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Pastoralism and ecosystem-based adaptation in Kenyan Masailand

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Abstract

Purpose – The purpose of this paper is to assess the potential for pastoral communities inhabiting Kenyan Masailand to adapt to climate change using conservancies and payments for ecosystem services.

Design/methodology/approach – Multiple methods and data sources were used, comprising: a socio-economic survey of 295 households; informal interviews with pastoralists, conservancy managers, and tourism investors; focus group discussions; a stakeholder workshop. Monthly rainfall data was used to analyse drought frequency and intensity. A framework of the interactions between pastoralists' drought coping and risk mitigation strategies and the conservancy effects was developed, and used to qualitatively assess some interactions across the three study sites. Changes in household livestock holdings and sources of cash income are calculated in relation to the 2008-09 drought.

Findings – The frequency and intensity of droughts are increasing but are localised across the three study sites. The proportion of households with per capita livestock holdings below the 4.5 TLU poverty vulnerability threshold increased by 34 per cent in Kitengela and 5 per cent in the Mara site, mainly due to the drought in 2008-2009. Payment for ecosystem services was found to buffer households from fluctuating livestock income, but also generates synergies and/or trade-offs depending on land use restrictions.

Originality/value – The contribution of conservancies to drought coping and risk mitigation strategies of pastoralists is analyzed as a basis for evaluating the potential for ecosystem-based adaptation.

Keywords Pastoralism, Conservancies, Ecosystem-based adaptation, Payments for ecosystem services, Maasai, Kenya, Ecosystems

Paper type Research paper

1. Introduction

The Maasai are a pastoral ethnic community that occupy southern Kenya and northern Tanzania; an area generally described as "Maasailand" (Homewood *et al.*, 2009). They live in arid and semi-arid lands (ASALs) which are characterized by high spatial and

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temporal variability in rainfall. Their nomadic livelihood, based on keeping cattle, goats and sheep, is highly vulnerable to repetitive but unpredictable drought (Western and Manzolillo Nightingale, 2003). While the Maasai have developed indigenous ways of adapting to the shocks imposed by drought (Nassef *et al.*, 2009), climate change is now bringing new challenges that may make these indigenous adaptation strategies inadequate (Nori and Davies, 2007). Climate change may influence their pastoral life through changing amount of rainfall, higher temperatures and greater climate variability (Ericksen *et al.*, 2013). Climate variability which includes increased frequency and severity of droughts and flood events (Galvin *et al.*, 2004), will expose pastoralists and their herds to increased risk, and will require effective risk management and coping strategies (Birch and Grahn, 2007).

The effects of climatic hazards, in particular loss of pastoral livestock herds which erodes the basis of their livelihoods, amplify other challenges affecting pastoral livelihoods, including high human population growth; loss of herding lands to private farms, parks, and urbanization; privatization of ownership (tenure) of formerly communal lands and the associated sedenterisation; and periodic disruptions brought about by economic shocks, political instability and civil war (Fratkin, 1997). These processes jointly heighten the vulnerability of pastoral communities in Africa to the effects of climate change, with increased poverty as a possible result. Such poverty in turn increases the vulnerability of pastoralists to climate change, a positive feedback cycle which further deepens poverty (Eriksen and O'Brien, 2007).

Pastoralists have developed adaptive strategies to reduce overall vulnerability to current climate variability ("adaptive strategies *sensu stricto*") and to manage impacts *ex post* ("coping strategies") (Morton, 2007). Both of these contribute towards climate change adaptation; the adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. Climate change adaptation depends greatly on the adaptive capacity – that is the ability of the affected community to cope with the impacts and risks of climate change, which depends on the socioeconomic characteristics of the community (Smit and Wandel, 2006).

The strategies to enhance climate change adaptation in pastoral communities focus primarily on livestock which is the mainstay of pastoral livelihoods. Yet, apart from benefits from livestock, pastoralists also derive benefits from other dryland ecosystem services. This is particularly so in areas such as Maasailand with assemblages of wildlife and biodiversity that supports eco-tourism (Homewood *et al.*, 2009). There is an interest in the potential for ecosystem-based adaptation (EBA) – the use of biodiversity and ecosystem services as part of an overall adaptation strategy to the impacts of climate change (SCBD, 2009). The sustainable management of grasslands and rangelands to enhance pastoral livelihoods and the conservation of wildlife habitats is one form of EBA that can provide multiple socio-cultural (recreation and tourism), economic (income for local communities), and biodiversity (forage for grazing animals and wildlife habitats) co-benefits (SCBD, 2009). In Maasailand, the establishment of wildlife conservancies, through partnerships between Maasai landowners and commercial tourism enterprises can be considered as an EBA because conservancies involve the management of rangelands to enhance both wildlife tourism and pastoral livelihoods (Osano, 2011). In Kenya, a "wildlife conservancy" is defined as "a conservation area set aside by an individual landowner, group of owners or a community for purposes of wildlife conservation in accordance with the provisions of the Wildlife Act" (Republic of Kenya, 2011).

Some conservancies and initiatives supported by governments to promote wildlife conservation on private and communal lands include a component of direct payment for biodiversity conservation (Ferraro and Kiss, 2002). The authors consider such programs as a subset of payments for environmental services (PES), which are defined as "a voluntary, conditional agreement between at least one "seller" and one "buyer" over a well-defined environmental service – or a land use presumed to produce that service" (Wunder, 2007).

