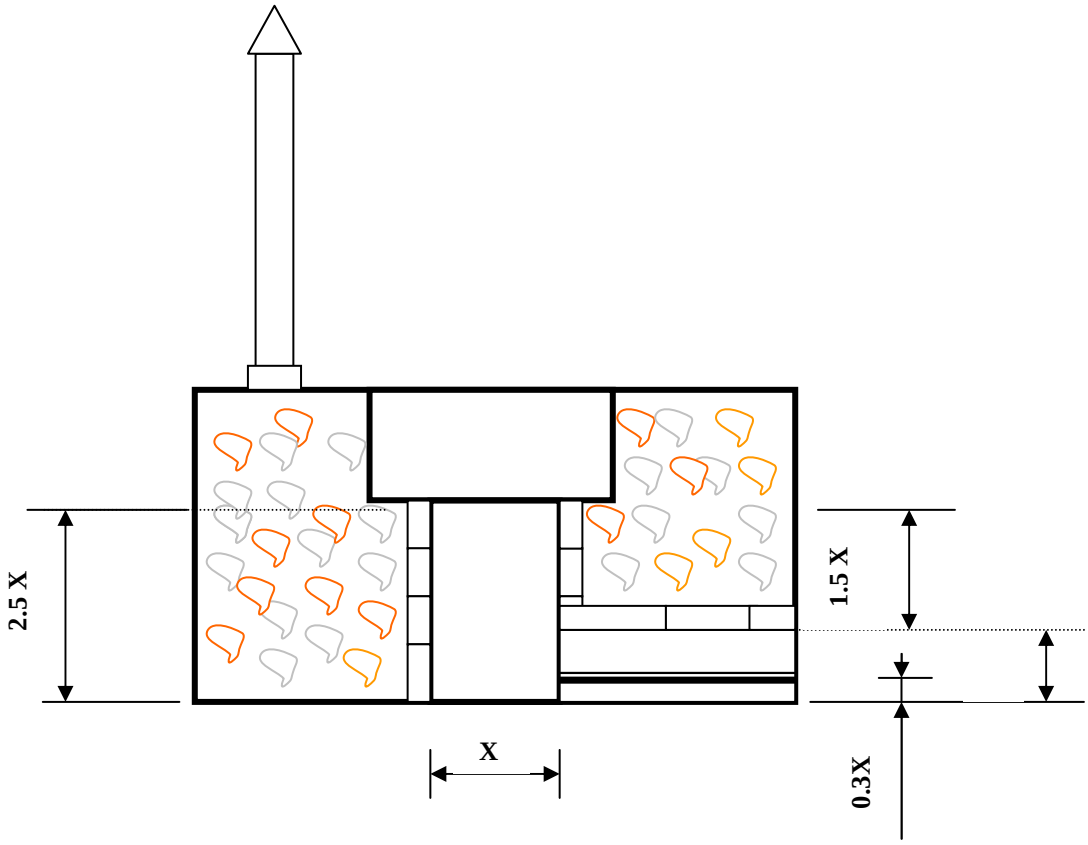


Figure 5: Important Parameters of the Firewood stove

Based on the field experience the performance of the stove in terms of fuel saving range from 60% - 80%. A good example is a stove installed at Kilindi Primary school in Kilimanjaro region where fire wood consumption were reduced from 736 pieces per day to 90 pieces of firewood.

2.2. Proposed Project Activities

The proposed project activities will involve the following:

- Collect baseline information and participatory local level planning
- Build capacity of District officers local partners and village technicians to plan and promote the efficient stoves
- Construct efficient stoves
- Project monitoring and quality management
  -Project information management

The stone made stoves will be constructed in selected households and SMEs in the project villages. The technology will involve the use of construction materials like stones, cement, lime, fabricated metallic chimney/ cement chimney, flat bar, sand, iron round bars and water. The village technicians will be trained in the construction, marketing, installation and maintenance of stoves. Figure 3 shown the efficient stove to be promoted.

