

# Human Ecology–Political Economy Nexus of Drivers of Drought-Vulnerabilities on Maasai Pastoralists' Coupled Social-Ecological System in Kenya

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# Abstract

Maasai pastoralists subsist on rainfall-dependent livelihood production system in the savanna rangelands of East Africa. This study explores drought-ravages on the system of Maasai-pastoralism in Kenya, a strongly coupled social-ecological system, using an integrated approach. Proximate and underlying drivers of drought-vulnerability in Maasai-pastoralism are explored; drought-disaster/risk trajectory is conceptualized in a nexus approach. The current study reveals drought-ravages on Maasaipastoralism are generated at the confluence of multiple inextricably interlinked variable and historically-contingent societal mainly this system's human ecology factors coupled with cross-scale political economy within which it is embedded, and is in constant flux—climatic, and ecological factors, processes, contexts, and their interactions. Operating through various interactions/feedbacks, diverse proximate and underlying social-biophysical drivers occasion drought-vulnerability. Persistent and growing livestock-based wealth-class divide is rapidly imprinting on Maasai-pastoralism under recurrent drought conditions. Drought-rayages in Maasai-pastoralism are *contextual manifestations*; the present drought-event is only partially responsible for the same. Over 90% observed impacts are devastative, and were trivial, even non-existent, in the past. Persistent, even rapid, deleterious impacts of climate change alongside cross-scale permeation of and shifts in diverse socioeconomic/sociopolitical globalization factors, processes, and their interactions constitute additional challenges on Maasaipastoralism. Thus, apropos Maasai-pastoralism, a paradigm shift vis-à-vis drought-adaptation and/or drought-disasters reduction becomes necessary. This study cast useful insights into the landscapes of drought-ravages on Maasai-pastoralism in Kenya, and indeed similar systems across the Greater Horn of Africa, where droughts are recurrent, drought-adaptive capacities low, drought-disaster/risk persistent, and drought-vulnerable landscapes predominate. Overall, it should be clear: the necessity for practical bridging of research-policy-practice divide cannot be overemphasized.

# **Keywords**

Drought, Drought-Impacts, Drought-Disasters, Drought-Vulnerability, Maasai-Pastoralism, Climate Change, Maasai Pastoralists, Disaster/Risk Trajectory, Drought-Ravages

# 1. Introduction

"My child, listen [pauses, and intently addresses the interviewer] ... drought brings damage to everything ... to livestock, to families, to wild animals, to everything ... [sigh] ... to everything [he intonates] ... drought has no in-laws<sup>1</sup>...."

-Ole Nkatia

A Maasai elder responding to a question about droughtimpacts

Drought is the most devastative climatic-hazard disrupting

<sup>1</sup> Interpreted, "my child" is a generational endearing relational term that is

commonly used by an elderly person to address a younger person; "drought has no in-laws," means has no respect (derives from the great respect accorded to ones' in-laws among the Maasai), i.e., it indiscriminately affects all facets of livelihood, all people, all things, and all places. Ole Nkatia is not his real name

lives and livelihood production systems across the rangelands of Kenya, and indeed the Greater Horn of Africa (GHA). The impacts of this climatic-hazard are widely documented, particularly by the mass-media and in various developmentstudies; and coarser-scale data about drought-impacts on lives and on major sectors and resources of the broader systems of livelihood are widely and readily available for the region ([1-6]). However, the proximate and underlying drivers of droughtvulnerabilities, particularly for at the finer-resolution scales, are rarely documented. In addition, the documented droughtimpacts are predominantly for major-drought events with scant engagement of the affected (see [7-9]) for major-droughts in the region, and [9] for drought-categories]. The reports of these major-droughts primarily focus on isolated resources-mainly food, and specifically its shortage; broadly-defined sectors such as agriculture (particularly failure of commercially-important staple crop, mainly maize, Zea mays) and pastoralism (mainly livestock-mortalities); and key resources such as water (mainly reduced volumes or flows in the regular reservoirs).

As regards rangelands (arid and semi-arid lands (ASALs)) of East Africa, drought is a normal climatic event and is, in fact, a frequent occurrence in the Maasai-inhabited savannas of Kenya ([9-12]). In these savannas, over 85% droughts of major-drought category have occurred during the last 30 years alone [9]. Apropos Maasai-inhabited rangelands of Kenya, widespread, cyclic, and intermittently clustered across timescale droughtevents of varying intensities and predominantly of majordrought category have been observed over the last few decades [ibid.]. It must be pointed out that, like most ASALs across Africa, these droughts occur against a backdrop of diverse and cross-scale socioeconomic, sociopolitical, and ecological pressures (e.g., [10, 12-22]). Inevitably, therefore, the very geography of this climatic-hazard vis-à-vis this region<sup>2</sup> variously shapes the feasibility and operation of the various sectors and resources structuring this climate-sensitive subsistence livelihood-production system in ways yet undocumented. Therefore, an informed understanding of the actual drivers of drought-vulnerabilities-particularly at the finer-resolution scales within where the drought-affected inhabitants livewould be informative toward devising practical droughtadaptation and/or drought-disaster-reduction strategies.

