The expansion of agriculture in Kenya and its effect on the African elephant

Utbredningen av åkermark i Kenya och dess påverkan på Afrikansk elefant

Charlotte Öhman

Skara 2015

Etologi och djurskyddsprogrammet

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Studentarbete 608, Skara 2015

G2E, 15 hp, Etologi och djurskyddsprogrammet, självständigt arbete i biologi, kurskod EX0520

Handledare: Jens Jung, SLU Skara: Forskningshuset, Gråbrödragatan 9, 532 23 Skara

Examinator: Claes Anderson, Ulls väg 26, 750 07 Uppsala

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Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens miljö och hälsa
Box 234, 532 23 SKARA
E-post: hmh@slu.se, **Hemsida:** www.slu.se/husdjurmiljohalsa

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Abstract
The human-elephant conflict is the biggest threat to the population of African elephants (*Loxodonta africana*). One example of this is elephants entering and raiding cropland that sometimes destroys farmers' major source of income. Methods of preventing crop-raids often result in fatal injuries for both people and elephants. The increasing human population demands expansion of cropland to sustain future generations. The detrimental effect of this is agriculture’s expansion in elephants' habitat and migration routes that fragments areas of importance for elephants. It also creates higher availability of farmland that subsequently increases the risk of crop raids. Investigating the relationship between the agricultural expansion and the fluctuating elephant population is therefore important to determine the focus for future conservation. Qualitative interviews performed outside of Maasai Mara National Reserve showed mainly negative attitudes towards elephants. Descriptive statistics of elephant census data, agricultural data, and human population data were compiled from Kenya National Bureau of Statistics and Food and Agriculture Organization between 1977 and 2012. The result displayed decreasing trends of the population of African elephant and increasing trends of agriculture and the human population. These trends in combination with the interviews show that there is a need to calm the current human-elephant crop raiding conflict and improve the attitudes of farmers. A suggestion is to support community-based wildlife management and strengthen the communication between farmers and responsible authorities. The agricultural expansion will persist but research on intensification of crop productivity could possibly reduce the area required.

1. Introduction

Humans and the African elephant (*Loxodonta africana*) have long lived alongside each other and the conflict between the two has always been evident (Lee & Graham, 2006). In Kenya, history shows an arms race with protective methods of both people and agriculture whilst elephants continuously show their adaptive ability and finds ways around these measures (Osborn & Parker, 2003). With economic development follows greater availability of weapons that gives humans the upper hand (Lee & Graham, 2006). The increase of conflicts between humans and animals is described to be one of the major threats to the population of elephants (Blanc, 2008). The IUCN red list displays that the global elephant population is currently increasing (Blanc, 2008) and is distributed through West, South, East, and Central Africa (Fig. 1). However, the population is more and more fragmented and there are local decreasing trends in parts of Africa (Blanc, 2008).