3. Calculations on amount of fuelwood served by proposed stoves

Field experience shows that average daily firewood consumption for a household using three stone fire places is 7.89kg, which gives annual consumption of 2,879 kg.

Assuming that the net calorific value for firewood is 15.5GJ/tone (www.woodheat.org)
Therefore the annual fuel consumption 44.6GJ per household

4. Emissions Calculations

4.1 Project Baseline

The baseline scenario will be based on the quantity of woodfuels consumed by households using three stones fireplace without the project. Calculation has been done as follows;

Assumptions

The wood fuel is air dry with 20% moisture content, so the energy content is 15GJ/t (According to IPCC).

Daily fuel consumption per household is = 15GJ/t x 7.89 kg /1000
= 0.11835 GJ/household/day

The annual energy baseline will be 0.11835 GJ/household/day x 365 days/year
= 43.198 GJ/household/year
= 0.043 TJ/household/year

Greenhouse gas emissions by the baseline scenario

(a) Carbon dioxide

Carbon dioxide emission factor for Solid biomass is 29.9 tC/TJ (IPCC)

That is 29.9 x 44/12 = 109.63 tCO_2/TJ

CO_2 Quantity (Tonnes) = annual fuel consumption (Tera Joules) x CO_2 emission factor

CO_2 Gas Quantity (Tonnes) = 0.043 TJ/household/year x 109.63 tCO_2/TJ

= **4.714 tCO_2/household/year**

(b) Methane and Nitrous

According to AEA Tech.2001[4], emission factor of methane and nitrous from combustion of wood fuel is 24kgCH_4/Tera Joule (TJ) or 85.71Kg CH_4/Gwh and 3.4kgN_2O/TJ or12.14Kg N_2O/Gwh respectively.

The annual energy baseline is 8896.88 kWh/household/year from above calculation.

Hence emission factor are calculated as

Methane Emission tCH_4/hh/yr) = 8896.88kWh/hh/yr * 85.71kgCH_4/10^6kWh

= 0.76kgCH_4/hh/yr

= **$\underline{7.63*10^{-04}\ tCH_4/hh/yr}$**

$CO_{2\,e}$ Equivalent = $7.63*10^{-04}$ **tone** CH_4 /year x 21tCO_{2e}/t CH_4

= **$\underline{0.016tCO_2e/household/year}$**

Nitrous (N_20)

N_2O (t/hh/year) = 8896.88kWh/hh/yr *12.14kg **N_20**/10^6kWh

=0.108kg **N_20**/hh/yr

=**$\underline{1.080*10^{-04}\ tN_20/hh/yr}$**

$CO_{2\,e}$ Equivalent = $1.080*10^{-04}$ **tN_20** /year x 310tCO_{2e}/t **N_20**

= **$\underline{0.033tCO_2e/household/year}$**

Table 1: Greenhouse gas emissions by the Baseline scenario (A)

Gas Type	Gas Quantity (Tones/household/year)	CO_{2e} Equivalent (Tones/household/year)
CO_2	4.714	4.714
CH_4	$7.63*10^{-04}$	0.016
N_2O	$1.08*10^{-04}$	0.033
Total A	**4.71**	**4.76**

In this case, to calculate baseline emission for the project one need to multiply the emission per household by the units of traditional three stone stoves to be replaced.

4.2 Emission due to efficient stoves

The technology to be introduced will reduce the fuelwood consumption by 60%, this means that energy extracted by improved stove is 4 times that extracted by three stone stoves. That means 2 kg (7.89/4) of firewood will be used instead of 7.89kg. The anticipated greenhouse gas emissions under the project scenario will be calculated based on 2 kg of wood per household per day.

