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1      Effect of Wildebeest Migration Pattern on Sustainability of  
2      Tourism Development at Mara-Serengeti Ecosystem: A  
3      Transboundary Resource Management Perspective

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8      **Abstract**

9      Sustainable tourism development in the Serengeti-Mara region seemingly depends largely on  
10     the wildebeest migration phenomenon. This is particularly due to its appeal to the tourist and  
11     its classification as one of the new wonders of the world by UNESCO. The phenomenon has  
12     over the years been used as a flagship/marketing tool to project the ecosystem as a leading  
13     tourism destination.

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15     **Index terms—**

16     Abstract-Sustainable tourism development in the Serengeti-Mara region seemingly depends largely on the  
17     wildebeest migration phenomenon. This is particularly due to its appeal to the tourist and its classification  
18     as one of the new wonders of the world by UNESCO. The phenomenon has over the years been used as  
19     a flagship/marketing tool to project the ecosystem as a leading tourism destination. This has resulted in  
20     proportionate flow of tourist to the region to witness this unique occurrence. Development of facilities to meet  
21     demands of tourists has also grown in tandem. However, continuity/persistence of the phenomenon has not  
22     been interrogated. Environmental management, resource use practices & other human activities on either side  
23     of the Kenya-Tanzania boundary have begun to alter the spectacular nature of the migration. Eventually, this  
24     trend may truncate the phenomenon altogether. This questions sustainability of tourism development. The main  
25     objective of this study was to assess the role of the wildebeest migration phenomenon in sustainable tourism  
26     development in the MSE. This was done by interrogating continuity of the phenomenon from a transboundary  
27     resource use and management perspective. Thematically, the migration phenomenon was looked at from its  
28     spectacular features namely; the migration route, population/numbers, migration pattern/season & timing and  
29     composition of the migrating community. The intention was to assess the relationship between these features and  
30     tourism development in the region. The study was guided by Rational Choice Theory and Tragedy of Commons  
31     Theory. Among the concepts explored included Political Ecology, Transboundary Natural Resource Management,  
32     Integrated Natural Resource Management and the concept of sustainability. A questionnaire was used to collect  
33     primary data from the field.

34     A pilot survey at Lake Nakuru National Park was used to test reliability of the research instrument. The  
35     research instrument was also subjected to scrutiny by subject matter experts to determine content validity.  
36     The target population for the study was 14983 individuals drawn from conservation agencies employees, business  
37     community and local community members. A strata sample size of 221 was obtained using coefficient of variation  
38     from Nassiuma's formula. The sample size was adjusted upwards based on response rate from the pilot survey  
39     to cater for nonresponse during the main study.

40     Based on this, an adjusted sample size of 339 was adopted I. Introduction a) Background to the Study look at  
41     the world map reveals a patchwork of independent states which was a result of colonial powers subdivision  
42     of continents into states for easy governance. The subdivision resulted in much of the natural resources  
43     and ecosystems lying astride boundaries between or among countries. This situation of shared resources and  
44     ecosystems has today called for territorial integrity as a principle to govern the relations between and/or among  
45     governments in order to avoid conflicts in resources utilization (see Braack et al. 2006). There exists multiple

## 1 I. LONG DISTANCE MIGRATION OF ANIMALS

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46 phenomena associated with transboundary wildlife resources, management of which has proved challenging. An  
47 elaborate example is that of wildlife migration, particularly Long Distance Migration (LDM).

### 48 1 i. Long Distance Migration of Animals

49 Long distance migration of animals is one of earth's dazzling biological phenomena. This eyecatching phenomenon  
50 has over the years attracted many scholars trying to understand how, why and when animals migrate. Long-  
51 distance migrations, where there is a seasonal movements of animals between distinct areas which are not used at  
52 certain times of the year, used to happen or take place in many marine, fresh water and terrestrial taxa (Berger,  
53 2004). Aggregate mammal migration which entails the seasonal and cyclic or oscilative movement of animals  
54 between certain distinct areas (Thirgood et al. 2004) is a unique phenomenon which attracts the attention of  
55 many, ranging from conservationists to tourists. Dingle & Drake (2007) observe that seasonal migration, where  
56 individuals make a return trip to and from physically separated home ranges to take advantage of variations in  
57 the biophysical conditions, is familiar among many taxonomic groups. Hebblewhite and Merrill (2007) note that  
58 the seasonal long distance movement is an adaptive response tactic that allows herbivores to avoid lack of food  
59 supply and perhaps diminish the risk of being fed on by predators. Harris et al (2009), who studied and mapped  
60 global aggregate migrations, have documented thus:

61 Twenty-four large mammal species (and subspecies) are known to migrate or to have migrated in aggregations-  
62 all ungulates. Mass migrations for 6 of these are extinct or their status unknown: springbok *Antidorcas*  
63 *marsupialis*, black wildebeest *Connochaetes gnou*, blesbok *Damaliscus dorcas*, kulan *Equus hemionus*, scimitar  
64 horned oryx *Oryx dammah*, quagga *Equus quagga*. Most migratory populations lack reports on their numbers,  
65 distances traveled, geographical routes, ecological drivers and threats. Where data exist, they are often over a  
66 decade old.

67 According to these authors, most of these aggregate migrations have occurred or occur in Africa, where  
68 there are nine (9) enduring migrants occurring in six (6) areas namely Boma-Jonglei, Sudan; Mara-Serengeti  
69 ecosystem of Kenya and Tanzania; Tarangire in Tanzania; Liuwa between Zambia and Angola; Chobe and  
70 Kalihari in Botswana and; (Harris et al, 2009). Elsewhere in the world, there is also reported or documented  
71 six (6) combined wanerers left over for Eurasia, and four (4) for North America where the caribou or reindeer  
72 (*Rangifer tarandus*) occur in both.

73 Some of the known examples of long distance migrations and which are among the most stunning natural  
74 occurrence or event include the long-distance recurrent movements of monarch butterflies *Danaus plexippus* in  
75 Northern American continent, the wildebeest *Connochaetes taurinus* in the Mara-Serengeti ecosystem, pallian  
76 birds athwart the Americas, and grey *Eschrichtius robustus* and humpback whales *Megaptera novaeangliae* in  
77 the Pacific Ocean (Wilcove, 2009).

78 Though the mapping of geographical locations of remnant aggregate migrants has been done, scientists' and  
79 conservationists' overall knowledge of migrations is still low (Berger 2004). Whereas a lot of research has been done  
80 on ecological drivers of aggregate migrations, more needs to be done on collective combined environmental and  
81 demographic changes affecting or which are likely to affect continuity/persistence of such migrations. Persistence  
82 of aggregate migrations is pertinent because of many reasons. For example, Frank (1998), ??cNaughton et al.  
83 (1988) & Caughley (1976), all cited in Harris et al. (2009) say that "mass migrants have positive feedback effects  
84 on grassland forage and indirect effects on ecosystem processes (e.g. increasing grassland production and raising  
85 nitrogen mineralization), and therefore losing migrations may result in ecosystem collapse". Mass migrations also  
86 boost economies of destinations through tourism. Truncation of such migrations will have a trickledown effect on  
87 other animal and plant species in the affected ecosystems. For example, if the wildebeest migration phenomenon  
88 never happened in the MSE, populations of other herbivores would without any doubt decline, the followed by  
89 the carnivore populations, and Serengeti-Mara would lose tourism business (Harris et al. 2009).

