An Exploratory Guide on Constructing Livelihood Indicators for the Sentinel Landscape Project: The Case of Mau Forest Site in the Nile-Congo Sentinel Landscape

Brian Chiputwa (B.Chiputwa@cgiar.org)

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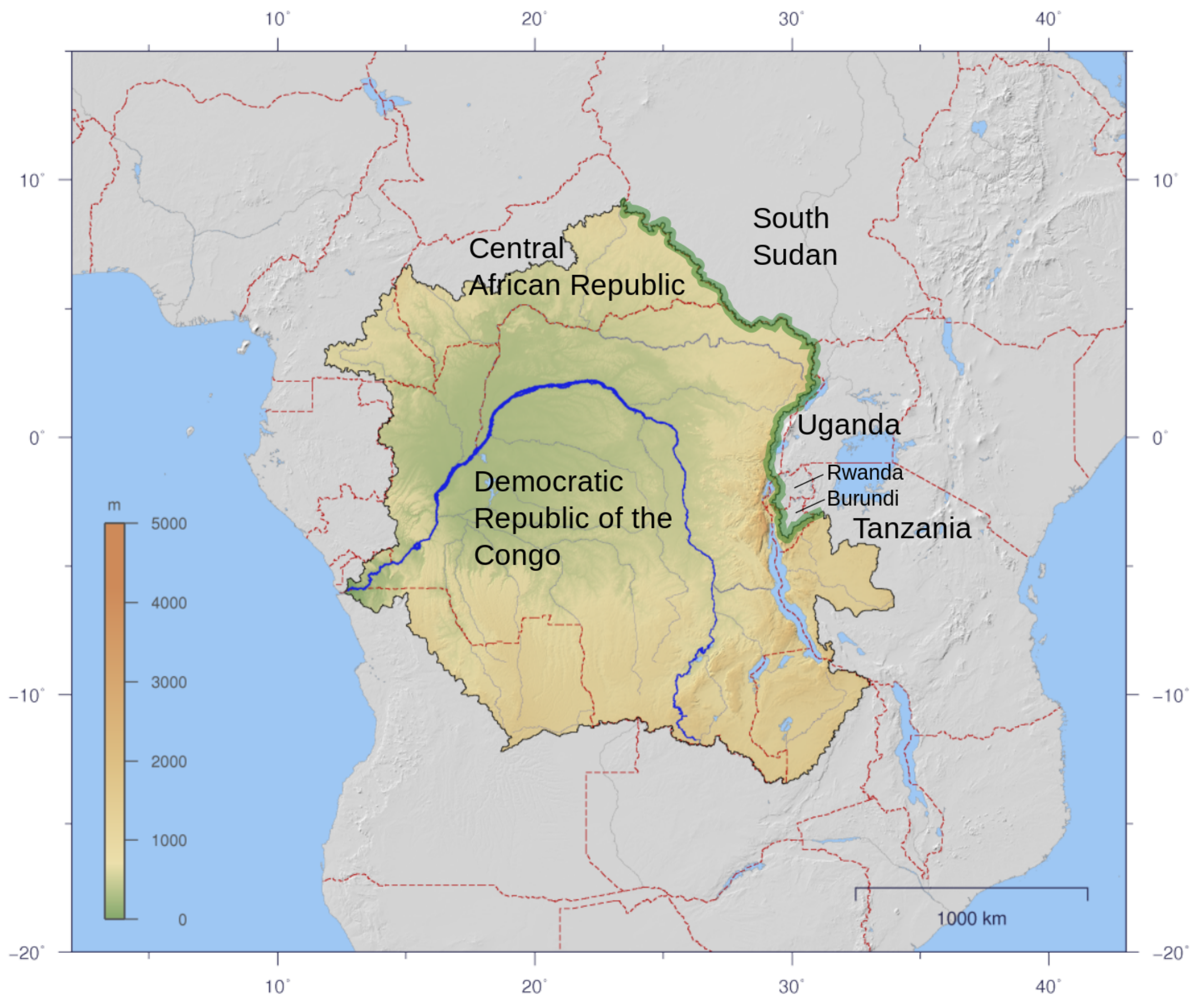

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Composition of the Nile-Congo Sentinel Landscape Team

RMG team

Anja Gassner, Brian Chiputwa, Paul Baraka, Makui Parmutia, Dave Harris

Nile-Congo Sentinel team:

Clement Okia, Anne Kuria, Fergus Sinclair

Local Partners:

CIFOR

Enumerator Training Team

Brian Chiputwa, Paul Baraka, Clement Okia

Field and Logistics Team

Clement Okia, Anne Kuria, David Lelei

Data collection team

Caroline Chepkoech, Hellen Kechei, Rogers Korir, Edhaline Cherotich, Micah Kiprotich, Kibet M. Joshua, Duncan Cheruiyot, Peter Cheruiyot, Walter Koech, Collins Kiprotich

Data cleaning

Paul Baraka, Makui Parmutia, Clement Okia, Brian Chiputwa

Development of R coding

Makui Parmutia

Data analysis coordinators

Brian Chiputwa, Anja Gassner

List of acronyms

AIDS	Acquired Immuno Deficiency Syndrome
AEU	Adult Equivalent Units
ADR	Age Dependency Ratio
CGIAR	Consultative Group on International Agricultural Research
CRP	CGIAR Research Programs
DFID	Department for International Development
FCS	Food Consumption Score
FDS	Food Diversity Score
FSS	FSS Food Security Score
FTA	Forests Trees and Agroforestry
HIV	Human Immunodeficiency Virus
HDDS	Household Dietary Diversity Score
ha	Hactres
KES	Kenyan Shillings
km	Kilometres
PPI	Progress Out of Poverty Index
PPP	Purchasing Power Parity
SL	Sentinel Landscape
SLF	Sustainable Livelihoods Framework
SID	Simpson Index of Diversity
SWID	Shannon-Weaver Index of Diversity
USD	United States Dollar

1. Background information and introduction

Introduction to the indicator guide

The underlying objective of this manual is to provide practical guidelines on how livelihood indicators from the Sentinel Landscapes network were constructed using various using household survey data from the Sentinel Landscape project. The livelihood indicators illustrated in this manual provides a summary of the social, economic, demographic and livelihood strategies among the sampled households and can be used as a first step to explore differences across sampled villages, sentinel sites and at the landscape level. The indicators covered in this guide are organized into four broad categories:

i household demographics and asset ownership

ii household farm dependency and income diversity

iii household wealth, poverty and happiness

iv household food security and nutrition diversity.

In order to make analysis reproducible, all analysis in the manual are conducted using R Statistical Software software and the write up using type setting programs: R Markdown and Latex. All R codes used in this manual will be available on the Sentinel Landscape website.

The distribution and concept of the Sentinel Landscapes Network

Figure 1: Distribution of Sentinel Landscapes Network of sites

The Sentinel Landscape network, was set up to develop and implement a standardized matrix, consisting of a set of institutional, environmental and livelihood indicators to monitor landscape sustainability across a wide variation of cultural, institutional and environmental settings. It is part of the CGIAR Research Program (CRP) 6 on Forests, Trees and Agroforestry (FTA): Livelihoods, Landscapes and Governance [1] which aims at enhancing the management and use of forests, agroforestry and tree genetic resources across the landscape from forests to farms. The network consist of 7 landscapes that a comprises of parts of a contiguous forest transition curve. The term "sentinel" is borrowed from the health sector (especially epidemiology) where it is used to describe a community from which in-depth health data are gathered and the resulting analysis is used to inform programs and policies affecting a larger geographic area.

[1] http://foreststreesagroforestry.org/fta-sentinel-landscapes//

Map showing location of households sampled in the Mau site

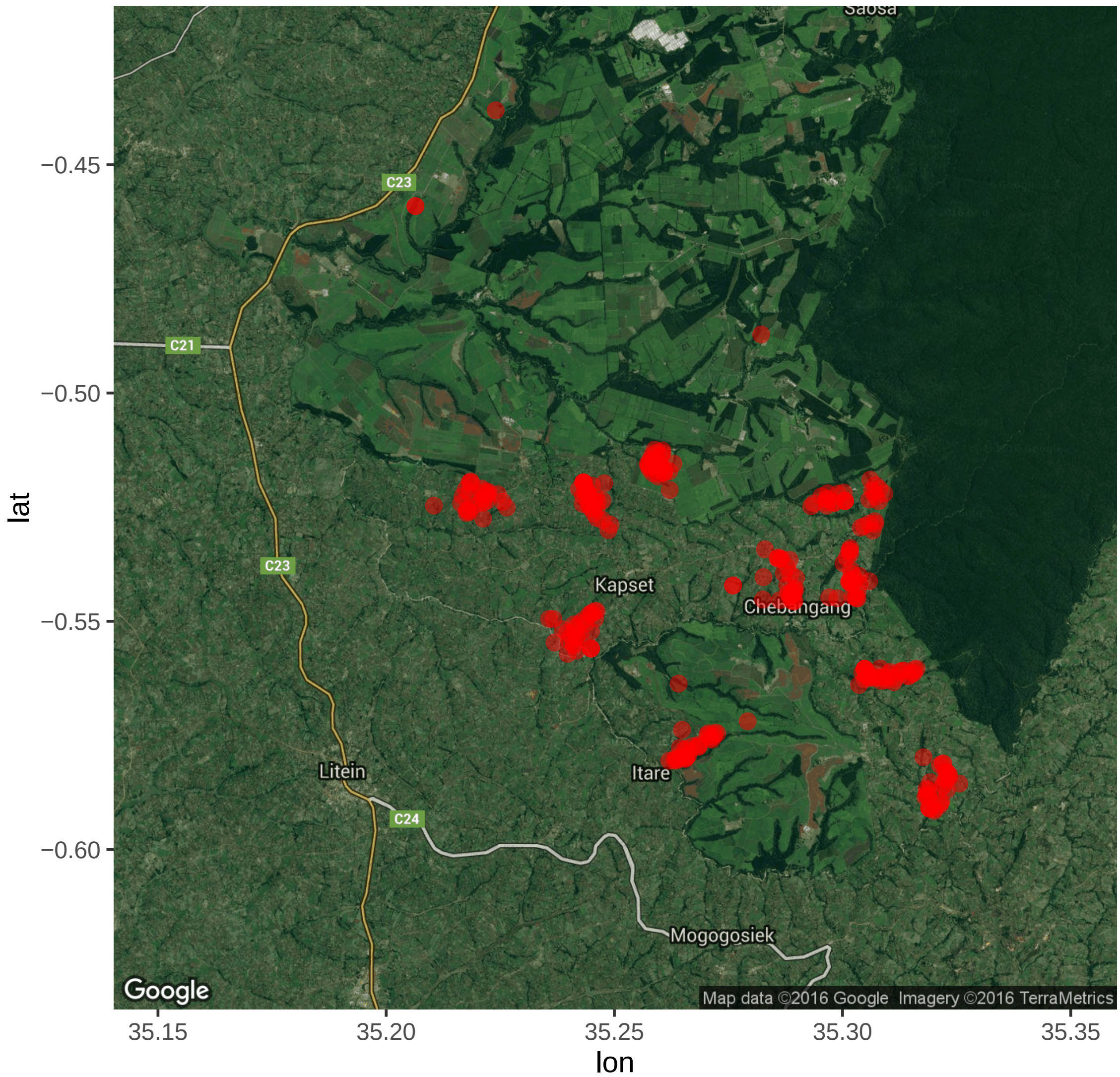

Figure 2: Map of sampled households in Mau.

The extent of the Nile-Congo Sentinel Landscape

The Nile-Congo SL covers four sites; Mau forest in Kenya, Mount Elgon in Uganda, Lake Kivu in Democratic Republic of Congo and Gishwati in Rwanda. Each Sentinel site covers an area of $10x10km^2$ extendable to an agreed buffer zone depending on context. This analysis is based on household data collected in the Mau Forest sentinel site.

General sample statistics

This guide draws on household data collected from 300 households randomly sampled ten villages in the Mau Forest sentinel site. The household interviews were conducted between August and September, 2015. Following the SL's sampling protocol, a total of 30 households were selected in each of the ten villages within the site and almost half of the respondents were female in accordance the CGIAR Gender dis-aggregated data collection protocol. [2]

Table 1: Summary statistics of sampled villages

Village Name	Number of farmers interviewed	% of female respondents	% of male respondents
Nyoigeno North	30	63.3	36.7
Mongokwo A	30	56.7	43.3
Kondamet	30	70	30
Kiptenden	30	60	40
Kimuita	30	56.7	43.3
Kimugul	30	63.3	36.7
Kapsinendet	30	53.3	46.7
Kapkeronjo	30	76.7	23.3
Kapchep-tuenik	30	66.7	33.3
Kaboisio	30	40	60
Total	300	60.7	39.3

[2] http://www.pim.cgiar.org/files/2012/05/Standards-for-Collecting-Sex-Disaggregated-Data-for-Gender-Analysis.pdf

2. Household demographics and asset ownership

Measures of household demographics

Measures of household demographics are computed from section D of the questionnaire shown in Table 2 below.

Indicator 1. Household size

Respondents were asked to list all members in their household that regularly eat in the household, even if they are not related to the household head. Individual characteristics of each member such as name, age, sex, relationship to household head, occupation and marital status were captured (see Table 2 below). Therefore, household size is a head count of all household members listed $\boldsymbol{j}$ interviewed, is computed as follows:

$$\textbf{Household size} = \sum_{i=1}^{n} \mathbf{HHMID}_i^j, \quad (1)$$

where $\boldsymbol{i}$ is a member of the $\boldsymbol{j}^{th}$ household. Household size is used as a base for *per-capita* computations and sometimes used as a proxy for labor capacity. However, it is not a very good basis for this since it does not control for age, gender and ability of each member. Adult equivalent units are normally preferred.

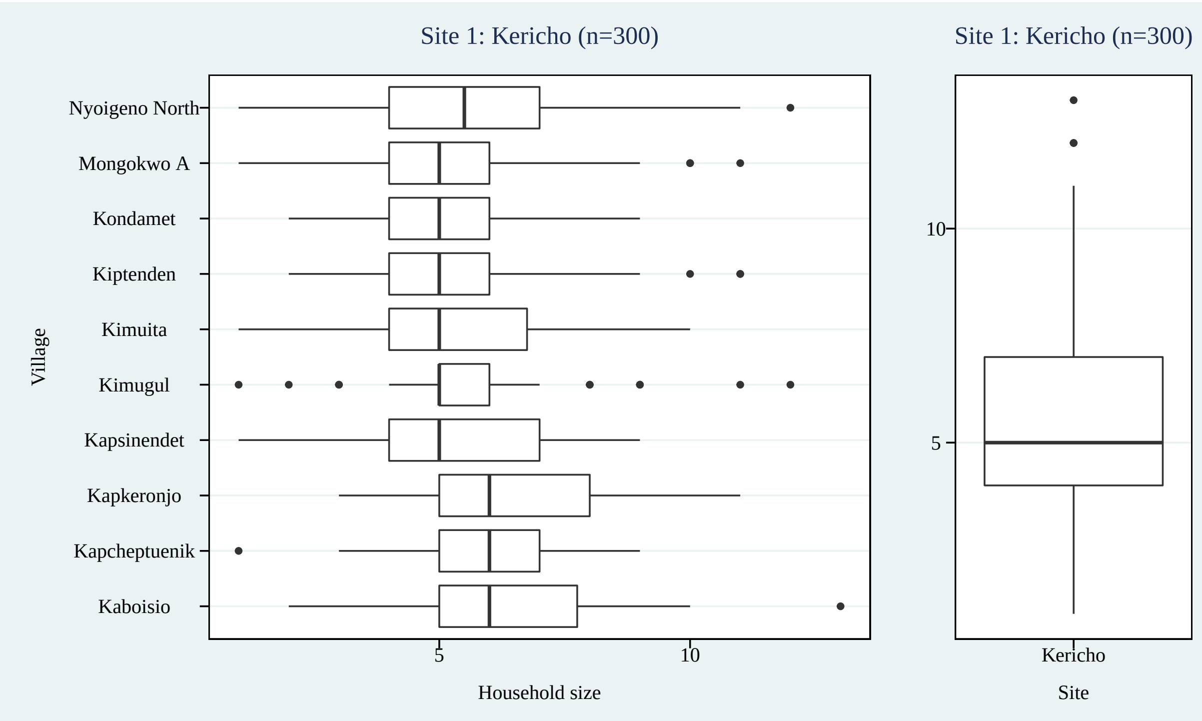

Figure 3: Household size

Table 2: Section D on Demography of the questionnaire.

Section D. Demography

Could you list all members of your household? We consider member of a household all people that regularly eat in your household, even if they are not related to you.

Please start with yourself first, followed by your spouse/spouses and your children. Please also list any workers that live with you.

HH member ID <HHMID>	**Name (*)** <HHMNAME>	**Sex** <HHMSEX> *1 = Male* *2 = Female*	**Age** <HHMAGE>	**Relationship to head of Household** <HHMRSHP> *Use Key D1*	**Occupation** <HHMOCCP> *No key, please specify exactly the job title*	**Has*been employed last week?** <HHMEMPLY> *1 = Yes* *2 = No*	**Marital Status** <HHMSTATUS> *Use Key D2*	**If married, does spouse live in this household now?** <HHMSPTOG> *1 = Yes* *2 = No*	**If married, is the spouse from this village?** <HHMSPSAMEVIL> *1 = Yes* *2 = No*
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
Key D1	1=Head, 2=Spouse, 3=Son/Daughter, 4=adopted son/daughter, 5=Sister/Brother, 6=Grandchild, 7=Father/Mother, 8=Cousin, 9= other								
Key D2	1=Single 2=Married formal, 3= Married informal, 4=Polygamous Married, 5=Separated, 6=Divorced, 7=Widow/widower								

Indicator 2. Adult equivalents units/labor capacity/worker equivalents

The adult equivalent is a proxy for the household labor capacity. This indicator is calculated by weighing all household members according to worker or adult equivalents. The weights are assigned according to the gender and age of each household member as shown in Table 3.