The annual energy baseline will be" should be changed to "Emission under project activity will be;

Therefore,

CO_2 Gas Quantity (Tonnes) = 4.714 tCO_2/household/year /4

= $\underline{1.179\ tCO_2/household/year}$

Assuming 10% losses at the beginning and end of cooking (to be in the safe side)
Adjusted CO_2 Gas Quantity (Tonnes) = 1.179/0.9 = 1.310 tCO_2/household/year

(b) The emission of methane and nitrous oxide from the improved stoves is negligible

4.3. Avoided emission due to the project activity

This is calculated as: -

Avoided emission = Baseline emission (Traditional three stone) - Emission from efficient stove

= 4.714 – 1.310 = **3.404 tonne CO_2/household/year**

5.0 Project Implementation Approach

A systematic field implementation approach developed by TaTEDO based on her more than ten years experience of implementing sustainable rural energy projects and programmes will be employed in the implementation of the proposed project. The approach is structured in a number of implementation phases; namely establishing baseline indicators, assessing in a participatory manner local level needs and priorities, preparing participatory local level plans, demonstrating appropriate sustainable energy technologies, providing training on the technology installation/ production to the local technicians/artisans and providing knowledge on the operation and maintenance of the technology. The approach supports development of local markets through Enterprise Development Services (EDS) provision. The approach has proved successful in the implementation of energy projects and programmes in the project areas. Collaborating partners and local communities have commended the approach as it broaden understanding of all key stakeholders, enhance good relationship with local authorities, target groups social, technical and financing institutions, enhance ownership of the programme process and outcomes, thus ensuring transparency, high accountability and sustainability of the achievements.

5.1 Technical Barriers

The proposed technology is best practice locally, because it uses woodfuels, which are locally available and can be generated at household level. However, the technology can be easily replicated in other regions of Tanzania, where more than 95 % of households still relay on traditional three stone stove fireplaces.

Experience from other area where the proposed stoves were disseminated, show low adoption rate due to reluctance of the people to change. Dissemination of the technology will be initiated among the villagers and furthermore, obstacles and barriers will be overcome strategically through:

- Greater awareness to the communities to be involved in the project through education and mobilization regarding existing and proposed stove technology, health and home economics aspects.

- Project terms negotiation will include local contributions and signing of agreements.
- Training of local artisans in the design and construction of the proposed stoves as an income earning activity will provide an incentive for larger scale uptake and use of the stoves.

6.0 Proposed Project Outputs

The proposed project will contribute to socio-economic development of the country in a way that is economically, socially and environmentally sustainable.

At the local level, the proposed project will lead to the following socio-economic benefits:

- ***Income generation***

  Efficient stone made woodstoves will be an income generating activity for the trained village technicians. Income generation for the users (Households & SMEs) will be through either from spending saved time on the other productive activities or from direct saving on the expenditure on fuelwood.

- ***Creation of employment opportunities***

Since installation of the stove involve direct construction of stoves in households, opportunities will be generated for the rural people to procure construction materials and also be involved in the construction works. This will result in enhancing employment of the rural people. More employment will also be created for the trained village technicians. It will create more than 120 new employment opportunities to local people.

- ***Reduce workload for women and children***

  Women and children are the main suppliers of fuelwood. The average time and walking distance for fetching and transporting fuelwood in many rural areas is 4 hours and 6 kilometer respectively. This show that household members particularly women and girls, invest a considerable amount of time and energy in searching fuelwood at the expense of productive and educational requirements. Proposed technology will release women's and girls' time to collect fuelwood and thus, allow them to participate in development activities.

- ***Health Improvements***

  A better burning process and chimney in the proposed stoves reduces indoor air pollution and heat through the wall. This means that risk to respiratory diseases will be reduced due to less exposure to toxic pollutants

  At national level, the project will mitigate deforestation. Unsustainable harvest of fuelwood is one of the causes of deforestation.

  At global level, besides lessening the pressure on biomass resources, improved stone made woodstoves also, will reduce emissions of carbon dioxide and other greenhouse gases with a high potential for global warming.

7.0 Project Background information on the institutional and financial arrangement

7.1 Project Manager

TaTEDO and local partners will manage the project. TaTEDO will provide field personnel who will work together with local partners staff during project period.