In addition to focusing on isolated resources and/or generalized sectors. existing studies on the subject predominantly focus on current direct impacts of an ongoing broader-scale drought-event-with a scant reference to the preceding events and/or proximate and underlying socialbiophysical drivers of drought-vulnerability. Therefore, such reporting is skewed. Worth noting, this skewed allusion to the ravages of such broad-scale events takes the form of, 'it is the worst in 50 years,' and 'it has never been seen before.' Such designations are necessarily flawed, and correctly so because studies have established frequent occurrences of major-droughts at both finer and broader scales for this region ([8, 9]). In fact, shorter timescale droughts of major category occur frequently in Maasai-inhabited rangelands of Kenya [9]. Therefore, ceteris

*paribus*, the dynamics of generated drought-vulnerabilities plausibly unfold in similar fashion. Designations such as, '*are facing starvation*,' '*are in dire need of food*' '*maize has failed*,' and '*pastoralists have invaded farms*' are commonly used to describe the impacts of such droughts. Little, if any, attention is given to preceding or future exposure or sensitivity to this climatic-hazard, or to specifics concerning modes and/or sectors of the affected livelihood that could potentially have precipitated this 'dire need for food' or "starvation' or 'pastoralists' invasion of farms.' In a region characterized with vast and diversely coupled social-ecological livelihood production systems that GHA epitomizes, plausibly, a variable, even disparate, drivers of drought-vulnerability should be expected.

It is acknowledged that, extensive research undertakings and academic discourses have addressed the suitability of pastoralism undertakings in the rangelands of Africa ([13, 14], 15]). Moreover, as regards the savanna rangelands of Kenya, studies have documented effects of drought on the dynamics of livestock at specified temporal and spatial scales; and livestockdata are widely and readily available, especially estimates for different counties and hence for the country ([23, 24]). Most importantly, this phenomenon called drought is comprehensively explicated in the various salient works of the prominent drought scholar, Donald Wilhite (e.g., [25]). Wilhite's works offers solid foundation upon which to buttress informatively studies on the various dimensions of drought as appertains to societal concerns-for example, drought-impacts, disasters, and -vulnerabilities.

In addition, it must be acknowledged that vast repositories of information concerning social and biophysical factors exist for the Maasai-inhabited rangelands of Kenya (e.g., see section 3, *this paper*)—these are scattered across disciplines and publication platforms. Little is known, however, about the actual types of proximate and underlying drivers of drought-vulnerability, and indeed that of drought-disaster, at the fine-resolution scales as regards Maasai-pastoralism in Kenya. As the rapidity with which shifts in socioeconomic/sociopolitical and changes in climate intensify, it is imperative that studies on and management of drought-impacts and/or drought-disaster/risk account for these changing landscapes (for specific examples of these changes (see [10, 12-22, 26-30]).

It must be pointed out that apropos droughtdisaster/risk, multiple documentations exists concerning reduction strategies, particularly as regards rainfalldependent coupled social-ecological livelihood-production systems across the rangelands of Kenya (mainly agriculture and pastoralism and their derivatives), the GHA, and indeed other ASALs across Africa ([3, 4, 5, 6, 10, 11]). Moreover, in Kenya where the current study area is located, the existence of various efforts, even long-term endeavors, by the government and various nongovernmental entities toward disaster/risk reduction in the region <sup>3</sup> denote that data are vastly available and undertakings ongoing. What's more, and apropos Maasaipastoralism, the diverse, nested, and multiscalar drought-

<sup>2</sup> see [9] for the geography of drought for this region

<sup>3 [</sup>e.g.: [31, Matthew et al., unpl. ms])

adaptation and livelihood-coping strategies utilized are comprehensively documented (see [10, 11]).

Paradoxically, notwithstanding these efforts, data availability, and vast repositories of information, droughtdisasters and vulnerabilities have remained persistent, even widespread, in the region ([3-6, 9, 10]). Likewise, drought-disaster/risk management across scales and adaptive capacities remain inadequate for the various rainfall-dependent livelihood production systems [Matthew et al., op. cit.]. Apropos this last point, and ceteris paribus, drought-vulnerable lives and livelihoods are therefore to be expected. Worth mentioning, the very existence of various policies formulated and programs implemented under the aegis of the government of Kenya and indeed her bilateral/multilateral development partners (e.g., through USAID & UNDP) denote existence of, even active, broader-scale efforts toward disaster/risk reduction.

Apropos Maasai-pastoralism, simultaneous information about drought, its effects, and the geography of the same on this system *in the context of* the persistent, even rapid, deleterious impacts of climate change alongside crossscale permeation of and shifts in diverse socioeconomic and/or sociopolitical globalization factors, processes, and their interactions, remain unexplored. This study explores the drivers of drought-impacts on Maasai-pastoralism-a climate-sensitive strongly coupled social-ecological livelihood-production system-practiced in the savanna rangelands of Kenya, East Africa. (Elsewhere in East Africa, Maasais are to be found in Tanzania, and they practice pastoralism and its various derivatives and indeed other modes of livelihood-production systems). The current study specifically evaluates the types of droughtimpacts and social-biophysical drivers of droughtvulnerabilities. Factors, processes, and contexts driving drought-vulnerability on this livelihood-production system are explicated. Additionally, the current study engages a nexus approach to conceptualize, in brief, the droughtdisaster/risk trajectory in the system of Maasaipastoralism, ceteris paribus, under persistent, even rapid, deleterious impacts of climate change alongside crossscale permeation of and shifts in diverse socioeconomic/sociopolitical globalization factors. processes, and their interactions. This study utilizes an integrated approach that strongly leans on politicalecology, political economy and social-ecological systems perspectives to interpret and contextualize the findings thereof ([16, 17, 32-35]).



Figure 1. Location of Kajiado County, Kenya. Political administrative units, divisions, are shown. \*Presently, Isinya, a new administrative unit is located here. Inset: Map of Kenya and continental Africa showing geographical location of Kajiado in the context of the broader region. Source: [9].