Table 3: Adult-equivalent conversion factors according to age and gender.

	Adult-equivalent factors by gender	
Age (years)	**Male**	**Female**
< 9	0.4	0.4
9 - 15	0.7	0.7
16 - 49	1	0.9
> 49	0.8	0.8

The adult-equivalent fraction assigned to each individual was determined by the ratio between the calorie requirements (according to age and gender and the estimated adult reference value (2,550kcal). [3] Summing the weights of all household members gives the total adult equivalent units (AEU) of the household. AEU are sometimes used as a proxy for labor capacity or worker equivalents[4]. Again, this indicator can be adjusted depending on the context of each SL site.

[3]For an in-depth discussion refer to Claro, et al, 2010

[4]See empirical applications in Chiputwa and Qaim (2016); Chiputwa, et al (2015); Yiridoe et al. (2006) and Runge-Metzger (1988)

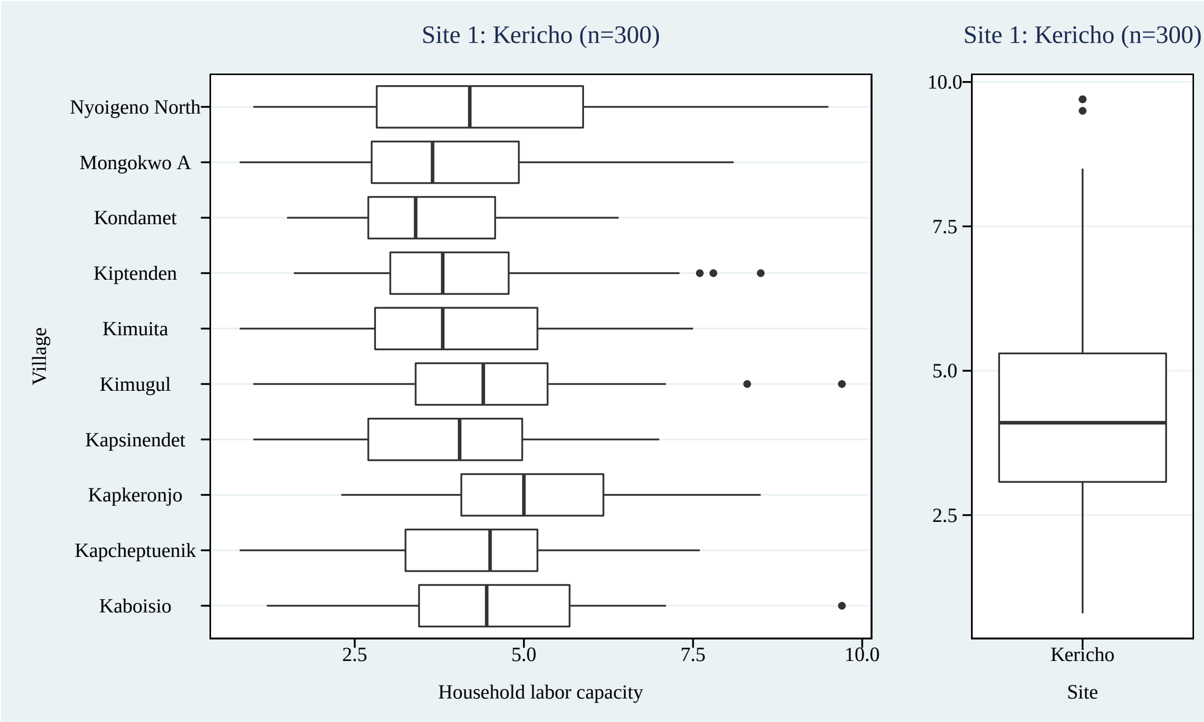

Figure 4: Household labor capacity.

Indicator 3. Age Dependency Ratio (ADR) [5]

The ADR is the ratio of people below 5 years and above 64 years old over people between 5 and 64 years within a household and can represented for each household as follows: General formulae:

$$\mathbf{ADR} = \frac{\textbf{Number of household members below 5 years and above 64 years}}{\textbf{Number of household members between 5 and 64 years}} \tag{2}$$

A caveat on the ADR: The dependency ratio is an approximation of the proportion of dependents in the household to members that are economically active. Hence, the dependency ratio suggests that children under age 5 as well as members aged above 64 years of age are economically dependent while members aged between 5 and 64 years of age are economically active. However, depending on SL setting and context, people may not necessarily stop being economically active at age 65 and above, nor is it the case that members aged between 5 and 64 years of age are economically active. For example, older people sometimes become less economically active well before 65 years (e.g. because of chronic illnesses like HIV/AIDS) or way after 65 years of age (e.g. due to higher accumulated capital over the years that they are independent). In more recent years, as the period of training for a productive life increases, most adolescents and young adults remain in school and out of the official labour force, effectively extending the period of young-age dependency. [6]

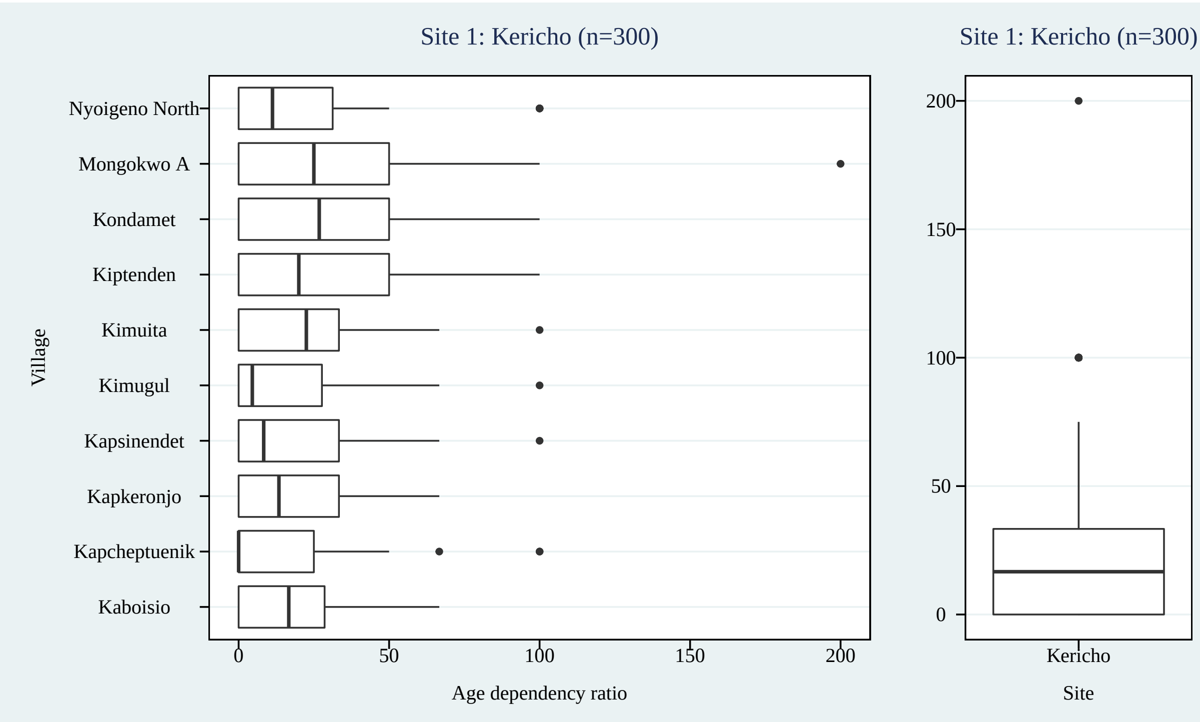

Figure 5: Age dependency ratio.

[5] http://data.worldbank.org/indicator/SP.POP.DPND.OL
[6] http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/demographics/dependency_ratio.pdf

Indicator 4. Proportion of households hiring-in labor

Respondents were asked whether they usually hire any labor to help with either cash crops or food crops. The responses were recorded as a dummy variable.

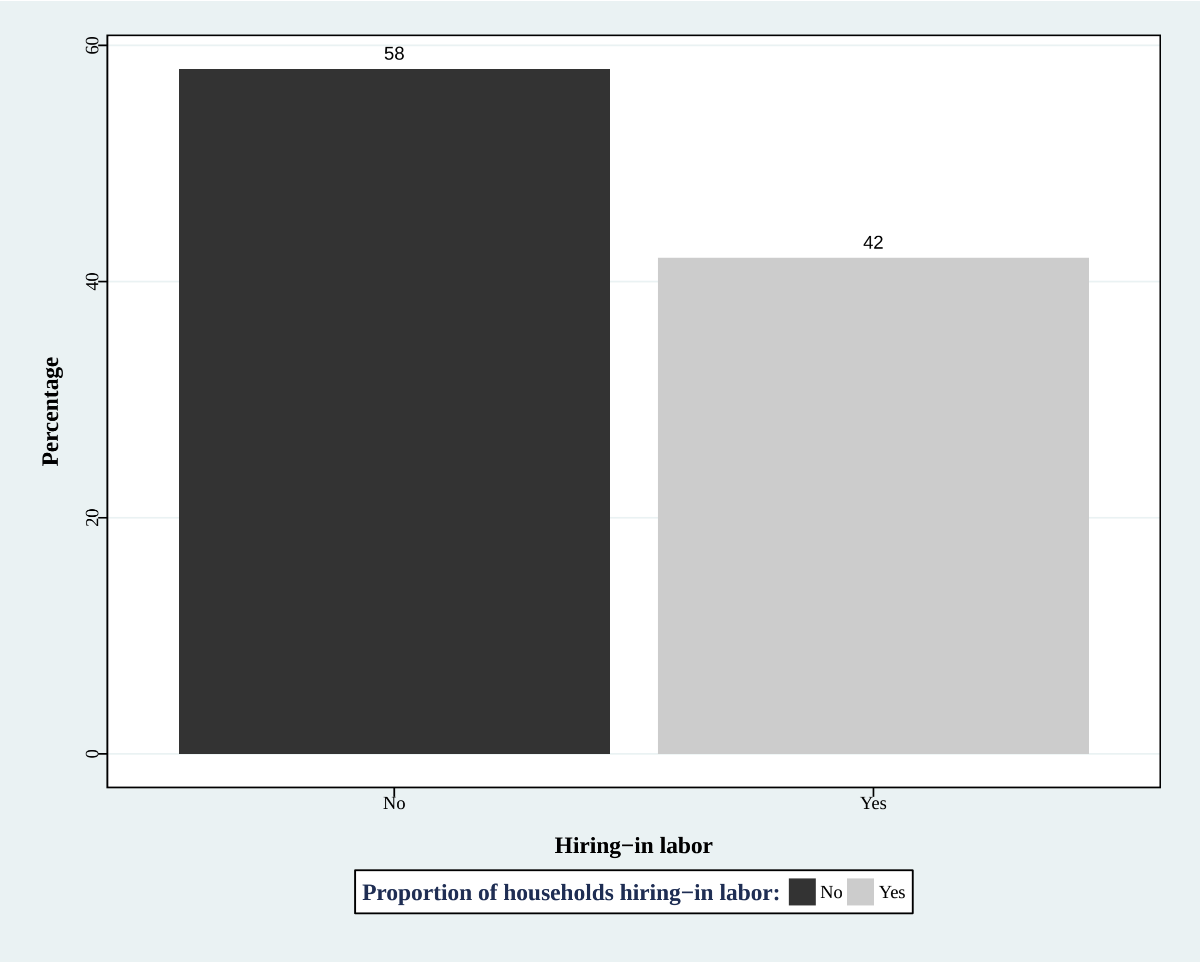

Figure 6: Proportion of households hiring-in labor.

Measures of farm characteristics and assets

Measures of farm characteristics and assets are computed from Section F of the questionnaire shown in Table 4.

Indicator 5. Farm size

This variable represents the total farm land used by the household. After conversion of all different units listed in column **USIZE** in Table 4 into hectares, total farm size is computed as shown below;

$$\textbf{Farm size (ha)} = \sum_{i=1}^{5} \mathbf{PSIZE}_i \tag{3}$$

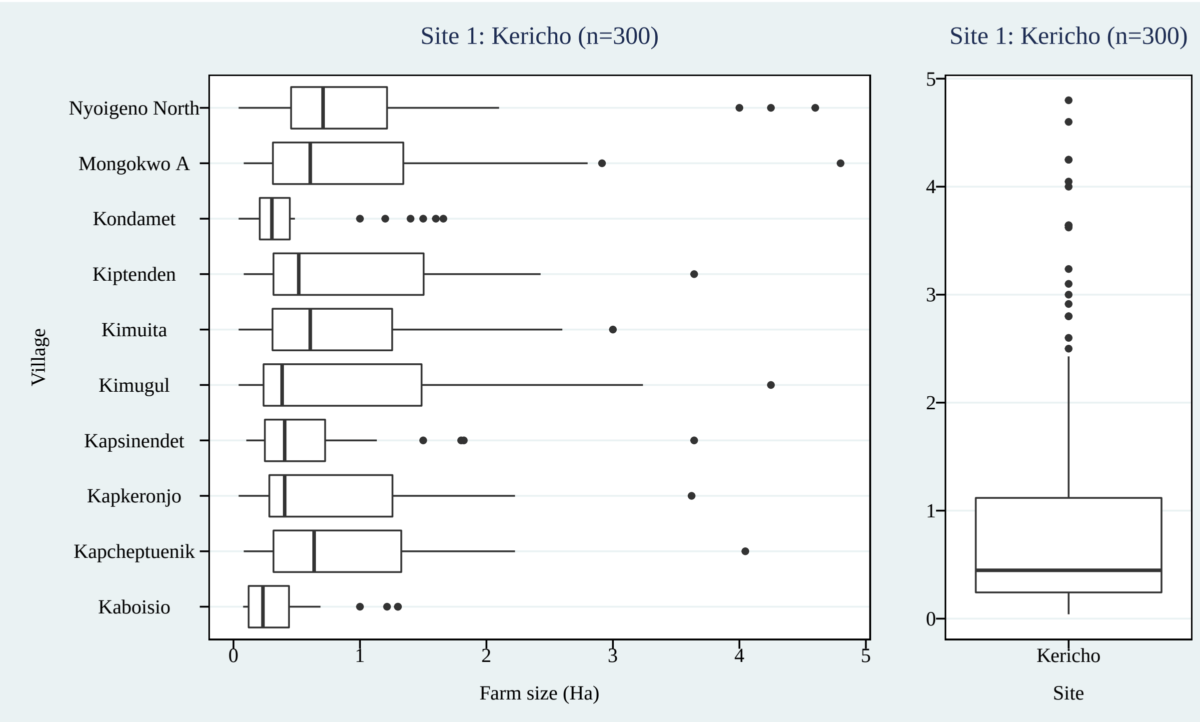

Figure 7: Farm size in hectares.

Indicator 6. Total number of plots

This variable represents the total number of plots used by each household. For each household, this is simply a count of the number of plots listed in Table 4 in column **PID** and is computed as shown below;

$$\textbf{Number of plots used} = \sum_{i=1}^{n} \mathbf{PID}_i \tag{4}$$

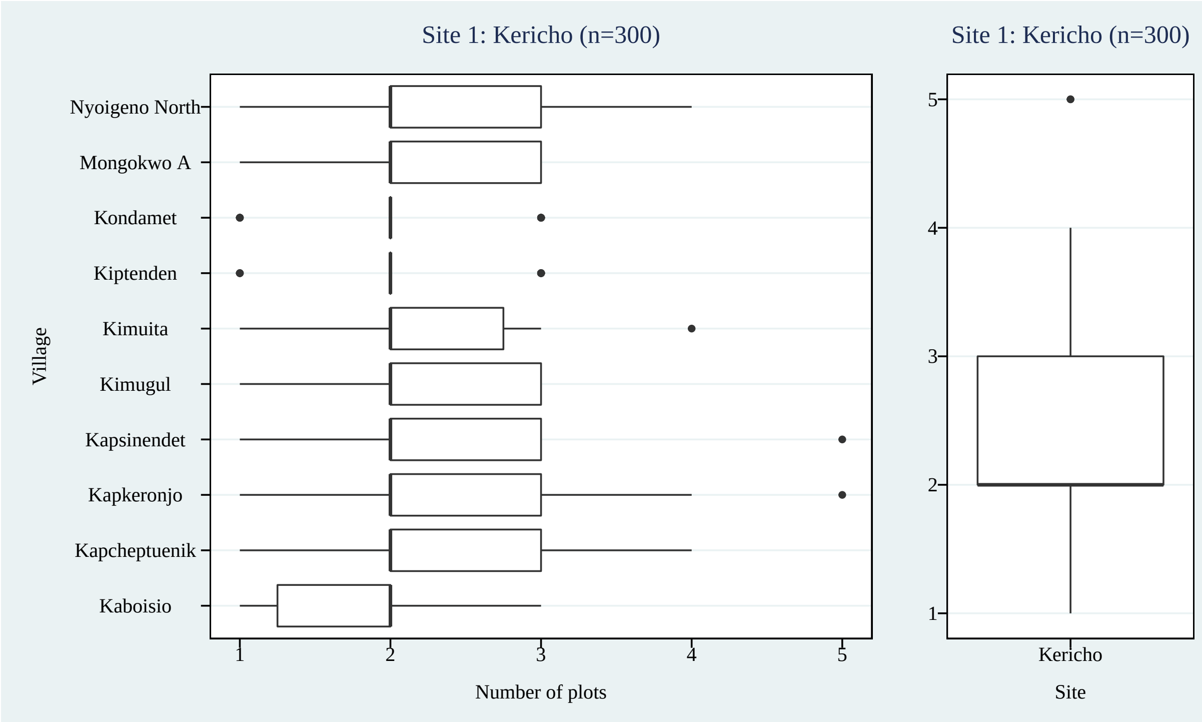

Figure 8: Total number of plots.

