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In pursuit of livelihood sustainability and drought resilience: The human dimension of drought-adaptation in the Maasai pastoralists coupled socio-ecological systems across Kajiado County, Kenya

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ABSTRACT

The system of Maasai-pastoralism, practiced in the savanna rangelands of Kenya, epitomizes an ideal learning platform upon which the dynamics of factors and/or processes that shape sustainability and drought resilience in a coupled socio-ecological system can be unravelled. This study engaged an integrated approach to examine the dynamics of drought-adaptation strategies utilized in Maasai-pastoralism, a strongly coupled socio-ecological system. The current empirical evidence reveals the integrative utilization of varied and multipurpose adaptation strategies. Migrate-livestock, diversify-livelihood, and diversify-livestock, in that order, dominate as the most widely utilized drought-adaptations in Maasai-pastoralism. In this system, drought-adaptation strategies that take advantage of drought conditions are rare. In addition, over 50% of the Maasais' households frequently use an admixture of over half of the existing strategies. The study reveals that droughtadaptation strategies in Maasai-pastoralism are inextricably interconnected systematic endeavours that simultaneously help alleviate deleterious drought-impacts and livelihood-risks, manage resilience, ensure sustainability of the core socioeconomic sector and of critical rangeland resources, and deal with cross-scale social and biophysical happenings and conditions within which this system is entrenched. As drought recurrences intensify, and shifts in social, political, economic, ecological factors and processes persist, the Maasai's adaptation strategies and livelihood subsistence, as well as pathways of development, will be transformed in ways that we are yet to understand. Therefore, efforts toward enhancing drought-adaptations and the Maasai's livelihoods should be based on a holistic understanding of the social-biophysical landscapes within which this system is entrenched. In policy terms, such efforts should be participatory and be mainstreamed within policies and/or programs related to, and/or operating in, Maasai-inhabited regions.

KEY WORDS: adaptation, drought-adaptation strategies, Kenya, Maasai pastoralists, drought resilience, livelihood sustainability

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1. Introduction

Like similar pastoral production systems operating across the rangelands of Kenya, and indeed other arid and semi-arid lands (ASALs) regions across the Greater Horn of Africa (GHA), Maasai-pastoralism is a strongly coupled socioecological system practiced in the savanna rangelands of Kenya and Tanzania, has suffered the brunt of drought. Apropos this region, droughts are recurrent, and devastations emanating from this climatic hazard are widespread (e.g., MWANGI, 2012, 2018; EM-DAT, 2017). A participatory study conducted with the Maasai people of Kenya revealed that over 80% of households lost *ca*. 43% of cattle from their pre-drought herd to an extreme-drought-event that plagued the region during 2005; in that year alone, about 52% of households lost *ca*. 61% of the average cattle-holding to this extreme-drought (LEDP¹, 2018). With regard to the current study area, Kajiado County, a Maasai rangeland in Kenya, studies

¹A long-term project on livelihoods, environment, & development (LEDP).

have documented occurrences of recurrent, cyclic, occasionally temporally clustered, and widespread droughts (MWANGI, 2016). In fact, an estimated 86% of *major-droughts* plagued this county over the last three decades alone. The manifest intensities with which these droughts are experienced vary across spatial, temporal, and social scales (*ibid*.).

Another important and devastating consequence of drought is that Maasai pastoralists, who migrate with their livestock to other parts of Kenya in search of pastures for their livestock, have been caught up in serious conflicts with other landusers. For example, in 2005, a prolonged drought forced the Maasai to migrate with their livestock to the Mai Mahiu area during which their animals trespassed into other people's croplands: a conflict ensued that left fourteen people and several livestock dead (IRIN, 2005). During the same period, Maasai pastoralists also conflicted with arable farmers over water (IRIN, 2005; EASTANDARD, 2005a) and with ranchers over natural pastures (EASTANDARD, 2005b). Recent empirical evidence shows an estimated 60% co-occurrence of livestockmigration and human-conflicts plague the Maasais of Kenya during periods of drought; and that livestock decimation affects over 80% of households that predominantly rely on livestock husbandry (LEDP, OP. CIT., MWANGI, 2005). Losses and conflicts of this nature could become common as drought occurrences, and/or rainfall variability, increase as climate continues to change, and as encroachments of other land-use types intensify into historically Maasai pasturelands. Thus far, it should be clear: the system of Maasai-pastoralism, practiced in the savanna rangelands of Kenva, epitomizes an ideal learning platform upon which the dynamics of factors, and/or processes that shape livelihood sustainability and drought resilience in a coupled socio-ecological system can be unravelled.

