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Ministry of Energy
Republic of Kenya

FEASIBILITY STUDY
ON
SMALL HYDROPOWER PROJECT
FOR 12 SITES FOR TEA FACTORIES
IN KENYA

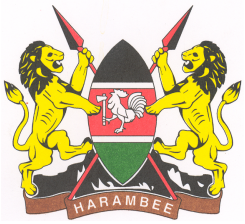
Final Report

Volume III.
Supporting Report (2)
(Social Impacts Assessment)

Weru South Mara

AUGUST 2009

Q-Energy
Que Energy Limited
Nairobi, Kenya



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This Report consists of

Executive Summary

Volume III Supporting Report (2)

(Social Impacts Assessment)

This Study was fully Supported by Government of Kenya in a 10 month Feasibility Assessment of some 12 sites for Tea Factories in Kenya.

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1.1 Introduction

1.1.1 Survey objective

The objective of this survey is to investigate the social and economic conditions of people living around tea factories so as to establish the impact of developing local small hydro power schemes to improve on their livelihoods.

1.1.2 Methodology

The study used a semi - structured questionnaire to collect the primary data. Data was collected from184 respondents.

The survey targeted potential beneficiaries of Small hydro scheme with the sample comprising all the households within a 3km radius from the Weru Tea Factory, as well as those living along the area where the canals will be constructed.

Stratified sampling technique was used, where the sample was divided into four strata and random sampling done in each stratum with equal distribution in all the parts of the strata. 184 households were randomly selected, which involved 123 households within a 3km radius of the factory and 61 households along the two canals i.e. 30 and 31 households per canal.

A structured questionnaire was developed, pre-tested and reviewed. This was then used to collect primary data on the social and economic status of the respondents. These were administered face to face by interviewers who were local residents of the area and also the potential beneficiaries.

Questionnaires were administered to each randomly selected household and responses recorded. It took an average of 30 minutes to gather the necessary information from each household.
The collected data was then coded, cleaned and entered into SPSS software to build a database that was subjected to data analysis. Descriptive statistics such as percentages, correlation analysis and graphs were used to describe, analyze and present the survey findings. The survey was carried out in various homesteads in Muthambi, Mugumoni and Mwimbi Divisions in Maara and Meru South Districts.
Out of the 184 survey respondents 149 were men (81.0%) and 35 women (19.0%).

1.1.3 Limitations and opportunities of the study

The study coincided with the rainy season when people were busy planting food crops and picking tea thus it took more time to locate the respondents. Most respondents could not fill in the questionnaires by themselves and they were therefore interviewed and their responses recorded on the questionnaire. This enhanced probing for further information. Most respondents could not understand the English language and the interviewers had to translate the questions to their mother tongue or Kiswahili language.
The interviewers had to convince the respondents to get the land register number which was impossible in most cases. There were also challenges getting information on the income levels and sources. Nevertheless, most of the information was obtained.

1.1.4 Summary of findings

Only 15 households out of the sampled 184, use electricity for lighting, while none uses electricity for cooking. Kerosene is the most commonly used type energy for lighting followed by firewood and solar. Regarding household expenditure on energy for lighting, households using kerosene and firewood spend more than those using electricity and rechargeable batteries. The main source of energy for cooking is firewood comprising 98.37% of the households; kerosene -22.28% and LPG - 1.63%. There is possibility that increased access electricity will result in increased use of electricity for lighting since it is cheaper than the energy types being used currently.

For households with no electricity, the approximate average distance from the nearest electricity line is 0.7 km; with a minimum of 0.1km and a maximum of 2km.
The survey reveals that most households have a small piece of land with an average of 1.9 acres with the majority owning between 1-2 acres due to the high population in the area. The average acreage under Tea is 0.56 acres and coffee 0.37 acres. The households sampled have access to regular incomes from cash and food crops, livestock as well as off-farm economic activities. Majority of households cultivate between 0.25 – 0.75 acres of tea and between 0.25 – 0.5 acres of coffee. The Majority of the households sampled (39.69%) earn between Kshs. 10,000/= and Kshs. 20,000/= annually from tea followed closely by 29.77% earning below Kshs. 10,000/= then 22.90% earning between Kshs. 20,000/= and Kshs. 30,000/= with the average earning being Kshs. 19,176/= per year.

Earnings from coffee are however low compared to tea. Coffee contributes an average of Kshs. 11,938/= per year with the majority earning below Kshs10, 000/= followed by those earning between Kshs 10,000 /= and Kshs 20,000/= per year. Decisions on how income from cash crops is used are mainly made by both husband and wife.

Average annual earnings for households growing bananas for sale is Kshs. 17,132/=; beans - Kshs. 6,439/=; maize-Kshs. 14,571/=; yams – Kshs. 11,115/=; potatoes Kshs. 13,971/=; arrow roots-Kshs. 3,267/=; cassava - Kshs. 5,636/=. In most cases, food crops are grown for both subsistence and sale (91.91%). 7.51% of the crops are grown purely for subsistence while those grown purely for sale are only 0.58%. Decisions on how income from food crops is spent are mainly made by both husband and wife. Husbands however make decisions more often than wives with regard to use of incomes from food crops.

93.5% of the sampled households keep cattle, with the main products being milk, manure and meat. The average number of cattle per household is 2 animals. Poultry rearing is practised by 83.7% of the households sampled with eggs, meat and manure being the main products. The average number of poultry per household is 8 chickens. 73.4% of the households are involved in goat rearing with the main products being meat, milk, and manure. The average number of goats per household is 4.Sheep rearing is practiced by 40.8% of the households sampled with the main products being meat, wool, manure and milk. The average number of sheep per household is 4..

The average annual earnings from cattle is Kshs. 17,576/=; poultry - Kshs. 11,000/=; sheep - Kshs.5, 000/=; and goats -Kshs 5,906/=. Decisions on how income from livestock is spent are made by both husband and wife. Women however seem make decisions more often than men on livestock income expenditure. Animal products are mainly used for both subsistence and sale (95.27%); subsistence only (4.14%), sale only (0.59%)

In addition to farming, most of the members the households sampled engage in various other economic activities ranging from day casual labour (57.65%), agricultural commodity businesses (17.35%), retail businesses (17.35%), formal employment (5.61%), and remittances from relatives (2.04%). Majority of the households interviewed earn between Kshs.10, 000/= and 20,000/= (29.82%); between Kshs. 20,000/= and 30,000/= (18.42%); below Kshs. 10,000/= (16.67%); between Kshs. 30,000/= and 50,000/= (12.28%); between Kshs. 130,000/= and 150,000/= (7.89%); between Kshs. 70,000/= and 90,000/= (7.02%); between Kshs. 110,000/= and 130,000/= (6.14%) and between Kshs. 50,000/= and 70,000/= (1.75%).

With regard to average overall annual income, 45.86% of the sampled households earn an average of between Kshs. 100,000/= and Kshs. 150,000/=; followed by 20.99% earning between Kshs. 50,000/= and Kshs. 100,000/=; 14.92% earning between Kshs. 150,000/= and Kshs. 200,000/=; 6.63% earning between Kshs. 200,000/= and Kshs. 250,000/=; 7.73% earning Kshs. 250, 000/= and above.

The average number of houses per homestead is 4 while the average number of rooms per household is 8 rooms. In majority of households, the walls are constructed with wood (94.6%), stones (27.7%), iron sheets (2.2%), mud (0.54%). All the homesteads sampled have houses that are roofed with iron sheets.

65.8% of the households owned a radio cassette player; 56.5% of the households own a radio; 82.1% of the households own a torch; 45.1% of households own black and white TVs, 35.9% of the household own video players and 19.02% own colour TVs.

Men are mostly involved in the purchase of all electrical appliances with very few instances where women alone are involved in the purchase and sometimes together with the husbands. Access to electricity will encourage more people to purchase electrical equipments thereby improving their lives by bringing services closer, creation of employment and business opportunities and increasing access to entertainment and information for more households.

All family members mostly have access to and use of all appliances. Access to electricity will improve access to these facilities to benefit the whole family. Appliances are mainly located in the sitting room in most households with the exception of the light bulbs which are also located in the bedroom, kitchen and in all rooms in some households; torches are also located in the bedrooms and in all the rooms; in very few instances the radio and coloured TV are located in the bedroom. The fact that the electrical appliances are located in the sitting room most of the times in most of the households means that all family members will benefit.

Women and girls are mainly responsible for firewood collection. The average time spent collecting firewood is 2.2 hrs. Considering that firewood is not only used for cooking by most households but also for lighting and heating, access to electricity will contribute to reduction of drudgery for women and girls. This will also allow more study time for girls and more time for productive activities for women.

Majority of households (82.94%) have noticed a change in the type and volume of energy they consume in relation to their family needs, while 17.06% have not noticed any change. For majority of

respondents demand for energy has increased in the household (45.51%); firewood and kerosene are very expensive (34.62%); scarcity of trees for firewood (9.62%); high cost of energy sources (4.49%), cost of purchasing kerosene has reduced drastically after purchasing a Solar Home System (3.21%); expenses in kerosene reduced after switching to electricity (2.56%). There is clear indication that once electricity is installed in households, expenditure on energy will reduce as it will replace kerosene for lighting.

88.76% of the respondents would like to change to a different form of energy while 11.24% satisfied with the kind of energy they are using comprising those already using electricity and some with Solar Home Systems.

The main reasons why most households are not connected to electricity although they would like include high electricity connection fee (31.25%); delay/lack of electricity connection fees (25.69%) and electricity is not accessible/ homes are far from the transformers (22.92%). Other reasons include high maintenance cost/ very expensive and high wiring expenses. This clearly demonstrates that there are a large percentage of households who would be ready for connection to electricity if it was available close to their homes. Any electrification project should consider innovative financing mechanisms that could enable more households to connect to electricity.

Furthermore 79.89% of respondents said they have access to financial facilities such as cooperatives; another 72.83% said they have access to merry go rounds and social networks and 25.54% have access to credit from MFIs. Households could be encouraged to these could be used to finance connections to households.

With regard to household energy expenditure the average monthly expenditure on energy accounts for a high percentage of the household budget. Average monthly expenditure on electricity for those using is Kshs. 467/=. While majority of households depend on kerosene and fuel wood for cooking, lighting and warming they pay more for these energy forms than those using electricity with the average monthly expenditure on firewood being Kshs. 1311/= and majority of households spending between Kshs. 500/= and Kshs. 2000/=.

Average monthly expenditure on kerosene is Kshs. 399/= with majority of households spending between Kshs. 200/= and Kshs. 500/=. Average monthly expenditure on rechargeable batteries is Kshs. 112/= with the majority of households spending Kshs. 100/=, while majority spend between Kshs. 100/= and Kshs. 300/= on dry cells. This means that household expenditure on energy would be reduced if households invested in electricity connection, since combined expenditure on different energy forms such as kerosene, charcoal, firewood, kerosene, dry cells etc. per household is quite high. This also means that majority of households would be able pay for electricity once connected.

About 89 of the households interviewed have bought an average of 2 rechargeable batteries in the last five years with some purchasing a total of 4 batteries. The cost range was mainly Kshs. 5000 and above comprising 79.4%; between Kshs. 4001 to Kshs. 5000/= (10.3%); Kshs. 2001 to Kshs.3000/= (4.7%); Kshs. 3001 to Kshs. 4000/= (2.8%); and also 2.8% costing Kshs. 2000/= and below. This clearly demonstrates that people in this community are keen to acquire alternative energy options and would therefore be ready to invest in electricity connection. Furthermore they travel an average distance 1.5 km to the nearest battery charging facility.