90 It is however noted that the phenomenon of long distance migration across many animal species and in  
91 many parts of the planet is being truncated and under threat from anthropocentric activities and developments  
92 leading to habitat destruction, barriers to movement, resource damage or depletion and climate change (Wikelski  
93 & Wilcove, 2008;and Dobson et al., 2010). As observed in the works of Bolger et al., (2008) and Harris et  
94 al., (2009), recurrent cyclic movement of animals was once a common phenomenon around the world, but this  
95 phenomenon has collapsed in many areas as a result of pressures from human activities and transformations in  
96 land-use and ownership. Berger (2004) observes that "many of the massive and historically described treks by  
97 herd-dwelling mammals have been lost from Asian steppes, North American grasslands and African savannas".  
98 Examples given include the bison of the North American Great Plains, where the population once comprised of  
99 as many as 30 million animals but nowadays only very few remnants exist, this being the result of unsustainable  
100 utilization (Bolger et al., 2008); similarly, the Saiga antelope of Central Asia, was also observed decline from well  
101 more than 1 million animals in the 1980s to under 200,000 animals by 2000 (Milner-Gulland et al., 2001); also  
102 the seasonal movement of large numbers of Thomson's gazelle and zebra between Kenya's Lakes Elmentaita &  
103 Nakuru and the Lake Baringo was witnessed truncate earlier in the 20th century due to uncontrolled utilization,  
104 habitat destruction, and other anthropogenic activities & developments (Ogutu et al., 2012). Harris et al., (2009)  
105 and Wilcove, (2009) further indicate that seasonal movement of animals is not well understood and much of it  
106 remain unknown and undocumented. This is proven by discovery of a migration event of large mammals in  
107 Sudan that is similar to that of the Serengeti in abundance, which stayed largely undocumented until 2007. It

108 is of great value to understand migrations. A greater insight into the ecology of seasonal migration of wildlife is  
109 an important area in the planning of the management of functionally connected landscapes, in the conservation  
110 and management of species and for the protection and maintenance of threatened natural events or occurrences  
111 (Epps et al., 2011;Fynn & Bonyongo, 2011;Crooks & Sanjayan, 2006;Brower & Malcolm, 1991; ??riers, 2002; ??.

112 Remnants of the migration phenomenon in the world today, particularly those that are transboundary, are  
113 threatened due to variations in the ways such resources are used and managed on either side of the boundary.  
114 There exists multiple phenomena associated with transboundary wildlife resources, management of which has  
115 proved challenging. This situation of shared resources and ecosystems has today called for territorial integrity  
116 as a principle to govern the relations between and/or among governments in order to avoid conflicts in resources  
117 utilization (Braack et al. 2006). Whereas much research work has been carried out on how, why and when  
118 animal migrations occur, not much effort has been directed towards establishing strategies towards retaining and  
119 sustaining remnants of such phenomena. The designing of successful strategies to ensure continuity or persistence  
120 such phenomena has also proved tricky as observed by Grooves et al. ??2002), who note that planners face  
121 challenges because of variation in biological value and consequent use of landscapes.

122 In the Serengeti ecosystem for example, much effort has been directed at understanding how, when and why  
123 the wildebeest migrate. Majority of the longitudinal studies/surveys have used natural scientific experiment  
124 method in the field to study movement of collared animals using Global Positioning System (GPS) telemetry  
125 and aerial images. Other studies on the migration phenomenon need to be done. For this study, focus will  
126 be on the effect of the migration occurrence on sustainability of tourism development. The interrogation will  
127 be focused on how the variation of phenomenal elements or components of wildebeest migration, namely the  
128 migration route, migrating population numbers, migration pattern & composition of migrating community will  
129 affect sustainability of tourism development. Migration route refers to the exact path or corridor followed by  
130 animals when on the move. Migration pattern is the calendar (season and timing) detailing where the animals  
131 are at a particular month of the year. Numbers refer to the population size while migrating community refer  
132 to the species composition of the animals. These features of the migration phenomenon may vary depending on  
133 human activities and changes in the environment. The variations will also have implications in the sustainability  
134 of tourism development in the MSE.

## 135 **2 ii. Transboundary Resources in the East African Community**

136 The East African Community is a regional block made up by six partners in the African Great Lakes region  
137 namely, Kenya, Rwanda, Burundi, Uganda, Tanzania and Southern Sudan. Cooperation among the member  
138 states is currently focused on customs union, common market, monetary union and political federation (Reith  
139 and Boltz, 2011). These states share many earthly and water ecosystems which are viewed as resources and a stock  
140 up of wealth for the economies of these countries. They include, but not limited to, wildlife (flora and fauna)  
141 and rich mineral reserves which if well put into use, could positively impact on the welfare of the community and  
142 alleviate poverty.

143 It is noted that the above mentioned shared ecosystems are facing major threats, including depletion of natural  
144 resources due to ever increasing anthropogenic pressure manifested in ballooning anthropocentric developments  
145 resulting in overutilization, untenable agricultural practices, overharvesting of fish, dumping of wastes affecting  
146 both on site and off site sources and sink capacities, uncontrolled reclamation and eventual damage of wetlands  
147 and ecosystems in and around sensitive places such as Lake Victoria and other set aside areas such as the MSE.  
148 If this is not addressed on time, these threats may result in momentous negative ecological, economic and social  
149 impacts.

150 Even though much is being done to appraise the policy, come up with legal and institutional frameworks  
151 aiming at the management of the natural resource base and the environment, those which touch the management  
152 of shared ecosystems and resources are inadequate and yet to be considered. The EAC Secretariat is struggling  
153 to harmonize the policies and institutional frameworks to address the management of natural resources lying  
154 astride the boundaries amid setbacks/hiccups of the ratification of the same in the individual member states.  
155 For example in Article 114, section 2 of EAC, Protocol for Environment and Natural Resource Management was  
156 signed by the Republics of Kenya, Uganda and United Republic of Tanzania on 3rd April 2006. The Protocol  
157 has since been ratified by the Republic of Uganda and the Republic of Kenya in 2010 and 2011 respectively.  
158 However, the United Republic of Tanzania is dragging her feet in ratifying the Protocol with reasons best known  
159 to them. The process to address their issues in order to finalize the ratification process and make the Protocol  
160 operational is still ongoing under the guidance of the Council of Ministers. The Republic of Rwanda, the Republic  
161 of Burundi, Southern Sudan and DRC Congo were not yet EAC Partner States at the time the Protocol was  
162 negotiated and signed. Furthermore, the Protocol is at present not in operation and hence not a lawfully binding  
163 document until it is ratified by all Partner States including new entrants.

## 164 **3 b) Statement of the Problem**

165 The wildebeest migration phenomenon at the Mara-Serengeti ecosystem (MSE) has been declared by UNESCO  
166 one of the new wonders of the world. This phenomenon itself together with other wildlife resources in the Mara  
167 and Serengeti ecosystem have led to development of tourism and growth of tourism business Year 2022 ( ) F in