Much attention concerning livelihoods implications of PES has focussed on the direct benefits of income provision and poverty reduction. Little attention has been paid to the indirect benefits or co-benefits of PES, including its role in EBA (Wertz-Kanounnikoff *et al.*, 2011; Van De Sand, 2012). This paper aims to fill this knowledge gap by evaluating the contribution of conservancies and PES to climate change adaptation among the Maasai pastoralists in southern Kenya. PES in the context of this study refers to initiatives that involve:

- contracts between pastoral landholders and government and non-governmental conservation organisations or commercial tourism companies;
- explicit payments to landowners for maintaining a stipulated land use that supports wildlife conservation, sometimes jointly with nature-based tourism; and
- payments in cash directly to households and not through communal institutions.

Thus, PES can be implemented independently of conservancies, or in a subset of conservancies.

This paper examines how conservancies and PES programs affect pastoralists' drought coping and risk mitigation strategies and, their implications for pastoralists' adaptation to climate change. The remainder of the paper is arranged as follows. Section 2 describes the methods, Section 3 the results and discussions, while Section 4 presents the conclusions.

2. Methods

2.1 Analytical framework

During a workshop held in August 2011, the authors developed a conceptual framework, which reviewed the different effects of conservancies in relation to pastoralists' traditional drought coping and mitigation strategies. These strategies include mobility, switch in the livestock species composition and stocking levels, participation in livestock and land markets, breeding and feeding of herds, investments in water, tapping on social networks, insurance, income diversification, savings and exiting pastoralism (Campbell, 1999; Eriksen and Lind, 2009). These strategies have herd-related and non herd-related effects which are summarised in Figure 1. The figure also shows a variety of effects of conservancies on four dimensions of the life of pastoralists: income, social issues, ecosystems services and land management.

The analytical framework was developed on the understanding that there is plenty of literature on traditional drought management strategies among pastoral communities, but there is insufficient attention to the role of conservancies and PES in climate change adaptation. The framework therefore provides a basis for analysis of the interactions between traditional drought management strategies and the drought management effects of conservancies and PES programs in an integrated way. The interactions among three conservancy effects of income diversification and

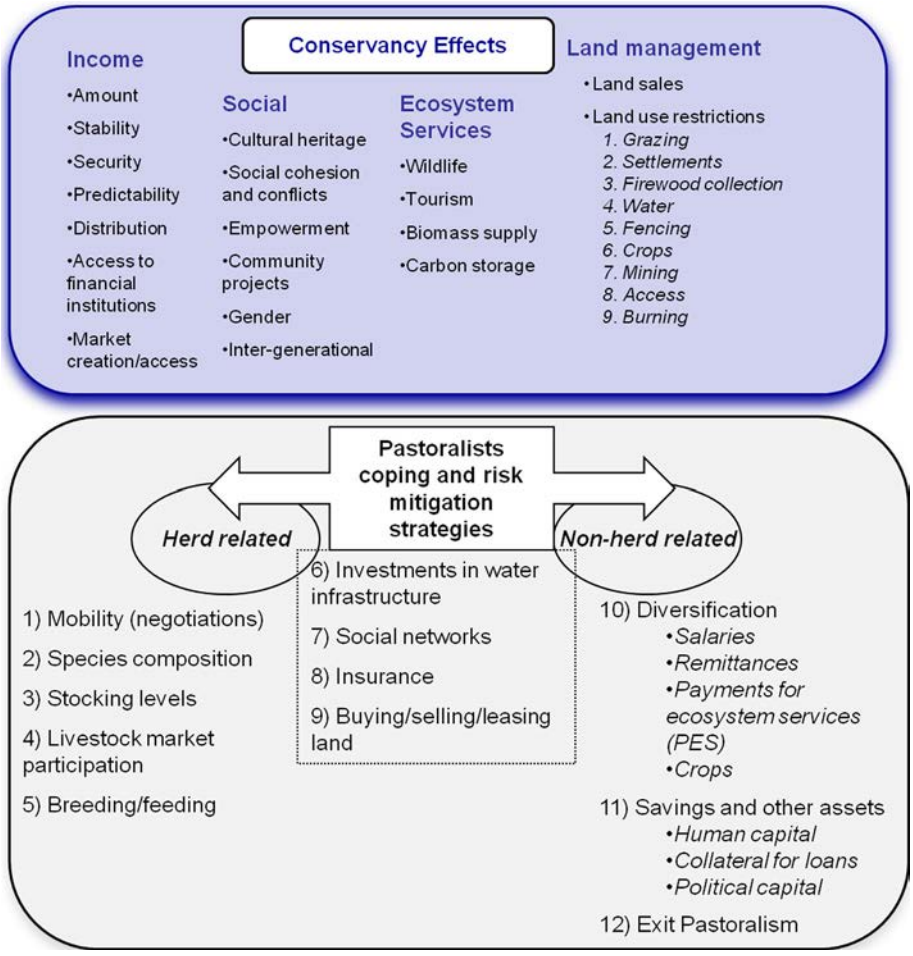


Figure 1.
Analytical framework of the (i) effects of payments for ecosystem services in conservancies on income, social situation, ecosystem services and land management and (ii) the impacts of traditional pastoral drought risk coping and mitigation strategies

augmentation, ecosystem services and land management, and four pastoral coping and risk mitigation strategies of mobility, diversification of land use, water provision and land markets are reviewed in this paper.