Indicator 7. Proportion of cultivated plots

For every listed plot, households were required to indicate the main use as shown in column **PMAINLUSE** of Table 4. Plots whose main use is for annual crops, perennial crops or both annual and perennial crops were considered as plots under cultivation. Proportion of the number of plots under cultivation to the total number of plots listed is presented below.

$$\textbf{Proportion of cultivated plots} = \frac{\sum_{PMAINLUSE=1}^{3} \mathbf{PID}_i}{\sum_{i=1}^{n} \mathbf{PID}_i} \tag{5}$$

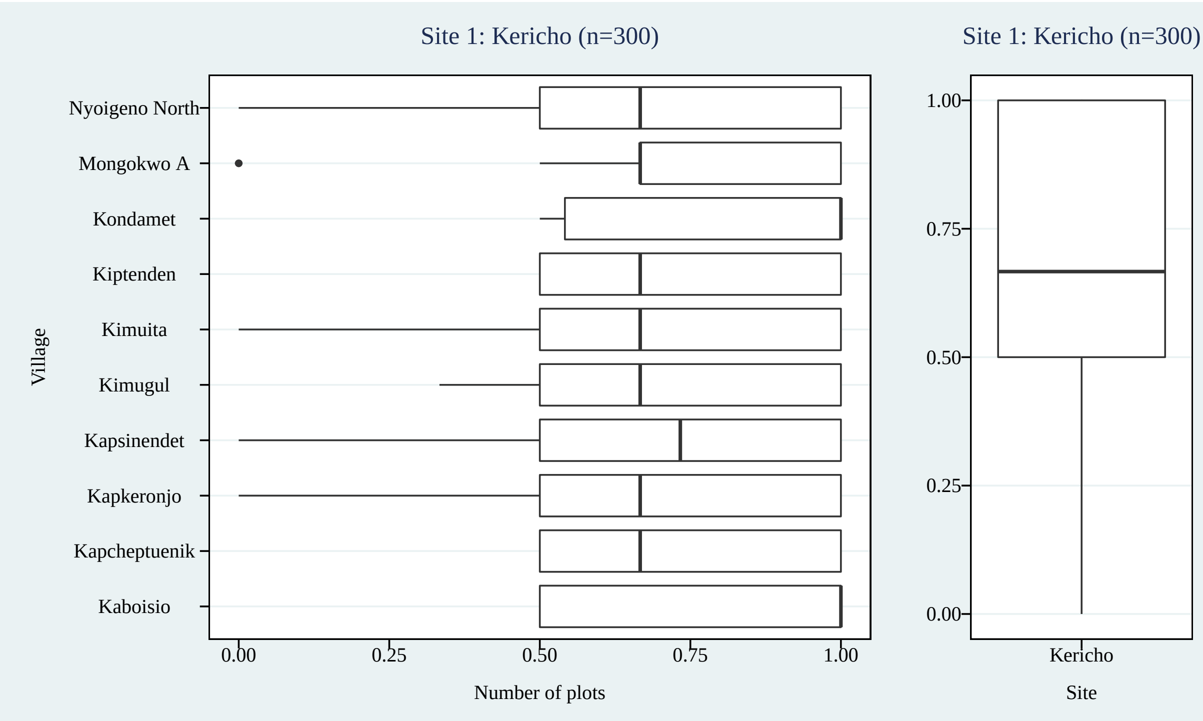

Figure 9: Proportion of cultivated plots

Indicator 8. Farm under cultivation

Farm under cultivation is represented as the area of land that is under cultivation and is computed as the proportion farm land that is dedicated to the cultivation of annual, perennial crops and/or annual crops integrated with perennial crops as reported in column **PMAINLUSE** in Table 4 for every plot.

$$\textbf{Farm under cultivation} = \frac{\sum_{PMAINLUSE=1}^{3} \textbf{PSIZE}_i}{\sum_{i=1}^{n} \textbf{PSIZE}_i} \tag{6}$$

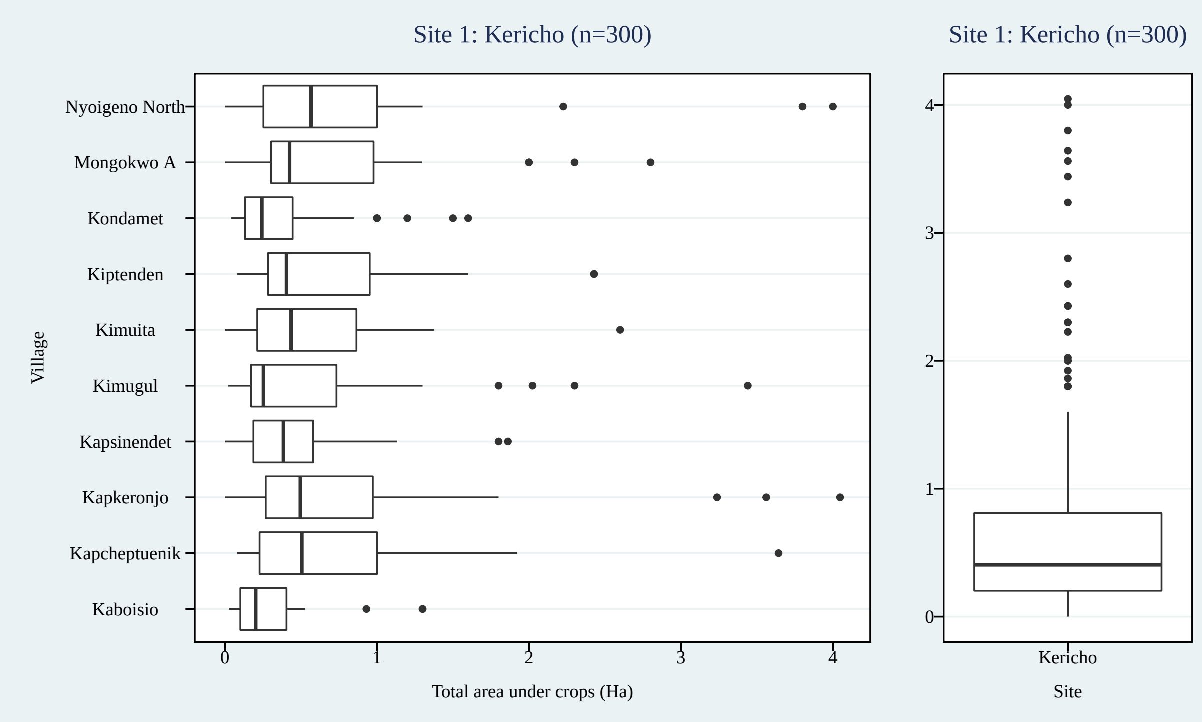

Figure 10: Farm size under crops in hectares.

Indicator 9. Trees on farm

Respondents were asked to indicate, for each plot they have access to; whether they (i) have planted any trees, (ii) trees that are managed and (iii) whether they planted fruit trees. This is reported in columns **PTPLANTN**, **PTREEMNGM**, and **PFRUITTRES** columns in Table 4. This indicator shows the proportion of farmers that practice agroforestry on their farms. However, this indicator does not shed any light on tree density, diversity and richness.

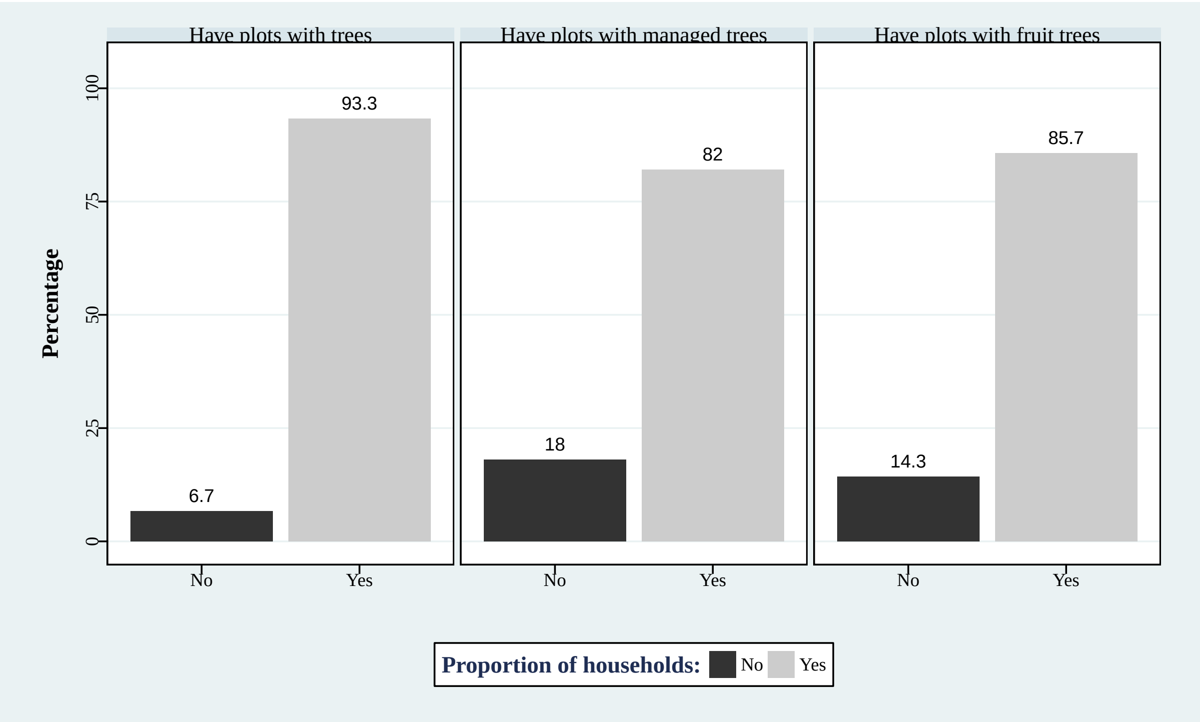

Figure 11: Proportion of households with trees on farm.

Table 4: Section F on Land Assets of the questionnaire.

Section F. Land Assets

I would like to ask a few questions about the land/s that your household uses.

Plot ID <PID>	Size <PSIZE>	Unit of size <USIZE> *Use Key F1*	Tenure <PTENURE> *Use Key F2*	Ownership <POWNSHP> *Use ID codes of HH members. Use and specify others*	Mode of acquisition <PACQSTN> *Use Key F3*	Sources of water <PH20SRCE> *Use Key F4*	Distance from house <PHSEDISTANCE> (m)	If cultivated, enter first year of cultivation. <P1CULTVN> *If not cultivated, leave blank.*	Fenced? <PFENCED> *1 = Yes 2 = No*	Main land use <PMAINLUSE> *Use Key F5*	Have you planted any trees on this land? <PTPLANTN> *1 = Yes 2 = No*	Do you manage any trees on this plot? <PTREEMNGM> *1 = Yes 2 = No*	Does the plot have fruit trees? <PFRUITRES> *1 = Yes 2 = No*
1													
2													
3													
4													
5													

Key F1	1 = Acre, 2 = Hectare, 3 = Metre square, 4 = Other, specify conversion in metric system<OTHRMS>
Key F2	1= Title deed, 2= Owned but not titled, 3= Communal land, 4= Rented-in/ sharecropped or other short term arrangement, 5= Other (specify) <LDOTHSPFY>
Key F3	1 = Inherited, 2 = Donated, 3 = Bought, 4 = Borrow for free, 5 = Rent, 6 = Others, specify <MDOTHRSPFY>
Key F4	1 = Rainwater, 2 = Tanks, 3 = Infrastructure for water harvesting, 4 = Dams or water ponds, 5 = Boreholes, 6 = Water pumps, 7 = River/stream, 8 = Lake
Key F5	1= annual crops, 2=perennial crop, 3=annual crops integrated with perennial crops, 4= Fallow, 5= Wood lot, 6= grazing area, 7= Forest, 8= other, specify <LDUSESPFY>

Indicator 10. Tropical livestock unit (TLU)

The Tropical Livestock Unit (TLU) is a common unit that describes livestock numbers across species to produce a single figure weighted according to the specie type and age using the "Exchange Ratio" concept. Livestock is considered an important source for the supply of energy, food and support for agricultural production. Among rural families in different parts of the world livestock is also a store of wealth. The more livestock a household owns the wealthier they are considered in society. [7]

Table 5 below shows conversion rates for the definition of TLU used in the analysis. This version of TLU does not account for breed and feed system differences. Using the conversion equivalents below, TLU was computed as follows;

$$\textbf{Total livestock holding} = \sum_{i=1}^{n} \textbf{TLU}_i \tag{7}$$

Table 5: Section P: Tropical Livestock Units (TLU) conversion rates

Species (animal type)	**TLU equivalent**
Cattle - Oxen/bull	1.0
Cattle - local cow	0.8
Cattle - heifers	0.5
Cattle - immature males	0.6
Cattle - calves	0.2
Sheep/goats	0.1
Horses	0.8
Camel	1.1
Donkeys/mules	0.5
Poultry	0.01

[7] see Njuki et al, (2011) for further details

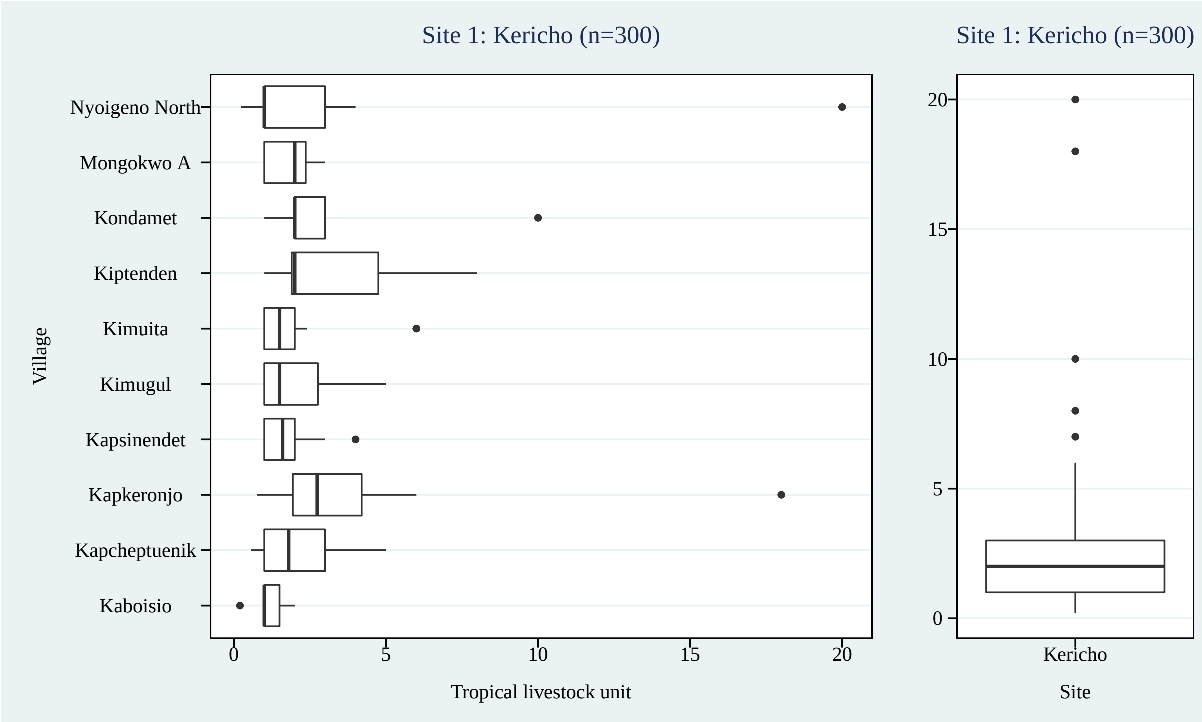

Figure 12: Tropical livestock unit.

Indicator 11. **Household domestic asset index**

The household domestic asset indicator describes all movable assets including livestock and was adapted for from analyses of all projects under the Bill and Melinda and Gates funded projects (BMGF, 2010). Each of the assets is assigned a weight ω_a and then adjusted for age as shown in Table 6 below.

After assigning weights and adjusting for age, the household domestic asset index is computed as below using weights as presented in Table 6;

$$\textbf{Household Domestic Asset Index} = \sum_{g=1}^{g} \left[\sum_{i=1}^{n} (\omega_{gi} \mathbf{*a}) \right] \quad (8)$$

Table 6: Section G: Weight and age adjustments for calculating the asset index

		Age (adjustment for age shown in cell (a))		
Asset (g)	**Weight of asset (wg)**	**< 3 yrs old**	**3 - 7 yrs old**	**> 7 yrs old**
Animal				
Cattle	10			
Horses	10			
Sheep/goats	3		no adjustment	
Poultry	1			
Pigs	2			
Domestic assets				
Cooker	2			
Kitchen cupboard	2			
Refrigerator	4			
Radio	2			
Television	4			
DVD player	4			
Cell phone	3	*1	*0.8	*0.5
Chairs	1			
Mosquito nets	1			
Gas stove	2			
Transport				
Car/truck	160			
Motorcycle	48			
Bicycle	6	*1	*0.8	*0.5
Cart (animal drawn)	12			
Productive				
Hoes	1			
Spades/shovels	1			
Ploughs	4			
Treadle pump	6	*1	*0.8	*0.5
Powered pump	12			
Sewing machine	4			

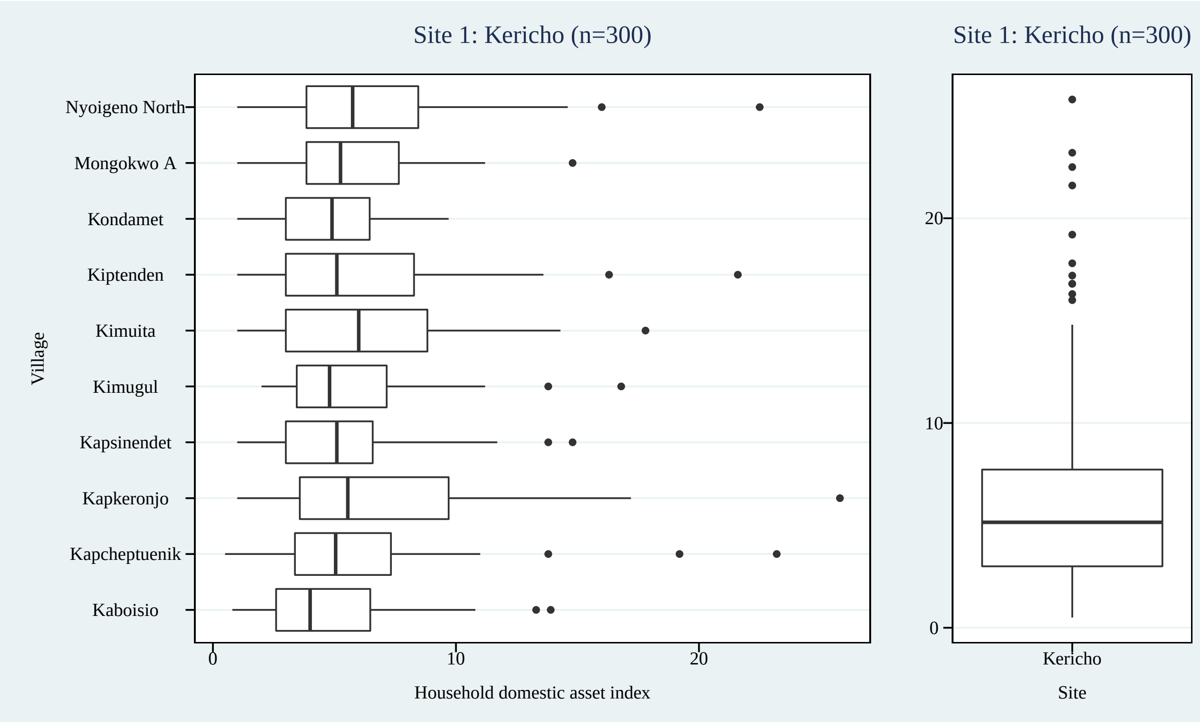

Figure 13: Household domestic asset index.