# 2. Study Area, Data Acquisition, Management, and Approach

The current study covers the Maasai-inhabited savanna rangelands of Kenya, namely, Kajiado, Laikipia and Narok. The participatory data on drought-impacts drew mainly from Kajiado County. Geographically, Kajiado is located at approximately 2°S and 37° (Figure 1); and covers an area of ca. 21903 km<sup>2</sup> with much of the county laying at ca. 1000 meters above sea level (m a.s.l), but generally from 500-2500 m a.s.l ([24, 36, 37, 38]). Although the county is predominantly semiarid, it harbors diverse agroecological spaces; and characterized by various land-use types under diverse holding ([24, 39, 40, 41, 42, 43, 44]). Other details about the study area-such as specifics about county's topography and rainfall/drought spatiotemporal dynamics and land-use/cover change-are comprehensively addressed in recent relevant publications and, therefore, are not duplicated here (e.g.: [9, 10]).

The participatory data on drought-impacts drew from the entire Kajiado County (N=120); data concerning proximate and underlying social-biophysical drivers of drought-vulnerabilities in Maasai social-ecological systems captured all Maasai-inhabited rangelands of Kenya (N=1131)—the study is a component of ongoing undertakings [LEDP<sup>4</sup>]. The study's sample-sizes are sufficient vis-à-vis ascertaining statistical robustness—in statistics, the recommendation is sample size of 20 observations/independent-variables [45]. It is pointed out that further details—for example, the rationale for direct engagement of Maasai pastoralists as well as for utilization of specific approach; data acquisition, management, and approach—are presented in recent relevant publications derived from the broader project and, unless where necessary, are excluded in the current paper (e.g.: [9, 10, 46]).

Presented proximate and underlying drivers of droughtvulnerability in the system of Maasai-pastoralism are derived from systematic search of literature. In the current paper, only relevant presentation of these drivers is included (detailed statistics are presented elsewhere). In temporal terms, data captured span pre-colonial Kenya to the present period. The participatory study with the Maasai pastoralists utilized a pre-prepared questionnaire that integratively drew from the structure and procedures outlined in relevant salient works (see [47, 48, 49]).

# 3. Results

In Table 1, observed drought-impacts alongside selected determinant-variables are shown—selection is based on the variables' capacity to inform the set objectives. Note that, determinant-variables are variously significant (p < 0.05, N=120). For example, temporal-contrast is highly significant for *frequently migrate-livestock* and *livestock-mortality*, and is in favor of present. Wealth-contrast is highly significant for

rampant destitution and human-morbidity, and is in favor of resource-limited households. Some impacts have equally significant wealth and temporal contrast (p<0.05) for example, rampant destitution, frequently migrate-livestock, and unfavorable livestock-market. Majority of the presently observed drought-impacts bear significant temporal-contrast; only a few show significant p-values for wealth.

Table 2 shows the variables driving drought-vulnerability in Maasai social-ecological systems across the Maasaiinhabited savanna rangelands of Kenya. Note that diverse climatic, ecological, and social variables driving droughtvulnerabilities on the social-ecological systems of Maasaipastoralism are documented. Examples of climatic include Climate change & climate variability, and Occurrence of extreme climatic-events. Examples of ecological variables include CRR spatiotemporal change and variability, and Encroachment of unpalatable plants & invasives. Social variables include Rearing of economically unviable herd-size, and Absence of EWS on impending drought. The category 'Other Drivers'-predominantly underlying, but also proximate drivers and their social-biophysical links-include diverse variables such as unsuitable economic/rangeland development policies, inappropriate livelihood æ diversifications, ecological and socioeconomic/sociopolitical marginalization. Overall, diverse social-biophysical-climatic, ecological, and social variables-constituting proximate and underlying socialbiophysical drivers of drought-vulnerability are widely documented.

In Figure 2, field observations depict widespread depletion of grass<sup>5</sup>, the dominant pastures for the Maasais' livestock. More specifically, in Figure 2(i) depletion of grass is evident, and the standing woody species (mainly trees in this particular image) are nearly defoliated. Elsewhere in the same county, plentiful but dry grass is evident in relatively high potential spaces during periods of drought (Figure 2(ii)). Under conditions of extreme-drought-for example during the drought event that plagued the region in 2005-entire landscapes devoid of grass are common, and water scarcity predominate; in such times sometimes Maasai men help ferry water (a deviation from traditional norm vis-à-vis gender roles), often from distant places, for domestic consumption (Figure 2(iii)). Water scarcity and indeed grass depletion (the dominant pasture) are common during periods of drought (see Figure 2 & 3, Table 1). Figure 3 shows quadruplicate images of drought-impacts on Lake Amboseli<sup>6</sup> and its environs within Amboseli National Park in Kajiado County, Kenya. Drought-impact on critical rangeland resources

<sup>4</sup> A long-term and on-going project on livelihoods, environments, & development

<sup>5</sup> Common grass observed in Kajiado County include, *Chloris* spp on hilly-spaces and plains (e.g., greater Mashuru); *Digitaria* (e.g., plains of Mashuru); *Pennisetum* (common covering fertile patches e.g., valleys and floodplains dispersed across the county); *Sporobolus* (common in western Loitokitok, especially in poorly drained clayey soils evident in Amboseli National Park)); and *Themeda* spp dominate especially the valley areas [LEDP, op. cit.]

<sup>6</sup> In addition to being occasioned by drought, the reducing water volume over Lake Amboseli is plausibly attributable to reduced discharge of groundwater (see discussion, this paper).

(CRR, mainly water and pastures) at different stages of drought development is clear: on-set stages (July 2005),

extreme (August 2005) and under sufficient rainfall conditions (Jan-2007).



Figure 2. Portraits of drought-impacts on societal and environmental sectors and resources in the savanna rangelands during periods of drought in Kajiado County, Kenya. (i). Landscape around Maasai-homestead (Boma, Enkang) deplete of grass (dominant pastures); nearly defoliated trees. (ii). Abundant but dry grass in relatively high potential spaces during drought. (iii). Landscape deplete of grass, and presently dominated of woody-species, mainly trees and shrubs; Maasai men hand-ferrying water (in the middle) in plastic-containers at the height of an extremely devastating drought that plagued the region in 2005. Photo Credit: Margaret Mwangi



Figure 3. Quadruplicate images showing drought-impacts on Lake Amboseli and its environs within Amboseli National Park in Kajiado County, Kenya. Photo Credit: Margaret Mwangi [LEDP, op. cit.].

