

IWRA's XVII WORLD WATER CONGRESS

제 17차 IWRA 세계물총회

29 November – 3 December 2021
EXCO, Daegu, Republic of Korea



Provisioning of water ecosystem services in Kapingazi catchment, Embu County, Kenya. Can prospects of willingness to pay improve water quality and quantity within the catchment?

Burnice Karimi Ileri

Egerton University, Njoro, Kenya

burnice.karimi@gmail.com

November 30, 2021

**Prof. Paul M. Makenzi – Egerton University
Dr. Stanley M. Makindi – Machakos University
Dr. Peter A. Minang – World Agroforestry
Prof. John M. Mironga – Egerton University**





Introduction

- Ecosystems provide a wide range of valuable ecosystem services which are the foundation of man's sustainable development such as water provision. However, when humans exploit ecosystems in providing for their own sustenance, they affect ecosystem services intensively, endangering man's survival and development.
- Kapingazi catchment is home to a range of ecosystem services mainly water provision to downstream users including national hydroelectric power stations that contribute to 52.1% of hydro-electric power of Kenya's electricity. Destruction of the catchment area through agricultural and industrial activities, have negatively impacted Kapingazi River with its water quality and flows fluctuating significantly.
- These impacts weaken water provision through changing ecosystem structure, therefore there is need to reverse them in Kapingazi catchment. Payment for ecosystem services is one of the approaches which can enhance adoption of sustainable land management practices leading to restore water quality and water quantity in Kapingazi catchment.



Statement of the Problem

The ecosystems functions and environmental supporting services are systematically being lost as a result of degradation of the upper and middle catchment of Kapingazi .

The degradation is caused by increased soil erosion that contribute to siltation leading to significant reduction of volume of water in Kapingazi River, the high sediment load also ends in river Tana, its tributaries and thus posing a danger of siltation of the hydro- electric dams along the river.

This problem is, further, exacerbated by land-use changes in the Kapingazi catchment caused by land-use decisions which do not incorporate the value attached to supply of high quality water to downstream users.

One means of addressing this is by eliciting willingness to pay for improved water provision services from the catchment users as basis to conduct payment for ecosystem services in the catchment in order to restore lost ecosystem services in terms of water quality and water quantity and ultimately conserve the environment in Kapingazi catchment in Embu County, Kenya.



Objective

The objective of this study was to establish the willingness to pay for water provision services restoration in Kapingazi catchment in Embu County, Kenya.