Table 7: Section I on Income of the questionnaire.

Section I. Income

During the last 12 months did any cash come to the household through any of the following means?

Means of CASH income in the last 12 month (please mark all that apply in the next column) <H_INCSRCE>		**Mark the single most important source of cash income here:** <HINCMOSTIMP>	**Please estimate the annual household income from all household members over the past 12 months (excluding this survey month)**	
			Amount over past 12 months (*local currency*) <H_INCYR>	**Amount over month prior to this survey month (*local currency*)** <H_INCMO>
1. Sale of food crops				
2. Sale of livestock				
3. Sale of livestock products				
4. Sale of cash crops				
5. Business income				
6. Wages or salaries in cash				
7. Other casual cash earnings				
8. Cash remittances				
9. Fishing				
10. Selling local brew				
11. Sale of forest products (e.g. charcoal, firewood, timber, honey, medicinal plants, wild foods)				
12. Rent received				
13. Pension received				
14. Governmental allowances				
15. Other (Specify: <H_INCOTH>)				
16. Estimated Total Annual Household Income			<HINCTOT1>	<HINCTOT2>

3. Household farm dependency and income diversity

Measures of farm dependency

There are several definitions that can be used to refer to farm dependency. Here we adopt the definition of farm income as income from activities that are from the farmers' property. Non-farm income, on the other hand includes income from activities that are outside the farmers' farm like off-farm wages, business, and fishing among others. We use information on household income from different sources which is elicited from Section I of the questionnaire (as shown in Table 7) to compute measures of farm dependency.
[8]

[8] Based on total income in local currency (KES) received by the household in the last 12 months from the Section I table

Table 8: Section I: Categories of different sources of income

Off farm income sources	**On farm income sources**	**Forest income sources**
Business income	Sale of food crops	Sale of forest products
Wages or salaries in cash	Sale of livestock	
Other casual cash earnings	Sale of livestock products	
Cash remittances	Sale of cash crops	
Selling local brew		
Fishing		
Rent received		
Pension received		
Government allowances		

Indicator 12. Contribution of farm activities to household income

The share or contribution of farm income represents the proportion of income coming from farm sources compared to the total income i.e. income from sale of the sale of crops, livestock and livestock products. If the household's stated incomes are exclusively derived from sources 1-4 in Table 7, then the share of farm income is 100%. Similarly, if the household stated income is from sources 5-15, then the share of farm income is 0%. The higher the farm income share of the village, the less diverse it is in terms of income hence the more dependent it is on agriculture. The share of farm income is calculated for each household as:

$$\textbf{Share of farm income} = \sum_{i=1}^{4} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} \tag{9}$$

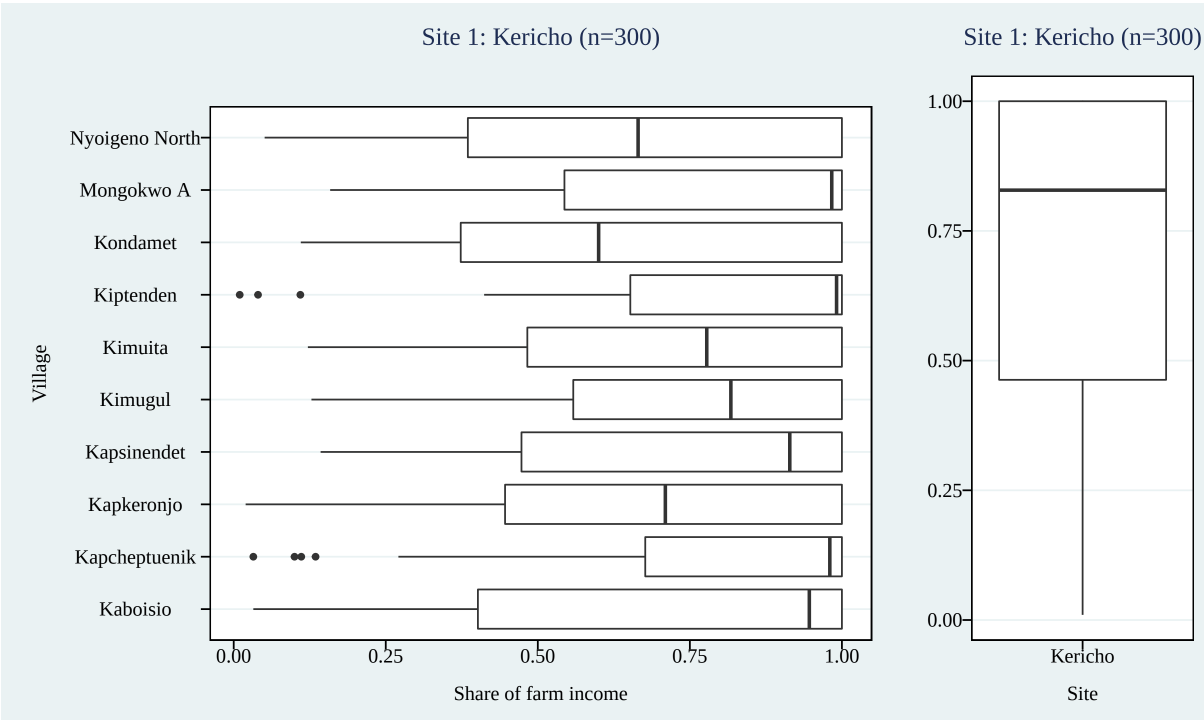

Figure 14: Share of farm income.

Indicator 13. Contribution of non-farm activities to household income

The share or contribution of non-farm income represents the proportion of income coming from non-farm sources relative to the total income i.e. income from sources that are not related to the farm i.e. from sources 5-10 and 11-15 in Table 7. If the household's stated incomes are exclusively derived from these sources, then the share of non-farm income is 100%. Similarly, if the household stated income is from sources 1-4 and 11, then the share of non-farm income is 0%. The share of non-farm income is calculated for each household as:

$$\textbf{Share of non-farm income} = \sum_{i=5}^{15} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} \tag{10}$$

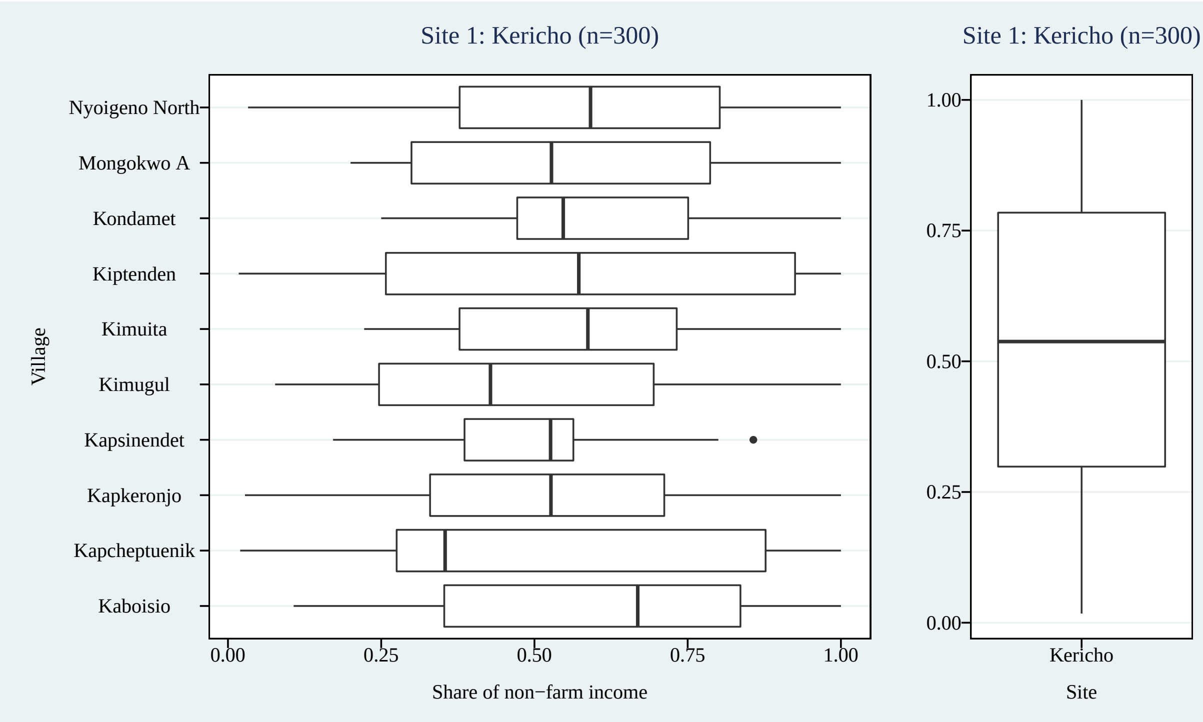

Figure 15: Share of off-farm income.

Indicator 14. Contribution of forest amenities to household income

The share or contribution of forest income is the proportion of income stated as coming from the sale of forest products (e.g. charcoal, firewood, timber, honey, medicinal plants and wild foods) compared to the total income i.e. income from source 11 in Table 7. If the household's stated incomes are exclusively derived from sale of forest products then the share of forest income is 100%. Similarly, if the household stated income is from all other sources (excluding source 11) then the share of forest income is 0%. The share of forest income is calculated for each household as:

$$\textbf{Share of forest income} = \sum_{i=11}^{11} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} \tag{11}$$

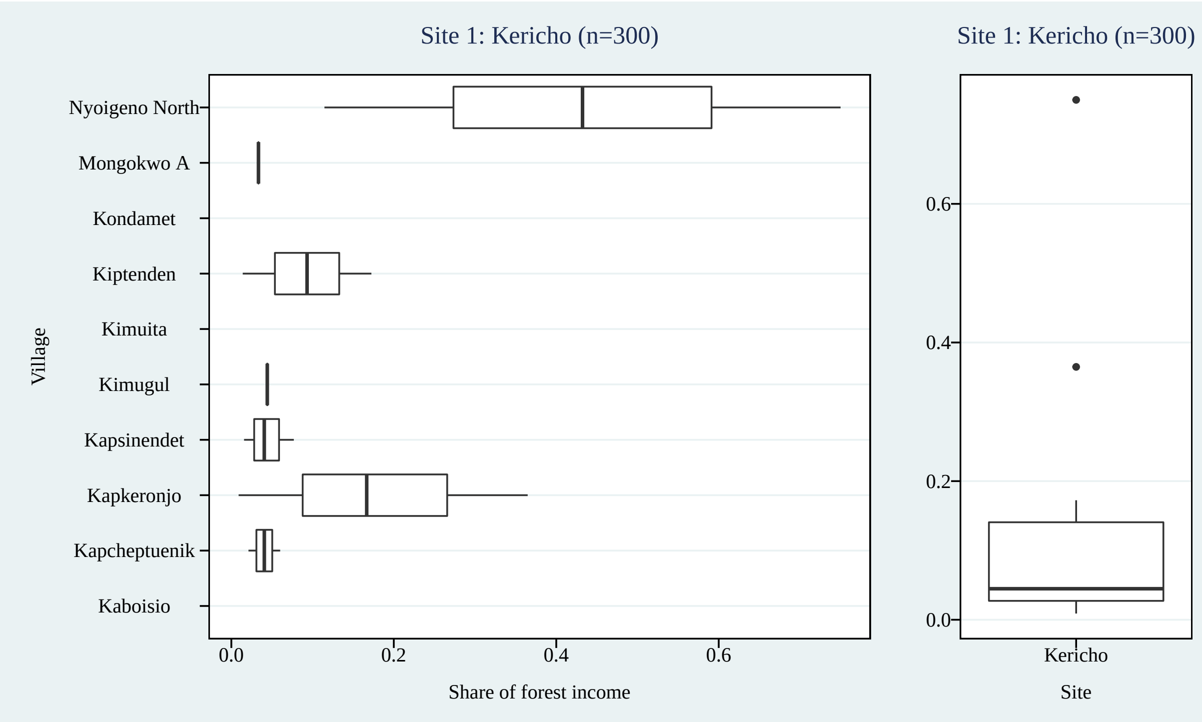

Figure 16: Share of forest income.

Measures of Income diversity[9]

Income diversification can be defined in several ways. Measures of income diversity can vary from a simple count of the number of different income sources to other measures that consider the proportions of each source. Income diversification is often associated with high variability of income sources especially in the case of risk-averse households thus poor rural households practicing rain-fed agriculture in low-potential areas are more likely to have diverse income sources than richer households in areas with greater agro-ecological potential. [10]

All the indicators presented in this section are computed based on Table 7 of Section I of the questionnaire.

Indicator 15. Number of income sources

This is simply a count of the number of distinct income sources as referred to in the Income table (refer Table 7) from Section I without distinguishing by type. The number of sources will therefore range from 1 to at least 15 depending on the SL site. A household with three different income sources is more diverse than one with two. While this indicator gives a general sense of income diversification, it does not take into account the relative contribution of each income source.

$$\textbf{Number of income sources} = \sum_{i=1}^{15} \textbf{H\_INCSRCE}_i \tag{12}$$

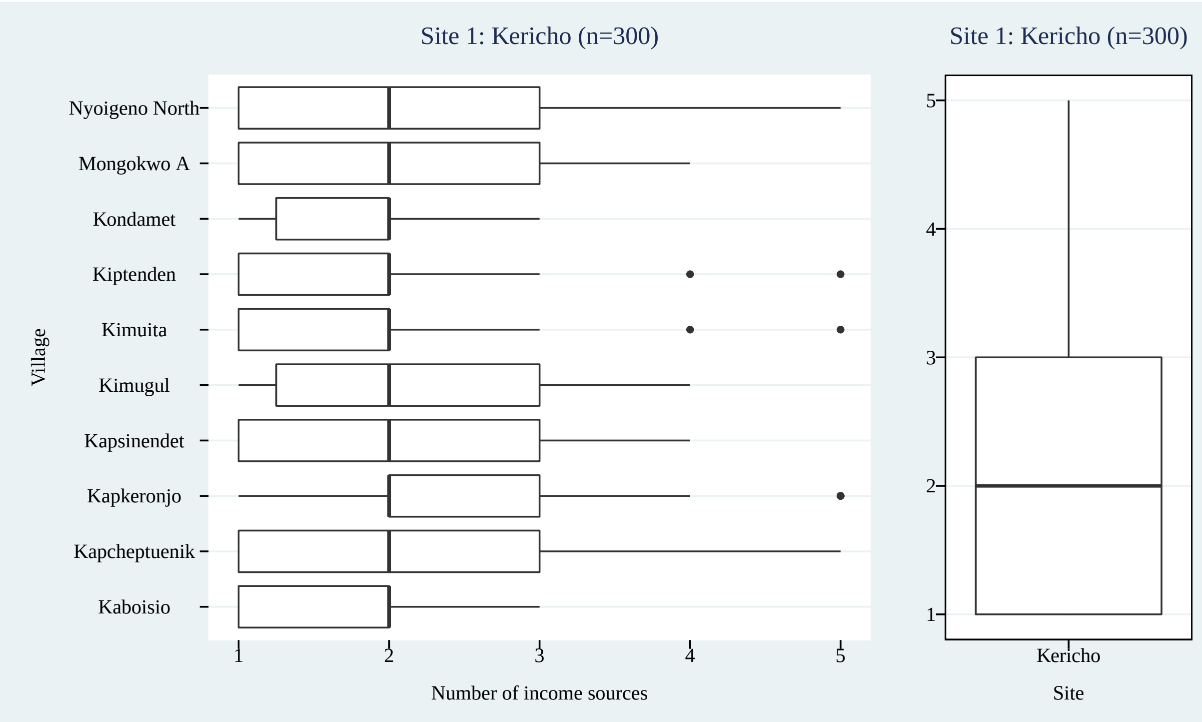

Figure 17: Number of income sources.

[9]Based on total income received by the household in local currency (KES) the last 12 months from the Section I table on Income as shown in Table 7

[10]See Minot et al, 2006 for an in-depth discussion.