7.2 Project owner

TaTEDO and the community in the respective project areas will own funds due to emission reduction. Half of the fund will be used to replicate the project activities in other areas and the second half will be used by the participatory community to meet their developmental needs. The flow of information and resources within the project is shown in Figure 5.

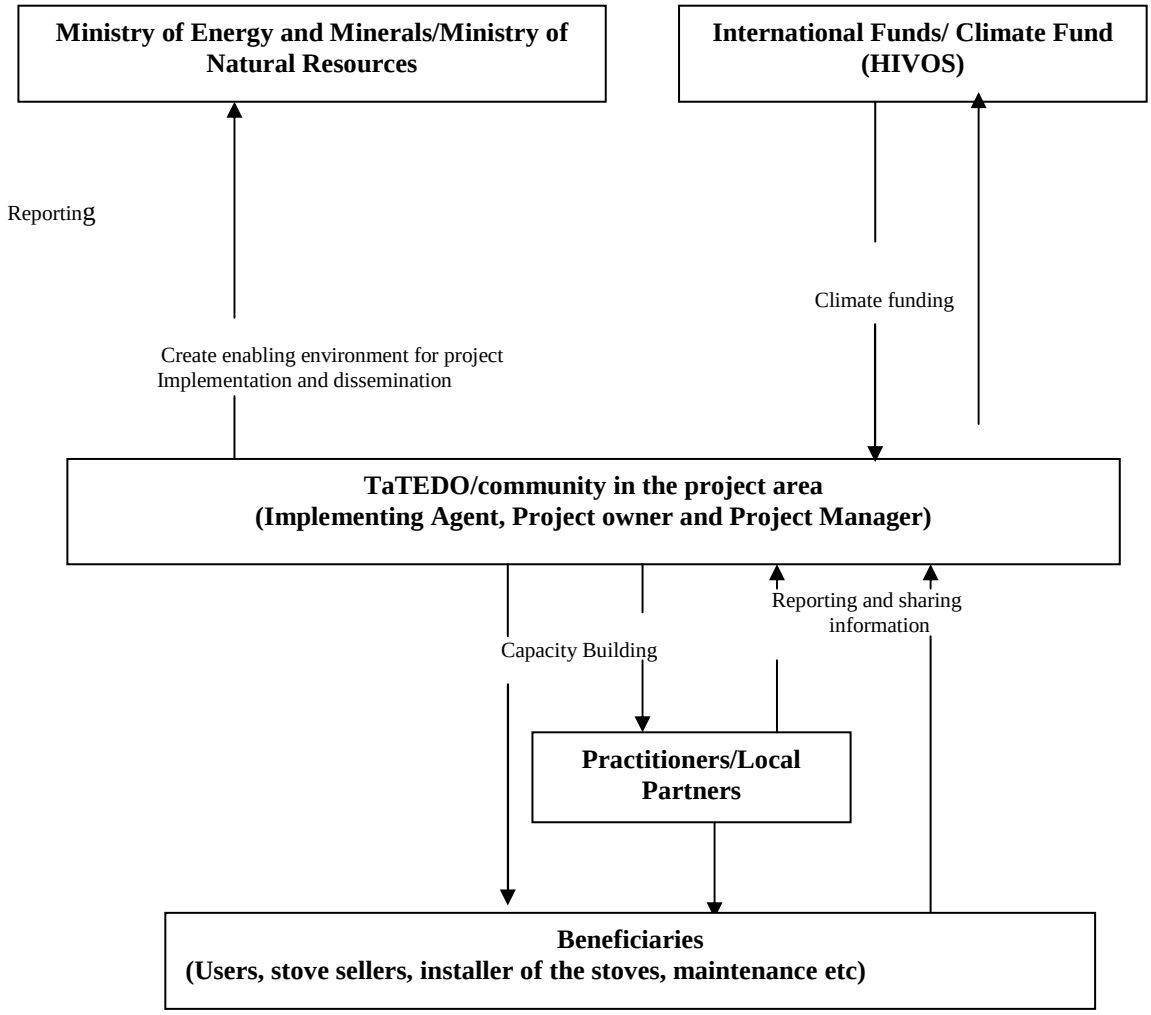


Figure 6: Flow of information and resources in the project

7.3 Underlying financing

Potential financing sources for this project is climate fund from HIVOS

8.0 Sustainability

In order to ensure sustainability of the proposed project activities, capacity building through training will be carried out for the collaborating partners, districts staff and local community. Village artisans will be trained on the manufacturing, marketing, installing and maintaining of stone made woodfuel stoves. At least this will open an employment to the village technicians even after the project period. Involvement of district staff and village leaders in project activity will be further strengthened. Also district authorities will be encouraged to make commitment to establish mechanisms to support local communities and households participating in the project.

The stone made stoves technology involved in this project is appropriate to the needs of the rural people. Hence, provision of appropriate stoves technologies will have a continued effect of generating income, conserving forests and eliminating poverty in the areas covered by this project. The knowledge of improved energy technologies and environment that project will impart to the stakeholders, will have perpetual effect to the target groups because there is still high demand of these technologies in the target areas. Extension staffs, artisans, and village technicians who will receive the knowledge are going to train others in the project areas. Therefore, it is expected that there will be multiplier effect of diffusion of knowledge from one group to others even after completion of programme phase.

9.0 Eligibility criteria

- **Additionally**