## 5 II. LITERATURE REVIEW A) THEORETICAL REVIEW I. THEORIES GUIDING THE STUDY II. RATIONAL CHOICE THEORY

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168 MSE area over the years. For the tourism development to thrive and be sustainable in the MSE, the ecosystem has  
169 to retain its self perpetuating status unaltered and its wildlife based tourism product has to persist, particularly  
170 the wildebeest migration phenomenon. In recent times the phenomenon has been, and continues to be used as  
171 a flagship marketing tool for the Masai Mara National Reserve & Serengeti National Park tourism & business.  
172 In the ideal situation, it is expected that the MSE will be sustained, the tourism development and growth will  
173 continue positively in terms of profitability & provision of jobs and livelihoods of the local people maintained as  
174 long as the spectacular nature of this migration phenomenon persists. However, the continuity of the ecosystem  
175 and persistence of this wildlife product (wildebeest migration phenomenon) has not been crossexamined. The  
176 Mara-Serengeti ecosystem experiences diverse and conflicting interests from different stakeholders surrounding the  
177 Mara and the Serengeti. This is compounded with different and conflicting resource use and conservation policies  
178 emanating from the fact that the ecosystem lies astride the border between Kenya and Tanzania. For example,  
179 resource use and conservation policies on the Tanzanian side allow settlement, cultivation & farming, hunting  
180 and harvesting of wildlife while on the Kenyan side tourism is allowed as the only acceptable use (Thirgood et  
181 al 2004). In brief, the Mara-Serengeti is a common property ecosystem shared between two governments and  
182 their respective surrounding communities. Due to conflicting interests and conflicting resource use policies, it has  
183 been described as, and is regarded as an ecosystem under siege (Mukeka, 2019& Waithaka, 2004). Its wildlife  
184 resources are likely to suffer a tragedy a result of wanton use and destruction minding only on gains without  
185 much care on the resulting negative environmental and socioeconomic impacts (Frischmann et al, 2019;Katerere  
186 et al, 2001). The ecosystem is facing enormous threats from a ballooning and burgeoning human population with  
187 higher poverty levels, conflicting land tenure systems on either side of the border, land subdivisions, fencing,  
188 fragmentation and destruction of habitats, changing of land use from livestock keeping (nomadic pastoralism)  
189 to crop farming, sedentarisation (settlement) and growth of market centers. All these anthropocentric processes  
190 are leading to blocking of wild game migratory corridors; range contraction, heightens poaching and general  
191 degradation of the environment ??Ogutu et Furthermore, it has been observed that similar/related spectacular  
192 Long Distance Migration of animals elsewhere has been truncated due to similar anthropogenic issues beginning  
193 to impact the MSE. For instance, Wikelski & Wilcove (2008) and Dobson et al., (2010) ascertain that the  
194 phenomenon across many animal species and in many parts of the planet has been truncated or is under threat  
195 from anthropogenic pressures resulting in habitat destruction, causing barriers to movement, resource depletion  
196 and climate change. Bolger et al., (2008) and Harris et al., (2009) further observe that this phenomenon has  
197 collapsed in many areas because of transformations in land use and anthropocentric developments. Berger (2004)  
198 further observes that "many of the massive and historically described treks by herddwelling mammals have been  
199 lost from Asian steppes, North American grasslands and African savannas". As an examples given from the  
200 Great Plains of North America, the bison population was about 30 million animals but has since reduced to a  
201 dismal number due to unsustainable utilization (Bolger et al., 2008); from Central Asia, the saiga antelope once  
202 had a population of over one million animals in the 1980s, which has been observed decline to about 200,000  
203 members by 2000 (Milner-Gulland et al., 2001); in Kenya, migration of large numbers of Thomson's gazelle and  
204 zebra between Lake Baringo and Lake Nakuru-Elementaita region was witnessed truncate in the early part of  
205 the 20th century, majorly caused by uncontrolled utilization, habitat destruction, and other disturbances from  
206 anthropogenic developments (Ogutu et al., 2012). Furthermore, Ogutu et al (2012) have observed that the Athi-  
207 Kapiti to Masai Mara wildebeest migration route has been lost, truncating the migration phenomenon. This has  
208 been due to habitat destruction & loss, and other human settlement and activities across the Narok & Kajiado  
209 landscape.

210 The migration phenomenon of the wildebeest at the MSE may eventually truncate completely given the goings  
211 on in and around the ecosystem. This will affect sustainability of the ecosystem, tourism businesses & development  
212 and livelihoods of the surrounding communities. Sustainability of tourism development and businesses dependent  
213 on this wildebeest migration phenomenon needs to be interrogated. For sustainable tourism development to be  
214 realized, continuity of migration should be ensured. It is therefore sensible to sieve through site-specific field  
215 information regarding the resource use and management practices and natural happenings that are likely to  
216 impact negatively on the migration phenomenon and by extension affect sustainability of the MSE. This will  
217 thereafter help in coming up with recommendations and strategies that are policy related towards retaining the  
218 phenomenon to ensure sustainable tourism development in the MSE.

### 219 4 c) Objectives of the Study i. Overall Objective

220 The overall objective of the study was to assess the role of the in the Maasai Mara & Serengeti ecosystem from  
221 wildebeest migration pattern on sustainability of tourism development a transboundary perspective.

### 222 5 II. Literature Review a) Theoretical Review i. Theories 223 Guiding the Study ii. Rational Choice Theory

224 This is a theory also known sometimes as Choice Theory or Decision Theory. According to Blume & Easley  
225 (2007), it is also sometimes referred to as Rational Action Theory (RAT). Although its origin may be a bit  
226 murky, Oppenheimer (2008) observe that modern roots of Rational Choice Theory (RCT) stem from the socalled

227 'age of reason' in the 1650s when Thomas Hobbes Leviathan tried to explain the essential operation of political  
228 institutions by means of individuals' choices.

229 Hobbes formed an opinion that choices are anchored on universally held 'appetites' and 'aversions'. In a  
230 layman's language, choices over given options/alternatives will be based on desires/wishes for or oppositions to  
231 those given alternatives. This kind of argument was later continued in the 1770s by famous persons such as  
232 Francis Hutcheson, David Hume, Adam Smith, and later on by Utilitarians as Jeremy Bentham and John Stuart  
233 Mill in the 1800s. This was further supported by many others who followed in the 1900s, including many in  
234 economics e.g. Robbins in 1938 (Oppenheir, 2008). These works spawned what has come to be thought of as  
235 classical or conventional rational choice theory.

236 The classical RCT rides on three premises: peoples' favorite judgements are made in pair-wise comparisons;  
237 all choices from which one pick or decide are comparable; allows two pair-wise associations to be inherited by  
238 a third pair in the following manner: if the relation is transitive then if x relates to y, and y relates to z, then  
239 x relates to z (Blume & Easley, 2007). The RCT has formed a construction for comprehending and quite often  
240 modeling social and economic behavior. The essential hypothesis of rational choice theory is that collective social  
241 behavior is a consequence of the behavior of entity actors/participants, each of whom is making their personal  
242 choices. The RCT therefore concentrates on the influencers of the personal choices sometimes referred to as  
243 methodological individualism.

244 In summary, RCT rides on the assumption that an actor has favorites among the available options or  
245 alternatives allowing each of the players to pick on preferred choice. The second assumption in the RCT is  
246 that the preferences are complete in themselves i.e. the individual can constantly say which of the available  
247 alternatives they consider favorable or that neither is chosen or favored to the other. The third & last assumption  
248 is that the two alternatives can relate to a third option i.e. transitive (if choice x is preferred over choice y and  
249 choice y is preferred over choice z, then x is preferred over z). In this case, according to Blume & Easley (2007)  
250 & Mortazavi, S. (2004), "the rational agent is assumed to take account of available information, probabilities  
251 of events, and potential costs and benefits in determining preferences, and to act consistently in choosing the  
252 self-determined best choice of action".

253 In reference to the MSE, among the many choices which stakeholders have on the table include choosing to:  
254 conserve biodiversity (wildlife); sustain tourism development/experiences; sustain private companies businesses;  
255 sustain local people's livelihood. Depending on the category of the stakeholders, the rational agent will choose  
256 from among these alternatives according to the perceived benefits and/or costs expected to accrue from their  
257 choices.

## 258 6 b) Empirical Review

### 259 7 i. Migratory Pattern (Season and Timing)

260 The wildebeest migration (& the accompanying community) in the MSE is regulated by availability of water/rain  
261 and vegetable food (green grass). From a study carried out in 2004 titled "Can parks protect migratory ungulates?  
262 The case of the Serengeti wildebeest" by researchers, the common pattern of motion indicates that the animals  
263 are located or sighted in the southern Serengeti National Park and Ngorongoro Conservation Area in the months  
264 of March and April. They then move westwards and then north into the western region in the months of May &  
265 June. From here, they continue moving north through Grumeti Game Reserve, Ikoma Open Area and Ikorongo  
266 Game Reserve during June and July. The migrating community reaches the south of Maasai Mara National  
267 Reserve and Northern Serengeti National Park during July and August. Most of the wildebeest remain in or  
268 close to the MMNR throughout August and September prior to going back to the south in October and November  
269 and finally concentrating in the Southern Serengeti & Ngorongoro Conservation Area in the wet season spanning  
270 December to April (Thirgood 2004). A summary of the movement is illustrated in figure 2 in appendix 1.

