Maragua and Thika/Chania Baseline Survey for the Upper Tana-Nairobi Water Fund



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Water is the driving force of all nature – Leonardo da Vinci



Executive summary

To establish the baseline land and water-use measurements for a monitoring programme in two sub-catchments of Kenya's upper Tana River and to inform the design of the Upper Tana Water Fund, a survey of 730 individuals was conducted in October 2013.

Six wards in the Maragua and Thika/Chania sub-catchments were randomly selected, and cluster sampling was used within wards to select interviewees. The data collection was done using iPads and quicktapsurvey software. Interview questions covered land use, livestock management, environmental management, water use, agricultural practices, and participation in community associations. The margin of error for the survey is 3.4% when the two sub-catchments are combined and 5.1% for each individual sub-catchment. The two sub-catchments are largely located within central Kenya's Murang'a County.

The 2009 Kenya census found that 70% (±2.2%) of Murang'a County had completed primary school or higher and 18% (±2.2%) had completed secondary school or higher. This compares with 74% (±3.4%) in the survey data for primary school or higher and 24% (±3.4%) for secondary school or higher. Given the margins of error and the four-year time difference, this suggests the survey data are valid estimations of the overall population in the survey area. Murang'a County is largely uniform in ethnicity and economic livelihoods—almost all are Kikuyus and farmers—which suggests that the survey results are generalizable for all of Murang'a County.

The average respondent was 48 years old, a male (57%) and a farmer (98%). Female-headed households totalled 5% of the 730 respondents. The average household size was 5.4.

Landholding averaged 2.0 acres of which 1.5 acres were farmland. There are approximately 175,000 landholders in the two sub-catchments, and there is minimal variation in landholdings (mean=2.0, median=1.5, min=0.1, max=20.0 acres).

All respondents grew crops in the last 12 months. Maize was the most frequently grown crop (97%). Only 23% of respondents were food secure year round. 32% of respondents stated that they irrigate during the dry season. 77% of respondents said erosion occurs on their land. 54% stated they had 25% or less of their land under soil conservation measures. Terracing and grass strips were the most common soil conservation measures. 53% said the vegetation cover on their farm has declined compared to five years ago, and 79% say the colour of the local river after a rain is a higher intensity now than five years ago, suggesting that soil erosion is increasing. 45% said it takes more than one month for the colour of the local river water to clear after a rain. While the land and water issues in the study area are substantial, 93% of respondents said they would be interested in joining a land and water conservation project.

The survey data suggest a KENFAP focus on Kambiti and Nginda wards and a SACDEP focus on Gituamba and perhaps Kangari wards in the portions upstream from the Thika dam and Mwagu water intake. (Downstream areas would, of course, make no difference to the water fund's objective of improving water quality and quantity to Nairobi.)

Overall water fund activities should target the 39% of respondents who cultivate near a river or stream, say erosion occurs on their land, and have less than 51% of their land under soil conservation. Another target group is the 32% of respondents who farm on steep or very steep land, say soil erosion occurs on their land, and have less than 51% of their land under soil conservation.

For the water fund design, the survey data suggest that the Maragua sub-catchment has greater land and water-use issues than the Thika/Chania sub-catchment. The data also suggest there is greater variations in land use in Maragua than Thika/Chania, which will thus require a greater range of on-the-ground activities to address local issues. Livelihood strategies, for example, vary in Maragua's Kambiti ward from village to village (mangos in one, French green beans in another), but the wards in Thika/Chania tend to have largely similar livelihood strategies (tea, coffee and bananas). Hence, Thika/Chania may be an easier place to address water quality and quantity issues linked to land use. The tea-growing areas in the Thika/Chania sub-catchment, however, tend to have minimal soil erosion issues, and water quality and quantity gains in these areas are likely to be nominal.

Specific recommendations for both sub-catchments are to do a Rare Pride Campaign to build local knowledge and awareness about land and water issues, work with the local water resources users associations because they already have a fair degree of local presence, and if possible, leave Kigumo and Kariara wards as controls for an eventual impact assessment.

For an impact evaluation with the greatest potential to show positive benefits, project activities should focus on large changes in a few key areas in the next three to five years such as terracing of steep and very steep farmlands and buffer zones of permanent vegetation along local rivers. Consider going deep on a few activities rather than wide on many different activities.

This baseline assessment is designed to allow either a panel data or a random/cluster sample approach for the impact evaluation. Such as evaluation makes sense only if the target audience for the impact assessment are numbers-driven policymakers and donors. A qualitative

assessment would be a more cost-effective option if the target audience for the assessment are more interested in understanding what worked and why and less interested in quantitative evidence of impacts. Should resources and time allow, doing both qualitative and quantitative assessments would be ideal.

It is not necessary to collect data on all of the 100+ indicators in this report at a later stage. For the impact evaluation, the following 14 indicators would be sufficient:

- 1. Respondent characteristics (average household size, gender, marital status, age, and education level)
- 2. Consumer durable assets to show the changes in wealth.
- 3. % saying they are food insecure more than half the year.
- 4. % saying vegetation cover on their farm has decreased compared to five years ago.
- 5. % saying their cultivated land neighbours a river or stream and that the distance from the river or stream to the edge of the cultivated areas is 0-2 metres.
- 6. % saying there is no buffer zone of permanent vegetation along all or most of the riverbanks in their area.
- 7. % of buffer zone along riverbanks that is 0-2 meters wide.
- 8. % saying it takes more than one month for the colour of the local river water to clear after a rain.
- 9. % saying soil erosion occurs on their land.
- 10. % with zero and 1-25% of their land having soil conservation measures.
- 11. % saying overgrazing is common in their area.
- 12. Average number of trees on respondents' land.
- 13. % who participate in a water resource users association.
- 14. % who participate in a community forest association.



1 Introduction

The Tana is Kenya's largest and longest river and stretches 1,000 km (620 miles) from the edge of the Great Rift Valley to the Indian Ocean. Kenya is a water-scare country, so it is no surprise that one in four Kenyan's live near the Tana River or its tributaries. The river is powered by the twin 'water towers' of Kenya: the Aberdare Mountains and Mount Kenya. The water towers themselves are protected areas that exclude development, and thus the headwaters of the Tana River are relatively well protected. Downstream of the protected areas, the water issues begin that impact the lives of million of people and the wildlife that depends on the river.

The upper Tana River watershed is shaped like a hand with each finger supplying water to the arm of the river. Two tributaries in the 'thumb' of the hand provide 90% of the water for Nairobi, Kenya's largest city. Sediment levels at Nairobi's municipal water treatment plants are high, and the city spends the equivalent of several million US dollars each year to filter out the sediment. Several days a year, sediment loads exceed the treatment capacity and the main water intake is closed. This leaves a city of 5 million daytime residents without a continuous source of piped water.

The upper Tana River also provides the water that feeds a cascade of five hydropower dams that supply 66% of the electricity in Kenya. Sediment loads, however, are higher than anticipated, and the reservoir capacity of the farthest upstream dam (Masinga) is decreasing faster than expected. This reduces water storage capacity and power production during the dry season, which is when Kenya most needs the power.

Reducing the sediment loads and increasing dry-season water flows in its tributaries would improve the well-being of millions of people by increasing the availability of water and electricity. This would also benefit the river itself and the wildlife it supports.

To improve water quality and quantity, The Nature Conservancy has partnered with several organizations in Kenya to develop a water fund in the upper Tana watershed. The water fund catalyses better upstream watershed management with funding from downstream water users. It builds on experiences in Latin America for establishing payments for watershed services and is founded on the principle that it is cheaper to prevent water problems at the source than treat them later.

The Upper Tana Water Fund uses a learning-by-doing approach, and several pilot projects have been developed in partnership with national NGOs. The Kenya National Federation of Agricultural Producers (KENFAP) and the Sustainable Agriculture Community Development Programme (SACDEP) have designed pilot projects aimed at improving water quality and quantity in the upper Tana. The Nature Conservancy (TNC) and the United Nations Development Programme's (UNDP's) GEF small-grants programme helped fund the pilots.

KENFAP is focusing its pilot activities on the Maragua River sub-catchment. This area is a primary source of the sediments flowing into Kenyan's Masinga reservoir that feeds the cascade of hydroelectric dams downstream.

SACDEP is focusing its pilot activities on the Thika/Chania Rivers, which supply most of Nairobi's water. Water is transferred from the Thika to the Chania sub-catchment via a tunnel and then to Nairobi. A map of the Nairobi water system is included near the end of the main report (page 46).

Building long-term support for the water fund requires demonstrating that measurable change on the ground is possible. Yet the upper Tana is a complex landscape of several million people, institutions with under-funded mandates, and a colonial history of forced soil conservation measures.

This report details the baseline socioeconomic measurements collected from the Maragua and Thika/Chania sub-catchments. The ability to measure changes on the ground is vital to the learning-by-doing approach.

The fieldwork for baseline data collection took place from 30 September to 17 October 2013 and was done with a combined team of KENFAP and SACDEP enumerators and supervisors. Costs were shared by KENFAP, SACDEP, UNDP-GEF, TNC and Pentair.

The objectives of the fieldwork were to (i) establish baseline land and water-use measurements for a monitoring programme in the two sub-catchments and (ii) inform the detailed design of the Upper Tana Water Fund.

2 Methods

This baseline survey was designed to support a future impact assessment. Ecologists know the design as a before-after, control-impact (BACI) assessment and economists know it as a

difference-in-differences (DiD) assessment. The survey was also designed to provide the option of a panel-data structure.

The preparations for the survey fieldwork took two months and entailed reaching general agreement among the partners on the survey approach, developing the budget, arranging the fieldwork, hiring enumerators, preparing the draft questionnaire, and having a third party review the human subject research protocols to ensure they meet TNC's Standard Operating Procedures.

Because there have already been extensive consultations with stakeholders in the upper Tana and because the baseline needed to be completed as soon as possible so pilot water fund activities could commence, the team elected to focus on quantitative survey results. Local knowledge of the study area among the water fund team is high given that several of them grew up in the study area, and the team felt qualitative tools such as focus group discussion and key information interviews would not add many nuances to the understanding of the local context and would add to the time needed to complete the baseline.

Once the field team and draft questionnaire were ready, the field team met in the study area for two days of training for the six enumerators and two field supervisors including a pre-test of the questionnaire with 18 households. The questionnaire was revised after the pre-test and used for a half day of interviews in several villages and then revised once more. The final questionnaire contained 104 questions and is included as an annex.

This baseline used an innovative approach for data collection. Six Apple iPad minis (Cupertino, CA, USA, 2013) with 16GB, WiFi and iOS7 were purchased along with waterproof covers and electrical plug adapters. Each iPad cost US\$343.

The software application was QuickTapSurvey version 5.4 (<u>www.quicktapsurvey.com</u>, TabbleDabble Inc. Toronto, Canada, 2013). This is a tablet-only app that allows for the creation of surveys with skip and branching logic, multiple question types, offline data collection, encrypted data transfer and storage, and cloud-based data downloads. Pricing depends on the length of the survey, the number of survey tablets in use, and the number of surveys conducted. For the Kenya survey, the cost for a two-month subscription to the software was \$288. Survey data were collected offline and uploaded each evening to the software provider's server via a local WiFi connection.

	Name of enumerator?	
	Everine	
	John	
*	Kelvin	
	Margaret	
	Mary	
	Samuel	rev.
	the state of the s	

The paper questionnaire in the annex was updated to reflect the precise order and wording of the electronic survey used to collect data via iPads. The questionnaire itself was developed by KENFAP with input from SACDEP and TNC. The indicators were chosen based on a theory of change from expected water fund activities, which highlighted likely changes in land use, livestock management, environmental management, water use, agricultural practices, and participation in community associations.

Under the 2010 constitution, Kenya is administratively organized into Counties, Constituencies and Wards. The sample frame was the Constituencies in Murang'a and Kiambu Counties bordering the Maragua and Thika/Chania rivers. This area is almost exclusively inhabited by the Kikuyu tribe—the largest ethnic group in Kenya and not a self-identified indigenous group. Murang'a County, where the majority of the survey area is located, has one of the lowest <u>ethnolinguistic fractionalization</u> scores among Kenyan counties. In other words, there is high ethnolinguistic homogeneity in the study area. There is no demographic information available at the ward level, but at the constituency level, the inter-constituency correlation is high with nominal differences among the focal constituencies in male/female ratios, average household size, and government spending per capita (2009 census data). This suggests that the generalizability of the survey data is likely to be high for all of Murang'a County.

The survey was a cluster sample of households in six randomly selected wards. The constituencies along the Maragua, Thika and Chania rivers where the project was likely to work were highlighted by KENFAP and SACDEP leaders. The 30 wards within these constituencies were then put into a list and a random number generator was used to select the six sample wards (Figure 1). The boundaries of the wards and several of the ward names have changed from the 2009 GIS data used for the map below, but the circles show the sampling areas. One notable change was that Maragua Ridge ward was merged with Kambiti ward prior to the March 2013 election. This report uses the ward names as per the 2013 electoral registry (Annex 2).