Drought-impacts on Maasai-pastoralism, N=120		
	Determinant-Variables (Contrasts) <sup>¥</sup>	
Drought-impact Descriptions	Temporal	Wealth (Livestock)
Rampant destitution	***	***
Frequently migrate-livestock	***	**
Human-morbidity	*	***
Increased livestock diseases & pests	***	ns
Livestock-mortality	***	ns
Human resources-competitions & conflicts	***	*
Wildlife predations & resource-competitions	**	*
Infrastructural damage <sup>a</sup>	*	ns
Migration inconveniences & hardships	***	ns
Food-shortage & malnutrition	***	***
Declined livestock output & breeding	***	ns
Pasture-shortage <sup>b</sup>	***	ns
Unfavorable livestock market <sup>e</sup>	**	ns
Increased water-shortage	***	*
Other	n.d	n.d

Table 1. Selected dominant determinant-variables associated with the observed drought-impacts on the system of Maasai-pastoralism. Source: Field Data by Margaret Mwangi.

<sup>\*</sup>Mean estimate (selected variables): all Wealth: median herd-size wealth; rich=livestock>/=20 heads, else poor; poor>rich, but reverse for *frequently migrate-livestock*; all Temporal: present>past. <sup>a</sup>Roads, watering-points (e.g., dams, water-pans, & boreholes), water-pumps, dips, & bridges. <sup>b</sup>Regular-fields & dry-season reserves. <sup>c</sup>livestock & livestock-products market. \*p<0.05, \*\*p<0.01, \*\*\*p<0.001, ns=not significant, n.d=not determined

 Table 2. Proximate and underlying social-biophysical drivers of drought-vulnerabilities in Maasai social-ecological systems in savanna rangelands of Kenya.

 Credit: Margaret Mwangi

Drought-vulnerability drivers in Maasai social-ecological systems in rangelands of Kenya ( <i>N=1131</i> ) <sup>¥</sup>		
Absence of EWS on impending drought	Cognitive/sociocultural factors	
Poor & susceptible livestock breeds	Climate change & climate variability	
Unfavorable livestock-markets	CRR spatiotemporal change & variability	
Frequent livestock movements & migrations	Inadequate drought-adaptive capacities	
Livestock diseases & pests	Simultaneous onset of unfavorable conditions	
Inadequate infrastructure	Encroachment of unfavorable land-use types	
Economic over-dependency on livestock	Occurrence of extreme climatic-events	
Rearing economically unviable herd-size	Destitution & food-insecurity/malnutrition	
Encroachment of unpalatable plants & invasives	Other Drivers <sup><math>\lambda</math></sup>	

<sup>4</sup>Selected variables, most are scalar & interlinked; Maasai rangelands include Kajiado, Laikipia, & Narok. <sup>\[\lambda]</sup>Examples of Other Drivers: Insecure land tenure; unsuitable economic/rangeland development policies, poor social institution/governance/power structures; dependence on external aid; frequent economic shocks; inappropriate livelihood diversifications; ecological & socioeconomic/sociopolitical marginalization; rapid population growth

# 4. Discussions

This section employs an integrated approach to interpret and contextualize findings on the types of drought-impacts and drivers of drought-vulnerability on the system of Maasaipastoralism, a strongly coupled social-ecological system. Factors, processes, and contexts driving droughtvulnerabilities on this climate-sensitive livelihood-production system are explicated.

From the current study, the observed types of droughtimpacts reveal the multiplicity of drought-ravages. The impacts reflect the diversity and consequences of this climatic-hazard on specific societal<sup>7</sup> and ecological systems' sector and/or resource structuring Maasai-pastoralism. This is the focus of the present section.

#### 4.1. Multiplicity and Predominance of Deleterious Drought-Impacts in the System of Maasai-Pastoralism

The current empirical evidence reveals that the observed drought-impacts are of diverse types, are numerous, and bear varied statistical significance (Table 1 & Figures 2 & 3). The evident diverse drought-impacts characterizing Maasaipastoralism during periods of drought denote the ravages of this climatic-hazard on the various social, economic, and ecological sectors and resources that structure this system. Thus, rampant destitution and pasture-shortage are respectively socioeconomic and ecological deleterious impacts characterizing periods of drought. Broadly, most impacts are directly under the ecological-system (Table 1). Apropos socioeconomic sector, impacts on livestock—for example heightened mortality; reduced output and breeding; increased afflictions by diseases, infestations by pests, and

<sup>7</sup> For the purpose of this work, societal is preferred, and is used synonymously with human-system's facets (i.e., social, political, economic, cultural, and their various combinations), unless otherwise specified

predations by wild-animals—dominate during periods of drought. As regards ecological sector, pasture- and water-shortage predominate.