Tanzania energy policy advocates for use of efficient woodfuels technologies but is not obligatory for rural household due to high cost of efficient stoves. The cost of three stone fireplaces is free and rural people are poor, therefore without proposed project people won't invest in efficient firewood stoves and could continue to use inefficient stoves with high GHG emissions.

- **Projects Beneficiaries**

Households: *H*ouseholds are the primary project beneficiaries. Improved stone made stoves will be constructed in their houses after a signed agreement on loans and mode of payment between them and project developer. TaTEDO will make special arrangement with micro financing institutions (Savings and Credit Cooperatives (SACCOs) being one of them). In order for beneficiaries to obtain loan from SACCOs one of the condition is to become a member of stove owners groups associations. Formulation of these associations will be facilitated by TaTEDO in collaboration with village leadership. In this case, SACCOs will be responsible for managing loans extended to project beneficiaries.

During implementation of the project, beneficiaries will be informed on expected benefits to be shared among which include emission reduction funds. This is thought to motivate beneficiaries in taking the responsibility of paying back the loan. Furthermore, all installed stoves and their exact location will be registered and TaTEDO will sign ten (10) years contract with stove owners concerning proper use and management of the built stoves. The agreement will state clearly that TaTEDO is the owner of all emission reduction rights related to stove.

Village Leaders: They will be responsible with ensuring that regulations and by laws governing efficient stoves are observed and promotion of efficient stoves through appropriate policies, strategies and by laws.

TaTEDO: A national non-governmental energy development organization, in this project will be responsible for building capacity, training, educating and awareness creating of local technicians concerning the technology and climate changes aspects.

Ministry of Energy and Minerals: The ministry will be responsible for creation of enabling environment such as appropriate policies that will enhance promotion and use of efficient stoves.