The survey revealed that the average distance households travel to social amenities such as schools, health centres, markets, schools etc. is 2.2km. Majority of respondents travel an average of 6.6 and 6.1km to the nearest Hospital or Maternity facility respectively.

Although majority of households have piped water comprising 40.5%, 24.6% collect water from rivers, while a further 30.1% rely on rain water.

Majority of respondents said that the local Dispensaries and Health Centres are not well equipped to handle cases of complicated conditions and maternal deliveries because of lack of proper structures, equipment and facilities; lack of trained personnel to handle the cases; and shortage of staff. A smaller proportion of households said that the health facilities are able to handle complicated cases include: use electrical equipment for testing diseases and experienced Doctors and Nurses available in case of complicated cases.

Local primary Schools mainly use electricity (86.71%), generators (6.33%). A further 6.96% of Primary Schools are not using any energy type. Provision of electricity to those using generators will greatly reduce costs while access to electricity by the schools without will provide more study time hence improved performance.

Local Secondary Schools mainly use electricity (88.40%), with a small number using generators (3.87%), while 7.73% have no access to any energy type. Increased access to electricity in secondary schools will greatly benefit students as they will have more study time thus improved performance. Local churches mainly use electricity (76.67%), generators (3.89%), solar energy (1.11%) and 18.33 have no energy type, those using generators as well as those with no access would benefit from any electrification project.

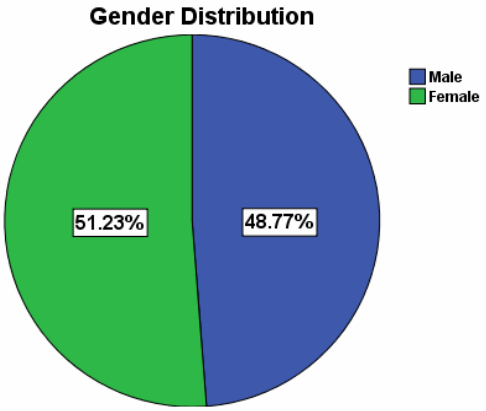
There is a range of businesses that are operated by women and men at market centres. The most common businesses operated by women are grocery shops, general and wholesale shops, hotels, tailoring, salons, open air market for clothes, kiosks/canteens. Key businesses operated by men include general shops, butcheries, groceries, carpentry shops, hotels, tailors, club/bars/pubs, shoe repair, barber shops among others. All these businesses operated by both women and men would increase earnings if electricity was available as this would either increase working hours as well as improve quality of services. Availing to electricity to market centres would also encourage establishment of other businesses and increase efficiency of others.

For most residents access to electricity would improve livelihoods of people in their community. There would be benefits such as increasing business opportunities; creation of employment opportunities; improvement of agriculture; making work easier through use of machines; improvement on livestock rearing; improving lighting in homes; reduction of cost, time and energy spent seeking services; better services in Hospitals and Dispensaries; improving security in homes and market centres; improvement of markets; people becoming more enlightened e.g. by buying and using TVs and Computers; improving peoples overall economic base; reducing crime rate by opening business opportunities for the youth; environmental conservation/sanitation; increasing working hours since people can work day and nights; improvement of schools and reduction of stress through listening to music.

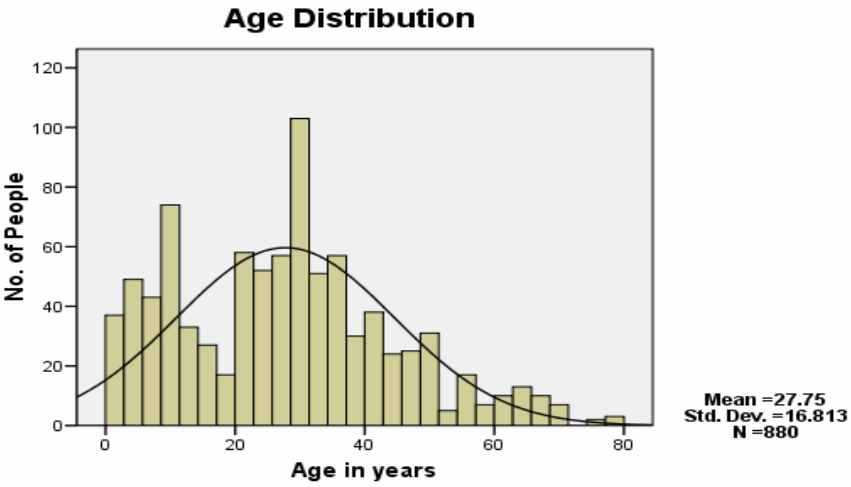
3.0 Survey findings

3.1 Household characteristics

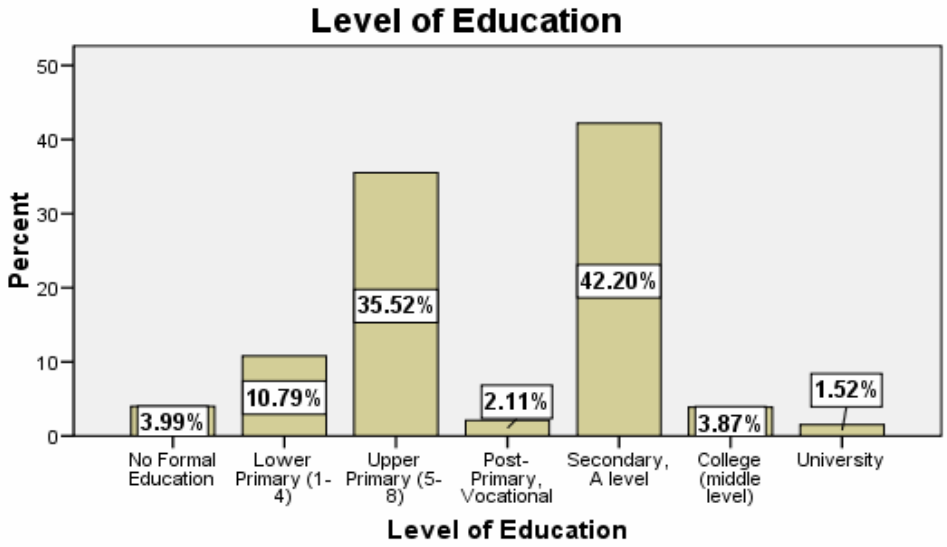
The mean household size is 5 people per household with an equal gender distribution of males and females with 48.77% and 51.23% respectively.



The average age of the population in the target area is 27.75 years with the majority being between 20 and 35 years, followed by children and teenagers between ages 5-19 years, then those aged between 36 and 60 years of age. The elderly (above 60 years) make up a small part of the population as shown in the histogram below.



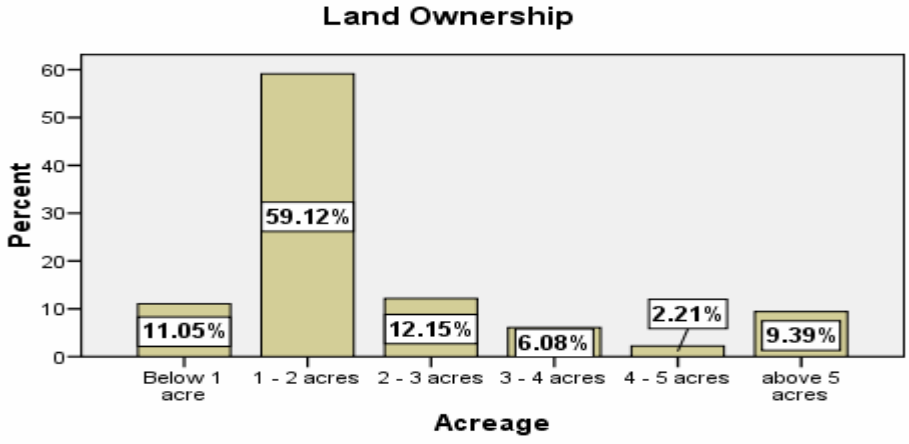
The current education level of the majority of the people in the community is Secondary and A-Level comprising 42.20%, followed by Upper Primary (35.52%); Lower Primary (10.79%); College (3.87%) and Post primary/vocational (2.11%). About 3.99% of the population have no formal education, and only 1.52% have university education.



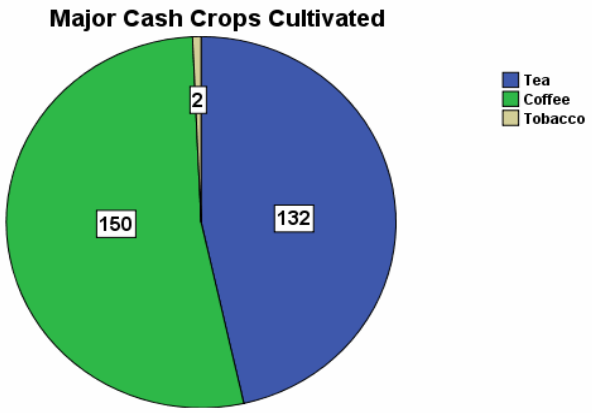
The majority of the population are farmers comprising 36.9 % of the sampled households while 31.1% are students. Other occupations include housekeepers (11.6%), self-employment (4.5%); teachers (2.9%); running businesses (2.0%); masonry (1.7%); drivers (1.7%); casual workers (1.4%); retired (0.8%); doctors (0.7%); carpenters (0.6%); coffee clerks (0.6%); mechanics (0.3%) and accountants (0.3%). while 2.3% are unemployed. About 0.5% did not specify their employment status.

3.2 Household income/assets

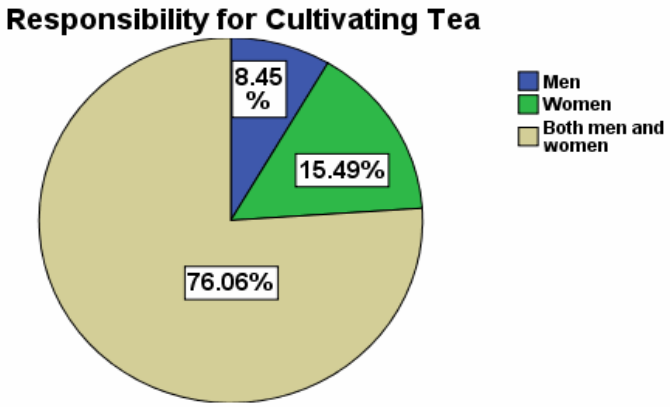
The average acreage of land owned by each household is 1.9 acres, with the maximum of 11 acres and a minimum of 0.13 acres. 11.05% of the households sampled own less than 1 acre of land; 59.12% owning between 1-2 acres; 12.15% owning between 2-3 acres; 6.08% owning 3-4 acres; 2.21% owning 4-5 acres and 9.39% owning above 5 acres.



The major cash crops cultivated by the members of the households sampled are tea and coffee. Tea is cultivated by 132 out of the 184 households while coffee is cultivated by 150 households. Only 2 households cultivate Tobacco.



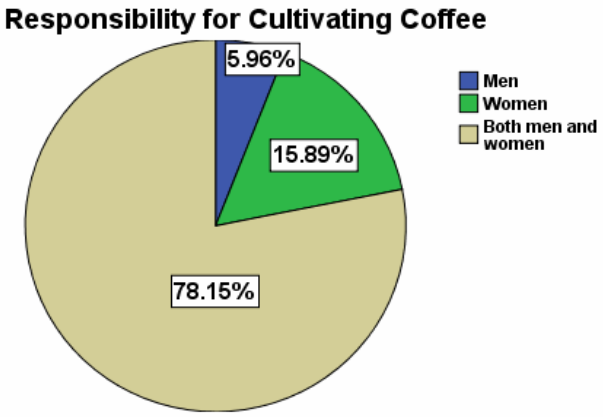
The average acreage of land under tea is 0.56 acres; the largest is 3 acres, while the minimum is 0.13 of an acre. The majority comprising 85.1% cultivate between 0.25 - 0.75acres. Tea cultivation is a collective responsibility for both women and men most of the times (76.06%), while in a few instances only women cultivate (15.49%) and men alone (8.45%).