Figure 1. Map of Maragua and Thika/Chania sub-catchments showing the approximate location of the survey wards

2.1 Counterfactuals

Measuring the indicators in this report before and after project activities will show what has changed in the wards, but will not show if project activities drove the changes. Some of the observed changes may have been driven by other factor such as other projects in the area or economic growth. It is possible to infer what would have happened by using control groups (i.e., attribution). This is known as the 'counterfactual' or what would have happened anyway without the project.

The challenge in identifying a viable counterfactual is finding a control group with similar characteristics to the participant group in everything except for the project activities. There are statistical techniques that can help such as nearest-neighbour matching, but matching often requires large datasets from which to draw the controls. This makes it difficult to do at the local level.

If several of the wards in the sample end up with no project activities within their borders, these wards can serve as the control groups. For statistical power, there would need to be at least two wards (about 240 interviews) that serve as the controls. This would provide the basic inputs for the before-after, control-impact (BACI) design.

If, however, five or more of the wards are home to project activities, then an alternative design is possible using what is known as 'panel data'. Panel data follow groups of participating and

non-participating individuals over time and measure changes in indicators for each individual periodically in a BACI design. With panel data, only the relative changes in an individual's indicators are measured. The current dataset has the names and mobile phone numbers for 680 individuals in a password-protected file. For the follow-up survey, one could re-interview the 680 baseline participants with contact info and divide them into participating and non-participating groups. Assuming between 40% (n=272) and 60% (n=408) of the 680 individuals participate in project activities, and assuming a high proportion of the baseline respondents remain contactable, one could then measure the average changes in each group between the baseline and the follow-on surveys.

Panel data surveys, however, take more time and are higher cost than a random-sample or cluster-sample survey. They also require more diligence. Individuals who cannot be re-contacted during the follow-up survey are considered 'lost to follow-up', and a sample of the loss to follow-up group needs to be tracked down and interviewed to understand why they dropped out. This is a time-intensive effort, but without this check, there is a risk that the loss to follow-up individuals could have been negatively impacted by the project and left the area. Panel data studies that do not include a loss to follow-up check will not stand up to peer review.

Doing the follow-up assessment by mobile phone could greatly reduce the costs of the data collection. This could be done by texting potential respondents and offering a small M-PESA transfer in exchange for a interview by phone to ask them a selection of the same questions in the baseline survey.

2.2 Sampling

This survey used cluster sampling. With topographical maps as a reference, local experts in each ward (usually the local chief or sub-chief) were asked to identify villages in their ward that were typical and atypical in wealth and dominant livelihoods. A sample of villages that were 'typical' and those that were 'different' (approximately five to seven villages) were chosen in each ward. Formal permission was requested to conduct the survey from the chief of each ward. The local chief also generally provided recommendations for local guides. There was one local guide for each two enumerators.



Refusal rates for interviews were less than 10% in all the wards.

For the sample size, a design effect of 0.9 was assumed given the cluster sample approach and high inter-cluster correlation among wards. The anticipated prevalence rate for all indicators was 50% (the most conservative). For each sub-catchment, a 95% Confidence Interval and a 5% margin of error were the targets. There were approximately 30,000 households in the sample area in December 2012 according to government estimates.

The original plan was to use voter lists from the March 2013 election to randomly select households in a ward for interviews. Unfortunately, there were delays in securing the voter lists, and they arrived too late for this survey. The voter lists come from a registration process in late 2012 where 14.3 million people registered to vote. In Murang'a County, 457,000 people registered out of population of approximately 943,000 (48%). Only those 18 or older can register to vote in Kenya. The demographics of who actually registered have not yet been released. If it is similar to other countries, those who registered to vote tend to be older and wealthier than the average.

3 Results

3.1 Reliability and validity

Completed and valid interviews totalled 730. The distribution of the sample over the six wards is shown in Table 1. The average interview lasted 21 minutes, and each enumerator completed an average of 9.6 interviews a day.

Sub-catchment and ward	Population (2009)	Average household size	Number of households	Households sampled	Margin of error
Subtotal Maragua	68,875	5.4	12,817	362	5.1%
Kambiti ward	21,195	4.9	4,306	116	9.0%
Kigumo ward	23,320	5.9	3,980	128	8.5%
Nginda ward	24,360	5.3	4,563	118	8.9%
Subtotal Thika/Chania	92,801	5.3	17,489	368	5.1%
Gituamba ward	25,434	5.1	5,028	86	10.5%
Kangari ward	29,195	5.5	5,263	148	7.9%
Kariara ward	38,172	5.3	7,184	134	8.4%
Total	161,676	5.4	30,306	730	3.4%
Gituamba ward Kangari ward Kariara ward Total	25,434 29,195 38,172 161,676	5.1 5.5 5.3 5.4	5,028 5,263 7,184 30,306	86 148 134 730	10.5% 7.9% 8.4% 3.4%

Table 1. Sample overview

To ensure internal reliability in the survey, a number of key questions, such as land size, irrigation and water sources, were asked in two different ways so that answers could be cross-checked for consistence.

To ensure inter-enumerator reliability, no out-of-range data could be entered by the enumerators, and the time taken for each interview was tracked automatically by the survey software. The one interview of less than two minutes was deleted.

On validity, the sample size provides a 3.4% overall margin of error and a 5.1% margin of error for each sub-catchment with a 95% confidence interval.

The 2009 Kenya census found that 70% (\pm 2.2%) of Murang'a county had completed primary school or higher and 18% (\pm 2.2%) had completed secondary school or higher. This compares with 74% (\pm 3.4%) in the survey data for primary school or higher and 24% (\pm 3.4%) for secondary school or higher. Given the margins of error and the four-year time difference, this suggests the survey data are valid estimations of the overall population in the survey area.

Where there are similar averages between the two sub-catchments, the generalizability of the results to other parts of the Maragua and Thika/Chania sub-catchments is high. Where there are substantial differences between the two sub-catchments, caution is warranted in generalizing the findings to other areas.



3.2 Respondent characteristics

The average respondent was male, the household head, and married. Female-headed household comprised 5% of the sample population (59% of whom were widows) (Tables 2 and 3).

Sub-catchment and ward	Male	Female	Head of household	Spouse	Other household member
Maragua average	56%	44%	68%	26%	6%
Kambiti ward	49%	51%	64%	28%	8%
Kigumo ward	68%	32%	79%	16%	5%
Nginda ward	49%	51%	61%	33%	6%
Thika/Chania average	58%	42%	68%	24%	8%
Gituamba ward	55%	45%	64%	27%	9%

Table 2. Respondent's gender and household status

Kangari ward	61%	39%	71%	24%	5%
Kariara ward	57%	43%	68%	22%	10%
Overall average	57%	43%	68%	25%	7%
n	415	315	498	180	52

Table 3. Respondent's marital status

Sub-catchment and ward	Married	Divorced	Widowed	Single
Maragua average	82%	1%	7%	10%
Kambiti ward	75%		8%	17%
Kigumo ward	88%	1%	5%	7%
Nginda ward	83%	2%	8%	7%
Thika/Chania average	83%	1%	9%	7%
Gituamba ward	81%	2%	9%	7%
Kangari ward	90%		4%	6%
Kariara ward	76%		15%	9%
Overall average	82%	1%	8%	9%
n	602	5	59	64

Most respondents were born in the area where they currently live (76%), but there are large differences in the Maragua area. Of those born outside the area, 79% are female. The average respondent was 48 years old (Table 4).

Table 4. Respondent's area of birth, age and occupation

Sub-catchment and ward	Born	Born outside	Average
Sub catemient and ward	in the area	the area	age
Maragua average	67%	33%	49
Kambiti ward	46%	54%	46
Kigumo ward	92%	8%	53
Nginda ward	62%	38%	48
Thika/Chania average	85%	15%	48
Gituamba ward	87%	13%	49
Kangari ward	84%	16%	46
Kariara ward	84%	16%	49
Overall average	76%	24%	48
n	556	174	730

A majority of respondents (50%) completed primary school, and 21% of respondents completed secondary school (Table 5).

Table 5. Respondent's education

Sub-catchment and ward	No formal education	Some primary school	Completed primary school	Completed secondary school	College/ polytechnic
Maragua average	7%	23%	48%	19%	4%
Kambiti ward	8%	28%	39%	20%	5%
Kigumo ward	8%	18%	53%	19%	2%
Nginda ward	4%	22%	50%	19%	4%
Thika/Chania average	6%	16%	53%	23%	2%
Gituamba ward	8%	23%	48%	20%	1%
Kangari ward	3%	10%	64%	20%	3%
Kariara ward	8%	19%	44%	27%	2%
Overall average	6%	19%	50%	21%	3%
п	46	142	367	153	22

Maragua has a greater range of both food secure and insecure respondents than Thika/Chania (Table 6).

Sub-catchment and ward	Food secure vear round	Insecure less than half the vear	Insecure more than half the year	Dependent on relief/food aid
Maragua average	31%	44%	24%	1%
Kambiti ward	8%	73%	20%	
Kigumo ward	40%	43%	15%	2%
Nginda ward	26%	54%	20%	1%
Thika/Chania average	15%	66%	19%	
Gituamba ward	20%	66%	14%	
Kangari ward	22%	54%	24%	
Kariara ward	20%	61%	19%	
Overall average	23%	58%	19%	
n	166	421	140	3

Almost all respondents stated that their primary source of income was from farming (Table 7).

Table 7. Filliary source	ormeome			
Sub-catchment and ward	Farming	Own business	Other	n
Maragua average	97.8%	1.1%	1.1%	362
Kambiti ward	95.7%	0.8%	0.6%	116
Kigumo ward	100.0%			128
Nginda ward	97.5%	0.3%	0.6%	118
Thika/Chania average	98.6%	0.8%	0.5%	368
Gituamba ward	100.0%			86

Table 7. Primary source of income

Sub-catchment and ward	Farming	Own business	Other	n
Kangari ward	99.3%		0.3%	148
Kariara ward	97.0%	0.8%	0.3%	134
Overall average	98.2%	1.0%	0.8%	730

About a third of respondents (37%) farmed for income only, and 4% farmed just for subsistence. Most respondents sold more than half their crops (84%) and only 16% consumed more than half their crops (Table 8).

	-		I				
Sub-catchment and ward	No crop consumption (income only)	1-25%	26-50%	51-75%	76-99%	100% consumption (subsistence)	n
Maragua average	17%	38%	19%	14%	4%	7%	362
Kambiti ward		52%	12%	23%	3%	9%	116
Kigumo ward	47%	15%	17%	6%	4%	11%	128
Nginda ward	3%	51%	27%	13%	5%	2%	118
Thika/Chania average	56%	18%	19%	5%	1%	1%	368
Gituamba ward	44%	27%	22%	6%	1%		86
Kangari ward	53%	18%	22%	5%	1%	1%	148
Kariara ward	66%	13%	13%	5%	1%	1%	134
Overall average	37%	28%	19%	9%	3%	4%	730

Table 8. Percentage of crops for own consumption

Asset ownership is a proxy for wealth, and the majority of respondents have a bed, radio, mobile phone, kerosene lamp and settee/sofa (Table 9). Only 22% of homes have electricity but this varies by ward (Figure 2). The survey area has substantially more consumer durable assets than the 2009 national average for rural areas (71% for radio, 53% for mobile phone, and 18% for television) (DHS 2009).

Table 9. Asset ownership

Asset	Kambiti ward	Kigumo ward	Nginda ward	Gituamba ward	Kangari ward	Kariara ward	п
Bed or mattress	97%	99%	97%	99%	99%	98%	717
Radio	91%	93%	92%	92%	95%	93%	677
Mobile phone	91%	83%	82%	90%	92%	87%	638
Kerosene lamp	62%	85%	76%	76%	86%	66%	553
Settee or sofa	66%	53%	67%	60%	62%	63%	453
Clock	48%	37%	57%	37%	36%	46%	316
Television	21%	15%	27%	26%	24%	42%	189
Electricity	15%	13%	28%	26%	19%	33%	160
Kerosene stove	22%	20%	15%	23%	21%	17%	143
Iron	18%	7%	19%	10%	6%	11%	85
Solar light	7%	6%	3%	6%	5%	5%	38
Solar panel	16%	1%	4%	6%	2%	1%	34

Asset	Kambiti ward	Kigumo ward	Nginda ward	Gituamba ward	Kangari ward	Kariara ward	n
Generator	2%	2%	3%		1%	1%	10
Gas lamp	1%	3%			1%		6
Kerosene cooker	1%	1%	2%			1%	5
Refrigerator		2%	2%				4



Figure 2. Overall ownership of consumer durable assets

3.3 Land uses

All 730 respondents owned land and stated they grew crops in the last 12 months. Landholdings tended to be small, with an average of 2.0 acres (0.8 hectares). The minimum in the survey was 0.1 acres and the maximum was 20 acres. Among the wards, the average landholding varies by as much as 45% (Table 10). About half the respondents (57%) had a portion of land they did not cultivate, but 87% of these respondents said the uncultivated land was where their house was located. Only 4% of respondents (n=33) had arable land that was not under cultivation.