Studies that anticipate enhancing the droughtadaptive capacity of the Maasai should first seek to understand the state of the various aspects of drought-adaptation in this coupled socio-ecological livelihood production system. The current study offers the first step towards achieving this need. This study examines the types, and attributes, of drought-adaptation² strategies utilized to alleviate drought-impacts and/or cushion the sectors and resources that structure Maasai-pastoralism against the deleterious effects of this climatic-hazard. Determinant-variables, particularly social and temporal, associated with the usage-rate of the strategies are explored. The study illuminates the types and pathways of factors, processes, and contexts shaping the state of drought-adaptation strategies in Maasai-pastoralism. This study is guided by two interconnected salient questions. (i) What types of drought-adaptation strategies do Maasais utilize to cushion the various sectors/ resources characterizing their livelihood production system against drought-impacts? (ii) How often are these strategies used, particularly across sociospatial scales? This study contributes to the subject of drought-adaptation in indigenous socioecological systems in ASALs. With regard to droughtadaptation, Maasai-pastoralism, and this particular region, the present research exemplifies original work that simultaneously explores multiple social, temporal, spatial scales vis-à-vis specific factors of climate-hazard, savanna rangeland resources, and socio-ecological system to unravel the geography of drought-adaptation. Apropos this exemplified innovativeness of the present work, it is not to be construed to mean non-existence of work on the different components of the subject of drought and/or pastoralists in Africa, or across the ASALs – such works exist, (e.g., DAHL & HJORT, 1976; Ellis et al., 1993; Niamir-Fuller, 1999; NICHOLSON, 2014), rather this particular undertaking is unique in that it simultaneously and integratively captures germane factors, processes, and their various interactions to understand the geography of drought-adaptations vis-à-vis Maasai-pastoralism as a strongly coupled socio-ecological system. This holistic unravelling of the geography of drought-adaptation at the local-scale, where the drought-affected live, becomes instructive especially under landscapes of persistently changing climate. As regards climate change and at the continental scale, Africa is, and will remain, vulnerable particularly due to her low adaptive capacities (IPCC, 2001, 2007, 2014).

Apropos these last points, a necessity therefore exists to highlight some of the feasible adaptations to the deleterious effects of the changing climate across Africa. The current explication of the geography of adaptations in the system of Maasai-pastoralism – articularly under the present conditions of recurrent droughts, and cross-scale unfavourable changes in socioeconomic, ecological, and political factors, processes, and their interactions – epitomizes an informative endeavour from which feasible adaptations inform policy/practice and/or can be benchmarked for similar socio-ecological systems. By highlighting drought-adaptation in

² Adaptation, as used in this work, draw from climate change literature (see IPCC, 2001; UNDP, 2005) with a focus on droughtadaptation rather than ASALs-coping strategies. ASALs-coping strategies are widely addressed in various works (e.g., Fratkin, 2001; Niamir-Fuller, 1999; Smith et al., 2000) and this study interprets adaptation in the context of ASALs' biophysical and social landscapes.

an evolving indigenous socio-ecological system, the current study is significant and a timely contribution towards that necessity. Furthermore, since the current study entails participatory surveys with the Maasais, that necessity is inherently and informatively, attained by incorporating "...the perspective of the people who have no prejudices, but live it [climate change]" (TOPRAK, 2016).

The premise of this study is that the *type* and usage-rate of drought-adaptation strategies among the Maasai are inextricably embedded within crossscale social, political, and economic as well as environmental and ecological factors, processes, contexts, and their various interactions. Consequently, the current study engages an integrated approach using data from archived sources and participatory surveys with the Maasai people of Kenya. The sensitivity of this approach to historically contingent and variable social, political, economic, ecological, and environmental factors, contexts, and/or processes, especially as occasioned by its power to combine knowledge from multiple fields, equips this study with the capacity to inform on the various elements shaping drought-adaptation in Maasai-pastoralism. Most importantly, the current research on droughtadaptations, coupled with the already established geography of drought and rainfall for the Maasaidominated rangelands of Kajiado County, Kenya (LEDP, OP. CIT.; MWANGI, 2012, 2016) is a timely contribution to the climate identity discourse (TOPRAK ET AL., 2013) and therefore, by extension, holistically informs associated policies and practices.