Average acreage under major cash crops

	N	Minimum	Maximum	Mean
Tea acreage	114	0.13	3.00	.5550
Coffee acreage	123	0.10	1.00	.3742

The average acreage under coffee is 0.37 acres; the largest acreage is 1 acre while the minimum is 0.1acres. The majority of the households comprising 86.2% cultivate between 0.25 – 0.5 acres. Coffee cultivation is also a collective responsibility involving both women and men with 78.15% with women only cultivating (15.89%) and men alone cultivate (5.96%).



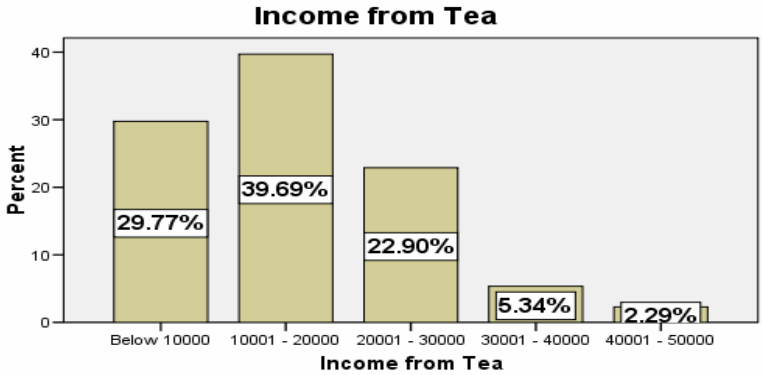
3.3 Cash crop income

Tea contributes an average of Kshs. 19,176/= per year for the sampled households and a minimum of Kshs. 3000/= per year. The highest earnings from tea are up to Kshs. 45,000/= per year.

Average annual income from cash crops

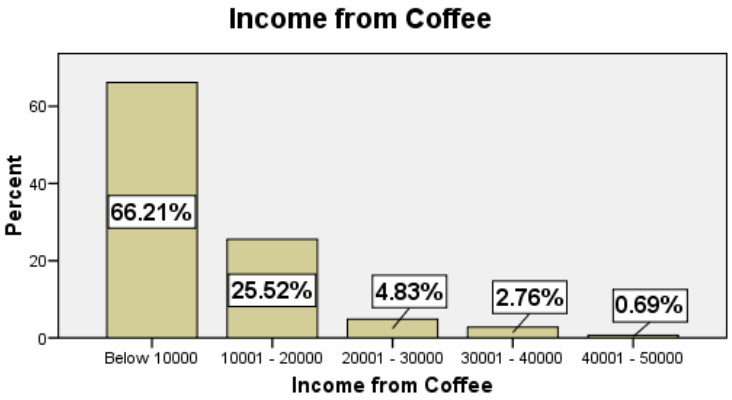
Cash crops	No. of HHs	Minimum Kshs	Maximum Kshs	Average Kshs
Tea	131	3000	45000	19175.57
Coffee	145	2000	50000	11937.93
Tobacco	2	30000	30000	30000.00

Majority of the households sampled (39.69%) earn between Kshs. 10,000/= and Kshs. 20,000/= annually from tea; 29.77% earn below Kshs. 10,000/=; 22.90% earn between Kshs. 20,000/= and Kshs. 30,000/=; 5.34% earn between Kshs. 30,000/= and Kshs. 40,000/=; 2.29% earn between Kshs. 40,000/= and Kshs. 50,000/=.



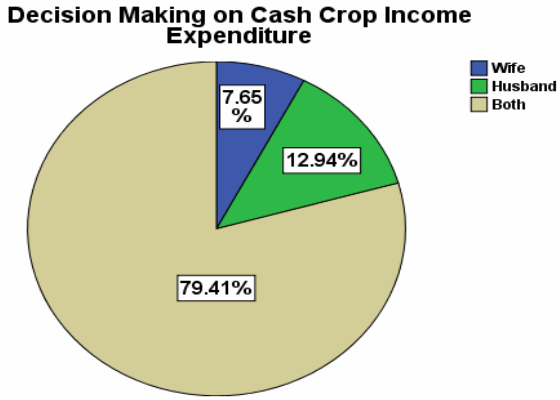
Coffee contributes an average of Kshs. 11,938/= per year to the households sampled and a minimum of Kshs. 2000/= per year. The highest earnings from coffee are up to Kshs. 50,000/= per year. Majority of the households sampled (66.21%) earn below Kshs. 10.000/=; 25.52% earn between Kshs.

10,000/= and Kshs. 20.000/=; 4.83% earn between Kshs. 20,000/= and 30,000/=; 2.74% earn between Kshs. 30,000 and 40,000/= and 0.69% earn between Kshs. 40,000 and 50,000/=.



From the 2 households growing Tobacco the average annual income is Kshs. 30,000/=.

Decision making expenditure of income from cash crops is mainly made by both husband and wife (79.41%). In 12.94% and 7.65% the decisions are made by husband and wife respectively.



3.4 Food crops

Major food crops cultivated by the members of the households sampled are beans, bananas, maize, cassava, yams, potatoes, arrowroots. Others include sweet potatoes, sugarcane, *sukumawiki* and passion fruits.

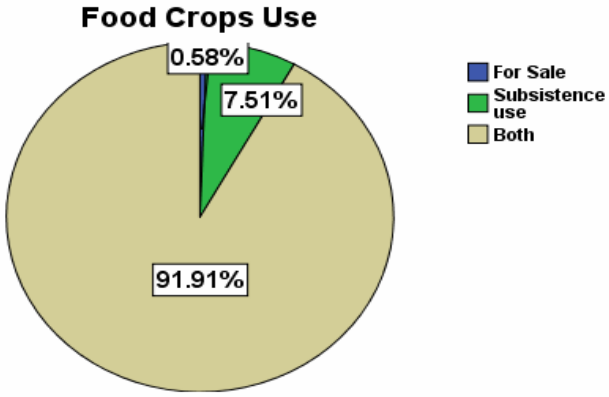
Beans are the main food crop cultivated by the majority of the respondents (177 households out of the total 184 sampled), followed closely by bananas cultivated by 175 households and maize (173 households), cassava (65 households), yams (49 households), potatoes (47 households), arrowroots (38 households).

Both men and women are involved in the cultivation of all food crops with an exception of beans which are mainly cultivated by women. A larger percentage of women are however more involved in cultivation of the food crops as compared to men. However, men are more involved in cultivation of yams.

Food crops grown

Crop	Frequency	Total	Percent %
Maize	173	184	94.02
Bananas	175	184	95.11
Beans	180	184	97.83
Arrow roots	38	184	20.65
Passion fruits	6	184	3.26
Potatoes	47	184	25.54
Sugarcanes	8	184	4.35
Yams	49	184	26.63
Cassava	65	184	35.33
Sweet potatoes	8	184	4.35
Sukumawiki	7	184	3.80

In most cases, food crops are grown for both subsistence and sale (91.91%). 7.51% of the crops are grown purely for subsistence while those grown purely for sale are only 0.58%.



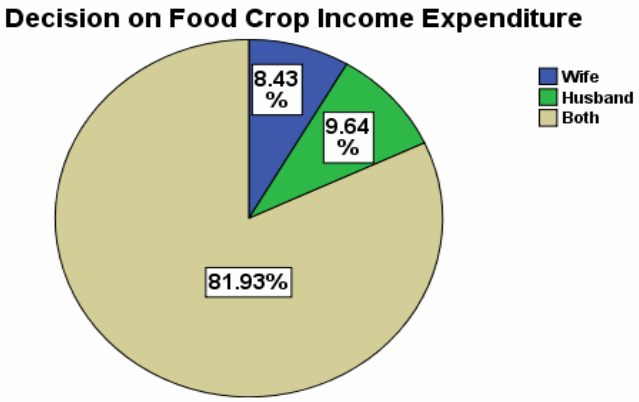
3.5 Incomes from major food crops

Average annual earnings for the 151 households growing bananas for sale or both sale and subsistence is Kshs. 14, 571/=; 41 households growing beans - Kshs. 6,439/=; 28 households growing maize - Kshs. 14,571/=; 26 households growing yams - Kshs. 11,115/=; 17 households growing potatoes - Kshs. 13,970/=; 15 households growing arrowroots - Kshs. 3,266. More details are provided in the table below.

Average annual household income from food crops (in Kshs.)

Food crop	No of HH	Minimum (Kshs)	Maximum (Kshs)	Average (Kshs)
Maize	28	1000	50000	14571.43
Bananas	151	1000	50000	17132.45
Beans	41	1000	15000	6439.02
Arrowroots	15	1000	10000	3266.67
Passion fruits	4	5000	25000	15000.00
Potatoes	17	1000	45000	13970.59
Yams	26	5000	18000	11115.38
Cassava	11	4000	10000	5636.36
Sweet potatoes	4	2000	5000	3000.00
Sukuma wiki	5	5000	10000	7000.00

Decisions on how income from food crops is spent are mainly made by both husband and wife comprising 81.93%. Husbands alone however make decisions more often than wives alone (9.64% and 8.43% respectively).



3.6 Livestock incomes

The major livestock types reared are cattle, poultry, goats and sheep. 93.5% of the households sampled keep cattle. The main livestock products mentioned are milk (77.8%) manure (11.6%), and meat- (10.6%). The average number of cattle per household is 2 animals, with the highest being 5 animals and the lowest 1 animal.

Poultry rearing is practiced by 83.7% with the main products mentioned being eggs (49.8%), meat (48.6%), and manure (1.6%). The average number of poultry per household is 8 chickens with the maximum being 30 chickens and the minimum 2 chicken.

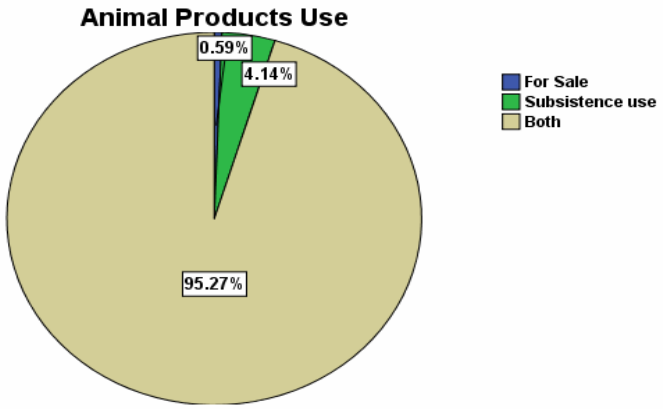
Sheep rearing is practiced by 40.8% of the households sampled with the main products being meat (77.1%), wool (9.6%), manure (8.4%), and milk (4.8%).The average number of sheep per household is 4 sheep with the highest number being 8 and the lowest 1 sheep.

73.4% of the households are involved in goat rearing with the main products being meat (63.4%), milk (23.6%), and manure (13.0%). The average number of goats per household is 4 with the highest number being 6 goats and the lowest 1 goat.

