Baseline Report

MILLENNIUM RESEARCH VILLAGE

SAURI, KENYA

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About the Millennium Villages Project

The Millennium Villages Project is aimed at empowering and working with impoverished communities in rural Africa to achieve the Millennium Development Goals. The Millennium Villages Project (MVP) applies all the Millennium Development Goals (MDGs) – specific targets for reducing poverty by 2015, agreed upon by all countries of the world in 2000 – as a holistic package of site-specific interventions for 12 impoverished villages in Kenya, Ethiopia, Ghana, Malawi, Mali, Nigeria, Senegal, Rwanda, Tanzania, and Uganda. These villages are carefully selected to represent each of twelve principal agro-ecological zones and farming systems of Africa. Millennium Village communities are partnering with local governments, The Earth Institute at Columbia University, The Millennium Promise Alliance, UNDP, and other development partners as a proof of concept that the MDGs can be achieved in a 10 year time frame at the local level, through participation and empowerment of the communities and investments and capacity building in different sectors. This community driven project is guided by the recommendations of the UN Millennium Project[1] on the types of interventions in agriculture, nutrition, health, education, energy, water, communications, and the environment. In order to plan and monitor progress in the Millennium Villages, detailed baseline assessments are required. Detailed information on the Millennium Villages and the baseline tools and methods can be obtained on the Millennium Villages Project website at http://www.earth.columbia.edu/mvp.

In July 2004, Sauri, Kenya was selected to be the first Millennium Research Village. The report contains the results of the baseline surveys and measurements taken in Sauri between January 2005 and January 2006. In addition to this document that highlights the site characterization and MDG indicators there will be separate companion volumes for each of the surveys with the detailed responses to all questions in tabular form.

Executive Summary

A summary of the baseline status of the MDGs in Sauri, Kenya, is given below. The numbered list refers to official MDG indicators (UN Millennium Project, 2000). Additional indicators, denoted by an asterisk (*), are used to supplement the original MDG indicators.

Goal 1: Eradicate Extreme Hunger and Poverty	
Target 1: Between 1990 and 2015, halve the proportion of people living on $1 per day	
1. Proportion of population below $1 per day	79% live below $1 per day 89.5% live below $2 per day
2. Poverty gap ratio	54.5%
3. Share of poorest quintile in national (village*) consumption	2%
Target 2: Between 1990 and 2015, halve the proportion of people who suffer from hunger	
4. Prevalence of under weight children under 5 years of age	17% underweight 7% severely underweight
5. Proportion of population below minimum dietary energy consumption	See proxy in report

[1] UN Millennium Project, 2005. *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals.* New York.

Goal 2: Achieve Universal Primary Education	
Target 3: Ensure completion of primary course by all children by the year 2015	
6. Net enrollment ratio in primary education	84.6% (Kenya=76%) for primary school 19.2% (Kenya=40%) for secondary school
7. Proportion of pupils starting grade 1 who reach grade 5	63.6% by age 12-14 years 89% by age 18 years
8. Literacy rate of 15 -24 year olds	95.3% (self reported)

Goal 3: Promote Gender Equality and Empower Women	
Target 4: Eliminate gender disparity in primary and secondary education and preferably by 2005 and in all levels of education no later than 2015	
9. Ratio of girls to boys in primary, secondary and tertiary education	Primary- 99.1:100; Secondary- 86.7:100 Tertiary- 64.8:100
10. Ratio of literate women to men aged 15 – 24 years old	0.94 (self-reported) (Kenya=99%)
11.Share of women in wage employment in the non agricultural sector	Forthcoming
12. Proportion of seats held by women in national parliament	Not measured

Goal 4: Reduce Child Mortality	
Target 5: Reduce the under five child mortality by 2/3 between 1990 and by 2015	
13. Under five child mortality rate †	149/1,000 live births (1999-2003)
14. Infant mortality rates †	95 per 1,000 live births (1999-2003)
15. Proportion of 1 year old children immunized against measles†	Proxy: 67.1% of children with vaccination cards received measles vaccination
* Proportion of children under 5 testing positive for malaria	66% of boys 60% of girls
* Proportion of children age 2-4 testing positive for intestinal helminth infection	48%
* Proportion of mothers adding sugar or other liquids to infant feed	68%

Goal 5: Improve Maternal Health	
Target 6: Reduce by ¾ the maternal mortality ratio between 1990 and 2015	
16. Maternal mortality ratio	Not measured; see proxies below
* Proportion of reproductive-age women (15-49) using a method of contraception	28%
* Proportion of unwanted pregnancies per child bearing woman	1.3
* Proportion of women receiving adequate antenatal care (4 visits per pregnancy from a skilled provider)	18.1%
17. Proportion of births attended by skilled health personnel	51.8%
* Proportion of women reporting pregnancy complications	49%
* Proportion of women with access to emergency obstetric care	0%

Goal 6: Combat HIV/AIDS, Malaria and other diseases	
Target 7: Halt and reverse the spread of HIV AIDS by 2015	
18. HIV prevalence among pregnant women aged 15 – 24 years	Proxy: 30% of women tested during ante-natal care at Yala Sub District Hospital tested positive
19. Condom use rate of the contraceptive prevalence rate	Male condoms account for 32% of overall contraceptive use
19a. Condom use at last high-risk sex †	45.5% at last sex (not high-risk)
19b. % of population 15-24 with comprehensive correct knowledge of HIV/AIDS	38%
19c. Contraceptive prevalence rate	28% of reproductive age women are currently using a form of contraception
20. Ratio of school attendance of orphans to attendance of non-orphans 10-14 yrs	0.98:1
* Number of people using Anti-Retroviral Treatment	5
Target 8: Halt and reverse the incidence of malaria and other major diseases by 2015	
21. Prevalence and death rates associated with malaria	55% prevalence in population sampled
22. % of population in malaria risk areas using effective preventative measures.	21% of households own at least one malaria bed net 53% of malaria bed nets had been pretreated with insecticide when purchased
23. Prevalence and death rates associated with TB †	Prevalence: 943 per 100,000 Mortality: 171 per 100,000
24. % of TB cases detected and cured under recommended TB control strategy DOTS	35%
* Prevalence of Soil-Transmitted Helminths in pre-school children (2-4), school going children (9-10), and reproductive age women (15-49)	48% in children age 2-4 80% in children age 9-10 75% in women 15-49
* Prevalence of anemia	64% overall 76% in children under 5 years

Goal 7: Ensure environmental sustainability	
Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	
Target 10: Halve the % of people without sustainable access to safe drinking water and basic sanitation	
25. % of land area covered by forest	1-5%
26. Ratio of area protected to maintain biodiversity to surface area	0%
27. Energy use per $1,000 equivalent GDP	113 kgoe/$1000 GDP(PPP) per household
28. Carbon dioxide emissions per capita and consumption of CFCs	Not measured
29. % of population using solid fuels	99%
30. % of population with sustainable access to an improved water source †	46.6% obtain adequate amounts of water at a reasonable distance
31. % of population with access to improved sanitation	13.9% excluding earthen floor latrines 85.4% including earthen floor latrines

** denotes additional indicators of the MDGs monitored by the Millennium Villages Project*
† denotes statistics that are reported differently from national-level figures to account for the village-level sample size or data complications

I. General Site Characteristics

1. CLIMATE

Sauri Millennium Village (MV) is located in the Kenya highlands, 1400-1500 meters above sea level, west of the Rift Valley and 30 km north of Lake Victoria. The equator lies just to the south of Sauri (0^{o} 06N). The general topography is undulating with ephemeral streams, rivers and wetlands meandering through rounded hills.

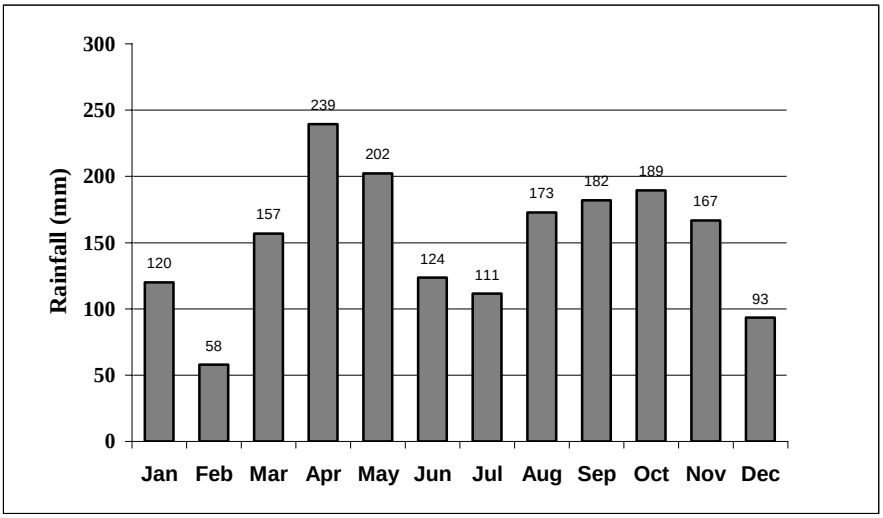
The area is classified as the sub-humid tropics with an average temperature of 24^{o}C, ranging from 18 to 27^{o}C with an annual rainfall of 1800 mm. Rainfall is bimodal, divided into the long rainy season from March to June (1120 mm) and the short rainy season from September to December (710 mm). The short rains are extremely variable but highly predictable due to strong influence of the El Nino Southern Oscillation. Nine years of rainfall data collected daily at the Yala township weather station, located adjacent to the MV, are given in Table 1. Figure 1 shows the mean values for these years, reflecting the bimodal rains cycle with the highest rainfall generally occurring in April and lowest rainfall generally occurring in February. The total of these monthly means is 1816 mm.

TABLE 1. Monthly total rainfall (mm) at Yala weather station, 1996-2004[2]

	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
January	95	76	175	82	12	213	120	150	158	120
February	100	16	68	2	43	104	11	45	131	58
March	152	104	150	309	81	150	196	184	88	157
April	241	100	391	281	160	246	314	201	222	239
May	278	64	150	192	298	211	271	229	128	202
June	89	58	312	99	115	131	87	161	61	124
July	130	80	62	153	172	49	159	68	130	111
August	170	64	214	328	145	203	155	172	105	173
September	351	39	191	139	186	208	102	267	155	182
October	195	98	159	203	219	263	135	175	259	189
November	147	199	103	234	135	175	248	109	150	167
December	38	151	18	64	150	42	143	138	99	93
Total	**1985**	**1049**	**1992**	**2084**	**1715**	**1995**	**1940**	**1899**	**1684**	**1816**

[2] Kenya Ministry of Water, 2005

FIGURE 1. Monthly mean rainfall at Yala weather station, 1996-2004[3]



2. VILLAGE GOVERNANCE AND TRADITIONAL STRUCTURES

The Sauri sub-location is a conglomerate of 11 villages encompassing 5,000 people within Yala Township location, Yala Division, Siaya District, Nyanza Province in the western region of Kenya. The sub-location covers 8 sq km. A chief (covering the location), assistant chief (sub-location) and village elders undergo interviews to be representatives of the Office of the President. A Councilor is elected through official government elections and represents the villagers at the locational, divisional and district levels.

3. INFRASTRUCTURE AND SERVICES FROM THE GOVERNMENT

The sub-location is adjacent to a major paved road that runs between Kisumu and Busia, with the nearest major town being Kisumu, 40km from the site. There are dirt roads that access the village. To the east of the sub-location there is a functioning rail line that goes to the towns of Butere and Kisumu. The electric grid is at the southern periphery of the village, with a small part of the site having grid access. The site is within cell phone range.

There are no land line telephones in the village, and although some villagers possess cell phones they are often left uncharged and are used almost exclusively to receive calls (the caller is usually charged for a cell phone call). The village has near-complete coverage (with the exception of some areas by the Yala River) for both CelTel and Safaricom mobile telephone networks. A single wire phone line once served central parts of the village, but this was removed, presumably by vandals. There are no other known sources of telecommunications or computer/internet connections within the 11 villages of the sub-location.

The Yala River Piped Water Supply (Sidindi-Malanga Water Scheme), an extensive water system drawing water from the Yala River, was installed by the government in the late 1970s. Since then, it has rarely functioned properly or served much of the sub-location. In 2000, some villages within the Sauri Millennium Village put in pipes off of the main line, but again they rarely received water from the pumping station. The water pipeline is unequally distributed over the sub-location – three entire villages and most of another do not have any piped water coverage. Only 74 homesteads (12%) and the three primary schools were mapped as having a water tap connection. In 2004 and 2005 the government repaired one turbine and installed a new one at the water pumping station and water began to be supplied twice a week in 2005.

[3] Kenya Ministry of Water, 2005

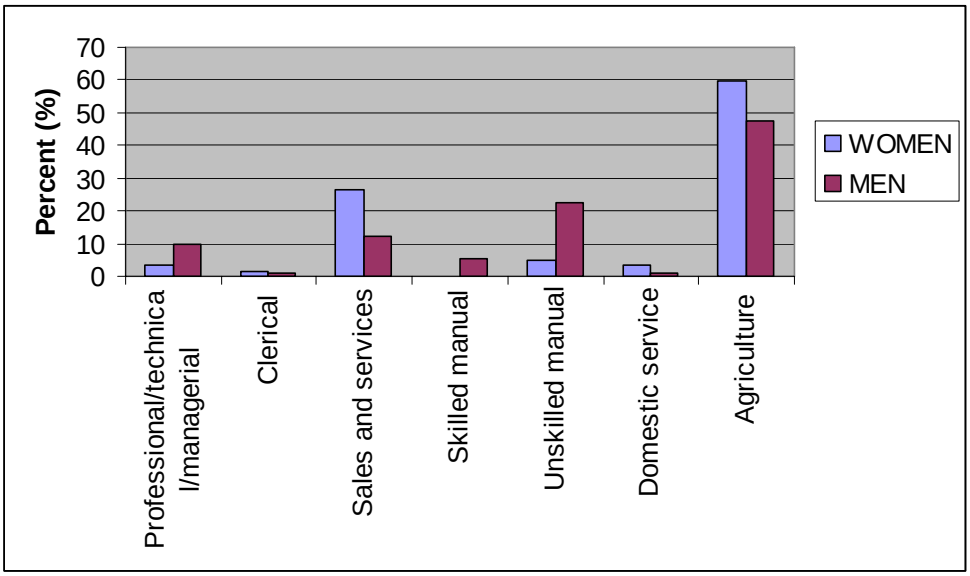
4. PROXIMITY TO MAJOR CITIES, MAJOR INDUSTRY

Sauri is located 40 km from Kisumu, the nearest city. Although Kisumu is a potential center for markets and other resources, few Sauri residents have access to the city mainly because of transport costs.

5. DISTRICT DATA OF LIVELIHOODS

Livelihood data is available on a provincial level. In the Nyanza province, nearly half of all men (47.4%) and the majority of women (59.9%) are employed in the agriculture sector (Figure 2).

FIGURE 2. Livelihood strategies for men and women in Nyanza Province, Kenya, as percentage of total for each group[4]



6. AGRICULTURAL SYSTEM, SEASONS, YIELDS, FERTILIZER USE

This area is a rain-fed maize-based farming system according to Dixon's classification (2001). Other crops include beans, sweet potatoes, bananas/plantains, cassava, sorghum, millet, ground nuts, kale, tomatoes, and onions. The bimodal rainfall and high temperature allow two crops per year, though the short rainy season is risky with the crop failing almost half of the time. District statistics show that maize, beans, sorghum and cassava occupy 89% of the total area under crop production in the entire district.[5] There are only two cash crops grown; cotton and tobacco, occupying 0.2% and less than 0.1% of the total planted area, respectively.

In 2004, maize was planted on 34,041 ha in the district, with an average production of 0.9 tons/ha (4 bags per acre). This yield was not any different from the average of the previous 7 years (1997-2003), which was 1.1 tons/ha. Sorghum, which is considered a food security crop was planted on 8,111 ha in 2004. Sorghum yields ranged from 0.7-1.1 tons/ha during the 1997-2004 period. Beans were planted on 20,768 ha in the whole district in 2004, and the production was 0.3 tons/ha (1.2 bags per acre), similar to previous years. In 2004, cassava was been planted on 1,600 ha with a production of 5 tons/ha; a production level that has been consistent since 1997.

Farmers in Siaya district had been using nitrogenous and phosphate fertilizers in their fields. From 2000 to 2004, the average annual N- and P-fertilizers bought by farmers were 108.5 tons and 80.9 tons, respectively. These fertilizer application rates translated to 1.5 kgs of N-fertilizers per ha and 1.1 kgs of P-fertilizers per ha. This is a clear indication that fertilizer use was quite minimal, hence the poor crop production in the district. A larger proportion of the fertilizers were used during the long rains (55% of N-fertilizer and 67% of P-fertilizer).

[4] Kenya Demographic and Health Survey, 2003.
[5] Siaya District Agriculture report, 2004

7. DISTRICT DATA ON POVERTY LEVEL

The latest report on the poverty level for Siaya district dates 2003, and indicates that the district average is 64%.[6] Location-wise, poverty levels range from 49% to 78%. Yala township location, where Sauri falls, has a poverty level of 62%.

Over the last 10 years poverty levels have been increasing in Siaya at an alarming rate. Poverty has increased from 41% in 1994 to 58% in 2002,[7] and 64% in 2003. This trend can be explained mainly by the collapse of some agricultural sub-sectors, such as cotton and sugar. For example, many farmers could successfully grow cotton as a cash crop before the collapse of cotton marketing institutions in the late 1990s.. In addition, large sections of the district used to have out-growers scheme for local sugar factories until the late 1990s, when most local sugar factories defaulted on loans.

8. DISTRICT DATA ON KEY HEALTH VARIABLES

Malnutrition and poor health plague the community; villagers have limited access to medical care and most cannot afford to buy the few medicines that are available. The Yala sub-district hospital borders the sub-location, with a catchment area of 96,000 people. At the beginning of the project, there was no medical doctor at the sub-district hospital. Sauri is a holoendemic area for malaria, which is prevalent all year round, with children carrying a higher burden of morbidity and mortality than do the surviving adults who become partially immune. The district has a population of about 500,000 people. There were 180,000 cases of malaria in the district in the year 2005. 11,400 insecticidal bednets have been distributed through various partners, notably the Centres for Disease Control and Prevention, to sublocations in nearby Gem.

HIV statistics from surveillance data of surrounding sentinel sites indicate prevalence in excess of 10% and perhaps as high as 30%.[8] A total of 5 people were on Antiretroviral therapy in April 2005 at the nearest Yala sub-district hospital.

Twenty-four percent[9] of district-wide deliveries are conducted in hospital under the attendance of trained healthcare workers, with the rest occurring in homes under the care of traditional birth attendants (TBA's) and family members. A government effort through the Ministry of Health to train TBA's on universal precautions, prevention of mother-to-child transmission of HIV, and identification and referral of high-risk pregnancies with the aim of reducing mortality does not seem to have borne fruit. Maternal mortality stands at about 8 per 1000 deliveries,[10] against a national average of about 5 per 1000. Infant mortality is 135 per 1000 live-births, and cumulative under-5 mortality stands at 234 per 1000.

The proportion of children fully immunized against all the standard immunizable diseases under the country's Expanded Program on Immunization (TB, Polio, Diphtheria, Pertussis, Tetanus, Hepatitis B, Haemophilus Influenza Type B, and Measles) at the age of one year is 45%; 85% of children receive birth BCG vaccination.

[6] Ministry of Planning and National Development, 2003
[7] District Development Plan, 2002-2008
[8] District Medical Office of Health, 2005
[9] Ibid.
[10] Ibid.

II. Methods of Baseline Data Collection

A series of data collection instruments were developed for use in Sauri and the other Millennium Research Villages. These instruments have been adapted to the specific sociocultural and biophysical contexts of each village, but core questions remain the same in order to enable cross-site comparisons.

In this report we make every effort to point out any difficulties with data analysis and methods used to compensate for these difficulties. In some cases, difficulties in data analysis revealed that changes were necessary in survey questions, data entry templates, or data collection techniques. In these cases, the surveys and techniques were revised before being fielded in the other villages.

Data were collected in three ways: through a set of 14 survey instruments (Appendix 1), through clinical measurements and blood samples, and through environmental assessments and sampling.

A Demographic and Key Variables survey instrument was fielded first, before any project activities were implemented. This one page survey generated a quick dataset on key asset variables and population characteristics for use in designing the sampling framework and generating a wealth index. Stratified sampling, according to geography within the sublocation and wealth categories, was then done in order to select a representative sample of about 300 households to use in fielding the comprehensive sectoral and single-topic surveys.

Survey instruments and measurements were fielded from January 29, 2005 to November 26, 2005 (Table 2). The period or season in which the surveys are fielded is critical to note. The results of the surveys would change with the different seasons and therefore any repeat surveys and samples must be taken during the same period. For example, the nutrition survey should be conducted to indicate hunger times prior to harvests, and malaria surveys should be conducted during malaria season, particularly for those sites with epidemic rather than endemic malaria.

Clinical data was collected to supplement information derived from the health survey modules. Clinical data includes blood samples, which were collected from about 900 individuals randomly selected from the 300 households sub-sample. The blood samples were then used to determine the clinical and nutritional status of the various age and gender cohorts of the population in terms of levels of anemia, parasitemia, and vitamin A deficiencies. Anthropometric measurements of these individuals were taken as well. This data is linked to the information collected in the Human Nutrition survey, the Socioeconomic survey, and Water and Sanitation data.

Spatial data were collected using remotely sensed satellite imagery and aerial photography of the sites, in combination with Global Positioning System (GPS) points taken on household locations, water points, roads, and schools. Biophysical data on soils, vegetation, water, land use, and ecology were collected through field sampling and transect methodologies. Rainfall information was gathered from the nearest meteorological station.

TABLE 2. Dates during which surveys and sampling were conducted in Sauri

SURVEY INSTRUMENT	Start date	End date
Quickbird satellite image	8/12/2004	9/28/2004
Soil sampling	12/20/2004	12/29/2004
Vegetation	12/20/2004	12/29/2004
Socio economic survey	1/29/2005	3/12/2005
Human nutrition	3/5/2005	3/31/2005
Blood sampling	3/7/2005	4/22/2005
Antropometrics	3/7/2005	4/22/2005
Malaria	3/17/2005	4/8/2005
Agriculture and environment	4/17/2005	5/9/2005
Land use classification	4/13/2005	4/16/2005
Energy	4/26/2005	5/19/2005
Women's health	5/23/2005	6/27/2005
Water and sanitation	6/7/2005	6/23/2005
STI and HIV/AIDS	6/23/2005	7/1/2005
Men's health	7/8/2005	7/28/2005
Water quality	7/9/2005	7/16/2005
Transport and communication	7/13/2005	10/26/2005
Market for energy	8/25/2005	8/26/2005
Partial time budget	8/30/2005	9/12/2005
Orphans	10/19/2005	10/29/2005
Men and women's health	11/4/2005	11/26/2005
Stool sampling	12/22/2005	1/9/2006

RESULTS

The data presented in the following sections are taken from analysis of the Sauri Socioeconomic Survey, unless otherwise stated.

III. Characteristics of Sauri Households

1. DISTRIBUTION OF HOUSEHOLDS IN SAURI VILLAGE

Sauri MV covers 11 smaller villages: Nyamboga, Silula, Nyamninia A, Nyamninia B, Sauri A, Sauri B, Luero, Madiri, Yala A, Yala B, Kosoro, and Yala Town (Figure 3). There are 614 homesteads within Sauri, with an average of 1.6 households in each homestead (min=1 max =7). Distribution of homesteads within these villages is shown in Figure 4.

Figure 3. Villages included within Sauri Sublocation, which comprises the Sauri Millennium Village

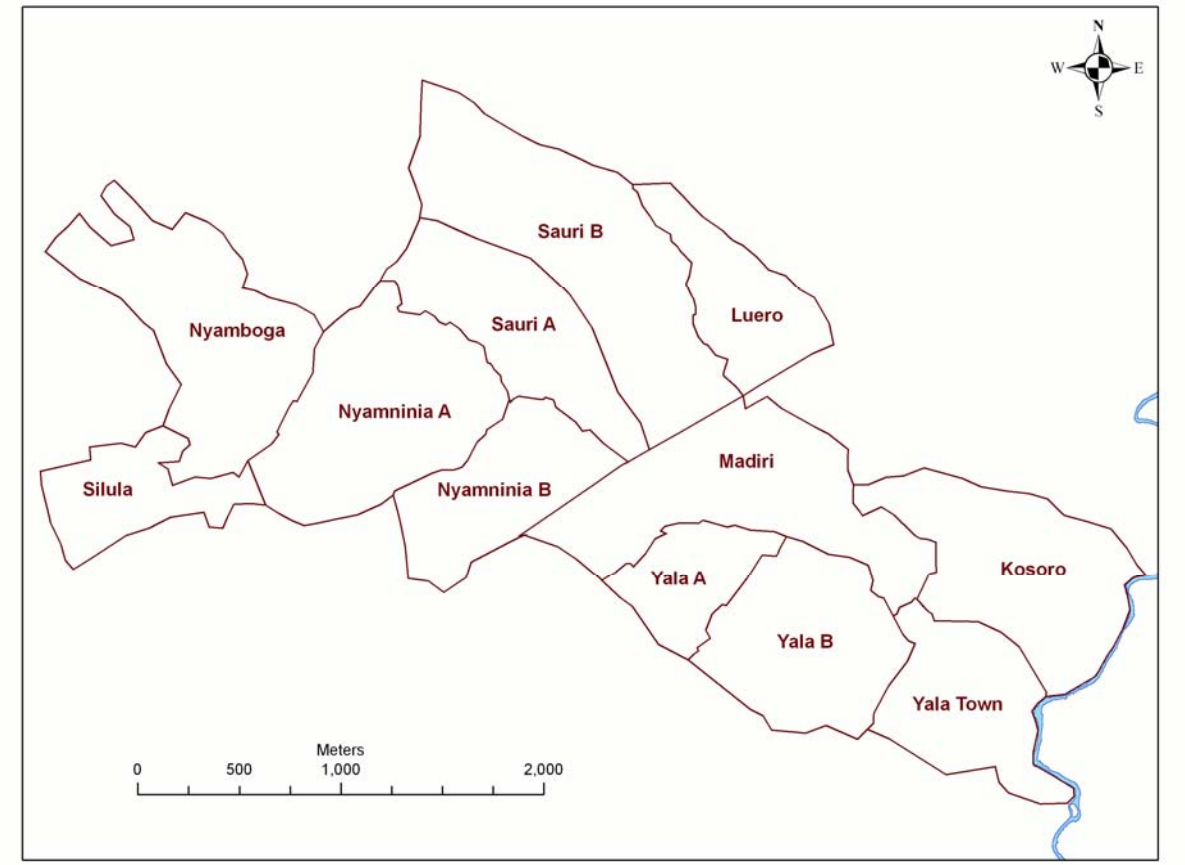
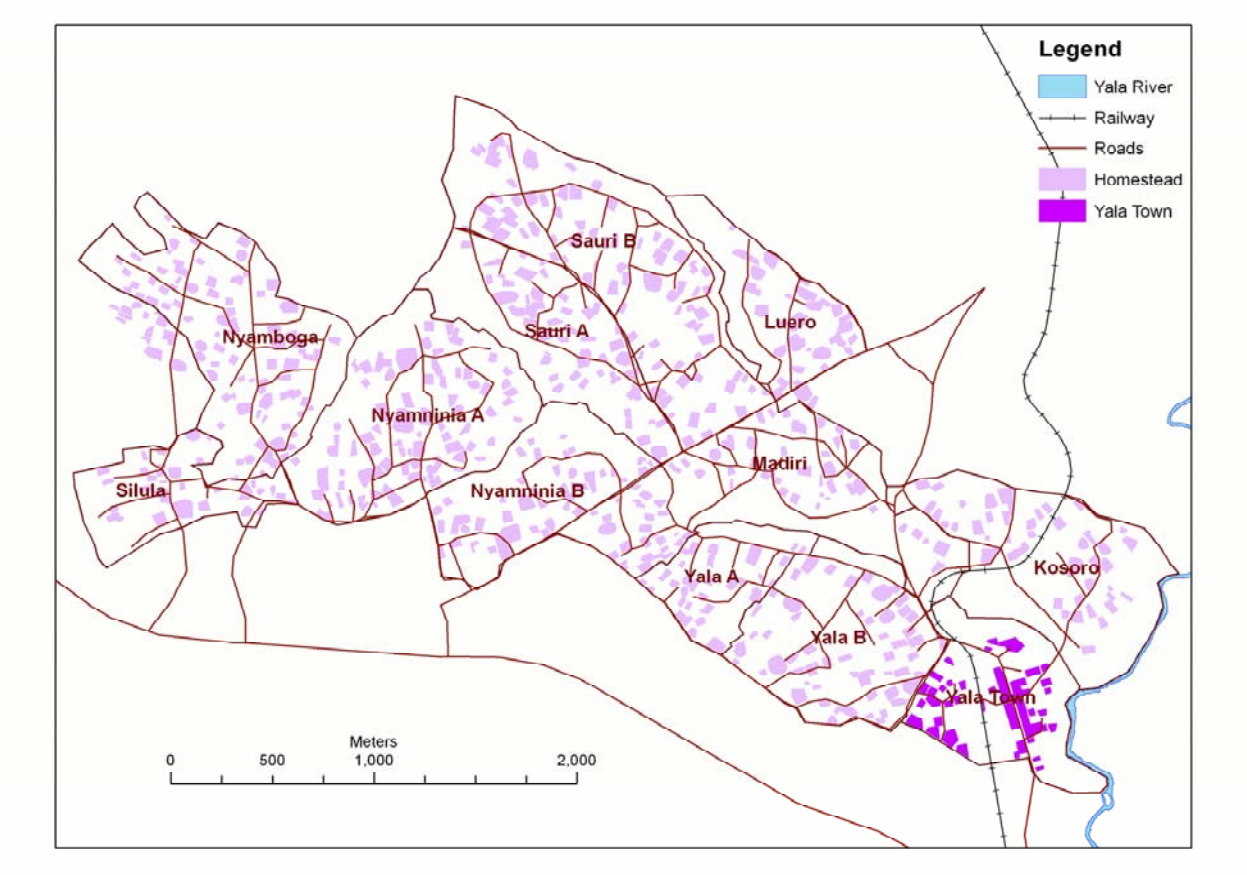


FIGURE 4. Distribution of homesteads within Sauri Millennium Village



2. HOUSEHOLD COMPOSITION AND TYPES

In total there are 967 households in Sauri. The average size for a household in Sauri is 5.7 persons. On average, each household has 2.9 adults (18 years and older) and 2.3 children.