2. Study area and research approach

The study area is located in Kajiado County, a Maasai-dominated savanna rangeland, in Kenya, East Africa, at approximately 2°S and 37°E (Fig. 1). Semiarid spaces dominate the greater Kajiado County; however, diverse agroecological regions are present (JAETZOLD & SCHMIDT, 1983; GOK, 2002, 1997). Kajiado County spans an estimated 21 903 km² (KATAMPOI ET AL., 1990; GOK, 2002, 1994) and is entirely in the Rift Valley Province. Topographically, the county stands at 500-2500 meters above sea level (m a.s.l), with most places standing at ca. 1000 m a.s.l. (GEORGIADIS, 1989; GOK, 2002). The average temperature for this county varies from 25–27°C; the county receives a mean annual rainfall (MAR) of 500-1250 mm, with most areas (ca. 90%) recording below 700 mm (GOK, 2002, 1994). Rainfall for Kajiado occurs in two distinct rainy-seasons (i.e., bimodal): long rains Maa: Nkokua (LEDP, OP. CIT.; MWANGI, 2016), ca. 625 mm/year (GOK, 1994, 2002) occur from MarchMay, while the short rains Maa: *Oltumuret* (LEDP, OP. CIT.; MWANGI, 2016), ca.375 mm/year (GOK, 1994, 2002) are received from October–December. These two rainy-seasons are separated by a distinct dry-season (locally called the drizzling season, Maa: *Oloirurujuruj* (LEDP, OP. CIT.; MWANGI, 2016), during which the pastures are expected to be low supply relative to *Nkokua* and *Oltumuret* (MWANGI, 2012, 2016; LEDP, OP. CIT.).



Fig. 1. Kajiado County, Kenya, showing administrative divisions *Central Division has since been sub-divided. Inset: Map of Kenya and Africa showing the location of Kajiado County in the context of the broader region (Source: Mwangi, 2016)

Drawing from the entire county, extensive cross-sectional participatory interviews with the Maasais of Kenya, participant observation, acquisition from instrument measurements, and retrieval from archives provided data for this study (see also MWANGI, 2016, 2017, 2018). All in-text quotations are excerpts from the interviews/ discussions with households, focus groups, and/or with key-informants. The study entailed an indepth study where randomized households were interviewed until the desired sample size was achieved (N = 120). Respondents – females and males aged 18 years and older participated in a two-phase cross-sectional participatory survey liberally identified various factors related to the specifics of drought-adaptation (e.g., types, usage, timing, and associated variables). As regards information acquisition from the Maasai people, it is acknowledged that although elderly Maasai pastoralists rarely speak English (Kenya's official language), they are excellently fluent in Kiswahili (Kenya's national language). Consequently, the various interviews and discussions informing the current study were conducted in either language as deemed appropriate - the author is conversant with both, as well as with the cultural context of usage. The sample size (*N=120*) is adequate towards ensuring robustness of the statistical contrasts -

a sample size of 20 observations per independent variable is sufficient (STEVENS, 1986) – employed for independent variables used in this work.

The usage of strategy was ranked based on a pre-prepared questionnaire that integratively drew from the structure and procedure from relevant salient works (FAO, 1990; FRIIS-HANSEN & STHAPIT, 2000; QUINN ET AL., 2003). In this work, Pv and Sv represent the proportion of mentions of specific drought-adaptation (0=not mentioned, 1=mentioned by all) and the scaled-estimate of the respondents' ranking of the usage-rate of the mentioned strategy is a nominal three-point likert scaledestimate (1=low, 2=moderate, 3=high) respectively and are simultaneously presented. More specifically, Pv deals with the number of households, across the greater county, using it, and is thus an evaluation of inter-household dynamics of Maasais using the same; Sv is an added measure evaluating intrahousehold dynamics of usage. Strategy citing *p*-value is for the proportion of mentions of specific droughtadaptation. For the purpose of this paper temporalcontrasts are examined, and represent a past/ present dichotomy. Whenever presented, excerpts are data from the interviews, and are italicized and placed in direct quote marks. The purpose of these values is to show the importance and relationship of the various variables vis-à-vis their overall contribution to the issues in question based on views and experiences of the Maasais - the drought-affected inhabitants - from the household to the community scale.

3. Results: drought-adaptations of the Maasai

Fig. 2 and Table 1 show types and attributes of drought-adaptation strategies presently utilized in the system of Maasai-pastoralism in the savanna rangelands of Kajiado County, Kenya, East Africa. Notably, most frequently-mentioned strategies for example, migrate-livestock, diversify-livelihood, and diversify-livestock, are also highly-ranked (*Pv≈1.00, Sv*>1.44≤ 3.00). Others, for example, trade in livestock and receive food-aid (relief-food) are frequently-mentioned and assigned a moderate importance-value. Some like reserve dry-season-/drought-fallbacks (these are patches of high potential ecozones) and preserve food for household are scantily-mentioned and lowly-ranked. Overall, different types of drought-adaptation strategies, which are variously mentioned and ranked, are utilized in the system of Maasai-pastoralism.

