

Livelihood outcomes of participation in a payment for ecosystem services (PES) program in Mt Elgon forest, Kenya

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Background

- ▶ Forest ecosystems provide a range of services including provisioning, support, regulating and cultural services (FAO&UNEP, 2020)
- ▶ They are at risk of irreversible loss due to high degradation rates (FAO, 2018)
- ▶ High degradation levels risk livelihoods of forest communities and affect natural biodiversity.
- ▶ Hence a need to balance between livelihood improvement and reduced forest degradation

Background

- ▶ One such way is through incentive based conservation approaches such as payment for ecosystem services (PES)
- ▶ PES provides payments to households to align land use practices with sustainable natural resource management
- ▶ The arrangement allows for dual benefits: livelihood improvement ecosystem restoration

PES program in Kenya

- ▶ Mt Elgon forest is one of Kenya's major water towers
- ▶ Plantation Establishment Livelihood Improvement Scheme (PELIS) has been implemented in the region since 2005 .
- ▶ Households are allocated plots in degraded forest land for restoration with an allowance to cultivate crops until trees form a canopy.
- ▶ Crops cultivated entirely benefit the farm households as an incentive to tend the trees for restoration.



Research objectives

- ▶ To evaluate the effect of PES on household food security levels among households in Mt Elgon forest region
- ▶ To assess the effect of PES on income among households in Mt Elgon forest region

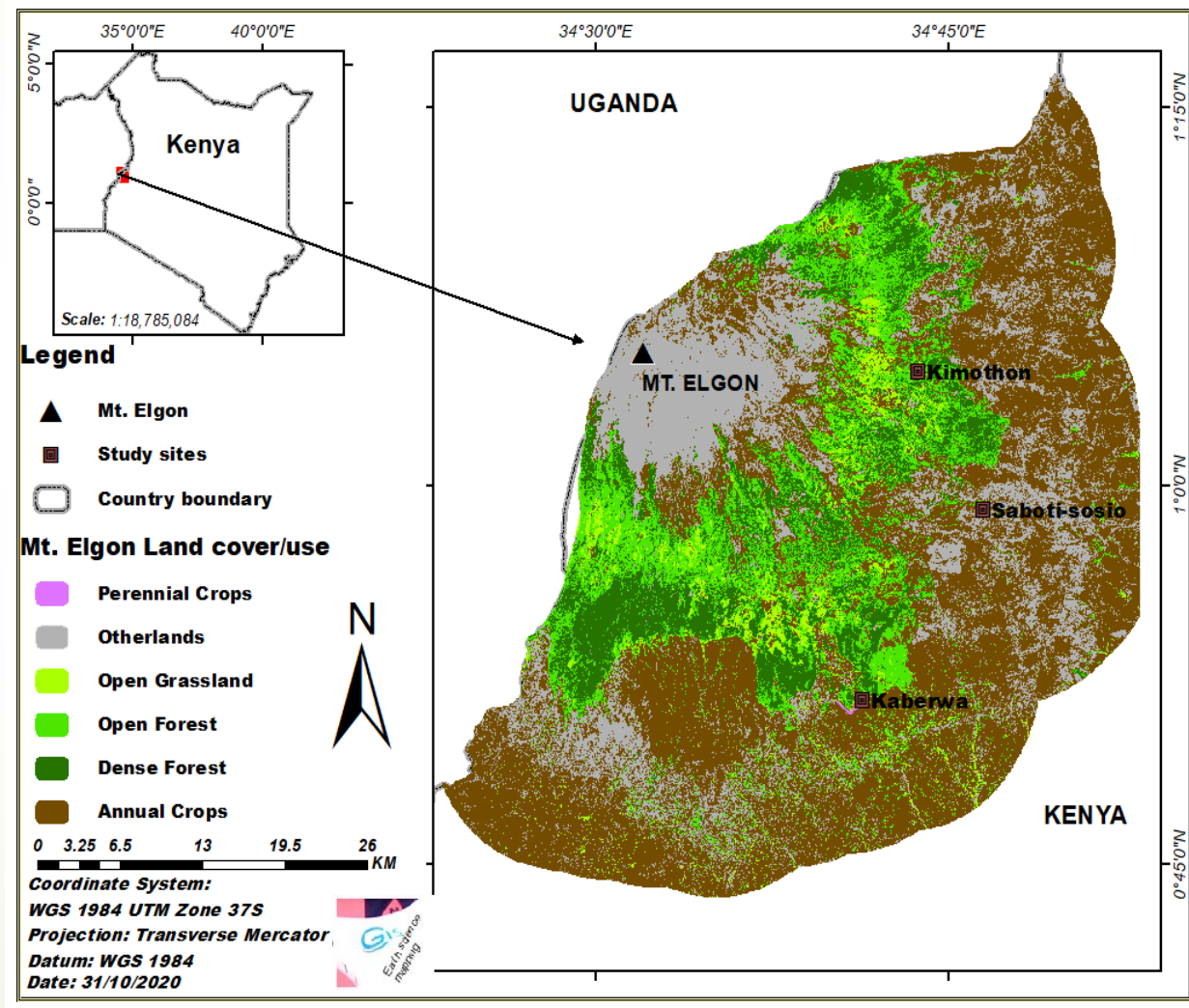
Data and Methods

- ▶ Participation is assessed as binary- Participants and non-participants in PELIS
- ▶ Food security- Measured using household Food Insecurity Experience Scale (FIES), Household Dietary Diversity Score (HDDS) and household food consumption expenditure (FCExp)
- ▶ Income-computed from all sources of household income
- ▶ Propensity score matching used to estimate the average treatment effect
- ▶ Quantile regression used to assess distributional effects of participating in PES