Average number of animals per household

Animal type	No of HHs	Minimum No.	Maximum No.	Average No.
Cattle	168	1	5	2
Sheep	75	1	8	4
Goats	133	1	6	4
Poultry	151	2	30	8

The animal products are mainly used for both subsistence and sale (95.27%); subsistence only (4.14%) and sale only (0.59%)

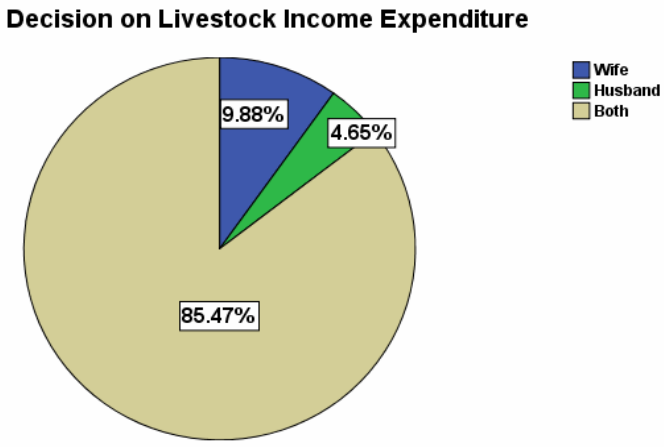


The average earnings from cattle is Kshs. 17,576/=, the lowest being Kshs. 2000/= and the highest Kshs. 84,000/=. Average earnings from poultry is Kshs 11,000= with a minimum of Kshs. 1000/= and a maximum of Kshs.25, 000/=. 73 households earn an average of Kshs. 5,000/= from sheep with the minimum being Kshs. 1000/= and the maximum being Kshs. 15,000/=. Average earnings from goats is Kshs 5,906/= with a minimum of Kshs. 2000/= and a maximum of Kshs.15, 000/=

Average annual income from sale of livestock and products

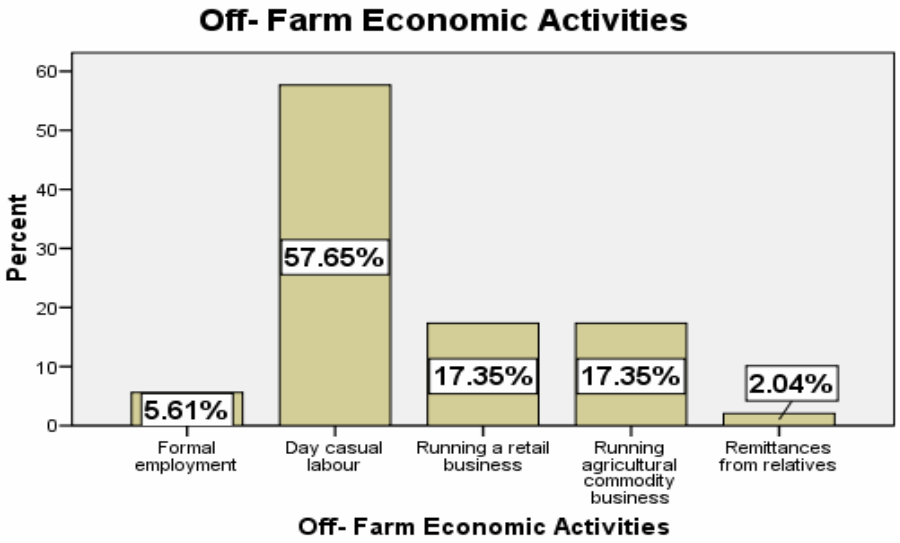
Livestock/products	No. of HHs	Minimum (Kshs)	Maximum (Kshs)	Average (Kshs)
Cattle/Products	151	2000	84000	17576.16
Sheep/Products	73	1000	15000	5001.37
Goats/Products	107	2000	15000	5906.54
Poultry/Products	121	1000	25000	11000.00

Decisions on how income from livestock is spent are made by both husband and wife (85.47%); wife only (9.88%) and husband only (4.65%).



3.7 Off-farm economic activities

In addition to farming, most of the members the households sampled engage in various other economic activities ranging from day casual labour (57.65%); running retail businesses (17.35%); running agricultural commodity businesses (17.35%); formal employment (5.61%); and remittances from relatives (2.04%).

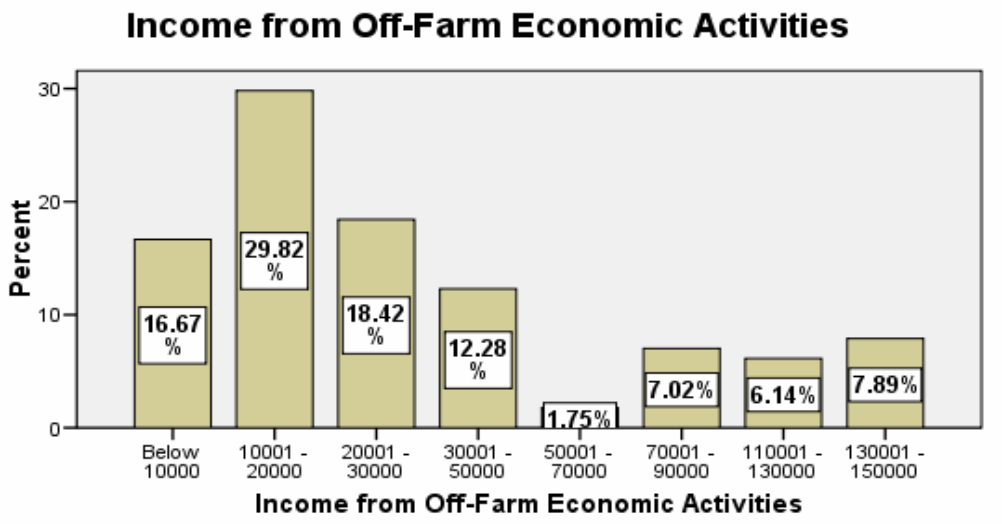


Average earnings per year are Kshs. 43,833/=, with minimum of Kshs. 5000/= and a maximum of Kshs. 150,000/=

Average annual income from off- farm economic activities

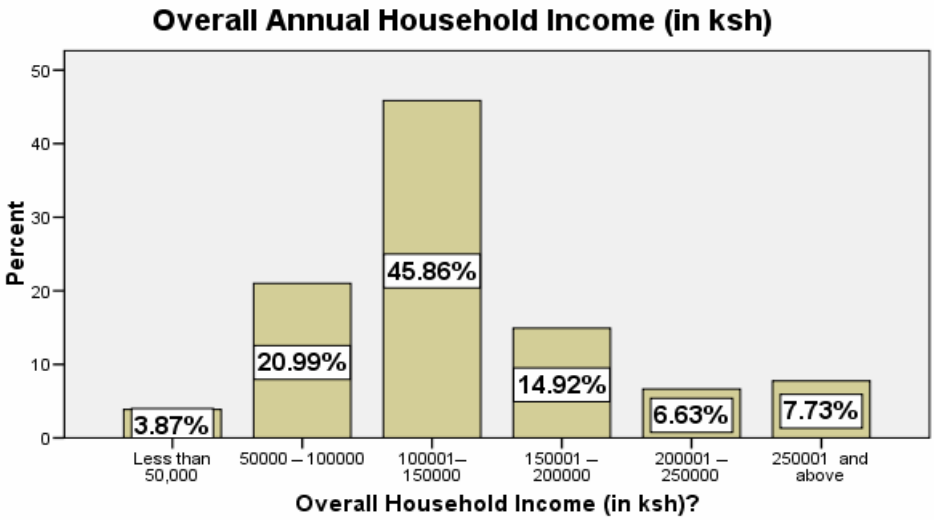
	No of HH	Minimum (Kshs)	Maximum (Kshs)	Average (Kshs)
Average annual income from off-farm economic activities	114	5000	150000	43833.33

Majority of the households interviewed earn between Kshs.10, 000/= and 20,000/= (29.82%); between Kshs. 20,000/= and 30,000/= (18.42%); below Kshs. 10,000/= (16.67%); between Kshs. 30,000/= and 50,000/= (12.28%); between Kshs. 130,000/= and 150,000/= (7.89%); between Kshs. 70,000/= and 90,000/= (7.02%); between Kshs. 110,000/= and 130,000/= (6.14%) and between Kshs. 50,000/= and 70,000/= (1.75%); More details can be seen in the graph below.



3.8 Overall Household Income

45.86% of the sampled households earn an average overall annual income of between Kshs. 100,000/= and Kshs. 150,000/=; followed by 20.99% earning between Kshs. 50,000/= and Kshs. 100,000/=; 14.92% earning between Kshs. 150,000/= and Kshs. 200,000/=; 6.63% earning between Kshs. 200,000/= and Kshs. 250,000/=; 7.73% earning Kshs. 250, 000/= and above. More details are shown in the graph below.



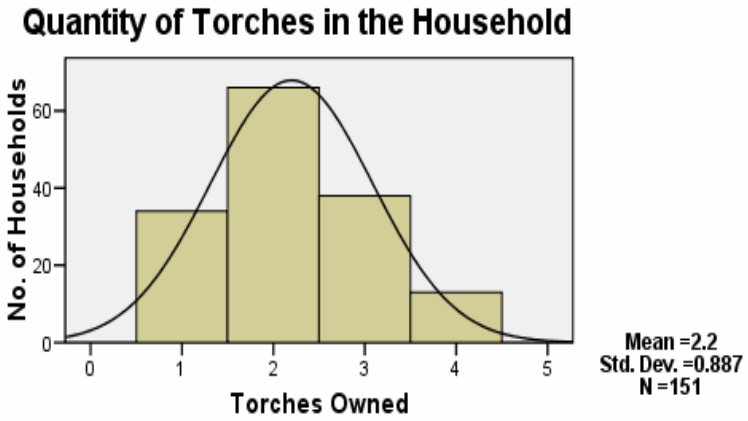
3.9 Housing

The average number of houses per homestead in the sampled households is 4 houses with a minimum of 1 house and a maximum of 6 houses. The average number of rooms per household is 8 rooms with the lowest being 4 rooms and the highest being 17 rooms.

Out of the 184 households interviewed, the walls are constructed with wood (174 households), stones (51 households), iron sheets (4 households), and mud (1 household). All the 184 households sampled have houses that are roofed with iron sheets

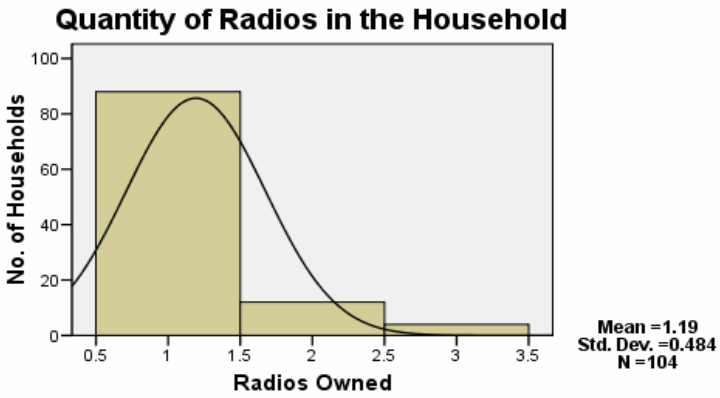
3.10 Ownership of electrical equipment

The torch is the most commonly owned electrical appliance (82.1%) with the average number being 2 torches; the minimum being 1 torch and the maximum being 4 torches.