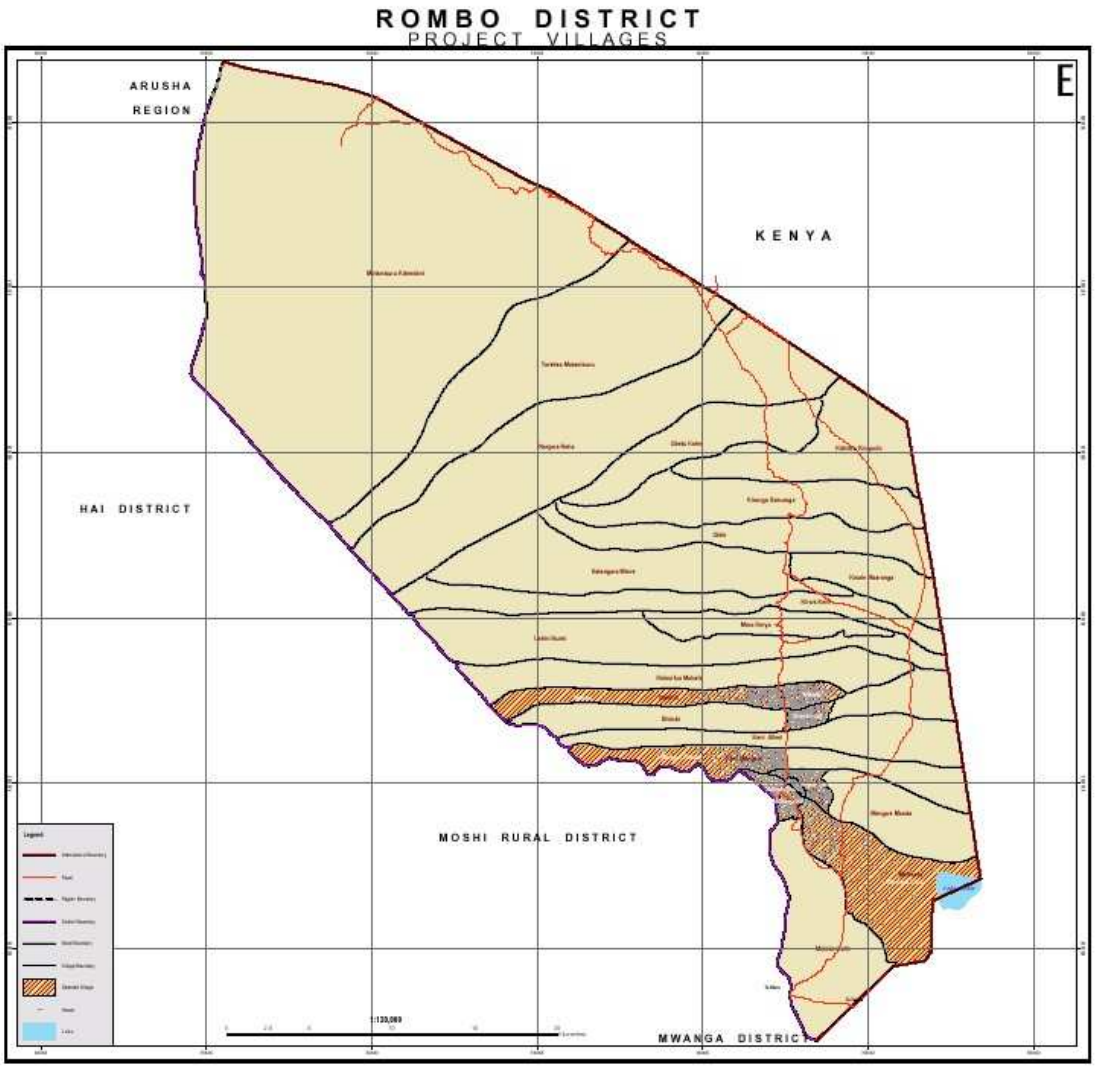
Table 2: Tentative Project Time Line

Item	Activities	Sept 2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	Prepare participatory village local planning										
2	Build capacity of District officers, local partners and local community to manage the forest resource sustainabily										
3	Construction of 6000 efficient stoves										
4	Project monitoring and quality management										

Table 3: Investment Estimate

Item	Activities	Costs (USD)
1	Prepare participatory village local planning	10,000
2	Build capacity of District officers, local partners and local community to manage the forest resource sustainabily	10,000
3	Construction of 6000 efficient stoves	180,000
4	Project monitoring and quality management	15,000
	Total	**215,000**