Research Methodology

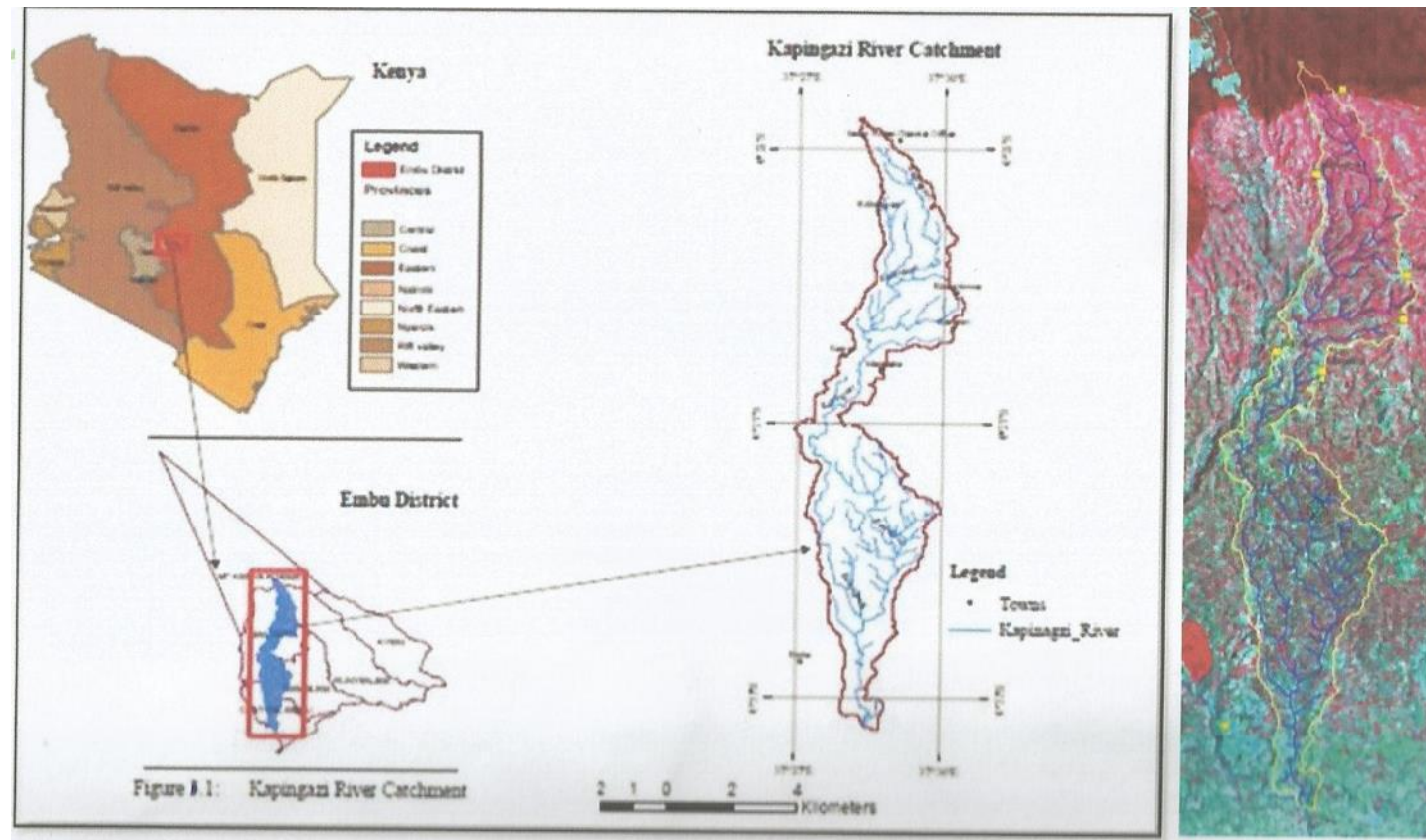
Research Design:

- Cross sectional survey research design with a cross sectional approach. According to Wiersma (1999), a survey involves studying a situation as it is in an attempt to explain why the situation is the way it is.
- This design facilitates the collection of information on attitudes and opinions on events, current practices, conditions, or procedures



Study Area

Kapingazi Catchment, Embu County, Kenya



Source: World Agroforestry, 2011



Sampling an Sampling Procedure

Sampling Procedure: Stratified sampling and systematic random sampling techniques was used. The formula for the sample size.

$$NC^2/C^2 + (N-1) e^2$$

Where;

- n required sample size
- N the given population i.e. Number of households (9,150)
- C Coefficient of variation (30%)
- E Margin of Error (3%)

Through substitution the sample size is calculated to be 100.



Continuation of Sampling and sampling procedure

- Sampling Frame: 9,150 households
- Sample size: 100
- Sampling Unit: 20

Focal Development Area	No. of Households
Kithunguriri	20
Kiriari	21
Kairuri	21
Mutunduri	24
Muthatari	14
Total	100



Data Collection Tools

- Household questionnaires
- Focus Group Discussions (KaWRUA, FDAC, Irangi CFA)
- Key Informant Schedule (NEMA, WARMA, EWASCO, KENGEN)



