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Land use typology and livelihood sources in the Maasai Mara wildlife dispersal area, Narok County, Kenya

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Abstract

The study sought to establish the relationship between the Maasai indigenous peoples' land use types and livelihood sources in the Maasai Mara wildlife dispersal area, in Narok County, Kenya. A total of 404 survey questionnaires were administered to the study respondents in Ololulunga, Mara and Osupuko Wards. The study hypothesis was that land uses have an effect livelihood sources and livelihoods in the study area. Interviews and observations supplemented data collection from study sites. The study respondents were randomly selected using cluster sampling. Livelihood assets such as crops and livestock were shown. With regard to livelihood sources, livestock rearing, basic commodities and petty business was dominant, accounting for 62.4% of the respondents. Analysis of variation of land use and livelihood sources found that pastoralism was not a significant land use type across the three study areas. Simple subsistence farming, livestock ranching and mixed (crop and livestock) farming were significant ($P<0.05$) amongst the three study areas. Further Spearman's rank correlation coefficients for land use types and livelihood strategies was computed using SPSS statistical tests. The test findings show that agro-pastoralism positively correlated with the farming (0.814). Subsistence land use strongly, negatively correlates with farming (-0.997). This finding implies that pastoralism as land use and livelihood source in Maasai Mara's dry season grazing land is shifting. The results point to a transition among the Maasai IPs, from traditional homogenous pastoralism activities, to a diversified combination of crop and livestock livelihoods, most notably agro-pastoralism. A trend of adopting farm and field and, off-farm livelihood strategies have implications on the security of Maasai IPs territories when pastoralism is no longer tenable. It is recommended that policy initiatives promote broader natural environment protection by regulating farming expansion and conserving livelihood sources that support Maasai IP livelihood and wildlife dispersal areas.

Keywords: *Land uses; livelihood sources; household head; indigenous peoples; wildlife dispersal area; environmental exploitation*

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Introduction

Environmental exploitation and expansion of agricultural land to natural reserves continues to appear in literature as an important livelihood source for low-income households worldwide (Angelson, Jagger, Babigumira, et.al.2014). As a product of a policy values and power agriculture land uses has imposed a new type of a labour activity to pastoral Maasai Indigenous Peoples in

East Africa. The land policy has cited that a general deterioration in land productivity and inadequate environmental management in the wider natural resource fields (ROK, 2009). For instance, it is argued that livelihood sources affect the process of land tenure system which in turn influences land use patterns (Oren and Newman 2006). Furthermore, land use changes have been associated with socio-economic development and environmental changes at the expense of the economic well- being of the resource poor peoples (Long *et al.,* (2007); Lambin and Meyfroidt, (2010); Msoffe *et al.,* (2011). From the literature, when a territory is a depended factor, the specific territory's socio-economic variables form the underlying frame of decision making for proper environmental management (Cowie *et al.,* 2018). Under the vulnerability context and based on policy reforms, traditional dry season grazing areas remain open to conversion to alternative tenure and land uses; the study variables of this phenomenon that were adopted for this study consist of: availability, accessibility, management and use of resources and, engagement of Maasai indigenous peoples' (IPs) in governance of group ranches in (Kameri-Mbote, 2019).

During the 1990s wave of global land policy shifts that allowed group land tenure, a dynamic competing land uses regime has been observed in the Eastern Africa savanna grassland areas (Mwangi *et al.,* 2018). Under the Land (Group Ranch representatives) Act 1958, Maasai IPs community who live in Group Ranches (GR) face livelihood security threats because of the effects of the 1990s land subdivision wave. According to Burnsliver and Mwangi (2007), events unfolding from land tenure reform policy in Narok, Kenya involve: land subdivisions into private land titles. Shifts from communal to individual land uses and; data gaps exist on emergent non-pastoral livelihood source groups in divisions of Maasai Mara wildlife dispersal area.

Kenya's land policy cited pastoral activities as both a pastoral tenure that is both a land use and a livelihood (Republic of Kenya, 2009). Understanding the relationship between land use typology and livelihood resource groups is important for understanding daily life processes. Efficient land use systems are essential for the environmental planning and management of Masai Mara wildlife dispersal area.

Previously, the Maasai households in East Africa survived predominantly from livestock herding by men in a communal grazing patch. Due to the land tenure policy shift, households have been converting land into a land labor unit that is expanding cultivation and fencing. (BurnSliver *et al.,* 2007, Nkedianye *et al.,* 2020). Furthermore, the land owners who are collectively members of a group ranch are confronted with demands by younger generation to be allowed to subdivide land for farming. Many more youths are excluded from a mixed wildlife and livestock livelihood source group (Nyberg *et al.,* 2015). If the remaining group ranches that were initiated by the Swynnerton plan of 1958 period by law subdivide for agriculture; the customary law regime that supports pastoralism, risk Maasai IP livelihood outcomes (Barume, 2014). This study provides data on land use typology and livelihood sources in Maasai Mara wildlife dispersal area in Narok county Kenya.

During the period of pre- independence, the Maasai IP households were expected to be co-opted into land plans through several laws and regulations. This land use regime commenced under the Development and Use of Land (Planning) Regulations, 1961. This was later repealed and enacted as part of the Land Planning Act, Cap. 303 of 1968 (Republic of Kenya 2015a). Development and Use of Land (Planning) Regulations, 1961, was later repealed and enacted as part of the Land Planning Act, Cap. 303 of 1968 (Republic of Kenya 2015b). One of the last laws to be passed before independence was the Registered Land Act of 1963 (Republic of Kenya 1963). This Act which was in force until 2012, made provision for the registration of land as well as for the registration of lease of agricultural tenancies (Republic of Kenya 2012). The new impetus to the land ownership regime is the 2010 constitution (Republic of Kenya 2010); that classified land into; community, private and public land ownership. The indigenous Maasai community collective group ranch labour group or individual land family labour unit within the ranches face competing land use challenge (s). These land uses appear similar; households

exploit natural resources and expect benefits into the future regardless of their specific labour practices (UNEP 2020, Dominguez and Luoma 2020). The study provides data around the Masai Mara game reserve on changing land use activities affecting Maasai IPs livelihood sources (Nkedianye *et al.,* 2020).