Table 1 shows the selected attributes of the various types of drought-adaptation strategies presently utilized in Maasai-pastoralism. (For the purpose of retaining clarity, in this section, italicised

phrases are verbatim presentation of droughtadaptation strategies shown in Table 1.) The mean estimate for strategy-citing for the frequentlymentioned drought-adaptation strategies (from Fig. 2), for example, migrate-livestock, diversifylivelihood, and diversify-livestock, have a very highly significant p-value (Table 1, p<0.0001). Strategies like *cull-livestock* and *receive* relief-food are frequently-mentioned and have a highly significant p-value (p<0.01). Some like reserve dry-season/ drought-fallbacks and household reduce consumption (families reduce the amount of food consumed) are scantily-mentioned have a statistically conservative p-value (*p*<0.05). Overall, drought-adaptations utilized in the system of Maasai-pastoralism are multiple, variously mentioned, and of various significance-values.

Table 1. Drought-adaptation strategies and importance estimates in the system of Maasai-pastoralism in the savanna rangelands of Kenya, (*p<0.05, N=120*)

Drought-adaptation strategies in Maasai-pastoralism, <i>N=120</i>	
Drought-adaptation strategies description	Strategy-citing ^β
Migrate livestock	***
Buffer livestock	**
Separate herd	**
Maintain contract livestock	*
Cull livestock	**
Reserve drought-fallbacks ^t	*
Preserve food§	ns
Reduce forage/water for livestock	***
Supplement pastures	***
Receive relief-food	**
Household reduce consumption	*
Diversify livelihood [£]	***
Diversify livestock [‡]	***
Trade in livestock & livestock-products ${\ensuremath{\varepsilon}}$	***
Other	***
mean estimate: ^β see Fig. 2 for strategy-citing, ^t Often derived from traditionally dry-season pastures spaces and farm rentals, [§] Mainly meat, fat, and/or milk (presently, undertaken as special treats, and sometimes by extremely poor households), [£] Excludes <i>Trade in livestock & livestock- product</i> , and <i>Trade in natural resources</i> , [‡] Includes composition and structure [€] Excludes barter-trade, [*] <i>p</i> <0.05, ^{**} <i>p</i> <0.01, *** <i>p</i> <0.001, ns = not significant	

In addition to strategy-citing, these droughtadaptation strategies have an assortment of estimates for the temporal determinant-variable (Table 1, *p*<0.05, *N*=120). For example, temporalcontrast is highly significant for *diversify-livelihood* and *diversify-livestock*, and is in favour of the present ($p_{\text{temporal (past<present)}} < 0.05$). Notably, excepting for *migrate-livestock*, the *temporal-contrast* is significant for all strategies (Table 1, p < 0.05).



Drought-adaptation strategy*

Fig. 2. Drought-adaptation strategies presently utilized in the system of Maasai-pastoralism in the savanna rangelands of Kenya, East Africa

Sv = Scaled-importance value, migr/stok = migrate-livestock, divr/liv = diversify-livelihood, bufr/stok = buffer-livestock, sepr/stok = separate-livestock, divr/stok = diversify-livestock, cntr/stok = maintain contract livestock, stok/trd = trade in livestock, cull/stok = cull-livestock, less/feed = reduce feed for livestock, rsrv/flbk = reserve drought-fallbacks, supp/ptr = supplement-pastures, prsv/food = preserve food for household, food/aid =receive relief-food/aid, less/food = reduce food for household, #Other = grouped multiple less-driven-by-drought ad lib drought-adaptations; *see additional details in Table 1

From Fig. 2 and Table 1, *migrate-livestock* has the highest usage and importance in both timescales (traditional/past=present: Pv=1.00, $Sv \ge 2.45 \le 3.00$). *Diversify-livelihood* (traditional/past: Pv=0; present: $Pv\approx1.00$, $Sv \ge 2.45 \le 3.00$), *receive relief-food* (traditional/past: Pv=0; present: $Pv\approx1.00$, Sv > 1.44<2.45), and *reserve drought-fallback* (traditional/past: $Pv\approx1.00$, $Sv \ge 2.45 \le 3.00$; present: $Pv\approx1.00$, Sv > 1.44<2.45), and *reserve drought-fallback* (traditional/past: $Pv\approx1.00$, $Sv\ge2.45\le 3.00$; present: Pv<0.50, $Sv\le 1.44$) have the greatest temporal change. Overall, determinant-variables are in various combinations and orders of significance; *migrate-livestock* has the highest usage and importance values.