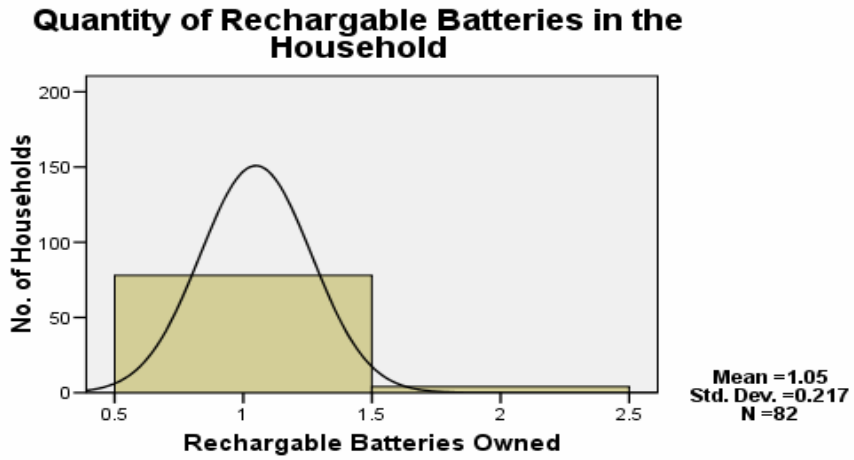
65.8% of the households sampled own a radio cassette player with one player per household.

56.5% of the households own a radio with the average number of radios per household being 1 radio, a minimum of 1 and a maximum of 3.



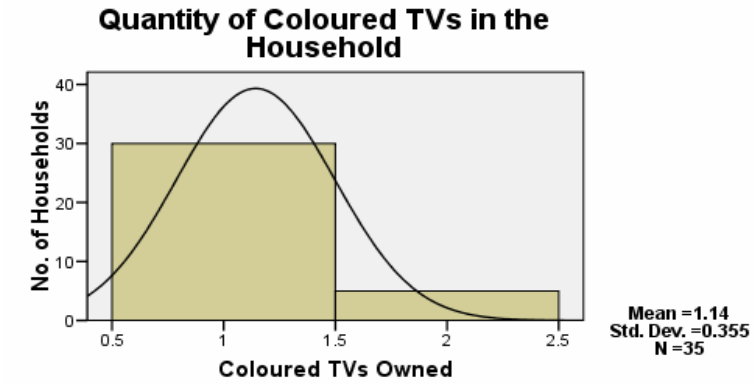
45.1% of the households own black and white television with one TV per household.

44.6% of the sampled households own rechargeable batteries with an average of 1 battery per household, a minimum of 1 and a maximum of 2.

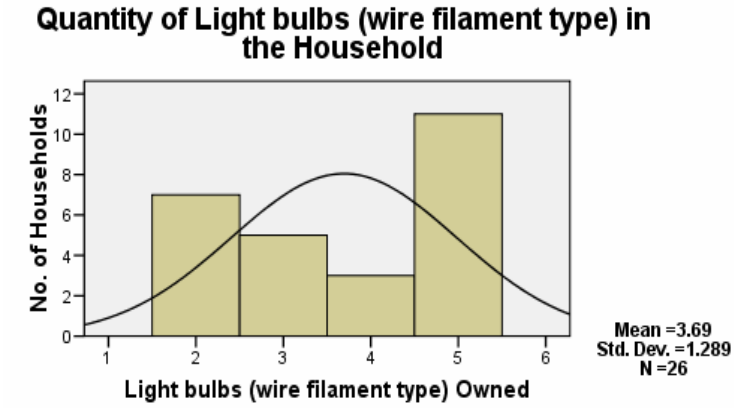


35.9% of households own a video player with one video player per household.

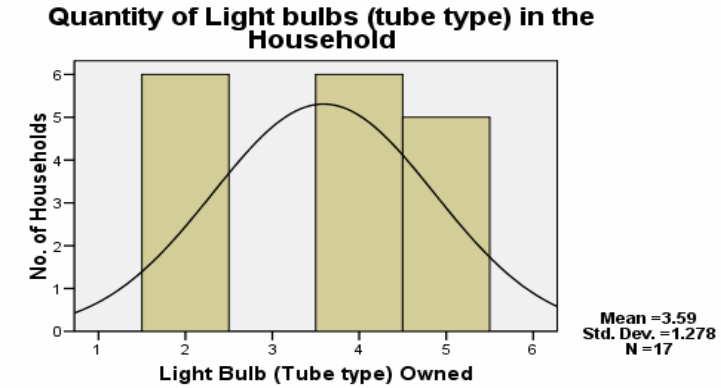
19.02% of households own a colour TV, the average being 1 TV, minimum of 1 and a maximum of 2.



14.1% of the sampled households own light bulbs (filament type) with the average being 4, minimum of 2 and maximum of 5.



9.2% of the sampled households own light bulb tube type (fluorescent); the average being 4, minimum of 2 and maximum of 5.



4.9% of the households own an electric iron with each household owning only one.

With regard to purchase of electrical appliances, men are mostly involved in the purchase of all appliances in very few instances women alone are involved in the purchase and sometimes together with the husband, boys and girls are not involved in any purchase. All family members however have access to and use of all appliances.

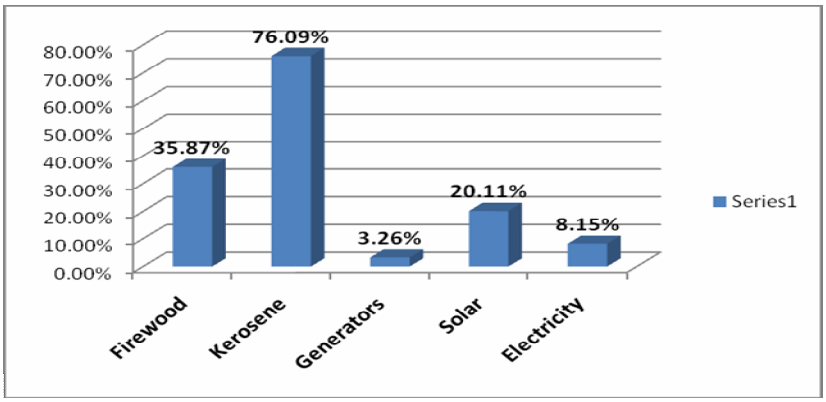
With regard to location of appliances, most are located in the sitting room in most households with the exception of the light bulbs which are also located in the bedroom, kitchen and in all rooms in some households; torches are also located in the bedrooms and in all the rooms; in very few instances the radio and coloured TV are located in the bedroom.

3.11 Energy and energy services

The main sources of energy used for lighting in the sampled households are kerosene which is used by 140 households comprising (76.1%); firewood -66 households (35.87%); solar 37 households-(20.11%); generators –6 households (3.26%); electricity 15 households (8.15%).

Main sources of energy for lighting

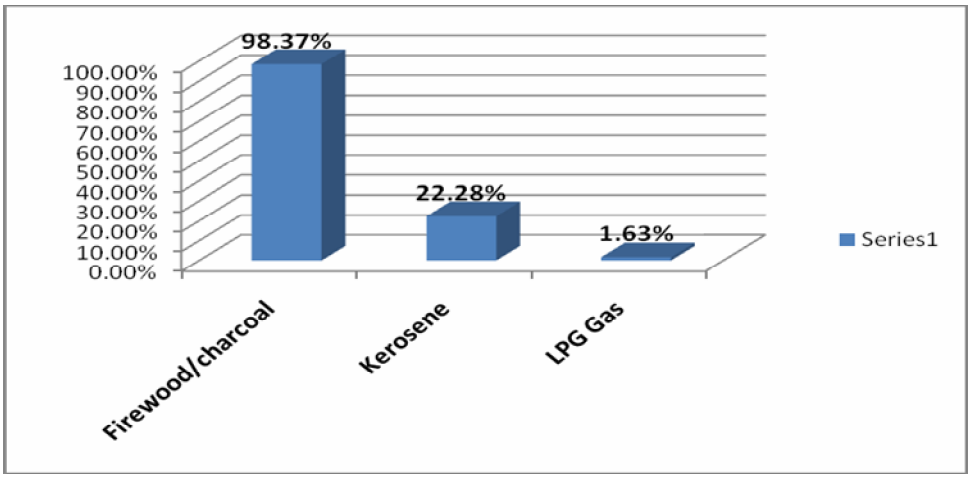
Energy type	No. of HHs	Total HHs	Percent (%)
Firewood	66	184	35.87%
Kerosene	140	184	76.09%
Generators	6	184	3.26%
Solar	37	184	20.11%
Electricity	15	184	8.15%



Decisions on the type of energy to use for lighting are mainly made by both husband and wife (75.8%); wife alone (15.9%) and husband alone (8.3%). The lighting is mainly located in the sitting room, bedroom and kitchen with 80.98%, 72.28% and 78.26% of households respectively. The main source of energy for cooking is fuel wood comprising 98.37% of the households; kerosene -22.28% and LPG -1.63%;

Main source of energy for cooking

Energy type	No. of HHs	Total HHs	Percent (%)
Firewood/charcoal	181	184	98.37%
Kerosene	41	184	22.28%
LPG Gas	3	184	1.63%

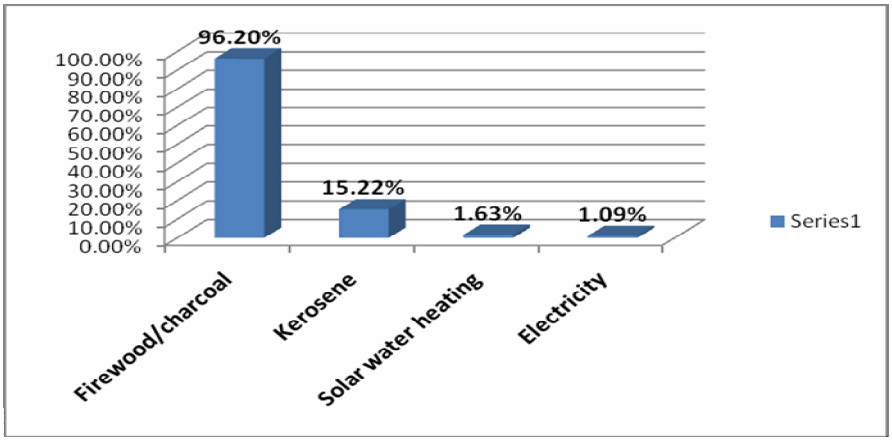


Decisions on appliances used for cooking are mainly made by both husband and wife (77.3%); wives (14.8%); husbands (7.8%).

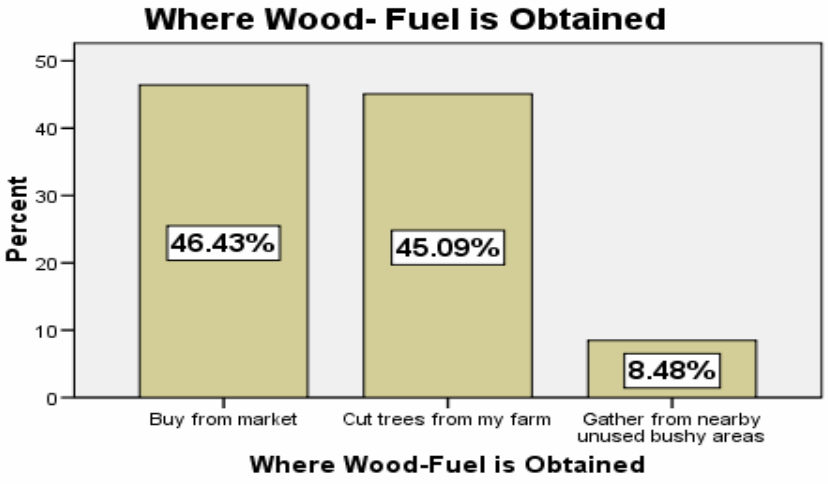
The main source of energy for space warming and water heating is firewood (96.2%); kerosene (15.22%). 1.63% of respondents use solar thermal for heating water; 1.09% use electricity.