Sampling and study area

- ▶ 919 households sampled
- ▶ First stage- purposive sampling forest stations
- ▶ Second stage - random sampling of 30 villages in select forest stations
- ▶ Last stage- random sampling from household lists as provided by village heads

Study area



Analytical models

Propensity score matching (PSM) (Rosenbaum and Rubin, 1983):

Average treatment effect is denoted as

$$ATT \equiv E\{Y_{1i} - Y_{0i} \mid Di = 1\}$$

Where $Y_{1i} - Y_{0i}$ implies the effect of participation on PES on food security (a) or Income (b)

Quantile regression model:

$$Y_i = \beta_\tau X_i + \varepsilon_{ti}, Q_\tau(Y_i|X_i) = \beta_\tau X_i, \tau \in (0,1)$$

Where $Q_\tau(Y_i|X_i)$ represents quantile τ of outcome Y i.e. total household income, dependent on X i.e. explanatory variables.

Quantiles τ range between values 0 and 1. β represents the coefficients of the covariates quantiles estimated.

Food security: FIES

Food security levels	Participants Freq (%)	Non-participants Freq (%)	Total Freq (%)	P-value
Food Secure	120 (27.40)	94 (21.27)	214 (24.32)	0.005
Mild food insecure	70 (15.98)	55 (12.44)	125 (14.2)	
Moderately food insecure	91 (20.78)	101 (22.85)	192 (21.82)	
Severely food insecure	157 (35.84)	192 (43.44)	349 (39.66)	

Largest proportion (39.66%) of households were severely food insecure with most of them being non-participants.

24.32% of the households were food secure with participants being more compared to their non-participating counterparts.

Food security : HDDS

Number of food groups consumed	1 Freq (%)	2 Freq (%)	3 Freq (%)	4 Freq (%)	5 Freq (%)	6 Freq (%)	7 Freq (%)	8 Freq (%)	9 Freq (%)	10 Freq (%)
Participants	0	0	0	14 (3.20)	68 (15.53)	174 (39.73)	107 (24.73)	46 (10.5)	26 (5.94)	3 (0.68)
Non-participants	1 (0.23)	7 (1.58)	9 (2.04)	15 (3.39)	85 (19.23)	170 (38.46)	84 (19)	56 (12.67)	15 (3.39)	0
Total	1 (0.11)	7 (0.80)	9 (1.02)	29 (3.30)	153 (17.39)	344 (39.09)	191 (21.70)	102 (11.59)	41 (4.66)	3 (0.34)

- The HDDS differed between participants and non-participants with non-participants consuming lesser food groups (1-9) compared to their participating counterparts (4-10)

Food security: FCExp

Food security levels	Participants Freq (%)	Non-participants Freq (%)	Total Freq (%)	P-value
Very vulnerable (food insecure)	241 (55.02)	263 (59.5)	504 (57.27)	0.19
High food insecurity	23 (5.25)	15 (3.39)	38 (4.32)	
Medium food insecurity	37 (8.45)	42 (9.50)	79 (8.98)	
Low food insecurity	137 (31.28)	122 (27.60)	259 (29.43)	

- A large proportion of all surveyed households (57.27%) were found to be highly vulnerable with the majority being non-participants in the PES program.
- About 29.43% of the households were found have low food security with a most being participants in PES

Treatment effects of PES on household income and food security

Livelihood indicators	n. treatment	n. control	ATT	Std. Err.	t
Food security					
FIES score	436	397	-0.495	0.239	-2.069
HDDS	436	397	0.118	0.092	1.290
FCexp	436	397	29.981	57.352	0.523
Income (using the 4 estimators)					
Nearest neighbour	436	164	32040.39	12654.781	2.532
Radius	436	397	22810.318	11505.210	1.983
Kernel	436	397	31356.621	11122.323	2.819
Stratified	436	397	33751.332	10816.330	3.120

- ▶ ATT value reveals that participation in PES reduces a household's FIES score by 0.495 implying a positive and significant effect on food security.
- ▶ HDDS and FCExp do not show any difference between participants and non-participants
- ▶ All PSM estimators show a positive effect of PES on household income