4. Discussions

4.1 Drought-adaptation in Maasai-pastoralism: multifaceted strategies and the link with the Maasai's drought perception and management efforts

From the current empirical evidence, the multiple and different drought-adaptation strategies presently utilized in the system of Maasai-pastoralism, indicate the multifaceted nature of coping and/or adjusting to the diverse drought-impacts. This finding can be attributed to two core reasons, *viz.*, (*i*) the Maasais' perception of the condition/phenomenon called *drought* and (*ii*) the numerous types of efforts that are necessary to alleviate multiple and different drought-impacts and/or to cushion the various ecological and/or

human-systems' facets of Maasai-pastoralism against the deleterious effects of this climatic-hazard.

Apropos the first reason, the different adaptations used in Maasai-pastoralism relate to the impacts of a specific component of drought as perceived through the lens of an indigenous livestock production system entrenched in multiple scalar and dynamic social-biophysical landscapes. In Maasai-pastoralism, drought (called pastoralistdrought) is, "...that condition that occurs when the expected seasonal rains are significantly shortened, or are spatially restricted, or are low; causing shortage of pasture and/or water; leading to insufficient nourishment for and output from livestock and/or reduced household socioeconomics; and/or impairing non-Maasai/non-pastoral social and economic landscapes in the region" (MWANGI, 2016, p. 13). This type of drought is structured, in part, by climatic, ecological, and socioeconomic phases in that order of manifestation (MWANGI, 2016). During the first phase, "... the [normally] expected seasonal rains are significantly shortened, or are spatially restricted, or are low..." (ibid.). This phase is conventionally, a meteorologicaldrought (WILHITE, 2000), and by itself is trivial vis-à-vis implementing a drought-adaptation strategy, because, in Maasai-pastoralism, drought has a shortage of pasture as the minimal constituent element. Nonetheless, this phase is crucial because it serves as an early-warning signal of the potential shortage of the critical rangeland-resources (CRR),

and can, therefore, help households to prepare for drought, for example by searching markets to dispose of some of their livestock – they can cull some stocks as deemed appropriate. They can also, ceteris paribus, intensify the usage of such adaptations as a separate herd and reduce forage/ water for livestock. Persistent manifestation of this drought-type triggers the second phase, which is characterized by "...shortage of pastures and/or water..." (MWANGI, 2016) conventionally, this is the agricultural and/or hydrological-drought (e.g., WILHITE, 2000). Under such conditions, households could, for example, migrate-livestock. It is pointed out that, in the system of Maasai-pastoralism, migration is constantly and widely utilized in drought periods: it is a long-standing droughtadaptation, and indeed an age-old adaptation strategy to CRR variability across the ASALs. However, when viewed through etic lens, the Maasai's migration can inadvertently be perceived as a temporary coping strategy - temporary in the sense that Maasais will eventually return home during the year since like most pastoralists across the ASALs of Africa, they are largely sedentary, and because they rarely utilize migration more than once per annum – rather than the constantly utilized drought-adaptation it is. A recent study on the subject of migration in Maasai-pastoralism reveals the focus is on moving the livestock rather than the household moving with the stock (MWANGI, 2012; LEDP, OP. CIT.). Having briefly expounded on migration, this explication continues with the thread of drought-type versus adaptation. In addition to migration, other modes such as reduce forage/water for livestock, separate herd and/or supplement pastures are often used, and where possible, their usage can be intensified (Table 1). Later, the manifestation of the second phase of the pastoralist-drought leads to the occurrence of the last phase, which is characterized by "...insufficient nourishment for and output from livestock and/or reduced household socioeconomics..." (MWANGI, 2016) – and is conventionally a socioeconomic-drought (WILHITE, 2000). During this last phase, pasture for livestock is supplemented. for example, with relief-aid-derived yellow maize grains or where locally available, maize-stovers (e.g., LEDP, OP. CIT.); resource-limited households could, for example, increasingly limit their daily food-intake. It must be pointed out that there are other examples of adaptations highlighted here which are not used in isolation; rather they are used integratively depending on one's access to a given type of adaptation strategy. Here, the highlights serve to reveal the most appropriate one at the various stages of drought evolution. Moreover,

there exist more adaptations beyond the ones mentioned in the present explication – most of which are under the category labelled "*Other*" (Table 1 and Fig. 2), and although most are beyond the scope of the current discussion, they are sporadically mentioned throughout this study. Nonetheless, worth mentioning here is that over 50% of households use an admixture of over half of the documented drought-adaptations revealing the skilfulness with which Maasais integratively utilize drought-adaptations.