Logically, productivity of livestock in Maasai-pastoralism is strongly directly linked to dynamics of pasture and water resources. By occasioning hunger and thirst, even malnutrition, pasture- and water-shortage directly reduces livestock productivity; therefore, the availability and access of these critical rangeland resources (CRR) is essential if sustainability of livestock-sector is to be ensured. This finding is not unexpected in rainfall-dependent subsistence coupled social-ecological system that Maasai-pastoralism epitomizes, and correctly so. Like in similar livelihoodproduction systems, societal and ecological systems usually influence and feedback into each other; and are inextricably interconnected into social-ecological system and so are their structural components ([10, 34, 35]). Consequently, factors contained in any of the system (or components) send horizontal and/or vertical ripples to one or more others [10]. Thus, unfavorable effects on core sectors and resources-e.g., reduced access and/or control of CRR, mainly pastures (grass) and water as regards Maasai-pastoralism (ibid.)-lead to lowered livestock-output, and when persistent, ultimately trigger livestock-mortality. This inextricable interconnectedness, coupled with the current frequent occurrences of consecutive droughts, alongside legacies of past drought-events and historically-contingent social, political, and economic factors and processes (see [ibid.] & Figure 3) contribute to the magnitude with which the present impacts manifest and their overlapping nature, and ultimately (as explained in later sections) occasions a vicious cycle of drought-disasters in Maasai-pastoralism. Lake Amboseli and its environs (see Figure 3), when accessible, is a watering and salt-lick point for Maasai's livestock. It must be point out that the reducing water volumes over this lake can also be attributed to reduced discharge of groundwater-emanating from increased demand for diverse human activities, landuse/land-cover changes, and reduced snowmelt over Mount Kilimanjaro: that is, in addition to drought occurrences and reduced rainfall-which intensify deleterious droughtimpacts. The CRR located within Amboseli National Park, a historically drought-fallback space for the Maasai pastoralists, are scantly accessible following creation of this protected, and physically fortressed, game-sanctuary. In fact, the various drought-fallback spaces located in this gamesanctuary and adjacent environs are inaccessible to the Maasai pastoralists due to existence of competing land-use types and predominance of mismatched with Maasaipastoralism land tenure. Thus, it should be clear: droughtimpacts/disasters are linked to land-use and land-tenure types and variability of CRR in this region. Therefore, practical adaptations and disaster-reduction strategies are one that account for these non-drought factors.

Similarly, in policy terms, this last finding also explains well why, for example, "food-handouts," a common broad-

scale drought-disaster adaptation strategy<sup>8</sup> have persistently failed to eradicate, or to sufficiently alleviate, the persistent challenge of food-shortage that characterize the broader region (the GHA) during periods of drought. The focus of such efforts is, and has been, on periphery-sector, rather than on the core, predominantly keystone, sector of the droughtlivelihood-production system. ravaged The evident recurrence of drought-disasters in Maasai-pastoralism, and indeed across the GHA, necessitates re-evaluating and questioning the prevailing, and past, pathway of livelihood sustainability, socioeconomic development, and droughtdisaster/risk reduction efforts.

That majority observed drought-impacts of are conspicuously deleterious (>95% deleterious, Table 1) coupled with the documented recurrence of drought in the region<sup>9</sup> signify the frequency with which deleterious droughtimpacts manifest on the various sectors and resources of Maasai-pastoralism. Conversely, this finding implies that the beneficial drought-impacts, for example the release of pressure on land-resources that accompany reduction of livestock population (and other ungulates inhabiting Maasais' ecosystems), is not perceived as such by the Maasais. This is not entirely unexpected because majority of the Maasais' households are resource-limited vis-à-vis livestock-holding (Table 1), and any reduction in one's herd-size serves to push one further into more privation; consequently, pressure release on land-resource is perceived as a liability to households' very survival, particularly when viewed from a pastoralist's socioeconomic perspective. Moreover, this pressure release occurs at a time when alternative pasturage is limited by non-drought factors, for example, land-use change and privatization, and hence inaccessibility and/or reduced accessibility to this CRR ([10, 44], (Figure 3)).

Apropos these last points, a salient and legitimate question necessarily emerges, viz: Excepting the aforementioned release of pressure on land-resources that accompany reduction of livestock population (and other ungulates inhabiting Maasais' ecosystems) during periods of drought, are there other beneficial conditions availed by existing drought conditions in the region, and particularly on the system of Maasai-pastoralism? Where present, how do these beneficial conditions cushion this system against persistent drought-ravages, alone and/or alongside the unfolding deleterious effects of the changing climate and unfavorable cross-scale permeation of and shifts in socioeconomic/sociopolitical globalization factors?

### 4.2. Proximate and Underlying Drivers of Drought-Vulnerability in Maasai Social-Ecological Systems in Kenya

The drought-vulnerabilities of the system of Maasaipastoralism in the rangelands of Kenya are linkable to various proximate and underlying social-biophysical drivers (see Table 2). As regards proximate drivers, assorted social-

<sup>8 [</sup>e.g.: [3, 4])

<sup>9 [9, 10]</sup> 

biophysical factors have been documented. It must be pointed out that although occurrence of frequent prolonged/extreme droughts is a proximate factor driving drought-vulnerability, the *pure occurrence* of this climatic phenomenon is not—like in most ASALs across the GHA, drought is a common occurrence in Maasai rangelands of Kenya<sup>10</sup>—, but rather its *increased* manifestation across temporal scales. Nonetheless, the occurrence of drought particularly the present drought-event—serves as a link between underlying and proximate factors in creating, and unveiling, vulnerable conditions.

Ecological marginalization (Table 2), an underlying factor-e.g., through disentitlement from access, use, or control of CRR for example generated via creation of fortressed wildlife sanctuaries-drives pasture- and watershortage: occurrence of drought amplifies the intensity with which these shortages manifest. The documented socioeconomic marginalization of the Maasais, a core proximate factor, plausibly generates intense drought-impact even for a normal-drought condition. Elsewhere, dependence on externally-sourced relief-aid <sup>11</sup> plausibly denies one's capacity for innovative drought-adaptation, and when this aid is inaccessible, renders one vulnerable to drought-impacts. Apropos these last points, it becomes clear: droughtvulnerability in Maasai-pastoralism is generated via one or multiple pathways of interlinked underlying and proximate factors.

Other social and/or biophysical drivers, for example, encroachment of unpalatable plants & invasives (a form of land degradation), and tribal clashes (a form of political shock) operate in similar manner via social and/or ecological systems of Maasai-pastoralism in generating droughtvulnerabilities. Suffice that, these social/biophysical links epitomize critical interactions/feedback processes shaping dynamics of drought-vulnerabilities in the system of Maasaipastoralism.