271 As can be seen in the account above, the great migration lasts a whole calendar year. From other observations  
272 elsewhere, tourism and hospitality facilities development has also traced and relied on the pattern of movement  
273 of the wildebeest. For example:

274 Serian's Serengeti South Camp, Serengeti, Tanzania: is operated between the months of December and April  
275 down south in the Ngorongoro conservation area where visitors are treated to a spectacle in Serengeti South  
276 plains experiencing the peak of the wildebeest calving season.

277 In the months of April & May, when the rains have hit back across the plains pouring millions of gallons of  
278 water on to the rich fertile soil. The landscape is transformed into green carpet of grass and other plants. The  
279 Seronera area soon becomes a moving mass of millions of migrating animals, the Moru Kopjes are a hot viewing  
280 spot, and as the season moves along on the western corridor, Grumet plays host to the herds.

281 June to July: this becomes the Singita Sasakwa Lodge opportunity to reap from the experience. Located in  
282 the privately run Grumeti reserve, it enjoys the advantage of being along the migration path giving the visitors  
283 a vantage position to view the migrating community surge on

284 The above examples of facilities could be just but a few of the many businesses and developments put in place  
285 or done to facilitate tourism activities geared towards experiencing the great migration among other attractions  
286 in the MSE.

287 Apart from determining the spread and situating of businesses across the MSE landscape, the pattern of

### 9 III. RESEARCH METHODOLOGY A) RESEARCH DESIGN

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288 movement sees the wildebeests and other members of the migrating community reach different parts of the MSE  
289 at different times of the year in their cyclic movement. This helps in ensuring environmental sustainability in a  
290 number of ways. The first one is nutrient cycling in the system. In their study entitled 'Collapse of the World's  
291 Largest Herbivores' (body mass ?100kg), Ripple et al (2015) detailed the role and effects of herbivores, such as  
292 the Serengeti wildebeest, on ecosystems. One of the roles the observed is nutrient cycling. The grazing and  
293 defecations across the landscape helps in the redistribution of nutrients. The migrating ungulate community in  
294 the Mara and Serengeti ecosystem consumes huge amount of plant and grass vegetable biomass per unit area.  
295 In so doing, they affect nutrient cycles through mechanisms which have both direct and indirect consequences  
296 in the functioning of an ecosystem. The ungulates (the wildebeests, the Zebras and Gazelles) greatly accelerate  
297 the recycling of nutrients in the Serengeti and the Mara through the consumption and resultant defecation and  
298 urination, thereby returning to the soil the consumed nutrients at more faster rates than would be through the  
299 natural longer process of leaf loss and grass drying and later decaying, releasing the nutrients slowly (Ripple et al,  
300 2015;Doughty et al, 2013). Also, through the consumption by the animals, the consumed nutrients are excreted  
301 in urine and feces creating patches of concentrated nutrients that can last for several years in the ecosystem,  
302 releasing the nutrients slowly for use or storing them for future use by other plant or vegetation communities  
303 ??Doughty et

## 304 8 c) Conceptual Framework

305 A field study would establish a relationship between the thematic areas of the migration pattern and sustainable  
306 tourism development. Conceptually, a proposed framework to study this relationship could be as shown here  
307 below:

## 308 9 III. Research Methodology a) Research Design

309 This study the study adopted a mixed method approach where both quantitative and qualitative techniques were  
310 utilized to collect information from respondents. Simply put, the study was executed by means of a mixed methods  
311 approach. As argued by Creswell (2012Creswell ( & 2009)), research problems are better understood when both  
312 quantitative and qualitative techniques are used in combination, giving an opportunity for gaining more insight  
313 than when one approach is used alone or by itself. Adopting a mixed methods approach in research allows  
314 the researcher to be somewhere in between the range or continuum of qualitative and quantitative techniques,  
315 an approach which began following a contention that using both qualitative and quantitative data "provides a  
316 stronger understanding of the problem or question than either by itself" (Creswell, ??Creswell, 2013 p.215).

317 Mixed methods research as a design brings into combination all the truth-seeking or theoretical assumptions  
318 with techniques guiding the gathering and analyzing of data, carefully drawing from the qualitative & quantitative  
319 mix in the many stages of the research process. As a research technique, mixed methods approach concentrates  
320 on gathering and analyzing both qualitative and quantitative data in one study or sometimes in more or a series  
321 of studies done continuously, itscentral foundation being seeking to better comprehend a research problem than  
322 when one approach is used alone ??Elliot, 2005). ??Elliot, 2005).

323 The target population for the study consists of government conservation agencies employees of the MSE,  
324 non-governmental conservation organizations employees, hospitality facilities owners/managers, tourism business  
325 owners, tourists and local community members.

326 A part of a sample population which ha been procedurally selected in order to represent that population in a  
327 study is referred to as a sample size ??Oso and Onen, 2008). This procedural selection of a part of the entire  
328 population is called sampling in which a few items are picked from a particular group aiming at obtaining relevant  
329 data which can be used in drawing conclusions about the entire group (Dwivedi, 2006). The sample size in a  
330 study is determined by the goals of the researcher i.e. the purpose of the study, what the researcher is seeking to  
331 know, credibility and viability of the study depending on the available time, space & resources, what is at stake  
332 and what will be of importance (Patton, 2002). Sample size should be determined carefully to ensure that it is  
333 manageable within the available resources in terms of time and finances (Kothari, 2008).

334 This study adopted Nassiuma's (2000) Coefficient of Variation in determining strata sample size in which it  
335 is assumed that in most surveys, "a coefficient of variation in the range of 21% and a standard error in the range  
336 usually acceptable". Guided by Nasssiuma's assertion, this study use a coefficient of variation of 30% and a  
337 standard error of 2% which were selected to ensure low variability in the sample and to minimize the degree of  
338 error respectively. Nassiuma's (2000) formula is presented as below:
$$n = NC^2 C^2 + (N-1) e^2$$

339 Stratified random sampling technique was used to increase precision and presentation (Kothari, 2004). From  
340 a target population of 14983, a sample of 221 respondents was selected for this study, i.e. n=221. Proportionate  
341 sampling was used to determine the number of respondents from each stratum as shown in the last column in  
342 the table above. In each stratum, simple random sampling was used to ensure that each individual had an equal  
343 chance of being included in the sample. Purposeful/convenience sampling was also used to select respondents  
344 from strata where exact total population could not be ascertained to purposively participate in this study.

345 The implementation of, and following of generally acceptable protocols and procedures marks the beginning of  
346 managing and controlling for nonresponse error in a study, for example comparing respondents to non-repondents  
347 in a small random sample [such as in a pilot survey], using appropriate protocols and procedures to maximize

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348 participation in the study to enable the researcher obtain "a high enough response rate to conclude that non-  
349 response rate is not a threat to external validity or obtain a response rate that warrants additional procedures  
350 for ensuring that non-response is not a threat to external validity" (Murphy et al. 2001). Furthermore Lunstrom  
351 and Sarndal (2001) observe that non-response can be catered for by straight expansion of the sample within each  
352 stratum using the inverse of the stratum response fraction with the assumption that every element within a given  
353 stratum in the sample frame responds with the same probability.