2.2 Study sites

This study was carried in three sites predominantly inhabited by the Maasai; the Mara, the Kitengela, and the Ol Kiramatian (Figure 2). The sites were chosen based on the presence or absence of a PES program and the existing differences in land tenure. Both the Mara and Kitengela have ongoing PES programs under privatised and individually owned lands, while Ol Kiramatian lacks a PES program, and land is communally owned. Table I shows the characterization of the study sites across different variables.

2.2.1 The Mara. The Mara is the northern most dry-season grazing reserve for the migrating Serengeti-Mara wildebeest population and includes the Maasai Mara National Reserve and adjacent pastoral lands to the north. The main land use issues

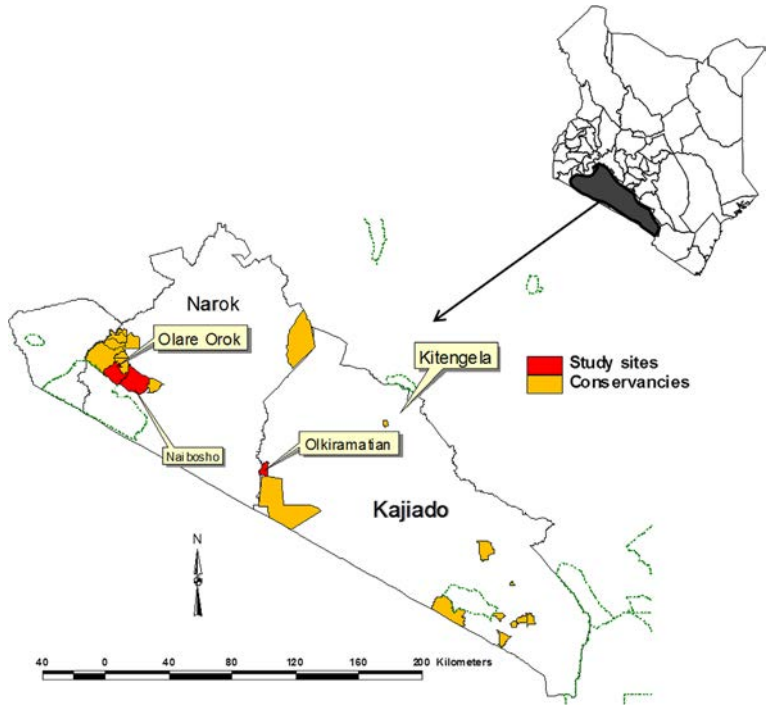


Figure 2.
A map showing the study sites – Olare Orok and Naibosho conservancies (Mara); the Kitengela; and Ol Kiramatian conservancy

Site	Kitengela	Mara	Ol Kiramatian
Conservancy/PES program	The wildlife conservation lease (WLP)	Olare Orok and Naboisho conservancies	Ol Kiramatian conservancy
Conservancy area (ha, 2010)	16,700	30,666[a]	21,612
Protected area	Nairobi National Park	Maasai Mara National Reserve	n/a
Rainfall (mm year^{-1})	370-800 (bimodal)	877-1,341 (bimodal)	350-600 (bimodal)
Land tenure	Private	Private	Communal
Landuse regulations	Restrictions on land sale, subdivision, fencing and cropping	Restriction on land sales, settlements, livestock grazing	Land use zonation (irrigated crops, wildlife and grazing)
Conservancy funding model	Public funding (direct payments)	Market (direct payment)	Market (indirect payment)

Notes: [a]The Olare Orok conservancy = 9,720 ha and Naboisho conservancy = 20,946 ha; characterization in terms of area, rainfall, wildlife protected areas, land tenure, land use regulations, sources of benefits and governance

Table I.
Characterization of the three study sites and the associated conservancies and payment for ecosystem service (PES programs)

outside the reserve include land privatization and sub-division, and expansion of crop cultivation and settlements. In the Mara, this study included both the Olare Orok and the Naibosho conservancies (Figure 2), but the authors restrict the analysis in this paper to the Olare Orok conservancy (OOC). The OOC was started in 2006 and covers

an area of 10,040 ha. It involves a partnership between 157 pastoral land owners and four tourist operators. It includes a PES program in which the landowners are allowed limited livestock grazing but are required to relocate their settlements from the land set aside for wildlife tourism. In turn, the tourist operators' pay each landowner an annual fee of US$39/ha (2009 rates) through a conservancy management company.

2.2.2 The Kitengela. The Kitengela is located to the south of the Nairobi National Park and Kenya's capital city of Nairobi and is a wet season dispersal area for zebra (*Equus quagga*) and wildebeest (*Connochaetes taurinus*). The main land use issues include the sub-division of privatised land, urbanization, expansion of crop cultivation and permanent settlements with fences. A PES program, the Wildlife Conservation Lease, was initiated in 2000 and by 2010 covered an area of 16,700 ha and involved 350 pastoral families. The PES program requires participating landowners to avoid fencing or sub-dividing their land and to allow free movement of wildlife in return for being paid an annual fee of US$10/ha provided by the Kenya Wildlife Service and the Global Environment Facility.

2.2.3 Ol Kiramatian. Ol Kiramatian is a group ranch that covers an area of 21,612 ha. The land is communally held under private title and is collectively owned and managed by the group ranch members who have refrained from formalizing the land sub-division to individual land holdings. Lacking formal land title deeds, landowners cannot sub-divide nor sell land. Ol Kiramatian is divided into three distinctive land-use zones. The livestock zone serves as a settlement and a wet season livestock grazing area, the agricultural zone is used for irrigation cropping, mainly for vegetable and horticulture, and the conservation zone (the "conservancy") is designated for wildlife and tourism but is also used for dry-season livestock grazing. The conservancy lacks a PES program, but the community has set up a tourism lodge and invest the tourism revenues in communal projects.