Table 10. Landholdings

Sub-catchment and ward	Average landholding (in acres)	Average land under cultivation (in acres)
Maragua average	2.0	1.4
Kambiti ward	2.4	1.6
Kigumo ward	1.3	1.1
Nginda ward	2.3	1.6
Thika/Chania average	2.0	1.5

Sub-catchment and ward	Average landholding (in acres)	Average land under cultivation (in acres)
Gituamba ward	1.4	1.0
Kangari ward	2.5	1.8
Kariara ward	2.0	1.5
Overall average	2.0	1.5
n	730	730

The majority of the respondents (64%) stated that they had the same landholdings as 10 years ago, but 30% had larger holdings, suggesting that consolidation of smaller landholdings or expansion into new areas is happening (Table 11).

Sub-catchment and ward	Same land as 10 years ago	More land than 10 years ago	Less land than 10 years ago	п
Maragua average	68%	23%	9%	362
Kambiti ward	72%	16%	12%	116
Kigumo ward	56%	38%	5%	128
Nginda ward	76%	14%	9%	118
Thika/Chania average	60%	37%	3%	368
Gituamba ward	58%	37%	5%	86
Kangari ward	61%	38%	1%	148
Kariara ward	60%	37%	3%	134
Overall average	64%	30%	6%	730

Table 11. Trends in landholdings

Land ownership was usually by the individual (50%) or family (48%). Only 2% of land was leased. 76% of respondents had a title deed to their land. In the three Maragua wards, 28% of respondents had no deed title. In the three Thika/Chania wards, 18% had no deed titles. It is likely to be easier to encourage long-term investments in land management in the Thika/Chania wards than in the Maragua wards because more people have secure tenure with formal land titles.

Agricultural land use varies by elevation in the sample areas. Kambiti and Nginda wards are the lowest in elevation and were the only wards with little or no coffee and tea production. Almost all households grew maize (97%) (Table 12).

Crops	Gituamba ward	Kangari ward	Kariara ward	Kambiti ward	Kigumo ward	Nginda ward	Total	n
Maize	98%	95%	97%	100%	97%	97%	97%	710
Trees	98%	97%	99%	72%	98%	81%	91%	665
Napier Grass	98%	98%	97%	62%	98%	86%	90%	657
Pulses (beans, peas &	94%	83%	93%	89%	88%	86%	88%	646

Table 12. Crops cultivated in last 12 months (respondents could select multiple crops)

lentils)								
Vegetables (pumpkins, sweet potatoes, greens, etc.)	95%	97%	91%	54%	88%	75%	84%	611
Bananas	99%	71%	90%	53%	98%	92%	83%	605
Coffee	99%	1%	62%		95%	2%	40%	292
Теа	2%	98%	90%		2%		37%	270
Other	1%	3%	1%	3%	3%	2%	2%	17
Bamboo		2%	1%				1%	5
Diversity index (1.00= <i>all</i> respondents grow <i>all</i> of above crops)	0.68	0.64	0.72	0.68	0.43	0.67	0.52	0.54

Most respondents reported no irrigation of crops during the dry season (68%), but among those who did (32%), most reported irrigating their vegetables (52%), suggesting that when irrigation is used in the sample areas, it is largely for vegetables. The Maragua wards have a higher average rate of irrigation than the Thika/Chania wards (Table 13), and Nginda ward (which is along a river valley) comprises 42% of all the respondents in the survey who irrigate.

0 1	0 7		
Sub-catchment and ward	Yes	No	п
Maragua average	39%	61%	362
Kambiti ward	38%	62%	116
Kigumo ward	22%	78%	128
Nginda ward	58%	42%	118
Thika/Chania average	24%	76%	368
Gituamba ward	35%	65%	86
Kangari ward	16%	84%	148
Kariara ward	27%	73%	134
Overall average	32%	68%	730

Table 13. Irrigate crops during the dry season?

The most profitable crops varied by ward (Table 14). The diversity of cash crops is greater in the Maragua wards than the Thika/Chania wards, suggesting a greater variety of land uses (Table 15). Tea, coffee and bananas comprise 94% of the cash crops in Thika/Chania.

Sub-catchment and ward	Теа	Coffee	Maize	Vegetables	Banana	Napier Grass	Trees	Other	
Maragua average		20%	28%	14%	23%		10%	4%	
Kambiti ward			40%	16%	5%		29%	10%	
Kigumo ward	1%	57%	20%	1%	18%	1%	1%	2%	
Nginda ward			24%	27%	47%		1%	2%	

Table 14. Highest income crop for each respondent

Thika/Chania average	71%	15%	2%	2%	7%		1%	3%
Gituamba ward	1%	52%	3%	5%	29%	1%	2%	6%
Kangari ward	99%							1%
Kariara ward	85%	8%	2%	1%			1%	2%

Table 15. Cash crop characteristics for each ward

Maragua
Kambiti ward = maize (40%), trees/mangos (29%), vegetables (16%) and others (15%)
Kigumo ward = coffee (57%), maize (20%), bananas (18%) and others (5%)
Nginda ward = bananas (47%), vegetables (27%), maize (24%), and others (2%)
Thika/Chania
Gituamba ward = coffee (52%), bananas (29%), vegetables (5%) and others (14%)
Kangari ward = tea (99%) and others (1%)
Kariara ward = tea (85%), coffee (8%), and others (7%)

Compared to five years ago, crop yields tend to be declining in Maragua and increasing slightly in Thika/Chania (Table 16). In the two wards were tea comprises the primary cash crop (Kangari and Kariara), most respondents perceived yields to be increasing.

Sub-catchment and ward	Declining	Same	Increasing	Don't know	п
Maragua average	71%	8%	20%	1%	362
Kambiti ward	77%	5%	17%	1%	116
Kigumo ward	73%	8%	19%		128
Nginda ward	64%	12%	24%	1%	118
Thika/Chania average	40%	13%	47%	1%	368
Gituamba ward	62%	7%	30%	1%	86
Kangari ward	34%	11%	54%	1%	148
Kariara ward	33%	17%	50%		134
Overall average	55%	10%	34%	1%	730

Table 16. Crop yields compared to five years ago?

Approximately 37% of all respondents say they consume none of the crops they grow (all are cash crops in other words). About 4% say they consume all they grow (no cash crops). Most respondents (47%) consume less than half of what they grow.

Most respondents said that the vegetation cover on their farm has decreased compared to five years ago (53%), but a substantial minority say vegetation cover increased (38%). There are variations by ward, and Kigumo ward had the highest percentage of respondents saying vegetation cover was decreasing (Table 17).

Sub-catchment and ward	Decreased	Increased	Same	n
Maragua average	56%	33%	11%	362
Kambiti ward	48%	38%	14%	116
Kigumo ward	67%	23%	9%	128
Nginda ward	53%	37%	10%	118
Thika/Chania average	49%	43%	8%	368
Gituamba ward	51%	41%	8%	86
Kangari ward	50%	43%	7%	148
Kariara ward	47%	45%	8%	134
Overall average	53%	38%	9%	730
Thika/Chania average Gituamba ward Kangari ward Kariara ward Overall average	49% 51% 50% 47% 53%	43% 41% 43% 45% 38%	8% 8% 7% 8% 9%	368 86 148 134 730

 Table 17. Vegetation cover on the farm compared to five years ago

For the question about 'soil deposits on the flood plains of your farm', 39% of respondents said it was the same (neither increasing nor decreasing). 20% perceived soil deposits were either increasing or decreasing. There is notable variation among the sample wards, however (Table 18).

Table 10. Son deposits on the farm									
Sub-catchment and ward	Increasing	Decreasing	Same	Don't know	n				
Maragua average	25%	20%	32%	23%	362				
Kambiti ward	18%	14%	35%	31%	116				
Kigumo ward	14%	23%	41%	23%	128				
Nginda ward	42%	22%	19%	17%	118				
Thika/Chania average	15%	21%	46%	18%	368				
Gituamba ward	17%	26%	35%	22%	86				
Kangari ward	14%	21%	51%	15%	148				
Kariara ward	16%	18%	48%	19%	134				
Overall average	20%	20%	39%	21%	730				

Table 18. Soil deposits on the farm

When asked if their land 'neighboured a river or stream', 65% said yes and 45% said no. Respondents next to rivers may be better targets for water fund activities than those farther away. Kambiti and Kigumo wards had a high percentage of respondents (66% and 65% respectively) who did *not* live next to a river or stream (Table 19). Erosion control activities in these wards may have less immediate impacts.

Table 19. Does your failu fielgibour a fiver of stream?								
Sub-catchment and ward	Yes	No	n					
Maragua average	48%	52%	362					
Kambiti ward	34%	66%	116					
Kigumo ward	35%	65%	128					
Nginda ward	74%	26%	118					

Table 19. Does your land neighbour a river or stream?

Sub-catchment and ward	Yes	No	п
Thika/Chania average	81%	19%	368
Gituamba ward	71%	29%	86
Kangari ward	82%	18%	148
Kariara ward	87%	13%	134
Overall average	65%	35%	730

Of the respondents who have land next to a river or stream, 84% said they cultivate near the river or stream. The most frequent distance from the river or stream edge and the cultivated area was 3 to 5 meters (Table 20).

Table 20. If your cultivated land neighbours a river or stream, what is the distance from the river or stream edge to your cultivated area?

Sub-catchment and ward	0-2 m	3-5 m	6-10 m	11-20 m	More than 20 m	п
Maragua average	38%	29%	22%	3%	8%	123
Kambiti ward	32%	32%	32%		9%	22
Kigumo ward	18%	26%	37%	5%	13%	38
Nginda ward	52%	30%	10%	3%	5%	63
Thika/Chania average	15%	37%	39%	4%	5%	270
Gituamba ward	19%	39%	32%	2%	9%	57
Kangari ward	10%	35%	45%	4%	5%	113
Kariara ward	19%	37%	35%	6%	3%	100
Overall average	22%	34%	33%	4%	6%	393

Respondents were asked if there was a 'buffer zone' of permanent vegetation along all or most of the riverbanks in their area and 37% said no (Table 21).

Table 21. Is there a 'buffer zone' of permanent vegetation along all or most of the riverbanks in your area?

V				
Sub-catchment and ward	Buffer zone	No buffer zone	n	
Sub catchment and ward	of vegetation	of vegetation	n	
Maragua average	54%	46%	362	
Kambiti ward	39%	61%	116	
Kigumo ward	46%	54%	128	
Nginda ward	78%	22%	118	
Thika/Chanai average	72%	28%	368	
Gituamba ward	59%	41%	86	
Kangari ward	78%	22%	148	
Kariara ward	75%	25%	134	
Overall average	63%	37%	730	

Among the 63% who said yes to a buffer zone, most said the average buffer zone is 3 to 5 meters wide (Table 22). Grass is the main vegetation cover in the buffer strip (76%) followed by trees (14%).

Sub-catchment and ward	0-2 m	3-5 m	6-10 m	11-20 m	More than 20 m	п
Maragua average	31%	35%	25%	5%	5%	196
Kambiti ward	40%	40%	9%	4%	7%	45
Kigumo ward	10%	41%	46%	3%		59
Nginda ward	39%	29%	20%	5%	7%	92
Thika/Chania average	11%	44%	39%	5%	2%	266
Gituamba ward	8%	61%	27%	2%		51
Kangari ward	8%	38%	49%	3%	3%	115
Kariara ward	15%	41%	33%	9%	2%	100
Overall average	19%	40%	33%	5%	3%	462

Table 22. If yes, average 'buffer zone' of vegetation along riverbanks

When asked about 'the intensity of the colour of the local river after a rain', overall 79% said it was higher, and in Nginda ward, 97% said higher intensity (Table 23). This suggests that Nginda's water quality is widely perceived to decline after a rain.

Table 23. Intensity of the local river colour after a rain?

Sub-catchment and ward	Higher intensity	Lower intensity	Same	Don't know	n
Maragua average	81%		2%	16%	362
Kambiti ward	74%		3%	23%	116
Kigumo ward	74%		3%	23%	128
Nginda ward	97%	1%	2%	1%	118
Thika/Chania average	76%	8%	10%	6%	368
Gituamba ward	73%	8%	2%	16%	86
Kangari ward	78%	13%	5%	3%	148
Kariara ward	75%	3%	20%	2%	134
Overall average	79%	4%	6%	11%	730



Compared to five years ago, most respondents (79%) perceived the colour intensity of the river to be higher (Figure 3).



Figure 3. Colour intensity of the local river compared to five years ago?

There is a lot of variation in how long it takes a local river to clear after a rain. In Maragua subcatchment, the time is usually much longer than in the Thika/Chania sub-catchment (Table 24).