354 To cater for non-response, the sample size was adjusted upwards using response rate from the pilot study. In  
355 this case it can be said that the pilot study was used to serve two purposes; one, to iron out the data collection tool  
356 (the questionnaire) and two, to determine the questionnaire return rate. In the pilot survey, 23 questionnaires  
357 were used (10% of the minimum sample i.e. n=221) out of which 15 were completed and returned (65.2% response  
358 rate). All of the returned questionnaires from the pilot study had no item nonresponse meaning they were valid.  
359 This means that in this study, if all 221 questionnaires are distributed and all of them returned, the response  
360 rate is 65.2%. in the real study, the sample was therefore adjusted upwards to 339 (100% response rate if all the  
361 339 distributed questionnaires are returned). With the foregoing, the adjusted sample used in the study is as  
362 given in table 1 below: This study utilized a structured questionnaire and an interview schedule for individual  
363 and focus group discussions. The questionnaire items were built on a five-point Likert scale (Amin, 2005; Boone  
364 & Boone, 2012; Sisson & Stocker, 1989), the questions gave the respondents opportunities to make a definite  
365 choice expressing the direction and strength of each statement, and for them not to give answers that are socially  
366 pleasant instead of providing the reality of the issue being investigated on (Nowlis, ??ahn & Dhar, 2002). Y = ?  
367 + ? X 1 + + ? X = the independent variables - X 1 -migrating pattern (season & timing) IV. Discussion of  
368 Findings a) Response Rate

369 Out of 339 questionnaires distributed in the field, 248 were completed and returned. 91 questionnaires were  
370 not returned. The response rate in this case was 73.2% indicating that respondents were willing to take part in  
371 the study and which is good enough for this study. The response rate results are tabulated below:

372 Quantitative data was analyzed using descriptive and correlation statistics which include frequencies,  
373 percentages and means. The multiple Regression analysis technique was used to determine the relationship  
374 between the independent variables (migration pattern features) and the dependent variable (sustainable tourism  
375 development), and is also used to test hypotheses of the study. The regression model used for this purpose is as  
376 given below:

377 Where:

378 Y = the dependent variable (Sustainable Tourism Development)

## 379 10 b) Screening and Preparation i. Analysis of Data Entry 380 Errors

381 Upon receipt of the filled questionnaires, screening was done to identify invalid questionnaires. Two types of invalid  
382 questionnaires were identified; incomplete questionnaires where some items were skipped (item nonresponse) and  
383 double marking on one item. These questionnaires were identified as invalid and expunged from the field data.  
384 In total 16 questionnaires were invalid. This left 232 questionnaires (with a response rate of 68.4%) to be valid  
385 and these are the ones which were used for the study.

## 386 11 c) Descriptive Statistics for the Various Variables Under 387 Investigation i. Migration Pattern on Sustainable Tourism 388 Development in the Mara-Serengeti ecosystem

389 The second specific objective was to assess the effect of Migration Pattern on sustainable tourism development in  
390 the Mara-Serengeti ecosystem. Migration pattern deals with season and timing of movement of the wildebeests.  
391 Much of this looks at the migration calendar throughout the migration cycle. The migration cycle lasts a full  
392 calendar year starting in January at South Serengeti and ending in the close of December when the animals return  
393 to South Serengeti again, starting the cycle all over again in January of the following year. In this study, it was  
394 assumed that tourism development in the MSE would be sustainable if the migration pattern of the migrating  
395 wildebeests would remain unchanged or persist in its original, favorable and ideal state without experiencing any  
396 variations in any of its aspects such as the timing of movement and location of the animals across the Mara-  
397 Serengeti landscape. As one of the features of the wildebeest migration phenomenon, the research sought to  
398 find out if Wildebeest Migration pattern is experiencing any variations and thus affecting sustainable tourism  
399 development in the MSE region. As with the previous feature, a number of given statements were assessed and  
400 ranked on a five-point Likert Scale by respondents to indicate characteristics of, and the extent to which the  
401 migration pattern, as one of the migration phenomenon features, has varied or changed over time. From the  
402 research, as to whether the migration starts earlier or late/delays than before, respondents were not sure of what  
403 happens. This is indicated by results thus; (mean 3.24, SD 1.352) and (mean 3.33, SD 1.328) respectively. This  
404 was also the same case with the migration cycle where respondents were to indicate whether the migration cycle  
405 (migration calendar) has been shortened or extended. The results are (mean 3.16, SD 1.034) and (mean 2.96, SD  
406 1.058) respectively. Most importantly, the research found out that of late the migration pattern (season & timing)

## 11 C) DESCRIPTIVE STATISTICS FOR THE VARIOUS VARIABLES UNDER INVESTIGATION I. MIGRATION PATTERN ON SUSTAINABLE TOURISM DEVELOPMENT IN THE MARA-SERENGETI ECOSYSTEM

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407 and migration cycle fluctuates from time to time (mean 3.92, SD 1.223) and (mean 3.81, SD 1.288) respectively.  
408 These results of fluctuation were corroborated with the disagreement by respondents to the statement that  
409 'migration season and timing have remained unchanged over the years' (mean 2.47, SD 1.322).

410 Two sets of cause could be blamed for the variations in the migration pattern aspects. They include natural  
411 occurrences in the MSE as indicated by responses from the field (mean 3.72, SD 1.075) and human activities &  
412 interferences in and around the MSE (mean 4.03, SD 2.211). Natural occurrences could be as a result of climate  
413 change which has led to erratic weather conditions in the region. The cycle is controlled by rains and availability  
414 of fresh grass growths in the larger MSE, and by instincts in the migratory wildebeests which trigger movement  
415 depending on where it is raining and thus availability of water and food. With erratic weather conditions due to  
416 climate change, the migration pattern is disrupted and altered (Dore, 2005; Fyumagwa et al. 2013; Walling, 2007).

417 The human factor in alteration of the migration pattern comes from the anthropogenic pressures in the MSE  
418 resulting from human activities (both those allowed and those illegal) and other interferences in the ecosystem  
419 (Homewood et al, 2001; ??oien & Lama, 1999). As it has been mentioned above, among the human activities  
420 interfering with the migration pattern is such as the use of prescribed fires in the managing of the savanna  
421 grassland vegetation (the grasses), a case where dry grasses are set on fire to give way to new fresh grass growth  
422 for livestock and also to control pests such as ticks. The prescribed fires are also used in the protected areas by  
423 government conservation agencies to trigger growth of young fresh grass for wildlife. The unfortunate eventuality  
424 is the fires ending up with an unintended result of repulsing or obstructing the movement of the wildebeest and  
425 other animals in the migrating community. Another human activity which has led to variations in the migration  
426 pattern feature is the fencing off of private land. This is governed by the land tenure system in place as earlier  
427 indicated above. It has already been indicated that on the Kenyan side of the MSE, there is provision for private  
428 ownership of land which is different from the Tanzanian side of the border where land is owned by government and  
429 Ujamaa Villages. On the Kenyan side, some land owners have preferred setting aside pasture for their livestock  
430 as opposed to sharing their grounds with wild animals although there exists many conservation initiatives but not  
431 many locals have access to these and benefits from such initiatives vary (Homewood et al, 2001). Some farmers  
432 have fenced their parcels obstructing wildebeest migratory routes hampering animals' movement. This has most  
433 of the time given way to or resulted in wildlife-human conflict. In the Mara on the Kenyan side of the MSE, some  
434 of the traditional wildebeest maternity grounds such as the Loita plains have been taken and fenced off by private  
435 land owners (refer to Figure ?? above of a picture taken by the researcher while in the field for data collection).  
436 It is these disturbances of obstructing wildebeest paths through fencing which have repulsed the animals, by  
437 making them to arrive late and depart earlier. It has also been observed that some farmers intentionally use  
438 prescribed fires to block movement of wildebeest. Prescribed fires have traditionally and culturally been used to  
439 manage land use practices in the Serengeti and Mara. The intended use has been burning away old dry grass to  
440 give way for regeneration of short green grass for both wild game (wildebeest and other herbivores) and for the  
441 livestock of local farmers. While this has been the practice, in contemporary times, the intentions have shifted  
442 either to blocking of wild animals from surging forward or with the intention of delaying their migration. This  
443 is either meant to make them stay longer at a given place to achieve a prolonged experience for tourists or push  
444 the animals back, scaring them from crossing over to either side of the boundary. The end result in some areas  
445 has been range contraction due to repulsion of wildebeest (Ogutu et al, 2011) or discouraging migration making  
446 some of the ungulates become residents on either side of the border. The change in fire regimes will continue  
447 to amplify interactions between anthropogenic drivers and end up creating a situation where we have difficulty  
448 in deciding trade-offs between environmental and social & economic objectives. More research needs to be done  
449 aiming at strategic collection of data on the impact of prescribed fires on migratory animals and thereof resultant  
450 impacts on socioeconomic variables characteristic of tourism development in the Mara and Serengeti ecosystem  
451 (Kelly et al, 2020).