2.3 Data and analysis

Data sources include:

- A socio-economic survey by the first author in 2009 and 2010 that involved 131 and 164 households in the Mara and Kitengela, respectively. The survey data was used to calculate the changes in per capita livestock holdings and the changes in the various sources of household cash income in 2008 and 2009.
- Informal interviews with landowners, conservancy managers, and tourist operators.
- Focus groups with landowners in Ol Kiramatian and with tourist operators in the Mara.
- A workshop that brought together pastoralists, tourism operators, and policy makers.

The data on monthly rainfall at the three sites was obtained from the Kenya Department of Meteorology and was used to calculate the intensity and frequency of drought occurrences. The drought intensity was categorized based on the criteria summarised in Table II (Ogutu *et al.*, 2007).

3. Results and discussions

3.1 Drought occurrence and the effect of 2008-2009 drought

There were recorded differences in the occurrence, frequency and intensity of droughts across the three sites. In the Mara, droughts in the dry and wet seasons and annually

were more frequent and severe in the period 1914-1960 than 1960-2011 (Figure 3(a)-(c)). The analysis of five-year moving averages shows a quasi-periodic pattern with dry phases often characterized with droughts. Although there is no consistent pattern of increasing or decreasing drought frequency and intensity since 1960, droughts were more common in the 1990s and the 2000s. In this period, a total of four extreme droughts (1966, 1976, 1984, and 1991) and seven severe droughts were recorded (Figure 3(c)).

In Kitengela there was no clear trend of increase or decrease in the dry and wet season, and annual rainfall and the long-term rainfall records showed a five-year quasi-cyclical pattern (Figure 4(a)-(c)). A total of five extreme droughts were recorded between 1960 and 2011 (in 1961, 1975, 1976, 1984 and 1999) and a further six severe droughts over the same period (Figure 4(c)).

In Ol Kiramatian, no clear pattern was recorded for wet-season rainfall, but there were variations in the frequency and intensity of the dry-season, and annual droughts which were highly prevalent from the 1970s to 1990s (Figure 5(a)-(c)). A total of three extreme (in 1961, 1982 and 2000) and seven severe droughts were recorded in Ol Kiramatian between 1960 and 2011 (Figure 5(c)).

Overall, the analysis shows that the extreme and severe droughts are increasing but are localised across the three study sites (Figures 3(c), 4(c) and 5(c)). The 2008-2009 drought, for example, was severe (in 2008) to moderate (in 2009) in both Kitengela and Mara, but was moderate (in 2008) to severe (in 2009) in Ol Kiramatian. The 2008-2009 drought disrupted the livelihoods of the majority of the Maasai pastoralists, many of whom lost a large share of their livestock as a result (Osano, 2011). Although the data on livestock mortality due to the 2008-2009 drought across the three sites is lacking, analysis of the survey data showed an increase (Table III) in the proportion of households with per capita livestock holdings below 4.5 tropical livestock units (TLU). This is considered as the threshold below which a pastoral household becomes vulnerable to poverty traps and climate shocks (Lybbert *et al.*, 2004). The declines in livestock holdings are attributed to drought-induced livestock mortality of 75 and 67 per cent for cattle and small stock (sheep and goats), respectively, (Western, 2010). Previous studies on drought-induced livestock mortality showed significantly higher livestock mortality rates in Kitengela despite having above-average rainfall compared to other parts of Maasailand (Nkedianye *et al.*, 2011).

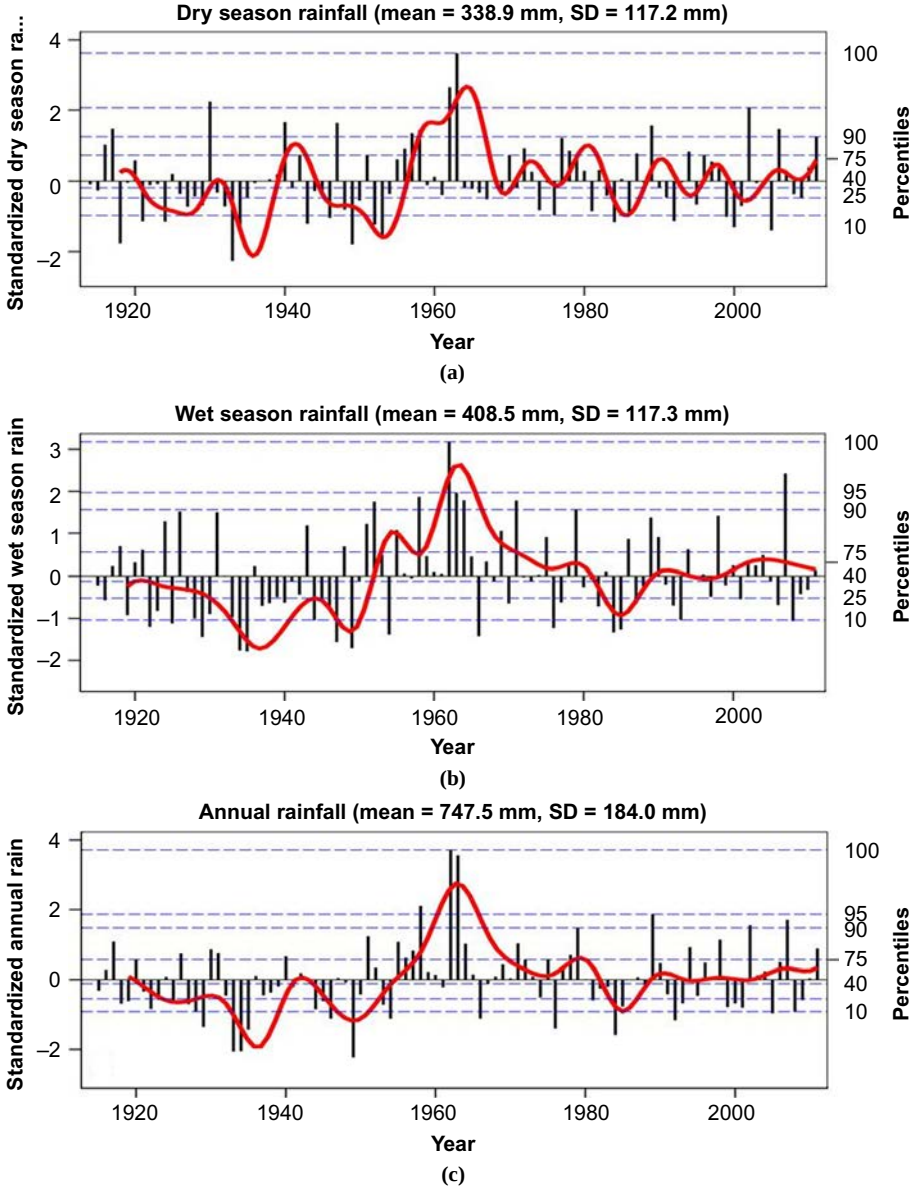
3.2 Conservancy effects on pastoral drought coping and risk mitigation strategies