Main sources of energy for warming

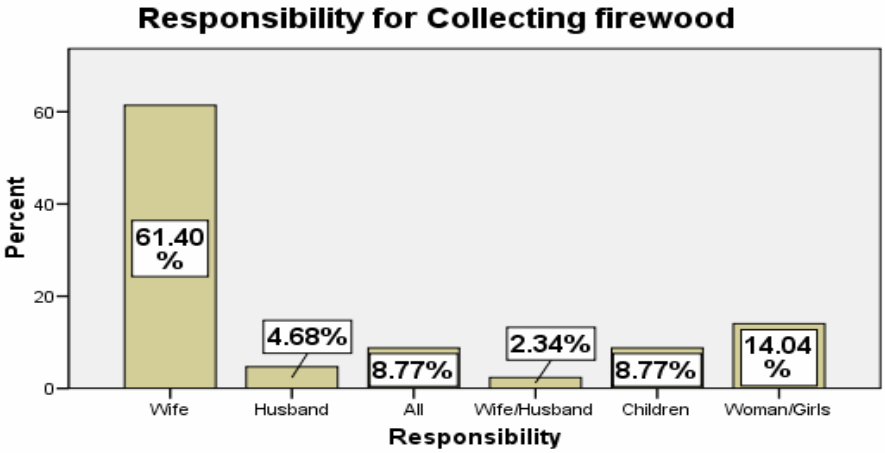
Energy type	Frequency	Total HHs	Percent (%)
Firewood/charcoal	177	184	96.20%
Kerosene	28	184	15.22%
Solar water heating	3	184	1.63%
Electricity	2	184	1.09%



Majority of respondents obtain wood fuel by buying from the market (46.43%); cutting trees in their own farms (45.09%); gathering from nearby unused bushes (8.48%).



Women are mainly involved in collecting firewood (61.4%); followed by women and girls (14.04%); children (8.77%); all family members (8.77%); men (4.68%); both wife and husband (2.34%);



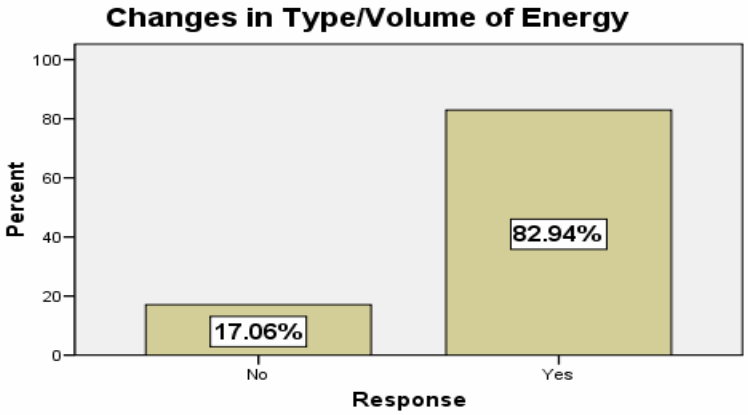
The average time spent collecting firewood is 2.2 hrs with a minimum of 0.5hrs and a maximum of 4hrs.

For residents who do not have access to electricity, the approximate average distance from the nearest electricity line is 0.7km, with a minimum of 0.1km and a maximum of 2km.

Approximately average distance from the nearest electricity line in kilometres

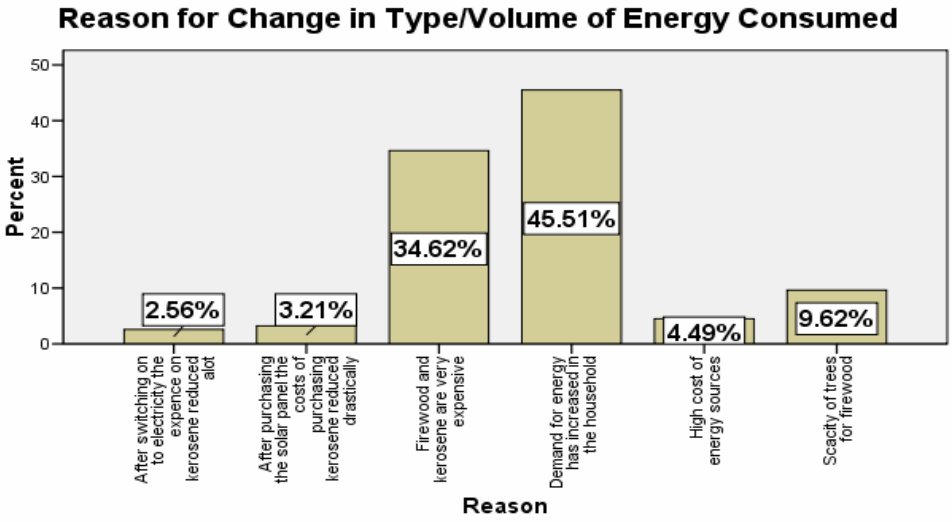
Distance	No. of HH	Minimum (Km)	Maximum (Km)	Average (Km)
Approximately distance from the nearest electricity line	140	.10	2.00	.7267

Majority of households (82.94%) have noticed change in the type and volume of energy they consume in relation to their family needs, while 17.06% have not noticed any change.

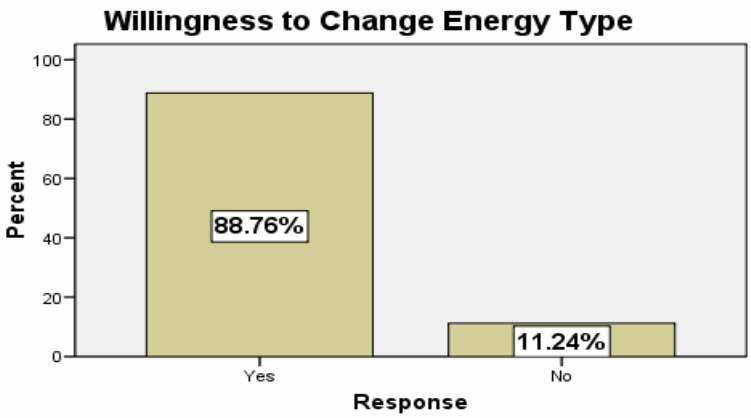


Changes include:

- Demand for energy has increased in the household (45.51%)
- Firewood and kerosene are very expensive (34.62%)
- Scarcity of trees for firewood (9.62%).
- High cost of energy sources (4.49%)
- Cost of purchasing kerosene reduced drastically after purchasing a Solar Home System (3.21%)
- Expenses in kerosene reduced after switching to electricity (2.56%)

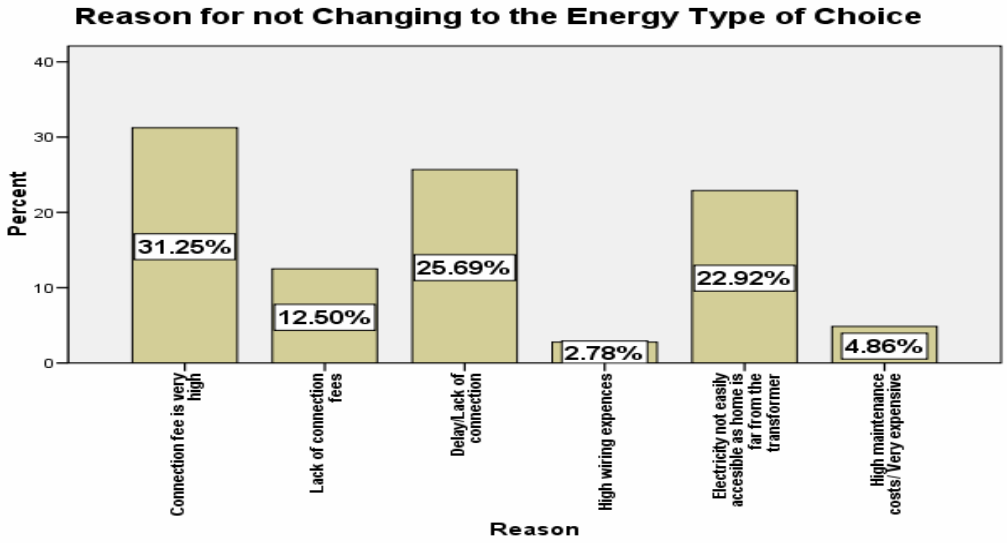


88.76% of the respondents said they would like to change to a different form of energy while 11.24% said they are satisfied with the kind of energy they are using comprising those already using electricity and some with Solar Home Systems.



Reasons given for not changing to energy type of choice are:

- Electricity connection fee is too high (31.25%)
- Delay/ Lack of connection (25.69%)
- Electricity is not accessible/ home is far from the transformers (22.92%)
- Lack of electricity connection fees (12.5%)
- High maintenance cost/very expensive (4.86%)
- High wiring expenses (2.78%)



3.12 Monthly energy expenditure

The average monthly expenditure on electricity for those using is Kshs. 467/= with the minimum being Kshs. 200/= and the maximum Kshs. 700/=. The majority of households spend Kshs. 600/=.

The average monthly expenditure on rechargeable batteries for the households using is Kshs. 112/= with a minimum of Kshs. 40/= and a maximum of Kshs. 300/=. The majority of households spend Kshs. 100/=.

Expenditure on firewood for households using is Kshs. 1311/= with the minimum being Kshs. 300/= and the maximum being Kshs. 3500/=. Majority of households spend between Kshs. 500/= and Kshs. 2000/= on firewood.

Average monthly expenditure on kerosene is Kshs. 399/= with a minimum of Kshs. 100/= and a maximum of Kshs. 1000/=. Majority of households spend between Kshs. 200/= and Kshs. 500/=.

Household expenditure on energy

Energy type	No. of HHs	Minimum (Kshs)	Maximum (Kshs)	Average (Kshs)
Electricity	15	200	700	466.67
Battery Charging	87	40	300	111.84
Firewood	147	300	3500	1310.54
Kerosene	162	100	1000	398.52
Dry cells	134	50	500	225.90
Gas	25	100	500	294.00
Charcoal	70	300	500	494.29
Candle	3	50	70	60.00
Solar PV	7	100	200	145.71

Expenditure on dry cells on the average is Kshs. 226/= with a minimum of Kshs. 50/= and a maximum of Kshs. 500/=. Majority spend between Kshs. 100/= and Kshs. 300/=.
Average monthly expenditure on LPG is Kshs. 294/= with a minimum of Kshs. 100/= and a maximum of Kshs. 500/=. Majority of households spend between Kshs. 200/= and Kshs. 500/=. Average monthly expenditure on charcoal is Kshs. 494/=. Majority of the households spends Kshs. 500/= per month. Average monthly expenditure on candles is Kshs. 60/= with a minimum of Kshs. 50/= and a maximum of Kshs. 70/=.

Average monthly expenditure on solar PV is Kshs. 146/= with a minimum of Kshs. 100/= and a maximum of Kshs. 200/=. Majority of the households spends Kshs. 150/= mainly on the purchase of battery water.

The average number of rechargeable batteries bought by 89 households in the last five years is 2, with a minimum of 1 and a maximum of 4 batteries. The cost range was mainly Kshs. 5000 and above comprising 79.4%; between Kshs. 4001 to Kshs. 5000/= (10.3%); Kshs. 2001 to Kshs.3000/= (4.7%); Kshs. 3001 to Kshs. 4000/= (2.8%); and also 2.8% costing Kshs. 2000/= and below.