Few days	1-2 weeks	3-4 weeks	More than one month	n
5%	17%	18%	60%	296
2%	16%	9%	72%	86
13%	17%	33%	38%	95
	18%	12%	70%	115
	Few days 5% 2% 13%	Few days 1-2 weeks 5% 17% 2% 16% 13% 17% 18%	Few days 1-2 weeks 3-4 weeks 5% 17% 18% 2% 16% 9% 13% 17% 33% 18% 12%	Few days 1-2 weeks 3-4 weeks More than one month 5% 17% 18% 60% 2% 16% 9% 72% 13% 17% 33% 38% 18% 12% 70%

Table 24. How long does it take for the colour of the local river water to clear after a rain?

Sub-catchment and ward	Few days	1-2 weeks	3-4 weeks	More than one month	п
Thika/Chania average	12%	35%	24%	30%	309
Gituamba ward	6%	34%	24%	36%	70
Kangari ward	20%	36%	24%	20%	135
Kariara ward	5%	34%	23%	38%	104
Overall average	8%	26%	21%	45%	605

The dry-season water level in local rivers compared to 10 years ago is viewed by a majority of respondents as lower in every ward (Table 25).

Sub-catchment and ward	Higher	Lower	Same	Don't know	n
Maragua average	16%	64%	4%	16%	362
Kambiti ward	10%	59%	7%	23%	116
Kigumo ward	6%	70%	2%	22%	128
Nginda ward	32%	64%	3%	2%	118
Thika/Chania average	15%	70%	8%	6%	368
Gituamba ward	12%	67%	6%	15%	86
Kangari ward	13%	78%	5%	5%	148
Kariara ward	20%	63%	14%	2%	134
Overall average	16%	67%	6%	11%	730

Table 25. Dry-season water level in the local river compared to 10 years ago

More than half the land in the Thika/Chania wards is steep or very steep and only 4% is flat (Table 26).

Table 26. Slope of your land	1?				
Sub-catchment and ward	Very steep	Steep	Sloping	Flat	n
Maragua average	6%	28%	45%	21%	362
Kambiti ward	7%	22%	53%	19%	116
Kigumo ward	7%	32%	56%	5%	128
Nginda ward	3%	30%	26%	42%	118
Thika/Chania average	11%	40%	45%	4%	368
Gituamba ward	22%	42%	35%	1%	86
Kangari ward	5%	39%	52%	4%	148
Kariara ward	10%	40%	45%	4%	134
Overall average	8%	34%	45%	12%	730

Table 26 CL - - **f** -



Overall, steep and very steep land is higher in the Thika/Chania wards than in the Maragua wards (Figure 4).



Figure 4. Steep + very steep land in each ward (error bars = Standard Error)

More than three-quarters of respondents (77%) say erosion occurs on their land (Table 27).

Sub-catchment and ward	Yes	No	n
Maragua average	84%	16%	362
Kambiti ward	84%	16%	116
Kigumo ward	88%	13%	128
Nginda ward	80%	20%	118
Thika/Chania average	71%	29%	368
Gituamba ward	83%	17%	86
Kangari ward	69%	31%	148
Kariara ward	66%	34%	134
Overall average	77%	23%	730

Table 27. Does so	oil erosion	occur on	your land?

Terracing followed by grass strips are the two primary soil conservation measures respondents take. The number and type of soil conservation measures are largely similar between the two sub-catchments (Table 28).

	noerra		abai eb	on lana	can nave	moreu	ian onej		
Sub-catchment and ward	Ter- racing	Grass strips	Cover crops	Agro- forestry	Contour farming	Mulch- ing	Gabions	Minimal tillage	n
Maragua average	33%	31%	11%	10%	7%	6%	2%	1%	667
Kambiti ward	21%	34%	9%	21%	7%	7%	1%		205
Kigumo ward	37%	30%	10%	6%	7%	5%	4%	2%	276
Nginda ward	38%	31%	15%	3%	6%	6%		1%	186
Thika/Chania aver.	38%	29%	12%	9%	6%	4%	2%	1%	587

Table 28. Soil conservation measures on land (can have more than one)

Sub-catchment and ward	Ter- racing	Grass strips	Cover crops	Agro- forestry	Contour farming	Mulch- ing	Gabions	Minimal tillage	п
Gituamba ward	45%	31%	7%	5%	4%	5%	3%		153
Kangari ward	31%	31%	15%	11%	6%	5%	1%		228
Kariara ward	40%	24%	12%	10%	7%	3%	2%	2%	206
Overall average	35%	30%	11%	9%	6%	5%	2%	1%	1,254

Most respondents have at least some percentage of their land under soil conservation measures, though only 11% have more than half their land under soil conservation measures (Table 29).

Sub-catchment and ward	None	1-25%	26-50%	51-75%	76-99%	All	п
Maragua average	3%	53%	35%	8%	1%		303
Kambiti ward	2%	71%	18%	7%	2%		97
Kigumo ward	4%	46%	39%	9%	1%		112
Nginda ward	3%	41%	47%	9%			94
Thika/Chania average	7%	44%	37%	12%			260
Gituamba ward	13%	51%	31%	6%			71
Kangari ward	7%	32%	47%	15%			101
Kariara ward	3%	52%	31%	13%	1%		88
Overall average	5%	49%	36%	10%	1%		563

Table 29. Proportion of land with soil conservation measures

Fertilizer is used by 97% of respondents, and chemical and farm-yard manure are the two most common types of fertilizer (Table 30).

Table 30. Types of fertilizer used (can have more than one)

Sub-catchment and ward	Chemical fertilizer	Farm-yard manure	Compost fertilizer	Other fertilizers	n
Maragua average	47%	46%	8%		705
Kambiti ward	49%	45%	5%		194
Kigumo ward	44%	44%	12%		282
Nginda ward	48%	48%	3%		229
Thika/Chania average	43%	43%	13%	1%	828
Gituamba ward	43%	46%	11%	1%	184
Kangari ward	42%	42%	16%		344
Kariara ward	43%	43%	12%	2%	300
Overall average	44%	44%	11%	1%	1,533

Perceived fertilizer use compared to five and ten years ago was largely consistent across the wards and thus only the overall averages are presented below (Figure 5).



Figure 5. Fertilizer use compared to five and ten years ago (error bars = Standard Error)

3.4 Environmental issues

Most respondents said there were no quarrying or brickmaking activities in their community (81%). For the 19% of respondents who said there were quarrying or brickmaking activities in their community, stone quarrying was the most prevalent activity. Nginda ward had the most activity (Table 31).

Sub-catchment and ward	Stone quarrying	Brickmaking	Sand quarrying	Ore quarrying	Other	n
Maragua count	77	29	18		1	125
Kambiti ward	33	12	7			52
Kigumo ward	4					4
Nginda ward	40	17	11		1	69
Thika/Chania count	43	1	1			45
Gituamba ward	21	1				22
Kangari ward						
Kariara ward	22		1			23
Overall count	120	30	19		1	170

Table 31. Count of quarrying and brickmaking activities by ward

Most respondents said landslides, mudslides surface erosion or gullies were not common in their area (71%). For the 29% who said they were common in their area, 72% said they are more common now than five years ago, with Nginda ward having the highest percentage. Surface erosion followed by gullies were the two most frequent erosion issues (Table 32), and again Nginda ward was the standout.

Sub-catchment and ward	Surface erosion	Gullies	Landslides/ mudslides	Other	п
Maragua average	61%	22%	15%	3%	184
Kambiti ward	66%	19%	15%		47
Kigumo ward	70%	19%	11%		37
Nginda ward	55%	24%	16%	5%	100
Thika/Chania average	52%	24%	22%	2%	147
Gituamba ward	63%	22%	15%		27
Kangari ward	62%	18%	20%		45
Kariara ward	41%	29%	25%	4%	75
Overall average	57%	23%	18%	2%	331

Table 32. Common erosion issues by ward

3.5 Livestock management

Most respondents keep livestock (92%). Cattle followed by poultry and goats were the most common (Table 33).

Sub-catchment and ward	Cattle	Poultry	Goats	Sheep	Pigs	Bee keeping	Fish farming	Others	n
Maragua average	36%	35%	22%	3%	2%	1%		1%	753
Kambiti ward	26%	36%	32%	2%	2%			2%	241
Kigumo ward	45%	33%	19%	2%				1%	247
Nginda ward	37%	35%	18%	4%	3%	2%		2%	265
Thika/Chania average	42%	34%	14%	8%	1%			1%	745
Gituamba ward	41%	39%	16%	2%	1%			1%	163
Kangari ward	41%	32%	9%	17%	1%				312
Kariara ward	42%	34%	18%	2%	1%			2%	270
Overall average	39%	34%	18%	6%	1%			1%	1,498

Table 33. Types of livestock by ward (can have more than one)

If a respondent owns livestock, the average number of animals tends to be modest. One respondent had 11 cattle (the maximum in the survey), but the average was 2. Goats had a maximum of 10 and an average of 2 (Table 34). Poultry were more numerous, and there was one respondent who owned 10,000. Gituamba ward is the standout for poultry because three respondents had 1,000 or more. This suggests that there are several large poultry farms in this ward. Gituamba poultry numbers also skew the overall average. The median number of poultry owned across all wards was 6.

Table 34. Average number of livestock owned and overall totals

0					
Sub-catchment and ward	Poultry	Cattle	Goats	Sheep	Pigs
Maragua average	13.4	1.8	2.3	0.4	0.4
Kambiti ward	20.0	1.9	3.2	0.5	0.5

Sub-catchment and ward	Poultry	Cattle	Goats	Sheep	Pigs
Kigumo ward	8.0	1.5	1.3	0.3	0.0
Nginda ward	12.8	2.0	2.2	0.5	0.7
Thika/Chania average	80.3	1.8	1.4	1.3	0.2
Gituamba ward	219.1	1.5	1.4	0.6	0.3
Kangari ward	44.0	1.9	1.2	2.2	0.2
Kariara ward	26.1	1.8	1.6	0.3	0.1
Overall average	46.7	1.8	1.9	0.9	0.3
Overall totals	26,938	1,102	800	249	78



Most respondents have no free-range animals. Of those who do have free-range animals, poultry is the biggest (29%). Kambiti and Nginda wards have high proportions of poultry and goats as free range (Table 35).

Sub-catchment and ward	None	Poultry	Goats	Cattle	Sheep	Pigs	Other	п
Maragua average	47%	38%	8%	5%	1%			343
Kambiti ward	30%	38%	18%	12%	1%	1%		125
Kigumo ward	74%	24%			1%		1%	104
Nginda ward	40%	52%	4%	3%	2%			114
Thika/Chania average	81%	18%			1%			303
Gituamba ward	86%	14%						73
Kangari ward	85%	14%			2%			117
Kariara ward	74%	25%	1%					113
Overall average	63%	29%	4%	3%	1%			646

Table 35. Proportion of free-range animals

Most respondents practice zero-grazing for their livestock (54%) or a mixed-farming system for livestock production (43%). Only 3% used grazing as their primary livestock rearing strategy. Livestock were fed primarily with a combination of grass, leaves and process feeds such as maize bran (Table 36). The major challenges for livestock management were largely about livestock feed (66%) but disease was also an issue (Table 37), and historically Kambiti and Nginda wards have had problems with tick-borne diseases in livestock.

Table 36. Types of livestock feed (can have more than one)

Sub-catchment and ward	Grass	Leaves	Process feeds	Minerals	Others	n
Maragua average	29%	29%	24%	18%		1,054
Kambiti ward	30%	29%	21%	19%		289
Kigumo ward	28%	29%	25%	18%		400
Nginda ward	29%	28%	24%	17%	1%	365
Thika/Chania average	28%	28%	25%	19%	1%	1,150
Gituamba ward	27%	28%	27%	17%		266
Kangari ward	28%	28%	24%	20%		475
Kariara ward	29%	28%	24%	18%	2%	409
Overall average	29%	28%	24%	18%	1%	2,204

Table 37. Major challenges for livestock management (can have more than one)

Sub-catchment and ward	Lack of enough feed	Expensive off- farm feeds	Diseases	Inadequate info on feed management	Others	n
Maragua average	34%	28%	23%	13%	2%	820
Kambiti ward	34%	25%	27%	12%	2%	224
Kigumo ward	35%	31%	18%	15%	2%	328
Nginda ward	34%	26%	26%	11%	2%	268
Thika/Chania average	36%	34%	16%	13%	2%	855
Gituamba ward	35%	39%	10%	13%	3%	188

Sub-catchment and ward	Lack of enough feed	Expensive off- farm feeds	Diseases	Inadequate info on feed management	Others	п
Kangari ward	33%	32%	19%	13%	3%	394
Kariara ward	41%	33%	14%	11%		273
Overall average	35%	31%	19%	13%	2%	1,675

3.6 Water uses

Most respondents get their water from a river of stream (40%) followed by a shared tap or an indoor tap (Table 38).