Data Analysis

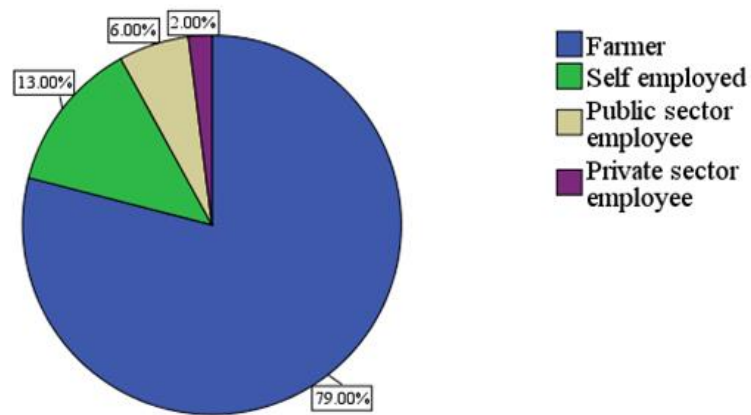
- Qualitative and Quantitative data was collected.
- Data was analysed using Descriptive statistics and Logistic regression.
- Statistical software: Statistical Package for Social Sciences (SPSS V22).



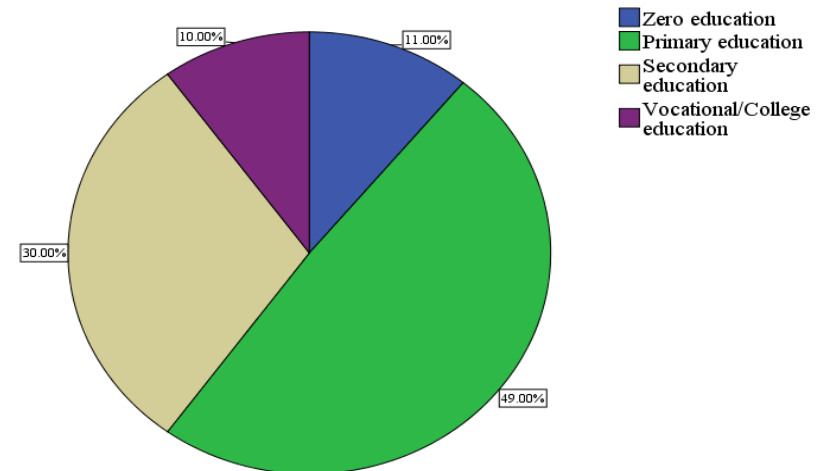
Key findings

Socio demographic information of the study population

- Survey was conducted in 33 villages of Kithunguriri, Kiriari, Kairuri, Muntunduri and Muthatari FDAs along Kapingazi River in Embu County, Kenya
- Gender: Female 53% ; Male 47%



Respondent's Main Economic Activities in Kapingazi Catchment



Education level of the respondents in Kapingazi catchment



Continuation.....

- Source of water; 95% are connected to tap water
- Survey involved household heads or members only above 18 years.
- Mean age of the respondents: 55 years . The group of 30 -39 years with a mean of 35 years was prominent hence productive and can make decisions concerning WTP for improved water services in Kapingazi catchment.
- Average household size: 6 members
- Average income per annum: KES 146,782 (USD 1453.29)
- Average land size: 2.3 acres – Small scale farmers
- Land tenure: Freehold with 74% with title deeds and 26% without title deeds since mostly its inherited land and in the process of succession.



What was the situation?

Human activities impacting on water provision service in Kapingazi catchment

•The impact of human activities on Kapingazi catchment was apparent. Human activities simplify the ecosystem in terms of reduction of structural composition of the biodiversity. Water quality and water quantity were increasingly being compromised by various sectors within Kapingazi catchment, consequently threatening and limiting the ecosystem resources and ecosystem services produced.

1. Changes in water quality

In this study, farming activities were the most important anthropogenic activities that had significant effect on changes on water quality at 95% confidence level in Kapingazi catchment which majorly included cultivation at the riparian area, deforestation at farm level and lack of soil and water conservation measures, chemical control of pests and diseases and quarrying. Results showed that the odds ratio for additional farming activities on changes on water quality in Kapingazi catchment was 36.863 which means that as farming activities increased, the probability of changes in water quality increased by 36.863 times or the odd of changes in water quantity increased by a factor of 36.863 as shown in the equation below.