The drought in 2008-2009 provided an opportunity to assess the various effects of conservancies and PES on pastoral coping and risk management strategies, with a focus on mobility, diversification, water provision and land markets (Table IV).

Table II.
Drought classification based on the percentile of the standardized observed rainfall values

Percentile values	Drought category
41-75th percentile	Normal
26-40th percentile	Moderate/mild drought
11-25th percentile	Severe drought
0-10th percentile	Extreme drought

Source: Ogutu *et al.* (2007)



Notes: The dashed horizontal lines are the percentiles; the solid vertical lines are the standardized observed rainfall values; the red solid line indicates the five-year moving averages

Figure 3.
Standard anomalies in rainfall in the Mara site showing (a) dry-season (July-October) rainfall, (b) wet-season rainfall (November-June), and (c) annual (sum of wet and dry-season) rainfall for the period 1914-2011

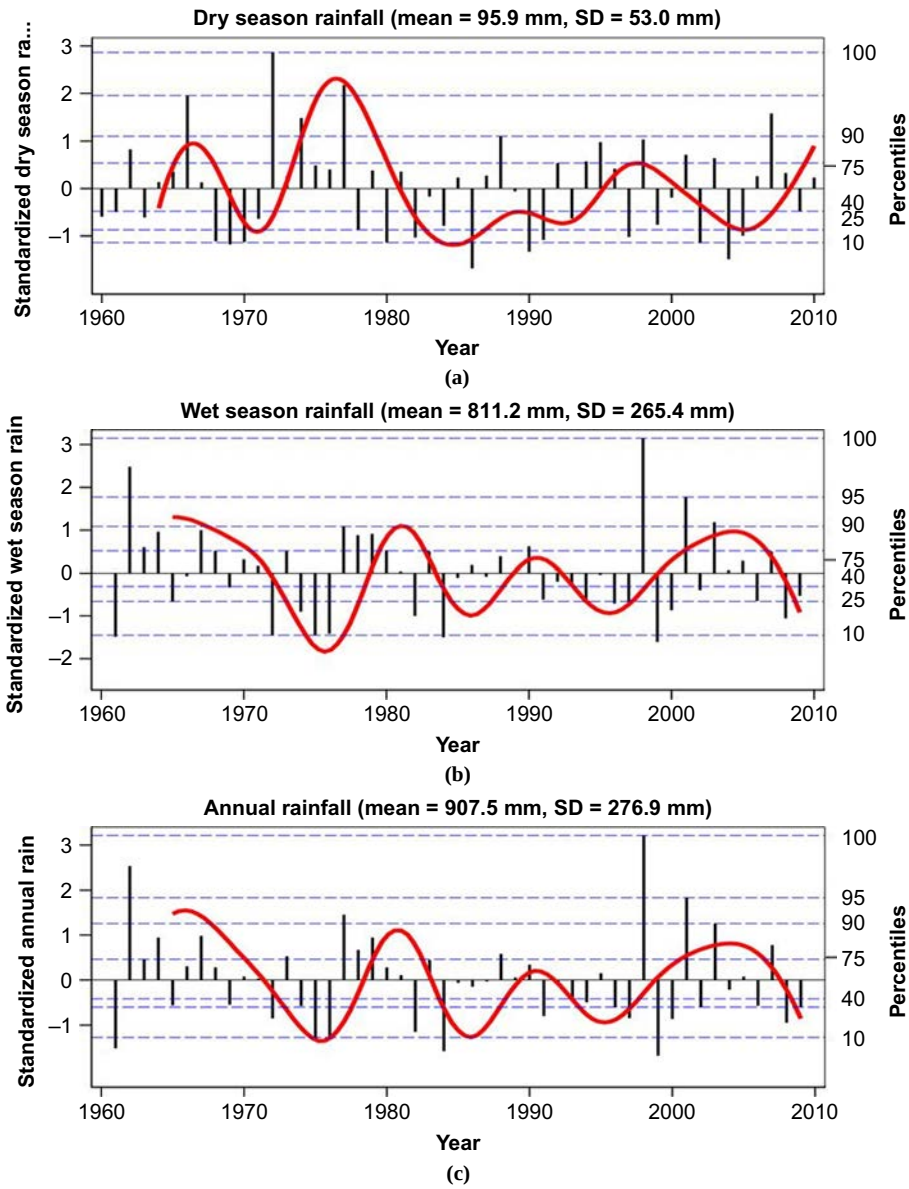
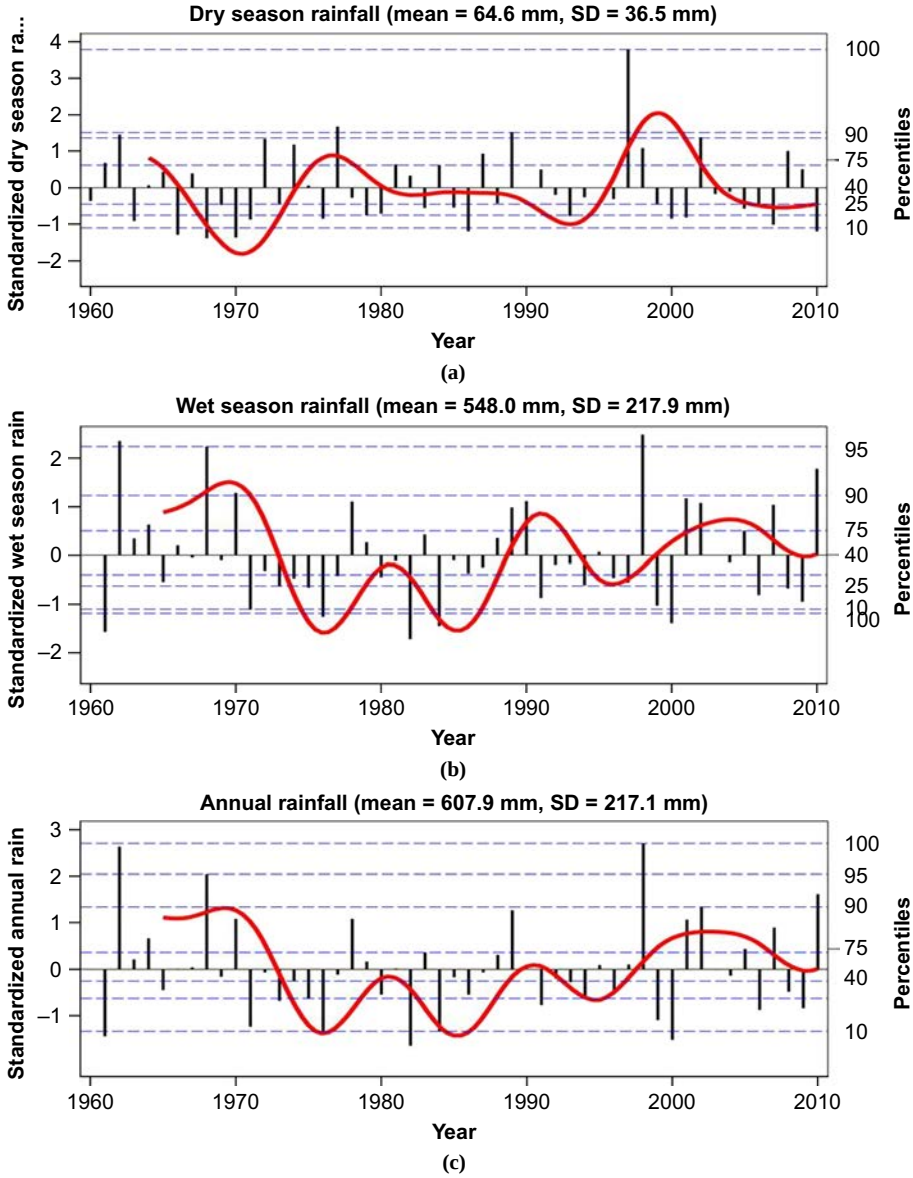


Figure 4.
