



MAASAI MARA

**THE CHALLENGES OF A WORLD
UNIQUE ECOSYSTEM**

— THE MAASAI MARA SCIENCE AND DEVELOPMENT INITIATIVE —

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Edited by:
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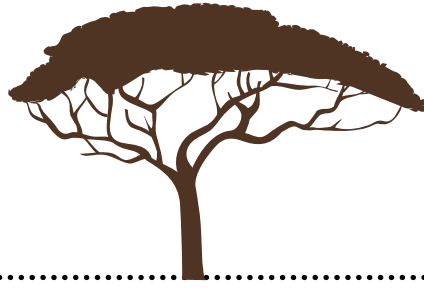
MAASAI MARA SCIENCE AND DEVELOPMENT INITIATIVE



Mararianda
Community

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Foreword

The Maasai Mara Science and Development Initiative (MMSDI) is an international, multi-stakeholder network aimed at creating systemic change through interdisciplinary research and development activities. It was founded in 2014 as a response to the urgent need for action in the Maasai Mara ecosystem. In April 2015, a group of researchers, stakeholders and members of the local Maasai community converged in Maasai Mara University of Kenya to discuss the challenges and development priorities in the Maasai Mara ecosystem. This report is based on input from the presentations and vivid dialogue during the Maasai Mara Science and Development Summit at the Maasai Mara University (April 21-23, 2015) and the Karen Blixen Camp Workshop (April 24-25, 2015).

Unquestionably, the Maasai Mara ecosystem is under severe threat from a multiplicity of interconnected and complex challenges. The emerging challenges have been categorized into (1) land use and climate challenges; (2) ecosystem challenges; (3) political and economic challenges; and (4) human and cultural challenges. It is important to note that these categories are not mutually exclusive and exhaustive. They are in many ways interrelated and interconnected, while at the same addressing other challenges in the process.

We hope that the MMSDI will be a strong platform for dialogue and knowledge exchange. Continuous and intense knowledge exchange with the many stakeholders in the Maasai Mara

region will give valuable input to the programme and in return, the research output can support decision-makers in developing sustainable solutions to the region's challenges. In other words, the MMSDI research agenda should contribute to challenges identified in collaboration with local, national and international stakeholders. Furthermore, the research agenda should be interdisciplinary to meet the complexity of the challenges, take a holistic approach, and adopt a portfolio thinking of research planning and management.

We wish to acknowledge and thank the speakers and participants at the Maasai Mara Summit and Karen Blixen Workshop for their time and contributions. A unique network of people and organizations has been created. We hope their efforts will continue to influence and open up the eyes of the world to the challenges of the Maasai Mara region so that our children will also have the opportunity to enjoy this unique place on earth.

Last but not least, our sincere gratitude goes to the editors of this report: Professor Elias Ayiemba, Dr. Samuel Owuor and Programme Director Pernille Kallehave.

Professor Richard Odingo
President,
The Maasai Mara Science
and Development Initiative

FIGURE 1

THE MIGRATION MAP

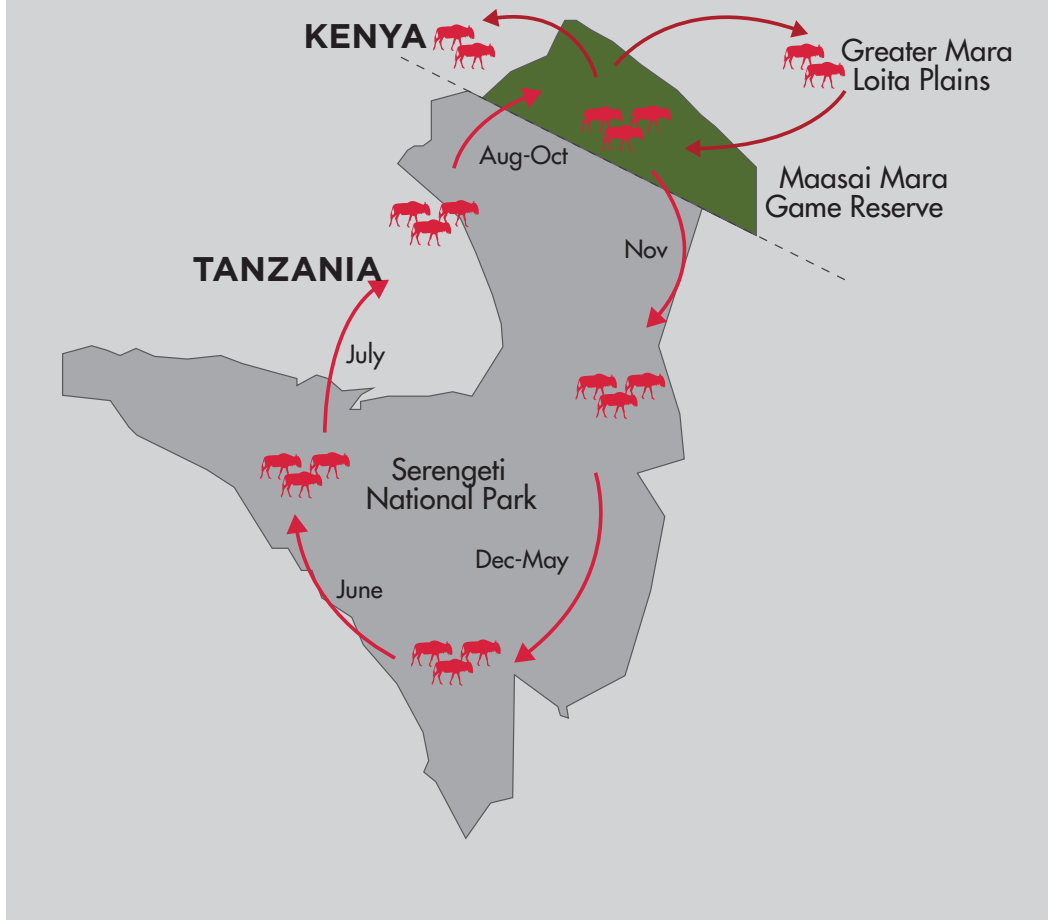
A WORLD UNIQUE ECOSYSTEM

The Maasai Mara is globally unique and famous for the great wildebeest migration - the largest and most species-diverse large mammal migration in the world, including 1.3 million wildebeest, 200,000 zebra and hundreds of thousands of Thomson's gazelle.

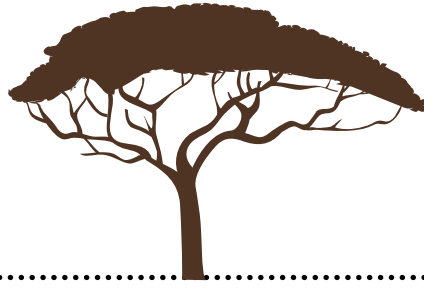
While rich megafaunas with large annual migrations like in the Maasai Mara were once common across the Earth, the Serengeti/Maasai-Mara migrations now form a unique African heritage and survives only in a declining, small part of the continent. Maasai Mara hence constitutes a unique and irreplaceable part of Africa's natural heritage.

THE GREATER MARA MAP

The Migration Route



• Source: Dr. Irene Amoke & Charles Ngero, Kenya Wildlife Trust and Maasai Mara Wildlife Conservancies Association



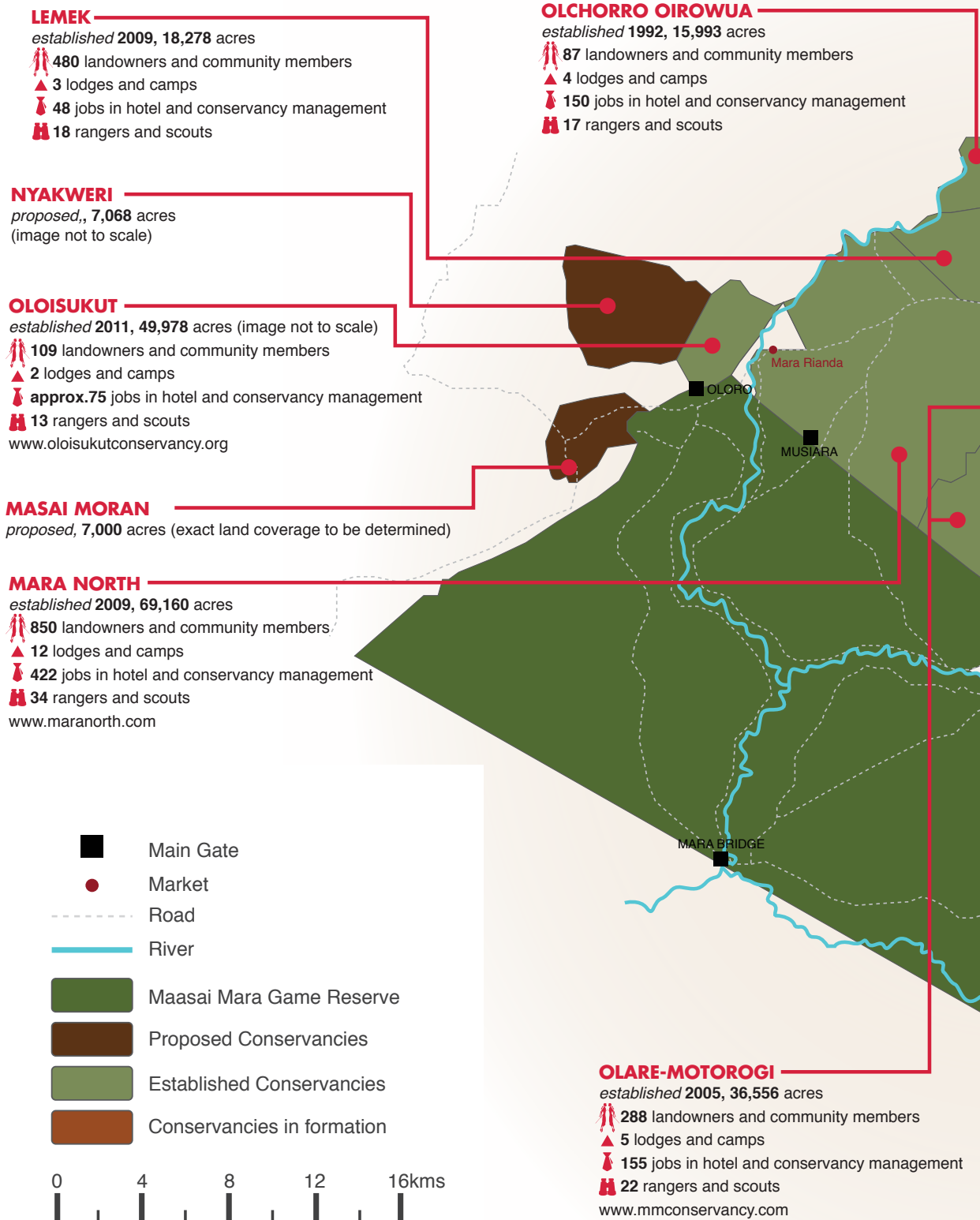
Introduction

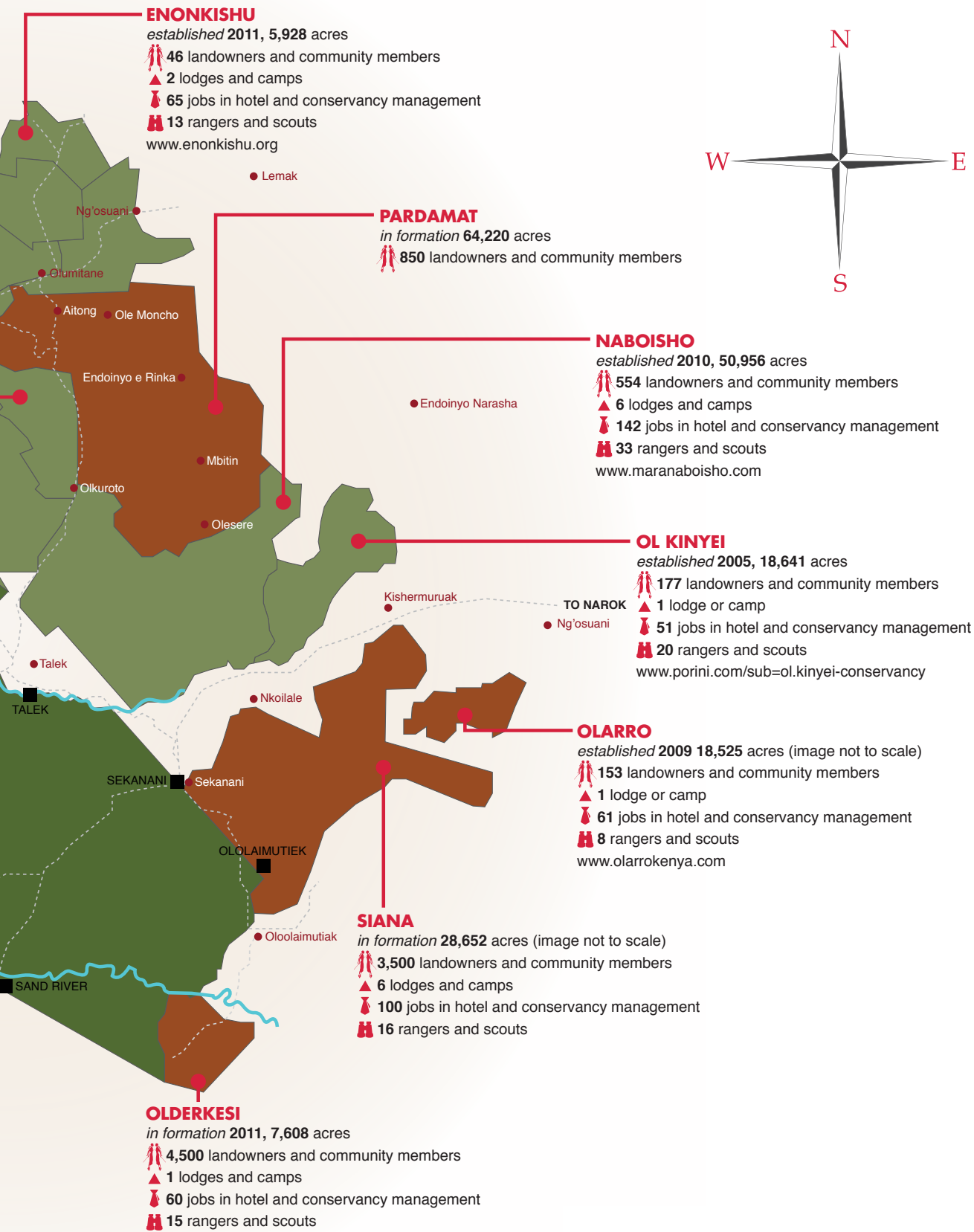
A Contribution to Saving the Maasai Mara Ecosystem

Biodiversity depletion and poverty of people are among the world's greatest problems today. Climate change and a rapidly growing world population put severe strain on world resources and ecosystem services. Land use trends affect natural resources, cultural environments and social development. The Maasai Mara ecosystem in south-western Kenya experiences all these challenges and faces great change in the coming decades. The Maasai Mara National Reserve – located in the Maasai Mara ecosystem – is globally unique and famous for the great wildebeest migration, one of the few great migratory systems remaining and the only one involving such a rich diversity of large wild animals. The Maasai Mara ecosystem is also home to the famous Maasai tribe. The Maasai, which once was a proud and self-sufficient society, is facing many social, economic, political and environmental challenges. The level of poverty among the Maasai is very high and their culture is quickly eroding.

The ecosystem and culture of the Maasai Mara are part of the common pool of global resources. The emerging challenges in the Maasai Mara ecosystem share the fate of so many other global challenges: they seem too complex to be solved and it is unclear who has the institutional capacity to take the necessary action. Traditional organizations appear to be incapable of adequately addressing global issues as the ones in the Maasai Mara and even though governmental institutions still play an important role, Ostrom (1990, 2000) suggests collective action as the way to protect and produce public goods. A model for such collective actions is networks of diverse actors. In collaboration with other stakeholders and the community, universities can contribute in such networks with valuable knowledge that can create transparency and data to support sustainable development decisions and solutions. This is indeed the aim of the Maasai Mara Science and Development Initiative programme.