Indicator 16. Income type categories

This indicator shows the degree of household dependency on income from the (i) farm only (ii) non-farm only and (iii) mixed: both farm and non-farm. The first category, farm only, represents households that stated all household income generated from the sale of crops, livestock and livestock products in the last 12 months. A household relies on farm only if:

$$\textbf{Share of farm income}: \sum_{i=1}^{4} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} = 100\% \tag{13}$$

The second category, non-farm only counts those households that stated their household income in the last 12 months as being generated only from non-farm sources 5-10 and 11-15 of section A. A household is as non-farm only if:

$$\textbf{Share of non-farm income}: \sum_{i=1}^{15} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} = 100\% \tag{14}$$

The third category, mixed, consists of households that stated their income as coming from a combination of both farm and non-farm sources. Therefore, a household is counted as mixed if the shares of farm and non-farm incomes are not equal to 0% i.e.:

$$\textbf{Share of farm income}: \sum_{i=1}^{4} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} \neq 100\% \textbf{ and} \tag{15}$$

$$\textbf{Share of non-farm income}: \sum_{i=1}^{15} \frac{\textbf{H\_INCSRCE}_i}{\textbf{Cal\_HINCTOT1}_i} \neq 100\% \tag{16}$$

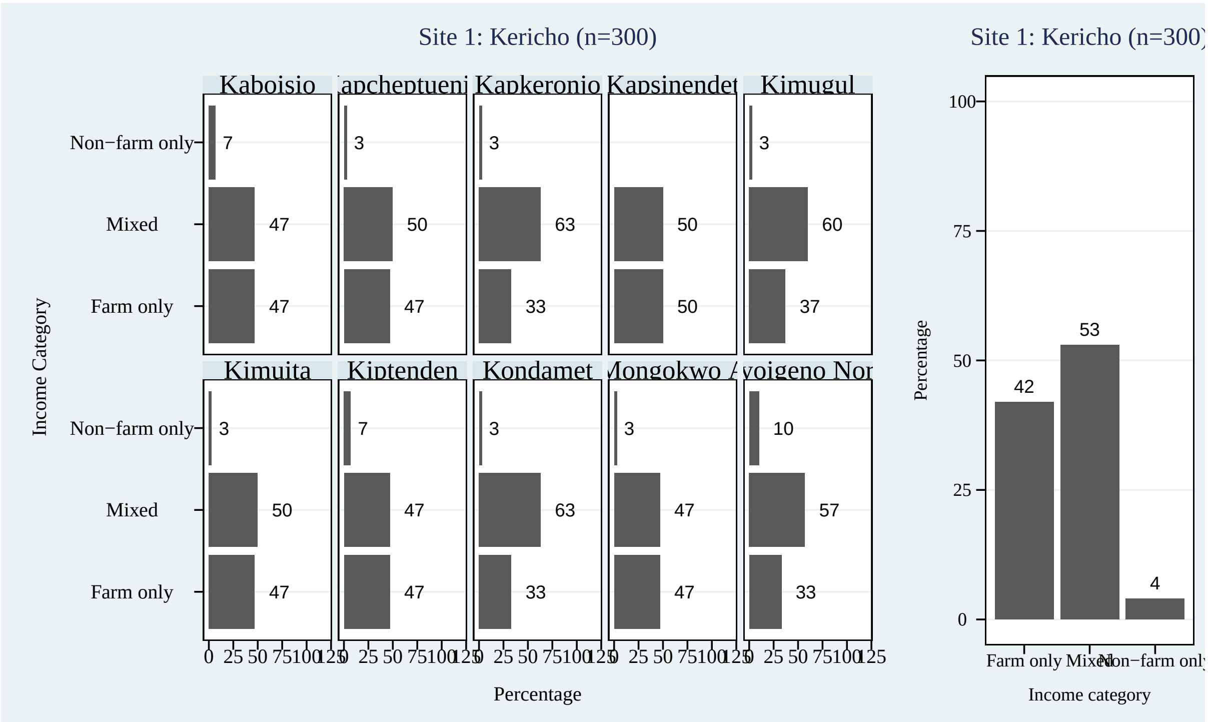

Figure 18: Income category types.

Indicator 17. Household perception on most important income source

This indicator is a representation of what the household perceives as the most important income sources. There are three mutually exclusive categories i.e. (i) farm, (ii) non-farm and (iii) forest. This is as reported in column **HINCMOSTIMP** in Table 7.

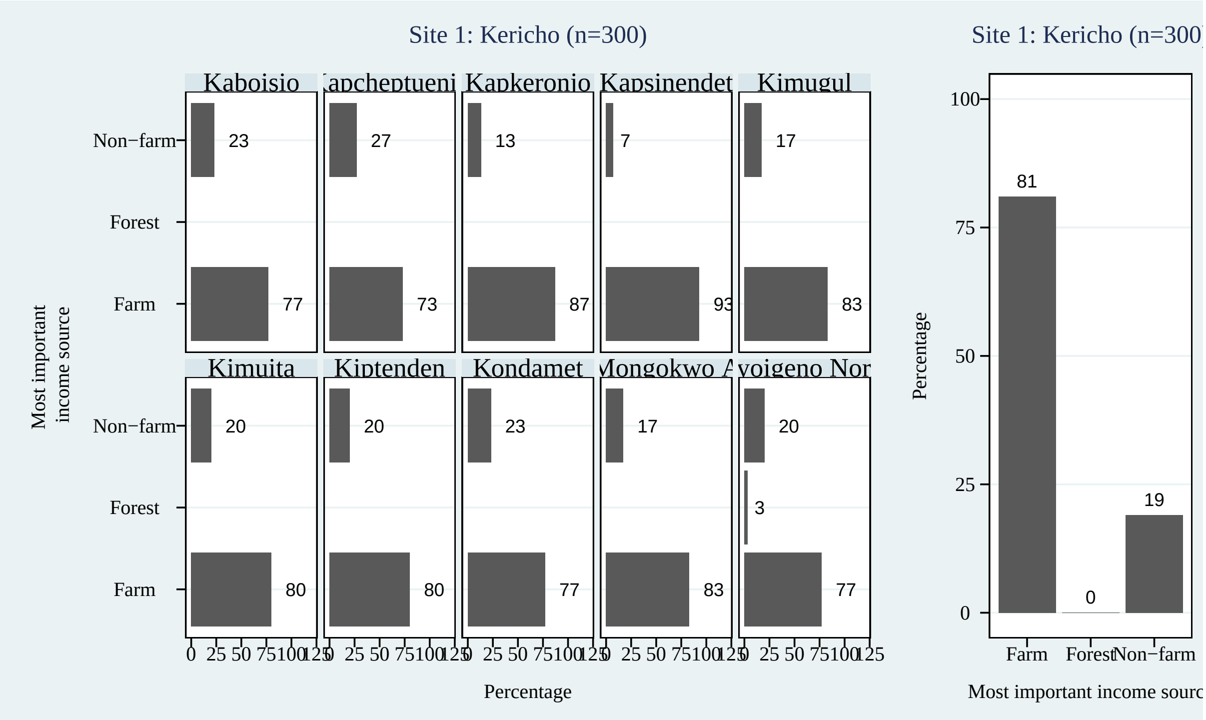

Figure 19: Perceptions on most important income source.

Indicator 18. The Simpson index of diversity

There are several other measures take into account both the number of income sources and the relative proportion contributed by each source. The Simpson index of diversity (SID), is a measure that is commonly applied to measure biodiversity of an ecosystem but has been applied to measure crop and income diversity [11].

The Simpson index of diversity is used to measure income diversity as:

$$\mathbf{SID} = 1 - \mathbf{P}^2 \tag{17}$$

where:

$$\mathbf{P} = \sum_{i=1}^{14} \frac{\mathbf{H\_INCSRCE}_i}{\mathbf{Cal\_HINCTOT}} \tag{18}$$

interpreting P as the proportion of income coming from source i. The value of SID always falls between 0 and 1. If a household stated only one source of income, implying that P = 1, then SID = 0. As the number of income sources increase, the shares (P) decline, as does the sum of the squared shares, so that SID approaches 1. In the case of n number of income sources, then SID falls between zero and 1 − 1/k.

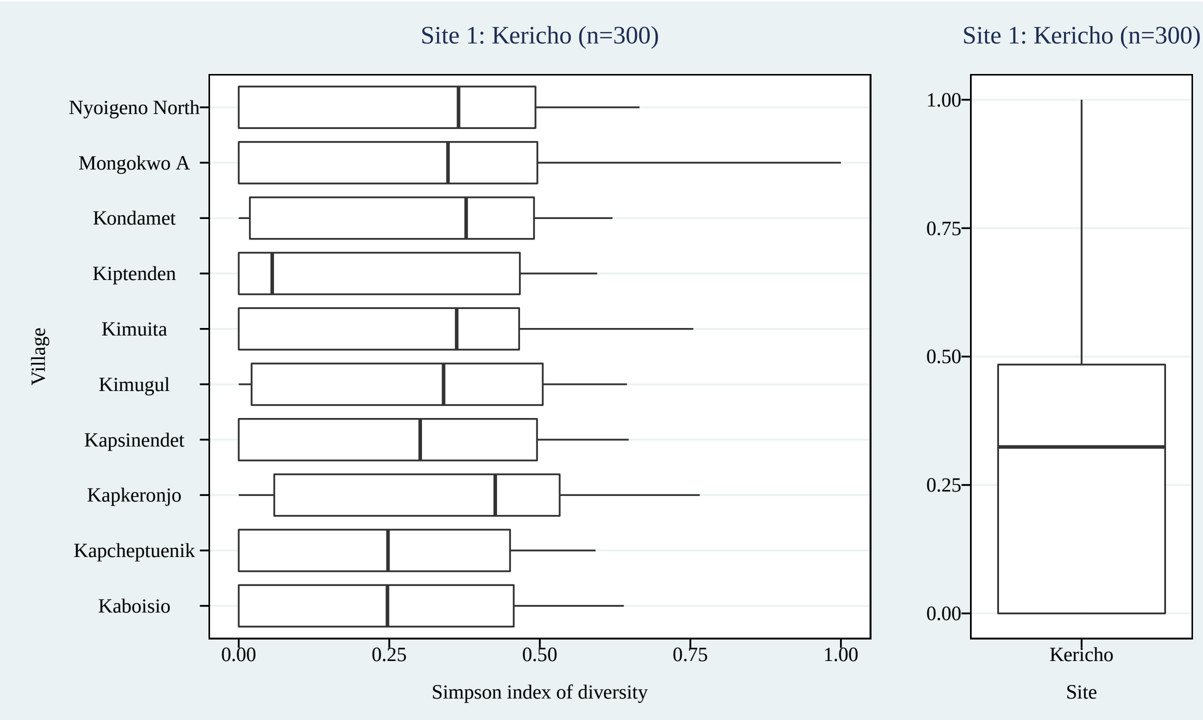

Figure 20: Simpson index of diversity.

[11] Crop diversity in Joshi et al, (2003) and income diversity in Minot et al, (2006)

Indicator 19. The Shannon-Weaver index of diversity

The Shannon-Weaver index of diversity (SWID) is also another measure of income diversity that takes into account both the number of income sources and their and their evenness. The SWID is less sensitive than the Simpson index to the degree of dominance of the largest categories and increases continuously with higher diversity.

The Shannon-Weaver index of diversity is used to measure income diversity as:

$$\mathbf{SWID} = -\sum_{i=1}^{n} \mathbf{P}_i \ln(\mathbf{P}_i) \tag{19}$$

where:

$$\mathbf{P} = \sum_{i=1}^{14} \frac{\mathbf{H\_INCSRCE}_i}{\mathbf{Cal\_HINCTOT}} \tag{20}$$

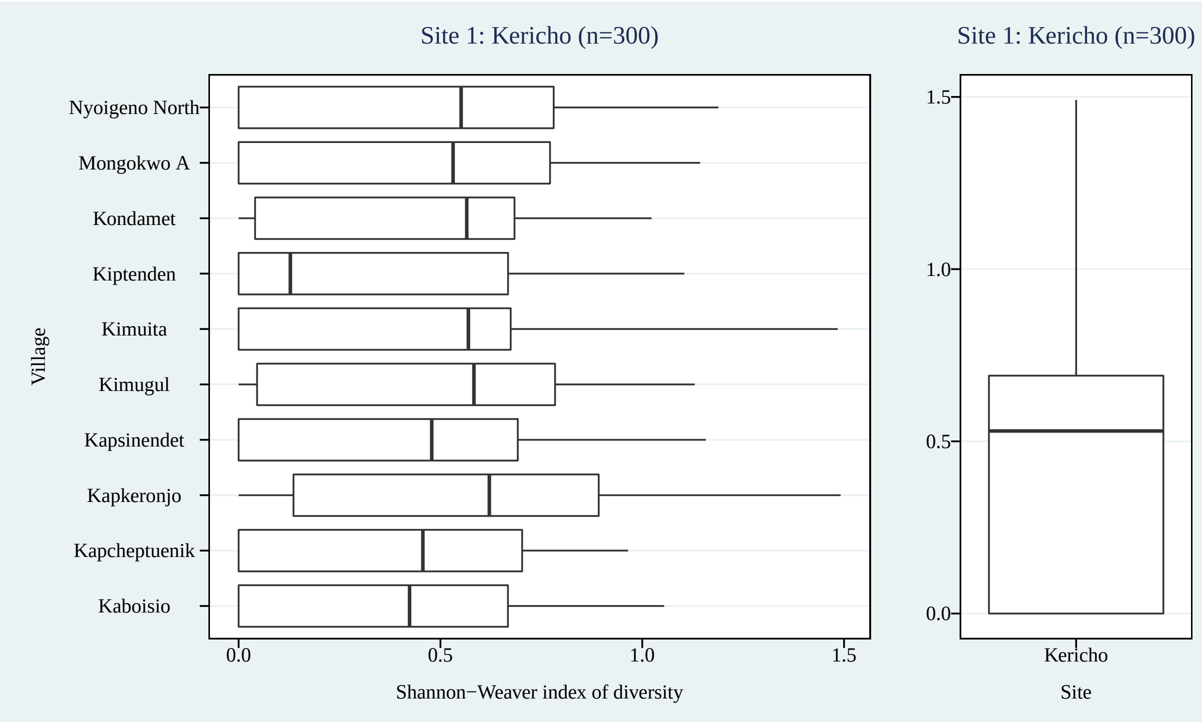

Figure 21: Shannon-Weaver index of diversity.

Comparison between SID and SWID

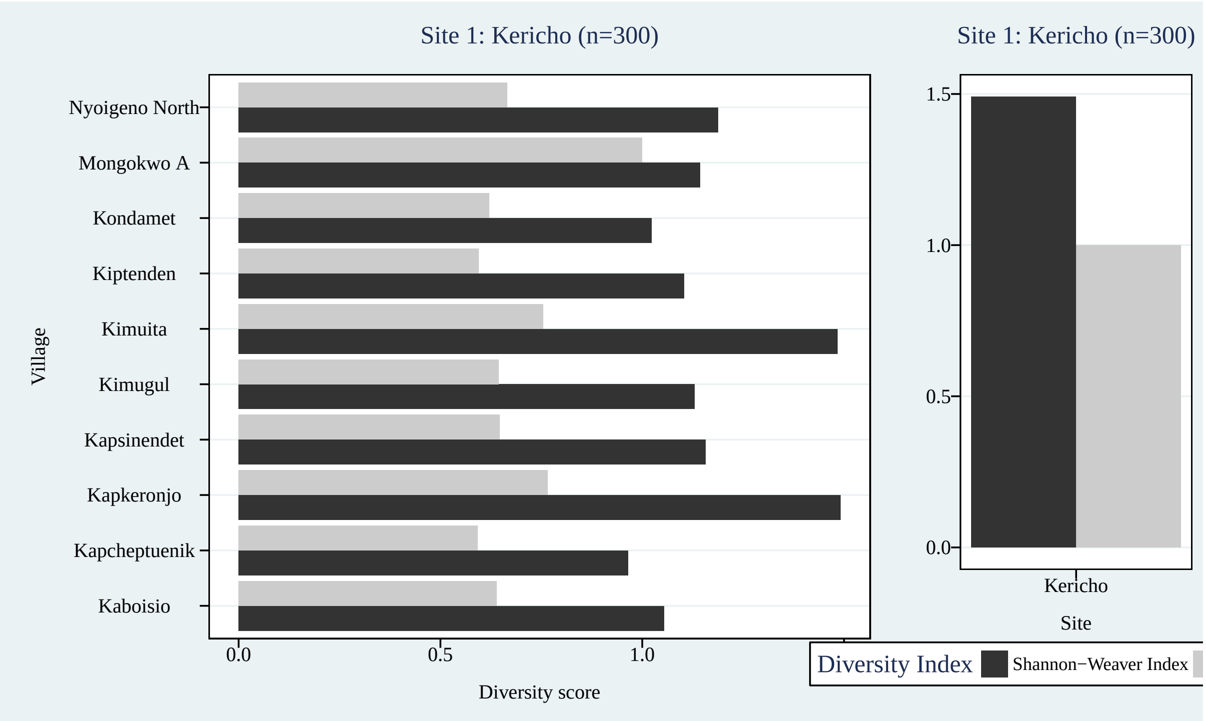

Figure 22: Shannon-Weaver and Simpson indices of diversity.

4. Household wealth, poverty and happiness

Measures of wealth, happiness and poverty

Measures of wealth and poverty are computed from Sections M, the Grameen's Progress out of poverty module in the appendix and other sections of the questionnaire on household and farm assets.