452 On the Kenyan side of the border where tourism & wildlife conservation have been embraced, some of the  
453 land owners have pooled their parcels of land together to form conservancies to participate in wildlife based  
454 tourism activities with the aim of generating extra income from tourism. These conservancies are extensions of  
455 conservation areas and free movement areas for wild herbivores and even carnivores which prey on the ungulates.  
456 ??mong The development of physical features along and across the wildebeest migratory corridors has also  
457 contributed to variations in the migration pattern of wildebeest. The developments are such as construction  
458 of roads to enable movement and traversing across the MSE landscape by both locals and tourists. Some  
459 proposed road projects are yet to be implemented (Fyumagwa, 2013; Dobson, 2010). When wildebeests reach  
460 such obstructions or barriers, they turn back cutting their journey short. Refer for example to the work of  
461 Holdo et al (2011) on predicted impact of barriers to migration on the Serengeti wildebeest. The construction of  
462 hospitality facilities across the MSE landscape and putting up of fences around them, is also a development which  
463 ends up obstructing and distracting forward movement of the migrating wildebeest and other members of the  
464 migrating community (refer to the Mara River Camp causing obstruction to crossing and movement of wildebeest  
465 in the migration route section above and appendix 9 in the appendices section). Hospitality facilities are built  
466 closer to migratory routes so as to give visitors the best opportunity to view and witness the migration spectacle  
467 at a closer range but ends up causing variations to the migration pattern. To this end it can be concluded that  
468 the strongest factor causing variation in the wildebeest migration pattern is the biotic human factor, (mean 4.03,

469 SD 2.211), coming in form of development activities by farmers and tourism business owners and interferences  
470 such as the lighting of prescribed fires across the MSE landscape.

471 To crosscheck on the results in the four objectives above, the researcher sought to find out the extent of  
472 dependence of the three attributes of the dependent variable (sustainable tourism development) on the migration  
473 phenomenon. The three attributes considered in this study included tourism business, livelihoods of the local  
474 people and environmental/ecosystem sustainability. In this case, it was also assumed that tourism development  
475 in the MSE would be sustainable if the tourism businesses, people's livelihoods would continue thriving & the  
476 ecosystem would remain or persist in its original, favorable and ideal state, without experiencing any variations  
477 due to alterations in the migration phenomenon. The research therefore sought to find out if there is any influence  
478 of the migration phenomenon on the above mentioned attributes of sustainable development. As in the case of  
479 the five objectives above, a number of statements were assessed and ranked on a five-point Likert Scale by  
480 respondents to indicate characteristics of, and the extent to which the migration phenomenon influence the said  
481 three attributes of sustainable development in the Mara and Serengeti ecosystem.

## 482 **12 iii. Tourism Business**

483 Regarding tourism businesses in the MSE, the research sought to know if choice of location and performance have  
484 depended or been influenced by the migration phenomenon. Further, the research sought to know if variations  
485 in the migration phenomenon have affected businesses in any way. The table below gives a summary of the  
486 findings: The research results indicate that all the four features of the migration phenomenon considered in  
487 the study influence location of tourism business. Of the four features, migration route is the best indicator  
488 in influencing the choice and location of business (mean 4.08, SD 1.214). Tourism business facilities such as  
489 hospitality facilities (hotels, lodges, tented camps and camp sites etc.) are built or set closer to migratory routes  
490 so as to give visitors the best opportunity to view and witness the migration spectacle at a closer range. Migration  
491 pattern come in as the second best indicator of choice and location of tourism business (mean 4.00, SD 1.087).  
492 Migration pattern is controlled by the sliding gradient of availability of resources (fresh vegetationgrasses &  
493 rain-water) for the migrating animals. Migrating numbers and migrating community composition come at the  
494 bottom after the above two in their influence on the choice of location of business (mean 3.81, SD 1.334 and  
495 mean 3.82, SD ???.113) respectively. The sighting of a million animals at a go and the variety of species involved,  
496 together with ambushes from carnivores is more pleasing and attractive to tourists. If such characteristics of the  
497 phenomenon deteriorate, the experience also deteriorates and thus becomes less spectacular and less attractive  
498 to the visitors. The research also strived to find out if business performance is influenced in any way by, or  
499 depends on the migration phenomenon. It was found that business performance depends more and more on  
500 the migration phenomenon (mean 3.85, SD 1.157). This outcome is corroborated with the negation to the  
501 statement that 'tourism business performance has depended less on the migration phenomenon' (mean 2.38, SD  
502 1.106). Further to the foregoing findings, it is confirmed that there has been observed a decline in performance  
503 of tourism business due to deterioration of the migration phenomenon over time (mean 3.64, SD 1.064). This  
504 finding is also corroborated with the

## 505 **13 Migration route influenced choice of location of business** 506 **Migration pattern influenced choice of location of business** 507 **Migrating numbers sighted influenced choice of location** 508 **of business Migrating community composition influenced** 509 **choice of location of business Choice of location of business** 510 **was never influenced by any of the features of the migration** 511 **phenomenon**

512 Business performance has depended more on the migration phenomenon Business performance has depended less  
513 on the migration phenomenon Deterioration on the migration phenomenon has led to decline in performance  
514 of business Businesses have downsized due to changes in the migration phenomenon Changes in the migration  
515 phenomenon have no significant changes in business perfomance Valid N (listwise)

516 ii. Sustainable Tourism Development negation to the statement that 'changes in the migration phenomenon  
517 have no significant changes in business performance (mean 2.03, SD 1.279). These findings put together with the  
518 findings indicating variations/alterations of the individual features of the migration phenomenon would point to  
519 a situation where tourism business development is not sustainable.

## 520 **14 iv. Livelihoods of the Local People**

521 Regarding livelihoods of the local people in and around the MSE, the research sought to know if they have  
522 depended, been influenced or affected by the migration phenomenon. Further, the research sought to know if  
523 variations in the migration phenomenon have affected livelihood opportunities in any way. The table below

## 15 V. ENVIRONMENTAL SUSTAINABILITY

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524 gives a summary of the findings: The research results indicate that all the four features of the migration  
525 phenomenon considered in the study influence local people's livelihoods. Of the four features, migrating  
526 community composition is the best indicator in influencing the said livelihoods. Research found out that migrating  
527 community composition has been, and continues to be economically beneficial to locals (mean 3.94, SD 1.170).  
528 This is more so to those operating businesses and those employed in the various facilities in and around the  
529 MSE. Tourism business facilities such as hospitality facilities (hotels, lodges, tented camps and camp sites etc.)  
530 are built or set closer to migratory corridors where we would have large concentrations of the migrating animals.  
531 This is meant to give visitors the best opportunity to view and witness the migration spectacle at a closer range.  
532 With persistent and more spectacular herds, the experience is more pleasing, attracting more visitors consistently.  
533 This means more business and ensured job opportunities. Migration pattern come in as the second best feature  
534 in influencing the livelihoods of the local people (mean 3.92, SD 1.160). Migration pattern is controlled by the  
535 sliding gradient of availability of resources (fresh vegetation-grasses & rain-water) for the migrating animals.  
536 Migration pattern looks at the season and timing of the arrival and departure of the migrating herds. This also  
537 helps in determining the high/ peak season and low season of business and accompanying benefits to the local  
538 people. Migrating numbers and migration route come at the bottom after the above two in their influence on the  
539 livelihoods of the local people. The results indicate that the migrating population numbers and the migratory  
540 route also have been, and continue to be of benefit to the local people (mean 3.79, SD 1.229 and mean 3.66, SD  
541 1.444) respectively.