There are 8 different household types within Sauri (Table 3). The predominant household type (42.6% of households) is male-headed with a single wife. The second largest household type (21.9% of households) is female-headed by widows of former single wife households. Overall, approximately 40% (384) of all households are female-headed and 60% (579) are male-headed. There are also 4 households, which are headed by children (age 16 or under).

TABLE 3. Household types in Sauri according to gender and marital status

Household Type	Number	Percentage
Male headed- single wife	412	42.6%
Male headed- polygamous	118	12.2%
Female headed widowed-single	212	21.9%
Female headed widowed-polygamous	106	11.0%
Female headed husband away	61	6.3%
Male headed- divorced or single, widower	49	5.1%
Female headed- divorced or single	5	0.5%
Child headed (Age 16 or under)- orphan	4	0.4%
Total	967	100.0%

3. ETHNICITY AND RELIGION

The majority of the Sauri population is of the Luo ethnic group (94.6%). Luhya comprise approximately 5% of the population, and all others less than 1% (Table 4).

TABLE 4. Composition of ethnic groups in Sauri

Ethnicity	Percentage
Luo	94.6%
Luhya	4.7%
Kisii	0.2%
Kikuyu	0.3%
Other	0.2%

Almost all the residents of Sauri identify themselves as Christians. Only 5 households identify themselves as Muslim. Of the 99% of households that are Christian, the largest denominations are the Anglican Church of Kenya (ACK) and the Catholic Church, which comprise 20% and 18.5% of Christian households, respectively (Table 5). The "Other" category (19.9%) is comprised of over 50 smaller Christian denominations.

TABLE 5. Breakdown of Christian denominations in Sauri

Denomination	Percentage
ACK	19.9%
Catholic	18.1%
CCA	11.0%
Roho ga Diera	8.1%
SDA	6.9%
Nomiya Church	5.6%
PEFA	3.0%
Legio Maria	2.9%
Outreach	1.5%
Pentecost	1.5%
Apostolic Church	1.7%
Other	19.9%

4. BREAKDOWN OF SOCIAL GROUPS AND AGE STRUCTURE IN SAURI POPULATION

Table 6 shows the proportion of Sauri's population belonging to different age and social groups. The mean age of the 5519 individuals who reported age is 23 years. The median age is 18 years. Key ratios that describe the population are presented in Table 7 and the age structure of the population is in Figure 5. The age structure shows that the majority of the population is under 15 years of age. The dependency ratio, or the ratio of the economically dependent part of the population (under 15 years and over 64 years) to the economically productive part of the population (ages 15-64), is 0.79 in Sauri. The child-woman ratio, or the number of children under age 5 per 1,000 women ages 15-49 in a population in a given year, is 559. The sex ratio, or the number of males per 100 females, is 97. The high dependency ratio of the Sauri population is mostly due to a large population under 15 years of age.

TABLE 6. Age and social categories in Sauri[11]

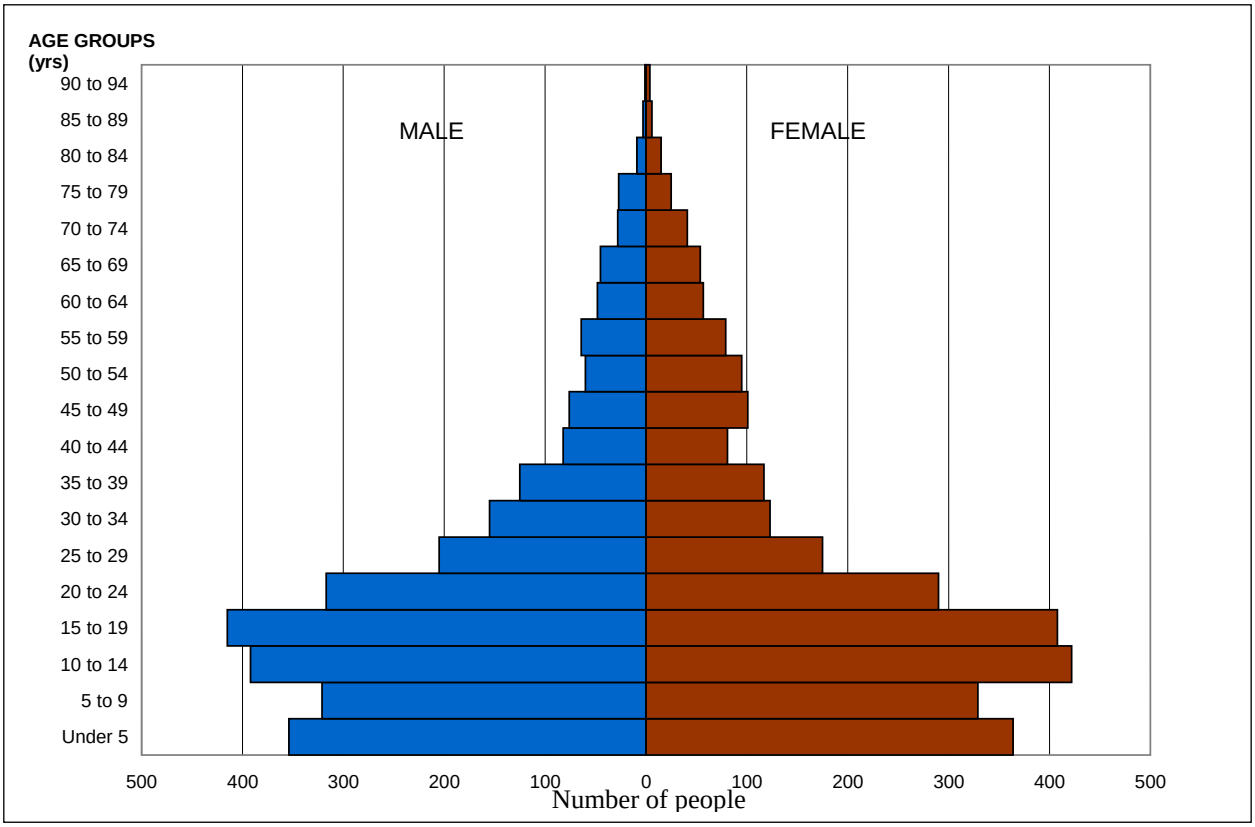
Social Group	Number	Percentage of Total Population
Eldery (60+ yrs)	400	7.2%
Women age 15-49	1295	23.5%
Widows	296	5.4%
Adolescents (15-24 yrs)	1430	25.9%
Female	698	12.6%
Male	732	13.3%
Teenagers (12-18 yrs)	1214	22.0%
Young females (under 15)	1116	20.2%
Children under 5 yrs	724	13.1%
Orphans	826	15.0%

TABLE 7. Ratios of key social groups

Measurable	Ratio
Sex ratio	97
Child-Woman ratio	559
Dependency ratio	.79

[11] The total in Table 5 adds to more than the population because some categories overlap.

FIGURE 5. Population pyramid for Sauri, Kenya



Orphans

Orphans are defined as children less than 18 years of age having lost either one or both parents. In Sauri there are 827 orphans, comprising 32% of the number of people less than 18. Over half of all orphans are paternal orphans, having lost the father, and one third are double orphans, meaning that the individual has lost both parents (Table 8). Of these 268 double orphans, information was available for 265 regarding their origin; the majority of them come from within the household or homestead in which they currently live (Table 9).

TABLE 8. The proportion of orphan types in Sauri

Orphans Type	Percentage of total orphans
Maternal	12.6%
Paternal	54.4%
Double Orphans	33.0%

TABLE 9. Origin of double orphans

	Number	Percent of double orphans (n=265)
Moved into household as orphans	19	7.2%
From household	75	28.3%
From homestead	72	27.2%
From relative	66	24.9%
From outside village	33	12.5%
Total	265	100.0%

5. EDUCATION LEVEL OF HOUSEHOLD HEAD

For the 880 self-reported household heads[12], the highest education level achieved by the majority of household heads (59.2%) is a primary school education, with less than 20% completing secondary school (Table 10). There were 166 responses with either blank or missing data, which is assumed to mean that no education level was completed by the household head. This is confirmed by the self-report that none of these household heads are currently enrolled in school.

TABLE 10. Education level completed by Sauri household heads

Education level	Percentage
Primary	59.2%
Secondary	18.9%
Tertiary	2.9%
No response	19.0%

6. AGRICULTURAL SYSTEM

Farm sizes

The average total farm size is 1.43 acres or 0.58 hectares and median farm size is 1.17 acres. The sizes of farms slightly increase for households in wealthier income groups as shown in Table 11.

TABLE 11. Farm size by income group[13]

Farm size (acres)	Q1	Q2	Q3	Q4
Average	1.29	1.32	1.41	1.76
Median	1.1	1.17	1.14	1.36

Land Tenure

Each household typically has many different plots of land (4.25 plots per household on average, median 4, min1, max 12). These plots of land are often under several different types of land tenure. Table 12 shows the different types of land tenure on a household level. Table 13 shows the prevalence of the different land tenure types in the village as a whole.

[12] Although there are 967 households, there are only 880 reported household heads. Many households that are polygamous do not report a household head, as the husband is already counted in another household.

[13] Data source: Sauri Agriculture Survey, 2005

TABLE 12. Types of land tenure on a household level

Type of land tenure	Number of HH who report tenure type for at least 1 plot	Average proportion of land tenure type to total farm size	Average size of area under land tenure type, in acres
Owned by head of homestead	82	89%	1.4
Owned by homestead head dependent	32	89%	1.1
Owned by a member that is not part of the larger homestead	2	71%	1.1
Belongs to homestead member with no full ownership rights	21	73%	0.6
Owner has temporary rights but not part of larger homestead	3	58%	0.9
Leasehold (rented)	36	50%	0.7
Leasehold (sharecropping)	1	26%	0.2
Inherited	177	90%	1.3

Rent

36 households rent at least 1 plot of land. On average, for these households 50% of their total land holdings in acres is rented. There are no households who solely rent land. The data for the cost of renting is inconclusive because most households did not report a unit of time.

Inherited

For the village on a whole. Inherited plots are the most prevalent type of ownership, accounting for 90% of the total farm area in Sauri.

TABLE 13. Prevalence of land tenure types on the village level in Sauri

Type of Land Tenure	# of plots	Average plot size (acres)	Proportion of total farm size in Sauri
Owned by head of homestead	366	0.30	5.7%
Owned by homestead head dependent	119	0.30	1.8%
Owned by a member that is not part of the larger homestead	5	0.42	0.1%
Belongs to homestead member with no full ownership rights	47	0.27	0.7%
Owner has temporary rights but not part of larger homestead	7	0.37	0.1%
Leasehold (rented)	52	0.45	1.2%
Leasehold (sharecropping)	1	0.18	0.01%
Inherited	676	2.57	90.3%

Formal Titles

For all plots in Sauri, only 50% had valid responses. Of these responses (n=1240), 41% have formal titles (Table 14).

Of the plots of land that are reported to be inherited, 66% do not have titles. Of the plots that are reported to be owned by head of homestead, the percent that do not have titles drop to 30%.

Of the 510 plots that have formal titles, the majority (80%) of titles have the name of the household head name on the title (Table 15).

TABLE 14. Households and formal titles

	Have formal title	Do not have formal title	NA and missing
Owned by head of homestead	70%	28%	2%
Owned by homestead head dependent	39%	61%	0%
Owned by a member that is not part of the larger homestead	0%	100%	0%
Belongs to homestead member with no full ownership rights	0%	98%	2%
Owner has temporary rights but not part of larger homestead	0%	100%	0%
Leasehold (rented)	2%	94%	4%
Leasehold (sharecropping)	0%	100%	0%
Inherited	30%	66%	4%

TABLE 15. Name on formal title

Name on formal title	Number of plots	Percentage
Household head name	410	80.4 %
Parents name	49	9.6 %
Other relative's name	13	2.6 %
Other	36	7.1 %
NA and missing	2	0.4 %
Total	510	100 %

For the long rainy season of 2004, a total of 220 hectares in Sauri were under maize, maize/beans cultivation. The average plot size for each major crop, as reported in the Sauri Agriculture Survey, is shown in Table 16 below. Farmers reported an average yield of 1.18 t/ha of maize (between 0.75 and 1.60 t/ha), a figure that is consistent with the District's longer-term average (1.1t/ha). On the other hand, field plot measurements from 90 farms indicated average (pre-harvest) yields of 1.98 t of maize/ha, the difference attributed to consumption of green maize and post-harvest losses. Farmers apply different soil fertility strategies including DAP, urea, boma manure, compost, *Tithonia diversifolia,* and combinations of these strategies. About 8% of the farmers did not apply any inputs in 2004.

TABLE 16. Average size of plot for maize, beans, and intercrop (2004 long rainy season; N=236)

Crop	# of plots	Average size of plot (acres)	Average size of plot (hectares)
maize only	52	0.25	0.10
maize and beans	385	0.46	0.19
Maize, beans and another intercrop	24	0.50	0.20
maize and other intercrop	14	0.15	0.06

The main constraints to agricultural production in this area are low soil fertility; the soils are deficient in both nitrogen and phosphorus. Yield increases of 3 to 4 times are commonly found when both nutrients are applied compared to soils where no fertilizers are applied. In addition to the soil infertility, maize production is reduced by the parasitic weed, *Striga*, maize streak virus, and maize stalk borers. For many farmers, small land holdings are also considered a constraint to food security.

Livestock

Eighty-six percent or 828 households report owning livestock. Chickens are the most prevalent livestock in Sauri, being owned by 77% of all households (Table 17); 26% own local breeds of cattle but only 4% own improved breeds.

TABLE 17. Livestock holdings in Sauri

Type of animal	Number of households owning	Average number owned
Chicken	744	7.6
Local cows	255	2.2
Dogs	208	2.1
Sheep	157	2.8
Heifers	129	1.7
Goats	89	2.5
Bulls	75	2
Ducks, other birds	44	6.4
Improved cows	43	2.1
Pigs	4	3

IV. Baseline Measurements of the Millennium Development Goals

1. Hunger and Poverty

The figures presented in section 1 were extrapolated from the Sauri Socioeconomic Survey unless otherwise noted.

1.1 POVERTY

1.1.1. Per capita income

Per capita income is calculated using results from the Sauri Socioeconomic Survey 2005.[14] The income figures presented are the sum of the value of agricultural production less the cost of agricultural input and hired labor, net non-agricultural income, and remittances. For detailed methodology on income calculations, refer to *MVP Data Collection and Analysis Methodology* (forthcoming).

Mean income in Sauri is at $336 per person per year, with median income at $161 (Table 18). This indicates a strong left-skew of income distribution.

TABLE 18. Income in Sauri, Kenya

	Yearly per capita income (PPP)
Mean	$336
Median	$161
SD	$675

1.1.2. Proportion of population below $1 (1993 PPP) per day (MDG INDICATOR 1)[15]

79% of the Sauri population (4516 people) lives below $1 (1993 PPP) per day.
89.5% of the Sauri population (5178 people) lives below $2 (1993 PPP) per day.

Estimates of poverty in Sauri are much higher than national estimates of poverty (Table 19). The national statistics were reported in 1994 and 1997 and showed a marked increase in poverty level over that 3 year time period; therefore it is difficult to compare the MV 2005 poverty levels for Sauri to these previous estimates. Either poverty has increased again substantially during this period or income was under-reported in the Sauri Socioeconomic Survey in 2005.

It is also useful to compare the Sauri poverty numbers to another detailed survey effort undertaken through the Rural Markets, Natural Capital and Dynamic Poverty Traps in East Africa project of the USAID BASIS CRSP. In neighboring Vihiga District a 2002 panel study found that poverty levels were similarly high. The study found that over 70% of households had per capita income of less than $.50 a day.[16] These figures are comparable to the results of the Sauri Socioeconomic Survey.

[14] As with all household surveys, the design of the Sauri Socioeconomic Survey represents best efforts to capture accurate information. However, there are several cases of either survey design or human error, which may affect the data presented.
[15] PPP(time of survey)= PPP(1993) * [CPI(time of survey) / CPI(1993)]
[16] Barrett, Chris et. al. 2006. Welfare Dynamics in Rural Kenya and Madagascar. Journal of Development Studies. 42:2. pg 248-277.

TABLE 19. Kenya poverty statistics[17]

National poverty line: proportion of population below the national poverty line	1994	Rural	47 %
		Urban	29 %
		National	40 %
	1997*	Rural	53 %
		Urban	49 %
		National	52 %
		Siaya District	64 %
		Yala Division	67 %
International poverty line: proportion of population below the international poverty line	1997 National	Population below $1 a day	22.8 %
		Poverty gap at $1 a day	5.9 %
		Population below $2 a day	58.3 %
		Poverty gap at $2 a day	23.9 %
	2005 Sauri, Kenya**	Population below $1/day	79 %
		Population below $2/day	89.5 %

*Using a conversion rate of 32.79 KSh/$1 US (PPP)

**National poverty line: Rural areas= 1239 KSh per month; Urban areas= 2648 KSh per month

1.1.3. Income quartiles

Despite possible underreporting, income groups can be compared relative to each other. The population was divided into four income quartile groups based on per capita income (Table 20). Quartiles refer to the value of the boundary at the 25th, 50th, or 75th percentiles of a frequency distribution divided into four parts, each containing a quarter of the population. Quartile 1 (Q1) represents the group with the lowest per capita income.

TABLE 20. Yearly and daily income in PPP for each income quartile

Income quartile	Yearly per capita income (PPP)	Daily per capita income (PPP)	Average household size, in persons
Q1	$39	$0.11	6.85
Q2	$113	$0.31	5.72
Q3	$231	$0.63	5.18
Q4	$959	$2.63	5.22

1.2 INCOME DISTRIBUTION

1.2.1. Poverty gap ratio [incidence x depth of poverty] (MDG INDICATOR 2)

The poverty gap ratio is the mean distance separating the population from the poverty line (with the non-poor being given a distance of zero), expressed as a percentage of the poverty line. The indicator measures the "poverty deficit" of the entire population, where the poverty deficit is the per capita amount of resources that would theoretically be needed to bring all poor people above the poverty line through perfectly targeted cash transfers. In Sauri, the mean percentage distance below $1 (PPP) per day is 54.5% at the poverty line of $1 a day. The poverty gap ratio for all of Kenya was 5.9% in 1997 at the poverty line of $1 a day.[18] A poverty gap ratio of 26% is reported for Yala division (1997) at the national poverty line, which is higher than the international poverty line. The Sauri figure may be high either because poverty in Sauri is higher than the national poverty level, or because income in Sauri is generally underreported, making the poverty gap ratio higher than expected. Because the survey was conducted seven years following the national census, it is difficult to compare values.

[17] Sources: World Development Indicators 2005; GoK (Government of Kenya) (2000a). Second report on poverty in Kenya. *Incidence and Depth of Poverty.* Volume 1. Ministry of Finance and Planning, Nairobi, Kenya

[18] World Development Indicators 2006

1.2.2. Share of poorest quintile in national consumption (MDG INDICATOR 3)

The share of the poorest quintile in national consumption refers to the income that the poorest fifth of the population accrues. In a society where income is equally distributed, the aggregate income of a fifth of the population would be 20% of the total aggregate income. Within Sauri, the sum of the income for the poorest fifth of the population is 2% of the aggregate income for the village. This indicator shows the inequality and left-skewness of the income distribution within the village.

1.3. COMPOSITION OF INCOME

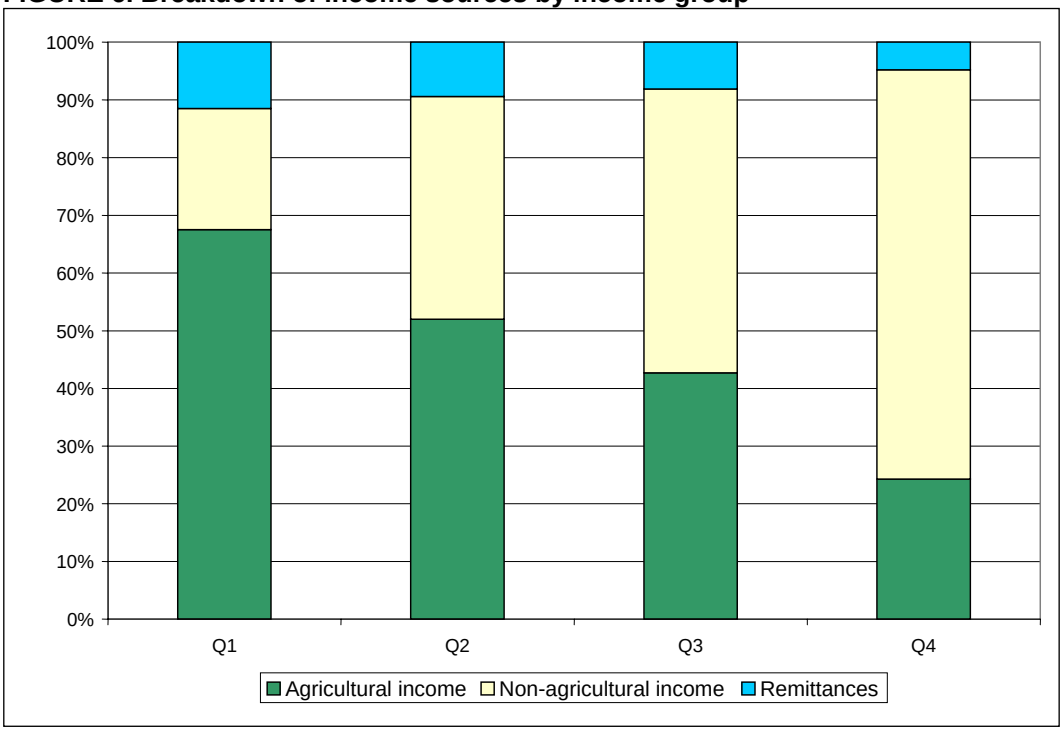
There are three main components of income in Sauri, Kenya, which are agricultural income, non-agricultural income, and remittances. Overall, agricultural income comprises 47% of household income in Sauri, compared with 45% of income generated from non-agricultural activities, and 8% of income in the form of remittances (Table 21). As expected, when divided into income quartiles the proportion of household income that comes from agricultural activities varies widely (Figure 6). Agricultural income as a percentage of total household income falls from 68% in quartile 1 to 24% in quartile 4. Accordingly, non-agricultural income as a percentage of total household income rises from 21% in quartile 1 to 71% in quartile 4. The data from Sauri supports the hypothesis that typically non agricultural activity is positively correlated with income and wealth in rural Africa, which is also largely supported by empirical evidence.[19]

TABLE 21. Composition of income for overall Sauri population

Source	Percent of total income
Agricultural income	47%
Non agricultural income	45%
Remittances	8%

[19] C. B. Barrett, T. Reardon and P. Webb. 2001. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy.* Volume 26, Issue 4, August 2001, Pages 315-331.

FIGURE 6. Breakdown of income sources by income group



1.3.1. Agricultural income

Agricultural income is calculated based on the value of household production of agricultural products less cost of agricultural inputs and hired labor. Table 22 summarizes important agricultural activities and the average contribution of each product to the total value of household agricultural production. Figure 7 shows the makeup of agricultural income by income quartiles. Although the share of agricultural income to total income is falling as income rises (Figure 6), it is apparent that agricultural income is still important to total income as seen through the steep rise in absolute agricultural income across income quartiles, with the wealthiest farmers earning 3 times more than the poorest (Figure 7). The difference in income between quartiles 1 and 4 is accounted for by the increased total value of staple crops (maize and beans) and milk.

TABLE 22. Composition of agricultural income by product

Agricultural product	Percent of agricultural income
Maize grain	36.1%
Beans	22.1%
Poultry	7.6%
Milk	7.1%
Green banana (matoke)	6.4%
Green maize	4.2%
Other*	16.4%

*Other is made up of approximately 35 other agricultural products, including vegetables and fruits.