It must be pointed out that these factors are not unique to Maasai-pastoralism in the rangelands of Kenya. Elsewhere, across Kenya, and the GHA and other ASALs across Africa, diverse underlying factors including demographic, socioeconomic, cultural, technological, polity and institutional, and indeed proximate ones are well documented (e.g., [10, 12-22, 26-30]). However, this commonness of factors should not be construed to imply uniformity of pathways through which drought-vulnerability unfold. Such interpretation is further from the reality, and correctly so. Drought-impacts' types and their variously interlinked drivers vary across place, time, and livelihood-system: thus, drought-vulnerability and its dynamics is in context. Continuing with this thread of argument, the evident manifestation of various climatic, ecological and societal drivers of drought-vulnerability (Table 2) indicates that the observed types of drought-impacts and/or their multiplicity (Table 1) are only partially responsible for the droughtravages on Maasai-pastoralism. Suffice that the observed drought-impacts types and/or their multiplicity in Maasaipastoralism are *contextual manifestations*. Collectively, as regards Maasai-pastoralism, these findings shed light on the necessity for a paradigm shift vis-à-vis drought-adaptation and/or drought-disasters reduction.

In addition to the observed drought-impacts and proximate and underlying drought-vulnerability factors (Tables 1 & 2), other diverse cross-scale social-biophysical factors play critical role in amplifying drought-ravages on the system of Maasai-pastoralism-and indeed similar social-ecological livelihood-production systems, particularly across the ASALs of the GHA. For example, the persistent, even rapid, deleterious impacts of climate change alongside cross-scale permeation of and shifts in diverse socioeconomic and/or sociopolitical globalization factors, processes, and their interactions <sup>12</sup> exemplify factors intensifying existing drought-ravages (see Table 1 & Figure 2 & 3) on Maasaipastoralism in various ways as highlighted in throughout this paper. It must be pointed out that, in this region, droughtdisasters are persistent, even widespread, and droughtdisaster/risk management and adaptive capacities inadequate, and inevitably, therefore, drought-vulnerable landscapes predominate ([5, 9, 10, LEDP, op. cit., Matthew et al., op. cit.]). Under these landscapes, the manifestation of these other diverse cross-scale social-biophysical factors necessarily alters the geography of drought-ravages, and indeed enfeebles the proper operation and state of various vital sectors and resources buttressing the predominantly climate-sensitive subsistence livelihood-production systems in the region. Worth highlighting, the common proximate drivers of drought-vulnerability in the Maasai-inhabited rangelands of Kenya, alongside the aforementioned other dominant diverse cross-scale social-biophysical factors, are essentially regular-livelihood-risks vis-à-vis the system of Maasai-pastoralism (e.g., [10]).

The existence of regular-livelihood-risks<sup>13</sup>, coupled with the evident numerous manifestation of deleterious droughtimpacts with significant temporal-contrast in favor of present (see Table 1) collectively indicate that Maasai-pastoralism is presently persistently plagued by multiple devastative drought-impacts than before. In fact, over 90% of droughtimpacts have significant temporal-contrast in favor of present simultaneously implying that these impacts are presently devastative, and were trivial, even non-existent, in the past. Examples of such include frequent migrate-livestock, pasture-shortage, and livestock-mortality (see Table 1); the drivers of which are inextricably interlinked as variously explained in this work.

Moreover, the regular manifestation of these risks, coupled with the diverse drivers that variously correlate with climatic and diverse ecological and societal factors (Table 2), indicates that the *present drought-event* is only partially responsible for the observed drought-impacts or their

<sup>10 (</sup>e.g.: [9, 10])

<sup>11</sup> a common resource during periods of drought (see [10])

<sup>12 ([26, 27, 28, 29, 50, 51, 52, 53])</sup> 

<sup>13 (</sup>e.g.: [10])

multiplicity. In light of the presence of these drivers, this last finding further indicates that the manifest drought-impacts in Maasai-pastoralism are *in context*, and need to be interpreted as such. Furthermore, the evident not-significant temporalcontrast, or where significant in favor of past, reveals the preexistence of some of these risks, and by extension signify pre-exposure of Maasai-pastoralism to drought. The presence of regular-livelihood-risks has important ramifications vis-àvis attributing the various observed drought-impacts, particularly their intensity, to the occurrence of this climatichazard alone.

The multiplicity of the livelihood-risks that Maasais encounter during periods of drought as well as in nondrought times denotes that drought occurrence is only partially influential vis-à-vis devastating the various structural components of Maasai-pastoralism: some of the observed drought-impacts are not purely triggered by this climatic-hazard but have non-drought causes [10]. Thus, for example, shortage of grazing land, a regular-livelihood-risk, translates to reduced extent of pastureland even before drought occurs [ibid.]. This finding concurs with arguments elsewhere that food-crisis (widely identified as famine) in certain parts of Africa-although predominantly associated with drought occurrences-, and particularly its shortage, is closely linked to the broader political economic factors and not to drought per se [54]. In fact, in one of his salient works, Amartya Sen, the prominent economist specifically asserts that entitlement failures-constituting the core proximate trigger that can manifest even under conditions of stable overall food production-is the core trigger of famines rather than decline in total food-availability [55]. Although Sen's arguments occasioned major paradigm shift vis-à-vis causes of food-crisis (ibid.), the reporting on famine with regard to Africa still attributes it to drought occurrences [LEDP, op. cit.]. In fact, almost all (100%) of the recorded famines for the broader region (the GHA) have been attributed to drought occurrences [ibid.].