When the State and commercial interests compete, socio-political power becomes a central determinant reason as to *why* ordinary people under customary tenure should be denied to own or access valuable common Group Ranch resources become significant (Nelson, 2009). Although there were Maasai who were consulted about the desirability of group ranches and were involved in their formation, these were primarily educated Maasai tied into the national political system. However, the majority of the Maasai being marginalized did not accept or even understand human dimensions (demography, culture and social structure) and geographical features (such as grazing quotas, boundary maintenance and the management committee) of the group ranch (von Braun, and Gatzweiler, 2014). Their reasons for accepting the idea of group ranches were therefore at odds with those of the government (Burnsliver *et al.,* 2007). They primarily saw group ranching as a way to secure their land against further incursions from; government, expanding non-Maasai cultivators' interests and, the elite Maasai men. Another reason was the perceived possibility of increasing their traditional wealth base (livestock numbers) through the provision of water facilities, disease control, and dips funded by supporting projects. According to Fratkin (2001), in the absence of environmental assessments, public sectors' authority site land projects based on a precise location or its close proximity to other livelihood amenities while land value depends on how new projects harness communal resources and restrict communal pastoralism. This incidentally triggers a labour shift from rural herding to subsistence activities (Leffers *et al.,* 2021). In the view of Lambin *et al*., (2010), the current plans in Maasai Mara Group ranches, are lessening land for nature by creating simultaneous use of a dry season grazing land encouraging scattered patches of infrastructural excisions and incursions.

A study on the impacts of land use change on rural livelihoods in the mountain Popa area of central Myanma, revealed that changes in land use had occurred in the study area and that these had impacted livelihoods both negatively and positively (Thiri *et al.,* 2019). Accordingly, land use changes had been brought about by industrialisation and land modification by rural households had created new opportunities for the local people but lead to new livelihoods associated with a decrease in the natural and financial assets of the people. A study on the dynamics of land use changes on the livelihoods of the local communities in Baringo County, revealed that competing land uses had exacerbated land use conflicts and land degradation hence threatening livelihoods in the study area (Kateiya *et al.,* 2021). Masayi *et al.,* (2020) have further elaborated the impact of land use and the associated changes on the livelihoods of rural communities. A study of this relationship on communities adjacent to the Mt. Elgon Forest ecosystem revealed a decline in natural forest, bamboo and grasslands cover while fallow land and land under mixed farming increased. The use of forest resources (and the associated livelihoods) had however declined although communities living closer to the forest ecosystem were still heavily dependent on it.

It is apparent from the foregoing that land uses and the associated changes do affect livelihood sources. Although a lot of studies have been undertaken on land use changes among the Maasai IP (Nyariki *et al.,* 2001; Nyberg *et al.,* 2015; Homewood *et al.,* 2009)., there is a dearth of literature on how specific land use changes have affected livelihood sources in fragile ecosystems such as wildlife dispersal areas. This study is an attempt to address this gap. This study hypothesized that there exists a link between land uses (and associated changes) and land-based livelihood sources in three group ranches that fall in a wildlife dispersal area.

Materials and methods

The study area consisted of Narok County (580 367 km^2) located in South-Western Kenya and the neighbouring, the Maasai Mara National Reserve. Based on the 2019 Kenya national census, Narok County had a population size of 1,157,837 people and 24,125 households (Kenya,

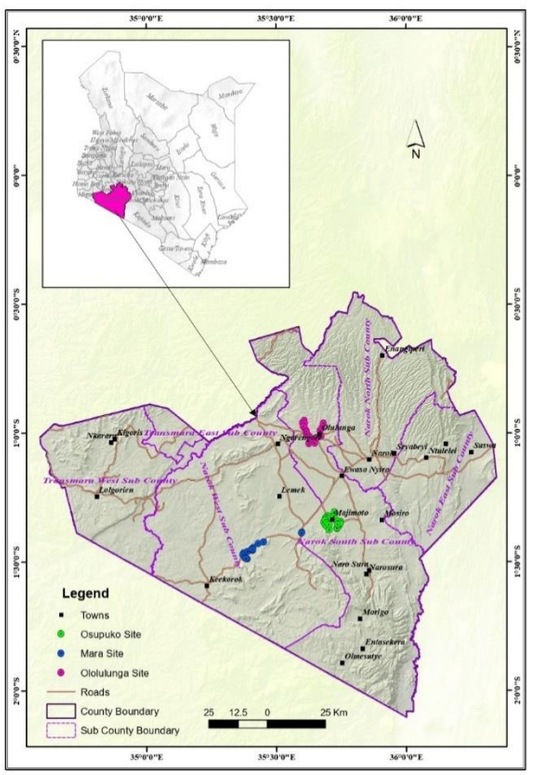
National Bureau of Statistics). 1,057,521 of people live in rural areas. They had a total population of 52,974 people living in the Masai Mara game reserve ecosystem, designated as a wildlife dispersal area. The study area was intended to be a buffer zone between the National Reserve and the northern farming areas although it is not clearly marked on the ground (Mukeka *et al.*, 2019). Simple random sampling targeted all Maasai IPs, within three wards that have formed a settlement pattern across outermost group ranches. The land use and livelihood sources have clusters that were previously thought to be homogenous. Chi- square test was employed to get significant differences between the group ranch clusters.