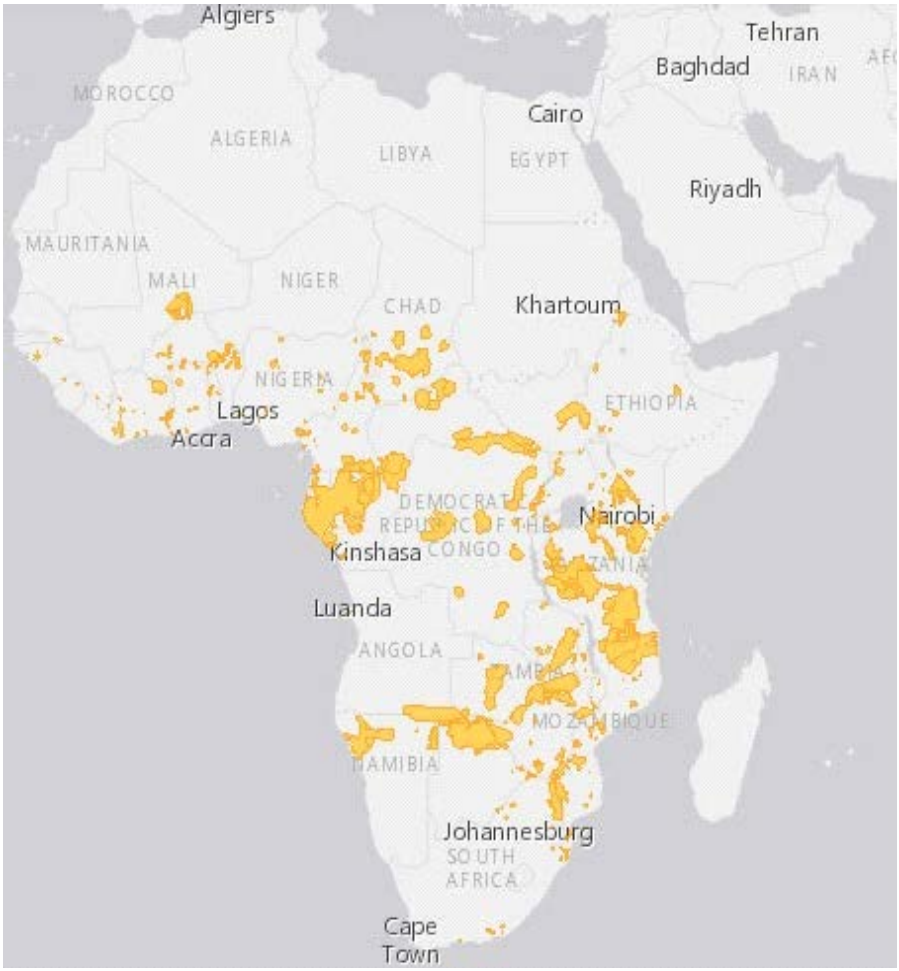

Figure 1. Distribution of the African elephant population (IUCN/SSC African Elephant Specialist Group, 2008)

The consequences of the conflict due to spread of agriculture are evident in both people (Hoare & Du Toit, 1999; Barua *et al.*, 2013; Harich *et al.*, 2013) and elephants (Lee & Graham, 2006). Crop raiding is one of the major manifestations of human-elephant conflict and is performed through elephants entering and raiding farmland containing crops (Lee & Graham, 2006). With a larger cultivated area there is a higher potential for human-animal encounters and subsequently a conflict between the two (Granados & Weladji, 2012). The percentage of households that report crop-raids have in a 13 year period increased from 40

to 58 per cent in Cameroon (Granados & Weladji, 2012). Negative attitudes regarding elephants are common and locals perceive that the elephant population has increased; the authors explain this by human settlements increasingly encroaching upon elephants' habitat (Granados & Weladji, 2012).

Spearing elephants in Kenya is common when deterring elephants (J. Kaigil, personal communication, March 22, 2015) but illegal (11th chapter, 92 § The Wildlife Conservation and Management Act, 2013 [Kenya Gazette Supplement no. 181.], Acts no. 47 of 2013). Farmers risk arrest but since they rarely get economic compensation for crop raiding due to difficulties to prove the occurrence, they sometimes feel that they are left with no other choice (J. Kaigil, personal communication, March 23, 2015). Legislation implemented in January 2014 is supposed to enable farmers to get compensation for damaged crops (5th chapter, 25 §, 4-5, The Wildlife Conservation and Management Act, 2013 [Kenya Gazette Supplement no. 181.], Acts no. 47 of 2013). However, conditions demand that reasonable methods of preventing crop raids have been performed beforehand.

Osborn (2004) describes that elephants are also vulnerable when crop raiding; the involved risk in moving out from the protected area is according to the author not worthwhile during early wet season when the nutritional content in grasses are equivalent to crops. Consequently, elephants' preferences for feeding grounds could be determined by seasonal differences (Osborn, 2004). During harvest there is an increase in crop raiding events due to the crops' high-calorie peak (Sitienei *et al.*, 2014). Farmers in India have solved this by harvesting before the crops are fully mature to avoid crop raiding with the result of receiving lower income (Thuppil & Coss, 2012). There are direct methods of preventing crop raiding but these are often too expensive for farmers as for example electric fencing (Kioko *et al.*, 2008), or laborious in relation to the effectiveness as patrolling at night (Sitati & Walpole, 2006).

1.1 Fragmentation and hindering of migration routes

Because of the agricultural expansion, elephant populations are threatened by a decreasing area of free movement and blocking of corridors between reserves (Lee & Graham, 2006). Transformation of forests and rangelands into agricultural land is pushing elephants away by diminishing their natural habitat (Hoare & Du Toit, 1999). Wildlife corridors help elephants to move between areas for e.g. seeking available forage (McComb *et al.*, 2011). Currently elephants are speeding through corridors with elevated signs of stress because of the proximity to people (Jachowski *et al.*, 2013). It has been proven that the presence of people is more useful in predicting elephant movement than forage quality and water availability (Boettiger *et al.*, 2011). When in a physiological state of stress elephants have a tendency to display aggressive behaviour when encountering people (Jachowski *et al.*, 2012). Therefore an expanding human population getting closer to corridors could be detrimental for both people and elephants (Goldman, 2009).

It seems important for elephants to migrate through corridors since they spend 47 per cent of the time outside of protected areas (Douglas-Hamilton *et al.*, 2005). However, there are many sociological and political factors that should be considered since creating corridors fragments other land (Goldman, 2009). Suggestions of fencing elephants within reserves are not preferable by all conservationists but they are proposed (O'Connell-Rodwell *et al.*,

2000). Reserves also risk increased fragmentation of elephant populations and consequently long-term inbreeding effects (Archie *et al.*, 2007).