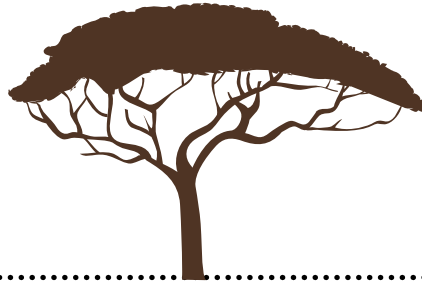
FIGURE 2
MAASAI MARA CONSERVANCIES





• Source: Dr. Irene Amoke & Charles Ngero, Kenya Wildlife Trust and Maasai Mara Wildlife Conservancies Association



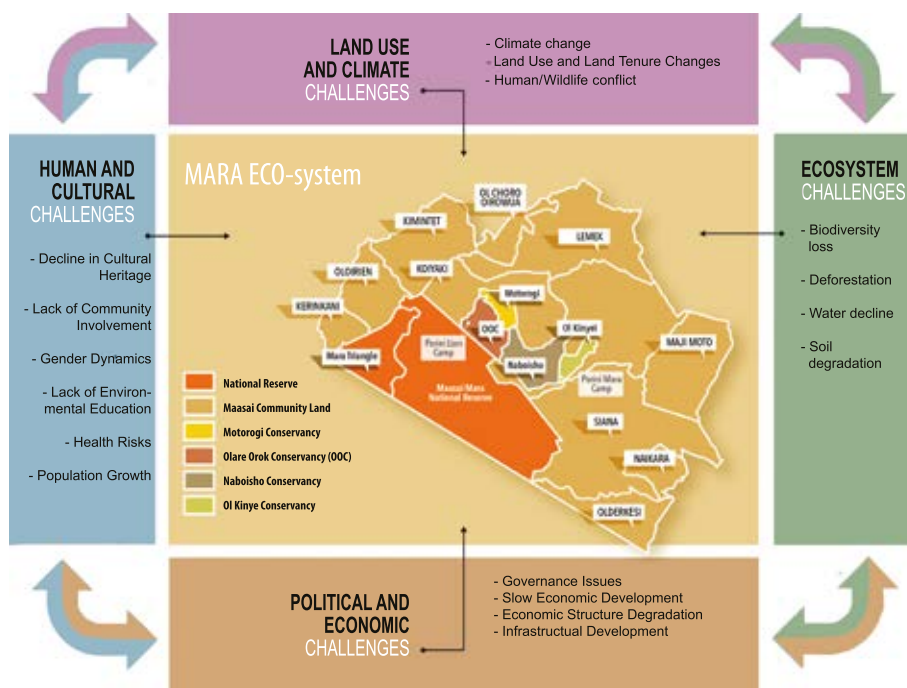


The Maasai Mara Ecosystem: Emerging Challenges

This section identifies the emerging challenges of the Maasai Mara ecosystem, partly based on the presentations and deliberations during the Maasai Mara Science and Development Summit at the Maasai Mara University (April 21-23, 2015) and the Karen Blixen Camp Workshop (April 24-25, 2015). There is no doubt that the Maasai Mara ecosystem is under severe threat from a multiplicity of interconnected and complex challenges as

presented in Figure 3. The emerging challenges have been categorized into: (1) land use and climate challenges; (2) ecosystem challenges; (3) political and economic challenges; and (4) human and cultural challenges. It is important to note that these categories are not mutually exclusive and exhaustive. They are in many ways interrelated and interconnected, while at the same addressing other challenges in the process.

FIGURE 3
EMERGING CHALLENGES IN THE MAASAI MARA ECOSYSTEM



• Source: Maasai Mara Science and Development Summit 2015

Climate Change and Land Use Challenges

A socio-ecological system consists of a “bio-geophysical” unit and its associated social actors and institutions. Socio-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context. The socio-ecosystem should not be viewed as static. The dynamic aspects of the system must be recognized (Ostrom 2009). Furthermore, there is a growing consensus that protected areas should no longer be considered ecological islands that function independently of the broader socio-ecological system in which they are embedded. In a world that is under massive transformation by human activity, this implies that we cannot talk about “restoration of the ecosystem to original state” without acknowledging that due to anthropogenic processes like climate change, there is no fixed original state that we will be able to restore to. As a result, the Maasai Mara must be viewed in its global context of environmental change, globalization and biodiversity depletion (the so-called sixth mass extinction). Indeed, the Maasai Mara is already now evolving into a different ecosystem characterized by new combinations of species relative to historical baselines. These may arise through changing climatic conditions, disequilibrium dynamics and invasive species (e.g. feral dogs) as well as anthropogenic-caused loss of species (e.g. due to poaching and habitat degradation). Such a changed ecosystem may have fundamentally different ecological functioning than the current ecosystems, e.g., due to trophic cascades induced by species losses and/or exotic species, which again may affect ecosystem services. Some of these changes may be reversible, others not, and understanding the dynamics of the Maasai Mara is important for conserving it as an ecosystem rich in species and provider of ecosystem services in this new situation.

Climate Change

Climate change is a new and growing potential threat to people and wildlife in the Maasai Mara ecosystem. Climate change results in unpredictable seasonal fluctuations. Across equatorial Africa, flora and fauna vastly depend on stable rainy seasons. Shifts in or shortening of rainy seasons can cause cataclysmic domino

effects to survival. The Maasai Mara region is no exception to these types of changes. Typically, the mean annual rainfall in the Maasai Mara is 950 mm (range 800-1200 mm) with a bimodal rainy season occurring from March to mid-June (long rainy season) and mid-October to December (short rainy season).

Impact on wildlife and their migratory patterns

Recent studies have shown a trend towards reduced rainfall and rising temperatures in the Mara-Serengeti; this has adversely affected the production and nutritional quality of vegetation as well as surface water availability. Given that rainfall is the prime climatic factor predicting African savannah ungulate population density and migratory patterns, uncharacteristic seasonal fluctuations in the Maasai Mara must be studied to disseminate the tangible solutions, especially since the effects of climate change are likely to intensify over time not only in the region but to Kenya as a whole.

.....
Extreme weather events due to climate change are likely to trigger loss of wildlife habitats and biodiversity, destruction of tourism infrastructure and increased risk of diseases

The increased frequency and severity of droughts and floods, which are expected to occur, will modify vegetation growth and hence forage for migrating animals (IPCC 2012). Migrating animals’ adaptability to changing climatic conditions is likely to be impaired by human-induced threats such as habitat loss and fragmentation. As migratory corridors and dispersal areas are lost due to land use changes, migratory movement will be curtailed and the ability to cope with the widening climatic variability expected as a consequence of global warming will be compromised (Owen-Smith & Ogutu 2012). Corridors and dispersal paths are also major determinants of sustained gene flow between populations, which in turn affects genetic diversity on several geographical scales.

Furthermore, research has shown that illegal use of the Maasai Mara ecosystem (e.g. overgrazing, poaching, etc.) increases in the dry season and during droughts. If climate change causes rainy seasons to become shorter, illegal

anthropogenic land use will continue to intensify towards more unsustainable rates, likely resulting in range confinement that amplifies the risk of local species extinctions. A better understanding of these relationships is necessary to effectively combat the increasing intense pressure on the Maasai Mara ecosystem in the future and to develop policies that promote sustainable land use, while accounting for wildlife migratory patterns and access to resources.

Impact on tourism

Climate change affects tourism destinations and their competitiveness and sustainability. Changes in biodiversity and species distribution are often correlated with climatic variables. The thriving tourism in the Maasai Mara ecosystem is based on existing biodiversity and its degradation would adversely affect the sector, livelihood of the local communities, the county and national economies. Extreme weather events due to climate change are likely to trigger loss of wildlife habitats and biodiversity, migration of wildlife to other favourable habitats, destruction of tourism infrastructure and increased risk of diseases (Turpie et al. 2002), leading to fewer opportunities for tourism development.

For example, in mid-2012, the main highway to the Maasai Mara National Reserve was closed for three days due to flooding and earth movement damage.

Impact on water resources

Kenya's economy remains highly dependent on a number of climate-sensitive economic sectors, including agriculture, tourism and energy production. This sensitivity mainly results from the dependence of these sectors on sufficient supply of water. Kenya is one of the most water-scarce countries in Africa. Through higher evaporation, altered rainfall patterns, accelerated loss of glaciers and sea-level rise, climate change might further reduce water availability in the country. Policies and strategies adopted by Kenya to address water scarcity include the Water Sector Investment Plan (2008-2030) and the Water Catchment Management Initiative. However, these initiatives focus on the economic benefits derived from improved access to and use of water resources, and they only indirectly address climate risks. Enhanced integration of climate risk management into these and other water management initiatives could improve Kenya's capacity to achieve its development goals.

FIGURE 4A
OBSERVED AND PROJECTED
CHANGES IN TEMPERATURE
IN KENYA

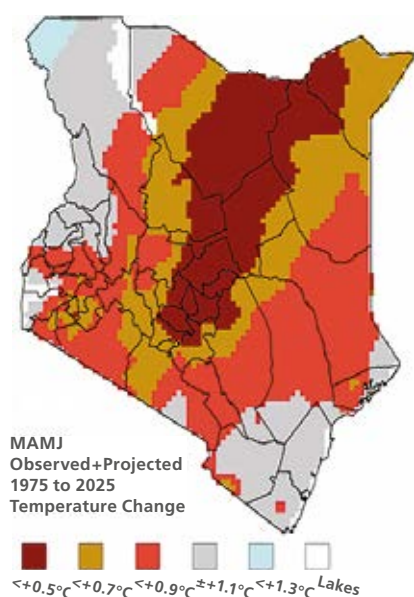
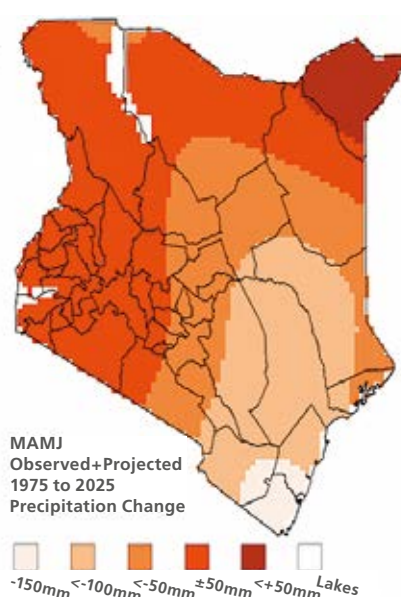


FIGURE 4B
OBSERVED AND PROJECTED
CHANGES IN PRECIPITATION
IN KENYA



• Source: Jo-Ellen Parry, Daniella Echeverria, Julie Dekens & Joseph Maitima (2012): Climate Risks, Vulnerability and Governance in Kenya: A review, UNDP, New York



Despite the huge capacity that the pastoral livelihood system has in the environmentally harsh regions, climate change is proving to be a significant burden to the Maasai community. Climate change, manifested through changes in the conventional seasons and weather patterns, has given rise to major concern in the Maasai Mara ecosystem. The region experiences a significant reduction in the amount of rain received annually, plus persistent and increased frequency of drought, resulting in substantial reduction in the availability of water and pasture for livestock and wildlife. Furthermore, the seasonal rivers and other alternative seasonal sources such as springs and wells are very unreliable and more often than not, dry out much faster than anticipated. This implies travelling long distances, especially during dry periods, in search of water and pasture. In summary, unpredictable rainfall patterns and long periods of drought can lead to:

- Drying of seasonal streams and wells resulting in acute water scarcity
- Scarcity and competition for pasture
- Increase in disease incidences (human and livestock)

- Disruption of livestock breeding patterns (e.g. premature calving and cows dying while giving birth)

Impact on energy resources

Traditional fuels such as wood fuel, charcoal, dung and agricultural residues continue to be used by over 85 percent of households in Kenya. Access to these energy sources is becoming increasingly restricted due to the loss of forest cover, rising population, existing land tenure arrangements and inefficient utilization of biotic resources. Climate change could accentuate these tendencies by altering the growth of forests and agricultural crops. At the same time, demand for electricity is increasing significantly with the growth of the population and the economy, and is expected to continue to expand. Reduced rainfall in recent years has already made hydroelectric power production unreliable, leading to the promotion of renewable sources of energy such as geothermal, solar, wind and biofuels, which are less vulnerable to climate change.



Land Use and Land Tenure Changes

The vulnerability of the Maasai Mara ecosystem is exacerbated by the recent changes in land ownership laws in Kenya. This has led to the previously vast communally owned group ranches being divided into small parcels (averaging 60Ha) with title deeds being granted to individual Maasai households. Socio-economic incentives are now driving a number of these parcels to be further sub-divided, developed and/or sold to commercial wheat farmers and speculators. These community lands are not only known to be key wildlife dispersal areas but also support a greater number of wildlife as the Maasai Mara National Reserve. Therefore, curbing fragmentation of this area outside the National Reserve and ensuring continual landscapes for wildlife and pastoralism is essential for long-term resilience of the Maasai Mara ecosystem.

Rapid population growth in the Maasai Mara, coupled with changing patterns of human activity have contributed to land tenure, land use and land cover changes that may impact

tourism and development of the region negatively. The Maasai Mara ecosystem has experienced significant changes in land tenure right from the colonial period to post independent Kenya.

In the colonial period (i.a. in 1911), the Maasai lost 60 percent of their ancestral land and were pushed further south into modern-day Narok and Kajiado Counties. Following independence, in order to improve livestock production, group ranches were established in the 1970s. In the northern plains, Koiyaki, Dagurugurueti, Ol Kinyei and Lemek, group ranches were registered as ranches with group title, while Ol Chorro Oirowa was registered as a private ranch. North of Maasai Mara National Reserve, especially in Lemek, there are both small-scale and large-scale farms which support the livelihood of both Maasai (especially elites) and immigrant farmers.

The sub-division of land outside the Maasai Mara National Reserve has also increased the mushrooming of conservancies (Figure 2), tourist lodges, human settlements, ranching, fencing, agriculture and other developments

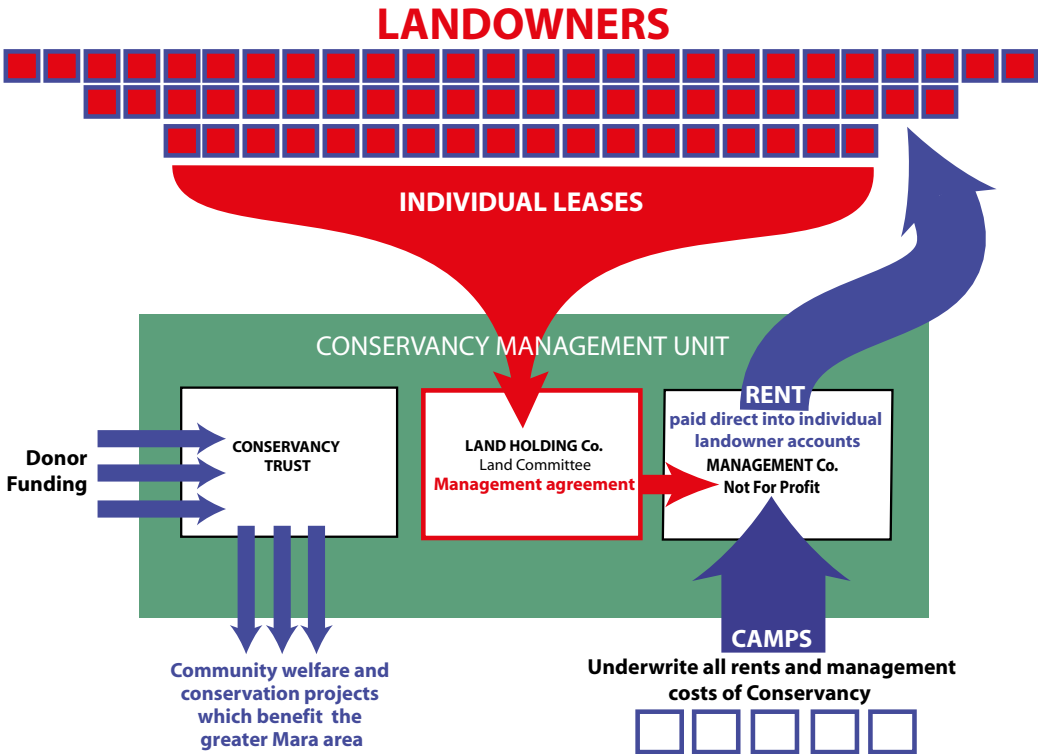
that have drastically reduced the former pristine wilderness and buffer zone for the reserve. Communities living in natural wildlife areas must therefore be provided with economic incentives to set aside their land for wildlife conservation. Without a systematic partnership between Maasai landowners and private developers, it will be difficult to ensure sustainable, well-coordinated and effective wildlife protection along with recognizable benefits for all stakeholders.