Table 50: Respondents water source							
Sub-catchment and ward	River or stream	Shared tap	Indoor tap water	Well	Buying water	Other	n
Maragua average	51%	22%	15%	10%	1%	1%	362
Kambiti ward	44%	30%	16%	8%	2%		116
Kigumo ward	33%	29%	27%	11%		1%	128
Nginda ward	77%	5%	2%	13%		3%	118
Thika/Chania average	30%	34%	31%	4%		1%	368
Gituamba ward	16%	42%	38%	3%			86
Kangari ward	37%	29%	28%	3%		3%	148
Kariara ward	31%	35%	29%	5%			134
Overall average	40%	28%	23%	7%		1%	730

Table 38. Respondents' water source

Most households dispose of wastewater informally. A number of people in Kangari and Kariara wards have central sewerage (Table 39).

Sub-catchment and ward	General disposal	Irrigated house garden	Central sewerage	Roadside drain	Live- stock	Nearby water body	Other	n
Maragua average	44%	33%	2%	6%	4%		12%	362
Kambiti ward	8%	47%	2%	16%	7%	1%	21%	116
Kigumo ward	60%	29%	2%	1%	4%		5%	128
Nginda ward	64%	23%	2%	1%	1%		10%	118
Thika/Chania aver.	59%	13%	17%		1%		10%	368
Gituamba ward	62%	31%	6%		1%			86
Kangari ward	53%	3%	27%		1%		17%	148
Kariara ward	63%	13%	14%		1%		8%	134
Overall average	52%	23%	10%	3%	2%		11%	730

Table 39. Disposal of household wastewater

30% of respondents reused household water, and the water was mostly reused for irrigation (78%) or livestock drinking (20%).

Irrigation of crops during the dry season was done by 32% of respondents, and Nginda ward had the highest rates (Table 40). The 'jerry can' with about 20 litres of capacity was the local unit of measurement for irrigation water.

Table 40. Irrigation of crops during the dry season						
Sub-catchment and ward	Yes	No	п			
Maragua average	39%	61%	362			
Kambiti ward	38%	62%	116			
Kigumo ward	22%	78%	128			
Nginda ward	58%	42%	118			
Thika/Chania average	24%	76%	368			
Gituamba ward	35%	65%	86			
Kangari ward	16%	84%	148			
Kariara ward	27%	73%	134			
Overall average	32%	68%	730			



The estimated water usage per day during the dry season, assuming 20 litres per jerry can, was an average of 4,024 litres per respondent who irrigated during the dry season (n = 231), with a median of 1,000 litres and a maximum of 24,000 litres. These numbers, however, are likely to be overestimations. After the first two days of the survey, the unit of measurement was changed from litres to 'jerry cans' because it was easier for respondents to estimate. Yet a number of the enumerators appear to have continued to use litres for several days when asking the question given the large numbers entered. To compensate, all data entries of more than 1,000 in the first

five days of the survey were converted to jerry cans. This was an imprecise way to control for the issue, and this question's data should be considered unreliable.

Among the 32% of respondents who irrigate in the dry season, half irrigate every day (Table 41).

Table 41. Frequency of frigation during the dry season						
Sub-catchment and ward	Once a day	Twice a day	Once a week	Twice a week	Other	n
Maragua average	44%	14%	10%	31%	2%	140
Kambiti ward	58%	9%	14%	16%	2%	43
Kigumo ward	68%	18%	7%	7%		28
Nginda ward	25%	14%	9%	49%	3%	69
Thika/Chania average	61%	16%	14%	7%	2%	90
Gituamba ward	60%	17%	20%	3%		30
Kangari ward	75%	8%	13%	4%		24
Kariara ward	53%	19%	11%	11%	6%	36
Overall average	50%	14%	12%	21%	2%	230

Table 41. Freque	ency of irrigation	during the dry season
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The main source of water for irrigation was a stream, spring or river for most respondents (Table 42). The streams and springs that supply irrigation water were largely perennial (81%) rather than seasonal (19%).

Sub-catchment and ward	Stream or spring	River	Tap/piped water	Bore- hole	Rain water	Open water source	Others	n
Maragua average	32%	43%	16%	6%	2%		1%	141
Kambiti ward	25%	36%	30%	2%	5%		2%	44
Kigumo ward	36%	29%	21%	14%				28
Nginda ward	35%	54%	4%	6%	1%			69
Thika/Chania average	40%	19%	28%	9%	2%		2%	90
Gituamba ward	43%	7%	33%	10%	3%		3%	30
Kangari ward	33%	38%	8%	17%			4%	24
Kariara ward	42%	17%	36%	3%	3%			36
Overall average	35%	34%	20%	7%	2%		1%	231

Table 42. Main source of water for irrigation

The average distance from the crops to the irrigation water source was 117 metres (with a maximum of 2,000 metres).

Most respondents harvest rainwater (85%), and rainwater tanks are the most common way this is done (Table 43).

Sub-catchment and ward	Tanks	Small containers	Dug wells	Trenches	Other	п
Maragua average	57%	43%				291
Kambiti ward	47%	53%				85
Kigumo ward	54%	46%				119
Nginda ward	71%	29%				87
Thika/Chania average	58%	42%				333
Gituamba ward	57%	43%				79
Kangari ward	61%	39%				140
Kariara ward	54%	46%				114
Overall average	57%	43%				624



There is minimal variation among the ward on perceived rainfall now compared to five years ago. Most respondents say it has decreased (Figure 6).



Figure 6. Status of rainfall now compared to five years ago

3.7 Agriculture practices

A majority of respondents (66%) practice crop rotation (Table 44).

Sub-catchment and ward	Yes	No	n
Maragua average	63%	37%	362
Kambiti ward	66%	34%	116
Kigumo ward	58%	42%	128
Nginda ward	66%	34%	118
Thika/Chania average	69%	31%	368
Gituamba ward	67%	33%	86
Kangari ward	72%	28%	148
Kariara ward	68%	32%	134
Overall average	66%	34%	730

Table 44. Do you practice crop rotation on your farm?

A majority of respondents (66%) say people in their area cultivate on steep land. The Thika/Chania sub-catchment has higher rates than the Maragua sub-catchment (Table 45).

Table 45. Do people cultiv	vate on stee	p land in you	ir area?
Sub-catchment and ward	Yes	No	п
Maragua average	61%	39%	362
Kambiti ward	54%	46%	116
Kigumo ward	67%	33%	128
Nginda ward	61%	39%	118
Thika/Chania average	70%	30%	368

Table 45. Do people cultivate on steep land in your area?

Sub-catchment and ward	Yes	No	n
Gituamba ward	80%	20%	86
Kangari ward	61%	39%	148
Kariara ward	74%	26%	134
Overall average	66%	34%	730

The main reason given for farming on steep land is because the land area is small (63%). Only 11% say people do it because they lack information on the consequences (Table 46).

Table 46. Why do people cultivate on steep land in your area? (Can have more than one reason.)

Sub-catchment and ward	Land is small	Increase yields	Lack info	Other	n
Maragua average	63%	24%	11%	2%	300
Kambiti ward	58%	20%	17%	5%	81
Kigumo ward	69%	23%	8%		118
Nginda ward	60%	28%	10%	2%	101
Thika/Chania average	62%	25%	11%	1%	373
Gituamba ward	64%	19%	17%	1%	107
Kangari ward	72%	23%	4%		112
Kariara ward	55%	31%	12%	3%	154
Overall average	63%	24%	11%	2%	673

Overgrazing does not appear to be a substantial issue, with only 17% of respondents saying it occurs in their area (Table 47).

Table 47. Does overgrazing	g occur in yo	ur area?	
Sub-catchment and ward	Yes	No	n
Maragua average	15%	85%	362
Kambiti ward	15%	85%	116
Kigumo ward	20%	80%	128
Nginda ward	10%	90%	118
Thika/Chania average	20%	80%	368
Gituamba ward	15%	85%	86
Kangari ward	28%	72%	148
Kariara ward	13%	87%	134
Overall average	17%	83%	730

Maragua wards on average have a higher number of trees than Thika/Chania wards (Figure 7). The overall average was 97 trees (on an average of 1.5 acres of arable land).



Figure 7. Average number of tree on respondents' land by ward (error bars = Standard Error)

All but a few respondents say that people cut down trees locally (Table 48).

Sub-catchment and ward	Yes	No	n
Maragua average	91%	9%	362
Kambiti ward	86%	14%	116
Kigumo ward	92%	8%	128
Nginda ward	93%	7%	118
Thika/Chania average	92%	8%	368
Gituamba ward	95%	5%	86
Kangari ward	99%	1%	148
Kariara ward	83%	17%	134
Overall average	91%	9%	730

Table 48. D	o neonle in	this area	cut down	trees locally?
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At the household level, most people use the cut wood for fires (70%). There is very little wood used for charcoal except in Kambiti ward (Table 49).

Table 49. What is util	Table 49. What is usile with the wood at the household level?							
Sub-catchment and ward	Firewood	Timber/building material	For sale	Charcoal	Other	n		
Maragua average	68%	17%	10%	5%	1%	319		
Kambiti ward	59%	24%	4%	12%	1%	93		
Kigumo ward	70%	7%	19%	2%	2%	118		
Nginda ward	72%	21%	5%	2%		108		
Thika/Chania average	72%	15%	12%		1%	337		

Table 49. What is done with the wood at the household level?

Sub-catchment and ward	Firewood	Timber/building material	For sale	Charcoal	Other	п
Gituamba ward	70%	11%	18%	1%		82
Kangari ward	77%	5%	16%		1%	146
Kariara ward	65%	32%	2%		1%	109
Overall average	70%	16%	11%	2%	1%	656



At the community level, wood cut locally is primarily used for settlement, factories (tea drying), and infrastructure. Illegal logging is a particular problem in Kigumo ward (Table 50).

Sub-catchment and ward	Settlement	Factories (tea drying)	Infrastructure	Learning institution	Illegal logging and sale	n
Maragua average	52%	20%	21%		7%	322
Kambiti ward	67%	13%	12%		7%	98
Kigumo ward	37%	26%	24%		13%	118
Nginda ward	56%	19%	25%			106
Thika/Chania average	34%	48%	13%		5%	321
Gituamba ward	41%	40%	13%		6%	78
Kangari ward	29%	60%	8%		4%	141
Kariara ward	35%	37%	21%		7%	102
Overall average	43%	34%	17%		6%	643

Table 50. What is done with the wood at the community level?

Almost all farms practice mixed farming. Few farms have rotational farming (Table 51). This calls into question the reliability of this question because in Table 44, 66% said that they practice rotational farming. Table 44 did not ask if rotational farming was the 'primary' practice on the farm only if it were practiced at all. Hence, Table 51 may be a better indicator of the prevalence of rotational farming in the survey area.

Sub-catchment and ward	Mixed farming	Agro- forestry	Mono- cropping	Rotational farming	Moisture conservation farming	n
Maragua average	93%	5%	1%	1%		328
Kambiti ward	85%	13%	1%	1%		100
Kigumo ward	96%	3%		1%		118
Nginda ward	98%		2%			110
Thika/Chania average	98%	1%		1%		339
Gituamba ward	96%	2%	1%			82
Kangari ward	98%	1%		1%		146
Kariara ward	98%			2%		111
Overall average	96%	3%	1%	1%		667

Table 51. Primary farming practices on your farm?

3.8 Local participation

Participation in local organization is an indicator of social cohesion, and building on existing organizational capacity in a community is often more sustainable than creating new capacity.

Overall, the sample wards have high levels of participation in self-help groups but low levels of participation in environmental groups (Table 52 and Table 53). This suggest that there is already an awareness of the benefits of participating in local organizations but that many do not yet see environmental issues as important to their well-being.

Sub-catchment and ward	Self-help group	Farmer co- operative union	Water Resource Users Association	Community Forestry Association	NDEKA	Green Belt Movement	Other environ- mental org	n
Maragua average	83%	9%	8%					235
Kambiti ward	89%	5%	5%				1%	84
Kigumo ward	84%	16%						67
Nginda ward	75%	7%	17%		1%			84
Thika/Chania aver	54%	12%	10%	14%	9%		1%	295
Gituamba ward	88%	12%						34
Kangari ward	36%	14%	14%	21%	14%			188
Kariara ward	85%	5%	3%	4%			3%	73
Overall average	67%	11%	9%	8%	5%		1%	530

Table 52. Participation in an organization (can highlight more than one)

Sub-catchment and ward	Yes	No	n
Maragua average	61%	39%	344
Kambiti ward	71%	29%	110
Kigumo ward	56%	44%	120
Nginda ward	57%	43%	114
Thika/Chania average	63%	37%	329
Gituamba ward	44%	56%	75
Kangari ward	76%	24%	136
Kariara ward	59%	41%	118
Overall average	62%	38%	673

Table 53. Are you a member of one of these organizations?

A bit more than half the respondents have access to a local financial institution (Table 54). Access to MPESA was not counted as access to a local financial institution.