Apropos the second reason, these different drought-adaptation strategies are geared toward alleviating and/or cushioning different ecological and/or human-system' sectors and resources that structure Maasai-pastoralism against the deleterious drought-impacts. For example, reservation of dryseason-/drought-fallbacks – e.g., Dokoya nkishu and Enkaroni pasture-spaces that are respectively reserved to cater for the initial and later stages of the dry-season (MWANGI, pers comm.) - ceteris paribus, contribute to alleviating pasture-shortage during the dry-spell and periods of drought. In droughtand/or CRR-management terms, the very existence and/or feasibility of Dokova nkishu and Enkaroni attests to the proper operation of the governance and institutional structures under which these pasturespaces are managed. Livestock-diversification, both in composition and structure, leads to optimizing livestock's utilization of the diverse plant types and forms that characterize this region (for example, predominant browsers like the goats and camels forage on leaves and twigs of woody plants, while grazers like cattle consume graminoids and herbaceous plants). In ecological and resourcemanagement terms, this mode of pasture extraction checks potential invasibility of either plant forms, and hence ensures sustained availability for both stocks. Migrate-livestock allows grazing- and/or drought-induced pasture depletion to recover by removing the pressure associated with keeping animals in one place. In eco-spatial terms, and apropos migrate-livestock, and given that the drought is widespread, leaving a few less-affected spaces, it translates to Maasais' taking advantage of biophysical heterogeneity and especially the environmental variability that characterizes the greater region. Livelihood-diversification, for example into arable farming, helps alleviate shortfalls in output derivable from livestock; the widespread adoption of agropastoralism and mixed-cropping insulates against drought-induced losses of livestock and/or crops. Livelihooddiversifications, for example, Maasais' engagement in entrepreneurial undertakings such as pose for paid 'Maasai' photos (LEDP, OP. CIT.) allows these

pastoralists to creatively and indirectly derive from the broader-tourism industry than would be otherwise possible, in a country where revenue from centralized tourism institutions have little, even negligible, trickle down effect on the chief stewards of these savanna rangelands, the Maasais. (It must be pointed out that there are other examples of livelihood-diversifications beyond the ones highlighted in the current discussion and are included in the category "Other" in Table 1). Examples, of such diversifications include engagement in various types of arable farming, and formal and informal employment and enterprises. Therefore, by extension, this second reason is simultaneously linked to the different goals that ensure adaptive management of livestock and exploitation of pastures across the Maasais' rangelands, and indeed, the overall feasibility of this livelihood production system. Thus, it should be clear: drought-adaptation strategies in Maasaipastoralism simultaneously help maintain resilience of the environment and enhance the proper operation of this livelihood to drought and environmental conditions - hey are not haphazard endeavours.

The numerous types of efforts necessary to alleviate drought-impacts and/or to cushion the various facets of Maasai-pastoralism against the deleterious effects of drought are also illustrated by the Maasais' widespread espousal of technology (e.g., LEDP, OP. CIT.). For example, use of cell-phones in tracking migrate-livestock, regular livestockherding, and livestock/livestock product sales, and indeed in everyday life and across age- and gender indeed, 'even old women and small boys carry phones' - collectively denoting technological adoption and diffusion. Closely related to this last point is the rearing of previously non-Maasai livestock such as pig, guinea fowl, ostrich, and camel (ibid.), which, where successful, translates to espousal of associated skills vis-à-vis their feasible husbandry.

4.2. Multifaceted drought-adaptation strategies: goal-oriented, multipurpose, and integrative utilization

From the current findings, it should be evident that drought-adaptations that take advantage of drought conditions are rarely utilized in the system of Maasai-pastoralism – but are not entirely nonexistent. Drawing from the climate change literature (e.g., IPCC, 2001, 2007, 2014), adaptation has two core goals: (*i*) to minimize deleterious impacts and/or (*ii*) to utilize the favourable

opportunities availed by occurrence of a given climatic-hazard. The majority of the droughtadaptation strategies in Maasai-pastoralism are predominantly focused on the first goal with scant consideration for the second. The evident livestocksales - predominantly undertaken by young Maasaimen, such as illustrated by the entrepreneurial undertaking by Lelion (LEDP, OP. CIT.) - epitomizes, ceteris paribus, the existence of favourable opportunities, for example through which unproductive and/or drought-susceptible stocks can be profitably culled. Presently, culling is typically undertaken for steers, bulls, and dry-cows, and awfully unproductive and weak stocks; while sale is mainly of sheep and goats (shoats), especially the latter (Fig. 3). Plausibly, there exist other favourable opportunities occasioned by drought conditions that the Maasais could exploit: this should be the focus of policy-research that anticipate improving the drought-adaptive capacity of the Maasais, and indeed similar socio-ecological systems in these rangelands. The need to discover such opportunities becomes more pressing as the climate continues to change, drought occurrences intensify, and factors of globalization persistently permeate into Maasai's societal and ecological landscapes, often with deleterious outcomes (MWANGI, 2012). Policies that anticipate informing the drought-adaptation of the Maasai must aim at simultaneously capturing these twin goals of adaptation, and should, in particular, advise on favourable opportunities, if any, brought about by drought conditions.