On a positive note, tourism camps and local Maasai leaders have found a sustainable long-term solution for the conservation of the area. An example is the Mara North Conservancy where 750 Maasai landowners decided to lease their land to the conservancy, which was officially established on January 1, 2009. This new partnership established a truly innovative approach (Figure 5), whereby the conservancy member camps guaranteed to pay fixed monthly lease payments to the Maasai

landowners, regardless of tourism ebbs and flows, for the privilege of carrying out their game drives within this exclusive wildlife area. However, the model has run into a new set of challenges. Many of the Maasai landowners decided to invest their leasing fee in new livestock, which has resulted in increased local livestock populations.

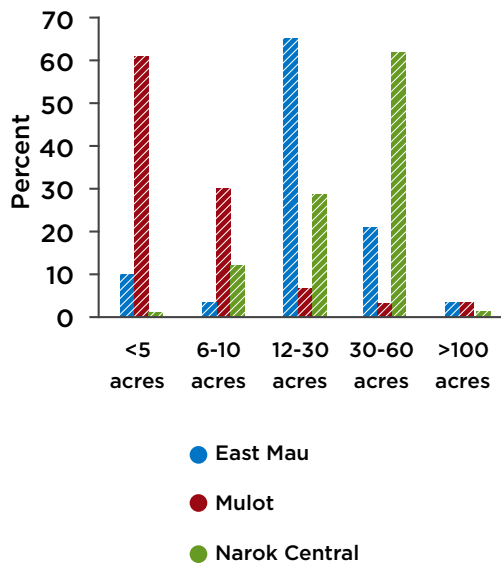
The increase in livestock puts pressure on the grazing areas where livestock compete with wildlife. In order to avoid human-wildlife conflicts, some conservancies like Mara North have set up specific initiatives to manage livestock grazing and to accommodate the diverse needs of wildlife, local communities and tourism partners. To do so the Mara North Conservancy maintains specific zones, and periods, for livestock grazing. Furthermore, the increasing sub-division of land implies that more families will have to share the land lease fee resulting in less income per family and lower incentive to support the conservation agreement with the

FIGURE 5
MARA NORTH CONSERVANCY INNOVATIVE APPROACH TO CONSERVATION



• Source: Robert O'meara & Dickson Ole Kaelo, Kenya Wildlife Conservancies Association

FIGURE 6
FARM SIZE IN THE NAROK
SAMPLE AREAS



• Source: Maina (2013)

conservancies. The sub-division of land parcel also makes it difficult for the Maasai to live off their land (see e.g. Figure 6). Many of them may start looking for more profitable ways of making a living out of their land.

On top of these challenges, the Maasai Mara region – as the rest of Kenya – has witnessed a severe drop in tourism due to terrorism. Many camps find it difficult to pay their fees to the conservancy and thus to pay the fixed monthly lease payments to the Maasai landowners, regardless of tourism ebbs and flows. The conservancies are now trying to re-negotiate the lease conditions, and this may again lead to a drop in local commitment to support conservation activities and to preserve wildlife.

Expanding agricultural practices and food security

Agriculture has become an important economic activity in the Maasai Mara ecosystem. While food security has improved around the world as a result of increased agricultural production, this has been accompanied by a significant decline in the state of ecosystems and the services they provide. The patterns of land use in the Maasai

Mara ecosystem have changed from nomadic pastoralism to sedentary pastoralism to agro-pastoralism and in some cases pure agriculture or cultivation.

Sustainable pastoralism can better support biodiversity through an integrated livestock-wildlife system than more intensive pastoralism or non-pastoralism agriculture such as maize and wheat production. Pastoralist production contributes substantially to food security (Box 1) and sustainable land use while maintaining landscape level ecosystems, but the co-benefits to ecosystems, biodiversity and other land users are not fully acknowledged. Furthermore, the persistent poverty experienced in pastoralist areas could be addressed through well placed investment in the untapped potential that exists there. The Maasai community is known to have a cattle-complex culture in which their livelihood largely depends on livestock keeping. There is no doubt that pastoralism is projected to be one of the livelihoods hardest hit by climate change. Supporting pastoralism bolsters a type of food production carried out by those who already possess expert knowledge in this regard. In addition, supporting pastoralism contributes to maintaining the dry lands ecosystem services.

The Maasai pastoralists can achieve their food security through:

1. Diversification to sustainable livelihood systems;
2. Sustainable use of environmental resources, especially water; and
3. An informed and responsive policy framework.

Efforts to promote integrated wildlife and livestock management need to ensure access for pastoralists to seasonal grazing and water and limit negative effects of wildlife integration such as disease transmission and crop damage.

Especially with food of animal origin, food safety becomes very important. The process of animal production, slaughtering and meat transportation and processing is of great importance, and the focus needs to be on veterinary control as well as increasing knowledge of the local producers.



Human-Wildlife Conflicts

Competition for pasture and loss of biodiversity

Human-wildlife conflict is undoubtedly one of the biggest threats within the Maasai Mara National Reserve and the surrounding community areas. As the human population continues to grow worldwide at unsustainable rates, so does the rate of species extinction. The Maasai Mara region is no exception. With a rapidly growing human population pressing hard at

the reserve's boundary, the human-wildlife conflict in the Maasai Mara has intensified as farms expand and reroute migrating wildlife. With the spread of arable agriculture, large tracts of forests and grasslands are being cleared. Moreover, pastoralism increases competition for pasture between wildlife and domestic animals in grasslands. Some of the land being converted to agriculture is wildlife dispersal areas and migration corridors, hence compromising the integrity of the ecosystem for wildlife conservation.



This has contributed to conflicts among land users as well as human-wildlife conflicts. Recent studies in the Enonkishu Conservancy show that forest cover has decreased by 92 percent in the last 20 years while grassland and cultivated areas has increased by 90 and 97 percent, respectively (Syallow 2013). The loss of forest land and woodlands is attributed to charcoal burning and conversion to pasture land and rain-fed agriculture. Land use and land cover changes have led to dramatic declines in wildlife numbers and diversity (Mundia & Muryama

2009; see also Figure 7). For example, the wildebeest population declined by 75 percent on the Kenyan side of the Maasai Mara ecosystem following destruction of the core breeding and calving grounds caused by mechanized agriculture from 1977 to 1997.

This worrying situation requires urgent efforts to secure wildlife habitats outside the protected areas. Loss of wildlife has a negative impact on tourism and the livelihood of the communities in the Maasai Mara region as well as on future

development. Since 2006, consolidation of the land around Maasai Mara National Reserve has been consolidated to create conservancies. However, creating cohesiveness among different land owners and sustaining the concept amidst the temptation of selling land for quick income pose quite some challenges.

As in the Maasai Mara National Reserve, wildlife often ranges outside these protected areas further increasing their conflict with humans. This conflict leads to the local population developing negative attitudes towards wildlife and the protected reserves. While the Maasai living within the neighbouring conservancies are trying to co-exist in harmony with the resident wildlife, the ecosystem's biodiversity is still under intense pressure due to the Maasai's growing grazing herds (Lamprey & Reid 2004) and lack of family planning, both of which cause direct competition for resources between the local people and wildlife.

However, the wildlife is not the only "victim". While the Maasai Mara is home to rich biodiversity and the highly publicized 'largest terrestrial migration on earth', local people are the ones often victimized by wildlife ranging

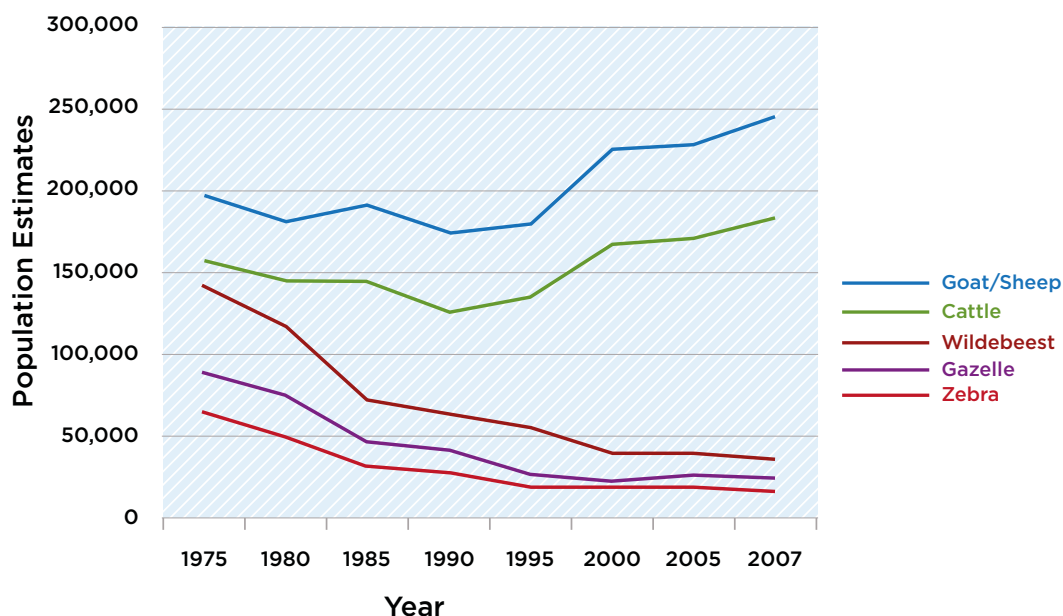
outside of the reserve – entering into their gardens and sometimes killing their livestock. This spatial overlap of wildlife and people can also result in more serious repercussions such as human and animal attacks and disease transmission. Thus it is important to find ways to minimize these negative interactions and find mutually beneficial, sustainable solutions to both wildlife and humans.

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 The increase in livestock puts pressure on the grazing areas where livestock compete with wildlife

Transmission of diseases and productivity

A major human-wildlife conflict arises from disease transmission from wildlife to humans, livestock and other domesticated animals, e.g. dogs, and vice versa. Those risks are particularly dominant in areas with close contact between wildlife and humans/livestock like in the Maasai Mara, where both share the same ground. Pathogens circulate within the wildlife population and cause severe diseases once being transferred to humans or livestock. Other pathogens regularly circulate in livestock and cause devas-

FIGURE 7 WILDLIFE AND LIVESTOCK POPULATION TRENDS IN THE MAASAI MARA ECOSYSTEM 1975–2007



• Source: Aerial Survey by Department of Resource Surveys and Remote Sensing



tating disease outbreaks in wildlife populations with the power to depopulate large areas of certain species. Therefore disease monitoring and risk assessment systems are vital to allow common use of the same areas for humans, livestock and wildlife with only low risk or early detection of increased risk of disease transmission. The competition between humans and livestock for access to grazing areas increases pressure on food availability for wildlife. On the other hand, land owners/users need to make their living based on livestock, underlying the need to keep livestock and having enough space to raise them successfully. A compromise should be found by improved veterinary management of livestock to develop the performance of each animal and taking into consideration the carrying capacity of the land. This can be supported by a better use of some of the livestock for human consumption, by improving the food chain of animal products (from slaughter to consumption), which is primarily a veterinary task.

This also includes the improvement of the food chain from producer to user. Transport ways should be minimized and optimized by local slaughterhouses and processing farms. At pres-

ent, animals are brought by foot or car, over long distances, to be slaughtered and the meat returns the same long distances back to the user. For improvement of food security and food safety, this may be optimized, leading to a better use of available meat and reduction of animals needed.

The mentioned procedure will help derive more value from each animal, again decreasing the need of having more and more livestock in areas reserved for wildlife grazing. It is essential to focus on how to minimize pressure on free-ranging animals while simultaneously improving the quality of livestock and its productivity without maximizing herd sizes. However, one should take note that quantity may traditionally mean more to the Maasai than quality. This is indeed an interesting area that requires further research.

.....
A compromise should be found by improved veterinary management of livestock.



Ecosystem Challenges

Biodiversity Loss

Populations of many wild ungulate species in Africa are currently declining largely because of intensified human activity. Analyses that monitor these declines and give insight into their underlying causes are critical to (cost-) effective management and conservation of natural ungulates. Temporal trends in abundance of wildlife and livestock populations in the Maasai Mara ecosystem with a few exceptions show that wildlife populations have declined progressively after 1977.

The majority of wildlife species have declined to a third or less of their previous population sizes both in the protected Maasai Mara National Reserve and in the adjacent habitats. Due to the human impact on already declining wildlife resources, intensified cultivation, growing and new settlements, fences, and livestock stocking levels on the pastoral ranches should be regulated. Between 1977 and 2009 most resident wildlife species declined in numbers almost as severely in the Maasai Mara National Reserve as in the adjoining group ranches. It seems, however, that two gazelle species, impala and giraffe, were all more abundant in the ranches than in the reserve, while buffaloes were effectively eliminated from the group ranches.

.....
The majority of wildlife species have declined to a third or less of their previous population sizes

The investigation of Ogotu et al. (2001) also suggested that no wildebeest were resident in the Maasai Mara National Reserve during the wet season, although several thousand remained in the group ranches, and few of the migrant wildebeest add to the resident individuals in the ranches during the dry season. Zebra populations showed a similar pattern. Although the number of cattle in the ranches changed little, the number of goats and sheep nearly tripled from 1977 to 2009, putting a serious pressure on the capability of the natural grasslands to recover from droughts during the wet season.

Deforestation

The Maasai Mara region, and especially Narok County, is a major source of biomass energy for the urban areas starting with Nairobi and Nakuru. Biomass energy here covers fuel wood and charcoal which combined are leading to massive deforestation and destruction of vegetation, and ultimate contribution to anthropogenic climate change in the next few decades, unless curbed by the government. In Kenya, biomass energy resources are derived from closed forests, woodland, bush land, farm land, plantations and agricultural and industrial residue. Biomass in the form of wood fuel is the largest form of primary energy consumed in Kenya, accounting for 74 percent of the total national primary energy supply and it provides for more than 90 percent of rural household energy needs (Kiplagat et al. 2011). A comprehensive assessment, mapping and appraisal of all the renewable energy resources in the country to determine their technical and economic viability remain to be made. Research on various energy sources will be paramount to enable the region to contribute to environmentally safe energy production without creating new problems. Changes in the energy sector are already required to stop land degradation in the next 20 years, and experience from the Maasai Mara will be crucial in the quest for alternative technologies to save the environment from total destruction.

Water Decline

The Mara River has its source in the Napuiyapui Swamp in the Mau Forest where an annual average of 1400 mm of rain is received, and this maintains seeps and springs that feed the Mara's main tributaries – the Amala and the Nyangores – as they flow through the Mau Forest. However, rapid deforestation in this region in recent decades has resulted in 32 percent loss of forest cover, leading to faster runoff of rainwater and greater rates of erosion, which in turn have led to changes in the hydrological regime of the upper tributaries, including higher and more frequent flash floods and lower and more prolonged low flows (Mango et al. 2011). Leaving the Mau Forest, the rivers flow through areas densely populated by small-scale settlements.



In this region, the Amala and Nyangores rivers provide a primary water resource for local communities, particularly during the dry seasons; however, they are increasingly impacted by degradation of riparian forests through cultivation and livestock watering, increasing rates of extraction for irrigation, and development of urban centres that lack sufficient facilities for sewage treatment or solid waste disposal. The two tributaries join to form the Mara River in a more arid region in which annual rainfall is below 1000 mm. Here, the Mara River

becomes the only permanent source of flowing water, providing a critical resource for the pastoralist Maasai community for watering of their livestock and for wildlife inhabiting the surrounding savannah grasslands. However, high livestock density and resulting overgrazing on this fragile land have led to declines in grassland cover, bringing rapid runoff and high sediment loads into the Mara river. Furthermore, it is also important to assess the impact of the emerging agricultural activities on the Mara River.