Table 54. Access to a local financial institution?						
Yes	No	п				
49%	51%	362				
47%	53%	116				
48%	52%	128				
51%	49%	118				
66%	34%	368				
57%	43%	86				
74%	26%	148				
63%	37%	134				
57%	43%	730				
	Yes 49% 47% 48% 51% 66% 57% 74% 63% 57%	Yes No 49% 51% 47% 53% 48% 52% 51% 49% 66% 34% 57% 43% 57% 43%				

	Table 54.	Access to	a local	financial	institution?
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Awareness of community forestry associations was limited. Even if a respondent did know about the existence of a community forestry association, most did not know of any activities undertaken by the association (Table 55 and Table 56). This suggests minimal awareness of what community forestry associations actually do.

Table 55. Is there a community forestry association in your area?							
Sub-catchment and ward	Yes	No	Don't know	п			
Maragua average	13%	43%	43%	357			
Kambiti ward	11%	34%	55%	114			
Kigumo ward	18%	59%	23%	125			
Nginda ward	11%	36%	53%	118			
Thika/Chania average	32%	45%	23%	366			

Sub-catchment and ward	Yes	No	Don't know	п
Gituamba ward	17%	54%	30%	84
Kangari ward	49%	41%	10%	148
Kariara ward	23%	45%	32%	134
Overall average	23%	44%	33%	723

Table 56. If yes, do you know of any major activities carried out by the community forestry association?

Sub-catchment and ward	Yes	No	п
Maragua average	10%	90%	329
Kambiti ward	10%	90%	105
Kigumo ward	12%	88%	114
Nginda ward	8%	92%	110
Thika/Chania average	33%	67%	323
Gituamba ward	14%	86%	72
Kangari ward	52%	48%	135
Kariara ward	22%	78%	116
Overall average	21%	79%	652

Water resource user associations were better know than community forestry associations with 44% saying there is one in their area and 82% of those saying yes also saying they know of activities carried out by the water resource user associations (Table 57 and Table 58). This suggests that water resources user associations have a fair degree of local awareness and some capacity for implementing activities. These organizations may be good local partner for the water fund.

Sub-catchment and ward	Yes	No	Don't know	п
Maragua average	44%	22%	34%	362
Kambiti ward	45%	16%	39%	116
Kigumo ward	40%	37%	23%	128
Nginda ward	47%	12%	42%	118
Thika/Chania average	43%	36%	21%	368
Gituamba ward	27%	42%	31%	86
Kangari ward	55%	36%	8%	148
Kariara ward	41%	31%	28%	134
Overall average	44%	29%	27%	730

Table 57. Is there a water resource user association in your area?

Sub-catchment and ward	Yes	No	п
Maragua average	78%	22%	157
Kambiti ward	83%	17%	52
Kigumo ward	86%	14%	50
Nginda ward	67%	33%	55
Thika/Chania average	86%	14%	160
Gituamba ward	70%	30%	23
Kangari ward	90%	10%	82
Kariara ward	85%	15%	55
Overall average	82%	18%	317

Table 58. If yes, do you know of any major activities carried out by the water resource users association?

A large number of the respondents (93%) said yes they are interested in participating in likely water fund activities (Table 59). The names and mobile phone numbers of all those who said they were interested in participating are in a password-protected file to be shared with each organization.

Table 59. Would you be interested in participating in a conservation project to improve your land and water use?

J - - - - - - - - - -	-		
Sub-catchment and ward	Yes	No	n
Maragua average	92%	8%	362
Kambiti ward	91%	9%	116
Kigumo ward	94%	6%	128
Nginda ward	92%	8%	118
Thika/Chania average	93%	7%	368
Gituamba ward	93%	7%	86
Kangari ward	94%	6%	148
Kariara ward	93%	7%	134
Overall average	93%	7%	730

3.9 Targeting of activities

Here several baseline indicators are combined to better identify potential targeting of water fund activities.

- Of the 77% who say that erosion occurs on their land (*n*=564), 54% say they have no soil conservation in place or only minimal soil conservation measures in place (1-25% of their land).
- Of the 42% who farm on steep or very steep land (*n*=309), 88% say erosion occurs on their land.

- Of the 42% who farm on steep or very steep land (*n*=309), 26% were born outside the local area, which is close to the overall average of 24% and suggests that migrant to the area did not settle in greater numbers on steep or very steep land. (79% of those born outside the area are female.)
- 39% of respondents (*n*=286) cultivate near a river or stream, say erosion occurs on their land, and have less than 51% of their land under soil conservation. This may be a suitable target group for water fund activities.
- 32% of respondents (*n*=230) farm on steep or very steep land, say soil erosion occurs on their land, have less than 51% of their land under soil conservation, and say yes to joining a land and water conservation project. This too may be a suitable target group for water fund activities.

Spatial targeting of activities is covered in the sections on the implications for KENFAP and SACDEP activities.



4 Discussion

4.1 Short-term indicators

The benefits from water fund activities such as tree planting in riparian areas tend to take years before they are measurable. Many indicators in the baseline will change only slowly because of the size of the population. Thus, measureable short-term changes using the indicators in this report are likely to be minimal. The indicators in this report are primarily for measuring longer-term changes—five years or more.

KENFAP. In the short term, KENFAP should consider comparing before and after crop yields for farmers who implement the drip irrigation with matched control farmers who do not have drip irrigation using a <u>difference-in-differences</u> approach. This would depend on accessing crop sales information from crop buyers such as Frigoken to establish the pre-existing differences between participating farmers and matched control farmers who had similar crop yields per acre as the participating farmers over the last five years. Using a multi-year baseline would compensate for differences in crop prices and rainfall that can influence yields in the near term. Being able to demonstrate that drip irrigation would benefit both water quantity and farmers' financial well-being would be a powerful incentive for the wider adoption of this technology.



SACDEP. In the short term, SACDEP should consider an intake survey of farmers who choose to participate in the erosion control activities and measure short-term indicators such as average number of trees and the percentage of land that is under soil conservation measures before and after project activities. Here a control group to provide the counterfactual (as per Section 2.1) is

less important because external factors are unlikely to influence the results given the short timeframe and the direct cause and effect nature of the activities (e.g., tree planting and soil erosion measures).

4.2 Long-term indicators

Collecting all of the baseline indicators in a follow-up impact assessment is unnecessary because many indicators were collected to inform the detailed design. Instead, consider collecting the key indicators below (with baseline averages from October 2013 and the source table):

- A. Respondent characteristics to establish that the baseline and follow-on surveys are comparable (average household size, gender, marital status, age, and education level, as per Table 1, Table 2, Table 3, Table 4, and Table 5)
- B. Consumer durable assets to show the changes in wealth (as per Figure 2).
- C. % saying they are food insecure more than half the year (19% as per Table 6)
- D. % saying vegetation cover on their farm has decreased compared to five years ago (53% as per Table 17).
- E. % saying their cultivated land neighbours a river or stream and that the distance from the river or stream to the edge of the cultivated areas is 0-2 metres (22% as per Table 20).
- F. % saying there is no buffer zone of permanent vegetation along all or most of the riverbanks in their area (37% as per Table 21).
- G. % of buffer zone along riverbanks that is 0-2 meters wide (19% as per Table 22).
- H. % saying it takes more than one month for the colour of the local river water to clear after a rain (45% as per Table 24).
- I. % saying soil erosion occurs on their land (77% as per Table 27).
- J. % with zero and 1-25% of their land having soil conservation measures (5% and 49% as per Table 29).
- K. % saying overgrazing is common in their area (17% as per Table 47).
- L. Average number of trees on respondents' land (97 per 1.5 acres as per Figure 7).
- M. % who participate in a water resource users association (9% as per Table 52).
- N. % who participate in a community forest association (8% as per Table 52).

4.3 Options for the impact evaluation

The options outlined here assume a need to show quantifiable impact from water fund activities in order to leverage policy and financial support for expanding the water fund to other subcatchments of the upper Tana River. If there is no need for quantitative data to influence policymakers and donors, then a qualitative assessment would be a more cost-effective option.

The baseline is designed to allow either a panel data or a random/cluster sample approach for the impact evaluation (see section 2.1). The thinking here assumes project activities focus on several of the sampled wards and create measurable land and water-use changes in these wards. If the project has many small activities over many areas, a quantitative impact evaluation is unlikely to find measurable changes because the impacts will be too diffuse to measure without a very large sample size. (The power of an assessment to detect change is driven by the sample size.) Project activities need to go deep rather than wide to have measurable impacts using the data in this report. For an impact evaluation with the greatest potential to show positive benefits, project activities should focus on large changes in a few land and water-use practices in a couple areas in the next three to five years.

For the impact evaluation, the recommendation here is to start with the panel-data option. In the baseline survey, 93% of participants (n=679) said yes to participating in a follow-up phone survey and provided their mobile numbers. Loss to follow-up and insufficient number of project participants in the phone list may preclude the panel-data option, however. The suggestion is to resample every 10th name in the list of phone numbers to determine the probable number of project participants in the list. If there is likely to be sufficient number of project participants in the list of an apanel-data analysis. If there is insufficient number of project participants in the list and a panel-data analysis. If there is insufficient number of project participants in the 10% resample, go with a random/cluster sample survey.

For either option, leave two of the six sampled wards out of project activities to serve as controls. Given the data in this report, the two wards were project activities are least likely to effect land and water use are Kigumo and Kariara.

4.4 Implication for Upper Tana water fund design

Focus on the wards with the worst land and water-use issues. When the six wards are ranked by the long-term indicators noted above, and the best ward is given a 6 and the worst ward given a 1, Kambiti ward is the worst in Maragua, and there are no real differences in the Thika/Chania wards (Table 60). Caution is warranted, however, because the samples from individual wards have margins of error that average 8.9%, and two of the indicators have ranges roughly equal to the margin of error (noted below with a *). Differences of three or less in the ward totals are meaningless due to the margin of error.

				0		,
Long-term indicators	Kambiti ward	Kigumo ward	Nginda ward	Gituamba ward	Kangari ward	Kariara ward
A. Respondent characteristics						
B. Consumer durable assets to show the changes in wealth.						
C. % saying they are food insecure more than half the year. *	1	3	5	4	6	2
D. % saying vegetation cover on their farm has decreased compared to five years ago.	5	1	2	3	4	6
E. % saying their cultivated land neighbours a river or stream and that the distance from the river or stream to the edge of the cultivated areas is 0-2 metres.	5	6	1	3	4	2
F. % saying there is no 'buffer zone' of permanent vegetation along all or most of the riverbanks in their area.	1	2	6	3	5	4
G. % of 'buffer zone' along riverbanks that is	2	5	1	6	4	3

Table 60. Ward rankings by long-term indicator (with 6 being the best and 1 the worse)

Long-term indicators	Kambiti ward	Kigumo ward	Nginda ward	Gituamba ward	Kangari ward	Kariara ward
0-2 meters wide.						
H. % saying it takes more than one month for the colour of the local river water to clear after a rain.	2	5	1	4	6	3
I. % saying soil erosion occurs on their land.	2	1	4	3	5	6
J1. % with 1-25% of their land having soil conservation measures.	1	3	5	2	6	4
J2. % with zero of their land having soil conservation measures.*	6	3	4	1	2	5
K. % saying overgrazing is common in their area.	4	2	6	3	1	5
L. Average number of trees on respondents' land.	1	2	5	6	3	4
M. % who participate in a water resource users association.	3	6	2	6	1	4
N. % who participate in a community forest association.	5	5	5	5	1	2
Total	38	43	47	48	48	50

* Range for this variable is equal to or less than the margin of error. Differences of three or less in the ward totals are meaningless.

Do a Rare pride campaign. It is generally better to build on what exists, and water resource user associations and community forestry associations exist in all of the sampled wards. Yet too few people know about them and even fewer people know what they do. Less than 1 in 10 respondents participate in one of these associations. The low level of awareness about forestry and water user associations is both a challenge for the water fund and an education opportunity. Education and outreach on forestry and water issues will have to be an integral part of water fund activities, and the water fund designers should consider doing <u>Rare pride campaigns</u> in each of the sub-catchments. This is a 'social marketing' campaign to educate people about environmental issues.

Work with the water resource user associations. Given that there is a fair degree of local awareness about the water resource users associations (44%), building long-term relationships with local water resources user associations and using the associations to assist with implementation activities, could be a fruitful strategy.

Leave two wards as controls. As noted above, leaving two of the sampled wards (one in each subcatchment) out of the project activities would provide control groups for the follow-on evaluation. Kigumo and Kariara are the two most likely control wards.

4.5 Implications for KENFAP project implementation

Target Nginda ward for drip irrigation. This ward has the highest percentage of respondents who irrigate their crops (42%). Kambiti (Maragua Ridge) ward is second.

Target farmers who cultivate next to a river for the drip irrigation installations. Among the 32% of respondents who irrigate during the dry season, 65% cultivate next to a river. Being next to a river makes one more likely to grow crops that need irrigation.

Consider partnering with water resource users associations when implementing project activities.

4.6 Implications for SACDEP project implementation

Target the river buffer zone areas with no permanent vegetation. In the Thika/Chania area, 28% said there was no buffer zone of permanent vegetation along all or most of the riverbanks in their area. All three wards have an equal number of respondents saying there is no buffer zone vegetation.