1.2 Foraging ecology

Kenya has different ecological areas ranging from semi-arid desert zones to more tropical coastline (Dharani, 2002). In most areas there is one short rain period in November and one longer period between March and May (Åse, 2015). The main part of Kenya is covered by woodland, bushland, and thicket (Dharani, 2002). Desert-dwelling elephants prefer long-term habitats close to rivers and to forage on flood plains (Matawa *et al.*, 2012). Elephants also have a seasonal preference of staying in open woodland and bushland during wet season and choose more consistently green areas such as thick woodland during dry season (Loarie *et al.*, 2009).

Though elephants are generalists and eat what the environment provides they are selective when high quality forage is available (Codron *et al.*, 2011). Depending on season their diet changes and they frequently switch between browsing and grazing (Codron *et al.*, 2011). Since crude protein is significantly higher in crops and has significantly lower fibre content than browse or grass the drive of an elephant to crop raid is understandable (Osborn, 2004). An elephant weighing 1700 kg eat approximately 100 kg each day (Laws, 1970) and one herd can therefore theoretically consume a field in one night (James Kaigil, personal communication, March 22, 2015). Elephants spend more time foraging at night in areas where human interactions are frequent (Graham *et al.*, 2009). D. Sayialel (Dupoto Community Association, personal communication, March 23, 2015) living outside of Maasai Mara National Reserve explains that it is more common to see elephants by the forest edge at night compared to the day when they normally reside within its boundaries. This is confirmed by Jackson *et al.* (2008) who state that crop raiding incidents were more frequent during dark. During dry season elephants stayed significantly closer to the human population and limited contact with people by mainly venturing close to waterholes at night (Jackson *et al.*, 2008).

1.3 The need for conservation of the African elephant and its ecological impacts

Without this so-called ecological engineer there would be less savanna and open areas and more trees, bushes, and shrubs (Haynes, 2012). They damage trees while foraging but also enable greater light availability and create favourable conditions for small vertebrates (Pringle, 2008). Elephants' feeding habits also rearrange the biomass while breaking or pushing over trees; the damage cause woody vegetation to sprout and increase forage quality under 1 meter height (Kohi *et al.*, 2011). This consequently provides high quality feed for smaller herbivorous species (Kohi *et al.*, 2011). However, elephants' feeding habits have also been proposed to affect biodiversity negatively as the abundance of woodland birds and ants are lower in areas where elephants are more densely populated (Cumming *et al.*, 1997).

1.4 Aim of this study

Previous studies have shown that the increase of agriculture is not necessarily in a linear relationship with the decline of the elephant population (Hoare & Du Toit, 1999); the definition of agricultural area is described in section 2.1. This ambiguous balance displays a need for further investigation in this matter. The purpose of this study is therefore to investigate the potential effect of the expansion of agriculture on the population of African elephants and also to explore sustainable long-term outcomes that will suit both the welfare of people and elephants. I focus in particular on the following questions and predictions.

- Is there a connection between the expansion of agriculture and the African elephant population in Kenya?
- What is the reason for the expansion of agriculture?
- How are people and the African elephant affected by their encounters?
- How can we prevent conflicts between local communities and African elephants in a sustainable way that benefits both parties?

My prediction is that the data in this study will show a negative relationship between the two variables agricultural area and the elephant population. This will be displayed by a negative trend of the elephant population and an increasing expansion of agriculture.

2. Methodology

The search words below were utilized when searching for articles for the literature review. Other literature for introduction and discussion were searched without using the search words and was not included in the literature review in the results section.

Search words: African elephant, *Loxodonta africana*, population, crop raiding, agricultural area, expansion, preventive methods, Kenya, crop production, human-elephant conflict, conservation, wildlife corridor, pasture.

Search engine: Google Scholar, Primo

Altogether the found articles from the search criteria summed up to 59. The number of utilized articles in the literature review in the result section was 29.

Some articles were excluded due to lack of relevance in this study. Human-animal conflict is a broad term of which crop raiding is only one example and articles on other conflicts were not utilized. Some studies regarded the ivory trade and these were also excluded. The majority of the articles was not necessary in answering my questions and was left out. Examples were articles about the physiology of crop production. Since my question was about agricultural expansion from a larger perspective there was no need for articles on detailed physiology of crops.

Non-peer-reviewed references:

- Databases with statistical data (Economic surveys, 1983, 1991-2003, 2006, 2008-2014; Blanc, 2008; FAO[a], 2015; FAO[b], 2015; FAO[c], 2015; World Bank, 2015)

- Reports with census data that were used to collect elephant population data for the statistical test (WWF, 2014)

- Kenya Wildlife Service: An authority in Kenya with a central position in African elephant conservation (KWS[a], 2015)

- The Swedish National Encyclopedia from where Kenya's climate information was retrieved (Åse, 2015)

2.1 Statistics

Previous statistical data on the Kenyan African elephant population was retrieved from Kenya National Bureau of Statistics' (from here on mentioned as KNBS) Economic surveys (1983, 1991-2003, 2006, 2008-2014) from 1977-2012 and put into a table in Microsoft Excel (from here on called Excel) where diagrams were created.