Changes in water quality (y) = -2.17 +3.61 (Farmers)



Continuation.....

2. Changes in water quantity

Similarly, changes in water quantity were significantly influenced by activities of coffee factories (water abstraction), tea factories (Deforestation at farm level for tea processing) and those of the farmers.

Changes in water quantity (y) = -1.51+2.09 (Farmers) +2.015 (Coffee factories) +3.04 (Tea factories)

- Coffee factories activities had the most significant influence on changes in water quantity in Kapingazi catchment. The results showed that as the coffee factories activities increase, the probability in changes in water quantity increased by 7.5 times. The odds ratio for additional or increased factories' activities is 7.5. Hence when coffee factories activities increases, the odds of changes in water quantity increases by a factor of 7.5. This was attributed to water abstraction by coffee factories within the catchment which are located along Kapingazi River as mentioned by 23.6% of the respondents.



Human activities impacting on water provision service in Kapingazi catchment

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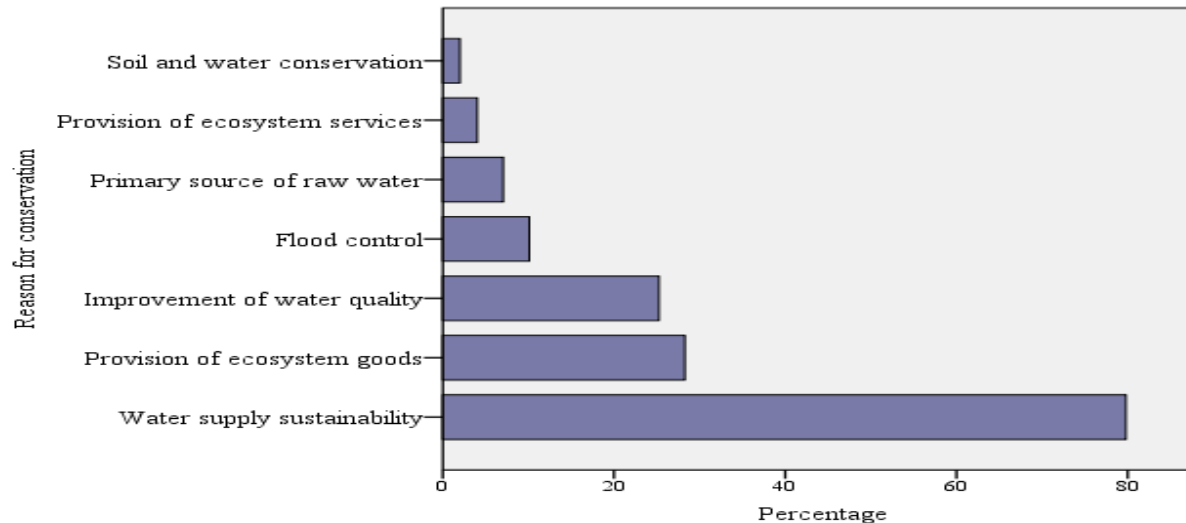




What can be done?

Can prospects of willingness to pay restore water provision services in Kapingazi catchment?

99% respondents were willing to participate in conserving Kapingazi catchment. However, 67% of the respondents were willing to pay for improved water services in terms of water quality and water quantity in Kapingazi catchment despite low awareness on payment for ecosystem services by 28% of the respondents.