The map of the study area and GIS position relative to the nearby center respectively was generated. Figure 1 shows the
Collection Sites of land uses and livelihood sources in Narok County in Kenya

Figure 1
Map of Narok South; Ololulunga, Mara and Osupuko divisions with GIS coordinates for data

Figure 1

Map of Narok South; Ololulunga, Mara and Osupuko divisions with GIS coordinates for data Collection Sites of land uses and livelihood sources in Narok County in Kenya



Source: Department of Resource Survey and Remote Sensing (2023)

Under the statistical design for the survey, the study population comprised of all the households within the three study areas in accordance with an updated list of 18,276 for

Ololulunga, 18,541 for Mara, and 16,157 households for Osupuko that was generated during the 2009 National Housing and Population Census (Kenya, National Bureau of Statistics, 2009). Probability random clustered sampling procedure was used to select a sample and households within each study area who met the inclusion criteria (Palinkas *et al.,* 2015). Probability cluster random sampling was ideal because the group ranches lie within existing wards that have clusters of settlements. Clusters are important random sampling points in obtaining livelihood trends of Maasai IP' livelihoods in the Maasai Mara dispersal area. A sample size of 404 household heads were selected for the study (Table 1). This was calculated to have a sufficient sample size of 159, 181, and 183 household heads for Osupuko, Ololulunga, and Mara, respectively.

Table 1

Study area response rates; Ololulunga, Mara and Osupuko wards in Narok

Study area	*Target		**Actual	
	Frequency	Percentage	Frequency	Percentage
Osupuko	135	30.7	122	90.4
Ololulunga	152	34.6	138	90.8
Mara	154	35.0	144	93.5
Total	440	100	404	91.8

*Initial sample sizes of 159, 181, and 183 households was randomly selected for Osupuko, Ololulunga, and Mara, respectively, according to the creative research online systems software (CRS, 2012), and based on Equation (i).

$$\boldsymbol{ss} = \frac{\boldsymbol{z^2 * (P) * (1-P)}}{\boldsymbol{c^2}} \quad \text{.....(i)}$$

Where: SS is the initial sample size, Z = Z score (1.96 for 95% confidence level), p = proportion of the population with targeted attribute (0.95), 1-p = proportion of the population without targeted attribute, c = confidence interval expressed as a decimal (4.27). **Sample correction was carried out for finite populations according to Equation (ii) to obtain a final sample of 135, 152 and 154 households for Osupuko, Ololulunga, and Mara, respectively.

$$New\ ss = \frac{ss}{1+\frac{ss-1}{pop}} \quad \text{.....(ii)}$$

Where new SS is the corrected sample size, SS the sample size obtained from the online software and pop the total number of households (53,974).

The probability cluster random sampling procedure was used to select household heads within each study site in order to obtain a reliable comparison (Nielsen *et al.,* 2015; Leung 2015). This sample size was sufficient to meet the study objectives under optimum use of limited financial resources.

Primary data was collated by administration of a questionnaire, informal conversations, observations and photography. Questionnaires were administered to clusters of household heads in settlements locations in the three wards of Narok County.

Primary data were collected using a designed livelihood survey questionnaire. A comprehensive questionnaire was constructed to capture household head demographic information, income streams, assets and resources. The questionnaire further had prompts of capturing livelihood sources and dry season and land tenure motivated changes in livelihood strategies to capture trends of shocks and risks experienced by a predominantly

pastoral Maasai IP households in selected Ololulunga, Mara and Osupuko wards (Appendix A). A set of face-to face questions that targeted sectoral administrators active in the area formed the interview guide for the study (Appendix B).

Secondary data was obtained from published and unpublished sources. These included documentary analysis of research reports, public laws and regulations, published papers, unpublished research theses and organization websites. Other observations made about the surrounding environment and settings of homesteads were recorded in a notebook. The observations helped to contextualize the data, validate findings and complexities that pastoral Maasai IP experience under a land tenure regime change. Global Positioning System (GPS) coordinate for each homestead was recorded in the questionnaires and aided in generating a map of the study area (Figure, 1).

Percentage of land use types, and percentage of effects of land use and livelihood sources and Strategies aided to show simple relative labour activities and adoption of new form of livelihoods strategies respectively. The group ranches are open field of community land used as a wildlife dispersal area. Land use and livelihood continuous variables were subjected to Analysis of Variance (ANOVA) to assess the variation of land use study sites (independent variable) in regard to land use and livelihoods (dependent variables). The Spearman's rank correlation coefficients were used to analyze data quantified the direction of change in land use type, and livelihood strategies to show patterns of change that underlie survival of Maasai households in a wildlife dispersal area.

Results

The administrative wards of Osupuko, Mara and Ololulunga were renamed from divisions that under the decentralization regime serve as administrative Narok County government and connect to the three Ololulunga, Mara and Osupuko study sites. These settlements sites are in a fundamentally transforming but the pathway of change is not clear. The presentation of results follow sequential field data presentations on land use and livelihood parameters (McCuster, *et al.,* 2013; Berman, *et al.,* 2017).

Land use typology

As far as land uses are concerned, research findings indicated a diversified land use typology (*Table 3*

Result for Land use types percentage in Osupuko, Ololulunga and Mara divisions).

The study findings (Table 2) revealed a diversity of land uses across the three study sites. Mixed farming, agro-pastoralism as well as subsistence farming were most significant competing land uses. As far as the Osupuko study site is concerned, mixed farming and agro-pastoralism were the major types of land use accounting for 41% and 34.4%, respectively of the respondents Accordingly, the two agro-systems were distinctly varied on the basis of both crop and animal production intensities (Table2, Table 2).