Target reforestation efforts on the buffer zones of rivers in Gituamba ward. There were no Gituamba respondents saying that the main vegetation cover in a river's buffer zone was trees (unlike in the other two wards), and Gituamba has about half as many trees per acre on average as the overall average for the wards. Kariara ward has the next lowest average number of trees.

Use agro-forestry species wherever possible for buffer zones and erosion control. There has been moderate use of agro-forestry as an erosion control measure in the Thika/Chania, so some awareness already exists. Using trees that provide financial benefits to people may help protect the trees in the longer term.

Focus on the areas upstream of the Thika dam and Mwagu water intake. To effect water quality and quantity changes for Nairobi water supply, the emphasis on field activities should be in the areas upstream from the Thika dam and the Mwagu water intake (Figure 8).



Figure 8. Schematic of Nairobi Water Supply System

Upper Tana Land and Water Use Survey of Farmers

Hello, I am... and am involved in a research project sponsored by KENFAP and SACDEP to understand the land and water use practices of people who live in this area. I am part of a group of interviewers who will interview households in the villages in this area over the next few days. This research is to better understand the current land, water and livestock management in the area and identify activities that could improve water quality and quantity.

<ask to speak to the household head, or if the household head is not there or busy, ask to speak to another adult member of the household. The person interviewed must be at least 18 years old.>

I would like to ask you about 100 questions related to yourself and your household. The interview would take about 30 minutes. Please note that all the information you provide will be treated completely confidentially and will not be shared with anyone else. The information will only be used to characterize the area in which you live. All individual information will be added together to determine the average for the whole community, so nobody will be able to identify individual participants.

Would you like to participate in this interview?

There are no right or wrong answers and only your opinion counts. Furthermore, your choice of whether or not to participate is voluntary. Can we find a quiet and comfortable place where I can ask you the questions?

1. Name of interview	/er	2. Household ID code	
3. Date of interview		Start time of the interview	
4. Location of the interview (ward, constituency, cour	nty)	Finish time of the interview	
5. Name of superviso	or	Coordinates (lat/long)	

<FILL OUT THE DATA BELOW>

SECTION 1: HOUSEHOLD INFORMATION

(Note: all the household info must to be stored in a locked or password-protected file to keep it confidential.

No.	Question	Answer codes	Number
6.	Respondent name?	Name:	
7.	Respondent's phone number?	Phone:	
8.	Respondent's gender?	1= Male	
_	-F	2= Female	
9.	Respondent's age?		
	<if 18,="" age="" and="" appologize="" end<="" th="" under=""><th></th><th></th></if>		
	THE INTERVIEW>		
10.	Relationship of the respondent to	1= Self	
	the owner of the household?	2= Spouse	
		3= Other	
11.	Marital status?	1= Married	
		2= Divorced	
		3= Widowed	
		4= Single	
12.	Number of people who normally		
	sleep and eat their meals together		
	in this household (including the		
	respondent)?		
	respondency.		
13.	What is the main occupation of the	1= Farmer	
	respondent?	2= Own business	
	respondent.	3= Government employee	
		4= Forest product gatherer	
		5= Private employee	
		6= Charcoal burner	
		7= Other	
14.	Level of education?	1= No formal education	
		2= Some primary school	
		3= Completed primary school	
		4= Completed secondary school	
		5= College/polytechnic	
15.	Place of birth?	1= In this area	
		2= Outside this area	

16.	Rank the sources of income for the	1= Farming	[]
	household in order of importance	2= Self employed (non farm)	[
		3= Paid work on a farm	[
	(most important first).	4= Paid work not on a farm	[
		5= Other		_
17.	What category best describes your	1= Secure year round		
	household's food security?	2= Insecure less than half of		
	nousenoia's tooa security.	the year		
		3= Insecure more than half of		
		the year		
		4= Dependent on relief/food		
		aid		
18.	Does your household have:		NO	YES
		Bed or mattress	2	1
		Settee or sofa	2	1
		Mobile telephone	2	1
		Electricity	2	1
		Kerosene lamp	2	1
		Radio	2	1
		Television	2	1
		Kerosene cooker	2	1
		Solar light	2	1
		Gas lamp	2	1
		Iron	2	1
		Refrigerator	2	1
		Generator	2	1
		Clock	2	1
		Kerosene cooker	2	1
		Solar panel	2	1

SECTION 2: CURRENT LAND USES

No.	Question	Answer code	Number
19.	Are you a farmer?	1= Yes	
		2= No <u>-> Q46</u>	
20.	If yes, which crops do you	1= Tea	
	cultivate in the last 12 months?	2= Coffee	
	cultivate in the last 12 months.	3= Maize	
		4= Pulses (beans, peas and	
		lentils)	
	<tick all="" apply="" that=""></tick>	5= Vegetables (pumpkins, sweet	
		potatoes, greens etc.)	
		6= Bananas	
		7= Napier Grass	
		8= Trees (including mango)	
		9= Bamboo	
		10= Other (specify)	
21.	If other, what other crops do you		
	grow?		
22	Which of your crops are irrigated?	1= Tea	
<i>LL</i> .	which of your crops are intigated.	2= Coffee	
		1	

	<tick all="" apply="" that=""></tick>	3= Maize	
		4= Pulses	
		5= Vegetables	
		6= Bananas	
		7= Napier Grass	
		8= Trees	
		9= Bamboo	
		10= Other (specify)	
		11= None	
23.	Which of your crops are rain-fed?	1= Tea	
-0.	trinen er yeur er ope ar e runn reur	2= Coffee	
	<tick all="" apply="" that=""></tick>	3= Maize	
		4= Pulses	
		5= Vegetables	
		6= Bananas	
		7= Napier Grass	
		8= Trees	
		9= Bamboo	
		10= Other (specify)	
		11= None	
24	What is the size of your land		
27.		Number of acres ->	
	(acres)?		
25	What was the size of your land 10	1= Same	
25.	what was the size of your land 10	2= Bigger	
	years ago?	3= Smaller	
26	What part of your land is under		
20.		Number of acres ->	
	cultivation (in acres)?		
27		1- Yoo	
27.	Is there some of your land that is	1 - 1 es	
	uncultivated?	2 = 100 - 223	
28.	What is the reason for leaving the	1= Lack of money for labour	
	land uncultivated?	2= Restore soil fertility	
		3= For grazing	
		4= Homesteading	
		5= Flooding	
		6= Others (specify)	
29.	What type is your land	1= Communal	
	ownorship?	2= Individual	
	ownership:	3= Leased	
		4= Institutional	
		5= Family land	
30.	Do you possess a title deed?	1= Yes	
	- ,	2= No	
31.	Which crop gives the highest	1= Tea	
	incomo in Ka/acro/waar?	2= Coffee	
	meome m kg/acre/year?	3= Maize	
		4= Pulses	
		5= Vegetables	
		6= Bananas	
		7= Napier Grass -> Q32	
1			

		9= Bamboo -> Q32
		10= Other (specify)
32.	What is the crop's estimated yield in Kg/acre/year?	Kg/acre/year ->
33.	Why do you cultivate this crop?	1= Consumption
		2= Sale
		3= Both
34.	How much does the crop fetch per year?	Amount ->
35.	Overall, how are your crop yields	1= Same
	compared to 5 years ago?	2= Declining
		3= Increasing
26		1 = None
30.	what percentage of your crops	2= 1-25%
	were consumed by the household?	3= 26-50%
		4= 51-75%
		5= 76-99%
		6= All
37.	How is the vegetation cover within	1= Decrease
	your farm compared to 5 years	2= Increase
	ago?	3= Same
38	Are the levels of soil deposits on	1= Increasing
50.	the flood plains in your farm	2= Decreasing
	the nood plants in your farm	3= Same
		4= Don't know
39.	Does your land neighbour a river	1= Yes
	or a stream?	2= No <u>-> Q43</u>
40.	If yes, give the name of the river.	1= Githanja
		2= Maragua
		3= Saba Saba
		4= Thika
41	De ver cultivate a car e viver er	1= Ves
41.	bo you cultivate near a river or	2= No -> Q43
	stream?	1 0 0
42.	If yes, what is the distance from	1 = 0 - 2m 2 - 3 - 5m
	the river or stream edge to the	3 = 6 - 10m
	cultivated area?	4 = 11 - 20 m
		5= more than 20m
43.	Along all or most of the riverbanks	1= Yes
	in your area, is there a huffer zone	2= No <u>-> Q46</u>
	of permanent vegetation?	
1.1	If yos how many matrix wide on	1 = 0 - 2m
44.	in yes, now many metres while on	2= 3-5m
	average?	3= 6-10m
		4= 11-20m
		5= more than 20m

45.	What's the main vegetation cover	1= Trees	
	along the buffer zone?	2= Grass	
		3= Crops	
		4= Bushes	
		5= Reeds	
		6= Other (specify)	
46.	How is the intensity of the colour	1= Higher	
	of local river water after the rains?	2- LOWEL 3- Same -> 049	
		4 = Don't know	
47	How doos this compare to 5 years	1= More intense	
47.	now does this compare to 5 years	2= Less intense	
	ago?	3= Same	
		4= Don't know	
48.	How long does it take for the	1= A few days	
	colour of the local river water to	2= 1-2 weeks	
	close often a rain?	3= 3-4 weeks	
	clear alter a rain?	4= More than one month	
49.	How is the dry season river water	1= Increasing	
	level in your area compared to 10	2= Decreasing	
	voors ago?	3= Same	
	years ago?	4= Don't know	
50.	How steep is your land?	1= Very steep	
	F J F	2= Steep	
		3= Sloping	
		4= Flat	
51.	Does erosion occur on your farm?	1= Yes	
		2= No <u>-> Q54</u>	
52.	If yes, what erosion control	1= Terracing	
	measures do you take?	2= Contour Tarming	
		A= Grass strips	
	<tick all="" apply="" that=""></tick>	5= Agro forestry	
		6= Gabions	
		7= Minimal tillage	
		8= Cover crops	
		9= Others (specify)	
53.	What percentage of your land is	1= None	
	under a soil conservation	2= 1-25%	
	mossuro?	3= 26-50%	
	ineasure:	4= 51-75%	
		5= 76-99%	
54.	Do you use fertilizer?	1= Yes 2- No -> 059	
		2- NO -> USS	
55.	If yes, what type of fertilizer do	2= Compost fortilizor	
	you use?	3= Farm-vard manure	
	TCK ALL THAT ADDIXN	4= Others (specify)	
	STON AND INAL AFFULZ		

56.	How does your fertilizer use	1= Declining
	compare to 5 years ago?	2= Increasing
	compare to 5 years ago?	3= Same
		4= Don't use
57.	How does your fertilizer use	1= Declining
	compare to 10 years ago?	2= Increasing
	compare to 10 years ago.	3= Same
		4= Don't use

SECTION 3: ENVIRONMENTAL ISSUES

No.	Question	Answer code	Number
58.	Does the community engage in quarrying or brickmaking activities?	1= Yes 2= No <u>-> Q60</u>	
59.	If yes, which ones? <tick all="" apply="" that=""></tick>	<pre>1= Stone quarrying 2= Sand quarrying 3= Ore quarrying 4= Brickmaking 5= Other (specify)</pre>	
60.	Are landslides, mudslides, surface erosion, or gulley erosion common in your area?	1= Yes 2= No <u>-> Q63</u>	
61.	Are they more common now than 5 years ago?	1= Yes 2= No <u>-> Q63</u>	
62.	If yes, which ones are more common now? <tick all="" apply="" that=""></tick>	<pre>1= Gullies 2= Landslides/ mudslide 3= Surface erosion 4= Other (specify)</pre>	

SECTION 4: LIVESTOCK MANAGEMENT

No.	Question	Answer code	Number
63.	Do you keep/rear livestock?	1= Yes	
		2= No <u>-> Q74</u>	
64.	If yes, which animals do you rear?	1= Cattle	
	5 .	2= Goats	
	<tick all="" apply="" that=""></tick>	3= Sheep	
		4= Pigs	
		5= Poultry	
		6= Fish farming	
		7= Bee keeping	
		8= Others (specify)	
65.	If cattle, how many?		