FIGURE 7. Annual agricultural income by product

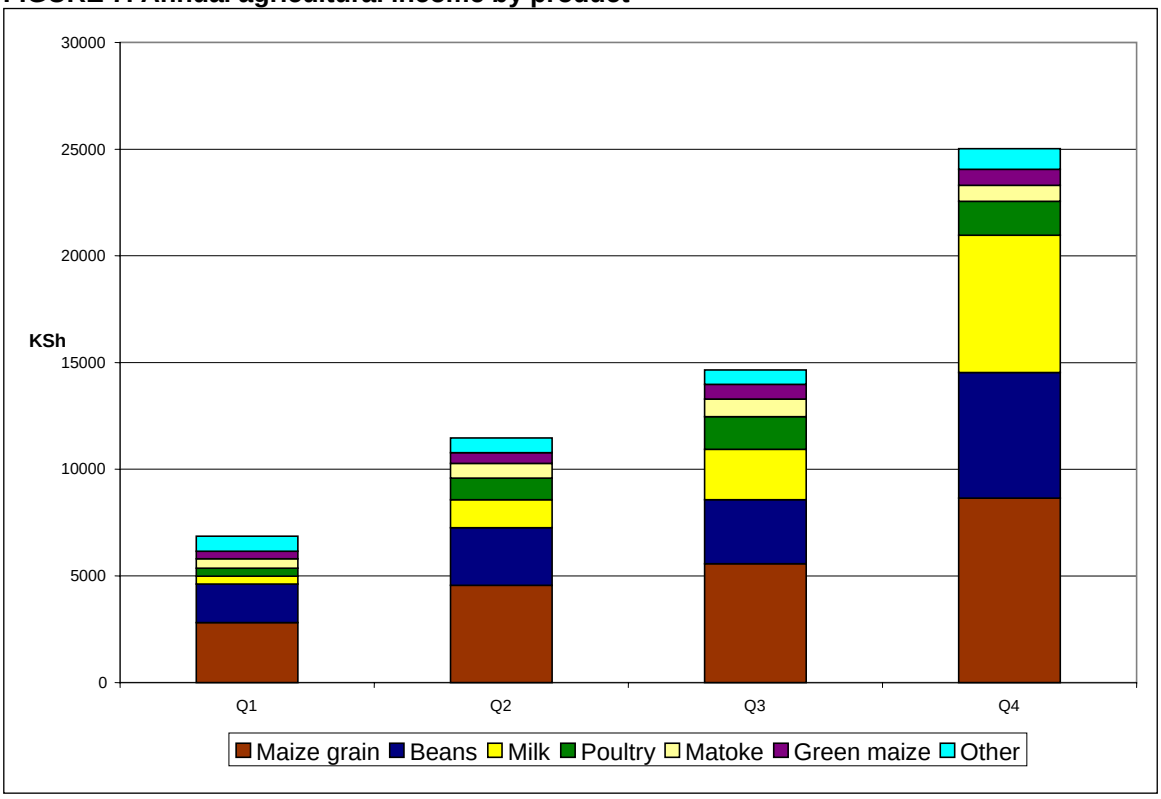


FIGURE 8. Sources of annual non-agricultural income

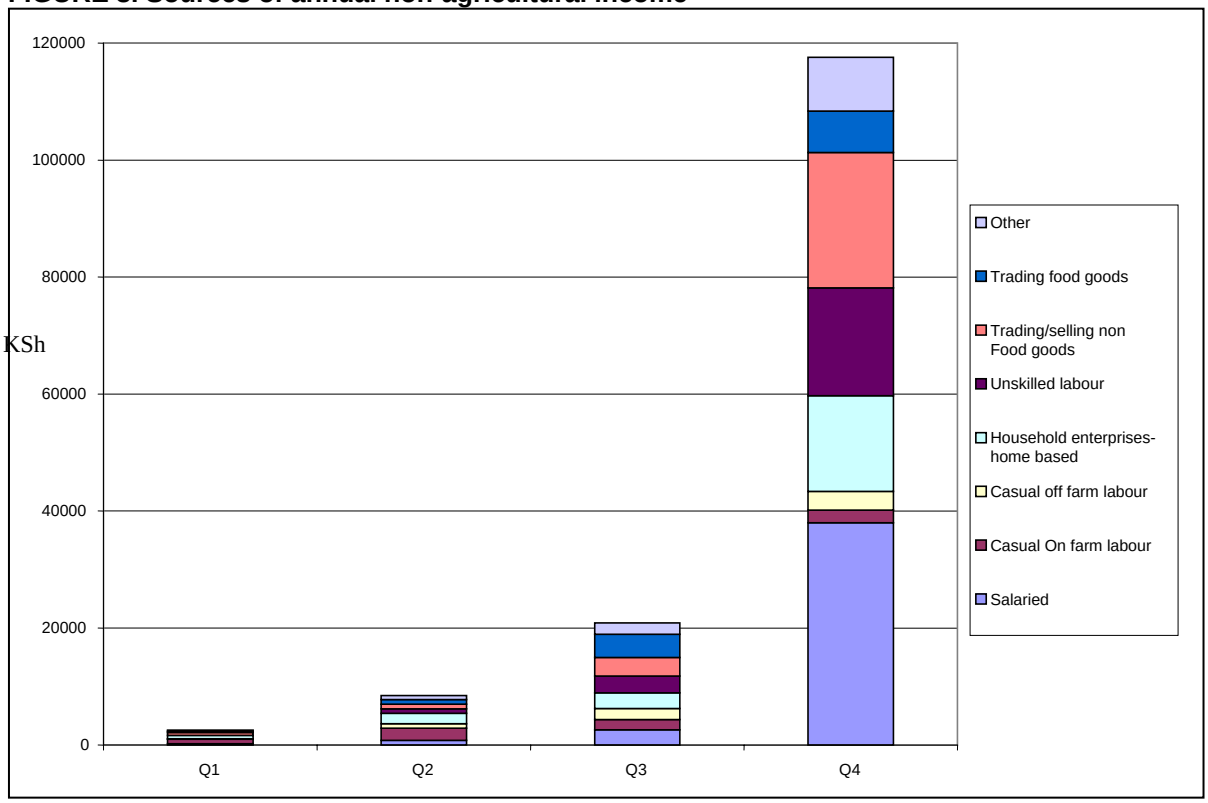


TABLE 23. Sources of non-agricultural income by quartile

	Q1	Q2	Q3	Q4
Salaried	8%	9%	12%	32%
Casual farm labour	30%	25%	8%	2%
Casual non-farm labour	5%	9%	9%	3%
Household enterprises-home based	21%	21%	13%	14%
Unskilled labour	1%	9%	14%	16%
Trading/selling non food goods	19%	9%	15%	20%
Trading food goods	8%	9%	19%	6%
Other	8%	8%	9%	8%

1.3.2. Non-agricultural income

Non-agricultural income is calculated based on the net earnings generated by non-agricultural livelihood strategies. Only variable costs are accounted for in these calculations. Table 23 and Figure 8 show the general make-up of non-agricultural income by general categories of livelihood strategies for each income quartile. The general categories include: salaried, casual farm labour, casual non-farm labour, household enterprises, unskilled labour, trading/selling of non food goods, trading food goods, and other.[20] The total non-agriculture income per year was less than KSh 5,000 for the lowest income quartile and more than 150,000 for the highest quartile. Different categories have different levels of importance for each income

[20] *Salaried*: professional, government, NGO, with full time regular pay. *Household enterprises* includes: brewing, charcoal burning, miller, tailor (home), basket weaving, pottery, jam/other food processing, knitting, hairdressing, other home based. *Unskilled labour* includes: bicycle repair/mechanic, boda boda, brick making, butcher, carpentry, construction, driver, tailor (outside of home). *Trading/selling non food goods* includes: clothes business trading, general kiosk owner, trading firewood, trading timber, trading non food goods, and transport business. *Trading food goods* includes: trading fish, trading farm produce, trading livestock, and poultry business. *Other* includes: renting out of land, midwifery, and other non farm.

quartile, the share of salaried income out of total non-agricultural income rises from 8% to 32% but the percentage income from farm labor decreases from 30% to 2%.

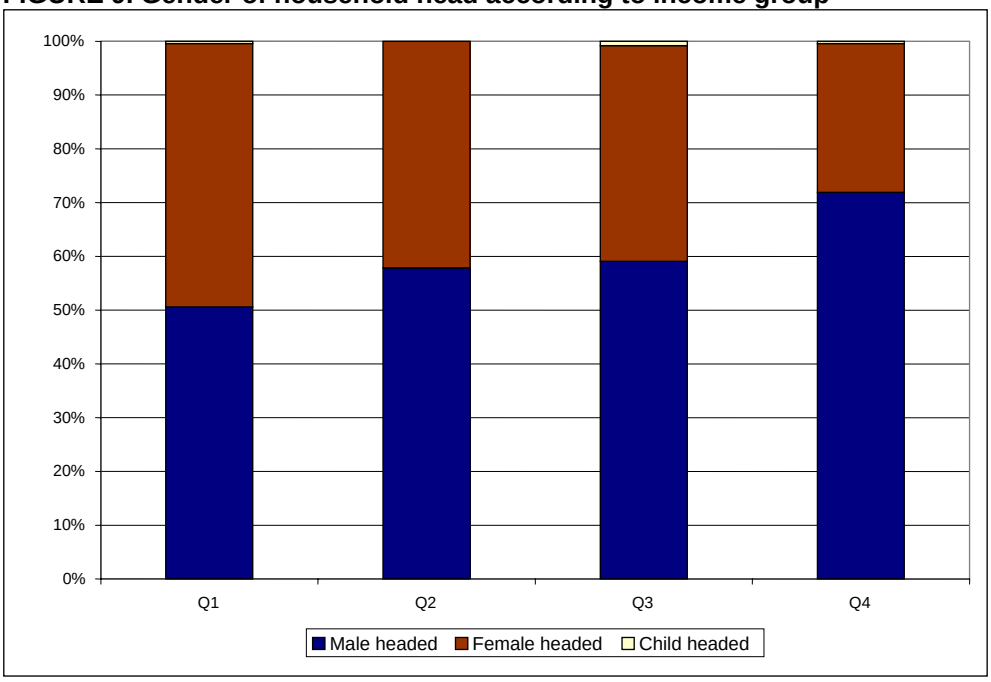
1.3.3. Remittances

Over half (55.4%) of households received remittances from a family member. The mean annual amount of remittances received is 4964 KSh or $151 US (PPP), and the median is 1500 KSh, or $45.7 US (PPP).

1.4. INCOME AND SOCIOECONOMIC PREDICTORS

The gender of the household head varies with per capita income of the household (Figure 9). Over 70% of households in quartile 4 are headed by males, whereas in quartile 1, households headed by males are about equal in number to the households headed by females. This result differs from the 1997 Kenyan Welfare Monitoring Survey,[21] which reported no significant difference in poverty levels by gender of the household head in rural areas.

FIGURE 9. Gender of household head according to income group



Income in Sauri is not clearly positively correlated with education level, which is different from the rest of the country according to the 1997 Kenyan Welfare Monitoring Survey. Although correlations between education level of the household head and household income are expected, Jollife (2002) shows that the maximum or average level of education in the household (as opposed to the education of the household head) is a better explanatory variable of household income.[22]

1.5. EXPENDITURES AND INCOME

Household yearly NON food expenditures rise as incomes rise (Figure 10). Income and expenditures should be roughly equal in poor rural economies, however, as shown in Figure 10 there are discrepancies

[21] Kenya Central Bureau of Statistics, 1997

[22] Jolliffe, Dean. 2002. Whose Education Matters in the Determination of Household Income? Evidence from a Developing Country. *Economic Development and Cultural Change*, volume 50 (2002), pages 287–312

in income and expenditure numbers. In Figure 11, the discrepancies for Q1 shows expenses greater than income on the order of $100 US (PPP) and income is larger than expenditures for the wealthiest group Q4 by $575 US (PPP). As the SE Survey did not capture savings or financial assets, the fact that income is more than expenditure is understandable for Q4 in the graph below. For Q1 and Q2, it is possible that the very poor have other ways of to deal with the lack of income, such as the sale of assets, which is not captured in the SE Survey which explains the negative bars below on the graph. Additionally, credit/loans could explain why expenditures for these two groups are greater than income.

Income numbers are generally more reliable than expenditures, and this is especially the case here because the time period of recall for expenditures in the Sauri SE Survey was the past year. In the future, the time period for recall will be adjustable based on the type of expenditure item. There are plans to analyze and do a wealth ranking based on an asset index, as well as planning on using assets as a proxy to track household income through time.

FIGURE 10. Mean yearly household per capita expenditures by income quartile (KSh)

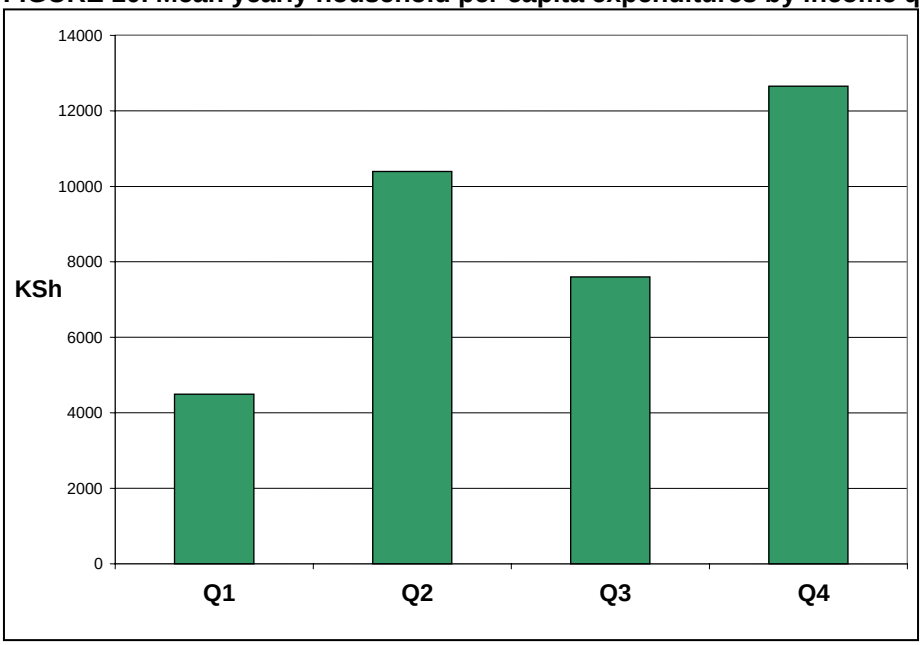
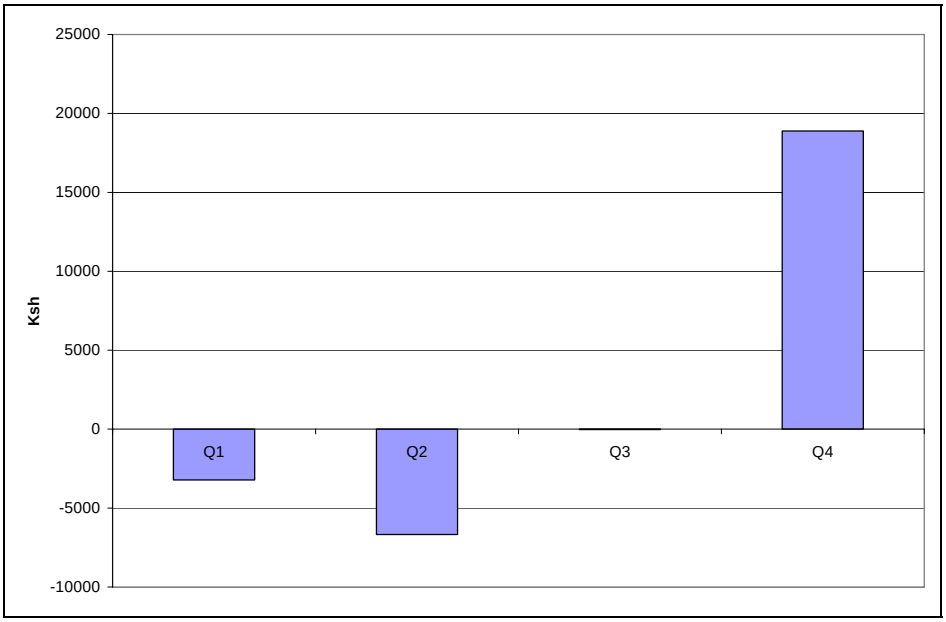


FIGURE 11. Difference between per capita HH income and expenditures, by income quartile



The table below shows the breakdown of average non food expenditures by household. On average total non-food expenditures per hh is 38,294.5 Ksh. It is interesting to note that energy accounts for almost 43% of expenditures, followed by school expenses which account for about 10%.

TABLE 24. Breakdown of non-food expenditures as percent of total expenditure

Non-food Item (over 2% expenditure)	%	Non-food item (under 2% expenditure)	%
charcoal	25.40%	home repairs	1.80%
kerosene	8.00%	mutual support groups	1.60%
school fees	6.40%	hh assets	1.50%
soap/detergent	6.00%	communication	1.40%
transport	5.40%	hair dressing/cut	1.40%
firewood	4.80%	transfers out(cash)	0.90%
medical drugs	4.80%	house rent	0.80%
disposable, nonrechargable drycells	3.90%	textbooks/schl items	0.70%
battery charging	3.20%	harambee contributions	0.60%
churches/mosques	3.10%	water	0.60%
clothing	3.10%	transfers out(in_kind)	0.50%
domestic services	2.70%	other local orgs	0.40%
medical services	2.60%	books, newspapers, stationery, envelopes, stamps	0.30%
women/youth grps	2.50%	insurance groups	0.20%
school uniform and sport kts	2.40%	motor/transportation fuel	0.20%
non_agro enterprise costs	2.10%	other cooking fuels(†)	0.20%
		school PTA	0.20%
		recreation	0.10%
		working electrical connection	0.10%

1.6. HUNGER

Statistics from the Hunger section were extrapolated from the Sauri Agriculture Survey unless otherwise noted.

1.6.1. Food deficiency

Households were asked the question: "Was your harvest sufficient to provide for your family until the next harvest?" Of the 301 respondents, 75% of households reported that their harvest after the long rains was not sufficient to provide food for the family until the next harvest (Table 24). 85% reported that their harvest after the short rains was not sufficient.

TABLE 25. Sufficiency of harvest to provide food for family until the next harvest

	Sufficient	Insufficient	Missing/NA
LR harvest	19%	75%	6%
SR harvest	9%	85%	6%

1.6.2. Food storage

244 households reported that they store their food (81% of survey sample). 222 (91% of those who store food) reported storage within the house as the method of storage. Only 4 households reported storing food in a traditional granary.

1.6.3. Food preservation

For beans, 73% report drying, and 22% report preservation with ash. For maize, 75% report drying, 20% report preservation with ash. For millet, 61% report drying and 17% preservation with ash. For wheat, 13% report preservation with ash, and 81% report "Other." This may correspond to milling and/or grinding. For fish, 49% report smoking, 12% drying, 10% salting. For meat, 44% report smoking, 16% salting, 11% drying.

1.6.4. Prevalence of underweight children under five years of age (MDG INDICATOR 4)

Overall, 17% of children under the age of 5 are underweight for their age (Table 26). 48% of children under 5 are under-height for their age (evidence of stunting), and 9% are underweight for their height (evidence of wasting). Underweight data was calculated using anthropometric measurements of weight and height.

TABLE 26. Stunting and wasting in children under 5 years of age

	% of Females	% of Males	% of Total
Under height/length for age (stunting)	53 %	42 %	48 %
Severely under height/length for age	29 %	21 %	25 %
Underweight for age	16 %	17 %	17 %
Severely underweight for age	4 %	9 %	7 %
Underweight for height (wasting)	9 %	8 %	9 %
Severely underweight for height	5 %	3 %	4 %

1.6.5. Proportion of the population below minimum dietary energy consumption (MDG INDICATOR 5)

Achieving food security requires that the aggregate availability of physical supplies of food is sufficient; that households have adequate access to those food supplies through their own production, through the market or through other sources; and that the utilization of those food supplies is appropriate to meet the specific dietary needs of individuals.

MVP has measured several indicators for food access, such as total income and crop income. Additionally, many food utilization indicators are also reported, such as anthropometry, and food frequencies.

This section aims to provide some indication of food availability. Maize, the staple food in Sauri, was used as a proxy for food availability The household production of maize was used to determine the availability of calories per family, which was then compared to the per capita caloric requirements for each household.

The daily caloric requirement for the household is calculated according to gender and age, as specified in Table 27 below. The production of maize of each household, as is self-reported from the Sauri Socioeconomic Survey, is also converted into available calories, assuming that 1 kg of edible maize provides 3,530 calories.[23]

[23] Okoruwa, A. E., J. G. Kling. 1996. Nutrition and quality of maize. IITA Research Guide 33. Training Program, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

TABLE 27. Daily caloric requirements based on gender and age*[24],[25]

	Moderate physical activity *kcal/d*	
Age	**Female**	**Male**
0-2	*850*	*950*
2-3	*1 050*	*1 125*
3-4	*1 150*	*1 250*
4-5	*1 250*	*1 350*
5-6	*1 325*	*1 475*
6-7	*1 425*	*1 575*
7-8	*1 550*	*1 700*
8-9	*1 700*	*1 825*
9-10	*1 850*	*1 975*
10-11	*2 000*	*2 150*
11-12	*2 150*	*2 350*
12-13	*2 275*	*2 550*
13-14	*2 375*	*2 775*
14-15	*2 450*	*3 000*
15-16	*2 500*	*3 175*
16-17	*2 500*	*3 325*
17-18	*2 500*	*3 400*
18-29	*2550*	*3050*
30-59	*2400*	*2950*
60 +	*2200*	*2450*

* Based on moderate physical activity

A study by Rommelse (2001)[26] in Western Kenya showed that an average of 73% of total energy intake was obtained from maize alone. The national Kenyan FAO food balance sheet shows that 36% of caloric intake was from maize calories alone in 2004.[27] Table 28 shows the number of households deficient in calories, with differing estimates of caloric intake based on different maize consumption scenarios—e.g. whether maize is assumed to make up 100% of all calories needed, or if it is only 75%, etc. If maize is assumed to comprise 35% of total energy intake, 76% of households are still deficient in calories, whereas if maize consumption comprises 100% of energy intake, then 95% of the households are energy deficient. Figure12 shows that those households in Q1 and Q2 suffer large caloric deficiencies, even when the maize calories are assumed to make up 35% of required caloric intake. Based on the 35% proportion, households in Q1 are deficient by an average of 4804 calories per day, which translate to 700 calories per person. However, this assumes that intra-household food distribution is equal; there is limited evidence that this may not be the case, as households exhibit pro-male and pro-adult biases in food distribution.[28]

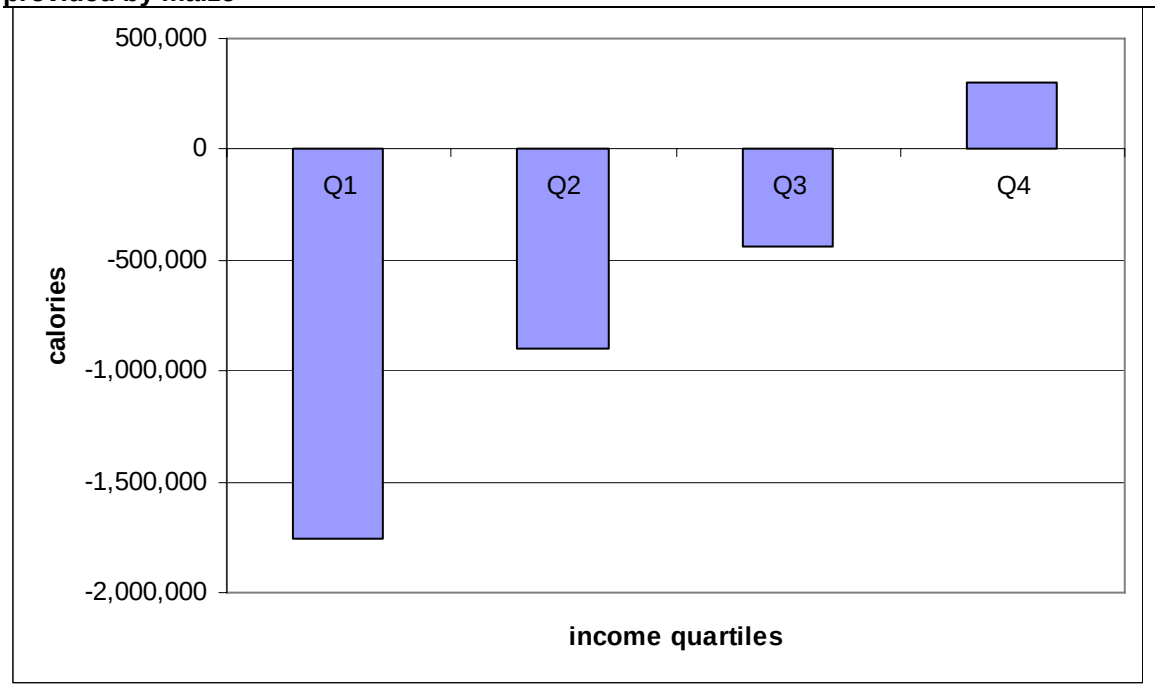
The food frequency and nutrition information for Sauri is currently being analyzed, which will give a clearer idea of a) intrahousehold distribution of food, and b) the proportion of energy intake that is derived from maize alone. These results are forthcoming.

[24] For adult males, these numbers are calculated assuming 70 kg mean weight, and a moderate to vigorous activity lifestyle. For adult females, these numbers are calculated assuming 65 kg mean weight and a moderate to vigorous activity lifestyle.
[25] FAO. 2004. Human energy requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Report Series 1.
[26] Rommelse, R. 2001. *The impact of improved fallows and biomass transfer on household poverty indicators in western Kenya: Methodology and empirical results from baseline survey.* Natural Resources Problems, Priorities, and Policies Working Paper 2001-2. Nairobi, Kenya: International Centre for Research in Agroforestry.
[27] FAOSTAT. 2004. Food Balance Sheets. http://faostat.fao.org/
[28] L. Haddad, C. Peña, C. Nishida, A. Quisumbing, and A. Slack.Food Security and Nutrition Implications of Intrahousehold Bias: A Review of Literature,. FCND Discussion Paper 19, IFPRI, Washington, D.C., 1996.

TABLE 29. Estimate of the number of households deficient in calories based on the percentage of calories provided by maize and the amount of maize produced

(n= 927)	**Maize calories =100% of calories needed**	**Maize calories= 75% of calories needed**	**Maize calories= 50% of calories needed**	**Maize calories = 35% of calories needed**	**Maize calories= 20% of calories needed**
# of households deficient in calories	876 (95%)	852 (92%)	795 (86%)	703 (76%)	518 (56%)

FIGURE 12. Annual household deficiency in calories, based on a diet with 35% of calories provided by maize



2. Education

The figures in this section were extrapolated from the Sauri Socioeconomic Survey unless otherwise stated.

2.1. NET ENROLLMENT IN PRIMARY EDUCATION (MDG INDICATOR 6)

The Kenyan education system consists of eight years of primary school, four years of secondary school, and various forms of post-secondary education such as university, college, and polytechnics. Primary school age is from 7-14 years and secondary school age is from 15-18 years. Universal primary education in Kenya was instituted in 2003, which explains the high primary school enrollment rates (Table 28, Figure 13).

The net primary or secondary school enrollment ratio is defined as the number of children enrolled in primary/secondary school who belong to the age group that officially corresponds to the schooling level, divided by the total population of the same age group. Net primary school enrollment in Sauri is 84.6% (Table 29). This is a higher ratio than the national figure, which shows net primary school of 76%.[29]

Gross primary or secondary school enrollment is the number of children enrolled in a primary or secondary school, regardless of their age, divided by the population of the age group that officially corresponds to the same level. Gross primary school enrollment in Sauri is 118%, which is higher than the 111% for Kenya as a whole (Table 29).

TABLE 28. School enrollment numbers in Sauri, Kenya, regardless of age

	# Male	# Female	Total
Primary school enrollment	714	719	1433
Secondary school enrollment	103	88	191
Tertiary school enrollment	41	26	67

As shown in Table 28, enrollment for secondary school in Sauri is drastically lower for both male and females than enrollment for primary school. Interestingly, secondary enrollment ratios also drop below national averages, even though primary school enrollment is higher in Sauri. This implies that access to secondary education is more of an issue than primary education in the Sauri area. Figure 13 illustrates the drastic drop in enrollment ratios from primary to secondary school and secondary to tertiary school. Table 29 compares net and gross school enrollment ratios in Sauri to those of Kenya as a whole.