542 Further results from the research indicate that local people have benefited more from the migration  
543 phenomenon (mean 3.69, SD 1.202) as opposed to its disadvantages (mean 2.70, SD 1.126). Among the  
544 benefits which come with the phenomenon include the business opportunities from tourism and the buffering  
545 of livestock from carnivores where carnivores will prefer preying on the wildebeests to local people's livestock.  
546 The disadvantages include competition for resources (water, pastures & space) and spread of diseases from  
547 wildlife to locals' livestock. Perhaps the most important finding in the livelihoods attribute is the finding that  
548 there is relationship between the migration phenomenon and the livelihoods of the locals. This is confirmed  
549 by the negation to the statement that 'there is no relationship between the phenomenon and the local people's  
550 livelihoods' (mean 1.99, SD 1.252). While business opportunities grew over time, thanks to the wildebeest  
551 migration phenomenon (mean 3.59, SD 1.078), the growth has not been sustained as there has also occurred  
552 a change to this growth. This has been indicated by the negation to the statement that 'locals' business  
553 opportunities have remained unchanged over time (mean 2.25, SD 1.027). Though, a study needs to be done  
554 specifically to establish the kind of change to business opportunities because respondents were not sure if there  
555 has been a decline in the said opportunities (mean 2.72, SD 1.017).

## 556 15 v. Environmental Sustainability

557 Lastly, the research sought to establish if the migration phenomenon plays any role in influencing environmental  
558 sustainability in the larger MSE. All the four features of the migration phenomenon i.e. migration route, migration  
559 pattern, migration population numbers and migrating community composition together with the control variable  
560 (resource use & management practices) were considered. Respondents were asked to assess and rank given  
561 statements regarding the phenomenon and environmental sustainability. Results are tabulated below: Resource  
562 use & management practices (the Control Variable) stood out to be the best indicator among environmental  
563 sustainability influencers (mean 3.83, SD 1.179). These include the uses & management practices which lead to  
564 variations in the features of the migration phenomenon. Resource use policies such as land tenure policies and  
565 wildlife resource use policies, on either ends of the wet ranges define how resources are used and managed. The  
566 using of prescribed fires during the dry season in and around protected areas, the fencing of privately owned  
567 land and around facilities along and across migratory corridors, direct harvesting of animals etc. disrupt the  
568 movement and numbers of the affected species across the MSE landscape. Another important feature of the  
569 migration which influences environmental sustainability is the migration pattern (mean 3.75, SD 1.138). As  
570 mentioned earlier in this research work, and relying on the findings from the research work of Ripple et al (2015),  
571 the pattern of movement sees the wildebeests and other members of the migrating community reach different parts  
572 of the MSE at different times of the year in their cyclic movement. It was observed that this helps in ensuring  
573 environmental sustainability in at least two ways. The first one is that of bringing about nutrient cycling in the  
574 system. The grazing and defecations across the landscape helps in the redistribution of nutrients. The migrating  
575 ungulate community in the Mara and Serengeti ecosystem consumes huge amount of plant and grass vegetable  
576 biomass per unit area. In so doing, they affect nutrient cycles through mechanisms which have both direct  
577 and indirect consequences in the functioning of an ecosystem. The ungulates (the wildebeests, the Zebras and  
578 Gazelles) greatly accelerate the recycling of nutrients in the Serengeti and the Mara through the consumption  
579 and resultant defecation and urination, thereby returning to the soil the consumed nutrients at more faster rates  
580 than would be through the natural longer process of leaf loss and grass drying and later decaying, releasing the  
581 nutrients slowly (Ripple et al, 2015;Doughty et al, 2013). Also, through the consumption by the animals, the  
582 consumed nutrients are excreted in urine and feces creating patches of concentrated nutrients that can last for  
583 several years in the ecosystem, releasing the nutrients slowly for use or storing them for future use by other  
584 plant or vegetation communities (Doughty et al, 2013;Danell et al, 2006). Thousands of the animals die at river  
585 crossings, part of the flesh is fed on by crocodiles, and the rest of the carcasses rot away releasing Carbon,

Nitrogen, Phosphorous and other nutrients into the aquatic system. The nutrients are finally passed on to the terrestrial system and process repeats itself (subalusky et al, 2017). The second way of ensuring environmental sustainability is the removal of millions of tones of biomass from the physical environment though feeding on vegetation (grasses & leaves from shrubs). Being among the large wild herbivores, the migratory Serengeti and Mara wildebeest together with the accompanying migrating community of Zebras and Gazelles play a crucial role in the sustenance of the Serengeti -Mara ecosystem and the surrounding local communities (Ripple et al, 2015). As noted earlier in this research work, they form (Connochaetes taurinus, migratory Zebra and Gazelle) a very vital transboundary resource in the Mara and Serengeti ecosystem, whose alteration or loss definitely have cascading catastrophic effects on other biotic & abiotic aspects of the Serengeti and the Mara, including far reaching negative impacts on large carnivores which prey on the wildebeest, and on ecological processes involving vegetation (the savanna grasses on which the wildebeests feed), Savanna grassland fire regimes (Subalusky et al, 2017;Ripple et al, 2015). In their feeding on grasses across the savanna of the MSE thereby helping in the removal of plant or vegetation biomass through increased grazing pressure, the sheer population numbers of the wildebeests and other migratory ungulates (migratory zebra and gazelles) of the ecosystem regulates the spatial distribution of fires across the landscape and also shapes the frequency & intensity of the fires (Kelly et al, 2020;Ripple et al, 2015). If the foregoing is anything to go by i.e. if the wildebeest population and those of the other migratory ungulates are altered, it may lead to a future of an ecosystem that will be deficient in or lack vital ecological services which these ungulates provide, whose end result will be enormous ecological, economic and social costs (Ripple et al, 2015).

This vegetation would otherwise dry up and help fuel up and intensify grass land fires during dry spells which escalate destruction & loss of habitat.

The contribution to environmental sustainability by migration pattern is compounded by the sheer numbers involved in the migration as found out by the study (3.63, SD 1.170). Apart from nutrient cycling, the ungulates also serve as food to thousands of carnivores in various parts of the MSE. The migratory route comes at the bottom in contributing to environmental sustainability. Respondents were almost neutral as to whether migration route is important (3.43, SD 1.375). From the foregoing results, one would conclude that all the features of the migration phenomenon are essential in ensuring a complete self-perpetuating system in the MSE. If the migration phenomenon is altered, the ecosystem is also disrupted.

## 16 d) Correlations Analysis

The study made use inferential statistics in trying to establish the relationship between the migration pattern and sustainable tourism development in the MSE. Each of the features of the migration pattern was assessed/run separately against sustainable development to establish the relationship. The results are presented in the tables below:

As for the migration pattern, the Pearson Correlation results in the table below show a weak but positive relationship between it and tourism development sustainability. This means that when the migration pattern status is at or restored to its most favorable and ideal state, it contributes up to 39% to tourism development sustainability. Equally, if the migration pattern is varied to unfavorable state (truncated or interrupted negatively), it affects tourism development sustainability negatively up to 39%. Similarly, as is with the case of migration route, the wildebeest migration pattern is also facing threats from both anthropogenic pressures (in form of human activities) in the name of development (Fyumagwa, 2013) and enhancing livelihoods (Mfundu, 2010;Fyumagwa et al. 2013), coupled with natural processes of climate change (Dore, 2005;Fyumagwa et al. 2013) and vegetation succession processes facilitated with soil breaking by hoofs of ungulates. These disruptions across the MSE landscape due to land-use changes and many other human activities may probably result in range contraction Ong'era et al. (2011). Pearson Correlation results for the migrating population numbers indicate that this feature of the wildebeest migration phenomenon also influences tourism development sustainability to some extent.

There is also a weak but positive relationship between migrating population numbers and sustainable tourism development. If its status is varied negatively from its original ideal and favorable state, it will negatively affect sustainability up to 31% as seen in the results. Similarly, if the status of this feature remains or is restored to its most ideal and favorable state, it will contribute positively to tourism development sustainability up to 31%. The calculated F-value is 42.928 while the critical F-value at degrees of freedom (1, 230) and at 0.05 significance level is 3.882. This also gives a higher calculated F-value than the critical F-Value, therefore falling in the rejection region of the F distribution graph. This implies that there is a statistically significant relationship between the migration pattern (season & timing) and sustainable tourism development in the MSE. Therefore for this given reason also, the null hypothesis that there is no statistically significant relationship between migration pattern or migration cycle and sustainable tourism development in the Mara-Serengeti ecosystem is rejected. The rejection of the null hypothesis is further confirmed by the P value of .000 in the coefficients table below.