Also notable, most of these drought-adaptations are multipurpose. For example, beside optimizing extraction of various plant types and forms that characterize the savanna rangelands of Kenya, diversify-livestock avails one's household's diverse sources of food and income; and, therefore helps spread risks - note that, food resources for diverse animal species, occasioned by this diversification, are differently affected by drought, and indeed by some diseases (e.g., the often diseased wildebeest calving spaces are often fatal to cattle, but, "goats seem to be fine in such sites" (LEDP, OP. CIT.) - which respectively alleviate food-shortages and improves one's socioeconomic status. This finding, coupled with over 50% of households using an admixture of over half of the documented drought-adaptations show that several adaptations are utilized simultaneously to meet multiple goals; it also reveals skilful integrative utilization of drought-adaptation among the Maasais.



Fig. 3. Portraits of drought-adaptations presently utilized in Maasai-pastoralism

(i) a young Maasai couple selling sheep and goats (shoats) at a local terminal livestock-market; (ii) a Maasai woman enroute home carrying a bag of relief-food (yellow maize grain) received from a distant trading center; and (iii) men helping fetch water for livestock and for domestic needs; and sometimes sell to small-scale traders, from distant well during the extremedrought that plagued the region in 2005

This skilful integration is also revealed in the evident differentially-favourable significant timingcontrast that characterize the majority of these strategies (Table 1), which denotes adaptive usage to changing conditions within human- and/or ecological sub-systems. For example, land-shortage construed here to mean loss of Maasais traditionallyheld land spaces - due to the encroachment of other land-uses, particularly agriculture [e.g., ibid.; UNEP- GOK, 2005; MAITIMA & OLSON, 2006); translate to loss of pasturage, blockage of movement corridors, as well as loss of access to CRR contained therein (MWANGI, 2012). Apropos this last point, diversifying livestock into sheep and goats (shoats), pigs, and poultry is interpretable as an adaptation to the available/accessible resource-base, land: these small-stocks need but small spaces. It must be emphasized that, the various social forces and phenomena (e.g., macroeconomic policies, cross-scale economic-inequality, and gender disparities (MWANGI, 2012, 2017, 2018) that directly/indirectly occasion land-use change in this region, also influence their consequence on resources - land, water, and ecosystems accessibility/availability in Maasai-pastoralism, and hence adaptations linked to the same.

Another dimension of this skilful integration is also revealed in the simultaneous utilization of everyday coping strategies during drought periods. Suffice that, some observed drought-adaptations bear elements of everyday coping strategies. Thus, livelihood-diversification, for example, arable farming, presently a dominant everyday coping strategy, is rendered a drought-adaptation strategy as heightened engagement, in use and/or type, (especially as all-day labourers in agriculture sector) become evident in times of drought; continual serving as a herding-hireling (Maasai) in drought periods also exemplify such an adaptation (MWANGI, 2012, 2017; LEDP, OP. CIT.). Suffice that adaptation categories are not cast on stone. For the age-old adaptation such as migration, long- and shortterm moves are common - long-term ones entail over three months away from home, especially where reliable long-term lease spaces exist and have been observed; additionally, most short-term moves from the initial point of migration, often develop into long-term as forward moves occur from one place to the next without returning home (LEDP, OP. CIT.); the former predominate thus rendering it a drought-adaptation strategy, rather than a short-term coping mechanism. Moreover, in etic terms, migration is a drought-adaptation strategy because the pastoralist makes decisions concerning migrating livestock pre-drought; the destination is predetermined before the drought occurrence and often households have preferences on the same (MWANGI, 2012; LEDP, OP. CIT.).

Skilful integration is also evident in the adaptation to direct and indirect drought-impacts. In the system of Maasai-pastoralism, both direct and indirect drought-impacts have been observed (MWANGI, 2012, 2018). With regard to adaptation to direct drought-impacts-for example, pasture- and watershortage depletion in regular locations (ibid.) *migrate-livestock* and/or *reduce forage/water for* livestock are utilized (Fig. 2). With regard to indirect drought-impacts - for example, unfavourable livestock prices and food-shortage (ibid.) -, adaptations such as increased livestock sales, and reduced household-consumption are respectively used (Fig. 2). It is plausible that adaptations, such as reduced household-consumption could persistently transcend periods of drought into everyday coping strategies as destitution among the Maasai escalates. Thus, adaptation to direct and indirect drought-impacts can overlap thus blurring this distinction. This last scenario is also exemplified by milk-deprivation for the calves through the drought-intensified practice of milking calves (LEDP, OP. CIT.).