In addition to livelihood-risks, the current evidence reveals temporal concurrence and differential significance of diverse drought-impacts along socioeconomic lines (see Table 1). For example, with regard to livestock-mortality, it is evident that the mean for wealth-contrast is not-significant implying that both affluent and resource-limited households are equally plagued by this drought-impact. This interpretation explains well, and correctly so because the affluent have large cattle-herds, which require more pastures, and with the shortage of this CRR, they lose some of their stock; the resource-limited will lose some, sometimes all, of their already few cattle-they still need pasture, however few they are. What's more, this latter socioeconomic group is unlikely to afford the cost of feed-supplement or leasing pastures for they are poor to start with. This indiscriminate manifestation of livestock-mortality regardless of wealth-classes is well articulated by a Maasai-elder's insight, "... drought has no inlaws... [Ole Nkatia, pers.comm.]." The highly significant temporal-contrast in favor of present for wealth provides evidence that this impacts is of concern presently than it was

in the past. Thus, frequent occurrences of drought translate to rapidity with which persistent and growing livestock-based wealth-class divide is imprinted on the system of Maasaipastoralism. Therefore, external interventions should account for this inequitable socioeconomic landscape.

The evident highly significant wealth-contrast for destitution and human-morbidity in favor of resource-limited Maasai households constitute strong evidence that, during periods of drought, these two impacts manifest more among poor Maasais; a situation explainable by the interconnectedness of drought-impacts (see [LEDP, op. cit]). The heightened destitution during periods of drought among the resource-limited Maasais is largely because they are poor to start with, and therefore, they are, in addition, unlikely to afford medical cost to address their current ailments or source better nutrition or sanitation to avert some potentially preventable diseases.

#### 4.3. The Paradox: Persistent Widespread Drought-Impacts and Disasters, Multiscale Disaster/Risk Reduction

Paradoxically, the evident frequent and persistent droughtravages (Table 1 & Figure 2) manifest under landscapes of diverse, nested, and multiscalar drought-adaptations and livelihood-coping strategies and multiple and cross-scale disaster/risk reduction efforts-including long-term practices, policies, and studies-and vast repositories of information ([3-6, 9-11], LEDP, op. cit]). In Kenya, where the current study area is located, the various ongoing, even long-term, efforts by the government and various non-governmental entities toward disaster/risk reduction in the region [31], connote that data are vastly available. Worth mentioning, the very continued existence of various policies formulated, and programs implemented, under the aegis of the government of Kenya and indeed her bilateral/multilateral development partners (e.g., through USAID & UNDP) denote broaderscale efforts, even ongoing undertakings, toward disaster/risk reduction. Apropos this last point, a salient question emerges, viz: do the policies/programs' priorities of the government and her development partners influence the outcome of their variously formulated/implemented drought-disaster/risk reduction strategies? An even more important question arises thus far, viz: why is drought-disaster persistent, even widespread, in the region amidst these efforts, data availability, and vast repositories of information?

The persistence of drought-disaster is attributable to the multiplicity and rapid proliferation of non-drought factors, for example, existing vulnerabilities, inadequate adaptive capacities, and implementation of partially-informed development policies, which logically diminish progress achieved via implemented strategies and/or limit the implementation of potentially feasible ones ([10, 41, 42, 43, 44, 50, Matthew *et al., op. cit.*], (Table 2)). Likewise, continual implementation of *unchanging* strategies in an *ever-changing* geography of *drought-disaster/risk* (DDR), coupled with reactive drought-adaptation strategies and scant focus on resilience-building effort occasions similar

outcome ([9, 10, LEDP, op. cit., Matthew et al., op. cit]). Furthermore, similar outcomes are plausibly occasioned by continual focus on monolithic component and perennial utilization of prescribed disaster/risk reduction strategies (predominantly deriving from templates tailored for/by the West) rather than engaging a system and/or integrated approach that provide for holistic incorporation of the various dimensions of the same ([10, 56, 31]). Closely linked to this last point, is the undefined stakeholders' priorities-undefined vis-à-vis practical priority for on-theground needs of drought-ravaged livelihoods and/or peoplegroups-for example, of the government of Kenya and indeed her bilateral/multilateral partners' policies and programs, necessarily generate similar outcomes. Suffice that, this persistent paradox reflect gap(s) in preceding and current research-policy-practice efforts, particularly those directly engaged in DDR management.

Under the landscapes of deleterious impacts of climate change alongside cross-scale permeation of and shifts in diverse socioeconomic and/or sociopolitical globalization factors, processes, and their interactions<sup>14</sup> altered geography of drought-impacts and disaster/risk in the system of Maasaipastoralism is to be expected. More specifically, and ceteris paribus, enfeebled proper operation and altered state of various vital sectors and resources buttressing this climatesensitive subsistence livelihood-production system, and intensified drought-ravages will continually manifest. In their effort to adapt to drought-ravages, Maasai pastoralists have had to contend with various deleterious impacts such as increased livestock-mortalities and resource-conflicts with other land-users [10]. Thus, it is plausible, the manifestation of climate change alongside and the aforementioned globalization factors translates to alteration of Maasais' interactions with other pastoral/non-pastoral land-users across spatiotemporal and sociospatial scales.

Thus far it should be clear: the aforementioned pure focus on major-droughts, macro-scale, broadly-defined sectors, isolated resources, and scant engagement of the droughtaffected inhabitants-which variously conceals the geography of drought-impacts/disasters-inadvertently renders ineffective the unchanging pathways of socioeconomic development and disaster reduction efforts (e.g., Matthew et al., op. cit). This last scenario is likely to persist under the aforementioned landscapes of climate change and cross-scale permeation of and shifts in diverse socioeconomic and/or sociopolitical globalization factors, processes, and their interactions.