[29] UNESCO Institute of statistics, 2004

FIGURE 13. Net enrollment ratio comparison of different levels of education

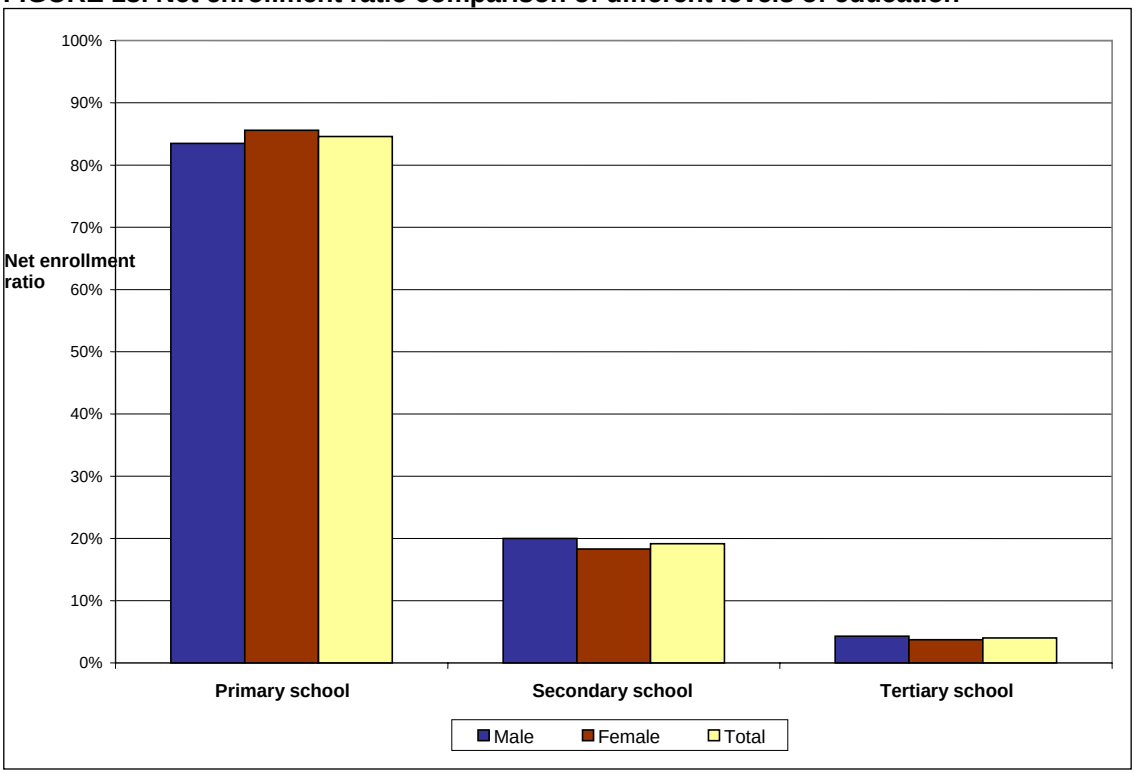


TABLE 29. Comparison of school enrollment ratios in Sauri to national ratios for Kenya

			Kenya 2004[30]	Sauri, Kenya 2005
Primary enrollment	**Net enrollment ratio**	Total	76 %	84.6 %
		Male	76 %	83.5 %
		Female	77 %	85.6 %
	Gross enrollment ratio	Total	111 %	118 %
		Male	114 %	118 %
		Female	108 %	117 %
Secondary enrollment	**Net enrollment ratio**	Total	40 %	19.2 %
		Male	40 %	20 %
		Female	40 %	18.3 %
	Gross enrollment ratio	Total	48 %	28 %
		Male	50 %	30 %
		Female	46 %	26 %
Tertiary enrollment (ages 19-22)	**Net enrollment ratio**	Total	--	4 %
		Male	--	4.3 %
		Female	--	3.7 %
	Gross enrollment ratio	Total	--	12.2 %
		Male	--	14.8 %
		Female	--	9.6 %

[30] Source: UNESCO Institute of Statistics (2004)

2.2. PROPORTION OF PUPILS STARTING GRADE 1 WHO REACH GRADE 5 (MDG INDICATOR 7)

When the Socioeconomic Survey is repeated in the future, it will be possible to track education survival rates. For now, two proxies are used. In Kenya, children are supposed to reach grade 5 by age 12 and complete primary school by age 14. In Sauri, the majority of those aged 12 and older who are no longer in school reached grade 5 or higher, implying high primary education survival rates (Table 30).

TABLE 30. Highest education achieved by persons not currently in school (12+ years old)

Age groups	% of age group not in school	Highest education achieved by those not currently in school		
		Less than grade 5	Grade 5 or higher	Don't know/missing
12 to 14	9.0%	21.2%	63.6%	15.2%
15 to 18	42.0%	9.1%	88.6%	2.3%
19 to 24	82.3%	7.3%	89.0%	3.7%
25+	98.2%	15.3%	68.3%	16.4%

In Sauri, children aged 4-6 years old may be enrolled in either pre-primary (nursery) or primary school. As Table 31 shows, approximately 35% of those aged 4-6 are not in school. It will be important to track the enrollment of this age group as UNESCO stresses the importance of early childhood education as fundamental to human development.

TABLE 31. School enrollment of children aged 4-6 years

	Male	Female	Total
Pre-primary %	39.6%	37%	38.3%
Primary %	22.9%	30.5%	26.9%
Not in school %	37.5%	32.5%	34.8%
Total persons	192	210	402

2.3. LITERACY RATE OF 15-24 YEAR OLDS (MDG INDICATOR 8)

In the MVP Socioeconomic Survey respondents were asked “Can s/he read and write?” This approach differs from the Kenya Demographic and Health Survey (2003)[31], wherein interviewers asked respondents to read a simple short sentence to establish literacy in either English, Kiswahili or 11 local vernaculars. It also differs from 2000 Kenyan Multiple Indicator Cluster Survey, wherein respondents were asked to read a simple short sentence. This causes difficulty for direct comparisons of data. It is likely that the MVP Socioeconomic Survey overestimates literacy rates due to the format of the question. Respondents may have answered 'yes' to the question "Can s/he read and write?" even though they are unable to either read or write. The question in its current format does not allow the respondent to answer 'yes' to reading and 'no' for writing and vice versa. In future versions of the Socioeconomic Survey, the question is separated so that we can more accurately assess literacy. It is also likely that the MVP data overstate literacy because of the lack of literacy tests and the possible reluctance of some illiterate persons to admit to their illiteracy.[32]

The literacy rate of 15-24 year olds in Sauri based on responses from the survey is 95.3% (Table 32, Figure 14). Although this figure is most likely an overestimate, these values are somewhat higher than the national and provincial values (Figure 14). The literacy rates estimated for different groups in Sauri can be useful when compared relative to each other. The data show that illiteracy among adult females (21.1%) is almost 5 times that of males (4.6%) (Figure 15). The difference is almost entirely due to the gender gap at older ages; for younger respondents the gap in literacy rates is significantly smaller (Figure 14).

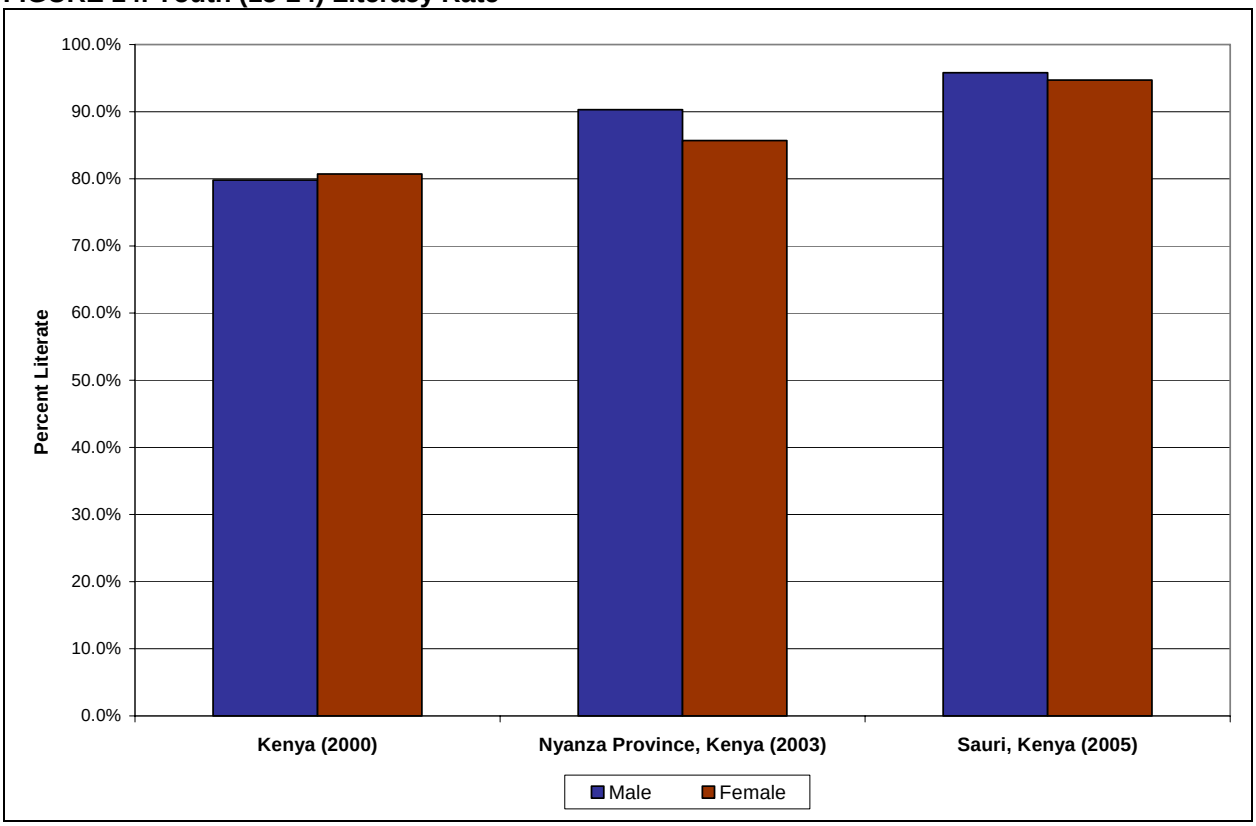
[31] Kenya Central Bureau of Statistics, 2003

[32] This is a common problem in literacy surveys. Source: United Nations. 1997. Principles and Recommendations for Population and Housing Censuses. Department of Economic and Social Affairs.

TABLE 32. Literacy rate of 15-24 year-olds

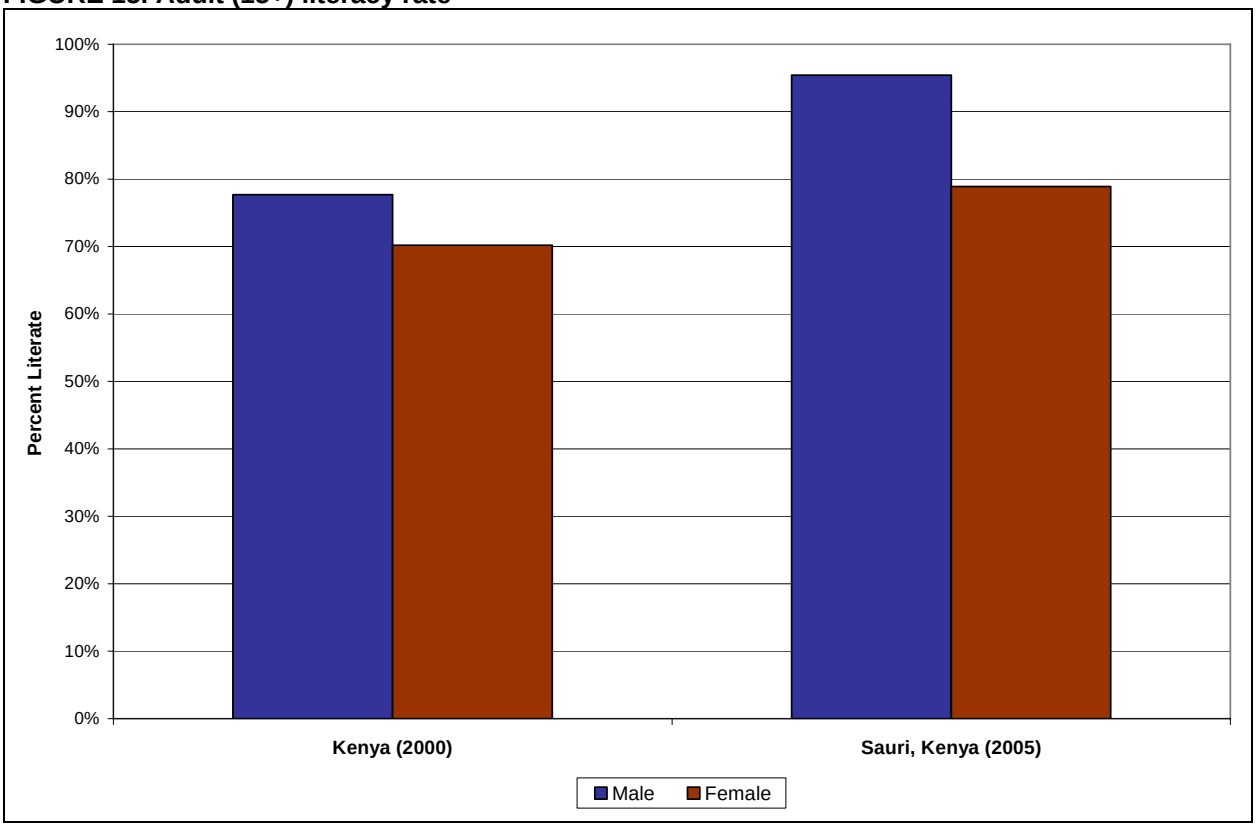
	Percentage
Male	95.9%
Female	94.8%
Total (both sexes)	95.3%

FIGURE 14. Youth (15-24) Literacy Rate[33]



[33] Sources: United Nations Educational, Scientific and Cultural Organization (UNESCO) and UNESCO/UIS (UNESCO Institute of Statistics), including the Multiple Indicator Cluster Survey 2000; Kenya DHS 2003; and Socioeconomic Survey, MVP Sauri, Kenya 2005

FIGURE 15. Adult (15+) literacy rate[34]



[34] Source: United Nations Educational, Scientific and Cultural Organization (UNESCO) and UNESCO/UIS (UNESCO Institute of Statistics), including the Multiple Indicator Cluster Survey 2000; Socioeconomic Survey, MVP Sauri, Kenya 2005

3. Gender Equality

3.1. RATIO OF GIRLS TO BOYS IN PRIMARY, SECONDARY, AND TERTIARY EDUCATION

The gender gap in education increases as the level of schooling increases. The greatest disparity is in the ratio of girls to boys in tertiary school (Table 33).

Net enrollment ratios (NER): females as % of males is a measure that reports the girls net enrollment ratio for girls divided by that of boys, as a percentage. The net enrollment ratio is the number of children enrolled in a school level who belong to the age group that officially corresponds to the schooling level, divided by the total population of the same age group.

Gross enrollment ratio (GER): females as % of males is a measure that reports girls gross enrollment ratio divided by that of boys, as a percentage. The gross enrolment ratio is the number of children enrolled in a schooling level (primary or secondary), regardless of age, divided by the population of the age group that officially corresponds to that level.

TABLE 33. Net and gross enrollment ratio: female as % of male

	Female as % of male	Kenya 2004	Sauri, Kenya 2005
Primary enrollment	NER	101 %	102.5 %
	GER	94.7 %	99.1 %
Secondary enrollment	NER	100 %	91.5 %
	GER	92 %	86.7 %
Tertiary enrollment	NER	--	86 %
	GER	--	64.8 %

3.2. RATIO OF LITERATE WOMEN TO MEN, 15-24 YEARS OLD

The gender gap in literacy among younger populations is 0.94 (Table 34). UNESCO Institute for Statistics estimates that the ratio was 0.99 for all of Kenya in 2004, which is more even than in Sauri. However the disparity in Sauri is markedly less than in other Sub Saharan African countries (Table 35).

TABLE 34. Ratio of literate women to men, 15-24 years old, in Sauri

Sauri, Kenya	
Number of literate Women (15-24)	653
Number of literate Men (15-24)	697
Ratio of literate women to men (15-24)	0.94

TABLE 35. International comparison:ratio of literate women to men (15-24)[35]

Country	2004
Ethiopia	0.82
Malawi	0.86
Mali	0.52
Senegal	0.68
Uganda	0.86

[35] UNESCO Institute of Statistics

4. Child Mortality

4.1. CHILD MORTALITY RATES

Under-five mortality rates and infant mortality rates are usually calculated as a number of deaths per 1,000 live births. Because of Sauri's small sample size, under-five mortality rate was extrapolated using the number of reported deaths out of the 190 reported live births during the five-year time period of calendar years 1999-2003.

4.1.1. Under-five mortality rate (MDG INDICATOR 13)

Under-five mortality rate was calculated using the probabilities of death during the age intervals 1-2, 2-3, 3-4, and 4-5 (Table 36). The resulting probability of surviving to the 5th birthday is .905, implying an under-five mortality rate of 149/1000. This figure is higher than the Kenya national average of 115/1,000 and lower than the Nyanza provincial level of 206/1000 for the five-year period preceding the 2003 KDHS survey.[36]

TABLE 36. Probability of child's survival to ages 1, 2, 3, 4, and 5

Probability of survival to age 1 (i.e. first birthday)	0.905
Probability of survival to age 2 conditional on survival to age 1	0.971
Probability of survival to age 3 conditional on survival to age 2	0.988
Probability of survival to age 4 conditional on survival to age 3	0.979
Probability of survival to age 5 conditional on survival to age 4	1.0

4.1.2. Infant mortality rate (MDG INDICATOR 14)

Of the 190 live births there were 18 instances of death before the first birthday. This brings the infant mortality rate to 95/1,000. This is higher than the Kenya national average of 77/1000 but lower than the Nyanza provincial rate of 133/1000 for the five-year period preceding the 2003 KDHS survey.[37]

4.1.3. Incidence of stillbirths per 1,000 live births

Household heads reported 8 stillbirths and 1,380 live births over the last 5 years. This brings the incidence of stillbirths to 5.8 per 1,000 births, or approximately 0.6%.

4.2. CHILD HEALTH

4.2.1. Proportion of 1-year-old children immunized against measles (MDG INDICATOR 15)

107 out of 146 women with children born since 2000 provided vaccination cards during interview. Vaccination cards were present for 146 out of 237 children 5 years of age and under. Of these children with vaccination cards, 98 (67.1%) had been vaccinated for measles. Measles vaccination information for children without vaccination records is unknown. More data is forthcoming.

4.2.2. Incidence of diarrhea

5% of children were reported to have had diarrhea in two weeks prior to survey.

4.2.3. Incidence of pneumonia

Less than 1% of children were reported to have pneumonia two weeks prior to survey

[36] Kenya Department of Health Statistics, *Demographic and Health Survey,* 2003. This statistic is calculated for the five-year period preceding the 2003 study.

[37] Kenya Department of Health Statistics, *Demographic and Health Survey,* 2003. This statistic is calculated for the five-year period preceding the 2003 study.

4.2.4. Prevalence of malaria parasitemia

66% of male children and 60% of female children under 5 tested positive for malaria parasitemia. For children aged 6-16, 63% of males and 62% of females tested positive for malaria parasitemia. See Section 6.3 for more information.

4.2.5. Prevalence and intensity of intestinal helminths

Three population groups at particular risk for the debilitating effects of these pathogens were surveyed for the presence of soil transmitted helminths and *Schistosoma mansoni*. The groups targeted for the baseline stool testing were: School-aged children 9-10 years of age; Preschool children 2-4 years of age; and Reproductive-age Women 15-49 years of age.

No *Schistosoma mansoni* was detected. All groups showed high prevalence of STHs, ranging from 48% in the preschool children to 80% in the schoolchildren (see details in Section 6.4.4). Since the prevalence in school-aged children exceeded 50%, this classifies Sauri as a “high risk” community according to WHO guidelines. Additionally, 13% of school-aged children had a high intensity infection, also considered a marker of need for mass preventative treatment (see section 6.4.4 for more information). In such high risk communities WHO recommends preventative chemotherapy for preschool and school-aged children at least twice a year, preferably three times.

5. Maternal Health

5.1 MATERNAL MORTALITY RATIO (MDG INDICATOR 16)

Maternal mortality is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. The maternal mortality ratio in Sauri is not determinable because of Sauri's relatively small sample size (maternal mortality rate is generally measured in # deaths per 100,000 live births). Instead, a number of proxies will be used to monitor factors that are widely recognized to contribute to maternal mortality. These indicators measure 'unmet needs' of the population, and include: prevalence of contraceptive use; proportion of wanted pregnancies; prevalence of ante-natal care; proportion of births attended by skilled health personnel; proportion of women who experienced a serious complication during pregnancy or child birth; and availability of emergency obstetric services.

5.1.1. Percentage of population using contraceptives

Contraceptive methods help reduce fertility rates, which improve health outcomes both for the mother and her children. Additionally, contraceptive measures can be one proxy measure for women's status if they are able to negotiate condom use and have more control over their fertility.

Of the 311 females aged 15-49 years, 88 (28%) reported use of some form of contraception. Approximately 80 (26%) reported using a "modern method" (condoms, vaginal barrier methods, contraceptive sterilization, intrauterine devices (IUDs), and hormonal methods). More information on contraceptive use is given in Section 6.1.6: Contraceptive prevalence rate (MDG indicator 19c).

5.1.2. Proportion of unwanted pregnancies

The number of unwanted children was derived by comparing the number of children each woman desired to the number of children she actually has. For women who gave no preference to desired number of children, it was assumed that she had no unwanted children.

This provided a total of 394 unwanted children for 310 childbearing women, giving an average of approximately 1.3 unwanted births per woman.

5.1.3. Prevalence of antenatal and postnatal care

Antenatal care

Antenatal care (ANC) is an important health intervention not only because women can receive pregnancy-related health education, but because assessing the progress of the pregnancy can help identify high-risk patients and potential complications. The World Health Organization recommends that women receive at least 4 ante-natal visits with a skilled provider (i.e. doctor, nurse, or midwife) during her pregnancy, and that the first visit should be in the first trimester, with the other visits spaced regularly throughout the pregnancy.

In preparation for birth, 91.4% of respondents reported having antenatal care during pregnancy. Of these, 98.8% received care from a skilled provider. 5.78% of women saw a doctor, 93% of women saw a nurse or midwife.

18.1% received ANC four times during their pregnancy (Table 37). The greatest percentage of women (23.6%) received ANC three times during their pregnancy. 13.08% (31 of 237 women reporting) received ANC during their first trimester. The greatest percentage of women, 69.62% (165 women), received ANC

during the second trimester of their pregnancy. 17.30% (41 women) received ANC during their third trimester.

The type of services and information received during antenatal care varied (Tables 39 and 40). During an antenatal care visit, 55.7% of women received HIV information and counseling, 53.9% received information on breast feeding, and 58.7% received information on complications that may arise during pregnancy and where to go for help. 39% bought or were given iron supplements and 28.5% received vitamin A supplementation during pregnancy. 94.2% received at least one tetanus vaccine and 34.7% took anti-malarial drugs during pregnancy. 17.4% always slept under a bed net during pregnancy and an additional 11.6% sometimes slept under a net during pregnancy. 44.8% of women reported that they sometimes went to bed hungry while they were pregnant.

TABLE 37. Frequency of antenatal care visits during duration of pregnancy

Number of visits	Percent
1	4.6%
2	9.7%
3	23.6%
4	18.1%
5	17.3%
6	13.1%
More than 6	13.5%

TABLE 38. Quality of Antenatal Care

Type of Care Received	Percent
HIV Information and Counseling	55.7%
Breast Feeding Information	53.9%
Information on Pregnancy Complications, where to seek help	58.7%
Iron Supplements bought or given	39%
Vitamin A Supplements	28.5%
Tetanus Vaccination (at least one)	94.2%
Anti-Malarial Drugs	34.7%
Other Indicators of Care	
Always Slept Under a Bed Net	17.4%
Sometimes Slept Under a Bed Net	11.6%
Sometimes Went to Bed Hungry	44.8%

TABLE 39. Location of antenatal care received

Location	Percent
Own home or parents' home	0.4 %
Other home	0.8 %
Government Hospital	81 %
Govt Health Center	14 %
Govt Maternity Clinic	0.8 %
Other public	0.8 %
Private hospital/clinic	2

Post-natal care

The neonatal period is a critical period for both the mother and the child. The primary cause of maternal death, post partum hemorrhage, occurs during this period. Of worldwide under-five mortality,

approximately 36% occurs during the first 28 days of life.[38] Neonatal mortalities reflect the quality of antenatal care and other factors during pregnancy. In the Sauri Survey, 98% of babies were breastfed after delivery. However, exclusivity and duration of breastfeeding are unknown. 68% of women reported adding sugar or other liquids to infant feeding by 3 days of age, an adverse practice that increases chance of infection and can be improved upon by health education and maternal nutrition. 28.5% of respondents who have had children in the last 5 years reported that they received vitamin A supplementation during pregnancy. 71% of children born within 5 years prior to the survey received vitamin A supplementation within the last 6 months prior to this survey.

5.1.4. Proportion of births attended by skilled health personnel (MDG INDICATOR 17)

Along with access to emergency obstetric facilities, skilled attendants are an essential component of reducing maternal mortality. Skilled birth attendants provide support to the mother, manage a normal, low-risk pregnancy and birth, help ensure a 'clean delivery,' provide immediate postpartum care and make referrals in cases of obstetric and neonatal complications. 'Skilled health personnel' include doctors, clinical officers, nurses, midwives and other 'accredited' professionals.[39] According to these standards, skilled health personnel were reported to be present for 51.8% (257) of the births that took place after the year 2000.

An additional 17.90% of respondents had a Traditional Birth Attendant (TBA) present. In general the quality of care from TBAs varies widely, as many have extensive experience in normal birth but lack formal training or the resources and skills necessary should complications arise.[40] For this reason TBAs are not included in the 'skilled health personnel' category.

5.1.5. Prevalence of complications during pregnancy or childbirth

49% of respondents reported pregnancy complications (no details on these complications are available).

5.1.6. Access to emergency obstetric care

There is no access to emergency obstetric care in Sauri. The closest facility is in Siaya District Hospital about 35 km from Sauri.

[38] Black, Morris, Bryce. "Where and Why are 10 million Children Dying Every Year?" Lancet. Volume 361, June 2003.

[39] WHO. Making Pregnancy Safer: The Critical Role of the Skilled Attendant. Joint Statement by WHO, ICM and FIGO. Geneva, 2004.

[40] UNFPA. Support to Traditional Birth Attendants. Evaluation/Findings, Issue 7, New York, 1996.

6. HIV/AIDS, Malaria, and Other Disease

6.1. HIV/AIDS

6.1.1. HIV prevalence among pregnant women aged 15-24 years (MDG INDICATOR 18)

Data on HIV prevalence among pregnant women aged 15-24 years was not collected by the Sauri HIV/AIDS and STI survey because of the low rates of HIV testing in Sauri, as well as ethical and confidentiality considerations.

Other sources provide proxy data for this indicator. One source comes from Yala sub-district hospital[41] where 86% of all pregnant women attending the ante-natal clinic (ANC) accept testing. Of those, approximately 30% tested positive for HIV. According to the Kenya Demographic and Health Survey (KDHS) of 2003[42], 7.3% of all pregnant women were HIV positive nationally suggesting that the prevalence among women of reproductive age around Sauri is about four times the national average. Officially, adult HIV prevalence in Siaya district where Sauri is located is estimated at 13.5% making it one of the most highly infected areas in Kenya.[43] Professionals involved with the HIV response in Siaya district assert that the 13.5% figure might be an underestimate. The District Medical Officer in Siaya district, the Centers for Disease Control and Prevention in Kisumu and others suggest that the prevalence figure in and around Sauri might be about 20% or higher.[44]

The Millennium Villages Project is not planning on collecting HIV prevalence data for pregnant women but we are urgently instituting a Prevention of Mother to Child Transmission program that will test all pregnant women who attend the Sauri clinic. With approval from the Ministry of Health, we are hoping to get (at least indicative) prevalence data from Sauri clinic. If the data is well collected it can be used to track HIV prevalence among pregnant women aged 15-24 years; otherwise, the data can track all pregnant women.

6.1.2. Prevention of HIV/AIDS

Due to the high prevalence of HIV in the province and district, there has been a great deal of HIV activities in Nyanza Province including awareness building, scale-up of testing, and treatment with anti-retrovirals. Despite this activity, comprehensive knowledge of HIV among the youth of Sauri remains low. Only 38.2% of those aged 15-24 answered all five key HIV knowledge questions accurately (see below).

While 100% of Sauri residents have heard of HIV/AIDS, detailed knowledge is not perfect. A prime example is that 27% of Sauri residents (and 26% of 15-24 year olds) believe that HIV can be transmitted through mosquito bites while 15% state that they do not know if it is possible.