Soil Degradation

Soil is a major natural resource on which humans depend for crop production. It also plays a key role in maintaining the complex terrestrial ecosystem and climate systems of the earth. Rapid increase in human population is asserting pressure on the world's resources. Only about 11 percent of the global land surface covered by soil is being used to raise crops and livestock. As a result of intensive agricultural activity and land overuse, soil resources are suffering deg-

radation and these include erosion compaction and hard setting, acidification, declining soil organic matter, soil fertility depletion, biological degradation, and soil pollution. The Maasai Mara ecosystem has suffered most of these effects especially through deforestation, clearing of land for cultivation and overgrazing during the dry season, and when it rains there are flash floods which result in soil erosion. As a result, investigative research must be carried out to determine the macro and micro-nutrients and micro-organism biodiversity in the soil.



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Political and Economic Challenges

The Maasai Mara National Reserve is administered by the county governments of Narok and Transmara. The more visited eastern parts of the park are managed by Narok County, while the western part – known as the Mara Triangle – is managed by the Transmara County, which is contracting management to the Mara Conservancy. The surrounding areas are inhabited by communities and privately owned conservation areas.

Governance Issues

Interplay of multiple sets of laws and policies

Functioning governance structures, legal and policy instruments as well as institutional capacity for judicious implementation and enforcement are a prerequisite for effective environmental governance. Policies and legislation provide direction in governance of the environment and its interactions. Solutions to environmental issues stem from a number of policies that have been initiated by the Government of Kenya assisted by international stakeholders. These include the Constitution of Kenya (2010), Vision 2030, Forest Policy 2014, Wildlife Policy 2011, National Environment Policy 2014, conservation policies and wetlands management policies, among others. The Government of Kenya is also a signatory to several international conventions and protocols on the conservation of the environment. However, some of these provisions need review, harmonization and clarity of institutional mandates to be effective.

The Maasai Mara ecosystem is a fragile ecosystem facing a number of environmental challenges that need to be urgently addressed. These challenges emanate from the fact that this multiplicity of policies is found at different levels, with different interests and addressing different issues. This is aggravated by lack of inclusiveness in policy formulation and implementation procedures. The multi-faceted nature of the environment and the need to integrate environmental considerations in all development planning and activities calls for cooperation and consultation among responsible government agencies and stakeholders at all levels. It is particularly important to recog-

nize the existing institutional mechanisms and consider ways and means by which coordination and cooperation can be enhanced among the many institutions whose mandates relate to all aspects of the environment.

Corruption and lack of good political will

The Kenya State of Environment Report (2012) states that policy and legislative implementation failures caused by weak institutional capacity, inadequate human and financial resources have encouraged human encroachment of wildlife habitats and loss of species, some of which are threatened with extinction (GoK 2012). In Kenya, official corruption, poor financial management, lack of political will, conflicting incentives, and weak enforcement of policies, laws and regulations affect all sectors of development including the tourism industry (Louisa 2006). The Maasai Mara ecosystem is very important to the county, nation and the world for its environmental and economic value. As a fragile ecosystem, the Maasai Mara should be restored at all costs. Though the challenges of the Maasai Mara ecosystem are numerous and mostly human-made and the policies for restoration and conservation exist, the challenges are still felt.

Policy and legislative implementation failures caused by weak institutional capacity means loss of wildlife habitats and species

As can be seen from the above, there is a need for interventions that include coordinated processes in policy formulation and implementation; encouragement of the use of renewable sources of energy to reduce charcoal burning; monitoring and evaluation of programmes and projects on the restoration and conservation; vetting of all the interested parties and their activities; harmonizing policies and providing a credible legal framework for implementation; adopting interdisciplinary and participatory problem solving initiatives in ecosystem conservation; sensitizing the communities on restoration and conservation processes; supporting partnership with donors in prioritizing and funding of projects; enforcing conservation laws; and establishing forums for the dissemination of research findings to stakeholders.

Slow Economic Development

Poverty vs conservation

Narok County experiences a poverty index of 41 percent and about 344,000 people are living in poverty (GoK 2013). Poverty reflects the state of illiteracy, low per capita income, unemployment, gender role issues and landscape development. Such factors determine communities' perception of environmental utility and risks. Poverty is therefore the greatest threat to the environment as poor people depend largely on biomass for survival. Clearance of vegetation for agriculture, livestock grazing and human settlements as seen in the Loita Plains have a negative impact on the spatial distribution and density of wildlife. These human activities compete for existing pasture, water resources, breeding grounds for wildlife, while at the same time interfering with the natural migration routes and behaviour of wildlife. Poverty also fuels environmental conflicts over access, use and management of natural resources, including tourism.

Rapid and uncontrolled tourism development

In the last fifty years, the Maasai Mara ecosystem has witnessed the rapid growth of unplanned tourist facilities such as hotels, lodges and campsites (see Figure 8). The first lodge with 25 beds was opened in 1965 and the number of beds in the reserve has been increasing steadily over the years to about 4000 to date. The rest are outside but within a radius of 10 km from the reserve boundary. In addition, a growing number of temporary campsites cater for extra visitors, especially during the peak tourist season.

The lodges, balloon safaris, air charters and other facilities within the protected area are

owned and managed by different companies. Outside the reserve, the situation is even more complex. There are lodges, permanent camps, mobile luxury camps and temporary camps scattered all over the area which are accessed through temporary roads. Utility airstrips open and close, depending on demand. Today, it is generally felt that the Maasai Mara ecosystem has exceeded its visitor and accommodation capacity. Despite the economic gains that might accrue from these tourist developments, there is a need to address the environmental challenges that are involved.

Poverty is the greatest threat to the environment and the wildlife

Historically, the establishment of wildlife-protected areas had a false start. Local communities were forcefully evicted from their traditional land without compensation. Communities lost their hunting rights and land entitlements in order to have wildlife protected. Consequently, negative attitudes towards wildlife conservation germinated in the livelihood of many communities (Frazee et al. 2003). This negative attitude is increasing today as human-wildlife conflicts rise due to competition for scarce natural resources. In the recent past, increased terrorism and related attacks in Kenya, including travel advisories to the citizens of the United States of America and United Kingdom, are adversely contributing to declining tourist numbers visiting the Maasai Mara National Reserve (Boynton 2014). Although the figure might be higher, Boynton (2014) estimates that a 30 percent drop in tourism has been recorded since the wave of bombings started in Kenya.

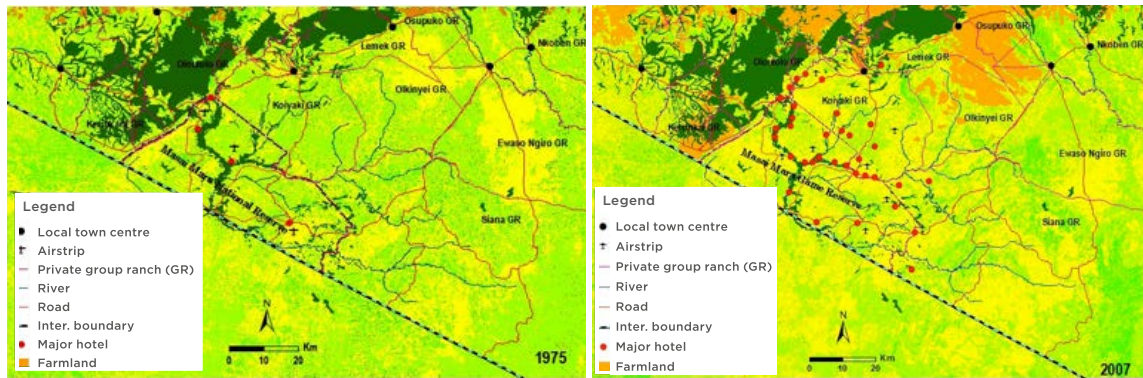
TABLE 1: ECONOMIC ACTIVITIES IN THE NAROK SLM TARGET AREA

Division	ECONOMIC ACTIVITIES IN THE NAROK SLM TARGET AREA				
	Crop farming	Mixed farming	Agro-pastoral	Pastoral	Trade
East Mau	0.8	2.3	93.2	3.0	0.8
Mulot	1.7	53.3	43.3	0.0	1.7
Narok Central	1.0	4.8	72.4	17.1	4.8

• Source: Maina (2013)

FIGURE 8

EXTENT OF AGRICULTURAL EXPANSION AND MUSHROOMING TOURISM FACILITIES IN THE MAASAI MARA ECOSYSTEM IN (A) 1975 AND (B) 2007



• Source: Mundia & Muryama (2009)

Economic Structure Degradation

Soon after independence there was much migration of subsistence agrarian communities and large wheat farming companies into the northern section of the ecosystem. In the 1970s, the government promoted wheat growing in the Loita Plains which made the Maasai Mara ecosystem one of the biggest producers of wheat and barley in the country. Group ranches are today being subdivided into privately owned smallholdings under freehold title. Such land is in turn being changed to both small-scale and large-scale agriculture, sedentary pastoralism and urban development. As a result, land intensification has taken root as more and more immigrants buy land for human settlement, agriculture and tourism enterprises. Land transformation and introduction of land use patterns that are incompatible with wildlife conservation has greatly affected the Maasai livelihoods as well as wildlife numbers and species diversity in the ecosystem. Deforestation, overgrazing and charcoal burning have destroyed important wildlife habitats, thereby significantly reducing wildlife populations.

The Maasai in Narok and other counties such as Kajiado are increasingly selling land to non-Maasai communities on a willing-seller willing-buyer basis. However, the Maasai community is, in most cases, disadvantaged because

the land buyers are wealthy, purchase the most fertile land and turn it into other forms of land use such as agriculture and settlement. This implies that land for grazing is diminishing and the Maasai are being pushed further towards marginal areas, hence increased overgrazing, land degradation and poverty – more often than not made worse by the increasing droughts. Despite the obvious urgency to manage habitat loss and fragmentation for both wildlife and pastoralism, the extent of major issues and relevant drivers of change are not fully understood and therefore minimal successful attempts have been undertaken to mitigate the outcomes.

Infrastructural Development

Infrastructural development in the Maasai Mara has both advantages and disadvantages. Tourists need to move and visit the wildlife, so conservancies develop a road network, river crossings and water sources to aid the functioning of the conservancy. The surrounding community benefit from improved access to the markets, schools and mobility of goods and services in areas where government infrastructure is insufficient. This ease of transport means lower living costs and costs of trade for all. However, there is little understanding of the negative impact of massive infrastructural development on the Maasai Mara ecosystem.



Human and Cultural Challenges

In 2010, the Maasai Mara National Reserve was placed on UNESCO's tentative list for evaluating its candidacy for inclusion in the world heritage sites. Its adjacent sister ecosystem, the Serengeti National Park in Tanzania, was given world heritage status in 1981. In terms of conservation and sustainability, achieving a world heritage site status affords many benefits that generate international attention, eco-tourism, research, funding, local pride, UN affiliation, governmental cooperation, and Geneva Convention protection, among others. Developing a long-term field site will provide both research and conservation initiatives that will further demonstrate the importance of the Maasai Mara ecosystem and may help promote its status as a world heritage site. A research station can also contribute to long-term capacity building that can help in the promotion of sustainable natural and cultural heritage management. As the Maasai Mara National Reserve is being evaluated for a world heritage site status, there is an urgent need to stop the rapidly eroding cultural heritage of the Maasai community.

Decline in Cultural Heritage

Traditional indigenous food and medicine

Whereas the Maasai used to depend largely on their livestock and environment for their food needs, the recent past has witnessed the community depending on food produced in other areas, a pattern pronounced during protracted drought. The contribution of traditional diets to energy and nutrients is declining. In addition, indigenous medicine-based knowledge is equally declining, yet very important for the Maasai pastoral livelihood system. Preservation

and maintenance of the indigenous knowledge of traditional Maasai food and medicine can be done through ethnobotany research (Box 1) that provides a quantitative, predictive understanding of potential impact of these changes to the Maasai Mara ecosystem. Continuously educating the young members of the Maasai community about their traditional foods, medicines and cultural contexts is important.

.....
There is an urgent need to stop the rapidly eroding cultural heritage of the Maasai community!

Traditional art and crafts

Traditionally, a Maasai woman would do beadwork for her own beauty, her daughter's beauty and for ceremonial purposes such as weddings, circumcision and childbirth ceremonies. Today, the beadwork is not only for beauty and ceremonies but is also done as a business, largely for sale to tourists. This is a very important income-generating activity and livelihood source for the Maasai woman, which is definitely sustained by the tourists visiting the Maasai Mara. However, the business is slowly being infiltrated by non-Maasai communities who either imitate the Maasai beadwork or buy them cheaply from the Maasai woman – denying the Maasai their traditional art and crafts heritage as well as income.

Traditional language

There might also be some challenges in terms of preserving the traditional language of the Maasai due to increased intermarriage with other communities and rapid urbanization associated with modernization. Language is an important aspect of culture, and losing one's language may lead to decline in tourism

BOX 1: ETHNOBOTANY

Ethnobotany (*ethnology* = study of culture and *botany* = study of plants) is the scientific study of the relationships that exist between people and plants.

- How are plants used?
- How are plants managed?
- How are plants perceived?

Ethnobotany continues to focus on *traditional people*.



because culture is a significant tourism product in the Maasai Mara just like wildlife. Language is an expression of identity, and language is in itself a repository of history because it forms an integral part of the sum of human knowledge.

Lack of Community Involvement

Community participation is a process of actively engaging and involving communities in the programme cycle from identification to evaluation with clear roles and responsibilities for all stakeholders, including men, women and children (UPHOLD-Uganda 2003). Participation in development means the inclusion of those people affected by proposed intervention into decision-making, and is determined by rules, norms, perceptions, endowments and attributes that can disadvantage certain members of society both individually and interactively (Agarwal 2001). For instance, due to cultural ties, women may be involved in the planning process, but men tend to make the final, and often the most important, decisions. By organizing at community level, citizens can

improve their life conditions by generating local resources and attracting resources from the central government, thus overcoming some of the most immediate needs they face (Pereira 2012). Communities benefit from community participation through ownership, managing, implementing and monitoring programmes, knowledge gains, attitude change and skills in performing various tasks and continued support, innovativeness as well as sustainability of the programme (UPHOLD-Uganda 2003). This is only possible if the various groups within the community have equal opportunities to participate, irrespective of gender roles within a household.

With the increasing problem of environmental changes, it is believed that survival of Africa's wildlife into the 21st century will depend on the goodwill of local communities, mainly through community-based wildlife management, through development of local crafts markets near wildlife tourism areas, full ownership of wildlife, and sharing of the benefits of tourism (Lamphrey & Reid 2004).



However, some of the drawbacks to community-based wildlife management initiatives in savannah land use include insecurity of land tenure, inequitable within-community distribution of benefits, outdated legislation, lack of expertise in managing wildlife as well as human population growth, and privatization of land. Also, the lack of standardized measure to ensure community participation, inadequate funding, high levels of poverty and reliance on volunteers without proper incentives and motivation compromise the results intended for community participation. Community participation is considered as a democratic right and as a means to the attainment of sustainable development and poverty alleviation (Rose 2003).

Gender Dynamics

The colonial and post-independence period saw significant socio-economic changes, which drastically altered the relationship between men and women (Hodgson 1999). Most of these changes were driven by gendered development programmes, privatization of land and unequal access to market economy (Talle 1988; Homewood 1995). Increasing land privatization and introduction of land tenure, legal structures have undermined the communal rangeland management system of the communities and deprived many Maasai families of important pasture land thereby encouraging a sedentary lifestyle.

With sedentarization and increased commoditization of the Maasai land and livestock economy, gender relations have changed. This has created disparities within the Maasai community where some elites acquire more land while the poor are pushed further to the periphery of development. Commoditization of land means that women can not attain land titles or memberships in the group ranches from which many

Maasai men benefit. As land tenure rights changed and the Maasai acquired title deeds, it became possible for them to sell their individual land parcels, something that was unknown up till then. In addition, women’s right of disposal over livestock products such as hides and milk became limited as these products became more commercialized and controlled by men (Hudgson 1999; Talle 1988).

Apart from group ranches, the economic landscape has been transformed by wage labour, tourism, businesses and agriculture, all of which have shaped the roles, rights and responsibilities of Maasai men and women. For instance, around the Maasai Mara National Reserve conservancies and community wildlife associations are mushrooming; here the land owners receive lease fees and are engaged in decision-making about wildlife conservation and management and tourism enterprises. Although women are affected by these developments, often they are excluded from decision-making because they do not own land.