Table 2

Result for Land use types percentage and rank in Osupuko, Ololulunga and Mara divisions

Land use type	Study site														
	Osupuko(n=122)					**Ololulunga(n=138)**					**Mara(n=144)**				
	Yes			No		Yes			No		Yes			no	
	F	%	Rank	F	%	F	%	Rank	F	%	F	%	Rank	F	%
Agro pastoralism	42	34.4	2	80	65.60	28	20.30	3	116	79.70	114	79.20	1	30	20.80
Subsistence farming	13	10.7	3	109	89.3	52	37.70	1	86	62.30	16	11.20	2	128	88.80
Livestock ranching	4	3.3	5	118	96.7	6	4.30	4	132	95.70	8	5.6	3	136	94.40
Mixed farming	50	41	1	72	59	29	21	2	109	79	3	2.10	4	141	97.90
Large scale crop production	9	7.4	4	113	92.60	3	2.20	5	135	97.80	0	0	5	144	100

Subsistence farming and large -scale crop farming was less prominent, accounting for only10.7% and 7.4% respectively, of the respondents. The other limited land use was livestock ranching. The Ololulunga site was dominated by subsistence farming, mixed farming and agro-pastoralism, each accounting for 37.7%, 21% and 20.3% respectively, of the **).**

In conclusion; the determinant of land uses in this study consist of both mixed farming and agro-pastoralism systems. Combination of crop and animal assets at varied intensities were common and were practiced among the sedentary and

respondents (Table 2). The Mara study site was largely an agro-pastoralism zone, with the land use accounting for 79.2% of the respondents while subsistence farming and livestock ranching combined accounted for 16.8% of the respondents. The most dominant land uses in each study site are demonstrated in this study (

nomadic Maasai IP across Ololulunga, Mara and Osupuko study sites (Figure 2). The main subsistence crops in the study sites included maize, beans, finger millets, cowpeas and pigeon peas. Wheat, maize, tomatoes, French beans, onions, potatoes and cabbage were the main large scale (cash) crops.

Figure 2:

Major land uses graph; Osupuko, Ololulunga and Mara divisions' Group Ranches

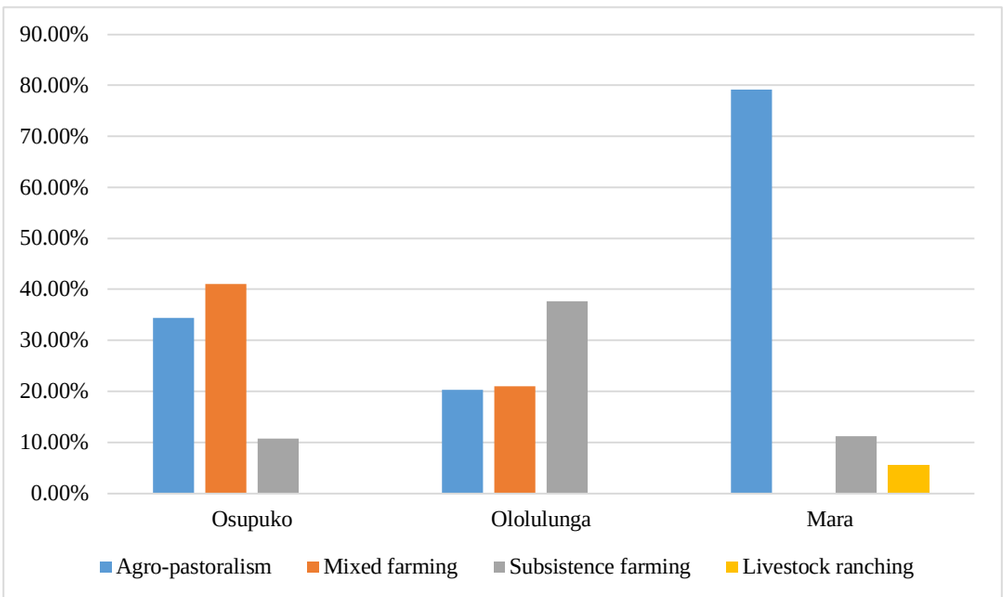


Table 3

Result for Land use types percentage in Osupuko, Ololulunga and Mara divisions

Land use type	Study site											
	Osupuko (n=122)				Ololulunga (n=138)				Mara (n=144)			
	Yes		No		Yes		No		Yes		No	
	F	%	F	%	F	%	F	%	F	%	F	%
Agro-pastoralism	42	34.4%	80	65.6%	28	20.3%	116	79.7%	114	79.2%	30	20.8%
Subsistence farming	13	10.7%	109	89.3%	52	37.7%	86	62.3%	16	11.2%	128	88.8%
Livestock ranching	4	3.3%	118	96.7%	6	4.3%	132	95.7%	8	5.6%	136	94.4%
Mixed farming	50	41%	72	59%	29	21%	109	79%	3	2.1%	141	97.9%
Large scale crop production	9	7.4%	113	92.6%	3	2.2%	135	97.8%	0	0	144	100

The study findings indicate that the Maasai IPs are shifting from a previously pastoralism land use and livelihood source and adopting a farm-based livelihood in a wildlife dispersal area. The types of farm-based land uses are also not homogenous. A major gap in this data is household head criteria of selection of the type of land use. Further study on the influence of the location of a household settlement on the adoption of a particular combination of land uses is recommended.

Percentage Livelihood source rankings

Table 4
Results for Livelihood sources percentage in Osupuko, Ololulunga and Mara indicates the research findings. In the Osupuko site, the dominant livelihood source was milk hawking basic merchandise trade, as well as bead work and ornaments as small business engagements, which accounted for 75.4% of the respondents. Other lesser sources were engagement in casual off-farm activities and formal employment which together accounted for 14.7% of the respondents. In the Ololulunga site, agro-pastoralism and engagement in business, which in combination accounted for 75.4% of the respondents, were the main livelihood sources. In the Mara site, an overwhelming majority of the respondents (78.1%). engaged in small business and to a lesser

It was also of interest to this study to establish rankings of the livelihood sources of the Maasai IP in the study area. (
extent in casual off- farm activities. Despite agro-pastoralism being a major land use type in Mara, it is apparent that it was not practised as a livelihood source, but and economic activity and income generation activity (Table 4).

Across the three study sites, engagement in small business is the main livelihood source accounting for 62.4% of total respondents, followed by agro-pastoralism which accounted for 15.3% of the respondents. Casual off-farm activities farming and formal employment combined accounted for 1.8% of all respondents. It's therefore apparent from the research findings that the main livelihood sources across the three study sites were engagement in business, agro-pastoralism and to lesser extent, casual off-farm activities, farming, and formal employment.