There are signs of encouragement however. 21% of 15-24 year olds have already been tested for HIV despite the lack of testing services in Sauri village. In addition, the sense of personal risk of infection is relatively high with 35% of those aged 15-24 stating that they have a moderate to high risk of infection. When asked if they would want to be tested for HIV, 85% of those aged 15-24 said yes and 85% said they knew of a place to get tested.

The Millennium Villages Project intends to raise the level of knowledge about the HIV epidemic and facilitate access to care and treatment among all residents of Sauri. This will increase the number accessing services such as testing as well as treatment and will also reduce the levels of stigma that lead 47% of residents to say that if a family member was infected, they would want it to remain a secret.

[41] Yala's official catchment area is 95,000 and Sauri cluster is 55,000 -- more than half. MVP interventions will likely have an impact on overall HIV prevalence (not just on pregnant women aged 15-24 but on a wider scale), hence our use of this proxy.
[42] Kenya Central Bureau of Statistics, 2003
[43] Figure is for adults aged 15-49 based on "National HIV Prevalence in Kenya" put out by the National AIDS Control Council and the National AIDS and STD Control Programme in November 2005. This is from sentinel surveillance data that is used to develop district estimates.
[44] Personal communications, Joel Negin

6.1.3. Condom use rate of the contraceptive prevalence rate (MDG INDICATOR 19)

A critical step in reducing HIV prevalence is increasing the use of barrier contraceptive methods during sexual intercourse. Of the women of reproductive age (15-49 years) surveyed, 28% reported that they are "currently using" some form of contraception. Of these contraceptive users, 32% reported using a male condom. This brings the condom use rate to 9% of all women surveyed. Recent research[45, 46] indicates that the female condom is comparable to the male condom in preventing transmission of HIV. There was one report of female condom use.

6.1.4. Condom use at last high-risk sex for population aged 15-24 (MDG INDICATOR 19a)

Data on condom use at last high-risk sex was not collected by the Sauri HIV/AIDS and STI survey. In follow up surveys however, the following question will be asked: "The last time you had sexual intercourse with someone who is not your main partner, did you use a condom?" The answers to this question will provide data for this indicator.

The Men's fertility survey asked 99 men between the ages of 15-24 if they used a method to avoid pregnancy the last time they had intercourse. Of the 99 men 15-24 years old surveyed, 56 (56.5%) reported that they did use a method to avoid pregnancy the last time they had intercourse. Of the 56 contraceptive users, 45 used male condoms for last sex, totaling 80% barrier use. Therefore, 45.5% of males aged 15-24 years report barrier method use at last intercourse.

At present, proxy data is available on a national level for this indicator. Based on the KDHS of 2003, 46.5% of men used a condom at last high-risk sex (up from 42.5% in 1998); 23.9% of women used a condom at last high-risk sex (up from 15.1% in 1998).

6.1.5. Percentage of population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS (MDG INDICATOR 19b)

The following survey questions were used to assess "comprehensive correct knowledge" of HIV/AIDS:

- Is there anything a person can do to avoid getting HIV/AIDS, or the virus that causes AIDS? (*Question 4)*
- Can a person get the AIDS virus from mosquito or other insect bites? *(Question 6)*
- Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex? *(Question 7)*
- Can a mother who is infected with the AIDS virus reduce the risk of giving the virus to the baby by taking certain drugs during pregnancy? *(Question 10)*
- Is there any medicine that a person with AIDS can take to stay alive? *(Question 40)*

Though there are other questions in the survey regarding HIV/AIDS, these five questions represent a broad and significant grasp of HIV/AIDS prevention (questions 4, 7 and 10), treatment (question 40), and awareness (question 6). Of the 144 people aged 15-24 who responded, 55 (38.2%) answered all five questions correctly. An additional 52 people (36.1%) answered four of the five questions correctly. Twenty-seven (18.8%) answered three questions correctly, seven (4.9%) answered two correctly, two (1.4%) answered one question correctly, and only one person (0.7%) answered none of the questions correctly (Table 40).

[45] Minnis AM and Padian NS. Effectiveness of female-controlled barrier methods in preventing sexually transmitted infections and HIV: current evidence and future research directions. Sexually Transmitted Infections. Vol 81, Iss 3, 2005. Pp. 193-200.

[46] French PP, Latka M, Gollub EL, Rogers C, Hoover DR, Stein ZA. Use-effectiveness of the Female Versus Male Condom in Preventing Sexually Transmitted Disease in Women. Sexually Transmitted Diseases. Vol 30, Iss 5, 2003. Pp. 433-439.

TABLE 40. Comprehensive knowledge of HIV/AIDS in youth aged 15-24

Number of questions answered correctly	Percentage
0	0.7%
1	1.4%
2	4.9%
3	18.8%
4	36.1%
5	38.2%

6.1.6. Contraceptive prevalence rate (MDG INDICATOR 19c)

All the 311 females aged 15-49 years that were interviewed completely responded to questions regarding current use of contraceptives. Of these women, 88 (28%) reported use of some form of contraception. A breakdown of the types of methods used is given in Figure 16.

Approximately 26% of the 311 respondents used "modern methods," which are defined as those that require supplies or clinical services, including contraceptive sterilization, intrauterine devices (IUDs), hormonal methods, condoms and vaginal barrier methods[47] (Figure 17). This includes 9 double-method users and 2 reports of emergency contraception. 15 women reported that they use traditional methods (withdrawal, herbs, and other methods), but 7 of those women reported using modern methods in addition to traditional methods.

Only barrier methods, however, prevent the spread of HIV. Barrier methods, including both male and female condoms, help reduce transmission of infections and are necessary for curbing the spread of HIV and other STIs. Among those surveyed practicing "modern methods" of contraception, 29 (36.3%) were using barrier methods (Figure 18). This means that 9.3% of the 311 women use a barrier method effective against HIV transmission.

[47] UN-STATS

FIGURE 16. Methods of contraception among female contraceptive users aged 15-49 years in Sauri (N=89)

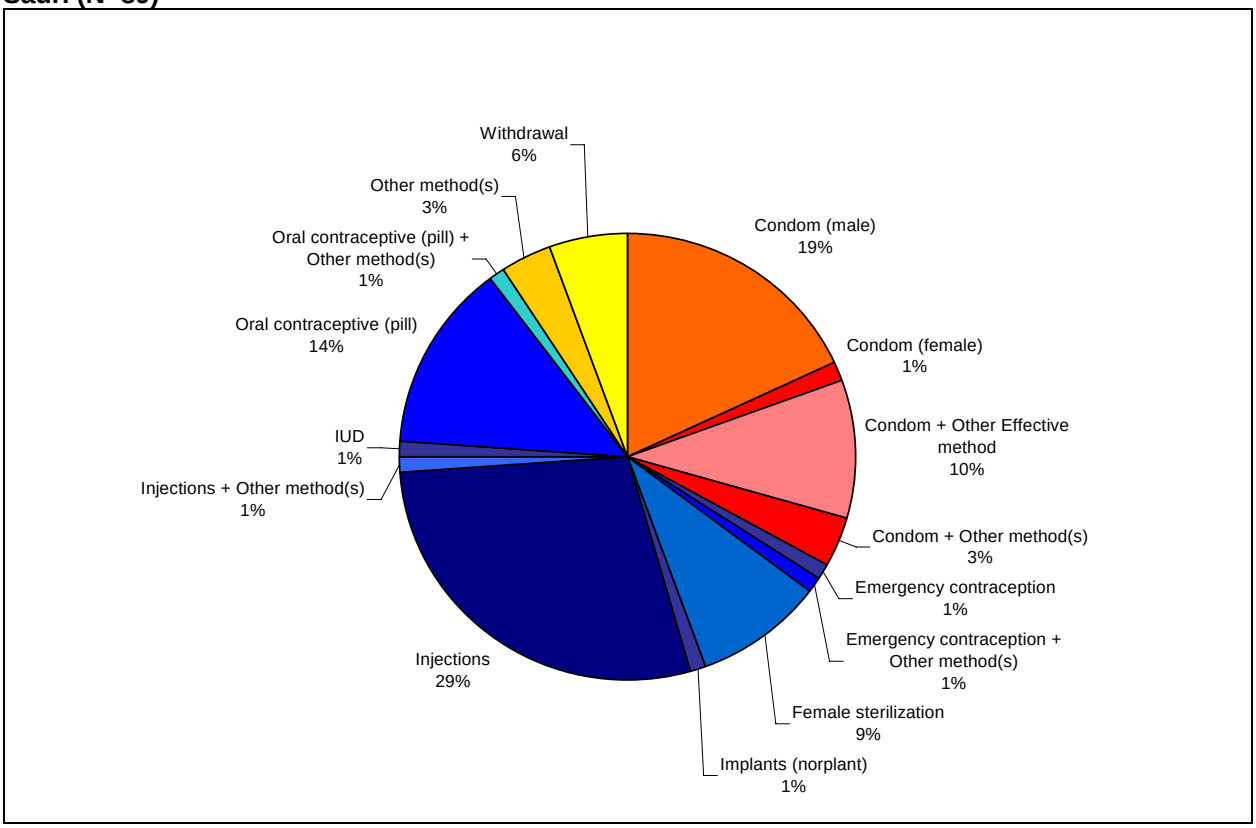


FIGURE 17. Contraceptive use among women 15-49 years old, Sauri (N=311)

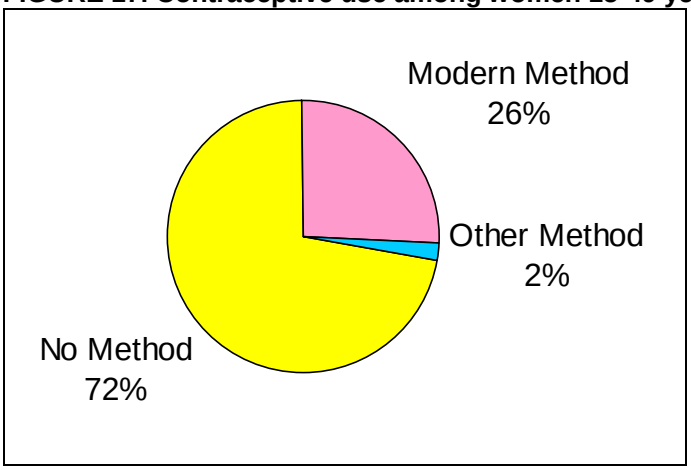
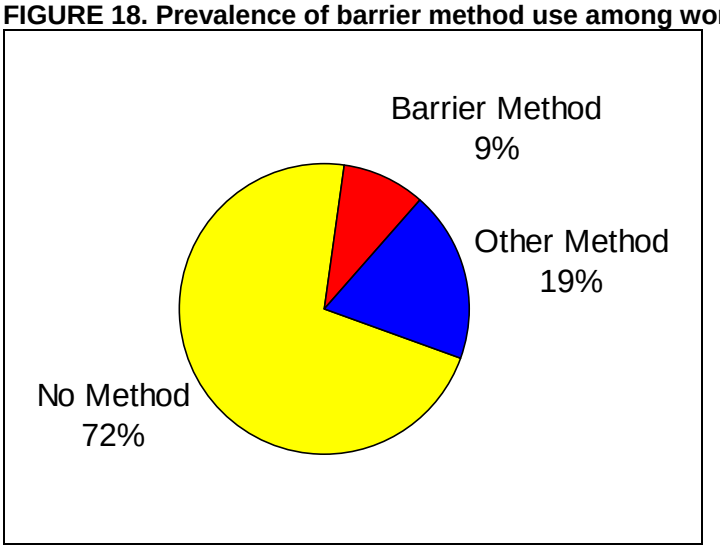


FIGURE 18. Prevalence of barrier method use among women 15-49 years old, Sauri (N=311)



6.1.7. Number of people on Anti-Retroviral Treatment (ART)

The number of Sauri residents receiving ARTs at the beginning for the project in late 2004 is not known. However, in September 2005 five people in Sauri village were on anti-retroviral treatment (ART); this will serve as the baseline. The information comes from Yala SubDistrict Hospital and was obtained following all protocols of confidentiality.

6.2. ORPHANS

6.2.1. Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years (MDG INDICATOR 20)

The ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years is 0.98:1. The Kenya national average is 1:1. (Table 41).

TABLE 41. School enrollment of orphans versus non-orphans in Sauri

	Enrolled in school	Not enrolled in school	Don't know/ missing	Total
Orphans (double)	113 (91.1%)	10 (8%)	1 (0.8%)	124
Non-orphans	621 (93.1%)	31 (4.6%)	15 (2.2%)	667

6.3. MALARIA

Malaria is a major cause of mortality and morbidity in African populations, especially in children and pregnant women. It is also a major contributor to anemia, malnutrition, and loss of labor productivity. Malaria infection in humans is caused by four species of parasites*: Plasmodium falciparum, P. vivax, P. malariae, and P. ovale. P. falciparum* is responsible for the majority of cases and almost all deaths associated with malaria.

Several methods were used for assessing the prevalence of malaria and the use of anti-malaria prevention measures in Sauri: i) analysis of the Socioeconomic and Malaria household surveys; ii) analysis of blood data to determine the presence, type and levels of *Plasmodium* in the blood; and iii) an in-depth entomological survey of 95 homesteads (248 households) to determine the number and type of

mosquitoes, the type of *Plasmodium* present in the mosquitoes, the indoor resting densities, sporozoite infection rates, and type of host (human or animal) on which the mosquitoes had been feeding.

6.3.1. Prevalence and death rates associated with malaria (MDG INDICATOR 21)

Information from 1633 individuals residing in 300 households was collected for the malaria survey. Of the 464 (28%) individuals who reported being febrile in the last two weeks, 344 (74%, or 21% of all individuals surveyed) suspected malaria to be the cause of their fever.

The entomological inoculation rate (EIR), which was estimated from the entomology study to approximate the force of transmission, was determined to be 24 infective bites per person per year (see Section IV-6.3.4). This is a very high EIR, as it has been shown that significant reductions in malaria prevalence can only be achieved by reducing EIR to less than 1 infective bite per person per year.[48]

Prevalence of malaria parasitemia in Sauri was determined by analysis of blood smears sampled from 909[49] individuals. The overall prevalence of malaria is 55% of those sampled.[50] *Plasmodium falciparum* was responsible for 87% of all malaria infections, and 11% of those infected with *P. falciparum* were co-infected with other species of malaria (Table 42). 9% of malarial infections were due to co-infections with more than one species.

TABLE 42. Prevalence of malaria in Sauri according to blood smears (N=909)

Malaria species	N	% of total	% of positive
Plasmodium falciparum	435	48 %	88 %
Plasmodium malariae	40	4 %	8 %
Plasmodium ovale	22	2 %	4 %
Plasmodium vivax	0	0 %	0 %
Plasmodium *coinfection*[†]	46	5 %	9 %
Gametocyte (sexual form)	45	5 %	9 %
Malaria, any species	497	55 %	100 %

[†]Breakdown of coinfection: 30 were *P.f./P.m.* positive, 16 were *P.f./P.o.*

Malaria shows higher prevalence in both children under 5 (63%) and school aged children (64%) compared to adults aged 16-50 years (21%) and adults over 51 years (16%). Prevalence of malaria infection stratified by age and gender is shown in Table 43.[51]

Of the males sampled, 55% tested positive, while 49% of females tested positive. Overall age groups, this difference in prevalence between sexes is not statistically significant (p value = 0.09). The difference between men and women above 51 is borderline significant (p=.05); however it could be due to small sample size in this group.

[48] Beier et. al, 1999. Short Report: Entomologic Innoculation Rates And Plasmodium Falciparum malaria prevalence in Africa. American Society of Tropical Medicine and Hygiene, 61:1, 109-113.

[49] For the malaria blood samples, 300 households were selected via stratified sampling based on an asset index, gender of household head, and geographic location (i.e. sub-village within Sauri). Selection of 700 individuals from the 300 households was stratified by age to include at least 200 children aged 6 months – 5 years, 100 children aged 5-13 years, and 100 men and 100 women aged 13-49 years. Additional individuals from households outside of the 300 households were selected to obtain the correct number of individuals for these specific age and sex categories. Replacement households were generally taken from the same stratified categories.

[50] The proportion of age groups in the sample may not reflect the proportion of age groups of the general Sauri population. Therefore the malaria prevalence for those sampled may differ from the prevalence in the general population.

[51] The overall sample size decreased from 909 to 875 because age and gender information was missing from some slides.

TABLE 43. Age and gender stratification of malaria prevalence (N=875)

	≤ 5 yrs		6 to ≤15		16 to ≤ 50		≥ 51 yrs		All ages	
	Female N=182	Male N=167	Female N=193	Male N=78	Female N=138	Male N=50	Female N=32	Male N=35	Female N=545	Male N=330
Malaria positive n (%)	111 (61%)	110 (66%)	122 (63%)	51 (65%)	30 (22%)	10 (20%)	2 (6%)	9 (26%)	265 (49%)	180 (55%)
P-value		0.38		0.78.		0.84		05		.09

There is a statistically significant difference in malaria prevalence by income level (χ^2_3=9.6, p-value=.02) indicating there may be an association between income and malaria prevalence. (Table 44). There is a 15 percentage point difference in malaria from those in the highest quartile to those in the lowest quartile (41% versus 56%). Malaria is still quite prevalent for those individuals in the wealthiest income bracket (41%). For this analysis income data was only available for 829 individuals, 410 of whom were positive for malaria.

TABLE 44. Prevalence of malaria by income quartile

	Q1* N=195	Q2 N=256	Q3 N=168	Q4 N=210	p-value
Malaria positive n (%)	110 (56%)	126 (49%)	87 (52%)	87 (41%)	0.02

* Quartile 1 depicts the group with the lowest income

6.3.2. Malaria, iron deficiency and hemoglobin levels

It is known that malaria decreases the amount of hemoglobin by destruction of red blood cells. Table 45 shows the association between malaria and hemoglobin levels stratified by age for Sauri. There is a stastistically significant difference in hemoglobin levels by malaria status for children aged 5 or younger.

TABLE 45. Variation in hemoglobin concentration by malaria status

Age	≤ 5 yrs		6 to ≤15		16 to ≤ 50		≥ 51 yrs	
Malaria status (n)	+ (210)	- (127)	+ (177)	- (107)	+ (47)	- (141)	+ (11)	- (55)
Hg concentration	9.28	10.40	11.63	12.07	11.58	11.92	10.55	11.61
P-value		0.003		0.13		0.28		0.77

More substantial is the apparent combined effect of malaria and iron deficiency on hemoglobin concentration (Table 46). As demonstrated by results from a generalized linear model (Table 46), there is a statistically significant difference in hemoglobin concentration by malaria and iron deficiency status within all age groups (p<.0001). Iron deficiency was judged by red blood cell indices, specifically low levels of mean red blood cell volumes and mean cell hemoglobin concentrations assayed by Coulter counter. Furthermore, as the population ages, malaria seems to have less of an impact on hemoglobin concentration as there is no difference in hemoglobin concentration by malaria status for a given iron deficiency status (data not shown).

TABLE 46. Variation in hemoglobin concentration by iron deficiency* and malaria status

Age (yrs)	Hemoglobin concentration Mean	p-value
<5		<.0001
Malaria+, iron deficiency n=95	8.6	
Malaria +, no iron deficiency n=79	9.5	
Malaria-, iron deficiency n=63	9.8	
Malaria -, no iron deficiency n=49	10.9	
5-15		<.0001
Malaria+, iron deficiency n=62	10.3	
Malaria +, no iron deficiency n=166	11.2	
Malaria-, iron deficiency n=38	11.1	
Malaria -, no iron deficiency n=84	12.4	
16-50		<.0001
Malaria+, iron deficiency n=10	8.8	
Malaria +, no iron deficiency n=22	12.0	
Malaria-, iron deficiency n=45	10.3	
Malaria -, no iron deficiency n=95	12.7	
51+		<.0001
Malaria+, iron deficiency n=7	9.1	
Malaria +, no iron deficiency n=4	11.6	
Malaria-, iron deficiency n=11	9.6	
Malaria -, no iron deficiency n=45	12.1	

* As assessed by red blood cell indices

6.3.3. Proportion of population in malaria-risk areas using effective malaria prevention and treatment measures (MDG INDICATOR 22A)

Prevention

The most common method of malaria prevention at the household level as reported by the head of household was the clearing of bushes to control mosquitoes (45%). Table 47 shows the prevalence of other prevention methods.

TABLE 47. Preventive measures for malaria used in Sauri

Measure	Head of households responding for house N=300
Bush clearing for mosquito control	136 (45%)
Taking of preventive antimalarials	79 (26%)
Nothing [1]	66 (22%)
Remove or spray stagnant water	57 (19%)
Bednets	39 (13%)
Other [2]	9 (3%)

[1] Reasons why did nothing: Lack of money (27), lack of knowledge (26), did not perceive malaria as a problem (3), God will provide (3), too old (2), other illness (1), busy (1)

[2] Other included: mosquito coil/repellent, praying, boiling water, herbs, ubani

Mosquito bednets have been shown to be highly effective in reducing malaria transmission. Distribution of long-lasting insecticide-treated bednets (LLITNs) is a core MVP intervention. The Socioeconomic Survey sampled all households in the village. Of the population sampled, only 204 of the 967 (21%) households reported owning bednets. Of those households owning bednets, 68.1% of households own one net (Table 48). 80% of households with bednets reported personally paying for the purchase. The bednets were acquired most commonly at a private vendor in a shop or on the street (46.1 % and 17.6 %, respectively). For the 20 percent of households that did not personally pay for bednets, they received the bednets from relatives, government clinics, and NGOs (Table 49).

In order for the bednets to effectively reduce the infection rate of malaria they must reduce the mosquitoes' contact with the persons sleeping under the nets. However, the efficacy of bed nets is drastically different depending on whether it has been treated with insecticide. The insecticide on a treated net, even one that is torn or has holes, has some deterrent/cidal effect on mosquitos. An untreated net has almost no effect, even without holes. Just over half (52.9%) of the bednets were reported to have holes. Additionally, only 53% of the bednets had been pretreated with insecticide when purchased. Therefore it is unclear how effective the bednets were in limiting human-mosquito contact. Still, ownership of a bed net prior to beginning of the interventions was associated with lower prevalence of malaria (53% versus 26% χ^2=18.8, p-value<.0001). Intriguingly, reporting that no holes were present in the bed net nor pretreating the bed net had any additional effect (χ^2=.28, p-value=.60 and χ^2=.007, p-value=.93, respectively).

Table 50 compares malaria prevalence with bednet ownership (as reported in the Socioeconomic Survey).

TABLE 48. Number of bednets owned in households, of those which own nets

Number of households with bednets	**204**	
Number of nets per household	**N**	**%**
1 net	139	68.1%
2 nets	42	20.6%
3 nets	12	5.9%
4 + nets	8	4.0%
N/A	3	1.0%

TABLE 49. Acquisition of bednets in Sauri

Personal payment for net	N	%
Yes	163	79.9%
No	38	18.6%
N/A	3	1.5%
Location purchased		
Shop	94	46.1%
Street vendor	36	17.6%
Ante-Natal (gov)	19	9.3%
Ante-Natal (private)	9	4.4%
Under 5 clinic (gov)	5	2.5%
Under 5 clinic (private)	16	7.8%
NGO	13	6.4%
Other	13	6.4%

TABLE 50. Malaria prevalence by ownership of bednet

	Malaria positive, n(%)	Chi-squared test
Bednet ownership		
Yes, n=72	19 (26 %)	
No, n=803	426 (53 %)	χ^2=18.8, p-value <0001
Pretreated bednets, among those with bednets		
Yes, n=38	9 (24 %)	
No, n=22	5 (23 %)	χ^2=0.007, p-value= 0.93
Holes in bednets, among those with bednets		
Yes, n=34	7 (21 %)	
No, n=36	11 (31 %)	χ^2= 0.28, p-value = 0.60

The higher income quartiles (3 and 4) were more likely to own a bed net than those in the lower income bracket (χ^2=37.3, p-value<.0001) (Table 51). This could be one of the reasons why a lower prevalence of malaria was observed in the higher income quartile at baseline.

Of the households who completed the survey, the parents (or single parent) sleep under the bednet over one third of the time. An additional one third reported that either parent sleep with a child under the bednet (Figure 19). It is important to note that pregnant women and young children who are most vulnerable to malaria infection are likely to benefit the most from a bednet.

FIGURE 19. Household members sleeping under bed nets, for those households owning nets.

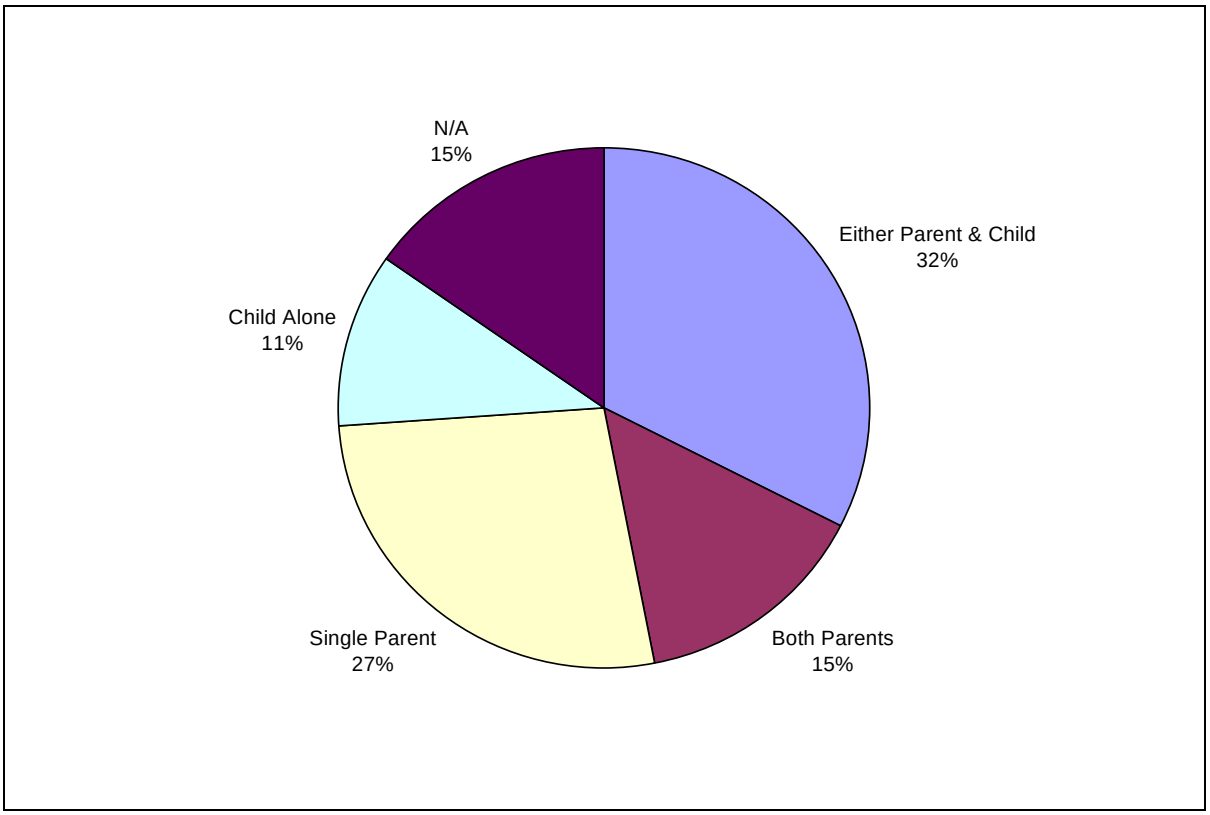


TABLE 51. Number of bednets owned by all 967 households surveyed

	0 bednets		1 bednet		2 bednets		3 + bednets		N/A	
	N	%	N	%	N	%	N	%	N	%
Quartile 1 (N=241)	211	88 %	23	10 %	4	2 %	2	1 %	1	0.5 %
Quartile 2 (N=242)	209	86 %	22	9 %	10	4 %	1	0 %	0	0 %
Quartile 3 (N=242)	185	76 %	47	20 %	8	3 %	2	1 %	0	0 %
Quartile 4 (N=242)	158	65 %	47	20 %	20	8 %	15	6 %	2	1 %
Total	763	81%	139	14%	42	4%	20	2%	3	0.3%

It should be noted that there has been an ITN implementation program by Center for Disease Control and Prevention (CDC) in some of the communities adjacent to Sauri. In these communities there has been high coverage of net ownership for 10 years. This project is well known by people in surrounding communities but has not impacted the net ownership in the Sauri study site. The expectation was that an awareness of ITN used by percolation of knowledge, attitudes, and practices from adjacent communities resulting in ITN acquisition and use would result in higher use in neighboring communities. However, a coverage of only 21% of households with bednets in Sauri indicates that this did not happen. The reasons could be inadequate awareness or lack of willingness and/or resources to purchase nets

In summary, baseline survey data from Sauri shows that malaria was a very common disease burden. It contributed to increasing anemia prevalence, especially at younger ages. Still, only a small minority of households used bednets; lack of bednet usage was more evident in lower socioeconomic groups. At baseline, bednet use could be linked to lower malarial prevalence.