Furthermore, the role of Maasai woman in conservation has received limited attention or has downright been ignored. The Maasai society still grapples with deep-seated socio-cultural reality and traditions that increasingly impede the attitude changes required to facilitate women’s actual role in conservation (i.e. patriarchy and property rights). Nevertheless, studies elsewhere in Kenya have shown that

women become excellent environmental stewards against the backdrop of cultural constraints.

Lack of Environmental Education

Education is a key ingredient and tool in environmental conservation and management. Higher levels of education may lead to positive attitudes and eliminate negative cultural norms and practices that undermine sustainable development. Education impacts desired knowledge, skills, attitudes and values in a community. It can prepare learners to build up their own knowledge and make the learning and values acquired permanent to be passed on to the next generation. However, the Maasai Mara region experiences relatively low levels of primary and secondary school attendance (see Table 2).

In unique ecosystems such as the Maasai Mara, an integration and infusion of environmental conservation in the school curriculum or extra-curricular activities would go a long way in the restoration efforts of the Maasai Mara. However, the current school curriculum in Kenya emphasizes academic performance and limits holistic development of a child. In addition, the learners spend most of their time in school (8 years in primary and 4 years in secondary school). There is limited time for learners to develop values and appreciation of wildlife and conservation of natural resources.

TABLE 2: SCHOOL ATTENDANCE AND GENDER PARITY IN NAROK COUNTY AND KENYA

EDUCATION	NAROK	KENYA
Primary school attendance rate (6-13yrs)*	69.6%	77% (3 out of 4 children aged 6-13 years attend school)
Secondary school attendance rate (14-17yrs)*	10.4%	23.5% (one in every 4 youths aged 14-17 years attend secondary school)
Gender parity in primary school attendance**	0.94%	0.97% (9.34 million children (4.80 million males and 4.54 million females)
Gender parity in secondary school attendance**	0.73%	0.91% (1.71million youths (0.79 million females and 0.92 million males). Girls are almost 10% less likely to attend secondary school than boys

* Net attendance rate is the percentage of school age children attending school out of the total population in that age range; primary 6-13 years, secondary 14-17 years

** Gender parity gross attendance rate for females divided by the gross attendance for males

• Source: Kenya National Bureau of Statistics, CETRAD (Nanyuki) and CDE (Switzerland) (2014)

There is also limited time for parents and the community to impart other skills and values about the environment to the children – as it was in the past. While changing the formal school curriculum would be practically impossible, environmental education in Maasai Mara can be spearheaded through extra-curricular activities and clubs such as Wildlife clubs, Conservation clubs and Environment clubs, among others. Advocating for integration of environmental conservation in the formal school curriculum would be ideal but a long-term goal. There is also a window for vocational training, advocacy and sensitization efforts – on all aspects of the environment and the Maasai Mara ecosystem.

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Poor access to health care is a
major concern
—————

Health Risks

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According to the Kenya Demographic and Health Survey 2008-2009, one in every 19 Kenyan children dies before its first birthday, while one in every 14 children does not survive to the age of 5. The situation is worse in arid and semi-arid lands that characterize parts of the Maasai Mara ecosystem. Poor access to health care is a major concern. Government health facilities are too far away and sick people often walk over long distances to reach them. The situation is severest for mothers and children. In Kenya, neonatal mortality is 31 deaths per 1000 live births while post-neonatal mortality is 21 per 1000 births meaning that 60 percent of infant deaths in Kenya occur in the first month. In Narok County, only 21.4 percent of the households have access to clean water. It ranks lowest among the 47 counties: 6.9 percent of households use piped water, 8.2 percent use protected springs and wells and 5.6 percent use boreholes (GoK 2009). The link between access to safe water and sanitation and health cannot be overemphasized.

Population Growth

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The population factors affecting tourism and sustainable development in the Maasai Mara region are grouped into three categories: (1) demographic characteristics (population size, distribution, density, growth rate and migration); (2) socio-economic characteristics (high illiteracy, low income per capita, unemployment, poverty, high crime rate, conflicts); and (3) institutional and external forces (negative cultural norms and practices, corruption, poor governance, policies, laws and regulations and their enforcement, trade and commerce). The impact of demographic factors on tourism arises from increasing demand for wildlife products. For example, illegal hunting for bushmeat (Loibooki et al. 2002) and poaching are increasing – largely by the non-Maasai immigrant population in the area. The high demand for ivory and rhino horns also encourages poaching (Louisa 2006). Furthermore, human-wildlife conflicts have resulted in arbitrary revenge killing of wildlife by the communities affected.

A large proportion of the population in the Maasai Mara ecosystem is rural, but the urban population is expected to increase due to rural-urban migration. The urban population, concentrated in the two urban centres of Kilgoris and Narok, is projected to increase from 49,000 in 2009 to 71,000 in 2017. Furthermore, the youth population aged 15-29 years is estimated to be approximately 335,000 in 2017, while the estimated labour force aged 15-64 years will reach about 587,000 – representing 47 percent of the county's total population. In addition, the rapid growth of Bomet town (Bomet County) in the upper Mara ecosystem will significantly influence the drainage systems into the Maasai Mara National Reserve.



Members of the founding group of the Maasai Mara Science and Development Initiative, Workshop at Karen Blixen Camp April 2015.

Towards a Research and Development Agenda

It is clear that the above massive challenges to the preservation of the Maasai Mara ecosystem call for a well-structured and coordinated multi-stakeholder and interdisciplinary approach to the research and development agenda. The MMSDI research and development agenda is discussed in detail in another MMSDI document – “The Strategy Paper”. A number of research projects have been undertaken in the Maasai Mara ecosystem, while others are taking place (see Appendix 5). A desktop content analysis of some of the existing studies in the Maasai Mara ecosystem reveals the following gaps that can inform the Maasai Mara Science and Development Initiative (MMSDI) programme:

1. Interdisciplinary approach to ecosystem management is conspicuously missing. A large majority of studies pursue a disciplinary-based approach to management of ecosystems.
2. Lack of a structured and coordinated approach in research. In other words, there is no forum where researchers can share and exchange information on their activities.
3. Research findings are rarely shared and communicated to the community, relevant government agencies and stakeholders.
4. Longitudinal data for a socio-ecological system like Maasai Mara are needed.

The Maasai Mara Science and Development Initiative (MMSDI) research agenda should achieve the following principles:

1. The research agenda should contribute to solving the major challenges of preserving the Maasai Mara ecosystem identified in collaboration with local stakeholders.
2. The research agenda should be interdisciplinary to meet the complexity of the challenges.
3. The research agenda should be conducted in close coordination and dialogue with other research projects, local research institutions and decision-makers.
4. The research results should be shared with stakeholders and implementation agencies.
5. The research agenda should take a holistic approach: interdisciplinary projects that address the challenges individually as well as an interconnected system.
6. The research agenda should adopt a portfolio thinking of research planning and management: small focused research projects should be seen as pieces in a puzzle that fit together to give a picture of the whole and not only the part.

A Committed Founding Group

The Maasai Mara Science and Development Initiative (MMSDI) was founded in 2014 as a response to the urgent need for action in the Maasai Mara ecosystem. The MMSDI is an international, multi-stakeholder network



Participants at the Maasai Mara Science and Development Summit April 2015

aimed at creating systemic change through interdisciplinary research and development activities. The ambitious MMSDI has been developed by a very committed and enthusiastic group of founding members, seriously engaged in the challenges of the Maasai Mara ecosystem. The founding group consists of more than 30 researchers from a broad range of disciplines (see Appendix 1).

The members come from four universities in Kenya and Europe; they have teamed up with representatives from the Maasai community and the private sector working and interested in the Maasai Mara region. The members acknowledge that the crisis in the Maasai Mara ecosystem calls for a new and innovative approach. This takes courage and – hopefully – support from donors who will join the group in this bold endeavour. The purpose of the partnership is to support a sustainable development of the Maasai Mara ecosystem through a research and development initiative for the next 20 years. It is our aim to develop evidence-based knowledge in a vibrant community of people engaged in saving and developing the Maasai Mara ecosystem.

.....
Research can - and must - contribute
to real life solutions.

The Programme Development Process

The programme development process is guided by the principles of transparency, dialogue and holistic thinking. Furthermore, the programme activities will be developed based on identifying and analysing the challenges and research needs of the Maasai Mara ecosystem. As an initial step, the MMSDI organized a Summit at Maasai Mara University (April 21-23, 2015) and a Workshop at Karen Blixen Camp (April 24-25, 2015) where a wide range of researchers, stakeholders and the local community presented their views on the challenges and needs for research and development in the Maasai Mara ecosystem (see Appendices 2, 3 and 4 for Summit and Workshop details).

The research planning and management scheme will be based on portfolio thinking: all research projects should be seen as pieces in a puzzle that fit together to give a picture of the whole and not only the part. A catalogue of potential research and development projects are currently being developed and will be presented to potential donors during 2015. The *Board* and *Scientific Board* with representatives from the four partner universities, the private sector and the local community have been appointed (Tables 1 and 2). Their mandates, among others, are to develop a strategy for the research activities including university capacity building and other partnerships in undertaking such as student exchange. A number of advisory boards will be set up during 2015 and 2016.

TABLE 3: THE MAASAI MARA SCIENCE AND DEVELOPMENT INITIATIVE BOARD

President	Professor, Nobel Peace Laureate Richard Odingo	University of Nairobi, Kenya
Vice-President	Professor, Vice-Chancellor Mary Walingo	Maasai Mara University, Kenya
Chairman	Professor, Centre Director Børge Obel	Aarhus University, Denmark
Vice-Chairman	Professor Michael Lierz	Justus-Liebig Universität Giessen, Germany
Member	Mr. Jesper Stagegaard	Karen Blixen Camp Ltd, Kenya
Member	Mr. David Noosaron	Mararianda Community, Kenya

TABLE 4: THE MAASAI MARA SCIENCE AND DEVELOPMENT INITIATIVE SCIENTIFIC BOARD

Professor Jens-Christian Svenning	Aarhus University, Denmark
Associate professor Dorthe Døjbak Håkonsson	Aarhus University, Denmark
Professor Maina Thuo	Maasai Mara University, Kenya
Professor Nathan Oyaro	Maasai Mara University, Kenya
Dr. Samuel Owuor	University of Nairobi, Kenya
Dr. Stellah Mikalista Mukhovi	University of Nairobi, Kenya
Professor Dr. Axel Wehrend	Justus-Liebig Universität Giessen, Germany
Professor Dr. Carlos Hermosilla	Justus-Liebig Universität Giessen, Germany
(Substitute) Professor Christine Wrenzycki	Justus-Liebig Universität Giessen, Germany
(Secretariat) PD Dr. Rainer Hospes	Justus-Liebig Universität Giessen, Germany

The Geographic Focus Area

To maximize the chances of making a real-world difference, we focus on the smaller, well-defined geographic area of the Maasai Mara ecosystem in Kenya; it consists of the Maasai Mara National Reserve and the adjacent communities, former group ranches and conservancies (Figure 9), including the Maasai Mara river and its catchment area which include part of the Mau Forest. At the same time we acknowledge that the connected areas are critical to the environmental and anthropogenic impact. The Maasai Mara in Kenya is a sub-system of the Mau-Mara-Serengeti ecosystem, one of the last major large-mammal wildlife refuges on earth, stretching 25,000 km² from the Ngorongoro Highlands in Tanzania to the Loita Hills of southern Kenya. Most famous for its annual migration of nearly two million wildebeest and zebra, the ecosystem is also home to an estimated 40 percent of Africa's large mammals. The Maasai Mara National Reserve, located in this ecosystem, is relatively small at only 1,510 km². About 5,000km² of the Maasai Mara ecosystem in Kenya is a mix of private and community-protected areas, alongside unprotected community or private land.

Naturally, the focus of this programme – the Maasai Mara ecosystem in Kenya – is linked to nearby ecosystems such as the Mara-Serengeti

and the Mau Forest Complex. These large-scale linkages have a major impact on the Maasai Mara ecosystem. Consequently, we decided to categorize them as two of several externalities. Other external factors include national political and economic forces and international stakeholders like the Chinese-funded infrastructure developments. For example, excision of the Mau Forest reserve to settle the landless has led to serious degradation of the forest, thereby affecting the drainage of the Mara River – the bloodline of the wildlife in the Maasai Mara ecosystem. The environmental impact of the Standard Gauge Railway (SGR) on wildlife protected and conservation areas and ecosystems is also debated – directly or indirectly. The SGR, initially from Mombasa to Nairobi, is being built by a state-owned Chinese company (China Road and Bridge Corporation).

Our objective is to have an interdisciplinary, holistic approach to address biological, geographical, social, cultural, political, economic and environmental issues in the area. The unit of analysis chosen exemplifies the global challenges found in many other regions and ecosystems and we expect to be able to generalize the principles of the solutions in the Maasai Mara ecosystem to other areas of the world with similar challenges.

FIGURE 9
GEOGRAPHIC FOCUS AREA OF THE MAASAI MARA SCIENCE AND DEVELOPMENT INITIATIVE







References

Summit and Workshop Paper Presentations

A Contested Paradise: Contextualising the Challenges and Opportunities Associated with Managing Boundary Resource (Salaton Tome)

An Overview of the Structure, Goals and Challenges of Mara North Conservancy (A Camp Perspective) (Jesper Stagegaard)

Biodiversity in a World of Human Dominance and Rapid Change - Anthropocene Challenges and Opportunities (Jens-Christian Svenning)

Climate Change and the Survival of Maasai Mara Ecosystem (Richard Odingo & Evaristus M. Irandu)

Education for Community Participation in Restoration of Maasai Mara National Game Reserve and the Ecosystem (Florence Kisirkoi)

Energy Systems and Dynamics in Maasai Mara of Narok County (Christopher Oludhe, Richard Odingo & Alice Oluoko-Odingo)

Environmental Costs and Opportunities of Agricultural Modernization in Maasai Mara: National Accelerated Agricultural Input Access Program (NAAIAP) Implementation in Narok County (Rose M. Mwangi)

Ethnoecology in a Changing World (Henrik Balslev)

Exploring Online Eco-Linguistic Communication Strategies on the Conservation of Maasai Mara Game Reserve (Bonface Isalambo Khadohi)

Final Remarks, Conclusions and Next Step (Alice Oluoko-Odingo, Tabitha Sewe & Pernille Kallehave)

Food Security and the Ecosystem (Mary Walingo)

Future Plans of the Ministry on the Development of the Maasai Mara (Alice Kaudia)

Gender Implications of Community Participation, Tourism and Development of Maasai Mara (S. Mukhovi, A.A. Oluoko-Odingo & E.M. Irandu)

How Farm-Animal Management may Support Wildlife Conservation and Social Development (Rainer Hospes, C. Hermosilla, A. Wehrend & M. Lierz)

Interrogating Previous Research Studies in the Restoration of the Maasai Mara Game Reserve and the Mau Forest Complex (Tabitha Sewe)

Introduction to the Maasai Mara Science and Development Initiative (Richard Odingo & Børge Obel)

Land Use, Livestock and Conservation: A Difficult Balance (David Noosaron)

Long-Term Research, Conservation and Sustainability in Protected Areas (Jessica Hartel)

Maasai People in Partnership in Wildlife and Tourism Development in the Mara (Jackson Looseyia)

Mara River Research – A Short Synthesis of 7 Years of Our Research (Christopher Dutton, Amanda Sublusky, David Post & Emma Rosi-Marshall)

Organization Audit and Design of the Collaborative Community of Maasai Mara (Børge Obel)

Population Threat to Tourism and Development in Maasai Mara (Elias Ayiemba, Samuel Owuor & Stellah Mukhovi)

Remote Sensing to Monitor and Study Ecosystem Dynamics and Degradation in the Maasai Mara (Peder Klith Bøcher)

Restoration of the Mara Ecosystem - Challenges and Opportunities (Jepkemboi R. Choge, Tabitha Sewe, Mary Walingo, Nancy Adagala & Khadoi Isalambo)

Saving the Mara is Saving the Maasai Woman's Livelihood (Bernadette Loloju)

State and Society – A Danish Contribution (Geert Aagaard Andersen)

The Challenge of Sustaining Pastoralism Land Tenure System for Ecological Conservation in the Maasai Mara Ecosystem (Gordon Wayumba, Richard Odingo & Evaristus M. Irandu)

The Maasai Mara for the Mara Elephant Project (Marc Goss)