Table 4

Results for Livelihood sources percentage in Osupuko, Ololulunga and Mara

Livelihood source	Study sites											
	Osupuko (n=122)				Ololulunga (n=138)				Mara (n=144)			
	Yes		**No**		**Yes**		**No**		**Yes**		**No**	
	F	%	**F**	%	**F**	%	**F**	%	**F**	%	**F**	%
Farming	5	4.1%	117	95.9%	20	14.5%	118	85.5%	2	1.4%	142	98.6%
Agro-pastoralism	5	4.1%	117	95.9%	57	41.3%	81	58.7%	0	0	144	100%
Business	92	75.4%	30	24.6%	47	34.1%	91	65.9%	113	78.1%	31	21.9%
Formal employment	7	5.7%	115	94.3%	7	5.1%	131	94.9%	7	4.9%	137	25.1%
Casual off-farm activities	11	9%	111	91%	7	5.1%	131	94.9%	22	15.3%	122	84.7%

Statistical analysis of Land use typology and livelihood sources across the three study sites
Analysis of Variance (ANOVA) test of independence was used since the data was classified on the basis of two factors land use type and livelihood sources. The null that *(H_O), there is no significant difference in the average land use and livelihood sources across the 3 study sites* was tested using SPSS (Meulman *et al*., 2012). The Analysis of Variation (ANOVA) results across Mara, Ololulunga an Osupuko study sites are tabulated in Table 5**.** The result suggests that there is no significant difference in the average land use and livelihood sources across the three study sites.

The explanation for the result is as follows: There exists notable distinction among land use types and livelihood sources within the study sites. Simple subsistence farming (F=12.791, p=0.000) shows a statistically significant difference across the study sites. This finding is an indicator of variations within specific farming in cluster areas surveyed. In a similar example, mixed farming shows a strong variation (F= 26.355, P=0.000).

Land use practices that do not stand out for a Maasai IP household were recorded. Pastoralism (F=0.551, P=0.578), livestock ranching 9F=4.556, p=0.0012 and large-scale crop production (F=0.829, P=0.364) did not show a significant difference across the study sites. The farming activities that Maasai IP are adopting are expanding into a wildlife dispersal area territory. The null hypothesis is rejected.

Table 5

Result of Analysis of Variation (Anova); landuse and livelihood sources across 3 study sites in Narok County

*Land use type	Df	F	P-Value
Pastoralism	2	0.551	0.578
Simple subsistence farming	2	12.791	**0.000**
Sedentary subsistence farming	1	0.348	0.556
Intense subsistence farming	1	0.479	0.490
Livestock ranching	2	4.585	**0.012**
Mixed farming	3	26.355	**0.000**
Large scale crop production	1	0.829	0.364

*Land use and livelihood continuous variables were subjected to ANOVA of land use and livelihoods across Ololulunga, Mara and Osupuko study sites.

The following hypotheses were tested: Ho: μ 1 =μ 2 =μ 3, there was no significant difference in the average land use and livelihood parameters in the three study sites, that the Maasai IPs in the study area have adopted a diversified land use typology. This implies that there was a significant variation in land use types in the three study sites, dominated by agro-pastoralism, mixed farming and subsistence agriculture. Gaps in data on the influence of climatic variables in the choice of land uses exist.

Linking land uses and livelihood sources

To determine the statistical significance of the research findings on the correlation between land use typology and livelihood sources, the *null hypothesis* that;

H_O There is no correlation between land use types and *livelihood sources in the 3 study sites;*

Was tested using Spearmans rank correlation co-efficient? A list of land use type and livelihood sources data set of samples taken from the three study sites is shown in Table 6. A correlation matrix showing the Spearman's rank correlation coefficients for land use types and livelihood strategies was computed using SPSS statistical tests (Meulman& Heiser, 2012) and results shown in Table 6.

Livelihood source Land use type	Farming	Formal employment	Casual off-farm activities	Business	Large scale cropping	Agro-pastoralism
Livestock ranching	0.179	0.365	-0.599*	-0.038	0.231	0.431
Subsistence farming	-0.977*	-0.292	-0.780*	-0.977*	-0.730*	0.632*
Large scale cropping	0.233	0.298	-0.315	0.174	1	-0.456

Agro-pastoralism	0.814*	-0.510*	-0.988*	-0.724*	-0.553*	1
Mixed farming	0.823*	0.251	0.458	0.367	0.235	0.676*

Table 6

Spearman correlation rank matrix; land use types & livelihood sources in Narok County

*Significant correlation coefficients at p=0.05. These calculated values of Spearman's rank correlation coefficient are between ±1 and +1 limits of acceptance at p=0.05(Table 7). The correlation coefficient lies in the interval (-1,1) with zero implying there is no correlation. A positive correlation is ikened to a linear correlation between x and y where x tends to increase as y increases and vice versa (Mc Bride (2005). The *Table value r critical for 5 values at p=0.05 is 0.0826.*

The result show that that there exist both positive and negative correlation models in a set of a land use types and livelihood sources (Table 7). The agro-pastoralism land use type is significantly positively correlated with the farming (0.814). Similarly, agro-pastoralism is significantly positively correlated with subsistence farming (.0632). Comparatively, mixed farming land use was strongly positively correlated with farming (0.823). The table Critical (r) for five variables at p=0.05 is 0.8236. In conclusion; Maasai IP household are in a diversification process. They adopt *agro-pastoralism models* as shown in Table 7 to cope during cyclic dry seasons in the own small land sizes space during fallow periods of farming, or subsistence farming for survival. More so the multiple on-farm land uses are further diversified into sets of combinations. Gaps in data on acceleration impact of multiple agriculture models to the dry season area environment exist. Further study on extent of crop farming expand to a wildlife dispersal area is recommended.