Indicator 20. Livelihood resources index/Wealth index

Households are generally endowed with varying levels of different wealth assets which can be classified as physical capital (e.g. transport, livestock); human capital (household labor capacity); natural capital (land); financial capital (access to credit, remittances) and social capital (social support networks e.g group associations). Due to the differences in measurement scales, it is imperative to normalize/weight these assets in order to aggregate these assets into a single indicator that can be used to rank households according to wealth status. However, a challenge arises in identifying relevant weights to assign for different types of assets and several methods have been suggested including assigning weights based on (i) qualitative and subjective judgement and (ii) a common factor e.g. market or shadow prices. These two methods may not be the most appropriate due to the diversity of asset endowment across households and hence difficulties in finding a common factor and due market imperfection in developing countries, respectively. In their seminal work Filmer and Pritchett (1998, 2001) proposed the use of Principal Component Analysis (PCA), a techniques that extracts from a set of variables those few orthogonal linear combinations of the variables that capture the common information. PCA statistically assigns weights to different assets and therefore is considered a more objective of calculating household's wealth indicator. The wealth index of each household can be calculated as follows:

$$W_j = \sum_{i=1}^{k} [b_i(a_{ij} - x_i)]/s_i, \tag{21}$$

where: W_j is a standardized wealth index for each household; b_i represents the weights (scores) assigned to the (k) variables on the first principal component; a_{ij} is the value of each household on each of the k variables; x_i is the mean of each of the k variables; and s_i the standard deviations.] That is, for each asset value, subtract its level from the mean , multiply the score and divide the product by the standard deviation . This generates the wealth index of each asset. Summing across all assets selected gives the overall index of wealth for each household. For empirical applications refer to Filmer and Pritchett (1998); Filmer and Pritchett (2001); Langyintuo & Mungoma (2008).

Table 9: Description of variables used in computing wealth index

Variable	Description
Human capital	
Household labor capacity	Household labor force in adult equivalent units
Hiring-in labor	1 if household hires-in labor and 0 otherwise
Natural capital	
Farm size (Ha)	Total size of land used by the household
Cultivated farm size (Ha)	Total size of land under annual, perennial or annual and perennial crops
Physical capital	
Domestic assets	Number of assets owned by the household
Transport assets	Number of assets owned by the household
Farm assets	Number of assets owned by the household
Social capital	
Participation in associations	1 if household participates in associations and 0 otherwise
Access to social support networks	1 if household has a relative in government and 0 otherwise
Financial capital	
Access to cash credit	1 if household has access to cash credit and 0 otherwise
Access to remittances	1 if household has receives remittances and 0 otherwise

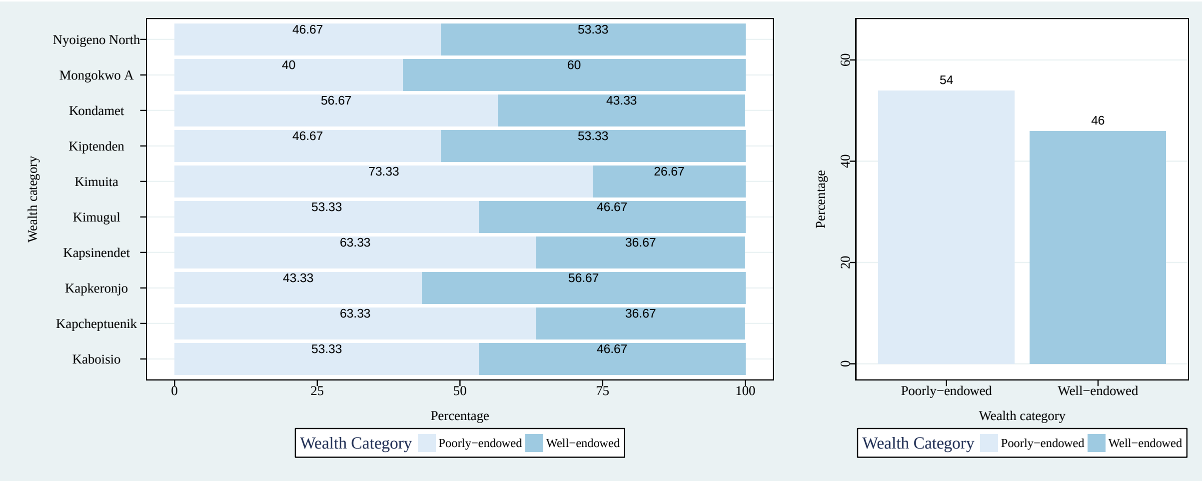

Figure 23: Wealth category plots.

Indicator 21. Progress out of Poverty Index (PPI) [12]

The Progress out of Poverty Index (PPI) is a poverty measure of the likelihood that a household falls below a certain threshold and was developed by the Grameen Foundation. There is a set of 10 questions socio-economic characteristics and asset ownership that are asked to the household and each item has a corresponding score. In the end each household will have one summed score which will be converted into a likelihood score in terms of a percentage which denotes the likelihood of a household falling below a given threshold. For this exercise, we use poverty thresholds at the internationally recognized US$ 1.25, US$ 2.50 and the USAID Extreme levels which are nationally adjusted at the 2005 Purchasing Power Parity (PPP). Therefore a likelihood score of x implies at the US$ 1.25 and US$ 2.50 implies that there is an x% chance or likelihood that the household in question is living below the International US$ 1.25 and US$ 2.50 per day 2005 PPP. If expressed relative to the USAID Extreme poverty line, then x% is the likelihood of a household not earning enough to afford their daily calorie requirements. The PPI ranges from 0-100% and is based on and hence the higher the PPI the more likely the household lives below the poverty line.

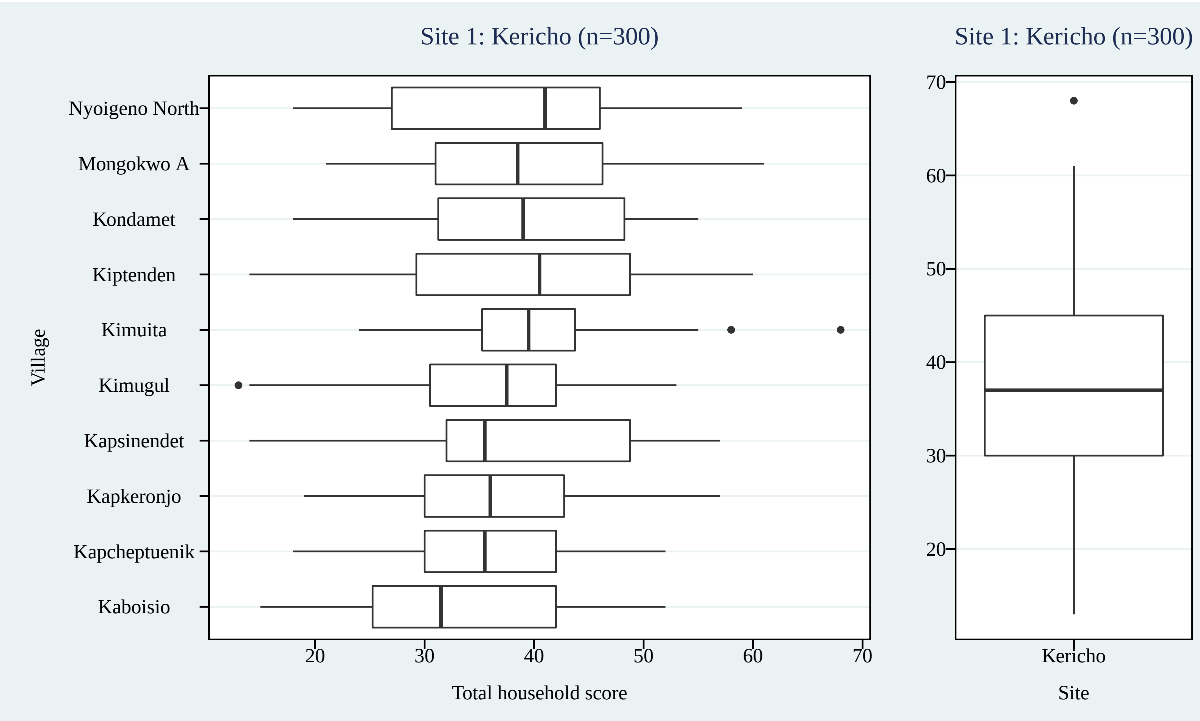

Figure 24: Distribution of progress out of poverty scores.

[12] For more detailed information, refer to http://www.progressoutofpoverty.org/country/kenya

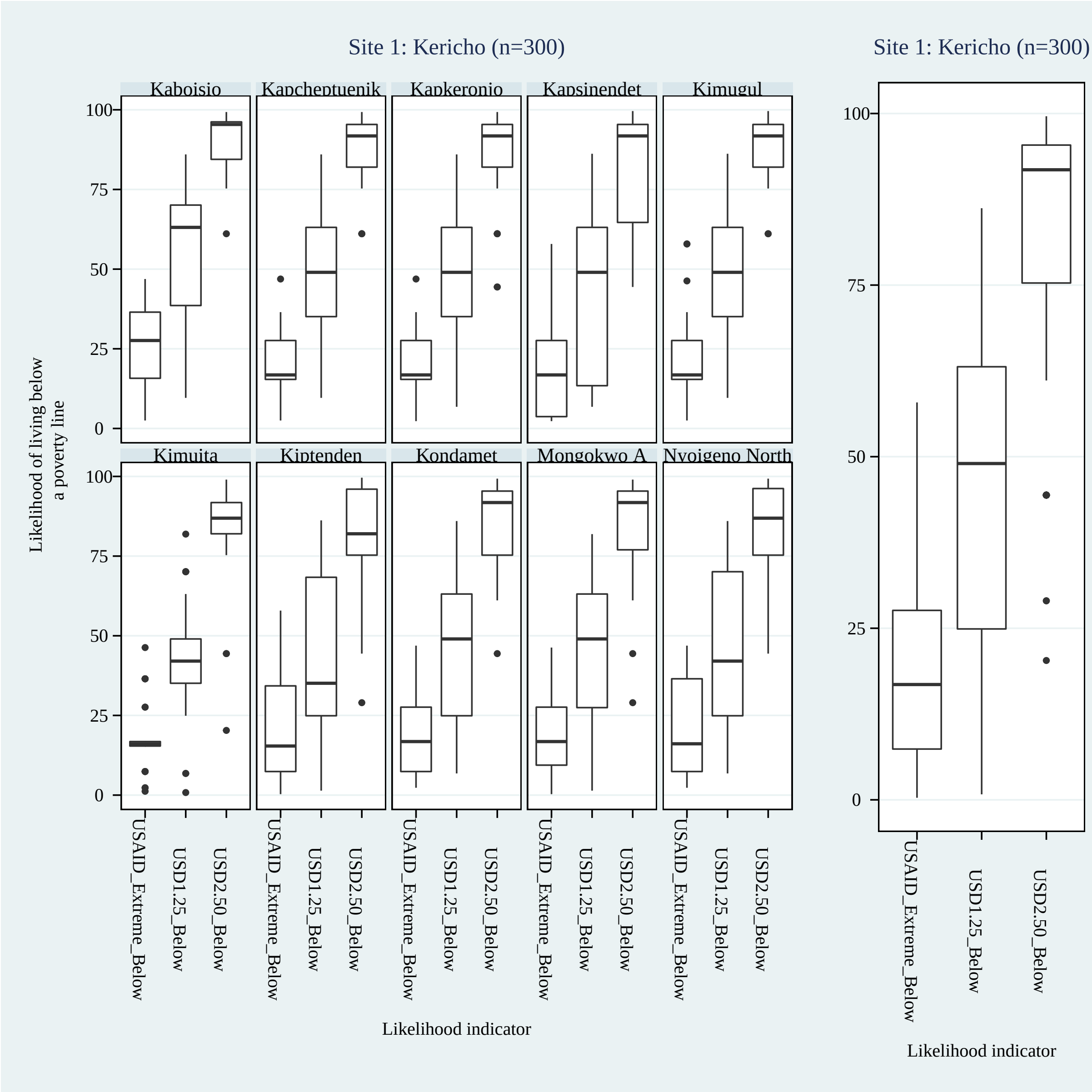

Figure 25: Progress out of poverty score across different thresholds.

Indicator 22. Happiness index

Respondents were asked to rank the level of satisfaction of various aspects of their lives such as; health, housing, agricultural fields, education of their children e.t.c, as shown in Table 10. The ranks varied from very satisfied to very dissatisfied.

These ranks were scored from 2 for very satisfied to -2 for very dissatisfied, after which and index of the level of happiness of the household was computed as the sum of all the scores over various aspects.

Households were also asked to rate themselves as either fortunate, average or unfortunate compared to other people from the same village.

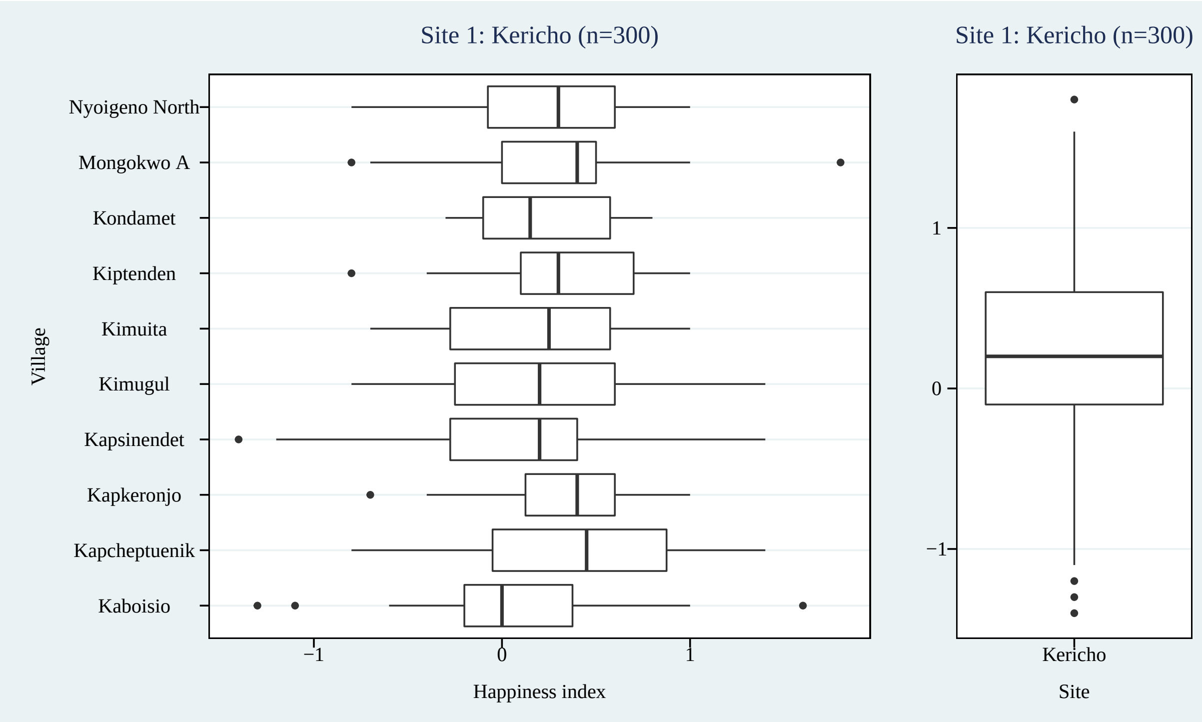

Figure 26: Happiness index plots.

Table 10: Section M on Welfare of the questionnaire.

Section M. Welfare

For each of the topics mentioned below, how would you describe your current feeling about it? *Tick one column per topic*

	Very satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Very dissatisfied	Not applicable
Your health <WHLTH>						
Your housing <WHSN>						
Your agricultural fields <WAGFLDS>						
The infrastructure in your village <WVINSTRE>						
Education available to your children <WCHLDEDU>						
Health care available <WHCARE>						
Drinking water available <WH20AVAI>						
Your protection against crime/ your safety <WCPRCTN>						
Support from your community when needed? <WCSPRT>						
Your life as a whole <WLIFE>						

Compared to other people in the village you feel <FLN>	Fortunate [___] Average [___] Unfortunate [___] No opinion [___]
If fortunate please explain <FLNFRTN>	
If unfortunate please explain <FLNUNFRTN>	

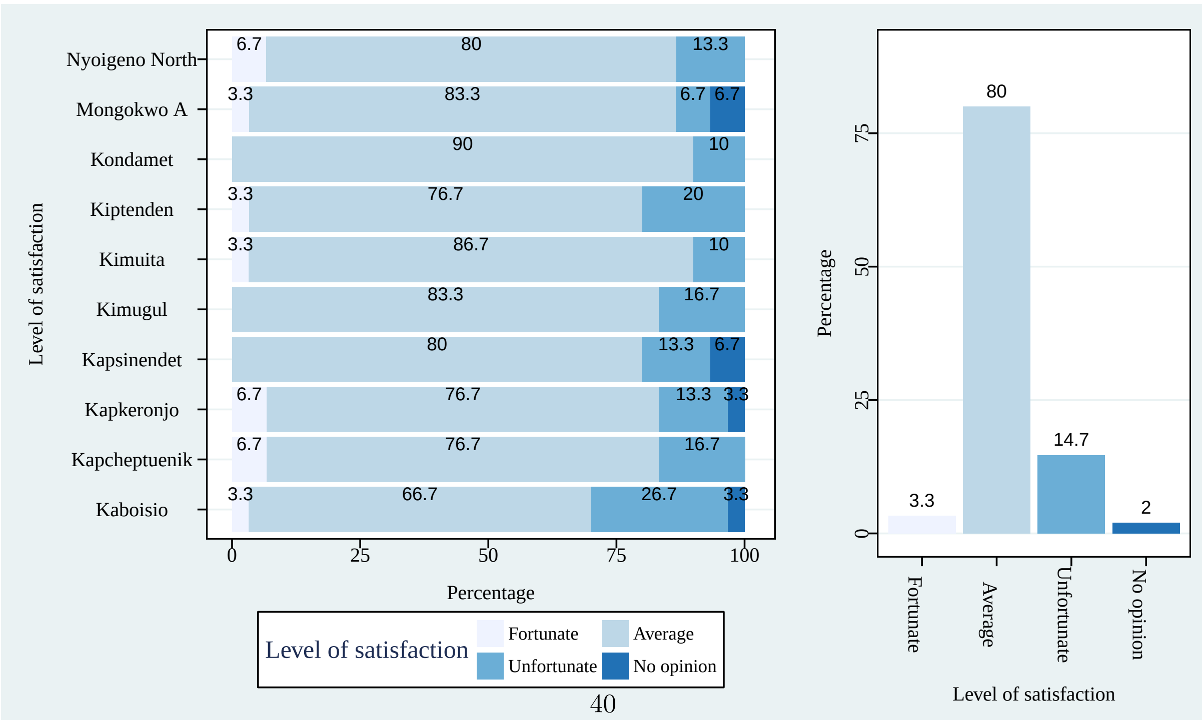

Figure 27: Level of satisfaction plots.