Most of the batteries were purchased new (90.7%) with the second hand ones (4.7%), those who mixed old and new (4.7%). The average distance to the nearest battery charging facility is 1.5 km, with a minimum of 0.5Km and a maximum of 3Km.

3.13 Social and other amenities

The average distance travelled to the nearest market place is 1.1Km, the minimum being 0.01Km and the maximum 8Km. Majority of households travel 0.5-3Km to the nearest market place.

Average distance travelled to the nearest hospital is 6.6Km with the minimum of 4Km and a maximum of 10Km. Majority of households travel between 5- 8Km to the nearest hospital.

Average distance to the Maternity facility is 6.1Km, minimum of 1Km and a maximum of 10Km. Majority of households travel between 5-8Km to the nearest Maternity facility.

The average distance to the nearest Shopping Centre is 1.2Km, with a minimum of 0.01Km and a maximum of 6Km. Majority of households travel between 0.5-3Km to the nearest shopping centre.

The average distance to the nearest Health Centre/Dispensary is 1.6Km with a minimum of 0.2Km and a maximum of 8Km. Majority of households travel between 1-3Km to the nearest Health Centre/ Dispensary. The average distance to the nearest water point is 0.5 Km with a minimum of 0.01Km a maximum of 3Km. Majority of households travel between 0.05-1.5Km to the nearest water point.

Average distance to the grain mill is 1.4Km with the minimum of 0.3Km and a maximum of 5Km. The majority of households travel between 0.5- 3Km to the nearest grain mill.

The average distance to the nearest Primary School is 1.1Km with a minimum of 0.02Km and a maximum of 4Km. Majority of households travel between 0.4-1Km to the nearest Primary School.

The average distance to the nearest Secondary School is 1.4Km, with the minimum being 0.05Km and the maximum of 4Km. Majority of households travel from 0.5-3Km to the nearest Secondary School.

The average distance to the nearest church is 1.2Km with the minimum 0.01Km and a maximum of 4Km. Majority of the households travel between 0.5 - 3Km to the nearest Church.

Average distance in kilometres from the nearest social amenity

Social Amenity	No. of HH	Minimum (km)	Maximum (km)	Average (km)
Market place	156	.01	8.00	1.1155
Hospital	179	4.00	10.00	6.6089
Maternity facility	175	1.00	10.00	6.1371
Shopping centre	180	.01	6.00	1.1593
Health centre/ dispensary	177	.02	8.00	1.5639
Water point	153	.010	3.000	.52869
Grain mill	178	.30	5.00	1.4392
Primary school	180	.02	4.00	1.1456
Secondary school	178	.05	4.00	1.3788
Church	175	.01	4.00	1.2473

Majority of households have access to piped water comprising 40.5%; rain water (30.1%), rivers (24.6%), boreholes/wells (4.9%). During the dry season 50.0% of households rely on rivers as the main source of water; piped water (27.2%); boreholes/wells (17.9%); rain water (5.0%). 149 respondents pay an average monthly expenditure of Kshs. 213/= on water, a minimum of Kshs. 100/= and a maximum of Kshs.1000/=.

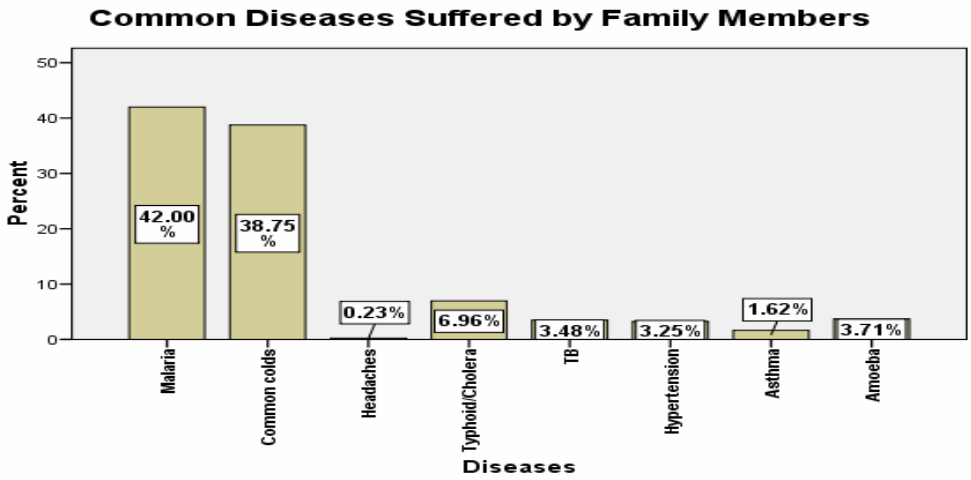
Responsibility for fetching water during the wet season falls on the women (38.4%), boys (29.0%), girls (24.3%), and fathers (8.3%). During the dry season, women fetch water most of the times (38.7%), followed by boys (26.8%), girls (25.1%), men (8.5%) and Water vendors (1.0%).

Water fetching duties during the wet and dry season

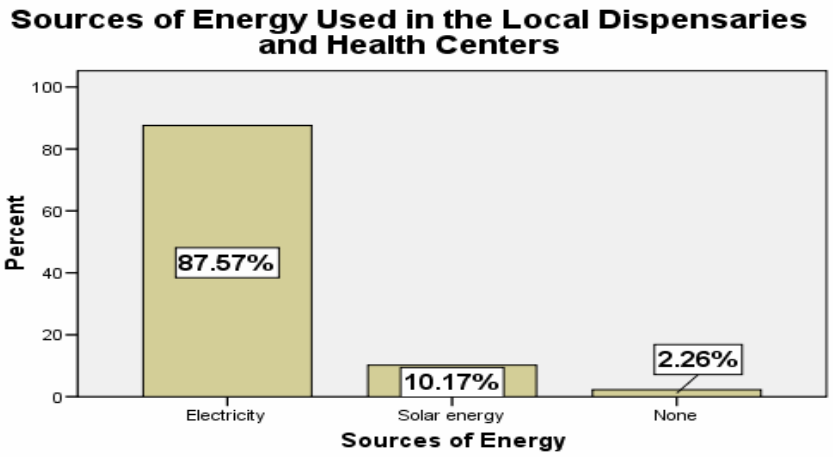
Responsible	Wet season		Dry season	
	Frequency	Percent	Frequency	Percent
Father	34	8.3	35	8.5
Mother	158	38.4	159	38.7
Boys	119	29.0	110	26.8
Girls	100	24.3	103	25.1
Water vendors	0	0.0	4	1.0

Water supply mainly runs by gravity as mentioned by 180 out of the total 184 households sampled.

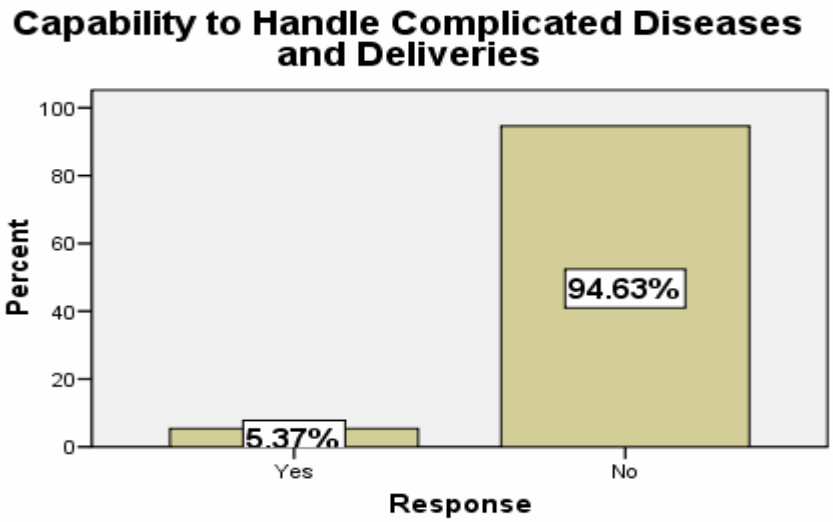
The most common diseases suffered by family members are malaria (42.0%), common cold (38.75%), Typhoid and Cholera (6.96%), amoeba (3.71%), TB (3.48%) and high blood pressure (3.25%). Others with negligible mentions include asthma and headaches



Sources of energy used in local Dispensaries and Health Centres include electricity (87.57%), 10.17% use solar energy while 2.26% of the Dispensaries and health Centres don't use any energy.



According to 94.63% of respondents, the local Dispensaries and Health Centres are not well equipped to handle cases of complicated conditions and maternal deliveries. 5.37% of respondents said that the local Dispensaries and Health centres can handle complicated conditions and deliveries;



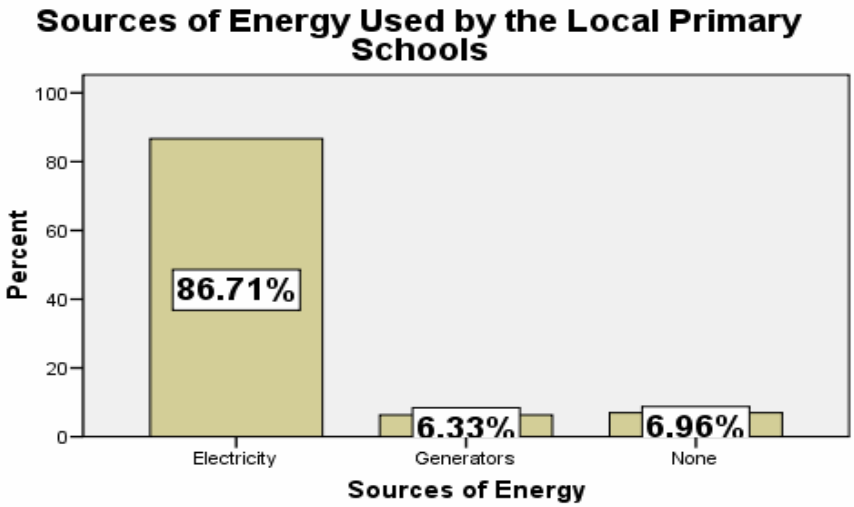
Reasons given to support inability of Dispensaries and Health Centres to handle complicated cases include:

- Not well equipped- lack of proper structures, equipment and facilities
- Lack of trained personnel to handle the cases
- Shortage of staff

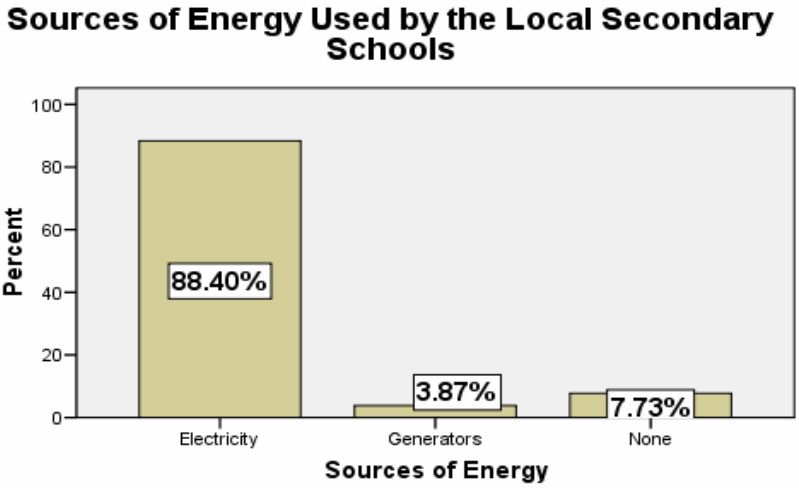
Reasons given to support ability of the facilities to handle complicated cases include:

- They use electrical equipment for testing diseases
- Experienced Doctors and Nurses available in case of complicated cases

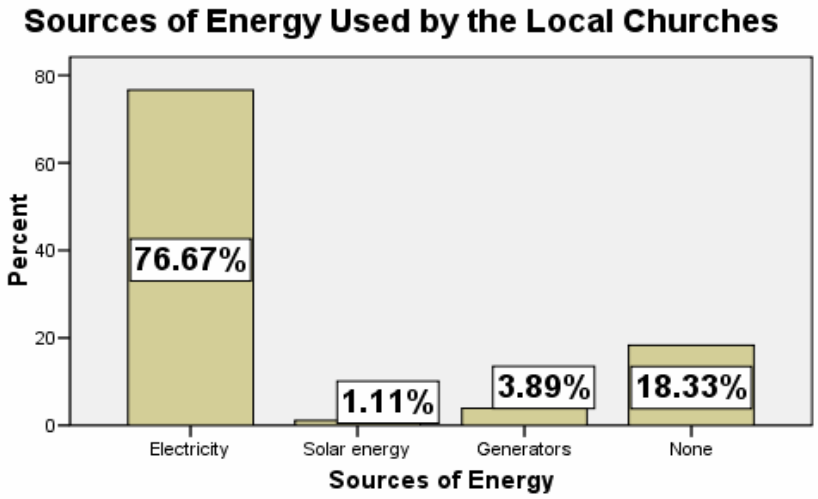
Sources of energy used by Local primary Schools include electricity (86.71%), generators (6.33%), with 6.96% of Primary Schools not using any energy type.