Treatment of Malaria

Of the 344 individuals who suspected malaria within the past 2 weeks, approximately 30% received care from a medical professional (community health worker; government doctor, nurse, or clinical officer; or a private practitioner). The vast majority (95%) of individuals who suspected malaria received some chemical drug; the majority (80%) received at least one antimalarial. However, of those receiving some antimalarials, 71% received monotherapy. Only one person received an artemisian based regimen.

Approximately 11% of the individuals who received chemical treatment failed to complete or continue the full dose of the first assigned medication. For these respondents, lack of funds was the primary reason cited (49%).

6.3.4. Entomology of Sauri mosquitoes from household capture study

A mosquito surveillance study was conducted to determine the malaria vector in the Millennium Village. Entomological information obtained included the species of mosquito transmitting malaria, the indoor resting densities, sporozoite infection rates and the feeding habits of the mosquitoes. The second part of the study assessed the types of mosquito breeding sites in the community, their spatial distribution and the densities of immature stages of mosquitoes. This will yield information on the species composition with respect to the members of the *Anopheles gambiae* complex and will form a baseline dataset for detecting any effect of treated nets on mosquito productivity and any shifts in species composition in the community.

A total of 95 homesteads, including 248 homes or approximately 15% of homesteads in the study area, were randomly selected for the entomological survey. Entomological data collection was carried out in March 2005. All houses were sampled in each homestead.

A total of 454 mosquitoes were collected from all the houses sampled. Of these mosquitoes, 111 were Culicines and the remaining 343 were Anophelines. *Anopheles funestus* and *A*. *gambiae ss,* both of which are potential malaria vectors*,* were the main anopheline species found in the study area. Both are more anthropophagic and this was reflected in the very high human blood indices found across the study area (Table 52). Indoor resting densities varied from no *Anopheles* mosquitoes per house in Yala A to about 10 per house in Luero (Table 53). The human blood index was very high in all the villages examined with most of the villages either 1 or close to 1. Bovine, goat and bird feeding by mosquitoes was rare. Luero village had the highest indoor resting density per house. Overall, 94% of the 108 *A. gambiae* identified to sub-species were *A. gambiae s.s.* Of all the 241 female anophelines collected only 5 were completely hungry - that is neither blood fed nor carrying eggs. Clearly, mosquito numbers were generally low but this is enough information to compare to a study done at the same period in another location. The majority were fully blood fed (72%) and the rest were either fully gravid or half gravid (Table 54).

TABLE 52. Entomological parameters by sub-village: mosquito numbers and physiological status and number of positive larval breeding sites

Village	Total Culicines	Total Anophelines	Total *A. funestus*	Total *A. gambiae*	Proportion (%) *A. gambiae s.s*	Fully fed	Half gravid	Gravid	Empty abdomen
Kosoro	0	11	0	11	88 %	8	0	0	0
Yala A	16	0	0	0	-	0	0	0	0
Yala B	0	3	0	3	100 %	0	0	0	0
Madiri	42	42	19	23	100 %	5	15	9	0
Luero	6	216	177	39	97 %	127	11	20	0
Sauri A	13	3	0	3	100 %	3	0	0	0
Sauri B	3	49	17	32	94 %	17	5	1	4
Nyamninia A	10	8	3	5	100 %	5	0	2	0
Nyamninia B	4	1	0	1	-	1	0	0	0
Silula	0	5	0	5	80 %	3	0	1	0
Nyamboga	17	5	0	5	67 %	4	0	0	1
TOTAL	**111**	**343**	**216**	**127**	**94 %**	**173**	**31**	**33**	**5**

The overall sporozoite rate, or the proportion of mosquitoes infected with the *Plasmodium* parasite, was 27% in the study area. The entomologic inoculation rate (EIR) was obtained by multiplying the human-biting rate by the sporozoite rate. The human-biting rate was estimated by dividing the total number of blood-fed mosquitoes collected from a house by the number of persons sleeping in that house the night preceding the collection. The samples were not enough to estimate EIRs for individual villages. The estimate thus obtained was 24 infective bites per person per year.

TABLE 53. Malaria transmission attributes for the different sub-villages in Sauri

Village	Indoor resting density (no. of *Anopheles* per house)	Human blood index	Sporozoite rate
Kosoro	0.8	0.9	0
Yala A	0.0	-	-
Yala B	0.4	-	-
Madiri	1.3	1.0	0
Luero	9.8	0.9	0.28
Sauri A	0.1	0.7	0.33
Sauri B	1.6	1.0	0.30
Nyamninia A	0.3	1.0	0.86
Nyamninia B	0.0	-	0
Silula	0.5	1.0	0
Nyamboga	0.2	1.0	0.6
TOTAL	**1.4**	**0.9**	**0.27**

A radius of 200m for each selected homestead was observed for larval habitats. Each habitat was sampled for presence of malaria vectors and larval density was determined using dippers (one dip per 1m of habitat edge). We also visited all valleys associated with each village to look for and investigate larval habitats. A total of 248 habitats were found in both compound environment and the valleys, of which 100 were positive for either *An. gambiae* or *An. funestus* (40.3%). The positive habitats were highly aggregated in the wetlands, 90% (n=90) of all positive habitats seen were found in the valley. A summary of the number of positive larval habitats per village is shown in Table 54. There is some association between this and the indoor resting densities.

TABLE 54 Larval breeding sites per village

Village	Number of positive larval breeding sites
Kosoro	3
Yala A	8
Yala B	8
Madiri	16
Luero	18
Sauri A	7
Sauri B	10
Nyamninia A	3
Nyamninia B	7
Silula	7
Nyamboga	13
TOTAL	**100**

6.4. OTHER DISEASES

6.4.1. Tuberculosis (TB)

Tuberculosis, a disease forgotten by many, re-emerged in the mid-1980s as a major global public health problem. Its resurgence resulted initially from the global health community's assumption that effective therapy alone would control the disease, and more recently the impact of the global HIV epidemic. With the return of TB, we face the paradox of a well-defined disease, caused by a well-defined agent

(*Mycobacterium tuberculosis*), that is fully treatable with effective and affordable drugs according to internationally recommended guidelines, but yet causes increasing human suffering and death. Tuberculosis is understood to be a limiting factor in life expectancy and productivity. Over a third of the world's population is infected with *M. tuberculosis*, with 90% of those individuals remaining asymptomatic for the duration of their life (latent TB infection). Left untreated, active TB is fatal in 50% of cases. It is estimated that 1.7 million deaths are attributable to the disease each year. Tuberculosis is therefore one of the leading causes of mortality, alongside HIV/AIDS and malaria.

Understanding the scope of the TB burden, the disease was finally declared a global health threat by the World Health Organization (WHO) in 1993. The Geneva-based organization subsequently launched the Directly Observed Therapy, Short course (DOTS), a control strategy aimed at detecting 70% of all estimated smear-positive cases, and at successfully curing 85% of the patients diagnosed.

While TB is still mostly a curable disease through a six-month antibiotic regimen, treatment has become more difficult and expensive in recent years. There has been an increase in cases of HIV/TB co-infection as well as Multi-Drug Resistant TB (MDR-TB), defined as tuberculosis that is resistant to both isoniazid and rifampicin, the two most potent drugs used to treat the disease. A person with smear-positive TB left untreated will infect an estimated fifteen persons a year while smear-negative TB is approximately 80% less infectious. TB transmission occurs through aerosol droplets expelled by persons with infectious pulmonary TB when they spit, sneeze, or cough.

While only 10% of latent TB infections progress to active TB disease in an average lifetime, reactivation reaches 10% every year in immunocompromised individuals. Importantly, persons living in poverty or co-infected with HIV/AIDS have compromised immune systems and most readily progress to TB disease. The result is that 98% of active TB cases are in developing countries and that TB is the leading killer of HIV/AIDS-infected persons.

6.4.2. Prevalence and death rates associated with tuberculosis (MDG INDICATOR 23)

The Men and Women Health survey was administered to 413 individuals from 204 households. In order to determine the baseline prevalence and death rates associated with TB (indicator 23), the survey included questions investigating cases of tuberculosis in the village, as well as all deaths related to TB in each household. Incidence and prevalence for Sauri for a 5-year average were calculated by using standard deviations, probability density functions, and the estimate of the local detection rate for TB

Prevalence of tuberculosis in Sauri is approximately 943 per 100,000; incidence is 560 per 100,000; and mortality is 171 per 100,000. Table 55 compares Sauri figures with the Kenya national averages.

6.4.3. Proportion of tuberculosis cases detected and cured under DOTS (MDG INDICATOR 24)

In order to estimate detection and cure rates under DOTS, the survey also included questions specific to outcome of TB treatment, and other questions regarding symptoms of upper respiratory illnesses. Those questions were useful to estimate the undiagnosed cases of TB. From those symptoms, it was estimated that 17 individuals failed to be diagnosed. Because only 9 individuals had ever diagnosed with TB, the baseline DOTS detection rate for Sauri is 35% (Table 55). These cases of TB occurred in different years so the incidence and prevalence of TB were extrapolated based on a 5 year average.

According to the WHO and USAIDS, countrywide DOTS was implemented in 1996 and its effectiveness has improved steadily. The Sauri detection rate, however, still compares unfavorably with Kenya's national detection rate of 46%. This may be true because cases prior to 1996 were considered when calculating the Sauri detection rate. Treatment completion was 77.8% and treatment success 44.4% for Sauri. The low figure for treatment success is attributable to missing data in the survey which rendered cure rates difficult to estimate.

TABLE 55. Comparison of Tuberculosis incidence, prevalence, mortality, and treatment in Sauri to Kenyan national figures

Measure	Sauri	Kenya
TB Mortality	171 per 100,000 (11 out of 82 deaths attributed to TB)	133 per 100,000
TB Incidence	560 per 100,000	619 per 100,000
TB Prevalence	943 per 100,000	888 per 100,000
DOTS Detection Rate	35% (9 diagnosed out of the 26 expected)	46%
DOTS Treatment Success Rate	44.4% (4 cured out of 7 put on treatment)	80%

6.4.4. Neglected Tropical Diseases

Schistosomiasis and soil-transmitted helminth infections cause worldwide morbidity and suffering, particularly in poor populations. Soil transmitted helminths (STH) and schistosomes are transmitted by eggs excreted in human feces or urine, which contaminate the soil or water sources in areas that lack adequate sanitation. Humans are infected through ingestion of infective eggs or larvae on contaminated food or hands (*Ascaris lumbricoides*, *Trichuris trichiura*) or penetration of the skin by infective larvae that contaminate the soil (hookworms) or fresh water (schistosomes). Since unlike viruses, bacteria, fungi, and protozoa these parasites do not multiply in the human host, re-infection after deworming occurs only as a result of new contact with the contaminated environment.

Morbidity from STH and schistosomiasis infections affects individuals in both overt and subtle ways. Some direct outcomes include iron-deficiency anemia, malnutrition, growth retardation, and intestinal obstruction. Other far reaching effects include poor cognitive development in children and increased school absenteeism, concomitant infections, increased maternal and fetal morbidity and mortality, and lower birth-weights. In addition, recent epidemiological evidence suggests that treatment of schistosomiasis and STH infections may lessen the transmission and burden of disease from HIV/AIDS, TB and malaria.[52] Periodic large-scale chemotherapy for these infections could thus help contribute to a number of Millennium Development Goals.

There is strong evidence that mass deworming interventions, involving single doses of inexpensive medications, lead to improvements in the affected populations. These improvements include a decrease in overall mortality and morbidity, decrease in infant mortality rate, decrease in malnutrition, as well as an improvement in socio-economic and educational outcomes. The World Health Organization has developed a comprehensive plan for mass deworming treatment interventions and recommends that a baseline survey for prevalence and intensity be conducted to help guide the level of treatment intervention. Baseline surveys allow the treatment team to compare prevalence and intensity with that found in follow-up surveys, thereby measuring the success of the deworming program and other interventions.

Three population groups at particular risk for the debilitating effects of these pathogens were surveyed for the presence of soil transmitted helminths and *Schistosoma mansoni*. The groups targeted for the baseline stool testing were: school-aged children 9-10 years of age; preschool children 2-4 years of age; and reproductive-age women 15-49 years of age.

[52] Preventive chemotherapy in human helminthiasis: Coordinated use of anthelminthic drugs in control interventions: a manual for health professionals and and programme managers. World Health Organization 2006.

One hundred and twenty individuals were randomly sampled from each age category and submitted stool samples for testing, which were processed using the Kato-Katz method.[53] The survey found high prevalence of soil transmitted helminths in all 3 populations tested. No *Schistosoma mansoni* was detected. All groups showed high prevalence of STHs, ranging from 48% in the preschool children to 80% in the schoolchildren (Table 56). Since the prevalence in school-aged children exceeded 50%, this classifies Sauri as a "high risk" community according to WHO guidelines.

TABLE 56. Prevalence of soil transmitted helminths in Sauri children

STH	Prevalence ages 2-4	Prevalence ages 9-10
Ascaris	38%	55%
Trichuris	21%	52%
Hookworm	23%	54%
Infection with any STH	**48%**	**80%**
Double infection	21%	35%
Triple infection	6%	24%

Additionally, 13% of school-aged children had a high intensity infection, also considered a marker of need for mass preventative treatment (Table 57). In such high risk communities WHO recommends preventative chemotherapy for preschool and school-aged children at least twice a year, preferably three times.

TABLE 57. Intensity of STH infections in Sauri children [54]

STH	Heavy intensity, ages 2-4	Heavy intensity, ages 9-10
Ascaris >50,000 epg	8%	10%
Trichuris >10,000 epg	2%	0%
Hookworm >4.000 epg	0%	3%
Total (any STH)	**10%**	**13%**

The women of reproductive age surveyed showed a high prevalence of infection with any STH of 75% (Table 58). 4% of these women had a heavy-intensity infection (Table 59). Unfortunately, albendazole and mebendazole, the drugs used for treatment of STH infections, are not licensed for use during the first trimester of pregnancy, despite the fact that there does not appear to be documented damage to the fetus. A number of small studies have in fact shown no ill effects in women treated with these drugs during the first trimester. Although a mass treatment would likely be a great benefit to women of reproductive age, WHO advocates the precautionary principle in this matter and thus does not recommend treating women in the first trimester of pregnancy, The individuals who test positive for STH infection during this study are thus referred to the clinic for determination of pregnancy status prior to deworming. Women who present themselves for antenatal care may be treated in the second and third trimester of pregnancy. Women of reproductive age who tested positive for STHs in the survey are being contacted and referred to the clinic for determination of pregnancy status prior to individual treatment, as per WHO recommendations.

[53] The Kato-Katz method involves microscopic examination of a fixed amount of fecal material to detect and identify the presence of different types of helminth eggs in stool, while also quantifying the intensity of the infection as measured by eggs per gram of stool (epg). These counts give an indirect measure of the parasite burden: in general the higher the egg count, the greater the number of parasites infecting the individual.

[54] For intensity data, WHO standards are used. Calculations are as described in WHO document Helminth Control in School Aged Children (www.who.int/wormcontrol/documents/en/012to28.pdf)

TABLE 58. Prevalence of STH infections in reproductive age women (15-49 years)

STH	**Prevalence**
Ascaris	29%
Trichuris	34%
Hookworm	65%
Infection with any STH	**75%**
Double infection	26%
Triple infection	13%

TABLE 59. Intensity of infection in reproductive age women (15-49 years)[55]

STH	**Heavy intensity**
Ascaris >50,000 epg	2%
Trichuris > 10,000 epg	0%
Hookworm > 4,000 epg	2%
Total (any STH)	**4%**

6.4.5. Anemia prevalence

Anemia is often associated with many other diseases including malaria, malnutrition, and hookworms. Anemia increases mortality and morbidity from many other diseases at all ages, along with lowered abilities for physical and work activities. In children, anemia is associated with slower cognitive development and learning skills. During pregnancy, anemia is linked to a higher risk of maternal mortality. Importantly, anemia is preventable and/or treatable.

In April and May 2005, 966 individuals provided venous blood samples for assessment of hematological status (using Colter counters). Aliquots of plasma were also frozen and stored for later analysis of micronutrients and other factors. Table 60 shows the number of females and males tested in different age groups. Women of child bearing age were sampled at 2x more than men because of their status has greatest relevance and importance in the 'life-cycle.'

In preliminary analyses, anemia is prevalent in all age groups but especially in children under 5. In the group sampled, severe anemia (hemoglobin levels 8 gm per deciliter or lower) is present in almost 1 of 5 children. Table 60 shows anemia prevalence rates for males and females in each age group using the WHO criteria for definition of anemia for each specific group.

Iron deficiency is prevalent in about one-half of the Sauri population, as indicated by the percentages of those with low mean cell hemoglobin concentrations (MCHC) and mean cell volumes (MCV). Iron deficiency is most common in children under 5 (67.7% for males and 49.3% for females), but it is also prevalent in women of child bearing age (51.0% for women between 16-50 years). Overall, 54.5% of males and 45.5% of females are anemic from iron deficiency

[55] For intensity data, WHO standards are used. Calculations are as described in WHO document Helminth Control in School Aged Children (www.who.int/wormcontrol/documents/en/012to28.pdf)

TABLE 60. Prevalence of anemia, severe anemia, and anemia from iron deficiency

	<=5 yrs old		**6-<=15yrs old**		**16-<=50yrs old**		**>=51 yrs old**	
	Female N=189	**Male** N=181	**Female** N=203	**Male** N=84	**Female** N=170	**Male** N=61	**Female** N=39	**Male** N=39
Anemia N (%)	144 (77%)	130 (76%)	88 (43%)	50 (62%)	102 (64%)	25 (43%)	20 (63%)	30 (86%)
Severe anemia N (%)	30 (16%)	35 (20%)	0 (0%)	0 (0%)	10 (6%)	0 (0%)	2 (6%)	2 (6%)
Anemia from iron deficiency N (%)	71 (49%)	88 (68%)	32 (36%)	23 (46%)	52 (51%)	8 (32%)	6 (30%)	9 (30%)

7. Environmental Sustainability

The MDG indicators for environmental sustainability include topics such as percent of area in forest cover, ratio of area protected for biodiversity, per capita energy use, and carbon dioxide emissions. The first two indicators may not be applicable to some of the Millennium Villages that are in areas of high population density that were deforested long ago, as is the case in Sauri. Proxy indicators that are relevant to environmental sustainability in agricultural landscapes, such as the proportion of land devoted to different land uses, the number of trees or tree cover, and on-site biodiversity – particularly the location and functional groups present – are useful for monitoring environmental sustainability.

7.1. LAND USE AND FOREST COVER

7.1.1. Land use

Two main approaches were taken to estimate the area in different land uses and that were covered by forest in Sauri: i) Spatial analysis of a QuickBird (QB) satellite image taken at the start of the project in September 2004; and ii) Analysis of plot level ecological data collected using landscape level transects. Analysis of the Quickbird image was used to gain an initial land classification map for the area and field information on land-use, vegetation types, soils on 78 plots in the transects was used to confirm the remotely sensed classification of land uses, as well as to provide additional data on soil fertility, vegetation, and land use in Sauri.

The land use types used for classification and land use map of Sauri from the analysis of the Quickbird image are noted in Table 61 and Figure 20. To account for varied definitions of "forest," an additional effort was made to quantify the proportion of land covered by hedgerows, which cover more area than forests and form the predominant "semi-natural habitat" in Sauri. This land use serves not only innumerous functions for humans, but also is one of the primary habitats for biodiversity conservation.

A LANDSAT[56] satellite image taken in March of 1986 was also analyzed to look at forest cover and for a study relating to potential carbon sequestration in Sauri.

Land Use Types: Land uses in Sauri as determined by the QuickBird classification are shown in Figure 21 and Table 62, indicating 16 different land uses. Yala town was excluded in this classification because it is not representative of the mean Sauri landscape. The predominant land use in Sauri is agricultural (Figure 21). According to the transect data the sum of all agricultural uses is almost 80%, including the cultivation of crops within a homestead boundary. Most of the landscape in Sauri is privately-owned, small-holder plots (79%). A smaller percentage (19%) is communally owned, and an even smaller percentage is under commercial use (3%). Of the agricultural land in Sauri, 41% is considered cropland and 27% is used as a natural fallow which often doubles as grazing land. In the QB image, fields and bare soils constitute 79.6% of the area, these classifications are considered indicative of agricultural area; this proportion is the same amount of agricultural land estimated by the transect data.

Though swamplands represent less then 5% of the landscape in Sauri, they serve very important ecological roles both in the conservation of biodiversity as well as in the filtration and purification of water. However they are also important areas for the cultivation of high-value vegetable crops, particularly during the dry season when water is not available in other parts of the sublocation.

[56] LANDSAT image is from March 08, 1986. Path 170, Row 86. Source: Landsat.org, Global Observatory for Ecosystem Services, Michigan State University (http://landsat.org).

TABLE 61. Methodology used for spatial analysis of land use types of QuickBird image

Land Use Classification	Methodology
Homesteads	Manual boundaries from QuickBird using ENVI classification of metal roofs and GPS units.
Yala Town	Homesteads and buildings manually identified from QuickBird
Public Institutions	Includes schools and clinics
Roads	Average width used, but there is variation between murramed and dirt roads
Railway	Average width used; varies near railway station
Ponds	ENVI Classification using Infrared Band
Orchards	Manually identified from Quickbird
Swamps	Manually identified from Quickbird
Yala River Forest	ENVI classification of canopy greater than $500m^2$ on the bank of the Yala River, with manual inclusion of unfarmed land around the canopy
Other Forests	ENVI classification of canopy greater than $500m^2$ that is not within a homestead, with manual inclusion of unfarmed land around the canopy
Natural Vegetation	Manually identified unfarmed vegetation near streams
Hedgerows	Manually identified from QuickBird
Fields	Obtained from subtracting land use area of categories above from village area Also from responses in the Socioeconomic household survey
Bare Soil Fields	Soils exposed indicate land being prepared for crops and excludes soils from roads, railway and homesteads

FIGURE 20. Land use in Sauri from QuickBird image The map of land uses in Sauri shows the categories that serve as the basis of the QuickBird classification. Note that although there are very few forest patches, Y transect data shows that individual trees were found in almost all plots collected in Sauri.

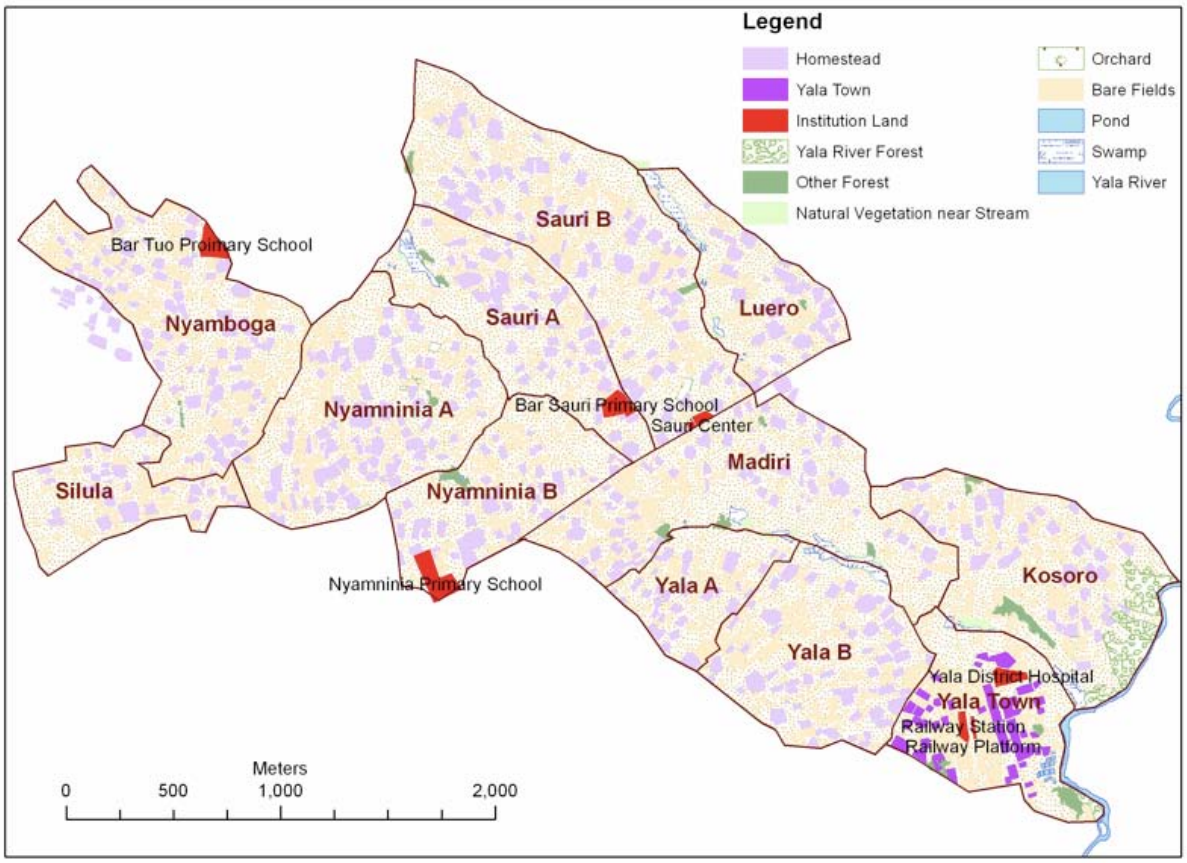


FIGURE 21. Dominant land uses in Sauri as recorded during the landscape transect survey