## 17 f) Focus Groups Discussion Results

In the focus groups discussions, the researcher sought to capture sentiments and/or feelings & opinions of respondents on, and about the relationship between the wildebeest migration phenomenon and: (i) sustainability

## 19 . MIGRATING POPULATION NUMBERS AND SUSTAINABLE TOURISM DEVELOPMENT

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646 of the Mara -Serengeti ecosystem i.e. the biotic and abiotic systems which make up the natural physical  
647 environment; (ii) sustainability of the tourism and hospitality businesses within and around the Mara-Serengeti  
648 ecosystem; and (iii) sustainability of the sociocultural and economic livelihoods of the local people living around  
649 the Mara-Serengeti ecosystem. In the group discussions, focus was on the four main thematic areas of the  
650 wildebeest migration phenomenon which include: (1) the wildebeest migration route; (2) the wildebeest migration  
651 pattern -season and timing looking at arrival and departure of the migrating community at different points along  
652 the migration route;  
653 (3) the migrating population -the size or numbers of moving or surging animals; and (4) the composition of  
654 the migrating community -wildebeests, zebras and gazelles.

655 In addition to the aforementioned areas of focus, the researcher also sought to capture feelings and sentiments  
656 or opinions of respondents in the engaged groups on and about how resource use and management practices &  
657 activities of communities living around the Mara-Serengeti ecosystem, the conservation agencies and the business  
658 owners affect the migration phenomenon and how, by extension, they affect sustainable tourism development  
659 at the MSE. In other words, the researcher sought to find out how the above mentioned communities resource  
660 use and management practices and activities affect the wildebeest migration route, wildebeest migration pattern  
661 (arrival and departure season & timing), wildebeest migration population (size or numbers) and the composition  
662 of the migrating community (wildebeest and the accompanying animals such as zebras and gazelles).

## 663 18 Model

664 Sum of Squares df Mean Square F Sig. As mentioned above, focus group discussions were conducted to get  
665 opinions, sentiments and feelings of respondents on the variables under study. To this end, and according  
666 to Green (2012), focused groups generally consisted of small groups which were constituted to discuss a specific  
667 topic on sustainability of tourism development in the MSE. The idea here was to get the collective views about the  
668 wildebeest migration phenomenon and its influence on sustainable tourism development in the Mara & Serengeti  
669 ecosystem. This was assumed could help to bring out the truth as individuals engaged each other in the discussions  
670 and any individual member of the group trying to lie or give a contrary opinion could be disapproved by the  
671 others. As observed by Gill (2008) focused group discussions were used in the study to help generate information  
672 on collective views regarding the salient features of the wildebeest migration phenomenon and the meanings that  
673 lie behind those views in matters sustainable tourism development in the MSE. The discussions in study were  
674 guided by an interview schedule designed by the researcher using carefully asked open ended questions to bring  
675 out the desired thematic information. Focused Group Discussions (FGDs) in this study, according to Stewart  
676 and Shamdasani (1990), were to help the researcher understand nuances of feelings, attitudes, beliefs, opinions  
677 and mainly get in-depth thematic information that can be used to back and supplement what the other data  
678 collection instruments (in this case the structured questionnaire) gathered. FGDs were also used because the  
679 researcher in certain instances had to engage a big audience in which case interacting with each individual could  
680 not be cost effective and necessary e.g. the Ololai Mutia market and the Sekenani Gate market situations. In this  
681 study the researcher guided the groups specifically to bring out the themes useful to the study. Interviewing and  
682 recording was used to capture statements, supplemented by tape recording when necessary particularly where  
683 there was time limitation.

684 In the focus group interviews, five groups in total were engaged. They included: (1) Participants in the focus  
685 group discussions were also asked to explain how (if at all they understood) their resource use, management  
686 practices and activities affect the migration phenomenon features and how the uses, management practices and  
687 activities affect or may affect sustainable tourism development in the Mara & Serengeti ecosystem. During  
688 these focus group discussions, five resource use, management practices and activities by locals and conservation  
689 agencies were identified. The results are presented in the table below: The study sought to assess the effect of  
690 the wildebeest migration pattern on sustainable tourism development in the Mara-Serengeti ecosystem. The  
691 assumption against this feature was that there is no statistically significant relationship between migration  
692 pattern and sustainable tourism development in the Mara-Serengeti ecosystem. From results realized, the study  
693 concluded that there is a statistically and significant positive relationship between migration pattern and tourism  
694 development sustainability in the MSE. The null hypothesis was rejected as well.

695 ii

## 696 19 . Migrating Population Numbers and Sustainable Tourism 697 Development

698 The third objective sought to assess the effect of migrating population numbers on sustainable tourism  
699 development in the Mara-Serengeti ecosystem. In this case, it was assumed that there is no statistically significant  
700 relationship between wildebeest population numbers and sustainable tourism development. As with the other  
701 migration features, research results indicated a positive relationship between population numbers and sustainable  
702 tourism development, rejecting the null hypothesis.



Figure 1:

Figure 2:

1

Ser.#	Category	Target Population	Sample	Adjusted Sample
1	Government agencies employees	236	4	5
2	Non-government agencies Employees	357	5	8
3	Business facilities Owners/Employees	645	10	15
4	Tourists	12167	179	275
5	Local community land owners	1578	23	36
	Totals	14983	221	339

Source: Researcher's Field Data

Figure 3: Table 1 :

2

Frequency	Percentage
Returned	248 73.2
Unreturned	91 26.8
Total	339 100

Source: Field data (2021)

Figure 4: Table 2 :

3

N	Minimum	Maximum	Mean	Std. Deviation
232	1	5	3.24	1.352
232	1	5	3.33	1.328
232	1	5	2.47	1.322
232	1	5	3.92	1.223
232	1	5	3.72	1.075
232	1	5	3.16	1.034
232	1	5	2.96	1.058
232	1	5	3.81	1.288
232				

Figure 5: Table 3 :

---

4

N	Minimum	Maximum	Mean	Std. Deviation
232	1	5	4.08	1.214
232	1	5	4.00	1.087
232	1	5	3.81	1.334
232	1	5	3.82	1.113
232	1	5	2.08	1.254
232	1	5	3.85	1.157
232	1	5	2.38	1.106
232	1	5	3.64	1.064
232	1	5	3.44	1.035
232	1	5	2.03	1.279
232				

Figure 6: Table 4 :

5

N	Minimum	Maximum	Mean	Std. Deviation

Figure 7: Table 5 :

6

N	Minimum	Maximum	Mean	Std. Deviation
232	1	5	3.43	1.375
232	1	5	3.75	1.138
232	1	5	3.63	1.170
232	1	5	3.55	1.119
232	1	5	3.83	1.179
232	1	5	2.47	1.135
232	1	5	2.36	1.161
232	1	5	2.35	1.164
232	1	5	2.50	1.057
232	1	5	2.11	1.274
232				

Figure 8: Table 6 :

7

Avsustoudevpt	Avmpatt

Figure 9: Table 7 :

8

Figure 10: Table 8 :

**9**

Dependent Variable: Avsustoudevpt

Figure 11: Table 9 :

**10**

the Siana Conservancy group; (2) the Ololai Mutiek or Ololai Mutia market group; (3) Keekorock Lodge group; (4) Sekenani Gate business community group; and (5) the Kenya Wildlife Service and Narok County Government guards group.

The Siana Conservancy group was constituted from the Siana Conservancy employees. The conservancy is a local community's conservation effort initiative where a

Figure 12: Table 10 :

**11**

Source: Field Data 2021

V. Conclusions and Recommendations

- a) Conclusion
  - i. Migratory Pattern and Sustainable Tourism Development

Figure 13: Table 11 :

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