Standardized anomalies in rainfall in the Kitengela site showing (a) dry-season (June-September) rainfall, (b) wet-season rainfall (October-May), and (c) annual (sum of wet and dry-season) rainfall for the period 1960-2011

Notes: The dashed horizontal lines are the percentiles; the solid vertical lines are the standardized observed rainfall values; the red solid line indicates the five-year moving averages



Notes: The dashed horizontal lines are the percentiles; the solid vertical lines are the standardized observed rainfall values; the red solid line indicates the five-year moving averages

Figure 5.
Standardized anomalies in rainfall in the Ol Kiramatian site showing (a) dry-season (June-September) rainfall, (b) wet-season rainfall (October-May), and (c) annual (sum of wet and dry-season) rainfall for the period 1960-2011

		Household category TLU per capita				
		<1	1-1.99	2-4.5	>4.5	Total
	Year			Mara ecosystem		
Households (%)	2009	5	10	25	60	100
	2008	3	7	25	65	100
TLU/capita (mean)	2009	0.63	1.55	3.00	13.30	
	2008	0.65	1.31	3.01	13.61	
				Kitengela		
Households (%)	2009	23	23	34	20	100
	2008	7	9	30	54	100
TLU/capita (mean)	2009	0.35	1.48	3.14	12.74	
	2008	0.06	1.44	3.25	13.45	