The Maasai Mara Game Reserve Conservation: Integrating the Maasai Woman into the Conservation Matrix through Social Entrepreneurship (Joslyn Nzau & Gladys Ngao)

The Plan for the Summit, the Workshop, the White Paper and the Development of the Strategy including Discussions (Børge Obel & Pernille Kallehave)

Today's Challenges in the Mara Conservancy Movement: The Constraints and Challenges in a 10-Year Perspective (Lars Lindkvist)

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Appendices

Appendix 1: The Founding Group of Researchers

MAASAI MARA UNIVERSITY, KENYA	
Professor Mary Walingo	Vice Chancellor
Professor Tabitha Sewe	
Professor Oyaro Nathan	Dean, School of Arts and Social Sciences
Dr. Bonface Isalambo Khadohi	Department of Languages, Linguistics, Communication & Journalism
Dr. Jepkemboi R. Choge	Department of Curriculum Instruction and Educational Management
Dr. Florence Kisirkoi	Department of Curriculum Instruction and Educational Management
Dr. Gladys Ngao	Department of Curriculum Instruction and Educational Management
UNIVERSITY OF NAIROBI, KENYA	
Professor Richard Odingo	Department of Geography and Environmental Studies
Professor Elias H.O. Ayiemba	Department of Geography and Environmental Studies
Dr. Alice Oluoko-Odingo	Department of Geography and Environmental Studies
Dr. Stellah Mikalitsa Mukhovi	Department of Geography and Environmental Studies
Dr. Samuel Owuor	Head of Department, Department of Geography and Environmental Studies
Dr. Gordon Wayumba	Technical University of Kenya
Prof. Evaristus Irandu	Department of Geography and Environmental Studies
Dr. Christopher Oludhe	Department of Geography and Environmental Studies
AARHUS UNIVERSITY, DENMARK	
Professor Børge Obel	Interdisciplinary Center for Organizational Architecture (ICOA)
Director of Development Pernille Kallehave	Interdisciplinary Center for Organizational Architecture (ICOA)

Associate professor Dorthe Døjbak Haakonsson	Department of Business and Technology/ICOA
Professor Jacob Eskildsen	Head of Department, Department of Business and Technology/ICOA
Professor Jens-Christian Svenning	Ecoinformatics & Biodiversity, Department of Bioscience
Professor Henrik Balslev	Ecoinformatics & Biodiversity, Department of Bioscience
GIS Coordinator Peder Klith Bøcher	Ecoinformatics & Biodiversity, Department of Bioscience
Associate professor Jan Ifversen	Vice Dean for Knowledge Exchange, Internationalisation and Strategy, Faculty of Arts
Professor Jørgen E. Olesen	Department of Agroecology
Professor Andreas Roepstorff	Interacting Minds Centre
Assistant professor Casper Andersen	Centre for Biocultural History
Assistant professor Lars Bach	Interacting Minds Centre, Department of Culture & Society and ICOA
Assistant professor Panos Mitkidis	Behavioural Economics and Experimental Anthropology, Interacting Minds Centre, Department of Culture and Society and ICOA
Professor Dorte Haubek	Department of Dentistry

JUSTUS-LIEBEG UNIVERSITÄT GIESSEN, GERMANY

Professor Michael Lierz	Clinic for Birds, Reptiles, Amphibians and Fish Diplomate of the European College of Poultry Veterinary Science Diplomate of the European College of Zoological Medicine (Wildlife Population Health) Diplomate of the Royal College of Veterinary Surgeons, Zoological Medicine Certified Specialist in Poultry and Avian Medicine Certified Specialist in Zoo- Wild- and Park Animals Certified Specialist in Microbiology Certified in Species Conservation
Dr. Rainer Hospes	Clinic for reproduction in animals Diplomate (ret.) of the European College of Bovine Health Management DVM, Certified specialist in animal reproduction
Professor Dr. Axel Wehrend	Clinic for reproduction in animals Diplomate of the European College of Animal Reproduction DVM, Certified specialist in animal reproduction
Professor Dr. Carlos Hermosilla	Institute for veterinary parasitology Diplomate of the European Veterinary Parasitology College DVM, Certified specialist in animal parasitology
Professor Dr. Christine Wrenzycki	Clinic for reproduction in animals DVM, Certified specialist in animal reproduction molecular genetics and in gene technology

Appendix 2: Summit and Workshop Program

MAASAI MARA SUMMIT PROGRAMME	
21 APRIL 2015	
4.00-4.30 PM	The plan for the summit, the workshop, the white paper and the development of the strategy including discussions Professor Børge Obel and Program Director Pernille Kallehave, Aarhus University
4.30-4.50	Remote sensing to monitor and study ecosystem dynamics and degradation in the Maasai Mara GIS Coordinator Peder Klith Bøcher, Ecoinformatics & Biodiversity, Department of Bioscience, Aarhus University
4.50-5.10	Long-term research, conservation and sustainability in protected areas Jessica Hartel, Post Doc, Centre for Biocultural History, Aarhus University
5.10-5.30	Education for community participation in restoration of Maasai Mara National Game Reserve and the ecosystem Dr. Florence Kisirkoi, Maasai Mara University
5.30-5.50	Exploring online eco-linguistic communication strategies on the conservation of Maasai Mara Game Reserve Mr. Bonface Isalambo Khadohi, Maasai Mara University
5.50-6.10	Interrogating previous research studies in the restoration of the Maasai Mara Game Reserve and the Mau Forest Complex Professor Tabitha Sewe, Maasai Mara University
22 April 2015	
8.00-8.30AM	INTRODUCTION Facilitator: Ms. Faith Njeru; Rapporteur: Professor Almadi Obere
8.30-9.10	Welcome Address <ul style="list-style-type: none"> • Professor Mary Walingo, Vice-Chancellor, Maasai Mara University • Professor J. Okumo, Chairman, Maasai Mara University Council • Professor P. Ngunjiri, Chancellor, Maasai Mara University • Dr. Belio Kipsang, PS Education
9.10-9.30	Introduction to the Maasai Mara Science and Development Initiative Professor Richard Odingo, University of Nairobi and Professor Børge Obel, Aarhus University
9.30-9.50	Honorable William Ole Ntimama
9.50-10.10	Health break POLICY Facilitator: Dr. Alice Oluoko-Odingo; Rapporteur: Professor Jess Hartel
10.10-10.30	Future plans of the Ministry on the development of the Maasai Mara Dr. Alice Kaudia, Environment Secretary, Ministry of Environment, Water and Natural Resources

10.30-10.50	Restoration of the Mara ecosystem – challenges and opportunities Dr. Jepkemboi R. Choge, Prof. Tabitha Sewe, Prof. Mary Walingo, Ms. Nancy Adagala and Mr. Khadoi Isalambo, Maasai Mara University
10.50-11.20	Discussion
11.20-11.30	Health break CHALLENGES AND ANALYSIS Facilitator: Professor Henrik Balslev; Rapporteur: Dr. Florence Kisirkoi
11.30-11.50	Today’s challenges in the Mara conservancy movement: The constraints and challenges in a 10-year perspective PhD. Lars Lindkvist, Maasai Mara Wildlife Conservancies Association
11.50-12.10	Organization audit and design of the collaborative community of Maasai Mara Professor Børge Obel, Interdisciplinary Centre for Organizational Architecture, Business and Social Sciences, Aarhus University
12.10-12.30	State and society – A Danish contribution Mr. Geert Aagaard Andersen, Ambassador of Denmark to Kenya
12.30-1.30PM	LUNCH THE AGE OF THE ANTHROPOCENE Facilitator: Professor Frederick Ogola; Rapporteur: Professor Lars Bach
1.30-1.50	Biodiversity in a world of human dominance and rapid change – Anthropocene challenges and opportunities Professor Jens-Christian Svenning, PhD, Aarhus University
1.50-2.10	Climate change and survival of the Maasai Mara ecosystem Professor Richard Odingo & Professor Evaristus M. Irandu, University of Nairobi TOURISM CONSERVATION AND DEVELOPMENT Facilitator: Dr. Samuel Owuor; Rapporteur: Ms. Jennifer Koikai
2.10-2.30	An overview of the structure, goals & challenges of Mara North conservancy (A camp perspective) Jesper Stagegaard, Chairman of the Board of Karen Blixen Camp in Mara North and Chania Frost, Chief Operating Officer, Mara North Conservancy
2.30-2.50	Maasai people in partnership in wildlife and tourism development in the Mara Jackson Looseyia, Professional Safari Guide, Maasai Mara
2.50-3.10	Population threat to tourism and development in Maasai Mara Professor Elias Ayiemba, Dr. Samuel Owuor & Dr. Stella Mukhovi, University of Nairobi
3.10-3.30	Discussion
3.30-3.45	Health break LAND USE AND LIVESTOCK Facilitator: Ms. Chania Frost; Rapporteur: Dr. Peder Klith Bøcher
3.45-4.05	Land use, livestock and conservation: A difficult balance David Noosaron, Maasai Landowner, Local Community Representative of Mara Rianta, Member of Mara North grazing committee
4.05-4.30	Sustaining pastoralism in Maasai Mara Dr. Gordon Wayumba, Professor Richard Odingo & Professor Evaristus M. Irandu, University of Nairobi

4.30-4.50	How farm-animal management may support wildlife conservation and social development PD Dr. Rainer Hospes, Prof. C. Hermosilla, Prof. Dr. A Wehrend & Prof. Dr. M. Lierz, Justus-Liebig-University Giessen, Germany, Faculty of Veterinary Medicine
7.00-8.30	Dinner
23 April 2015	
8.00-8.30AM	Facilitator: Professor Elias Ayiemba; Rapporteur: Mr. Khadohi Isalambo
8.30-8.55	Conclusions from the first summit day Professor Børge Obel and Professor Oyaro Nathan
8.55-9.15	A contested paradise: Contextualising the challenges and opportunities associated with managing boundary resource Mr. Salaton Tome
9.15-10.05	GENDER ISSUES Saving the Mara is saving the Maasai woman's livelihood Bernadette Loloju, World Vision
10.05-10.25	Gender implications of community participation, tourism and development in the Maasai Mara Dr. Stellah Mikalista Mukhovi, Dr. A. A. Oluoko-Odingo & Prof. E. M. Irandu, University of Nairobi
10.25-10.45	The Maasai Mara Game Reserve conservation: Integrating the Maasai woman into the conservation matrix through social entrepreneurship Joslyn Nzau & Dr. Gladys Ngao FOOD Facilitator: Associate professor Dorthe Døjbak Håkonsson; Rapporteur: Ms. Nancy Adagala
10.45-11.00	Food security and the eco-system Professor Mary Walingo, Vice-Chancellor, Maasai Mara University
11.00-11.20	Break
11.20-11.40	Ethnoecology in a changing world Professor Henrik Balslev, Aarhus University
11.40-12.00	ENERGY Energy systems/dynamics in Narok County Christopher Oludhe, Richard Odingo & Alice Oluoko-Odingo, University of Nairobi
12.00-12.10	Environmental costs and opportunities of agricultural modernization in Maasai Mara: National Accelerated Agricultural Input Access Program (NAAIAP) Implementation in Narok County Rose M. Mwangi, National Coordinator, Ministry of Agriculture in the Kenya Government
12.10-12.20	Final remarks, conclusions and next step Dr. Alice Oluoko-Odingo (University of Nairobi), Professor Tabitha Sewe (Maasai Mara University) and Head of Development Pernille Kallehave (University of Aarhus, Denmark)
12.20-12.30	Closing remarks Maasai Mara University

24 April 2015

9.00-9.20AM	<p>Mara River research – A short synthesis of 7 years of our research Christopher Dutton, Amanda Sublusky, David Post and Emma Rosi-Marshall Blog: http://maraadventure.blogspot.dk Research website: http://mara.yale.edu Network: https://thingspeak.com/channels/public?tag=MaMaSe</p>
9.20-9.40	<p>The Maasai Mara for the Mara Elephant Project Marc Goss Web: http://www.escapefoundation.org/projects/about-the-african-elephant-program/the-mara-elephant-project/</p>

THE WORKSHOP PROGRAM

24 April 2015

9:00-10:00	Presentations by Jesper Stagegaard, Karen Blixen Camp
10:00-11:00	Presentations by Marc Goos, Mara Elephant Project and Christopher Button, Mara Yale Project
11:00-11:30	Health break
11:30-1:00 PM	<p>Workshop</p> <ul style="list-style-type: none"> • The Board presents the vision and process • Discussion • White Paper workshop • Plenary sum-up
1:00-2:00	Lunch
2:30-4:00	More workshop
4:00-6:00	Tour to Mara Rianda and around the village

25 April 2015

9:00-11:00	<p>Workshop</p> <ul style="list-style-type: none"> • Groups continue working • Board meeting
11:00-12:00	Plenary sum-up and next step

Appendix 3: Summit and Workshop Participants

AARHUS UNIVERSITY, DENMARK

AARHUS BSS, SCHOOL OF BUSINESS AND SOCIAL SCIENCES

- Associate Professor Dorthe Døjbak Haakonsson, Department of Business and Technology /ICOA
- Director of Development Pernille Kallehave, Interdisciplinary Center for Organizational Architecture (ICOA)
- Professor Børge Obel, Interdisciplinary Center for Organizational Architecture (ICOA)
- Professor Jacob Eskildsen, Head of department, Department of Business and Technology/ICOA

SCIENCE & TECHNOLOGY

- GIS Coordinator Peder Klith Bøcher, Ecoinformatics & Biodiversity, Department of Bioscience
- Professor Henrik Balslev, Ecoinformatics & Biodiversity, Department of Bioscience
- Professor Jens-Christian Svenning, Ecoinformatics & Biodiversity, Department of Bioscience

ARTS

- Assistant professor Lars Bach, Interacting Minds Centre, Department of Culture & Society, ARTS and ICOA
- Assistant Professor Panos Mitkidis, Behavioural Economics and Experimental Anthropology, Interacting Minds Centre, Department of Culture & Society, ARTS and ICOA

HEALTH

- Professor Dorte Haubek, Department of Dentistry

UNIVERSITY OF NAIROBI, KENYA

- Dr. Alice Oluoko-Odingo, Department of Geography and Environmental Studies
- Dr. Gordon Wayumba, Technical University of Kenya
- Dr. Samuel Owuor, Department of Geography and Environmental Studies
- Dr. Stellah Mikalitsa Mukhovi, Department of Geography and Environmental Studies
- Professor Elias H.O. Ayiamba, Department of Geography and Environmental Studies
- Professor Evaristus M. Irandu, Department of Geography and Environmental Studies
- Professor Richard Odingo, Department of Geography and Environmental Studies

MAASAI MARA UNIVERSITY, KENYA

- Dr. Bonface Isalambo Khadohi, Department of Languages, Linguistics, Communication & Journalism
- Dr. Florence Kisirkoi
- Dr. Gladys Ngao
- Dr. Jepkemboi R. Choge, Department of Curriculum Instruction and Educational Management
- Nancy Adagala
- Professor Mary Walingo, Vice Chancellor
- Professor Oyaro Nathan, Dean, School of Arts and Social Sciences
- Professor Tabitha Sewe
- Mr. Reson Lankeu

JUSTUS-LIEBEG UNIVERSITÄT GIESSEN, GERMANY

- Dr. Rainer Hospes, Clinic for Reproduction

KAREN BLIXEN CAMP

- Jesper Stagegaard

SPEAKERS

- Honorable William Ole Ntimama
- Prof. Børge Obel, Aarhus University
- Director of Development, Pernille Kallehave, Aarhus University
- GIS Coordinator Peder Klith Bøcher, Aarhus University
- Post Doc, Jessica Hartel, Aarhus University
- Dr. Florence Kisirkoi, Maasai Mara University
- Mr. Bonface Isalambo Khadohi, Maasai Mara University
- Prof. Tabitha Sewe, Maasai Mara University
- Prof. Mary Walingo, Maasai Mara University
- Prof. J. Okumo, Maasai Mara University
- Prof. P. Jgunjiri, Maasai Mara University
- Dr. Belio Kipsang, Maasai Mara University
- Prof. Richard Odingo, University of Nairobi
- Ms. Faith Njeru, Maasai Mara University
- Prof. Almadi Obere, Maasai Mara University
- Dr. Alice Oluoko-Odingo, University of Nairobi
- Dr. Alice Kaudia, Ministry of Environment
- Dr. Jepkemboi R. Choge, Maasai Mara University
- Ms. Nancy Adagala, Maasai Mara University
- Prof. Henrik Balslev, Aarhus University
- PhD Lars Lindkvist, Maasai Mara Wildlife Conservancies Association
- Mr. Geert Aagaard Andersen, The Danish Ambassador to Kenya
- Prof. Jens-Christian Svenning, Aarhus University
- Dr. Christopher Oludhe, University of Nairobi
- Dr. G. Wayumba, University of Nairobi
- Prof. E.H.O. Ayiemba, University of Nairobi
- Dr. Samuel Owuor, University of Nairobi
- Ms. Jennifer Koikai, Maasai Mara University
- Professor Evaristus Irandu, University of Nairobi
- Jesper Stagegaard, Chairman of the Board of Karen Blixen Camp
- Chania Frost, Chief Operating Officer in Mara North Conservancy
- Jackson Looseyia, Professional Safari Guide in Maasai Mara
- David Noosaron, Maasai Land Owner
- Dr. Rainer Hospes, Justus-Liebig-University Giessen
- Mr. Salaton Tome, Maasai Mara University (Wildlife management)
- Bernadette Loloju, World Vision
- Dr. Stellah Mikalista Mukhovi, University of Nairobi
- Joslyn Nzau, M.A. in Gender and Environment
- Dr. Gladys Ngao, Maasai Mara University
- Prof. Dorthe Døjbak Håkonsson, Aarhus University
- Rose M. Mwangi, Ministry of Agriculture of Kenya
- Christopher Dutton, Yale University, The Mara Project
- David Post, Yale University, The Mara Project
- Emma Rosi-Marshall, Yale University, The Mara Project
- Marc Goss, Mara Elephant Project

Appendix 4: Abstracts of Presentations

ANTHROPOCENE ECOLOGICAL DYNAMICS

Jens-Christian Svenning

Human activity is now an increasingly dominant force in the Earth system. The global human population is growing and is likely to reach a staggering 11 billion by year 2100, and human resource use is increasing both in total and per capita. This development is leading to massive environmental changes, also in climate. It also has strong impacts on biodiversity, with high and likely increasing rates of biodiversity loss a particular concern.