Table 7

Result for percentage perception of Change in livelihood sources and strategies in Osupuko, Mara and Ololulunga study sites, Narok, County

Livelihood variable	**Study sites**											
	Osupuko (n=122)				**Ololulunga (n=138)**				**Mara (n=144)**			
	Yes		**No**		**Yes**		**No**		**Yes**		**No**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Changes in occupation	58	47.5 %	64	52.5 %	61	44.2 %	77	55.8%	24	16.7 %	120	83.3
Changes in income	116	95.1 %	6	4.9%	69	50%	69	50%	0	0		100%
Changes in number of livestock	120	98.4 %	2	1.6%	117	84.8 %	5	15.2%	141	97.9 %	3	2.1%
Changes in capital intensity	0	0	0	0	104	75.4 %	34	24.6%	120	83.3 %	24	16.7 %
Changes in farm technology	0	0	0	0	118	85.5 %	20	14.5%	72	50%	72	50%
Changes in location of	0	0	0	0	114	82.6 %	24	17.4%	72	50%	72	50%

livelihood production												
Changes in access to water	118	96.7 %	4	3.3%	108	78.3 %	30	21.7%	138	95.8 %	6	4.2%
Changes in access to pasture	0	0	0	0	120	87%	18	13%	88	61.1 %	56	38.9 %

Maasai IP households are adopting other livelihood sources that correlative negatively with other land uses. Livestock ranching land use is significantly negatively correlated with casual off-farm activities (-0.599). The subsistence land use strongly negatively correlates with farming (-0.997), business (-0.977), casual off-farm activities (-0.780) and large-scale cropping (-0.730) as livelihood sources. The co-efficient of correlation does not means that they are associated in nature. It means that there exist a diversity of seasonality or trends in the models (Mc Bride, 2005).

The negative correlation rank means that the land uses and livelihood sources are likely to change over time in cyclic nature (seasonal cycles). Likewise, the negative correlation implies that Maasai IP households utilise heterogenous income sources to manage drought risks with farming systems that are relatively capital intense; they sell livestock assets to support farming models in a cyclic intensive farming cycle. The negative correlation shows the existence of vulnerability of selected models on the ground (Mc Bride, 2005). The cyclic negative data indicate their vulnerability during seasons when they are not likely to access the dry season grazing land resources. Further study on vulnerability and risk to both drought, and livestock loss as well as farm produce shocks is recommended. As shown in Table 5, similar models of land use types and livelihood sources exist in the same locations.

Further, from the study findings, (Table 5) combined commoditizing livestock or introducing cropping is; raising capital and labour demand as natural resources become scarce. Marginalised Maasai IP pastoralists after land leases/ sale are living with immigrant farmers in a wildlife dispersal area prone to periodic drought in the three study divisions (Fratkin 2001, McCabe *et al.,* 2010; Nkedianye *et al.,* 2020). Further study on assessment of Maasai IP livelihood vulnerability and risk assessments is recommended. Gaps on data on now private land tenure system motivate competing farm and non-farm land uses and livelihood sources exist.

Maasai IP households' perspectives of Change in Livelihood Sources and Strategies in Ololulunga, Mara and Osupuko study sites

To further explain the ranked effects of land uses on livelihood sources, the study respondents were asked whether any changes had occurred in various livelihood variables as a result of land uses. Changes that had occurred in land use are tabulated and ranked (

16.7% of the respondents indicated they had changed their livelihoods, indicating that agro-pastoralism was still significant in the area, albeit side by side with subsistence agriculture (Table 7).

Table 7

Result for percentage perception of Change in livelihood sources and strategies in Osupuko, Mara and Ololulunga study sites, Narok, County).

Accordingly, various changes in livelihood variables were evident in the three study sites. Changes in occupation had occurred to 47.5% and 44.2% respondent in Osupuko and Ololulunga respectively. These changes are explained by the shift from pure pastoralism which is both a land use and livelihood source (ROK, 2009). However, in the Mara site, only

Changes in the number of livestock and access to water were evident across the three study sites. The changes in the number of livestock were most evident in Osupuko and Mara with 98.4% and 97.9% respectively, of the respondents indicating that the number of livestock reared had reduced. Reduced access to water was also more evident in Osupuko and Mara. (*Table 7;* Result for percentage perception of Change in

livelihood sources and strategies in Osupuko, Mara and Ololulunga study sites, Narok, County).

The percentages of respondents in Mara site largely contrast compared to Osupuko and Ololulunga, an indication of a more stable livelihood. Observations made during the interview survey indicated that land adjudication in Mara study site was still in process; yet the landscape is coping better with trends of adoption of farm-based livelihood sources that Ololulunga and Osupuko sites. The motivation for agropastoralism combination with subsistence farming to protect the environment and to survive the harsh drought period when pasture and water sources are not available or accessible was recorded from the data. According to Akall (2021), a variation of this nature depicts a social system change; from customary unrestricted grazing strategy that was not previously seen as a threat to; enclosed pastures.

The changes in the number of livestock and access to water are attributed to the changing land tenure system from communal to private land ownership leading to reduction in land grazing and the change to a sedentary lifestyle associated with the practice of agriculture. Furthermore, fencing of land has degraded land and hampered the free movement of livestock and zoned off water sources. As a result, the productivity of women has been negatively affected due to the long distances travelled to water points and sources.

Changes in capital intensity, farm technology, location of livelihood sources and in access to pasture were most prevalent in Ololulunga and Mara study sites. As far as access to pasture is concerned, no change was observed in Osupuko because the dry season grazing land was still being managed by a council of elders and was available for access during drought. However, this was not the case in Ololulunga and Mara where land ownership was being individualised and therefore limiting access to pasture. Furthermore, in Ololulunga the dry season grazing land is largely degraded due to devegetation, except in riparian areas.