66.	If goats, how many?		
67.	If sheep, how many?		
68.	If pigs, how many?		
69.	If poultry, how many?		
70.	Which of your animals are free range? <tick all="" apply="" that=""></tick>	<pre>1= None 2= Cattle 3= Goats 4= Sheep 5= Pigs 6= Poultry 7= Others (specify)</pre>	
71.	Which system of livestock production do you use?	<pre>1= Grazing/pastoralist 2= Mixed farming 3= Communal grazing 4= Zero grazing (including dairy) 5= Industrial/large scale</pre>	
72.	Which livestock feeds do you use? <tick all="" apply="" that=""></tick>	<pre>1= Grass 2= Leaves 3= Processed feeds e.g., maize bran 4= Minerals 5= Others (specify)</pre>	
73.	What are the major challenges related to livestock management that you face as farmers? <tick all="" apply="" that=""></tick>	<pre>1= Lack of enough feed 2= Inadequate Information on feed management 3= Expensive off-farm feeds 4= Diseases 5= Others (specify)</pre>	

SECTION 5: CURRENT WATER USES

No.	Question	Answer code	Number
74.	What is the major source of your	1= River or stream	
	household water supply?	2= Buying water	
	nousenoid water supply.	3= Shared tap	
		4= Well	
		5= Indoor tap water	
		6= Other (specify)	
75.	Where does most of your	1= General disposal	
	household wastewater go?	2= Roadside drain	
	nousenoid wastewater go:	3= Nearby water body	
		4= Livestock water	
		5= Central sewerage	
		6= Irrigate house garden	
		7= Other (specify)	
76.	Do you recycle the household	1= Yes	
		2= No	

	wastewater?		
77.	If yes, how?	<pre>1= Irrigation 2= Livestock (drinking) 3= Other (specify)</pre>	
78.	Do you irrigate any crops during the dry season?	1= Yes 2= No <u>-> Q84</u>	
79.	What is the estimated water usage for irrigation per day during the dry season (in jerry cans)?		
80.	How often do you irrigate the crops?	<pre>1= 1/day 2= 2/day 3= 1/week 4= 2/week 5= Other (specify)</pre>	
81.	What is your main source of water for farming/irrigation?	<pre>1= Stream or spring 2= River 3= Rainwater 4= Tap/piped water 5= Borehole 7= Open water sources 7= Others (specify)</pre>	
82.	If stream or spring, is it:	1= Perennial 2= Seasonal 3= Intermittent	
83.	What is the distance from your crops to the main source of water for irrigation (in metres)?		
84.	Do you harvest rainwater?	1= Yes 2= No <u>-> Q86</u>	
85.	If yes, how?	<pre>1= Small containers 2= Tanks 3= Dug wells 4= Trenches 5= Other (specify)</pre>	
86.	What is the status of the rainfall now compared to 5 years ago?	1= Increased 2= Decreased 3= Same 4= Don't know	

SECTION 6: AGRICULTURAL PRACTICES

No.	Question	Answer code	Number
87.	Do you practice crop rotation on	1= Yes	
	your farm?	2= No	
00	Do noonlo gultivato on stoon	1= Yes	
08.	Do people cultivate on steep	2- No > 000	
		Z= NO -> Q90	

	areas/ soils in your area?		
89.	If yes, why?	1= Land is small	
	5 , 5	2= Increase income	
	<tick all="" apply="" that=""></tick>	3= Lack of information on the	
		consequences	
		4= Other (specify)	
90.	Are there occurrences of	1= Yes	
	overgrazing in this area?	2= No	
	over grazing in this area.		
91.	Estimate the number of trees that		
	vou have on vour land.	Number - >	
	<i>y</i> = = = = = <i>y</i> = = = = = = = = = = = = = = = = = = =		
92.	Do people in this area cut down	1= Yes	
	trees locally?	2= No <u>-> Q96</u>	
93.	If yes, at the household level, what	1= For sale	
	is mainly done with the cut wood?	2= Timber/building material	
	is manny done with the cut wood.	(own use)	
		3= Firewood (own use)	
		4= Charcoal (own use)	
		5= Other (specify)	
94.	If yes, at the community level,	1= Settlement	
	what is mainly done with the cut	2= Factories (tea drying)	
	wood?	3= Infrastructure	
	wood:	4= Learning institution	
		5= Illegal logging	
95.	What is the primary farming	1= Mixed farming	
	practice on your farm?	2= Mono-cropping	
		3= Rotational farming	
		4= Agro forestry	
		5= Moisture conservation	
		farming	

SECTION 7: LOCAL PARTICIPATION

No.	Question	Answer code	Number
96.	Are you participating in any of the	1= Community Forest	
	following organizations?	Association (CFA)	
	following of gamzations.	2= Water Resource Users	
	<tick all="" apply="" that=""></tick>	Association (WRUA)	
		3= Self-help group	
		4= Farmers co-operative union	
		5= NDEKA	
		6= Green Belt Movement	
		7= Other organization or	
		environmental initiative	
		(specify)	
97.	If ves, are you a member?	1= Yes	
	· · · · · · · · · · · · · · · · · · ·	2= No	

98.	Does your household have access to local financial institution (credit/saving)?	1= Yes 2= No	
99.	Is there a Community Forestry Association in your area?	1= Yes 2= No <u>-> Q101</u> 3= Don't know <u>-> Q101</u>	
100.	If yes, do you know any major activities carried out by the Community Forestry Association?	1= Yes 2= No	
101.	Is there a Water Resource Users Association in your area?	1= Yes 2= No <u>-> Q103</u> 3= Don't know <u>-> Q103</u>	
102.	If yes, do you know any major activities carried out by the Water Resource Users Association?	1= Yes 2= No	
103.	Would you be interested in participating in a conservation project to improve your land and water use?	1= Yes 2= No <u>-> DONE</u>	
104.	If yes, could you please confirm your phone number again so someone can contact you?	Number - >	

<THANK RESPONDENT AND FINISH INTERVIEW>

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Annex 2: Ward names and sub-locations in the survey

County An	Centry Anna	Continuery Name	Continence	Conditionery Area I Sq. Kon (Approx.)	Contry Assembly W	Crearly Assaulty W	Courty Amountly W	County Associates W Arrea In Sig Kan (Approx.)	Ward Description	
-					0527	Giner	33,388	44,380	Comprises Galarita, Gathaki-Itri, Gennea/Megeka, Raril, Kigmign and Nyakihi Sub-Lacations of Marang'a County	
	Second a	187 Nigame	123,766	242.18	-	A CONTRACTOR OF A CONTRACTOR OFTA CONTRACTOR O		[the second s	
	-				0524	Kabantu	10,586	33,29	Comprises Megarno-Ite, Gakitpi, Gidenster, Kabarire and Kandati Judi-Locomete of Marang's County	
-					0529	Muturai	23,419	35.99	Comprises Manga-Ini, Kagnestito, Multithi, Kulturi and Gikeninga Soh-Locations of Munang's County	
	2	1000			9036	Kiguno	23,320	13.70	Comprises Ingoint, Marurai, Griteres and Kiene Solo-Locations of Marang's County	.1
-	-				0.531	Kangan	22,025	OK.CA	Comprises Makaretoko, Marian and Kangari Sab-Locantoni of Managia Commi	KENT
				-	8532	Kanata	28,246	75,50	Comprises Kumikabi, Onducto, Kinyona and Onduring: Sub-Lineations of Muraugu County	
- 14/	Mayang'a	188 Maragua	152,272	466.70	10000-	Charles and the second second			Strang	
	_				8533	Kinuren Wenga	32,365	125.90	Comprises Wenges, Gerbingsouro and Kensioni Sub-Locations of Manuag's County	
			-	-	8534	Makaya	26,910	134,40	Comprises Gulampi, Malorya ind Kirimeri Buti-Locations of Mirrang's County	12 2
					0535	Kenhis	21,195	77.80	Comprises Milariglo, Karia-Ini, Kambili, Margana Bidge, Maranian and Karmira Sel-Locations of Margins and Karmira	0+1-3

21. Marrang's	Cantinues No.	Continuery Population Continuery Avia II Continuery Avia II	County Learning We		Contry Associate We Population (Approx.)	County Assessed War Asses In Sig. Kon (Approx.)	County Assembly Mund Description	
		(and (a)	6545	liftenge	19,349	68,90	Comprises Kirsthari, Kagsika, Mianyani, Kwa Mokandi, Magania and Thiopprani. Sub-Country of Microsoft Country	
			0544	Katan Minister	31,144	217.70	Comprises Grantha Europeigi, Nauga and Thritian Sub-Locations of Macangia Consty	
			0542	Magamo-Ita	20.002	77.80	Comprises Mithendoku-Ini, Magano-Ini, Gathardwas, Mwitroglys, Galastat, Itlangleum and Kiglo Sab-Lucations of Maringle County	
			0544	Kotarebu-Ini	20,131	36.90	Comprises Kappings, Kiliambu-Ini, Noaga, Disita, Gisaamba, Xionyo, Rugatia, Giotigara, Midarawa, Midarwe and Noami Sub-Locations of Marang'a Coamy	
			0548	Gerarige	23,369	36.80	Comprises Chones, Gatange, Kirwars, Gerhanji, Kirto Iti, Maroke, Thase and Mahouda of Marang's County	
			0dS0	Ketan	MUH	149.10	Comprises Ganara, Kanongi, Kamukin, Minajiri, Kanonana, Kapangi, Minagao, Kanonga, Kiramadi Wanonga, Nidoka-bol, Glackula, Gelei USgore, Nilonyo Chegr and Ganargara Sali-Locatism of Morangia Channyan Sali-Locatism of Morangia	I Do Colone
22 Koambu	111 Gatanda South	114,189	158.80		-	-		and the second
			093)	Ktatricangi	36,371	27.54	Comprises Kigungs, Kanenseng, Needu and Gelage Sati-Locations of Kiandu Course	and the second second

The firmer	Control Trans	Continuery Au.	Constituency Name	Continuery Psycholiza	Larational and a	E soundy Assessed by Man	Contrip Assembly Way	Cauch Annucley Ward Population (Append)	Approx.	County Amountain Nucl Description	
		-				6030	Katabaha	34,180	47.8	Comprises Agorijo, Kabarati, Karmiluba and Saha Saha Sado-Locations of Marang'a Commo	
						0537	Settagaki .	23,255	.18.10	Comprises Giltomora, Ichagaki, Kitanjirami and Samar Sub-Locations of Misrang's	
21	Marang's	199	Kentura	150.443		25234	Nginda	24.340	42.70	Comprises Calution, Gathera, Jonsina, Imaga, Misegue and Kalaco Sole-Eccaricom of Manufacture Comprised Sole-Eccaricom	V Sut 2
					2,56,80	(11)0	Nglamava	18,005	21.90	Comprises Kassender, Naters and Nightenesia Sub-Locarizes of Maraneta Country	KENFAP
-						0540	Matuka	20,505	32.46	Comprises Garito, Marska/Kirmigs and Npitture Indi-Cocations of Microog's	
+			-			0541	Kagindu-Im	28,847	31.30	Computers Gatempett, Genera, Kabati, Kapanda-bei and Karrit Sub-Locations of	
						1642	Gautargera	28,363	46.60	Comprises Geochamista, Kagira, Kagirao- Int, Marao Ini, Ngarawo-Ini and Karisa-Cirdutti. Sub-Locations of Marconto	
						0543	Ithing	27,182	32,20	Comprises Gallon Karimanason, Gitlinya, Comprises Gallon Karimanason, Gitlinya, Kapathi, Kiari and Galazian Sudi-Lucations	
1						8044	Rathe	30,731	59.36	Comprises Galaxies Galaxies and Makaria"	

	annty Name	and communities	Conditioners	(maidinees) Area (Approx)	County Assessed	Constity Assembly Name	Construction Construction	County Averadely Area In Sq. Nat (Apprec.)	Control Assembly there is the evolution of the evolution	
					65.52	Kiganyo	27,334	55.20	Corperus Mayalore, Gantaka, Ndonda. Kigonjo, Ganta and Kisenworla Selo-Locariore of Kisenina Colump	
	1				6893	Ndango	28.345	50.40	Comprises Kitarigi, Manya-Isi, Gacharapi, Kasata, Girwe and Karinga Sah-Locatani of Kiambu County	
					6554	Ngersda	46,430	35,40	Comprises Itans, Kahogoini, Warrisong, Kriangari, Kononyu, Handege, Rithi and Gidningucha: Sah-Cocations of Kiambu County	
	a subset percent	112 Catanda North	100.611	246.99		Plant Frankrike		(Constant and the second s	
-	2 R.Landber	The Common Concession			0555	Graette	25.414	54,80	Comprises Mataura, Grazenha, Kiriko, Ndike, Ngreongo, Marta-Isi and Kanyoni Sub-Locationa of Kiamba', Gamry	1 SAC
					0556	Gidobokoni	21,415	133.40	Comprises Kieni, Galon, Kammyska, Njalo, Mwienin, Gachege, Gatheithe and Gatar Sub-Locations of Kiambo County	
					0557	Charris	36,977	28,00	Comprises Karnesugi, Ngina, Kairi, Igegania, Makiwa and Miningo State-Locations of Kiambu County	
-					0558	Margine	26,785	29.70	Comprises Nyamangara, Mitmi, Makurwe, Mango, Garakoys and Karari Sub-Locations of Kamba County	
			118.793	336.60	0	-				
2	2 Klambu	113 Juja	114.00		0.059	Mareta	13,887	59.50	Comprises Magnetia Sub-Location of Kiamba County	
				-	.0560	Thete	23,134	31.30	Cooperses Theta Sub-Location of Coanitie	