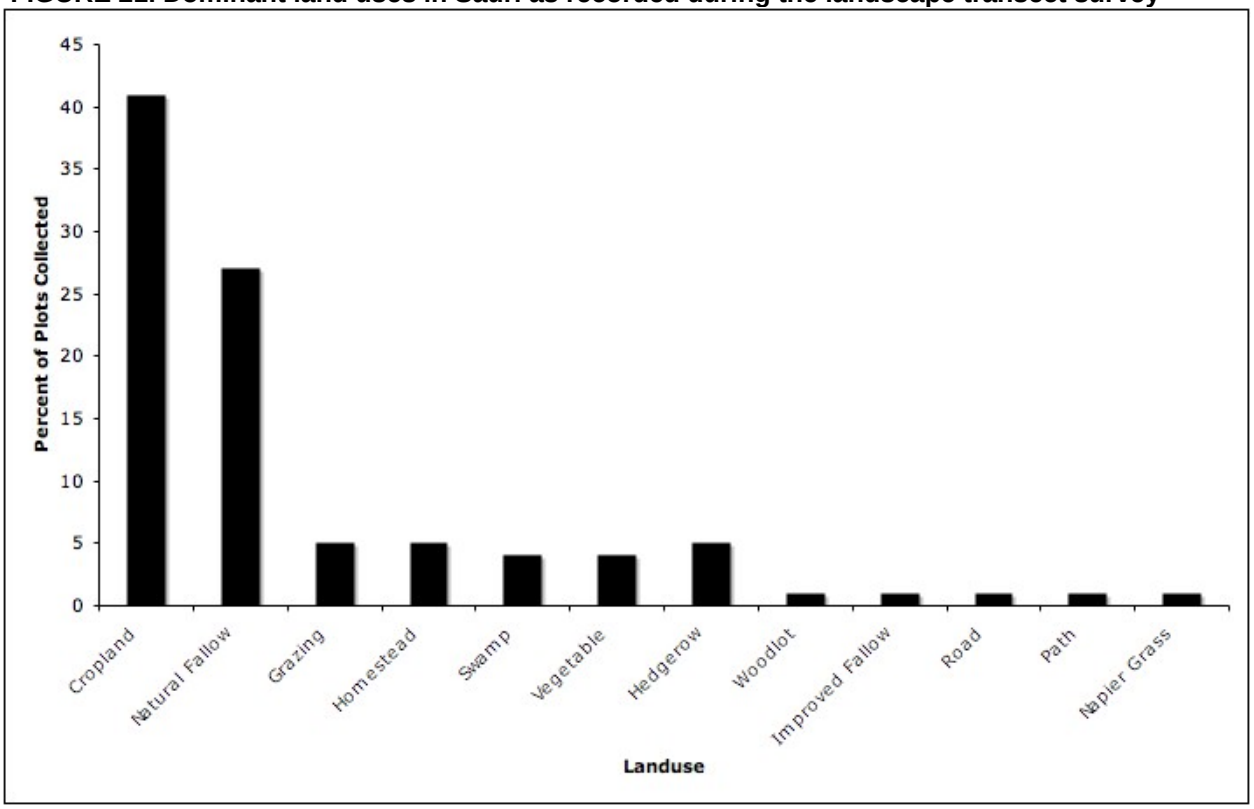


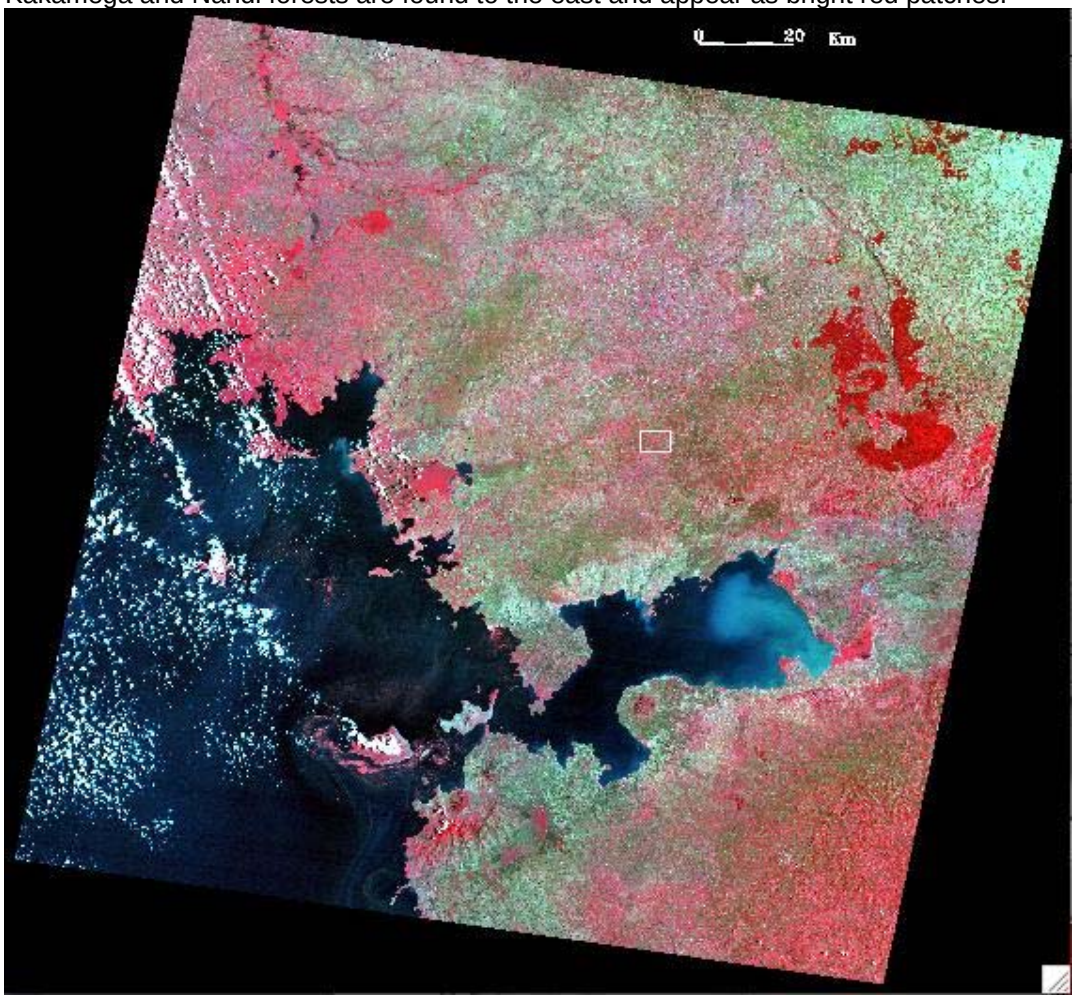
TABLE 62. QuickBird classification of land uses in Sauri, excluding Yala Town

Land Use	No. of Units	Area (ha)	Percentage	Assumptions
Homesteads	620	131.8	17.5	Except in Nyamoga
Public Inst.	5	5.5	0.7	
Roads	1	17.7	2.4	Width 4 m
Railways	1	0.6	0.1	Width 6 m
Ponds	7	0.1	0.01	
Orchards	7	1.1	0.1	
Swamps	9	8.2	1.1	
Yala River Forest	3	8.7	1.2	
Forests	19	6.9	0.9	
Nat. Vegetation	22	2.9	0.4	Unfarmed, near streams
Hedgerows		23.7	3.2	Width 2 m
Fields		546.0.	72.5	Remainder from above
All Villages	11	753.2	100	Except Yala Town
Bare Soil	1377	202.3	26.9	
Fields	1426	397.0	52.7	82 missing

7.1.2. Proportion of land area covered by forest (MDG INDICATOR 25)

According to a combination of estimates, the percent forest cover in Sauri lies between 1-5%. The analysis of the QuickBird image estimates forest cover at approximately 2.1% if the classification is limited to “forests” (0.9%) and the “Yala River Forest” (1.2%). However if “natural vegetation” (0.4%), and hedgerows (3.0%) are added, the percentage increases to approximately 5.6%. Using the Y transect data, only 1% of the landscape is classified as woodlot (forest cover). Analysis of the 1986 LANDSAT imagery gives a value of 4% forest cover in Sauri..

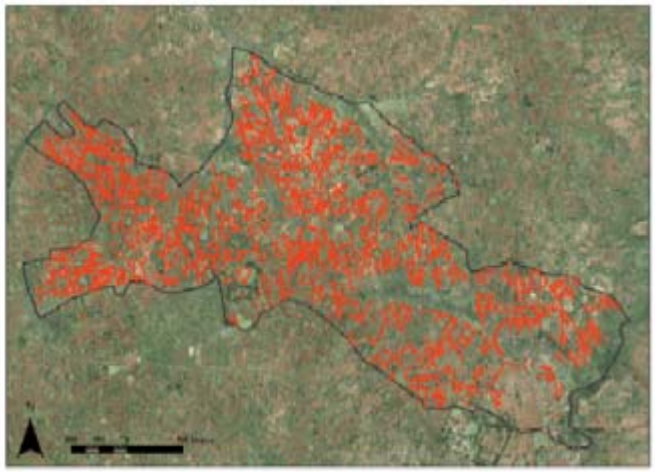
FIGURE 22. Landsat image of Western Kenya (March 1986) with Homa Bay of Lake Victoria prominently displayed. Sauri is found to the north of Homa Bay and is identified by a white rectangle. The Kakamega and Nandi forests are found to the east and appear as bright red patches.



In actuality, most trees in Sauri are found as isolated individuals, which do not fall under usual definitions of forest. A more accurate description of Sauri is as a woodland with scattered trees, and occasional patches of higher tree density. These scattered trees cannot be detected by remote sensing methods; even with data collected on the ground, such assemblages of trees often fail to qualify as “forest cover” to the surveyors. This most likely explains why the Y transect value of “forest cover” is the lowest of the three estimates.

Though densely forested areas are rare in the Sauri landscape, hedges, including homestead hedges, agricultural hedges, and roadside hedges, occupy 2-3% of the landscape (Figure 23). Analysis of the QuickBird image estimates hedges cover 3% while the Y-transect data estimates 2%. These hedges are scattered throughout the landscape, contain a diversity of trees and shrubs, and could provide many ecosystems services usually attributed to forest areas.

FIGURE 23. Distribution of Hedgerows in Sauri



Based on QuickBird analysis there are 20.9 ha of household hedges, which are hedges planted around homesteads as a means of delineating property, keeping livestock in the compound, and ensuring some degree or privacy. There are 16.2 ha of agricultural hedges, which are hedgerows that are found surrounding agricultural fields and which serve multiple purposes, including delineating property, providing a source of organic fertilizer, and as a soil conservation measure. Finally there are 3.8 ha of roadside hedges, which are those hedges that are found alongside roads. These roadside hedges typically also fall into one of the above categories since on the otherside of the hedge there typically is a field or a homestead. Hedgerows are dominated by shrubs (*Tithonia, Lantana,* and *Euphorbia*) though homestead hedges tend to be comprised of taller species and often include a greater percentage of tree species than the agricultural and roadside hedges.

7.1.3. Potential Areas for Reforestation

Potential areas for reforestation were identified through the spatial and spectral analysis of a Quickbird satellite image (Table 63). Roadside buffers, riparian areas, spring protection buffers, hedgerows, and degraded lands for orchard planting were identified as potential reforestation areas. Roadside buffers were defined as a 5 m strip on either side of existing roads. Riparian areas were defined as 5 m strip on either side of streams and 10 m strips on either side of the Yala River. Spring protection plantings were designed as a circular area with a 15 m radius where trees would be planted to reduce contamination of unprotected springs. Existing hedgerow areas were identified through visual inspection of the satellite image, and potential hedgerow area was assumed to be double the existing area. Degraded areas, defined as areas that either have a significant root limiting layer (laterite) within 20 cm of the soil surface (frequently at the soil surface), areas with compacted soils, or areas with significant evidence of erosion typically evidenced through the formation of gullies, or cut banks were assumed to occupy 100 ha, though exact areas for orchard planting on degraded lands were not identified.

TABLE 63. Potential reforestation areas in Sauri

Intervention	Area (ha)
Spring Buffers	2
Stream Buffers	11
Road Buffers	36
Hedgerows	74
Orchards	100
Total	**223**

7.1.4. Erosion

Almost three-quarters (73%) of all farms appeared to have at least one form of erosion. Sheet erosion was by far the most common (69%) followed by no erosion (24%), and rill (3%) and gully erosion (1)%).

Fortunately, 99% of farms show no sign of soil hardening, though 59% do not practice any form of soil conservation methods, and only 18% keep crop residues. Nearly 75% of farmers do not have soil conservation structures on site, though 13% had vegetative structures and 5% had physical or constructed breaks.

7.2. BIODIVERSITY

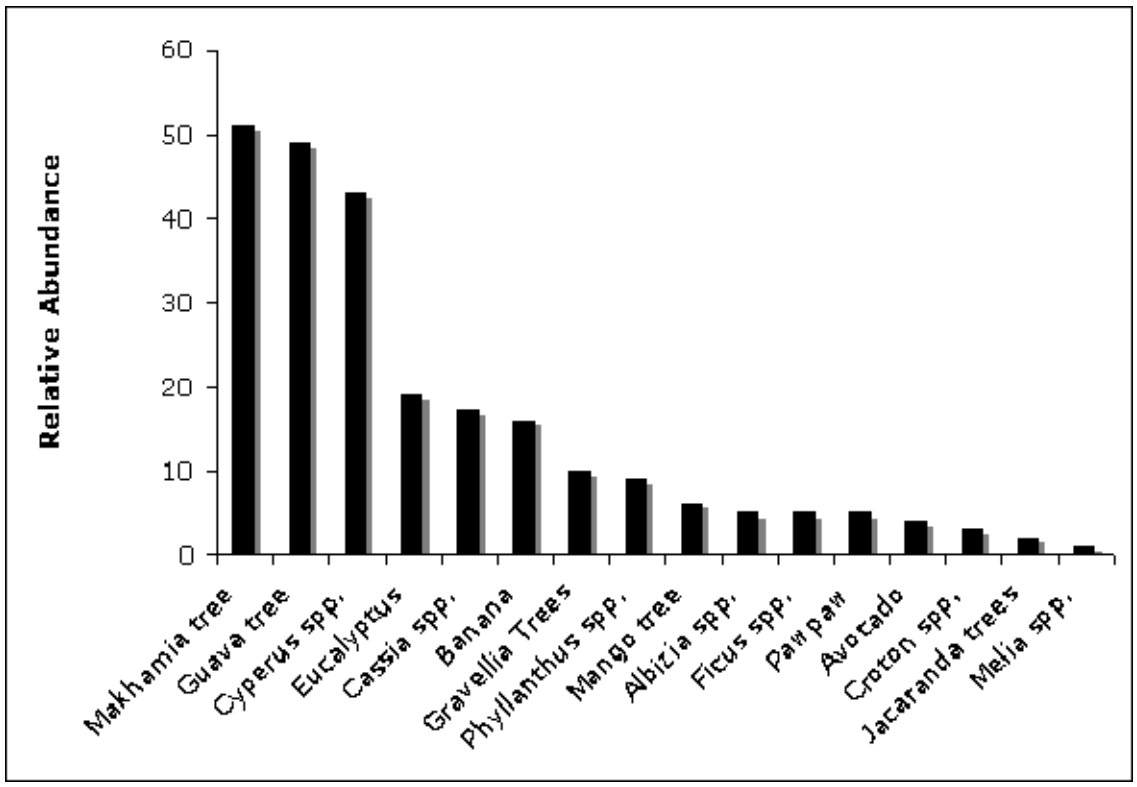
7.2.1. Ratio of area protected to maintain biological diversity to surface area (MDG INDICATOR 26)

0% of land in Sauri has been officially protected for maintaining biological diversity.

7.2.2. Tree species

Tree diversity in Sauri is relatively low with no natural forest fragments remaining. Only 16 species of trees were found in the initial transect (Figure 20), and almost half of these are exotics including three of the four most abundant trees: guava (*Psidium guajava*, originally from the American tropics*), Cupressus lusitanica* (from the American tropics) and *Eucalyptus spp*. (from Australia). Secondary vegetation may be returning along the banks of the Yala River in what we have been calling Yala River Forest, however visits to the site have failed to uncover anything that could truly be called a forest. The predominant tree cover in Sauri is found in woodlots dominated by *Markhamia lutea*, a native of eastern Africa that has been heavily promoted in reforestation with native species. Many of these *M. lutea* are coppiced and used for fuel wood. The second most abundant species in Sauri is Guava which is typically found in the hedgerows surrounding homesteads. The fruit of the guava are highly popular amongst children and wildlife in Sauri, both of which serve to disperse the species; the fruit are high in vitamin C though availability is seasonal.

FIGURE 20. Abundance of tree species in Sauri (noted as the % of transect points where individual species were encountered)



For non-tree species, a total of 88 species were recorded, however this result should not be considered as a floral census of Sauri. Native or particularly rare plants are the ones most likely to be overlooked in the initial Y transect. What can be stated is that Sauri's flora is dominated by species of agricultural

importance, and by weeds. The most common species is the grass *Digitaria*[57] (crab grass, amongst other common names), which is native to southern Africa but has been widely used as fodder and for soil conservation. In Sauri, *Digitaria* is found in 77% of plots where it is used for pasture, as well as being the predominant lawn species within homestead. The remaining top three species include *Biden pilosa* (47%), kidney weed (31%), and goat weed (28%), are all weedy species. Because the survey was conducted in late December during the end of the short rainy season, there is no accurate record of the abundance of crop plants.

Cluster analysis of species presence/absence by land use produces no clear species by land use relationships. There are several reasons for this. The first is that the data were collected during the dry season, so croplands do not separate out with the presence of maize, bean and other important crops. Secondly, we are limited by using presence/absence data. Within a single plot, multiple uses can be found, and though species dominance may change from one land use to the next, their presence/absence does not. For example, it is not uncommon to find bananas or even maize growing within a woodlot, or *Markhamia* trees bordering a maize field. This demonstrates the important point that although Sauri is comprised of distinct land uses, the uses are relatively small and are evenly distributed in a mosaic pattern throughout the landscape. (It is also important to note that land use categories are more fluid gradients that can change through time, rather than discrete and constant classes.)

7.2.3. Bird species

A bird survey that will be linked to the transect data is currently in progress in Sauri. There are several purposes to the bird survey, the first is to provide at least one form of baseline data on biodiversity in the community. By combining the bird and the land use data we can model how changing the landscape might affect avian diversity and try to plan the interventions so that they have a minimal impact on bird diversity.

At the time of this report, at least one round of sampling had been completed. Rarer species will most likely be added as the rounds are repeated. The most abundant species in the first round of sampling are shown in Table 64.

TABLE 64. Most abundant bird species in Sauri

Species name (common)	Number of individuals counted
Bronze manikin	73
Common bulbul	59
Baglafecht weaver	51
Bronze sunbird	49
Speckled moosebird	47
Tawny flanked prinia	33
Yellow-throated leaf-love	31
Black and white manikin	30
Tropical boubou	23

A total of 62 species have been observed, of which the remaining 53 have less than 20 individuals counted. Of the rarer species, Grey Crowned Cranes are frequently spotted, and Ross's Turaco has been seen on occasion. The crane is dependent on wetland/agricultural habitat, whereas the turaco requires siginificant tree cover. The presence of these two species indicates that at the start of the MVP, Sauri contained sufficient wetlands, and tree cover to maintain small populations of these two species. The continued presence of these two species could be important indicators of land use change and biodiversity.

[57] see http://www.tropicalforages.info/key/Forages/Media/Html/Digitaria_eriantha.htm for more common names

7.3. ENERGY

Energy analysis for Sauri was carried out using results from the Sauri Energy Survey of 300 households conducted in April 2005 and from the Sauri Socioeconomic Survey.

7.3.1. Proportion of population using solid fuels (MDG INDICATOR 29)

The dominant energy sources in Sauri are firewood, charcoal and kerosene. Households use an average of 449 kg of firewood and 46 kg of charcoal per capita per annum, the majority of which is used for cooking. In Sauri, 99% of households use a combination of solid fuels for cooking. Seventy-nine percent of households reported that they use some type of fuel for room warming, of which 99% use solid fuels for the majority of their room warming needs. Ninety-six percent of households reported using some type of fuel for heating water, of which 94% use solid fuels for the majority of their water heating needs. In comparison to the rest of the country, 81% of Kenyan households report that they use solid fuels for cooking and heating.[58]

The main cooking fuels are firewood and charcoal (see Figure 25), with an average consumption of 333 kg of firewood and 12 kg of charcoal per capita per annum for cooking. The dominant source of lighting throughout the village is kerosene. Households use an annual average of 9L of kerosene per capita.

FIGURE 25. Percentage of cooking done by fuel types

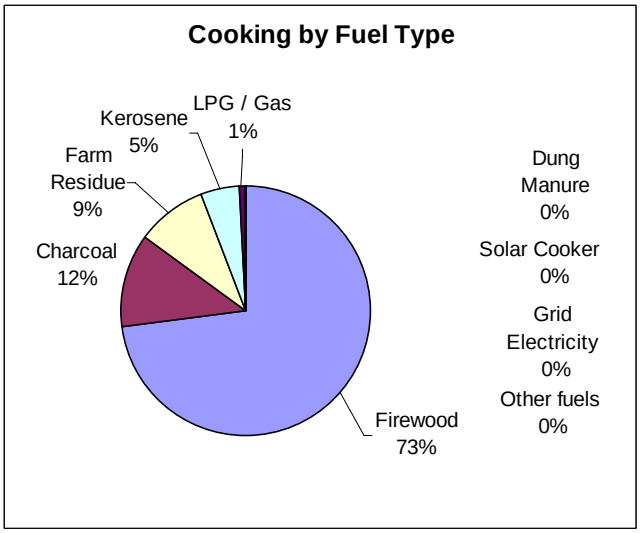


Table 65 and Figure 26 illustrate annual per capita use of dominant fuels by income level. The poorest households use 27% less firewood, 33% less charcoal and 50% less kerosene per capita per annum than the richest households. Households spend an average of 1,458 KSh per capita per annum (18.23 USD per year)[59] on all fuels, batteries and mechanical power services, including hired labor. This average masks the variation among income groups, as the data show that the poorest households tend to use less firewood per capita while simultaneously spending 61% more on firewood than the richest households (see Table 66 and Figure 27). It is important to recognize that the median expenditure figures are low in comparison to the means. For example, the median expenditure on firewood for Quartile 4 is zero. This reflects the fact that 54% of households in this quartile did not purchase firewood at all, while other households purchased amounts well above the average.

[58] http://millenniumindicators.un.org/unsd/mdg/SeriesDetail.aspx?srid=712, accessed July 13, 2006. Figure for Kenya solid fuel use reflects year 2004 data.
[59] Assuming 80 KSh per USD.

Fuel consumption figures have been converted to kilograms of oil equivalent to compare fuel types with differing energy contents[60]. Energy use in Sauri is about 188 kgoe per capita per year excluding mechanical power services. Eighty percent of this overall use is firewood for cooking purposes. Average firewood consumption in Sauri is 150 kgoe, as compared with 358 kgoe for rural Kenya, and average charcoal consumption is 31 kgoe, as compared with 104 kgoe for rural Kenya.

Figures 28, 29 and 30 illustrate the proportion of dominant fuels that are used for four main services: cooking, room warming, heating water and lighting. The majority of household firewood and charcoal is used for cooking. Kerosene is used almost exclusively for lighting.

Firewood and charcoal are acquired through a combination of sources. Approximately 46% of households obtain all of their firewood without paying for it, 3% regularly purchase all of their firewood while 51% supplement free collection by purchasing some firewood. As seen in Figure 31, of the firewood that is collected, 17% is collected or produced from fallow lands owned by the household, 31% is collected or produced from other land, fields or trees owned by the household and 29% is collected from the roadside, other's fields, or community land or forest. The majority of charcoal in Sauri is purchased, though 17% of charcoal is produced by household members using firewood, as seen in Figure 32.

TABLE 65. Annual per capita use of firewood (Kg/yr), charcoal (Kg/yr) and

Major Fuels	All	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Firewood (Kg/yr)					
Mean	449	377	418	512	484
Median	291	285	267	371	286
Charcoal (Kg/yr)					
Mean	46	31	25	57	74
Median	23	12	13	32	34
Kerosene (Liters/yr)					
Mean	9	6	8	11	12
Median	6	4	5	7	7

Calculations include zeroes and exclude blanks. Quartile 1 denotes poorest income group.

[60] The kgoe calculation assumes an energy content of 15 MJ/kg for firewood, 30 MJ/kg for charcoal and 45 MJ/kg for liquid petroleum products including kerosene. Thus 3 kg of wood are converted into 1 kgoe.

FIGURE 26. Annual per capita consumption of major fuels in kgoe by income quartile

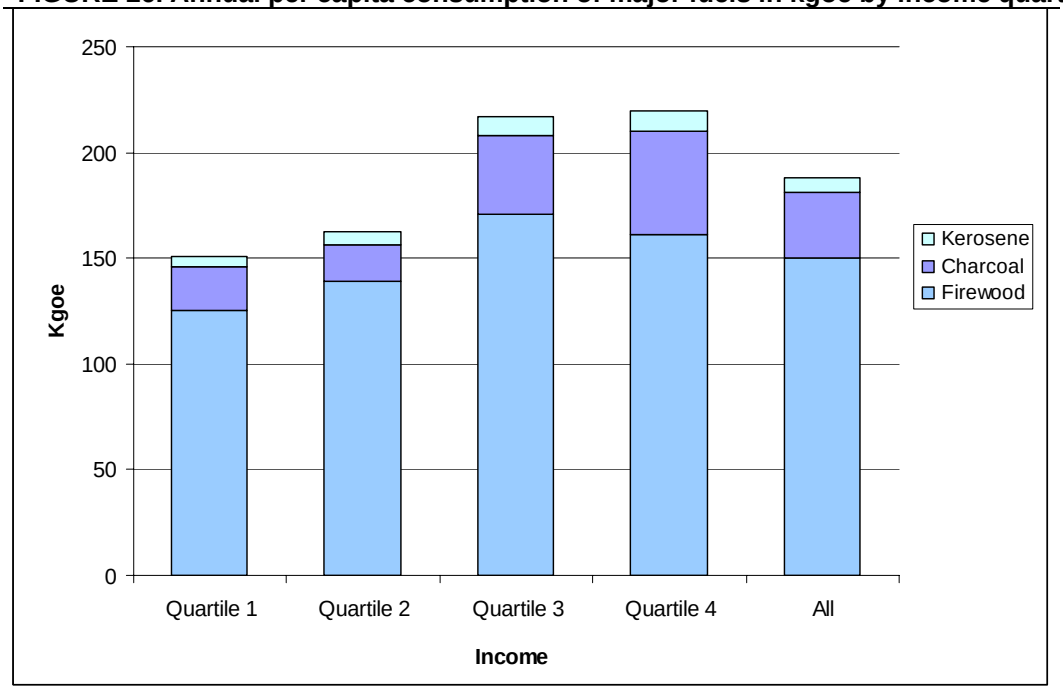


TABLE 66. Annual per capita expenditures on firewood, charcoal and kerosene

Major Fuels	All	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Firewood					
Mean	385	422	460	430	259
Median	38	38	13	160	0
Kerosene					
Mean	458	317	382	533	602
Median	300	200	262	349	363
Charcoal					
Mean	297	291	179	324	397
Median	113	82	96	150	201
Batteries					
Mean	318	203	249	300	512
Median	154	105	171	150	200
Total exp. on major fuels	1,458	1,233	1,269	1,588	1,770

Calculations include zeroes and exclude blanks. Quartile 1 denotes poorest income group.