The changes in the location of livelihood production were most prevalent in Ololulunga largely due to land privatisation and fencing for farming purposes. In Osupuko, new infrastructure such as urban centres and roads were reducing pastureland and increasing land disputes. It was also noted that the location of livelihood production was extending to the wildlife conservation area and changing the protection status of some key areas that were hitherto only accessed during dry seasons. Changes in farm technology were due to introduction of livelihood sources based on farming and included new farming implements, use of irrigation and therefore drilling of boreholes and the use of solar energy for lighting. These changes were brought about by private entities as well as the Narok County Government. The introduction of new livelihoods based on farming, employment and business led to changes in capital intensity. The new livelihood sources were observed to be more capital intense (for example, the need for money for farm inputs, fencing, irrigation, marketing, etc.) as compared to the hitherto practiced pastoral livelihoods. Even within farming, large-scale farming was observed to be more capital intense as compared to subsistence farming, mixed farming and agro-pastoralism.

Statistical Analysis of household head attributes, land use typology and livelihood sources

To determine the statistical significance of household attributes, land use typology and livelihood sources, the *null hypothesis* that,

H_0; household head attributes do not significantly affect the relationship between land use typology and livelihood sources in the3 study sites was tested using a chi-square(χ^2) test of independence (Table, Result of Household- head attributes land use typology and livelihood sources in Osupuko, Ololulunga and Mara study sites Narok County).

For the six attributes of the farm-household assessed, five were significantly different ($P<0.05$) amongst the three study sites (Table 8). The significance of occupation ($P< 0.001$), and sources of income ($P< 0.001$) depicts a changing of livelihood from a pastoral lifestyle towards an increasing potential to live off- land and attaching

significant value to specific points of strategic production.

Table 8

Result of Household- head attributes land use typology and livelihood sources in Osupuko, Ololulunga and Mara study sites Narok County

No	Attribute	χ^2	P Value
1	Occupation	64.641	<0.001
2	Source of income	51.111	<0.001
3	Education	20.705	0.008
4	Monthly income	19.611	0.003
5	Age	5.488	0.019
6	Gender	2.231	0.328

Chi-square test results show that household heads attributes; occupation ($p<0.001$) source of income ($p<0.001$), education ($p=0.008$), and age ($p=0.001$) are significantly associated with land uses and livelihood sources in Mara, Osupuko and Ololulunga study sites. Gender ($p=0.328$) was not significantly different across the three areas indicating that efforts towards gender empowerment and social inclusion for the Maasai IP are bearing fruit. Over the past two decades, governments have increasingly removed discriminating laws and have adopted laws promoting gender equality. Further, in several regions, women's participation in the land use decisions have increased while some regions have made progress in increasing access to land and natural resources in private land. For IPs specifically, harmful practices such as female genital mutilation and early and forced marriages have started to decline in some contexts. But there is still need for continued efforts towards gender mainstreaming and building the capacity of key institutions and mechanisms for promoting gender equality for IPs in relation to accessing and utilization of natural resources such as land.

The result show targeting individuals' levels of change and not a community for a better environmental management of Masai mara wildlife dispersal area. The significance of association of human capital attributes and livelihood strategies (Table 7) indicates that these attributes are not distributed equally or independently across Osupuko, Ololulunga, and Mara study sites. A similar study's demographic module used age, gender and education level to assess the importance of human capital in the livelihood of communities living adjacent to the Maasai Mara game reserve were collected (Sun *et al.,* 2023).

Discussion

The following discussions are guided by the study findings regarding land use typology and livelihood sources in Maasai Mara wildlife dispersal area. Multiple farm land uses are shaping Maasai Mara dispersal area that is likely a feeding grazing niche during drought. There is no spatial human-and natural system guide in the selection of group ranch settlements (Snider, 2012, ROK, 2015). Pastoralism was not a significant land use type across the three study areas. Pastoralist farming systems in East Africa are complex, diverse and extremely dynamic. Pastoralism as a livelihood and have for a long time also been characterized by low investment and policy neglect by governments (Odote, 2013). The pastoralist systems are perceived to be inefficient in the use of land due to failure to provide economic benefits on a scale commensurate with its land use requirements (Hesse & MacGregor, 2006). For a long time, pastoralism was not recognised as a legitimate land use and production system (ROK, 2010).

The socio-political issues around agriculture expansion have pushed cultivation activities to pastoral territory. This behaviour is marginalising indigenous peoples who practice pastoralism land use type. Pastoralism was

therefore considered as being no longer tenable across the study area due to increased encroachment from crop cultivation, the rise in private area enclosures, the resulting diminished rangelands and negative impacts of climate change such as increased frequency and intensity of droughts. Aware of the position of agriculture in development growth, Maasai IP are actively using self-determination as a strategy to save their land. The changing land uses are not having a lasting change in human behaviour because the transformations are not accompanied by culturally shared norms and values (Breukers, Mourik, & Heiskanen (2013). This study observed the contribution of development facilities by the County government as ways of enhancing livelihood sources and responding to impacts of drought.

The diversified land use typology signifies a transition from pure pastoralism as a land use and a livelihood often referred to a lifestyle to other tenure motivated land uses (ROK 2009). Byamugisha, (2013) has observed that off- farm income sources indicate that, land rental markets by land sales are driving labour mobility. Historically, this has not always been the case. This questions previously held assumptions of a homogenous pastoral community managing a harsh environment for future generations (Ayiemba *et al.,* 2015; Lambrecht and Asare, 2016). It is observed that subsistence agriculture activities have been elevated to a livelihood source in wildlife dispersal area yet it exploits large spaces used as wildlife and livestock pasture and water source points. Land tenure change has allowed access by an individual(s) farmer to community land as opposed to the earlier purposes of accessing land as group ranches for livestock production. It is apparent that there has been a transition in land use among the Maasai IP in the study area from traditional pure nomadic pastoralism to agro-pastoralism and sedentary crop farming lifestyle. This transition is documented by other researchers as well.