Respondent's reasons for willingness to participate in conserving Kapingazi catchment



Respondents' reasons for willingness to pay for improved water service provision in Kapingazi catchment

		Responses
		Percent
Reasons for WTP	To have clean reliable water supply	43.9%
	For the catchment to produce ecosystem services	12.1%
	My responsibility	0.9%
	For future generation	0.9%
	To benefit local community	7.5%
	Water is a problem	2.8%
	Enhanced security	0.9%
	The money will be used to conserve the catchment	27.1%
	Reduced cost of health	0.9%
	Income from surplus food	0.9%
	Improvement of aesthetic value	0.9%
	To control soil erosion	0.9%
Total		100.0%



Respondents' reasons for not willing to pay for improved water service in Kapingazi catchment

		Responses
		Percent
Reasons for not WTP	Inadequate finances	35.3%
	Money paid will be mismanaged	2.9%
	Public good	14.7%
	No improved catchment	2.9%
	No trust	2.9%
	Other bills to pay	8.8%
	Old age	8.8%
	Small land sizes	5.9%
	Common agreement by all	5.9%
	Strict rules on river water usage	2.9%
	Family land disputes	2.9%
	Have done enough conservation in my farm	5.9%
	Total	100.0%



Factors influencing willingness to pay for improved water service in Kapingazi catchment.

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1	Age	-.073	.026	7.963	1	.005	.929	.883	.978
	Income	.000	.000	.061	1	.805	1.000	1.000	1.000
	Land size	.053	.167	.099	1	.752	1.054	.760	1.461
	FDA(1)	-.634	.549	1.334	1	.248	.531	.181	1.556
	Land tenure(1)	-.226	.644	.123	1	.726	.798	.226	2.820
	Gender(1)	.112	.596	.036	1	.851	1.119	.348	3.596
	Main activity(1)	-.672	.752	.798	1	.372	.511	.117	2.231
	Education level(1)	1.481	.662	5.003	1	.025	4.396	1.201	16.089
	Water source(1)	-1.187	1.577	.567	1	.451	.305	.014	6.704
	Household size	.297	.151	3.836	1	.050	1.345	1.000	1.810
	Constant	4.002	1.949	4.215	1	.040	54.691		

a. Variable(s) entered on step 1: Age, Income, Land size, Focal Development Area (FDA), Land tenure, Gender, Main activity, Education level, Water source and Household size.

- Willingness to Pay by the respondents = 4.002 - 0.073(Age) + 1.481 (Education level) + 0.297 (Household size) at 95% significance level.



Continuation.....

- KENGEN were willing to pay for improved water services since they were contributing to the Water Services Trust Fund managed by WRA who manage catchments. They were also willing to participate in the conservation efforts with relevant partners.
- Embu Water and Sanitation Company (EWASCO) was willing to contribute to the conservation fund in partnership with relevant stakeholders.
- Water Resources Authority (WRA) have the water services trust fund which is used to manage catchments.
- From the focus group discussion (Kapingazi Water Resource Users Association (KaWRUA), Focal Development Area Committee (FDAC), Irangi Community Forest Association (CFA) were of the opinion that the farmers would be more willing to be paid other than contribute to a conservation fund.



Conclusions and Recommendation

- More than half of the respondents were willing to pay (WTP) for improved water services in Kapingazi catchment with the average WTP being USD 9.10 per annum. Hence there was willing to pay (WTP) for improved water services in Kapingazi catchment.
- The respondents' awareness about catchments, including their roles and importance in providing ecosystem services like sustainable supply of water as well as improved water quality could have been the reason why majority of respondents showed positive willingness to pay.
- The factors that influenced respondent's WTP were age, education and household size at different levels of significance. Consequently, income appeared to be insignificant to the respondents of Kapingazi catchment.
- Positive WTP for improvement in water services shown by the respondents of Kapingazi catchment would be solid basis for payment for ecosystem services programme to be implemented in the area by the policy and decision makers since is an alternative approach to catchment management which can enhance adoption of sustainable land management practices and reverse the negative impacts, therefore restoring desired water ecosystem services i.e. improved water quality and water supply in Kapingazi catchment hence serving as an incentive for catchment users to properly manage and conserve the environment and scale to other catchments



Thank You Very Much!
Asanteni Sana!