5. Household food security and nutrition

Measures of food security and nutrition diversity

Measures of food security and nutrition diversity were computed from Section L of the questionnaire.

Indicator 23. The Household Dietary Diversity Score (HDDS)

The Household Dietary Diversity Score (HDDS) or Individual Dietary Diversity Score (IDDS) is an attractive proxy for food security because a more diversified diet is an important outcome, and is also correlated with such factors as caloric and protein adequacy, percentage of protein from animal source foods and household incomes (Hoddinot and Yohannes, 2002). The dietary diversity can be calculated for the household (Household Dietary Diversity Score) or for individuals within the household (Individual Dietary Diversity Score-IDDS). The consumption of food is collected using a 24 hour recall and should be asked to household members responsible for food preparation and should only focus on foods consumed within the home. Foods consumed outside the home that were not prepared in the home (e.g hotel food) should not be included as they will rarely represent household level food security. Using the dietary diversity score, the consumption of animal source foods can also be determined. Refer to Table 11 for the list of food types that were used.

Table 11: Section L on Food security, consumption and composition of the questionnaire.

Types of food <FOODTYP>	**In the last 24 hours has your household consumed any of the following?** *1 = Yes, 2 = No*	**In the last 7 days, how many days have you consumed these?** <FTYPE_CONS>
A. Cereals, Grains and Cereal Products (Maize Grain/Flour; Green Maize; Rice; Finger Millet ; Pearl Millet; Sorghum; Wheat Flour; Bread; Pasta; Other Cereal) <FOODTYP1>		
B. Roots, Tubers, and Plantains (Cassava Tuber/Flour; Sweet Potato; Irish Potato; Other Tuber/Plantain) <FOODTYP2>		
C. Nuts and Pulses (Bean; Pigeon Pea; Macadamia Nut; Groundnut; Green Bean; Cow Pea; Other Nut/Pulse) <FOODTYP3>		
D. Vegetables (Onion; Cabbage; Wild Green Leaves; Tomato; Cucumber; Other Vegetables/Leaves) <FOODTYP4>		
E. Meat, Fish and Animal Products (Egg; Dried/Fresh/Smoked Fish (Excluding Fish Sauce/Powder); Beef; Goat Meat; Pork; Poultry; Other Meat) <FOODTYP5>		
F. Fruits (Mango; Banana; Citrus; Pineapple; Papaya; Guava; Avocado; Apple; Other Fruit) <FOODTYP6>		
G. Milk/Milk Products (Fresh/Powdered/Soured Milk; Yogurt; Cheese; Other Milk Product - Excluding Margarine/Butter or Small Amounts of Milk for Tea/Coffee) <FOODTYP7>		
H. Fats/Oil (Cooking Oil; Butter; Margarine; Other Fat/Oil) <FOODTYP8>		
I. Sugar/Sugar Products/Honey (Sugar; Sugar Cane; Honey; Jam; Jelly; Sweets/Candy/Chocolate; Other Sugar Product) <FOODTYP9>		
J. Spices/Condiments (Tea; Coffee/Cocoa/Milo; Salt; Spices; Yeast/Baking Powder; Tomato/Hot Sauce; Fish Powder/Sauce; Other Condiment - Including Small Amounts of Milk for Tea/Coffee) <FOODTYP10>		

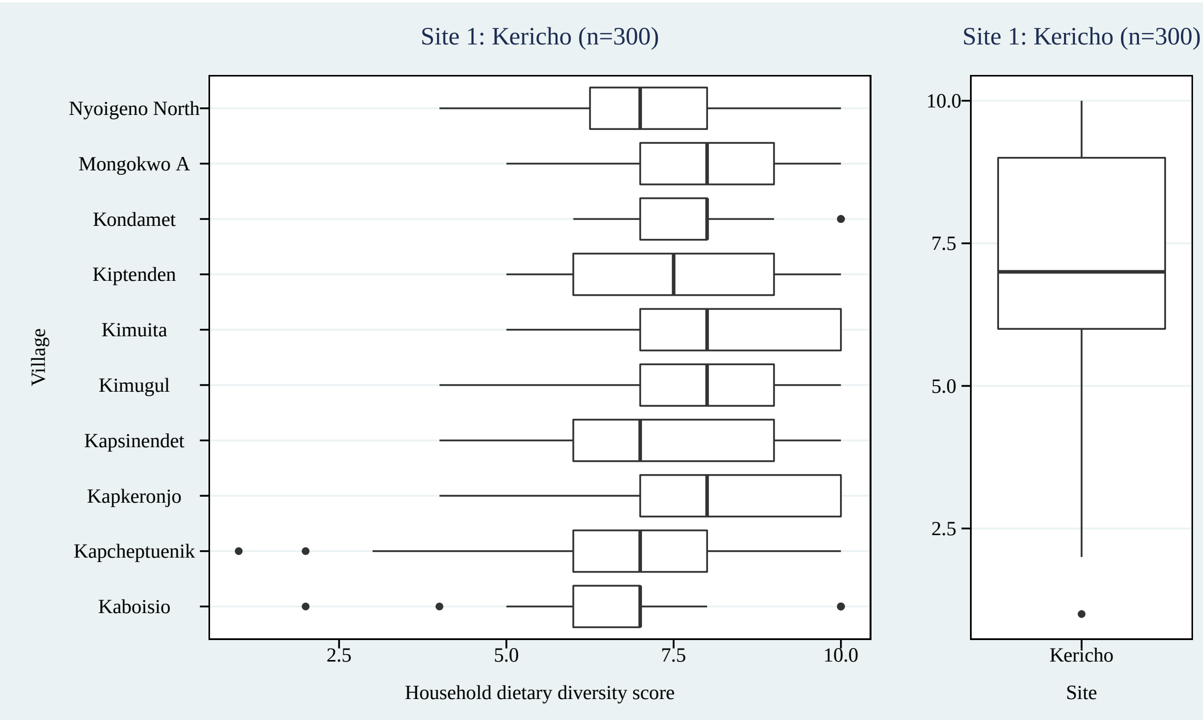

Figure 28: Household dietary diversity score.

Indicator 24. Food Security Score (FSS) [13]

The Food Security Score (FSS) is used to assess household food security status. The FSS is based on a set of household is by a combination of scores up to 10. A household is considered more food insecure when — in the last month and last 12 months —the household experienced (i) food shortages, (ii) not having enough to eat and no enough money to buy food, and (iii) the respondents' assessment of their food situation in the last 12 months. Questions used in development of the food security score were scored as shown in Table 12.

Table 12: Section L: Food security score questions

Question	Description	How it was scored
Has there been any days in the last month when your household experienced a shortage of food to eat?	Dummy variable	1 = Yes and 0 = No
Has there been any days in the last year when your household experienced a shortage of food to eat?	Dummy variable	1 = Yes and 0 = No
Which of the below statements best describes the food eaten in your household in the past 12 months?	Ranked statements	Often not enough to eat = 4 and 0 = Don't know
Please indicate the reason why you don't always have enough or the kinds of food you want.	Dummy variable	1 = Not enough money for food and 0 = Others
Please indicate whether the statement was often true, sometimes true, or never true for your household in the past 12 months.	Ranked statements	Often true = 1, Sometimes true = 0 and Never true = -1

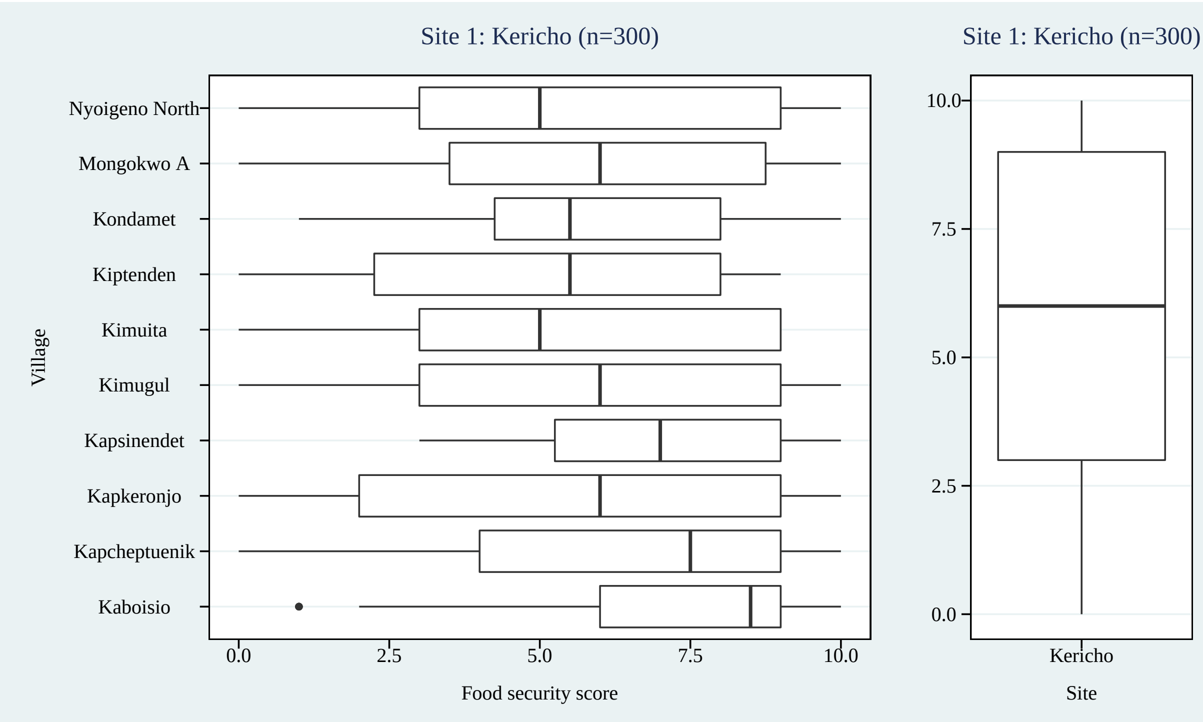

Figure 29: Food security socre.

[13] For more detailed information, refer to http://www.usaid.org

Indicator 25. Indicator 32: Food Consumption Score (FCS) [14]

The Food Consumption Score (FCS) is a weighted score used to assess households' access to food and the diversity of the diet. It is based on dietary diversity, food frequency and the nutritional importance of food groups consumed over a 7 day recall. FCS is calculated based on nine main food groups; main staples, vegetables, fruits, pulses, meat and fish, milk, oil, sugar and condiments. The food types are weighted based on the nutrient densities estimated by WFP (2008).

The procedure of calculating the FCS first starts with calculating the consumption frequencies (number of times the food type was eaten in the last 7 days) for each food group and then multiplying the frequency of each food group by its weight and sum the weighted food group scores to create the FCS. The weights used for different food groups are shown in Table 13 below.

Table 13: Section L: Food consumption score weights

Types of food	Weights
Cereals, Grains and Cereal Products	2
Roots, Tubers, and Plantains	2
Nuts and Pulses	3
Vegetables	1
Meat, Fish and Animal Products	4
Fruits	1
Milk/Milk Products	4
Fats/Oils	0.5
Sugar/Sugar Products/Honey	0.5
Spices/Condiments	0

The Food Consumption Score (FCS) is a weighted score used to assess households' access to food and its nutritional status. It is based on dietary diversity, food frequency and the nutritional importance of food groups consumed over a 7 day recall. FCS is measured as the sum of scores and ranges between 0 and 112 which would be achieved if a household ate each food group every day during the last 7 days. The higher the food score, the more food secure the household.

Limitations of FCS on measuring household nutrition Even though the FCS provides essential information on household diet, there are limitations: The FCS does not account consider foods consumed outside of the household e.g. meals consumed at the canteen or restaurants at work or school.

- It does not provide any information on intra-household food distribution i.e. no distinction as to the type and quantity of food consumed by males vs. females or by adults vs. minors.
- Using data on the collected as the number of days each food item was consumed in the last 7 days, makes it impossible to consider quantity of food eaten.
- Method fails to capture food loses due to perishing or food that was given to domestic animals e.g. dogs
- Using a seven day recall period, it provides a short term picture of food security irrespective of seasonality.

[14] For more detailed information, refer to http://home.wfp.org/

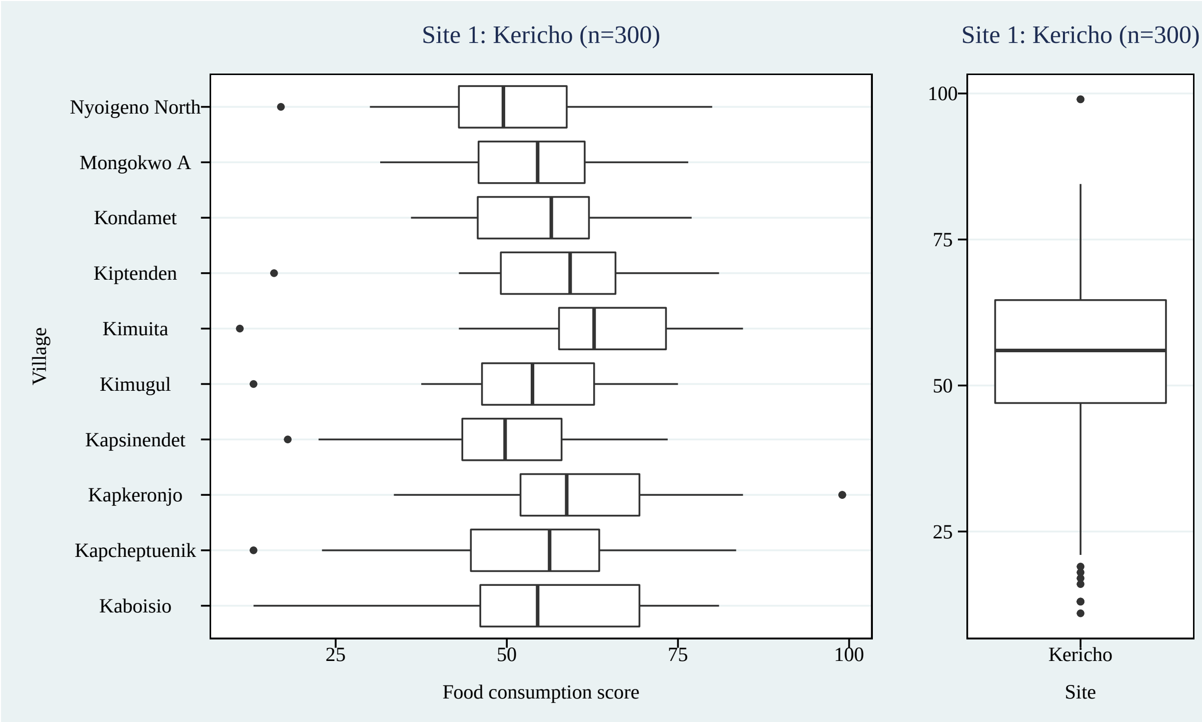

Figure 30: Food consumption score.