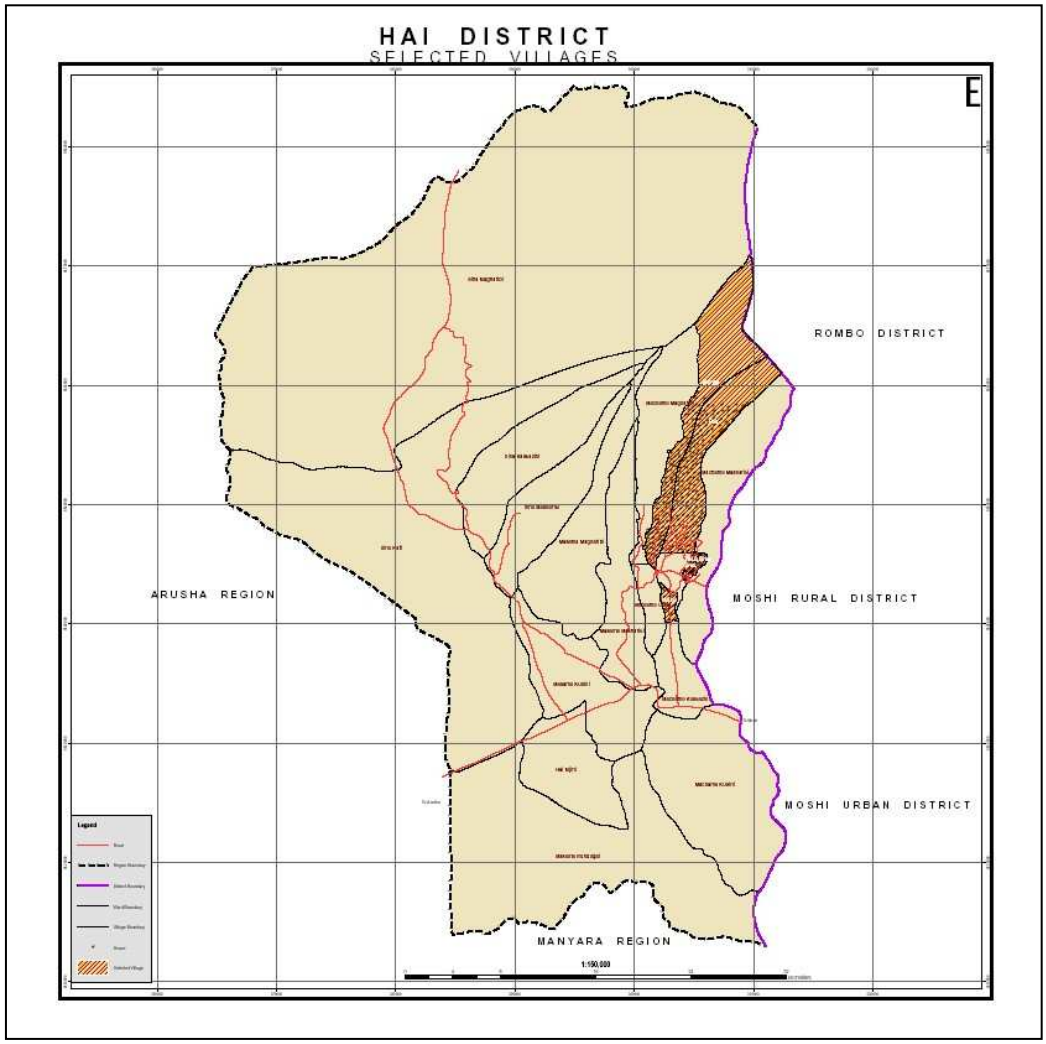
Appendix 1: Rombo District Map



Villages of Rombo District

1. Shimbi Kati
2. Maharo
3. Kitasha
4. Mengwe
5. Mamsera

Appendix 2: Hai District Map



Villages for Hai District

1. Nronga
2. Kisereni
3. Mkuu Sinde
4. Uduru
5. Mkweseko