FIGURE 27. Annual per capita expenditure on household energy sources by income quartile (KSh)

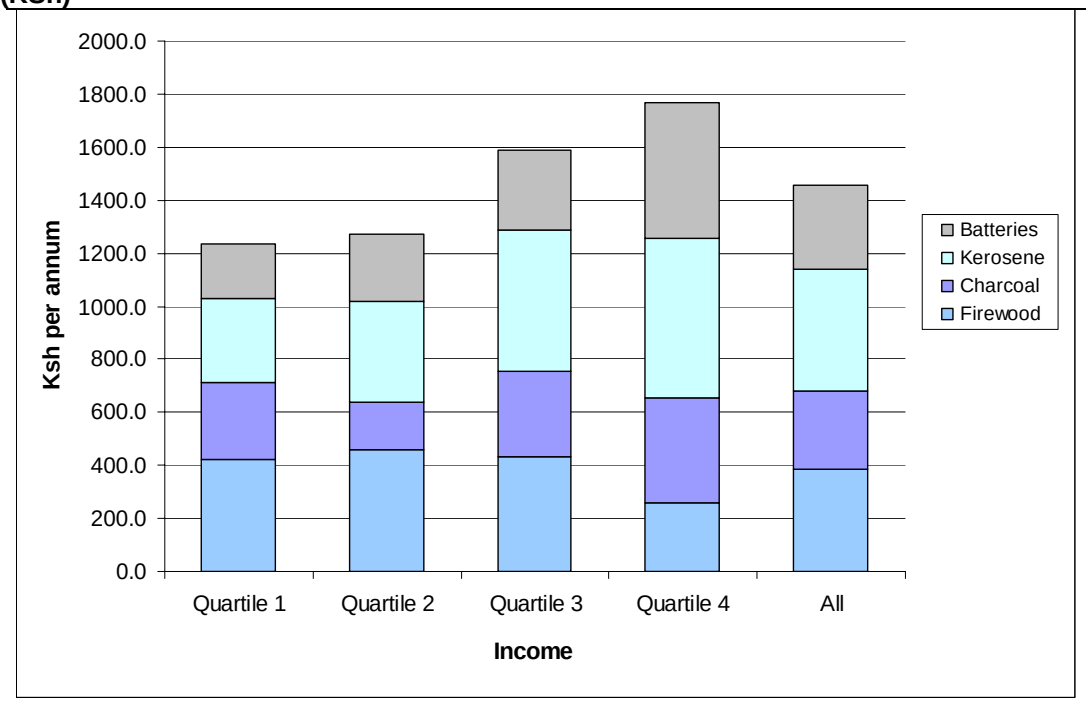


FIGURE 28. Main uses of firewood

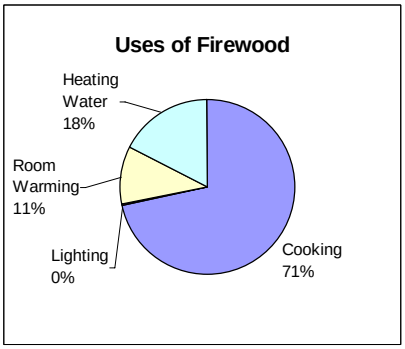


FIGURE 29. Main uses of charcoal

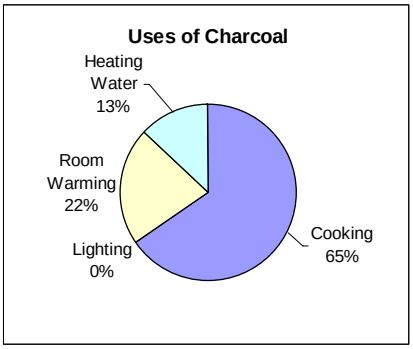


FIGURE 30. Main uses of kerosene

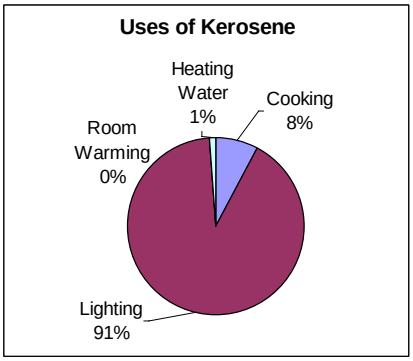


FIGURE 31. Sources of firewood for households in Sauri

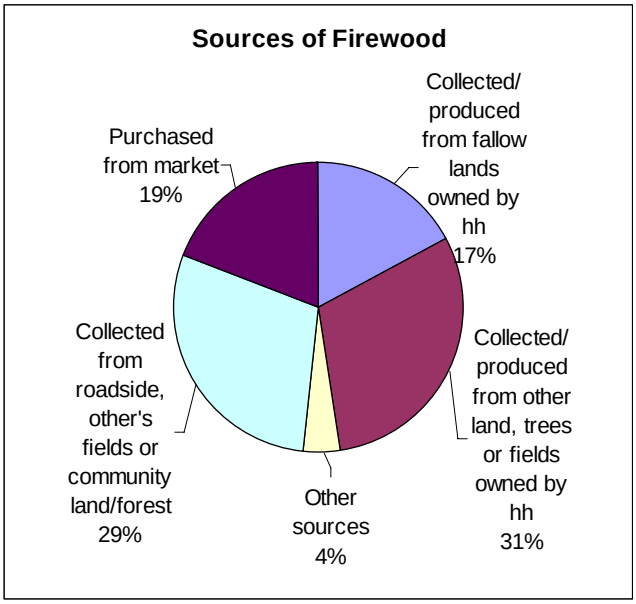
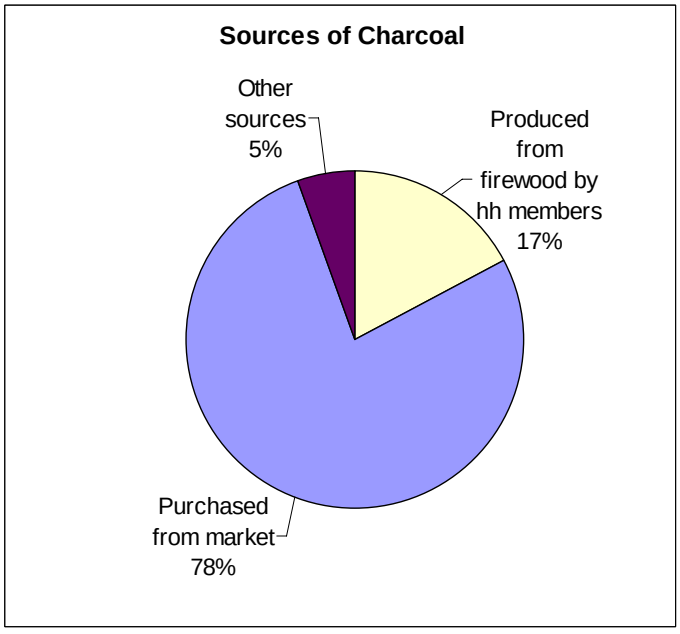


FIGURE 32. Sources of charcoal



Kerosene consumption in Sauri reflects the national rural average for Kenya. Firewood consumption is almost half and charcoal consumption is about a quarter of the national rural average for similar agro-ecological zones (Table 67).

Low firewood consumption figures in Sauri in comparison to national level data may be due to inaccuracies in unit conversions and self-reporting. Firewood consumption and expenditures in the Sauri Energy Survey were largely reported in numbers of bundles. A single conversion factor of 8.5 kg/bundle was determined by analyzing limited market data. In retrospect, we think that bundle sizes may vary by the source. For example, self-reported bundle sizes for fuelwood collected from a household's own fallow may be different from those purchased within the village or those purchased from a market. There may be

seasonal variations as well that are not accurately captured. Furthermore, inaccuracies in data entry necessitated dropping some observations when calculating fuel consumption and expenditure figures.

The Energy sector plans to supplement this survey with additional data gathering to obtain more accurate figures for the dominant fuel, firewood. Survey methodology has also been carefully revised to accurately capture usage and expenditure data.

TABLE 67. Comparison of fuel consumption in Sauri, Kenya to national rural averages

Per capita consumption	Medium potential zone	Rural average, Kenya	Sauri, Kenya
Firewood (Kg/yr)	845	741	449
Charcoal (Kg/yr)	178	156	46
Kerosene (L/yr)	N/A	8.6	9

Sauri is assumed to be a medium potential agro-ecological zone. Sauri data from MVP energy survey, April 2005
National consumption figures are from Republic of Kenya Ministry of Energy's *Study on Kenya's Energy Demand, Supply and Policy Strategy for Households, Small Scale industries and Service Establishment*, September 2002

7.3.2. Energy use in kgoe (kg oil equivalent) per $1,000 GDP (PPP) (MDG INDICATOR 27)

Sauri's GDP(PPP) is $336 per year per household, though this is most likely an underestimate as noted in Section 1.5. This makes the energy consumption 560 kgoe per $1,000 GDP(PPP) per household. Note that this figure can be misleading since much of the energy consumption is for firewood, which is used inefficiently. If firewood use is excluded, energy use drops to 38 kgoe, which makes energy consumption fall to 113 kgoe/$1,000 GDP(PPP) per household. The national figures for annual energy use and energy use per unit GDP for Kenya are 96 kgoe per capita and 96 kgoe per $1,000 GDP (PPP) per household.[61] However these figures are for "commercial" energy use which does not generally include non-industrial uses of fuelwood or charcoal. Hence a direct comparison is not feasible for the Sauri data.

7.4. WATER AND SANITATION

7.4.1. Proportion of population with sustainable access to an improved water source, urban and rural (MDG INDICATOR 30)

MDG Indicator 30 refers to the proportion of people using any of the following "improved" sources for drinking water: piped water, public tap, borehole or pump, protected well, protected spring, or rainwater. "Unimproved" sources include unprotected wells, unprotected springs, vendor-provided water, bottled water, and tanker truck provided water.

This proportion is meant to serve as a proxy for the more robust definition of sustainable access to water provided by the WHO/UNICEF Joint Monitoring Programme for Water and Sanitation (JMP). The JMP defines sustainable access to water as "the availability of 20 liters per capita per day at a distance no longer than 1,000 meters."[62,63] These 20 liters must be of high enough quality to safely use for drinking, cooking, and washing.

[61] Kenya kgoe figures from: Modi, Vijay, Saghir Lallement and Susan McDade. *Energy Services for the Millennium Development Goals.* Joint production of the Energy Sector Management Assistance Programme, United Nations Development Programme, UN Millennium Project and the World Bank. 2006.
[62] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, *Global Water Supply and Sanitation Assessment 2000 Report*
[63] *Indicators for Monitoring the Millennium Development Goals: Definitions, Rationale, Concepts, and Sources*. United Nations: New York, 2003

In Sauri, the majority of household water is collected from springs and rainwater harvesting systems (when rain is available) (see section on water sources below). Rainwater is considered an improved source. Springs, however, are considered either improved or unimproved depending on if they have been protected. Unfortunately, the Socioeconomic Survey and Water Survey, which were used to collect household water usage data, did not differentiate between protected and unprotected springs. This issue has been adjusted in future surveys. Furthermore, water quality tests of various water sources showed that even protected springs contain unsafe levels of fecal coliform bacteria. This section is broken down into measures of quantity of water collected, distance/time to sources, and quality of sources.

Quantity of Water Collected

The average amount of water collected by each household for all purposes[64] (n=283) is 175.7 liters per person per week during the wet season and 183.9 liters per person per week during the dry season. The average amount of water collected for household use (defined here as drinking, cooking, washing, and bathing, n=242) is 139.6 liter per person per week in the wet season and 140.7 liters per person per week in the dry season.[65] This is approximately equal to an average of 20 liters per capita per day during both the wet and dry seasons for household use (Table 68). Households in Kosoro and Yala B sub-villages reported the lowest daily per capita water collected: 14.9 and 15.8 liters respectively during the wet season, and 16.8 and 14.6 liters respectively during the dry season. Households in Luero reported the highest daily per capita water use in both seasons: 32.6 liters during the wet season and 33.9 liters during the dry season.

TABLE 68. Average amount of Water collected per capita (week and daily)

		All water collected regardless of use	**Only water collected for household use**
	Season	N=283 households	N=242 households
Average amount collected per capita per week (liters)	wet	175.7	139.6
	dry	183.9	140.7
Average amount collected per capita daily (liters)	wet	25.1	19.9
	dry	26.3	20.1

[64] Drinking, Cooking, Washing, Livestock, Bathing, Irrigation, construction, business, and Other

[65] N falls by 41 households because of the inability to link water use and water quantity collected tables for these households

TABLE 69. Average amount of water collected per capita daily by sub-village

Village	Average amount collected per capita daily (liters)		
	Wet	Dry	N
Kosoro	14.9	15.8	18
Yala A	19.1	18.1	32
Yala B	16.8	14.6	9
Madiri	20.8	16.9	30
Luero	32.6	33.9	17
Sauri A	16.3	15.9	20
Sauri B	20.9	18.6	32
Nyamninia A	17.3	21.5	33
Nyamninia B	24.9	24.5	20
Silula	15.9	21.8	12
Nyamboga	19.1	21.7	19

As shown in Table 70, the quantity of water collected per capita daily rises as income rises.

TABLE 70. Income quartiles and water collected per capita daily (liters)

		Q1 (N=49)	Q2 (N=73)	Q3 (N=64)	Q4 (N=56)
Average amount collected per capita daily (liters)	wet	15.6	17.8	22.4	23.7
	dry	15.3	18.4	23	23.2

Types of Water Sources Used

Most Sauri households rely on a combination of sources to provide water for household use. Of the 285 households surveyed, 60.4% reported using two sources, 21.8% reporting using three sources, and 14% reporting using just one source (Table 71). Among the households using one water source (40 households), primary springs are the predominant water source used for collection (35 households). The majority of households using two or three water sources combine a primary spring with an additional source. Overall, most households in Sauri combine a primary spring with some type of rainwater harvesting system (Table 72).

TABLE 71. Number of water sources used per household

Number of water sources used	Percentage of total households
1	14.0%
2	60.4%
3	21.8%
4	3.9%

TABLE 72. Most common combinations of water sources for Sauri households

Combination	Number of hh	% out of total 285
Primary spring and Rainwater harvest system without gutter	94	33.0%
Primary spring only	35	12.3%
Primary spring and rainwater harvest system with gutter	35	12.3%
Primary spring and RWH n gutter and private water tap	17	6.0%
Primary spring and private tap	15	5.3%

Households reported collecting an average of 860 liters per week during the wet season and 880 liters a week during the dry season for all uses (household and otherwise). The majority of water collected by households for all uses comes from rainwater collection systems and springs. In the wet season, 50.6% of water is collected from rainwater collection systems. This drops to 3.5% during the dry season, presumably due to lack of rainfall and long-term storage facilities. Springs provide 39% of water during the wet season, which shifts to 85% in the dry season, indicating a much heavier reliance on springs when rainwater is not available.

TABLE 73. Average % of total water collected by each household from each source (N=285)

Source	Wet	Dry
Household well	0.3%	0.3%
Communal or coop water tank	0.4%	0.1%
Rainwater collection system	50.6%	3.5%
Primary spring	37.3%	79.4%
Other springs	1.3%	5.6%
River or stream	0.4%	0.8%
Private Water tap	8.3%	9.4%
Other	1.5%	1.0%

Distance/Time Burden of Water Collection

Long distances to water sources and large amounts of time spent collecting water are major obstacles to improving community health and economy. Time spent collecting water could otherwise be spent on economic activities, child rearing, educational activities, etc. WHO has shown that when it takes more than a 30 minute trip to reach a water source, the amount of water collected is not enough to reach the minimum amount required for drinking, cooking, and personal hygiene.[66]

[66] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. *Water for Life: Making it Happen.* WHO/UNICEF: Geneva, 2005.

In Sauri, average time spent collecting water is 2.9 hours per person per day during the wet season and 4.3 hours per person per day during the dry season (Table 74). An average of 1.7 people (median=1; range=1-4) per household are responsible for collecting water. The average distance to a household's primarily used spring is 322.7m, and the average distance to a rainwater collection system is 139m (Table 75). The average distance traveled to a primary spring varies by sub-village (Table 76), with Luero households traveling the greatest distance (490m) and Sauri A households traveling the least distance (213.6m). Because Luero showed the greatest average quantity of water collected per capita (Table 69), it may be that households in Luero tend to rely on rainwater collecting systems (54% of Luero's water in the wet season) or water taps (12%) instead of springs. This also could be due to missing data, as only 5 Luero households reported distances to primary springs.

TABLE 74. Time spent by person/household collecting water by season

Time spent	Wet	Dry
Average hours per day per person	2.9 hours	4.3 hours
Average hours per week per person	20 hours	30 hours
Average hours per week for an entire household	32 hours	47 hours

TABLE 75. Average distance to different types of water sources

Source	N	Average distance (m)
Household well	3	11.0
Communal or coop water tank	1	2.0
Rainwater collection system	7	139.0
Primary spring	181	322.7
Other springs	12	408.3
River or stream	1	150.0
Private Water tap	53	48.8
Other	6	92.0

TABLE 76. Average distance in m to primary spring by sub-village

Village	Average distance (m)	Households reporting
Kosoro	467.6	17
Yala A	336.6	24
Yala B	350.0	5
Madiri	280.0	23
Luero	490.0	5
Sauri A	213.6	14
Sauri B	289.6	21
Nyamninia A	278.9	29
Nyamninia B	278.1	16
Silula	372.5	8
Nyamboga	292.1	19

Gender, age and time burden

The burden of fetching water in Sub-Saharan Africa tends to fall primarily on women and children, especially girls.[67] This is also true for Sauri, where 58.7% of adult women and 26.2% of female children (out of all people in 249 surveyed households) are responsible for collecting water in the wet season, compared with 12% and 18.3% of men and boys, respectively (Table 77). Though the time spent weekily collecting water by the different categories of people is not that different during the wet season, during the dry season more of the burden falls on women and girl children. Looking at the total number of people from those households that collect water (Table 78), the vast majority are adult women (57.9% in the wet season and 54.4% in the dry season), followed by female children (17.7% in the wet season and 20.7% in the dry season).

TABLE 77. Time burden of water collected by gender/age groups

		Wet season		Dry Season	
	Total number of individuals in age/gender groups (n=1333 from 249 households)	**Number of individuals in age/gender groups reported as collecting water**	**Average time spent collecting water per individual per week (hours)**	**Number of individuals in age/gender groups reported as collecting water**	**Average time spent collecting water per individual per week (hours)**
Male children (5 to <18)	284	52 (18.3%)	16.7	58 (20.4%)	23.7
Female children (5 to <18)	271	71 (26.2%)	17.7	80 (29.5%)	30.7
Male adults (18-80)	383	46 (12.0%)	19	38 (9.9%)	25
Female adults (18-80)	395	232 (58.7%)	21.2	210 (53.2%)	32.5

TABLE 78. Age/gender breakdown of those responsible for collecting water

Age/gender group	**Wet season (N=401)**	**Dry season (N=386)**
Male children (5 to <18)	52 (13.0%)	58 (15.0%)
Female children (5 to <18)	71 (17.7%)	80 (20.7%)
Male adults (18-80)	46 (11.5%)	38 (9.8%)
Female adults (18-80)	232 (57.9%)	210 (54.4%)

[67] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. *Water for Life: Making it Happen.* WHO/UNICEF: Geneva, 2005.

Water Quality

Baseline water quality was assessed using standard biophysical sampling procedures with sample collection and laboratory analysis performed in conjunction with Moi University, Kenya Marine and Fisheries Research Institute, and the Lake Victoria Environmental Monitoring Programme. Water sources were sampled in July 2005 for both biological and physical parameters. The physical/chemical parameters and biological parameters sampled included a combination of: temperature, pH, total phosphorus, reactive phosphorus, fluoride, residual chlorine, copper, lead, iron, zinc, nitrite, nitrate, total nitrogen, and total suspended solids. Biological parameters included combinations of total coliform bacteria, fecal coliform bacteria, and other coliforms. Only the physical and chemical parameters were used from this sampling event because of errors found within the biological measurements. Biological parameters were sampled from 11 sources in February 2006 before the onset of the wet season rains. These 11 samples are considered baseline. Chemical parameters of the 19 sources sampled were all found to be within WHO guidelines. Biological parameters, however, largely exceeded the maximum levels recommended by WHO. Of the 11 sources tested for baseline fecal coliform bacteria, 9 tested positive. All 9 of the positive sources were protected springs. The two sources found not to contain fecal coliform bacteria were a rainwater harvesting tank and a private tap. This difference highlights the need for continued monitoring and treatment of water from most natural sources. Even springs that have been protected require regular maintenance and repairs to truly provide water safe for drinking, cooking, and washing.

Water Access

Access to safe water refers to the percentage of the population with reasonable access to an adequate supply of safe water in their dwelling or within a convenient distance of their dwelling. Ideally, a measure of "access to water" would include components of distance/time and quantity for "improved" or high-quality sources only. However, because the Sauri Water Survey did not distinguish protected springs from unprotected springs or demarcate which sources are used for which uses, this measurement is not possible. The following measure is a proxy measure for water access that combines distance with amount of water collected.

The number of households that have sustainable access to an improved water source are those households that satisfy the following conditions:

1. Households collect at least 20 L per cap daily for **household use only** in both wet and dry seasons

2. Water sources used are less than 1000 m from household

For Sauri, all reported water sources are at distances of less than 1000 m from the household. Thus water access is determined by the liters per capita daily collected in both the wet and dry season. There are 155 households that do not have the minimum 20 liters per capita daily for both wet and dry seasons. Therefore 46.6% of households do have sustainable access to a water source (Table 79).

TABLE 79. Households that collect more than 20 liters per cap daily (N=290)

		Dry season		
		Yes	**No**	**Total**
Wet season	**Yes**	106	13	119
	No	16	155	171
Total		122	168	290

7.4.2. Proportion of population with access to improved sanitation (MDG INDICATOR 31)

Improving access to adequate sanitation facilities is a crucial step in improving drinking water quality, and has further implications for gender, education, and the environment. A 2004 assessment on the global status of the sanitation MDG found that Sub-Saharan Africa is extensively off-track to meeting the sanitation target.[68] The situation is especially severe in rural areas, where communities have less than half the sanitation coverage of urban areas.[69]

In Sauri, the majority of sanitation facilities used by households are earthen-floor latrines within the homestead (39.1%) and outside of the homestead (26.9%). Another 10.5% of latrines used are concrete-floor latrines within the homestead (Table 80).

TABLE 80. Types of toilet facilities used by households (967 households)[70]

Facility	#	%
Open space (field, forest, etc)	51	5.1%
Open pit at homestead	25	2.5%
Open pit away from homestead	21	2.1%
Covered latrine at homestead- earthen floor	391	39.1%
Covered latrine at homestead- concrete floor	105	10.5%
Covered latrine at homestead- unspecified floor type	27	2.7%
Covered latrine away from homestead- earthen floor	269	26.9%
Covered latrine away from homestead- concrete floor	24	2.4%
Covered latrine away from homestead- unspecified floor type	20	2.0%
Modern flush toilet	9	0.9%
Small pot/household container	10	1.0%
Other	18	1.8%
NA/Don't Know	29	2.9%

The MDGs define "improved sanitation" to be facilities that "hygienically separate human excreta from human, animal, and insect contact"[71] and are not public or shared facilities. This includes a connection to a public sewer or septic system, pour-flush latrines, ventilated improved pit latrines, and certain types of simple pit latrines.[72] For the purposes of this measurement, concrete-floor and properly constructed earthen-floor latrines are considered "improved."[73] However, without an extensive assessment it is impossible to tell whether an earthen-floor latrine has been properly constructed to separate human excreta from humans and the environment. Therefore, "adequate" sanitation was calculated using two definitions, one including and one excluding earthen floor latrines.

When "adequate sanitation" is defined as households that use concrete floor latrines or flush toilets, 135 households (13.9%) have adequate sanitation, meaning that they use either a covered latrine at homestead with concrete floors, covered latrine away from homestead with concrete floors, or a modern flush toilet. Of these households, only 5 households report that over 20 people use this same latrine facility. The proportion of households using adequate sanitation increases with income (Table 81).

[68] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. *Meeting the MDG Drinking Water and Sanitation Target: A Mid-Term Assessment of Progress*, 2004.
[69] Ibid.
[70] There are 32 multiple responses to this question.
[71] *Indicators for Monitoring the Millennium Development Goals: Definitions, Rationale, Concepts, and Sources*. United Nations: New York, 2003
[72] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. *Meeting the MDG Drinking Water and Sanitation Target: A Mid-Term Assessment of Progress*, 2004.
[73] Roberto Lenton, personal communication (Bronwen Konecky)

TABLE 81. Households with adequate sanitation (concrete latrines or flush toilets) by income quartile

	Q1 (N=241)	Q2 (N=242)	Q3 (N=242)	Q4 (N=242)
Percent having adequate sanitation	8.3%	8.7%	16.1%	22.7%

Of the households who do not use a concrete floor latrine or flush toilet, an additional 692 households (71.5%) use an earthen floor or unspecified floor material latrine. If using a definition of "adequate sanitation" that includes earthen floor or unspecified materials, the proportion of households with access to adequate sanitation rises to 85.4%. Of the households using earthen floor/unspecified latrines, 8 households report that over 20 people use this same latrine facility. The proportion of households using earthen/unspecified floor latrines by income quartile is shown in Table 82.

TABLE 82. Households using earthen-floor or unspecified-floor latrines by income quartile

	Q1 (N=241)	Q2 (N=242)	Q3 (N=242)	Q4 (N=242)
Percent using earthen/unspecified floor latrines	76.8%	76.0%	68.6%	64.9%

APPENDIX 1. Survey instruments fielded in Sauri, Kenya

Instrument		Variables / Objectives		Level	Sample Size
Surveys: Non-health					
1	**Socioeconomic Survey**	A	Agriculture	HH/Individual	967 Households
		B	Credit		
		C	Earnings and Expenses		
		D	Education		
		E	Employment		
		F	Environment		
		G	Health		
		H	Household composition		
		I	Mortality Rates		
		J	Nutrition		
		K	Organizations		
		L	Risks		
		M	Status of Orphans		
		N	Village organization		
		O	Vulnerability		
2	**Water and Sanitation**	A	Access to Water for Domestic and Potable Use	HH	300 Households (Population based on stratified sample)
		B	Access to Water for irrigation and other uses		
		C	Determine various water sources		
		D	Determine quality of water sources		
		E	Determine adequacy of water sources		
		F	Determine capacity for further improvement		
3	**Energy, Transport and Communication**	A	Condition	HH/ Individual	300 Households (Population based on stratified sample)
		B	Cost of different forms of communication		
		C	Determine accessibility of various modes of transportation		
		D	Determine any linkages between identified energy sources and their human health implication		
		E	Determine links between energy sources and their environmental impact		
		F	Determine the various forms of communication		
		G	Determine the various modes of transportation in use in the village		
		H	Efficiency		
		I	Level of use of different forms of communication		
		J	Popularity of different forms of communication		

		K	Problems associated with the two critical forms of physical infrastructure		
		L	Quality of sources of energy		
		M	Reliability of current sources of energy		
		N	Sources of energy currently in use in the village		
		O	Sustainability		
4	**Agriculture and the Environment**	A	Estimate various production functions of commonly produced crops as well as livestock and livestock products	HH/ Plot	300 Households (Population based on stratified sample)
		B	Determine various types of soil and water conservation activities		
		C	Determine major agricultural problems (i.e. risks, lack of access to and management)		
5	**Partial Time Budget**	A	Determine time use within the community by age, gender and social class	HH/Individual	40 Households
		B	Determine manner in which people split their time between work, type of work and leisure		
		C	Determine how time allocation is linked to cultural, social and economic preferences		
		D	Determine how time allocation changes with seasons in the course of the year		
Modules: Health					
6	**Malaria**	A	Determine the number of deaths due to malaria	HH	300 Households (Population based on stratified sample)
		B	Government and other health related organizations' role in combating malaria		
		C	Malaria treatment and control		
		D	Malaria diagnosis		
		E	Household, members and community's level of knowledge regarding malaria		
		F	Determine different forms of medication and/or control currently in use		
		G	Capture the incidence and prevalence of malaria		
7	**STI and HIV/AIDS**	A	What are the information tools used	Individual	426 adults (Selected randomly from the 300 HHs)
		B	Social stigma		
		C	Level of awareness and control of STI and HIV AIDS		

		D	Prevalence of high risk behaviors associated with HIV transmission		
8	**Human nutrition**	A	Determine calorific and nutrient intake deficiencies	Individual	871 Individuals; from the 300 HH
		B	Determine the average nutrient and calorie intake by age and gender		
		C	Varieties of food.		
		D	Determine the various types of foods consumed by the household members		
9	**Women's health**	A	Child care practices.	Individual	351 women (>13 yrs of age); from the 300 HH
		B	Vulnerability to poor nutrition		
		C	Vulnerability to diarrhea		
		D	Level of vaccination of the under fives		
		E	Child mortality rates		
		F	Domestic violence		
		G	Diseases such as TB, malaria, pneumonia		
		H	Vulnerability of pregnant women to poor ante-natal and post-natal care		
		I	Determine women and children welfare status		
10	**Men's health**	A	Preferences in terms of the number and sex of children to be born	Individual	390 men (>13 yrs of age); from the 300 HH
		B	Capacity to adopt new methods of contraception		
		C	Men's fertility perceptions		
11	**Men and women's health**	A	Level of knowledge of how the various infectious diseases are transmitted	Individual	413 adults (The same sample used for STI and HIV/AIDS module)
		B	Washing of hands before and after visiting public places		
		C	Refuse disposal		
		D	General public health concerns in terms of hygiene		
12	**Orphans Vulnerability**	A	Comparisons between orphans non orphans	Individual	218 Individuals
		B	Social stability		
		C	Access to security (both physical and psychological)		
		D	Access to food		
		E	Access to education		
		F	Good health practices		
		G	Determining the number of orphans and their welfare		
		H	Capture the psychological and financial tailspin (after-effects) of HIV AIDS deaths		

		I	Status of orphans in terms of schooling and health			