The massive human influence on the biosphere requires new foci for ecological research to provide scientific guidance for maintaining Earth's rich biodiversity and functional wild ecosystems in this Anthropocene epoch. I will discuss three key phenomena that demand attention and integration: ecological disequilibria, novel ecosystems, and trophic cascades, with attention to how these relate to the dynamics and preservation of the Maasai Mara-Serengeti ecosystem in the Anthropocene. The ongoing environmental changes are already driving changes in species ranges, community composition, and ecosystems and such changes are expected to continue. What is less appreciated is that these dynamics are likely to involve strong ecological disequilibria, where biota and ecosystems on one hand and climate on the other becomes mismatched, notably through extinction debts and immigration lags. The consequences can be complex and lead to unexpected ecological outcomes.

These dynamics together with other human-driven forces, notably globalization, will cause increasing proportions of wild nature around the world to be novel ecosystems. Novel ecosystems are self-perpetuating ecosystems that have resulted from human activities and do not have natural historical precedents. While much debated in recent years, we do not yet have a good understanding how such ecosystems function, notably the role of exotic species in these ecosystems, their capacity to harbour biodiversity, and how they will respond to further Anthropocene changes, notably in climate. Recent years have witnessed an increasing recognition of the role of trophic cascades in ecosystems, and jointly with this, their strong worldwide attrition due to defaunation. At the same time there is increasing interest in remedying this trophic downgrading, including via the usage of non-native species as ecological replacements for extinct species. However, only limited empirical work has been done to evaluate how such trophic cascades interplay with other Anthropocene dynamics, limiting our ability to guide their usage for biodiversity conservation and ecological restoration.

CLIMATE CHANGE AND SURVIVAL OF MAASAI MARA ECOSYSTEM

Richard Odingo, Evaristus M. Irandu & Christopher Oludhe

The Maasai Mara ecosystem, arguably Africa's most famous wildlife habitat, faces serious threats which may jeopardize its very survival. Some of the threats include climate change, human settlements and land use changes. Climate change is of particular relevance to tourism. This is because tourism destinations, enterprises and tourists are all sensitive to variability and change in climate and weather parameters. Climate also has an important influence on environmental conditions that can deter tourists, such as wildfires, diseases, pests and extreme weather events such as floods and droughts. Because climate represents both a vital resource to be exploited and important risk to be managed in tourism, it is expected that the integrated effects of climate change with shifts in both climatic means and extremes, will have profound impacts on tourism businesses and destinations. The expansion of human settlements in the Mara area, largely due to rapid population

growth coupled with land use changes, poses a grave threat to the sprawling ecosystem. Those facing the greatest threat are conservancies adjacent to the Maasai Mara National Reserve. These conservancies do not only provide an important buffer zone to encroaching farmlands and human settlements but are also seen as best practices in community wildlife conservation. However, the Mara ecosystem despite being a vast area incorporating the protected area, its considerable large mammal species requires access to large, unprotected dispersal ranges inhabited and increasingly transformed by agro-pastoral communities. As a result, human-wildlife conflicts are experienced both within and outside the protected areas of the ecosystem. These conflicts pose a major threat to the ecosystem viability. This paper examines the relationship between tourism and biodiversity, and tourism and livelihoods in the Maasai Mara ecosystem in the Narok County, Kenya. The impacts of climate change on these relationships are critically examined. The possible mitigation measures to ameliorate climate change impacts in the study area will also be discussed.

EFFECTIVENESS OF COMMUNITY RELATIONS STRATEGIES IN CONSERVATION OF MAASAI MARA AND MAU ECOSYSTEMS IN KENYA

Mary Walingo, Tabitha Sewe, Simon Seno, Oyaro Nathan,

Nancy Adagala & Khadohi Isalambo

The paper investigates the effectiveness of community relations strategies used by conservation groups and government agencies. The study employs stakeholder, conflict and situational theories to explain the communication engagement between the organizations and their publics. The paper analyses the community relations strategies used for community-based conservation of the Maasai Mara and Mau ecosystems. The findings reveal an absence of evaluation research and general planning of community relations strategies adopted by government agencies and conservation groups.

ENERGY SYSTEMS AND DYNAMICS IN MAASAI MARA OF NAROK COUNTY

Christopher Oludhe, Richard Odingo & Alice Oluoko-Odingo

Energy is a key input in the development process of any nation or county. Its availability, production and utilization are critical for a country's socio-economic growth. Petroleum and electricity are currently the key drivers of the modern commercial sector in Kenya. Wood fuel provides energy needs of the traditional sector including rural communities and the majority of urban households. In addition, industry (e.g. food processing, agro-processing and cement) and institutions are also switching from petroleum-based fuels or coal to using wood fuel for heating applications. Kenya's electricity generating capacity is made up of Hydro 48%, Thermal (fossil fuel) 38%, Geothermal 12%, Cogeneration (bagasse) 2% and Wind 0.3%. Hydro generation dominates the electricity supply mix but is highly vulnerable to weather conditions and climate change. Geothermal energy resources in Kenya are mainly located within the Rift Valley some of which fall within Narok County with an estimated potential of up to 10,000 MW. This resource is not affected by climatic variability and has high availability (capacity factor) at over 95 %. The Narok County is a major source of biomass energy in the form of fuelwood and charcoal which, combined, are leading to massive deforestation and devegetation, and ultimately contribute to anthropogenic climate change in the next few decades unless stopped by the Government. A comprehensive assessment, mapping and appraisal of all the renewable energy resources in the country have not been done to determine their technical and economic viability. This paper will review the available energy resources mentioned above, their

technologies, the challenges they present, and opportunities with special focus on the Maasai Mara portions of Narok County. Research on various sources of energy will be paramount to enable Narok County to contribute to environmentally safe energy production without creating new problems for the county, and for Kenya as a whole. Changes in the energy sector are already required to stop land degradation in the next 20 years, and experiences from the Maasai Mara will be crucial for finding alternative technologies to save the environment from total destruction.

ETHNOBOTANY IN A CHANGING WORLD

Henrik Balslev

Ethno-botany is the scientific study of the relationships that exist between people and plants. The term was coined over 100 years ago by Harsberger, who defined the field as the study of the use of plants by aboriginal people. The concept has since been widened to cover how plants are used, managed and perceived, but it remains focused on traditional cultures. Current interest in the concepts of local knowledge or traditional knowledge as expressed in the recent Nagoya Protocol of the United Nations has brought ethno-botany back in the forefront. Conservation under the Convention on Biological Diversity (CBD), now asks signatory countries to register and take into account local knowledge when planning development and conservation. For many years ethno-botany was a purely descriptive field of science, but over the past 30 year the field has grown into an analytical science employing a combination of anthropological and ecological theories and quantitative methods. A number of sub disciplines have developed such as ethno-medicine, ethno-taxonomy, ethno-ecology, and others – each of them emphasizing specific elements of the plant-man interaction in traditional cultures. Ethno-botany is also related to Economic Botany, and many plants that today are multibillion-dollar crops were discovered through ethno-botanical research. This includes tobacco (*Nicotiana tabacum*), which was discovered among traditional cultures in the Amazon basin, corn (*Zea mays*) which was discovered among traditional cultures in Mexico, coffee (*Coffea arabica*) which was discovered in the Ethiopian highlands and rice (*Oryza sativa*), which was domesticated in the Far East. But most ethno-botanical research documents the thousands of uses that are made of plants in rural settings and among traditional cultures. This work has its importance in documenting the value of native vegetation to the people who live in the forests and savannahs. Ethno-botany is also related to the debate on climatic change. Many plant species will change their distribution when the climate changes. Such changes can be studied using modern Species Distribution Modeling. It is a paradox that, while the industrialized world increases its knowledge capture capability, local knowledge is eroded in developing countries, because there are no means of capturing and transmitting the information when traditional groups are acculturated. The Global Biodiversity Information Facility now provides 529,254,560 occurrences of 1,605,262 species, but most knowledge of how they are used and how they can serve traditional cultures remain to be gathered and made available. Combining ethno-botanical studies with new information technology is one of the ways ahead. Finally, the omnipresent process of urbanization will impact the study of traditional knowledge and ethno-botany. In Brazil, the US and Western Europe it is forecasted that 90% of the population will live in cities by 2045. In China 70% and South East Asia over 60% will live in urban areas by the same time. This urbanization is maybe the greatest challenge to traditional knowledge and makes the study of ethno-botany and traditional knowledge so much more urgent.

EXPLORING ONLINE ECO-LINGUISTIC COMMUNICATION STRATEGIES ON THE CONSERVATION OF MAASAI MARA GAME RESERVE AND MAU FOREST COMPLEX

Khadohi Isalambo, Tabitha Sewe, Nancy Adagala, Ruth Choge & Florence Kisirgoi

This paper critically appraises the ways in which the environment, sustainability and ecologies within the Maasai Mara Game Reserve and Mau Forest Complex are presented, represented and constructed through various forms of language via online communication. The paper explores both the symmetrical and asymmetrical approaches used by environmental conservation bodies and agencies with focus on websites, blogs, Facebook accounts. Various theoretical concepts within environmental discourse analysis such as eco-critical discourse analysis, critical eco-linguistics, language of ecology and environmentalism are used to explore the discursive linguistic discourses on sustainable development used by both the conservationists and the targeted publics. The study analyses discourses used with a view to establishing best online linguistic practices with environmental publics.

FROM RESEARCH TO DEVELOPMENT

Henrik Borgtoft Pedersen

Development actions are frequently based on – or inspired by – results from research activities, but often the path from research to development is long and winding. The Maasai Mara Science and Development Initiative aim at making a shortcut, linking research and development as early as possible by addressing development challenges in Maasai Mara region in the design of the research projects. A number of actions may facilitate the process of turning research into tangible development, including:

- Base the research design on a holistic understanding of the challenges in the region, e.g. at the level of the Mara River Basin. The region is very dynamic; both naturally, with e.g. the annual migrations of wildebeest and the varying flow of the Mara river, as well as politically, economically, and culturally, with large changes related to increasing population, urbanisation, tourism, cultural changes among the Maasai pastoralist, and changes in land use in general. Climate change may add further to this complex dynamic, and in combination it all calls for a cross-disciplinary research approach to support sustainable development in the Maasai Mara.
- Discuss the research ideas with relevant stakeholders, including local communities, adjust as needed (preferably in a continuous process where dialogue regarding the applicability of the research is maintained throughout the lifespan of the programme).
- Close research cooperation with the Maasai Mara University. The university has an extensive knowledge of the region and its challenges, and it remains in the area once the joint programme is over.
- Involve students, employees from relevant local organizations and local community members as field assistants, guides, co-authors etc., emphasizing capacity building and knowledge exchange (both ways) during the process.
- Ensure efficient dissemination of research results through both scientific and popular media (the latter may include popular booklets and manuals, videos, radio, social media, etc.). Easy and open access to the information is important. Dissemination may be done in cooperation with local organizations.
- Coordinate with development practitioners (NGOs, public authorities, private companies) to ensure tangible development projects or strategies/policies are formulated, based on the

research results.

- If funds become available, support implementation of concrete development actions through local institutions (public or private), and/or liaise with relevant financing organisations/donors who may include the project proposals in their programmes.

GENDER IMPLICATION FOR COMMUNITY PARTICIPATION, TOURISM AND DEVELOPMENT IN THE MAASAI MARA ECOSYSTEM

E. Irandu, A.A. Oluoko-Odingo & S. Mukhovi

The Mara ecosystem, famous for its wildebeest migration, has one of the richest concentrations of bio-diversity in Kenya. The ecosystem is expansive, stretching between two countries Kenya and Tanzania. For the purpose of this paper, the Kenyan side of Maasai Mara and most specifically Narok County will form the basis of the discussion. The Maasai culture, livelihoods, wildlife and tourism are intertwined. Understanding some aspects of the Maasai community that has shaped and will continue to influence conservation and development is important. Active participation of the community in development and equitable sharing of benefits among community members is crucial for the sustainability of any resource. However, often some members of the community may not be given equal opportunities to participate because of how participation is constructed by culture and other social factors. Although highly contested, the relationship between tourism and development is now well established in academic and policy circles. What is less clear is the potential of tourism in contributing to the promotion of gender equality and women empowerment. The main objective of the paper is to discuss the current gender issues among the Maasai community living in Narok County and how these can hinder or promote participation in tourism in particular, and development in general. Understanding the changing patterns of gender relations, roles and identities and how they affect access to resources, social infrastructure and benefits accruing from tourism and other development activities is key to securing sustainable livelihoods of the Maasai community and promoting development in the county. Economic activities in the Mara such as tourism, livestock production and arable agriculture are analysed to understand the participation of men, women and youth. The challenges faced in promoting active gender participation in tourism activities in the Maasai Mara ecosystem are examined and possible mitigation measures suggested. Finally, the paper discusses gender mainstreaming in tourism and development and how environmental, socio-economic and political changes are shaping the gender dynamics in the Maasai community. To achieve the stated objective, literature review, content analysis of policy documents and personal observations in the Mara ecosystem were used.

INTERROGATING PREVIOUS RESEARCH STUDIES IN THE RESTORATION OF THE MAASAI MARA GAME RESERVE AND THE MAU FOREST COMPLEX

Tabitha Sewe, Mary Walingo, Simon Seno, Almadi Obere, Nathan Oyaro & Ruth Choge

The paper interrogates previous researches on the restoration of the Maasai Mara Game Reserve by analysing their objectives, methodologies, findings and recommendations. The study adopts a content analysis method with a view of classifying the researches into themes. The research identifies gaps in current restoration researches through various categories of researches identified.

LONG-TERM RESEARCH, CONSERVATION, AND SUSTAINABILITY IN PROTECTED AREAS

Jessica Hartel & Casper Andersen

In 2010, the Maasai Mara was placed on UNESCO's Tentative List for evaluating its candidacy for inclusion as a World Heritage Site. Its adjacent sister ecosystem, the Serengeti National Park in Tanzania, was given World Heritage status in 1981. The World Heritage List has been in operation for 40 years, providing abundant empirical material for measuring the long-term effects of World Heritage status to determine under what circumstances the status provides beneficial or detrimental outcomes. In terms of conservation and sustainability, achieving World Heritage Site status affords many benefits that generate international attention, eco-tourism, research, funding, local pride, UN affiliation, governmental cooperation, NGO development, and Geneva Convention protection. Developing a long-term field site will provide both research and conservation initiatives that will further demonstrate the importance of the Maasai Mara and may help further promote its inclusion as a World Heritage Site. To analyse the effects of World Heritage Status of the Mara, we need to investigate systematically the process and negotiations in the UNESCO heritage system pertaining to the status of the Mara. A research station can also contribute to long-term capacity building that can help to make World Heritage status a beneficial factor in the promotion sustainable natural and cultural heritage management in the Mara.