Table III.
Livestock holdings per capita (TLU/adult equivalent) among Maasai households in the Mara ($n = 131$) and the Kitengela ($n = 164$)

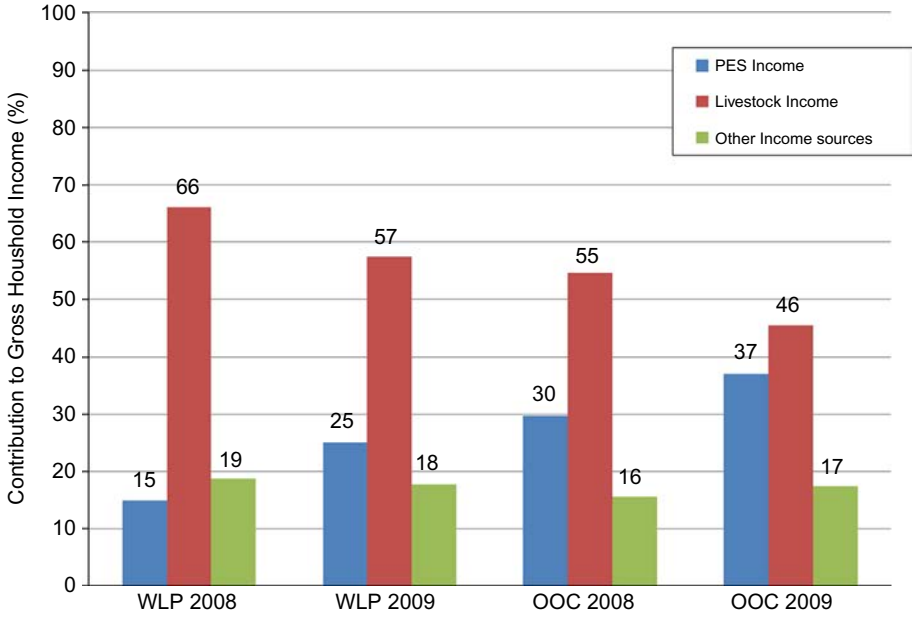
Notes: TLU – tropical livestock unit, a composite index equal to 250 kg of animal weight used to aggregate livestock species with differing weights
Source: First author's survey

Conservancy effect	Income	Land management	Ecosystem services: Wildlife	Ecosystem services: Biomass
		Site/coping strategy		
Mara				
Mobility		±	±	++
Diversification	±	±	++	++
Water infrastructure		++		
Land markets	±	±		
Kitengela				
Mobility		++	±	++
Diversification	±	±	++	++
Water infrastructure[a]		++		
Land markets	±	±		
Ol Kiramatian				
Mobility		++	±	++
Diversification	++	++	++	++
Water infrastructure		++		
Land markets	++	±		

Table IV.
Qualitative assessment by the authors of the interactions among three conservancy effects (income, land management and ecosystem services) and four pastoral household drought coping and risk mitigation strategies (mobility, diversification, water infrastructure and land markets) across three sites

Notes: [a]In AKP, there is no water infrastructure associated with the PWC, but the challenge is livestock accessibility to the Mbagathi River during dry-seasons or droughts; ++: synergies; ±: synergy and trade-offs; – – : trade-offs

3.2.1 Income diversification. The conservancies and PES enable pastoral households to diversify to wildlife and tourism income sources. PES in particular provides a regular and stable source of cash, which is critical during drought when income from livestock typically decline. In 2008-2009, for example, the share of household income derived from livestock among PES participants in the OOC in the Mara and the wildlife conservation lease in Kitengela declined by 9 per cent points but that for PES increased by 7 and 10 per cent points in the two programs, respectively, (Figure 6). The income share of PES increased, first in the OOC because of the upward adjustments in PES rates to landowners. The annual payment rates to OOC landowners increased from US$33/ha



Source: Osano (2013)

Figure 6.
The contribution of payments for ecosystem services, livestock and other income sources to the gross household cash income in the wildlife conservation lease program (WLP) in Kitengela and the OOC in the Mara in 2008 and 2009

in 2008 to US$39/ha in 2009. Second, because overall livestock income declined at both sites and the other incomes sources remained more or less stable (Figure 4).

In both the Mara and Kitengela, there exists a trade-off for participating households as the conditionality of the PES programs bar land use diversification to crop cultivation. Moreover, in the OOC, the relatively high PES rates are offset by the limitation imposed on livestock grazing inside the conservancy. This limitation does affect the traditional livestock grazing practices in the area and in the long run, can undermine the pastoralists' adaptive capacity to climate change. The Ol Kiramatian conservancy is a contrast because it lacks a PES program but land management is based on a self-regulated land use system that allows for a synergy between the generation of income from wildlife tourism and land use diversification to crop cultivation. The income from wildlife tourism has, however, been very limited and is invested in communal projects rather than being paid directly to the individual households.

3.2.2 Land management. Land use regulations in conservancies and conditionality in PES programs can lead to both synergies and trade-offs with pastoral practices (Table IV). In the PES program in Kitengela, landowners are paid to avoid crop cultivation and fencing properties but are allowed to keep and graze livestock herds on PES enrolled land. In the OOC, human settlements are excluded and livestock grazing is also limited and controlled. In the Ol Kiramatian conservancy, livestock grazing is carefully planned allowing members to use the conservancy as a drought refuge in dry-seasons. Overall, the land use restrictions adopted in one site may also affect herders across all the sites because of considerable mobility of herders among the three sites during droughts. In 2005-2006 drought, for example, herders moved with their livestock

to Kitengela (Nkedianye *et al.*, 2011) while in the 2008-2009 drought they moved with their livestock to the Mara (Philip Osano, personal observation). In summary, the land use practices that keep rangelands open support mobility, which is an important adaptation strategy for pastoral and agro-pastoral populations in Africa (Niamir-Fuller, 1999).