Once the food consumption score is calculated, the thresholds for the food consumption groups should be determined based on the frequency of the scores and the knowledge of the consumption behavior in that country/region. The typical thresholds are:

- Poor food consumption : 0 to 28
- Borderline food consumption : 28.5 to 35
- Acceptable food consumption : > 35

Below is a list of examples of case studies of application of FCS in different countries and regions;

- Community and Household Surveillance (CHS) in Lesotho [15]
- SADC VAC Towards identifying impacts of HIV/AIDS on Food Security in Southern Africa: 2003 [16]
- Armenia Food Security Survey: 2000 [17]

[15] For more detailed information, refer to https://www.humanitarianresponse.info/system/files/documents/files/WFP_LESOTHO_FACT_SHEET_CHS_OCT_2006.pdf

[16] For more detailed information, refer to http://reliefweb.int/report/botswana/towards-identifying-impacts-hivaids-food-security-southern-africa-and-implications

[17] For more detailed information, refer to http://reliefweb.int/report/armenia/wfpunicefunhcr-food-security-and-nutritional-status-survey

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Annexes

Indicators summary statistics tables

Table 14: Descriptive statistics of computed indicators 1

				Household size					Age dependency ratio					Household labor capacity			
	Site	Village	Sample size	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	30	2	13	6.00	2.50	29	0.00	66.67	18.27	17.29	1.20	9.70	4.58	1.70
2	Kericho	Kapcheptuenik	30	30	1	9	6.00	1.90	29	0.00	100.00	18.60	29.27	0.80	7.60	4.31	1.61
3	Kericho	Kapkeronjo	30	30	3	11	7.00	2.20	30	0.00	66.67	17.86	21.68	2.30	8.50	5.14	1.69
4	Kericho	Kapsinendet	30	30	1	9	5.00	2.10	30	0.00	100.00	21.00	27.29	1.00	7.00	3.91	1.58
5	Kericho	Kimugul	30	30	1	12	6.00	2.40	30	0.00	100.00	17.71	24.87	1.00	9.70	4.46	1.91
6	Kericho	Kimuita	30	30	1	10	5.00	2.10	28	0.00	100.00	23.84	24.57	0.80	7.50	3.98	1.61
7	Kericho	Kiptenden	30	30	2	11	6.00	2.30	30	0.00	100.00	32.99	36.37	1.60	8.50	4.19	1.80
8	Kericho	Kondamet	30	30	2	9	5.00	1.80	30	0.00	100.00	34.79	35.26	1.50	6.40	3.65	1.23
9	Kericho	Mongokwo A	30	30	1	11	5.00	2.40	29	0.00	200.00	35.53	43.39	0.80	8.10	4.10	1.88
10	Kericho	Nyoigeno North	30	30	1	12	6.00	2.50	30	0.00	100.00	24.16	33.38	1.00	9.50	4.49	1.94

Table 15: Descriptive statistics of computed indicators 2

				Farm size (Ha)					Number of plots					Farm under cultivation (Ha)				
	Site	Village	Sample size	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	30	0.08	1.30	0.39	0.37	30	1	3	2.00	0.59	30	0.03	1.30	0.31	0.33
2	Kericho	Kapcheptuenik	30	30	0.08	4.05	0.91	0.85	30	1	4	2.00	0.74	30	0.08	3.64	0.74	0.74
3	Kericho	Kapkeronjo	30	30	0.04	7.69	1.45	1.96	30	1	5	2.00	1.00	30	0.00	4.05	0.88	1.03
4	Kericho	Kapsinendet	30	30	0.10	3.64	0.67	0.73	30	1	5	2.00	0.75	30	0.00	1.86	0.49	0.47
5	Kericho	Kimugul	30	30	0.04	4.25	0.91	1.08	30	1	3	2.00	0.66	30	0.02	3.44	0.61	0.80
6	Kericho	Kimuita	30	30	0.04	3.00	0.88	0.78	30	1	4	2.00	0.73	30	0.00	2.60	0.58	0.55
7	Kericho	Kiptenden	30	30	0.08	3.64	0.91	0.84	30	1	3	2.00	0.61	30	0.08	2.43	0.67	0.62
8	Kericho	Kondamet	30	30	0.04	1.66	0.49	0.48	30	1	3	2.00	0.61	30	0.04	1.60	0.41	0.43
9	Kericho	Mongokwo A	30	30	0.08	4.80	1.04	1.11	30	1	3	2.00	0.66	30	0.00	2.80	0.72	0.71
10	Kericho	Nyoigeno North	30	30	0.04	24.77	1.94	4.47	30	1	4	2.00	0.76	30	0.00	16.27	1.33	2.98

Table 16: Descriptive statistics of computed indicators 3

				Tropical livestock unit (TLU)					Household domestic asset index (HDA)			
	Site	Village	Sample size	N	Min	Max	Mean	SD	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	7	0.20	2.00	1.17	0.64	0.80	13.90	4.99	3.35
2	Kericho	Kapcheptuenik	30	12	0.56	5.00	2.06	1.42	0.50	23.20	6.32	4.93
3	Kericho	Kapkeronjo	30	12	0.76	18.00	4.15	4.63	1.00	25.80	7.50	5.74
4	Kericho	Kapsinendet	30	11	1.00	4.00	1.78	0.98	1.00	14.80	5.46	3.33
5	Kericho	Kimugul	30	12	1.00	5.00	2.04	1.30	2.00	16.80	5.82	3.64
6	Kericho	Kimuita	30	10	1.00	6.00	1.94	1.53	1.00	17.80	6.42	4.07
7	Kericho	Kiptenden	30	8	1.00	8.00	3.45	2.65	1.00	21.60	6.26	4.67
8	Kericho	Kondamet	30	5	1.00	10.00	3.60	3.65	1.00	9.70	4.82	2.39
9	Kericho	Mongokwo A	30	9	1.00	3.00	1.93	0.80	1.00	14.80	5.93	3.25
10	Kericho	Nyoigeno North	30	11	0.24	20.00	3.32	5.66	1.00	22.50	6.80	4.58

Table 17: Descriptive statistics of computed indicators 4

				Male domestic asset index					Female domestic asset index					Joint domestic asset index					Gender asset disparity index			
	Site	Village	Sample size	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	30	0.00	1.00	0.38	0.39	30	0.00	1.00	0.25	0.30	30	0.00	1.00	0.37	0.43	0.00	Inf	Inf	Inf
2	Kericho	Kapcheptuenik	30	30	0.00	1.00	0.22	0.27	30	0.00	1.00	0.30	0.33	30	0.00	1.00	0.47	0.41	0.00	Inf	Inf	Inf
3	Kericho	Kapkeronjo	30	30	0.00	1.00	0.38	0.34	30	0.00	0.55	0.16	0.20	30	0.00	1.00	0.46	0.42	0.00	2.00	0.62	0.59
4	Kericho	Kapsinendet	30	30	0.00	1.00	0.29	0.35	30	0.00	1.00	0.27	0.35	30	0.00	1.00	0.45	0.44	0.00	Inf	Inf	Inf
5	Kericho	Kimugul	30	30	0.00	1.00	0.31	0.27	30	0.00	1.00	0.38	0.36	30	0.00	1.00	0.31	0.38	0.00	Inf	Inf	Inf
6	Kericho	Kimuita	30	30	0.00	1.00	0.39	0.32	30	0.00	1.00	0.31	0.29	30	0.00	1.00	0.30	0.38	0.00	Inf	Inf	Inf
7	Kericho	Kiptenden	30	30	0.00	1.00	0.38	0.33	30	0.00	1.00	0.24	0.30	30	0.00	1.00	0.38	0.41	0.00	Inf	Inf	Inf
8	Kericho	Kondamet	30	30	0.00	1.00	0.31	0.33	30	0.00	1.00	0.32	0.34	30	0.00	1.00	0.37	0.39	0.00	Inf	Inf	Inf
9	Kericho	Mongokwo A	30	30	0.00	1.00	0.33	0.30	30	0.00	1.00	0.33	0.33	30	0.00	1.00	0.34	0.40	0.00	Inf	Inf	Inf
10	Kericho	Nyoigeno North	30	30	0.00	1.00	0.40	0.37	30	0.00	0.68	0.18	0.24	30	0.00	1.00	0.43	0.45	0.00	Inf	Inf	Inf

Table 18: Descriptive statistics of computed indicators 5

				Gross crop production income					Farm income share					Off farm income share					Forest income share				
	Site	Village	Sample size	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	28	5600.00	1344000.00	87539.29	248600.32	28	0.03	1.00	0.72	0.35	16	0.11	1.00	0.62	0.30	0				
2	Kericho	Kapcheptuenik	30	28	1400.00	712000.00	150473.00	188110.21	29	0.03	1.00	0.76	0.34	15	0.02	1.00	0.52	0.35	2	0.02	0.06	0.04	0.03
3	Kericho	Kapkeronjo	30	29	2010.00	1596000.00	151180.00	292676.66	29	0.02	1.00	0.68	0.31	18	0.03	1.00	0.53	0.28	3	0.01	0.36	0.18	0.18
4	Kericho	Kapsinendet	30	29	640.00	191600.00	45288.00	52494.22	30	0.14	1.00	0.75	0.30	15	0.17	0.86	0.50	0.21	3	0.02	0.08	0.04	0.03
5	Kericho	Kimugul	30	27	4000.00	322000.00	81893.26	76555.60	28	0.13	1.00	0.75	0.28	19	0.08	1.00	0.48	0.29	2	0.04	0.04	0.04	0.00
6	Kericho	Kimuita	30	28	100.00	392000.00	60573.57	78189.77	29	0.12	1.00	0.72	0.32	16	0.22	1.00	0.58	0.24	0				
7	Kericho	Kiptenden	30	27	1498.00	1896000.00	183936.21	366108.41	28	0.01	1.00	0.78	0.32	15	0.02	1.00	0.53	0.37	2	0.01	0.17	0.09	0.11
8	Kericho	Kondamet	30	29	750.00	260000.00	41996.55	50447.70	29	0.11	1.00	0.63	0.32	20	0.25	1.00	0.59	0.22	0				
9	Kericho	Mongokwo A	30	27	560.00	336000.00	93314.44	92690.76	28	0.16	1.00	0.76	0.30	14	0.20	1.00	0.54	0.26	1	0.03	0.03	0.03	
10	Kericho	Nyoigeno North	30	26	1400.00	3209000.00	311085.00	814146.94	27	0.05	1.00	0.65	0.34	20	0.03	1.00	0.58	0.30	2	0.11	0.75	0.43	0.45

Table 19: Descriptive statistics of computed indicators 6

				Number of income sources					Simpson index				Shannon-Weiner index			
	Site	Village	Sample size	N	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	30	1	3	2.00	0.79	0.00	0.64	0.24	0.23	0.00	1.05	0.38	0.36
2	Kericho	Kapcheptuenik	30	30	1	5	2.00	1.03	0.00	0.59	0.25	0.21	0.00	0.96	0.40	0.34
3	Kericho	Kapkeronjo	30	30	1	5	2.00	1.28	0.00	0.77	0.36	0.25	0.00	1.49	0.59	0.44
4	Kericho	Kapsinendet	30	30	1	4	2.00	0.99	0.00	0.65	0.28	0.24	0.00	1.16	0.44	0.39
5	Kericho	Kimugul	30	30	1	4	2.00	1.10	0.00	0.64	0.30	0.23	0.00	1.13	0.51	0.38
6	Kericho	Kimuita	30	30	1	5	2.00	0.95	0.00	0.75	0.29	0.23	0.00	1.48	0.45	0.37
7	Kericho	Kiptenden	30	30	1	5	2.00	0.99	0.00	0.60	0.20	0.23	0.00	1.10	0.32	0.38
8	Kericho	Kondamet	30	30	1	3	2.00	0.63	0.00	0.62	0.30	0.22	0.00	1.02	0.46	0.34
9	Kericho	Mongokwo A	30	29	1	4	2.00	0.99	0.00	1.00	0.31	0.26	0.00	1.14	0.46	0.39
10	Kericho	Nyoigeno North	30	30	1	5	2.00	1.05	0.00	0.67	0.30	0.24	0.00	1.19	0.48	0.40

Table 20: Descriptive statistics of computed indicators 7

				Wealth index				Progress out of Poverty Index (PPI)				
	Site	Village	Sample size	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	-2.14	1.26	-0.10	0.80	30	15	52	32.80	9.77
2	Kericho	Kapcheptuenik	30	-2.00	1.81	-0.28	0.87	30	18	52	36.77	8.50
3	Kericho	Kapkeronjo	30	-1.96	7.78	0.45	1.75	30	19	57	37.27	10.11
4	Kericho	Kapsinendet	30	-2.72	0.92	-0.41	0.87	30	14	57	38.80	11.50
5	Kericho	Kimugul	30	-1.93	3.43	0.15	1.20	30	13	53	36.10	9.87
6	Kericho	Kimuita	30	-1.83	0.83	-0.37	0.62	30	24	68	40.23	9.45
7	Kericho	Kiptenden	30	-1.58	1.41	-0.03	0.62	30	14	60	39.67	11.80
8	Kericho	Kondamet	30	-0.54	1.45	0.11	0.47	30	18	55	39.43	9.80
9	Kericho	Mongokwo A	30	-1.25	3.00	0.20	0.82	30	21	61	38.27	10.87
10	Kericho	Nyoigeno North	30	-3.26	6.67	0.29	1.52	30	18	59	38.60	12.20

Table 21: Descriptive statistics of computed indicators 8

				Food security score (FSS)					Food consumption score (FCS)					Household Dietary Diversity Score (HDDS)				
	Site	Village	Sample size	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1	Kericho	Kaboisio	30	30	1.00	10.00	7.03	2.95	30	13.00	81.00	54.82	17.96	30	2.00	10.00	6.80	1.73
2	Kericho	Kapcheptuenik	30	30	0.00	10.00	6.23	3.05	30	13.00	83.50	52.73	17.46	30	1.00	10.00	6.77	2.14
3	Kericho	Kapkeronjo	30	30	0.00	10.00	5.10	3.45	30	33.50	99.00	60.88	15.40	30	4.00	10.00	8.13	1.85
4	Kericho	Kapsinendet	30	30	3.00	10.00	7.03	2.27	30	18.00	73.50	49.47	13.05	30	4.00	10.00	7.27	1.87
5	Kericho	Kimugul	30	30	0.00	10.00	5.73	3.35	30	13.00	75.00	53.87	12.84	30	4.00	10.00	7.77	1.59
6	Kericho	Kimuita	30	30	0.00	9.00	5.43	3.21	30	11.00	84.50	62.92	14.43	30	5.00	10.00	8.13	1.57
7	Kericho	Kiptenden	30	30	0.00	9.00	5.20	3.06	30	16.00	81.00	57.88	12.71	30	5.00	10.00	7.77	1.70
8	Kericho	Kondamet	30	30	1.00	10.00	5.77	2.61	30	36.00	77.00	55.35	10.67	30	6.00	10.00	7.60	1.19
9	Kericho	Mongokwo A	30	30	0.00	10.00	5.83	3.24	30	31.50	76.50	53.38	11.08	30	5.00	10.00	8.00	1.55
10	Kericho	Nyoigeno North	30	30	0.00	10.00	5.27	3.33	30	17.00	80.00	51.22	14.34	30	4.00	10.00	7.27	1.53

Sentinel landscapes Household Module

Section G: List of farm and domestic assets

Table 22: Section G: List of farm and domestic assets

Domestic	**Transport**	**Farm**
Gas stove/Gas cooker	Car/Truck	Hoes
Kerosine Stove	Motorcycle	Spades/Shovels
Charcoal/Wood fuel stove	Bicycle	Ox-Ploughs
Refrigenerator	Cart(animal drawn)	Sprayer-pump
Radio		Water-pump-manual
Television		Water-pump-diesel
Mobile phone		Machetes
Sofa set		Milking cans
Sewing machine		Granary
Mosquito nets		Grain Miller
Working Iron		
Bed/mattress		
Blender		
Water tanks		
Diesel machines		

Kenya PPI 2012 Scorecard and Look-up Tables

R packages used

This report was produced using the following R packages.

R Core Team (2015). *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.*

R Core Team (2015). *foreign: Read Data Stored by Minitab, S, SAS, SPSS, Stata, Systat, Weka, dBase, ... R package version 0.8-63. http://CRAN.R-project.org/package=foreign*

Hadley Wickham (2015). *plyr: Tools for Splitting, Applying and Combining Data. R package version 1.8.3. http://CRAN.R-project.org/package=plyr*

Hadley Wickham and Romain Francois (2015). *dplyr: A Grammar of Data Manipulation. R package version 0.4.2. http://CRAN.R-project.org/package=dplyr*

Hadley Wickham (2014). *reshape2: Flexibly Reshape Data: A Reboot of the Reshape Package.. R package version 1.4.1. http://CRAN.R-project.org/package=reshape2*

Hadley Wickham and Winston Chang (2015). *ggplot2: An Implementation of the Grammar of Graphics. R package version 1.0.1. http://CRAN.R-project.org/package=ggplot2*

Jeffrey B. Arnold (2015). *ggthemes: Extra Themes, Scales and Geoms for 'ggplot2'. R package version 2.2.1. http://CRAN.R-project.org/package=ggthemes*

Baptiste Auguie (2012). *gridExtra: functions in Grid graphics. R package version 0.9.1. http://CRAN.R-project.org/package=gridExtra*

Yihui Xie (2015). *knitr: A General-Purpose Package for Dynamic Report Generation in R. R package version 1.10.5. http://CRAN.R-project.org/package=knitr*

David Kahle and Hadley Wickham (2015). *ggmap: Spatial Visualization with ggplot2. R package version 2.5.2. http://CRAN.R-project.org/package=ggmap*

Markus Loecher (2015). *RgoogleMaps: Overlays on Google map tiles in R. R package version 1.2.0.7. http://CRAN.R-project.org/package=RgoogleMaps*

David B. Dahl (2014). *xtable: Export tables to LaTeX or HTML. R package version 1.7-4. http://CRAN.R-project.org/package=xtable*

Marek Hlavac (2015). *stargazer: Well-Formatted Regression and Summary Statistics Tables. R package version 5.2. http://CRAN.R-project.org/package=stargazer*

Søren Højsgaard, Ulrich Halekoh with contributions from Jim Robison-Cox, Kevin Wright, Alessandro A. Leidi and others. (2014). *doBy: Groupwise statistics, LSmeans, linear contrasts, utilities. R package version 4.5-13. http://CRAN.R-project.org/package=doBy*

Virasakdi Chongsuvivatwong (2012). *epicalc: Epidemiological calculator. R package version 2.15.1.0. http://CRAN.R-project.org/package=epicalc*

Gregory R. Warnes, Ben Bolker, Gregor Gorjanc, Gabor Grothendieck, Ales Korosec, Thomas Lumley, Don MacQueen, Arni Magnusson, Jim Rogers and others (2015). *gdata: Various R Programming Tools for Data Manipulation. R package version 2.16.1. http://CRAN.R-project.org/package=gdata*

R version used

Below is the description of the version of R used, operating system and attached or loaded packages.

- R version 3.2.1 (2015-06-18), `x86_64-apple-darwin13.4.0`
- Locale: `en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8`
- Base packages: base, datasets, graphics, grDevices, methods, stats, utils
- Other packages: doBy 4.5-13, dplyr 0.4.3, epicalc 2.15.1.0, foreign 0.8-63, gdata 2.16.1, ggmap 2.6.1, ggplot2 2.1.0, ggthemes 3.0.2, gridExtra 2.0.0, knitr 1.10.5, MASS 7.3-45, nnet 7.3-9, plyr 1.8.3, reshape2 1.4.1, RgoogleMaps 1.2.0.7, stargazer 5.2, survival 2.38-1, xtable 1.8-2
- Loaded via a namespace (and not attached): assertthat 0.1, colorspace 1.2-6, DBI 0.3.1, digest 0.6.9, geosphere 1.4-3, grid 3.2.1, gtable 0.2.0, gtools 3.5.0, jpeg 0.1-8, labeling 0.3, lattice 0.20-31, lazyeval 0.1.10, magrittr 1.5, mapproj 1.2-3, maps 2.3-10, Matrix 1.2-1, munsell 0.4.3, parallel 3.2.1, png 0.1-7, proto 0.3-10, R6 2.1.0, RColorBrewer 1.1-2, Rcpp 0.11.6, rjson 0.2.15, RJSONIO 1.3-0, scales 0.4.0, sp 1.1-1, splines 3.2.1, stringi 0.5-2, stringr 1.0.0, tools 3.2.1