Lind *et al.,* (2020) has cited in the literature that the Masai Mara landscape is transforming in paradoxical directions, away from customary production system. The United Nations has called to Member States to promote harmony with nature exemplified by IP as the UN philosophy of achieving sustainable development (United Nations Assembly, 2020). Mc Cabe, *et al.,* (2010) cited that Tanzanian Maasai IP adopted agriculture and integrated it with traditional pastoralism.

From the data findings (Table 3 and Table 7) of the study, this is bound to compete with pastoralism which supports wildlife management. Kariuki *et al.,*(2021), argued that pastoralist communities have been marginalised by processes driven by government policies that promote diversification of income sources and disregard the Environmental Management and Coordination laws under the Environment Management and Coordination Act 2009 (ROK, 2009a).

For instance, Nyariki *et al*., (2009), in a study on land use change and livestock production challenges in the Maasai-Mara ecosystem, established that patterns of land use had changed from a predominance of nomadic pastoralism to diversity characterised by sedentary pastoralism, pure cultivation and agro-pastoralism. Evidently, this change had negatively impacted on the Maasai Mara ecosystem leading to reduced productive capacity of people in a wildlife rich ecosystem. Kimanzi and Wishitemi (2001) documented the effects of land use changes on herbivores in Maasai Mara with a focus on three group ranches from the period 1975-1999. They acknowledged that changes had occurred in land-use patterns in historical wildlife dispersal areas had disrupted the hitherto existing co-existence equilibrium between a predominantly nomadic Maasai pastoralist community and wildlife.

The migration of young men from a previously livestock- based livelihood to sub-urban areas to 'make money' or generate income reflect a broader community transformation. The household heads are adopting individual choices contrary to collective to group ranch values. Nyberg *et al.,* (2015) in a study on transforming land, land livestock and livelihoods in West Pokot County indicated that there has been a transformation from land uses and livelihoods based on pastoralism to a livestock based agro-pastoralism system anchored on the use of enclosures for land and livestock management as

well as fodder production. The key motivation for this change was the need to intensify the use of limited land that is seen as a new frontier that is livelihood source for indigenous Maasai peoples. Undesired transformation becomes a global agenda when the power of the privileged few makes it hard for Maasai IP community to timely access communal livelihood resources; the Maasai IP community loses out in this game (Souza *et al.,* 2018; Sozi, 2019).

It is also evident from the study research findings that some land uses are strongly correlated (both positively and negatively) with livelihood sources. This implies that land uses affected livelihood sources in the study area. It was further established that land uses and the associated changes had affected certain livelihood variables. Homewood *et al.* (2009) noted the change in Maasai livelihood sources.

In a study on changing land use, livelihood and wildlife conservation in Maasailand, data findings indicated that since the 20th Century, there had been a decline in specialised pastoralism as a livelihood source and a shift towards agro-pastoralism and non-natural resource- based livelihoods, including non-farm activities. This shift is taking place alongside changes in land tenure that had led to diminished access to grazing land due to land privatisation and subdivision. The loss of communal rangelands that had been subdivided and converted into private land had led to loss of key resources for people and livestock (such as fodder and water) and impeded movement and increased competition for the resources. Seno & Shaw (2002) also acknowledged the transition of the Maasai community to new livelihood sources.

In a study on land tenure policies, Maasai traditions and wildlife conservation, they argued that the Maasai had embraced agro-pastoralism and employment as livelihood sources. However, they also noted that livestock were central in the Maasai traditions and were used as a measure of wealth by Maasai men. In a study on the trade-offs for climate resilient pastoral livelihoods in wildlife conservancies in the Mara ecosystem. Bedelian, *et al.,* (2017) noted that pastoralists in East Africa tried to spread the risk associated with livestock-based livelihoods by diversifying to tourism and by leasing out their land for formation of wildlife conservancies. They established that income from tourism and conservation was an important safety net for the pastoralists during drought and whenever wildlife incomes declined. However, they acknowledged that the two livelihood sources reduced access to rangeland resources, increased conflicts between the pastoralists and owners of conservancies as well as imposed restrictions on mobility of livestock and people.

Conclusion

The discussions above have highlighted the connectedness of socio-economic, environmental and cultural factors that are important for livelihood of Maasai IP. The nature of land use typology is diverse; monitoring the sustainability of livelihood sources during the transition; from pastoralism require joint monitoring of combinations of land uses adopted that fall in different Government sectors. Combinations of land use models associated with agriculture are expanding towards as farm, and off-farm activities that minimize the community open fields that harbour livelihood sources used by the poor to cope with events of drought. Proper planning of household's own land will require also managing the surrounding environment and allow wildlife dispersal in areas that also serve as livelihood sources. Given the hitherto existing co-existence equilibrium between a predominantly nomadic Maasai pastoralist community and wildlife, the diversification of land uses and livelihoods in a wildlife dispersal area is likely to change the delicate human-wildlife balance in a game reserve. Effects associated with change in a wildlife dispersal area has future implications on the security of Maasai IPs territories, co-existence with and the protection of a wildlife in Mara, Ololulunga and Narok study area.

Recommendations

At the planning level; spatial planning and zoning should incorporate settlements, fences, paths to water points as well as dry season grazing lands in Narok County and other similar ecosystems. The study has provided data with policy implications that show existing significant agriculture land use typology and strategies in a Maasai Mara game reserve. In addition, the study provides data to show that effects of livelihood

sources within group ranches motivated by income generation combinations in a wildlife dispersal area. Principles of better environmental planning and management targeting sustainable land use practices should be incorporated into the land policy change. Private land owners are recommended to adopt better behavioural change models that regard other land users and wildlife who need to use natural resources in previously group ranch land. At the policy level, this study recommends that; initiatives that promote broader natural environment protection; this will entail tenets that regulate farming expansion and conserving a dry season grazing land. Group collectives such as a group ranch should by a policy direction; set aside land for seasonal grazing and water points for the community and wildlife as a coping mechanism during drought. It is recommended that policy initiatives promote broader natural environment protection by regulating farming expansion and conserving livelihood sources that support Maasai IP livelihood and wildlife dispersal areas.

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