Quantile regression results on PES effects across income groups

Variables	Qt-1	Qt-2	Qt-3	Qt-4	Qt-5	Qt-6	Qt-7	Qt-8	Qt-9
PES	2842.267 (1179.4)**	6269.475 (1294.28)***	8306.245 (1468.13)***	11621.94 (2078.59)***	12919.07 (2383.42)***	12748.38 (2826.51)***	14318.63 (4108.14)***	15575.29 (6974.23)**	37510.3 (12511.07)***
Age	-65.887 (31.71)**	-119.057 (39.217)***	-174.731 (58.15)***	-150.136 (76.42)**	-183.264 (100.28)*	-183.696 (100.395)*	-244.478 (156.09)	-124.101 (214.501)	190.292 (298.057)
Household size	-356.907 (207.26)*	-574.991 (311.29)*	-975.58 (378.02)***	-949.649 (463.38)**	-1291.65 (500.01)***	-1064.521 (714.96)	-1360.614 (717.80)*	-2115.418 (1220.71)*	-2780.936 (1930.12)
Education level:	302.108 (1029.28)	2810.93 (1478.49)*	2528.71 (1887.23)	3947.074 (2634.254)	2879.149 (3182.54)	1624.162 (4292.66)	3524.42 (6450.61)	13370.76 (6893.53)*	16354.89 (14925.63)
Secondary	1503.47 (4665.39)	2338.333 (6678.54)	825.979 (6094.39)	298.207 (8169.70)	-1019.119 (14710.5)	11648.22 (16900.86)	14681.16 (19761.19)	1799.736 (22949.48)	-11888.22 (38861.87)
Tertiary	-429.822 (2346.19)	-8530.821 (4823.15)*	-8193.226 (5783.796)	-12545.96 (7449.21)*	-17607.32 (7624.64)**	-15167.27 (11436.27)	-34032.07 (1473.17)**	-36500.26 (16877.39)**	-25924.25 (39357.44)
Wealth categories:	-1517.03 (2607.72)	-11651.73 (5155.22)**	-9798.858 (6330.01)	-14649.7 (8361.15)*	-16946.82 (8317.01)**	-14856.62 (11597.59)	-31665.69 (15189.5)**	-36264.87 (16441.95)**	-22872.36 (41911.15)
Middle wealth	-21.598 (247.04)	281.910 (450.112)	489.795 (470.07)	520.364 (548.688)	376.805 (672.62)	490.931 (860.62)	-431.12 (1156.86)	-457.241 (1696.65)	36.922 (2684.71)
Poorest	221.184 (94.01)**	494.481 (157.06)***	792.678 (199.532)***	892.727 (170.84)***	1423.646 (303.045)***	1911.223 (290.89)***	2261.74 (386.85)***	2766.735 (440.96)***	2779.826 (673.27)***
Own land size	0.997 (0.008)***	1.007 (0.015)***	1.018 (0.017)***	1.009 (0.016)***	1.002 (0.018)***	1.012 (0.029)***	1.035 (0.039)***	1.056 (0.045)***	1.051 (0.055)***
Off-farm income	0.021 (0.046)	0.065 (0.097)	0.219 (0.087)**	0.245 (0.07)***	0.285 (0.088)***	0.322 (0.114)***	0.465 (0.195)**	0.456 (0.416)	1.197 (0.676)*
Asset value	0.019 (0.009)**	0.029 (0.013)**	0.023 (0.014)	0.025 (0.02)	0.035 (0.020)*	0.046 (0.028)	0.054 (0.043)	0.070 (0.055)	0.1584 (0.103)
Yearly expenditure	1093.59 (843.17)	1263.514 (1384.38)	1984.606 (1914.01)	3785.175 (2248.31)*	6503.578** (2993.13)	7625.29 (3965.07)*	11690.38 (5234.04)**	17803.87 (7537.31)**	8576.08 (14137.17)
Extension	0.025 (0.013)*	0.025 (0.027)	0.056 (0.036)	0.067 (0.04)*	0.059 (0.038)	0.077 (0.064)	0.139 (0.084)*	0.221 (0.117)*	0.238 (0.212)
Shocks value	33.315 (43.49)	-9.141 (72.34)	-123.143 (109.18)	-220.164 (138.77)	-321.345 (152.815)**	-437.605 (192.34)**	-403.903 (239.56)*	-552.892 (319.14)*	-641.641 (494.16)
Distance to road	1674.316 (872.82)*	2013.697 (1319.38)	730.879 (1585.03)	981.882 (1977.53)	606.289 (2066.17)	1566.01 (2810.54)	1454.442 (4544.11)	-1668.804 (7846.89)	8477.399 (12126.78)
Forest extraction	1949.567 (3139.27)	11821.68 (5751.84)**	15457.8 (7340.581)**	21425.77 (8822.88)**	30898.73 (10270.85)***	30602.99 (15962.74)*	60373.81 (21229.5)***	61322.93 (26053.03)**	26151.43 (48175.51)
Constant									

Standard errors in parentheses *** P<0.001 **P<0.05 *P<0.10

Key messages

- ▶ PELIS has a positive effect on food security especially the food sufficiency dimension
- ▶ The scheme can be lauded for equity – It shows equal distributional impacts of income across all households.
- ▶ These findings imply attainment of double benefits, that is, ecosystem restoration and livelihood improvement.
- ▶ A major policy implication: involving forest dependent communities in forest management through incentive-based programs can be a pathway to increased income, improved food security, reduced poverty and enhanced equality among households.

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