Local Secondary Schools mainly use electricity (88.4%); generators (3.87%); with 7.73% of Secondary Schools not using any energy type.



Sources of energy used by local churches include electricity (76.67%); generators (3.89%); solar (1.11%) with 18.33% of Churches do not use any energy type.



3.14 Businesses operated at market centres

The main businesses mentioned by respondents include general shops (17.4%), hotels (17.4%), groceries (13.8%), butcheries (12.4 %), clubs/bars/pubs (10.7%), tailoring (8.6%), barber shops (4.5 %), shoe making (3.9%), carpentry (3.7%), hair salons (1.8 %) , miraa dens (1.1%), vehicle repair (0.9%), wholesale shops (0.7%), hardware (0.5%), welding and panel beating (0.5%), electronics repair (0.4%), plumbing (0.4%), grain milling (0.3%) and kiosks and canteens (0.2%).

3.14.1 Female operated businesses/activities

Majority of respondents (23.0%) mentioned groceries as the main businesses run by women followed by general shops (22.3%), hotels (19.8%), tailoring (19.6%), clubs/pubs/bars (6.5%), open air market for clothes (3.7%), salons (0.9%), Kiosks/ canteens (0.9%) and wholesale shops (0.6%).

3.14.2 Male operated Businesses/activities

Majority of respondents (14.8%) mentioned general shops as the main businesses run by men followed by butcheries (12.7%), groceries (10.9%), carpentry (10.4%), hotels (10.2%), tailors (9.5%), clubs/bars/ pubs (6.8%), shoe repair (6.4%), barber shops (3.5%), miraa sale (2.3%), open air market clothes (2.2%), garages (1.5%), grain milling (1.5%), kiosks/canteens (1.4%), wholesale shops (1.3%), welding and panel beating (1.2%), radio/TV repair (0.8%), mechanics (0.6%), plumbing (0.5%), taxis (0.5%), Mpesa (0.5%), health clinics and chemists(0.3%) and building houses (0.1%)

3.15 Value of electricity to improvement of livelihoods

The major ways that the respondent's think access to electricity will improve on the livelihoods of the people in their community include:

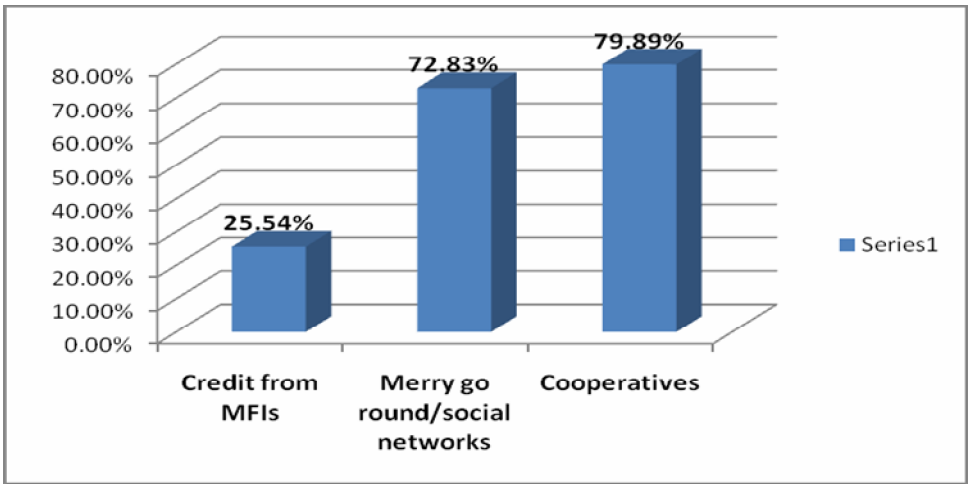
- Increasing business opportunities (25.8%)
- Creating employment opportunities (13.1%)
- Improvement of agriculture (12.7%)
- Making work easier since most will be done by machines (7.0%)
- Improving on livestock (6.7%)

- Improving lighting in homes (5.4%)
- Reduces cost, time and energy spent on such services (5.4%)
- Hospital and dispensary improvement (4.8%)
- Improving security in homes and market centres (4.5%)
- Markets improvement (3.8%)
- Making people more enlightened e.g. by buying TV and Computers (3.2%)
- Improving peoples overall economic base (1.9%)
- Factory improvement (1.9%)
- Reducing crime rate by opening business opportunities for the youth (1.0%)
- Environmental conservation/sanitation (1.0%)
- Increasing working hours since people can work day and nights (0.6%)
- School improvement (0.3%)
- Reduction of stress due to listening to music (0.3%)

3.16 Access to financial facilities

79.89% of respondents said they have access to cooperatives as a financial facility while another 72.83% said they have access to merry go rounds and social networks; 25.54% have access to credit from MFIs.

Access to Financial Facilities



4.0 Conclusions and recommendations

Only 15 households out of the 184 sampled use electricity for lighting, while none uses electricity for cooking. Majority of respondents said that they would like to change to electricity but are not able to because of the initial high cost involved for connection and wiring, delay in connection, as well as distance from the transformers. Efforts should be made to come up with innovative financing mechanisms to address these barriers among others, during the implementation of the electrification project. The approximate average distance from the nearest electricity line for households with no electricity is 0.7 km. 35% of the respondents are more than a kilometre away from the nearest electricity line which excludes them from benefiting from the rural electrification programme.

Household expenditure for households using kerosene and firewood for lighting is higher than for those using electricity and rechargeable batteries. There is possibility that increased access electricity will result in increased use of electricity for lighting since it is cheaper than the energy types being used currently.

The survey reveals that most households have a small piece of land with an average of 1.9 acres with the majority owning between 1-2 acres due to the high population in the area. The average acreage under tea and coffee is less than an acre. Despite the small acreage, the households sampled have access to regular incomes from cash and food crops, livestock as well as off-farm economic activities.

Majority of households would therefore be able to pay for electricity if connected. Since most households are spending more on energy for lighting access to electricity by most households would result in a reduction in household energy budgets in the long term. Electricity is also a cleaner energy compared to kerosene and firewood and also does not contribute to environmental degradation. There will be need to educate the households who believe that electricity connection fee is expensive that the initial costs in connection will be recovered quickly through savings from reduced kerosene and firewood use.

All family members mostly have access to and use of all electrical appliances which means that access to electricity will improve access to these facilities to benefit the whole family. Men are mostly involved in the purchase of all appliances and in very few instances women alone are involved in the purchase and sometimes together with the husbands. Any electrification project should aim at sensitizing the community to ensure that all family members participate in decision making regarding connections and appliances to be purchased. Efforts should be made to ensure both men's and women's views are listened to during implementation in order to ensure all benefit from the electrification project.

With regard to location of appliances, most are located in the sitting room in most households with the exception of the light bulbs which are located in the bedroom, kitchen and in all rooms in some households; torches are also located in the bedrooms and in all the rooms; in very few instances the radio and coloured TV are located in the bedroom. The fact that the electrical appliances are located in the sitting room most of the times in most of the households means that all family members would benefit. Efforts should however be made to create awareness to ensure that all rooms have lighting including the kitchen.

Women and girls are mainly responsible for firewood collection. The average time spent collecting firewood is 2.2 hrs. Considering that firewood is not only used for cooking by most households but also for lighting and heating, access to electricity will contribute to reducing drudgery for women and girls. This will also allow more study time for girls and more time for productive activities for women.

There are incentives to encourage residents to switch from using kerosene to electricity. For example, for majority of respondents demand for energy has increased in the household; firewood and kerosene are very expensive and trees for firewood are scarce. For others, expenses in kerosene reduced after switching to electricity or after purchasing Solar Home Systems. This clearly indicates that once electricity is installed in households, expenditure on energy will reduce as it will replace kerosene for lighting.

The main reasons why most households are not connected to electricity although they would like include high electricity connection fee; delay/lack of electricity connection fees and electricity is not accessible/ homes are far from the transformers. Other reasons include high maintenance cost/ very expensive and high wiring expenses. This clearly demonstrates that there are a large percentage of households who would be ready for connection to electricity if it was available close to their homes. Any electrification project should consider innovative financing mechanisms that could enable more households to connect to electricity. Furthermore 79.89% of respondents have access to financial facilities such as cooperatives; another 72.83% have access to merry go rounds and social networks and 25.54% have access to credit from MFIs. Households could be encouraged to these could be used to finance connections to households

Majority of the sampled households own radio cassette players and/or radios, TVs, and video players. Access to electricity would provide an alternative and cheaper energy for powering the equipment and increase access to entertainment and information. Access to information may also lead to an increase in earnings from cash crops as well as food crops grown for sale through links to new markets.

About half of the households interviewed have been investing in rechargeable batteries. They also travel some distance to the nearest battery charging facility. This clearly demonstrates that people in this community are keen to acquire alternative energy options and would therefore be ready to invest in electricity connection.

Community members travel an average of 2.2Km to social amenities such as schools, health centres, markets, schools. Majority of respondents travel an average of 6.6 and 6.1km to the nearest Hospital or Maternity facility respectively. They feel that the local Dispensaries and Health Centres are not well equipped to handle cases of complicated conditions and maternal deliveries. Availing electricity to more health facilities will ensure better health services through the purchase of modern electrical equipments. Providing electricity in staff quarters will also attract qualified staff thereby ensuring quality health services for the community members.

Local primary Schools and Secondary Schools using generators and those without any energy source would benefit from access to electricity and subsequent reduction in energy costs. Access to electricity by the schools without will provide more study time and facilities hence improved performance. Local Churches play a major role in community development and access to electricity by those without would lead to setting up development initiatives leading to better services to residents.

Access to electricity in market centres will support the wide range of businesses being operated by both women and men such as salons, hotels, tailoring, carpentry, butcheries, barber shops etc as well as create opportunity for new businesses to be established.

Most residents are aware of the wide range of benefits that electricity would bring to them, including increasing business opportunities; creation of employment opportunities; improvement of agriculture; making work easier through use of machines; improvement on livestock rearing; improving lighting in homes; reduction of cost, time and energy spent seeking services; better services in hospitals and dispensaries; improved security in homes and market centres and improvement of markets.