Along these lines, World Heritage status can also serve as a buffer to the ongoing human-wildlife conflict in the Mara, which is currently the biggest threat to the reserves longevity. As the human population continues to grow, so does the rate of species extinction. With a rapidly growing human population that presses hard at the reserves' boundary, the human-wildlife conflict in the Maasai Mara has intensified as farms expand and reroute migrating wildlife. This conflict leads to local populations developing negative attitudes towards the wildlife and the reserve. While the Mara is home to rich biodiversity and the highly publicized "largest terrestrial migration on earth", local populations are the ones often victimized by wildlife ranging outside of the reserve – entering into their gardens and killing their livestock. Scientists, conservationists, NGOs, tourists, and local populations must therefore find more effective modes of communication and collaboration in culturally appropriate/sensitive ways if the Maasai Mara – Serengeti ecosystem has a chance at long-term survival. Recently preliminary data from long-term great ape research sites have shown that long-term research investment promotes conservation of species and habitat, education, and local sustainability. We are interested in investigating this relationship from a bio-cultural perspective and how natural and cultural heritage affects research and conservation over time in the Maasai Mara. We propose a multi-level approach that incorporates an active research, conservation, and education programme modeled after the Kibale Chimpanzee Project, Kibale Snare Removal Program, and the Kasiisi Project, respectively.

ORGANIZATION AUDIT AND DESIGN OF THE COLLABORATIVE COMMUNITY OF MAASAI MARA

Børge Obel, Jacob Kjaer Eskildsen, Dorthe Dojbak Haakonsson & Pernille Kallehave

Organization design research focuses on how to analyse, design and redesign private and public organizations to secure their ability to excel now and in the future. In the Maasai Mara Science and Development Initiative our focus is to do research on the organizational design aspects of wildlife conservation and organizational, economic and political development. It is obvious that the right organizational design is vital for a successful conservation of the Maasai Mara as a whole in the

context of the modern and developed society. Due to the complex relations between the various stakeholders, conservation management experience shows that incentive structures can be critical in achieving the goals of conservation efforts. Conservation work in the Maasai Mara is no different in this respect as the sustainable preservation of wildlife takes place in a literal biological ecosystem as well as in a cultural/political/commercial ecosystem of stakeholders (NGOs, travelling businesses, national governments in Kenya and Tanzania, local governments, local pastoral groupings and other ethnic groups etc.). Hence, the alignment of goals and incentives of the complex network of actors and interests is crucial for achieving the goal of preservation of the Maasai Mara in a sustainable manner. The audit and design process could look like this:

- Mapping out the stakeholders and their mutual relation (economic, decisions and authority, and publicity/CSR) - an organizational audit.
- Applying a theoretical framework to identify critical relations in the present actors with influence on the Maasai Mara
- Running simulated model scenarios of the MME stakeholder network to develop sustainable design of the ecosystem as well of an implementation path.

From an organizational design perspective, the various stakeholders of the Maasai Mara network could be seen as different organizational units, differing one from the other in terms of mission, operational goals and expected outcomes, also called a multi-organizations configuration. The ecosystem itself explains that such units have complementarities. The combination of such units requires the adoption of a "LEGO approach", by which several "bricks" are put together to form a more general design. To this extend the desired ecosystem could be seen as an appropriate multi- organizations design able to satisfy the expected goals. The adoption of a multi-contingency approach and theories of collaborative communities are needed in order to set up a general organization design in which every stakeholder can fulfil its own interests, yet maximizing the general outcomes (wellness of population, preservation of the natural environment, economic growth, etc.). In order to do that, the above-mentioned sub phase 1) is as critical as the others.

POLICY IMPLICATION IN THE RESTORATION CONSERVATION OF THE MAASAI MARA GAME RESERVE, MAU FOREST COMPLEX

Jepkemboi R. Choge, Tabitha Sewe, Mary Walingo, Nancy

Adagala & Khadoi Isalambo

Maasai Mara Game and the Mau Forest Complex have been classified as the fragile ecosystems which require agent interventions for their survival. The Mau Forest Complex forms the largest closed-canopy forest ecosystem of Kenya, standing at 400,000 hectares, it is the single most important water catchment in Rift Valley and western Kenya, and is natural asset of national importance whose condition has a major impact on the agriculture, energy, and wildlife and tourism sectors. This critical ecosystem helps secure the provision of water supply to urban areas for domestic and industrial use and supports to the livelihoods of millions of people living in the rural areas, not only in Kenya, but also in neighbouring countries. Most importantly is that Maasai Mara Game reserve depends on it for its water supply. Despite its critical importance for sustaining current and future economic development, the Mau Forest Complex has been impacted by extensive irregular and ill-planned settlements, as well as illegal forest resources extraction that have reduced cover by more than 25% in the past 15 years. Since 2008, the government of Kenya has cultivated a sense of public urgency and political awareness to conserve and rehabilitate the Mau Forest Complex that has permeated all aspects of Kenyan society. The purpose of this paper is to present the challenges and opportunities in the policy formulation and implementation in the conservation of the Maasai Mara Game Reserve and Mau Forest Complex. The primary data, on the other hand, was generated

through interviews and focused group discussions (FGDs). These were conducted on the residents of Chemare and Chematich sub-locations both in Kiptororo location Kuresoi South Sub-county in Nakuru, Bomet and Narok Counties: the KFS staff, D.O, Chief and Assistant Chiefs, officials of CFAs and NGO, one timber merchant/logger, one charcoal maker/merchant and the opinion leaders. The respondents were identified through probability and non-probability sampling methods while the data obtained was analysed and presented in a descriptive method. The study found that there exist policies on environmental conservation. From the findings, the study concluded that the policies on environmental conservation in Kenya are adequate and clearly spelt out in the conservation of the Mau Forest Complex. However, the presence of good policies notwithstanding, the implementation in the conservation of the Mau Forest Complex is still wanting as it faces a myriad of challenges. The study further concluded that there is a thin line between politics and Mau Forest Complex conservation in Kenya

POPULATION DYNAMICS, TOURISM AND DEVELOPMENT IN MASAII MARA

Elias Ayiemba, Stella Mukhovi & Samuel Owuor

The Maasai Mara Ecosystem in south-western Kenya comprises of the Maasai Mara National Reserve and the adjoining group ranches and conservancies. The ecosystem has the richest concentration of wildlife in Kenya and is globally known for the annual spectacular wildebeest migration. Administratively, the Kenyan side of the ecosystem traverses Transmara and Narok Counties. However, the discussions presented in this paper are restricted to Narok County, which adequately represents the larger Masaai Mara landscape. In order to secure the future of the Mara ecosystem, a study on population dynamics and its impact on natural resource utilization, conservation and development is important. Population variables (human capital) can be both a threat and opportunity for development. Furthermore, the effects of population dynamics, both urban and rural, on land use and land cover changes are important variables in this study. This paper is based on the analysis of past, present and future population dynamics in Narok County in-as-much-as they relate to environmental resources, social infrastructure, wildlife conservation and management, and changing perceptions about resource use. Migration and urbanization will be integrated in the analysis of population dynamics. The paper also discusses population pressure and competition over resources among different land use actors and between people and wildlife, as well as conflicts that may arise and possible mitigation measures.

REMOTE SENSING TO MONITOR AND STUDY ECOSYSTEM DYNAMICS AND DEGRADATION IN THE MASAII MARA

Peder Klith Bøcher

Remote sensing (RS) is the measurement of properties of the earth's surface using data acquired from airborne or space-borne vehicles. RS-data provide a repetitive, full coverage, and consistent view of the earth that can be used for many purposes such as monitoring short-term and long-term changes, and assessing the impact of human activities.

Some of the important applications of RS-technology are: mapping (topography, land cover); natural resources (wetlands, soils, forests, vegetation types); human impacts (urban growth, roads, industry, waste); agriculture (crop types, crop conditions, soil erosion, irrigation regimes); hydrology (water streams, soil erosion, flooding risk assessments); and meteorology (atmosphere dynamics, precipitation, temperatures, wind speed). Many RS programmes scan the earth systematically with revisiting as frequent as every 14 days. These data are stored in large internet archives, and besides

providing the raw image data, several programmes provide refined and interpreted data such as measurements of vegetation indices, primary production, land cover maps, terrain elevation etc. RS-programmes from NASA and lately also ESA (European Space Agency) offer these kinds of RS data for free. Some of these archived data date back to 1980s thus providing a direct option to assess land changes over the past 30 years. The data span a range of pixel sizes of 1-km to 30-meter. A number of private companies provide satellite-based RS data with sub-meter resolution. These data are extremely valuable for making baseline maps with high accuracy and details but as they are commercial they are also expensive to buy. In recent years airborne laser scanning technology (LiDAR) has developed greatly. With this technology it is possible to scan an area from an airplane and assess the shape of the terrain surface in sub-meter resolution as well as assessing the 3D-structure of vegetation canopies etc. This powerful technology makes it possible to map and model the surface hydrological properties of the terrain and thereby analyse the hydrologic connectivity. This is utterly important for modelling the ecological impact of human activities, hazardous wastes, climate change etc. The presentation will outline some of the obviously interesting possibilities of remote sensing for the Maasai Mara project. It will demonstrate where we can launch activities at no or relatively low cost and where we will need to apply for funding. Moreover it will emphasize the importance of planning educational activities for the people involved (researchers, students, stake holders etc.) so as to learn to apply GIS and RS technologies.

THE CHALLENGE OF SUSTAINING PASTORALISM LAND TENURE SYSTEM FOR ECOLOGICAL CONSERVATION IN THE MAASAI MARA ECOSYSTEM

Gordon Wayumba, R. Odingo, E. Irandu & Christopher Oludhe

In the Maasai Mara ecosystem nomadic pastoralism remains a dominant form of land use where pastoralists align their livelihoods with seasonal climate variations by systematically moving their livestock to different grazing locations. In recent past, nomadic pastoralism in the Maasai Mara is challenged by the concept of private property where conventional private property regimes seek to allocate individual rights to land, traditionally over fixed and well-defined areas. Following the period of decolonization in Africa, implementation of these programmes became popular worldwide, even in regions with arid and semi-arid climate. However, pastoralism as a sustainable Land Tenure system has persisted and conflicts soon ensued with smallholder crop farmers. Contemporary drivers, many underpinned by climate change adaptation, further complicate these tenure conflicts: Surges in large-scale foreign investment in land, increased nature conservation activities, growth in tourism, forest depletion, oil and mineral extraction programmes all increase tensions between the different stakeholders. Under these circumstances, nomadic pastoralism often loses out in these climate change-inspired conflicts. While pastoralists are intrinsic climate change adaptors, they are weaker economically and legally. Unlike other land uses, pastoralism activities are not always assured by national land policy and administration frameworks. Private ownership is often given precedence over customary land tenures. Despite policy and legislative movements, approaches for practical recording remain unclear: knowledge on how to record pastoralism tenures in a manner that ensures sustainable ecosystem conservation is almost non-existent. The climate change adaptation offers an opportunity to develop methodologies for recording pastoralism. Currently, there is a general agreement that pastoralism has a major role to play in supporting sustainable ecological and economic systems. Moreover, the limitations of conventional private property approaches are clear as the national land policies already reflect the changing ideology.

The challenge is to operationalize the new ideology. Many studies focus on understanding the status quo: pastoralism actors, related resources, and various interactions are studied. Others seek solutions. Clear acceptance of pastoralist tenures at all levels is an important ingredient in operationalization: all successfully secured formal land tenures rely on clear descriptive and spatial identification. Fit-for-purpose adjudication, mapping, and recording processes deliver this point

of authority to communities, governments, and NGOs. Understanding the spatial and temporal aspects of migratory routes will assist in developing this authority. Whilst pastoralism has been widely studied and some routes are recorded many remain undocumented and only vague ideas exist of how pastoralists move. Moreover, the climate change-induced shifts in migratory routes are also unknown. Conventional land administration tools are not equipped to capture or manage pastoralist tenures. This paper therefore seeks to look into the changing land tenure and land use regime in the Maasai Mara conservancy and proposes a methodology for the comprehensive documentation of the changes as a means of further understanding the climate change induced migration, and thereby understand how pastoralism can be better sustained for better ecological management.

HOW FARM ANIMAL MANAGEMENT MAY SUPPORT WILDLIFE CONSERVATION AND SOCIAL DEVELOPMENT

Michael Lierz, Axel Wehrend, Christine Wrenzycki, Carlos

Hermosilla & Rainer Hospes

The Maasai Mara National Game Reserve and its surrounding areas represent a fragile eco-system, which is seriously threatened by many different factors concerning its function and existence. One of the major problems seems to be the competition of grazing farm animals with wildlife on pastures and shared habitats. Economic and social motives lead to increasing herds of livestock and, as a consequence, to continuous displacement of free-ranging animals. In a first assessment step on the needs and aims of landowners and the current parameters of animal production, as well as the situation of wildlife, information has to be gathered. This will be performed in coordination with local experts and socio-economic researchers, so that interactions between livestock and wildlife can be described and evaluated. Special emphasis is placed on monitoring infectious and zoonotic diseases, health maintenance programmes, productivity and reproductive performance (herd and individual) in both wildlife and livestock. In a second step immediate measures will be initiated with the aim to improve the current performance as well as lifetime production of livestock, introducing the tools of modern veterinary science, adapting them to local conditions and requirements. Breaking chains of infections and zoonoses in interactions of livestock and wildlife as well as in farm dogs and free-ranging predators/stray dogs and installing an improved management is considered as prerequisite for balancing the coexistence between farm animals and wildlife. The aim will be to minimize the pressure on free-ranging animals and simultaneously improve the quality of livestock and its productivity without maximizing herd sizes. In a third step a long term cooperation in research and education will be installed, which includes the establishment of a research camp on-site for student and research workshops as well as the establishment of an exchange programme for students, teaching and scientific staff to increase the local knowledge to have the implemented methodologies self-sustaining in future.

Appendix 5: Ongoing Research in the Maasai Mara

NAME	INSTITUTION/SUPERVISOR	PROJECT
Claire Bedelian	ILRI, CGIAR,UCL	Community, Economic benefits of Conservancies PhD
Niels Mogensen	University of Copenhagen	Mara-Nabiosh Lion Project
Dr. Laurence Frank, Nicholas Elliot	University of California Berkeley	Mara Predator Project
Dr. Kay Holekamp & Co	Michigan State University	Mara Hyena Project
Connor Jandreau	University of Manitoba	Cattle/Community/onservancies
Dr. Bilal Butt	University of Michigan	Livestock, Political Ecology
Dickson Kaelo	University of Nairobi –Centre for Sustainable Dryland Ecosystem and Societies	Land Use
Crystal Courtney	University of Edinburgh	Grassroots interpretations of development in Koiyaki, Maasai Mara, Kenya, and its perceived relationship with the Koiyaki Conservancies- PhD Gnu Landscapes
Robin Reid, Jeff Worden, Jared Stabach	Colorado State University	Gnu Landscapes
Christopher Dutton	Yale University	Mara River http://maraadventure.blogspot.ca/
Femke	Oxford KWT	Maasai Mara Cheetah Project
Dr. Ian Douglas Hamilton, Mark Goss	Save the Elephants	Mara Elephant Project – Elephant movements, behaviour
Cara Steger	University of Michigan	Citizen Science methods can be reliable alternatives to conventional wildlife monitoring
Mariam Olivia Westervelt	ILRI, Katherine Homewood UCL	Loita Forest
Joseph Ogutu	Institute of Crop Science, University of Hohenheim, Germany	Everything... so many papers
Mohamed Said	ILRI	Livelihoods, wildlife, DRSRS data
Juliet Kariuki	University of Hohenheim, Germany	Political ecology approach to explore gender in payments for ecosystem service schemes



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