Besides the aforementioned factors, other various existing and/or emerging climatic, ecological, and/or sociopolitical/socioeconomic pressures will—*ceteris paribus*—continually enfeeble drought-adaptive capacities of Maasais ([57, 58, 59, 60, 61, 62, 63, 64, 65, LEDP, *op. cit.*, Matthew *et al.*, *op. cit.*], (Table 2)). Thus far, and particularly apropos these last points and their plausible deleterious outcomes on the various sectors and resources of Maasaipastoralism, salient and legitimate question necessarily emerges, viz:

Are the variously utilized diverse drought-adaptation and livelihood-coping strategies in Maasai-pastoralism feasible in cushioning the various social and/or ecological sectors and resources of this social-ecological system against the deleterious impacts of drought-disaster/hazard and increased rainfall-variability as the climate changes, alongside cross-scale permeation of and shifts in socioeconomic/sociopolitical globalization factors (see [10, 46, 63] for these strategies)?

In policy terms, and as regards enhancing drought-adaptive capacities and the overall resilience and sustainability of Maasai-pastoralism in the savanna rangelands of Kenya, feasible studies and/or drought-management policies/programs are those that variously consider the emerging salient questions in such efforts. (Responses to some aspects of these salient questions and others on the subject are detailed in a recent and an ongoing multiapproach comprehensive study<sup>15</sup> on selected strongly coupled livelihood-production social-ecological systems (see [Matthew et al., op. cit, LEDP, op. cit.].) Taken together, and apropos the explication thus far, it must be recognized that disaster/risk is place- and time-specific for it is ensconced in the variously explicated diverse and shifting politicalecological and political-economic landscapes; therefore, integrative accounting of the aforementioned scalar climatic and non-climatic drivers of DDR becomes necessary. Suffice that, the necessity for practical bridging of cross-scale research-policy-practice divide-e.g., through participatory improvement and/or re-defining of efforts by continual, engaged, and cross-scale appraisal of DDR reduction strategies-cannot be overemphasized. The evident recurrence of drought-disasters in Maasai-pastoralism, and indeed across the GHA, necessitates re-evaluating and questioning the prevailing, and past, pathway of livelihood sustainability, socioeconomic development, and DDR reduction efforts.

# 5. Conclusions, Emerging Themes and Recommendations

This study has explored the types of drought-impacts, alongside proximate and underlying social-biophysical drivers of drought-vulnerability, on the societal and ecological facets of Maasai-pastoralism—a strongly coupled social-ecological livelihood production system, practiced in the savanna rangelands of Kenya. Specific factors, processes, and contexts driving drought-ravages on this climatesensitive livelihood-production system were explicated. Additionally, the study engaged a nexus approach to

<sup>14 (</sup>e.g.: [12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 26, 27, 28, 29])

<sup>15</sup> It must pointed out that drought-disaster/risk trajectory vis-à-vis strongly coupled social-ecological system, such as epitomized by Maasai-pastoralism, is a broad and multifaceted subject, and is, therefore only briefly explicated here: it warrants an extensive explication. This recent study constitutes an effort in that direction.

conceptualize drought-disaster/risk trajectory in Maasaipastoralism, *ceteris paribus*, under persistent, even rapid, deleterious impacts of climate change alongside cross-scale permeation of and shifts in diverse socioeconomic/sociopolitical globalization factors, processes, and their interactions.

The current empirical evidence reveals that droughtimpacts on Maasai-pastoralism are inextricably interlinked and predominantly deleterious. The observed droughtimpacts types and/or their multiplicity in Maasai-pastoralism are contextual manifestations. Over 90% observed droughtimpacts in Maasai-pastoralism are presently devastative, and were trivial, even non-existent, in the past. The study reveals that diverse proximate and underlying social-biophysical drivers-operating through various interactions/feedbacksoccasion drought-vulnerabilities of Maasai-pastoralism. Under conditions of frequent occurrences of drought, the rapidity with which persistent and growing livestock-based wealth-class divide imprints on the system of Maasaipastoralism is intensified. The type and the way droughtimpacts plagues Maasai-pastoralism is mediated by multiple variable and historically-contingent cross-scale societal, ecological, climatic factors, processes, and their interactions. The study reveals that drought-impacts on Maasaipastoralism are *in context*, and need to be interpreted as such; that the *present drought-event* is only partially responsible for the observed drought-impacts and/or their multiplicity. The persistent, even rapid, deleterious impacts of climate change alongside cross-scale permeation of and shifts in diverse socioeconomic/sociopolitical globalization factors, processes, and their interactions constitute additional challenges on Maasai-pastoralism. Regionally, multiple rapidly proliferating non-drought factors occasion and/or amplify persistent drought-disaster/risk. In this region, drought-vulnerable landscapes predominate.

In light of the present findings, drought-impacts' mitigation and/or drought-adaptation strategies that anticipate benefiting Maasai people should simultaneously address proximate and/or underlying social-biophysical factors drivers. Most importantly, the necessity for practical bridging of research-policy-practice divide-e.g., through participatory improvement and/or re-defining of efforts by continual, engaged, and cross-scale appraisal of droughtdisaster/risk reduction strategies-cannot be overemphasized. The recurrence of drought-disasters in Maasai-pastoralism necessitates re-evaluating and questioning the prevailing, and past, pathway of livelihood sustainability, socioeconomic development, and DDR reduction efforts. Collectively, the current study cast useful insights into the landscapes of drought-ravages on Maasai-pastoralism, and, indeed, on other climate-sensitive primary livelihoods across the rangelands of Kenya, and similar social-ecological systems across the GHA, where droughts are recurrent, droughtadaptive capacities low, drought-disaster/risk persistent, and drought-vulnerable landscapes predominate. Apropos Maasai-pastoralism, the necessity for a paradigm shift vis-àvis drought-adaptation and/or drought-disaster reduction

cannot be overemphasized.

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## **Conflicts of Interest**

The author declares no conflict of interest

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