In terms of land use diversification the PES programs in the OOC and in Kitengela enable the landowners to lease out their land for wildlife and nature-based tourism, but not for crop cultivation. In the Ol Kiramatian, zonation allows for land use diversification to crop cultivation, in the irrigated zone which currently covers 142 ha but is being expanded to 405 ha (Joseph Ole Sirai, Secretary of Ol Kiramatian Group Ranch, pers.com, January 28, 2012). More than 50 per cent of pastoral families have reported being engaged in agriculture, mainly commercial cultivation for export market, and subsistence grain cultivation (Coast, 2002).

Land management may determine the provision and access to water. In both OOC in Ol Kiramatian, water projects have been implemented for the benefits of pastoralists living in these areas. The OOC has funded the construction of a water borehole and transmission pipes that supplies water to the local community, nearby schools and health centers, and the trading center in Talek. In Ol Kiramatian, an irrigation infrastructure has been constructed along the Nguruman escarpment to tap water for crop production in the irrigated zone. There is no water infrastructure directly associated with the PES program in Kitengela but by keeping land open in the area, the initiative enables pastoralists to access the Mbagathi River located at the southern edge of Nairobi National Park, the only perennial river used by livestock and wildlife during droughts.

Market exchange for land and pasture is also a key feature of land management across the three sites. Land privatization in the Mara and in Kitengela has led to an increase in the economic value of land in these areas, where pastoral landowners are now involved in the land markets by selling land, or leasing their land for crop production or for wildlife and tourism. There is however, a trade-off for landowners enrolled in the PES programs in the Mara and in Kitengela, with respect to land markets (Table IV). The PES programs in these two sites prohibit land sales, and also only allow landowners to lease their land for wildlife and tourism but not for crop cultivation. In Ol Kiramatian in contrast, households are allowed to lease the portion of land in the irrigated zone that is allocated to them to other farmers for crop production. However, they also lack the rights to sell land.

3.2.3 Ecosystem services. The two ecosystem services considered wildlife, tourism and biomass supply. The main issue with respect to wildlife is human-wildlife conflict especially livestock predation. Human-wildlife conflict results in a trade-off between keeping rangelands open for livestock and wildlife dispersal, and livestock mortality due to the potential of increased incidences of wildlife predation (Table IV). There exists a clear synergy between income and wildlife tourism because wildlife diversity and abundance serve as key tourist attractions (Table IV). The conservancies also enable biomass supply for cattle during droughts since they serve as set-aside pasture or "grass-bank" (*Olopololi*). This is a grassland management practice synergistic with pastoral livestock production (Table IV) and one that supports EBA because it reduces the drought risks to pastoralists. In Ol Kiramatian, for example, livestock mortality in the 2008-2009 drought was low because pasture was available in the *Olopololi*

(Stephen Moiko personal observation). A grass-bank can also be established *ex-situ* as is the case in the OOC which operates a mechanized hay bailing and storage project to provide fodder during the dry-season or droughts.

3.3 Limitations of the study

There are a number of limitations to this study. First, the study only addresses droughts and does not consider extremely wet conditions that can result in floods which can also negatively disrupt pastoral livelihoods. Second, it only looks at the short-term effects of conservancies and PES programs on drought and not the long-term implications of climate change for pastoral communities, a subject for which there remains considerable uncertainty. Third, the data on changes in household income during droughts is a snapshot of a single period in 2008 and 2009, thus limiting generalisation of the findings. Lastly, the study only focuses on conservancy and PES income from land lease payments, but does not consider other wildlife tourism income and benefits to local community such as employment, training, and strengthening of social capital, which are also important to local pastoral communities.

4. Conclusions

The objective of this paper is the assessment of the interaction between conservancies and PES, and pastoral drought management and risk mitigation strategies in the context of adaptation to climate change. The following conclusions emerge from the analysis and findings in this paper:

- The droughts are recurrent and severe across the three study sites which have recorded many extreme and severe droughts in the last two decades (1990s and 2000s) than in the three decades earlier (1960s, 1970s and 1980s). Moreover, the droughts are more localised, necessitating the need for mobility of herders and their livestock across the three sites and other parts of Maasailand in search for pasture and water during droughts.
- Drought increases the vulnerability of pastoral livelihoods in two ways. First, it leads to high livestock mortality resulting in the decline in per capita livestock holding among pastoral households. Second, it also leads to the reduction in the cash income derived from the sale of livestock and its products creating short-term liquidity constraints.
- Conservancies and PES programs promote EBA among pastoralists but affect pastoralists drought coping and risk mitigation strategies in multiple ways. Income from PES, for example, is critical during droughts because it can buffer pastoral families from fluctuating livestock income thereby helping them overcome liquidity constraints arising from drought effects.
- Conservancies and PES programs can generate synergies and/or trade-offs for pastoral families depending on the stipulated land use restrictions. There is thus a need to maximize synergies and minimize trade-offs arising from conservancy land management.
- It remains unclear what role the conservancies and PES can play in relation to climate change in the long-term. If droughts become more frequent and severe and have considerable negative impact on both livestock and wildlife then this can jeopardise the potential of conservancies and PES as a coping strategy.

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