The evident existence of multipurpose adaptation strategies and their integrated utilization, coupled with the knowledge that Maasai-pastoralism is an ASAL-based socio-ecological system, reveals that drought-adaptation strategies utilized in this pastoral production system go beyond addressing the drought-impact concerns to include other goals. Thus, although indigenous adaptations are few and scantily utilized today (Fig. 2 and Table 1), they are multipurpose and, collectively, they capture the traditional primary goals that ensured feasibility of this socioecological livelihood production system, viz.,: (i) to alleviate livelihoodrisks (e.g., SMITH ET AL., 2000), (ii) to manage general resilience (e.g., BERKES & FOLKE, 1998; HOLLING, 2001), and (iii) to ensure sustainable management of land and land-resources (e.g., DAHL & HJORT, 1976; Ellis et al., 1993; Niamir-Fuller, 1999). Besides being aimed at meeting these traditional goals, presently, these adaptations also help deal with various cross-scale social and biophysical happenings and conditions – for example, increasing aridity, demographic pressures, and unfavourable macro-economic policies (e.g., BASSETT, 1988; ZIMMERER & BASSETT, 2003; MWANGI, 2017, 2018) - within which, this livelihood, like similar socioecological systems, is entrenched.

5. Conclusions, emerging themes and recommendations

The current empirical evidence reveals that drought-adaptation strategies presently utilized

in Maasai-pastoralism are multiple, differentially utilized, and unequally accessed across variously interacting spatial, temporal, socioeconomic, and sociopolitical scales. They are also multipurpose and integratively utilized to meet diverse goals in Maasai-pastoralism during periods of drought. Some drought-adaptation strategies in this system are extemporized in nature, while others are simultaneously proactive, cautionary, and a wayof-life. Migrate-livestock, diversify-livelihood and diversify-livestock, in that order, dominate as the most widely utilized drought-adaptation strategies in the system of Maasai-pastoralism. Droughtadaptations that take advantage of drought conditions are rare in Maasai-pastoralism. Over 50% of the Maasais' households frequently use an admixture of over half of the documented droughtadaptation strategies.

The evident multifaceted strategies are linkable to the Maasais' perception of the condition/ phenomenon called *drought*; and the numerous types of effort that are necessary to alleviate multiple and different drought-impacts and/or to cushion the various ecological and/or facets of human-systems of Maasai-pastoralism against the deleterious effects of this climatic-hazard. Key drought-adaptation strategies have traditionally been adaptive and geared toward meeting primary goals of ensuring proper operation and feasible subsistence of Maasai-pastoralism in the rangelands. This study reveals that evident multipurpose adaptations are inextricably interconnected into goals that strive to alleviate deleterious droughtimpacts and livelihood-risks, to manage overall resilience, to ensure sustainable management of land and critical rangeland resources (CRR), and to deal with cross-scale social and biophysical happenings and conditions. Some adaptations are essentially regular livelihood strategies simultaneously geared at alleviating daily risks and managing for resilience to the environment.

The evident diverse integrative utilization of drought-adaptation reveals the Maasai's adaptive efforts to changing landscapes. The current empirical evidence reveals that diverse and shifting local, and non-local, as well as by place and non-place social, economic, political, and ecological factors, process, contexts, and their interactions differentially shape types and attributes, feasibility and sustainability, and preference and usage-rates of drought-adaptation strategies utilized in Maasaipastoralism. Overall, the system of Maasaipastoralism, practiced in the savanna rangelands of Kenya, epitomizes an ideal learning platform upon which the dynamics of factors, and/or processes that shape sustainability and resilience in a coupled social-ecological system can be unravelled. The system epitomizes an informative endeavour from which feasible adaptations inform policy/practice and/or be benchmarked for similar social-ecological systems.

Thus far, it should be clear that as droughtoccurrences become more frequent, and indeed shifts in social and ecological factors and processes persists, the Maasai's adaptation strategies, and indeed livelihood subsistence, as well as pathways of development, will be transformed in ways that we are yet to understand. Therefore, efforts toward enhancing drought-adaptation of, and feasible subsistence, on Maasai-pastoralism should be based on a holistic understanding of the social-biophysical landscapes within which this socioecological system is entrenched. Strategies for enhanced feasibility of this livelihood necessitate the implementation of additional and informed goals that are in tandem with the ever-evolving scalar social and biophysical factors and processes that pressurize this system. In policy terms, such efforts need to be participatory and be mainstreamed within policies and/or programs related to and/or operating in Maasai-inhabited regions.

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