Agricultural area, human population, and harvested index-crops were all collected from FAO (FAO[a], 2015; FAO[b], 2015; FAO[c], 2015) from the years 1977-2012. The definition of the term agricultural area included: arable land (temporary meadows for pasture or mowing both cultivated and wild praire or grazing land, temporary cropland where multicropped land counted once, land for sale, and temporary fallow land); permanent crops (long-term planted crops with no need of replanting for five or more years and land under trees not situated within a forest); and permanent meadows and pastures (land used for more than five years to grow herbaceous crops for forage, either cultivated or wild praire or grazing land).

Area of all harvested crops in Kenya were collected from FAO[c], (2015) and presented in the category "Harvested index-crops". This was done to visually compare with the size of "Agricultural area" due to the many categories included in the latter. Some crops were excluded in the calculation to avoid skewed results since data was lacking from one or more years. Therefore remaining crops' areas were totaled using Excel and acted as an index for total crop production in hectare.

Regional, national, and continental data was compared separately between elephant census data and agricultural area. The elephant population data from the Mara region (WWF, 2014) was compared with the total agricultural area in Kenya (FAO[a], 2015). National data included variables: agricultural area; elephant population; human population; m^2 agricultural area per person; harvested index-crops. Continental data included: agricultural area; elephant population; human population; m^2 agricultural area per person. Continental elephant census data was retrieved from The African Elephant Database (2015) for the years 1995, 1998, 2002, 2007, and 2013 by summing up the categories definite and probable and excluding possible and speculative. This choice was made to increase data reliability and exclude unsure data.

2.2 Study site and methodology of the interviews

Qualitative interviews were performed with farmers chosen by driving from the Maasai Mara National Reserve towards where my assistants knew farms were abundant. The chosen direction northwest of Maasai Mara exposes an escarpment which is on the path towards Nyakweri forest where many elephant cows come to give birth (J. Kaigil, personal communication, March 22, 2015). It is possible for the elephants to move through several wildlife corridors linking Maasai Mara National Reserve and Nyakweri Forest (J. Jung, personal communication, March 23, 2015). Maasai Mara National Reserve consists mostly of grassland and bushland (Dharani, 2002).

The method of driving from the reserve to adjacent villages enabled inclusion of farms situated near elephant-dense areas. The first visible and accessible farmland with people present was chosen. Five farmers were interviewed on March 25th-26th, 2015. Both days the two first interviewed farmers assisted in finding the second farmer and on the first day the second farmer helped to find the third one. All five interviews were done with people from the Maasai tribe. Four were performed assisted by a Maa-speaking translator and one interview was performed in English with the occasional help of the translator. All farmers explained their cropland size in acres, which was calculated to hectares by multiplying with 0.404685642, and rounded to one decimal. This was done to make it more accessible for a wider range of readers.

These interviews were summarized in a descriptive text in the results and used in the discussion in combination with the statistical results.

3. Results

3.1 Literature review

3.1.1 The reason for agricultural expansion

According to (Ray *et al.*, 2013) the productivity of agriculture is not increasing while the population continues to rise rapidly. Instead of expanding the agricultural area one could increase the productivity and thus the yield quantity from the same area. However, it is not as easy as it sounds (Bajželj *et al.*, 2014). An attempt in calculating how to supply the globe with enough food in 50 years reveals that Sub-Saharan Africa will have to massively increase their productivity to achieve this (Lotze-Campen *et al.*, 2010; Bajželj *et al.*, 2014), which is not possible with intensification alone (Bajželj *et al.*, 2014). There is a need for a global yield increase of 2.4 per cent per year but that current increase is 1.3-1.6 per cent (major crops: maize, rice, wheat, and soy bean), which is insufficient (Ray *et al*, 2013). According to Ray *et al.* (2013) specifically Kenya's maize productivity is actually decreasing. Without increased productivity croplands globally has to increase 27 per cent from 2009 until 2050; by taking into account that the land expanded on likely will be less fertile there is a need of as much as 41 per cent in the same time-span (Bajželj *et al.*, 2014). Since research is being executed to try to increase productivity expanded land will be less than 41 per cent (Mucheru-Muna *et al.*, 2010).

3.1.2 Physical injuries of both humans and elephants

Both elephants and people suffer by the conflict between them. A study revealed that 60 per cent of all discovered injured elephants between 2007 and 2011 were defined actively injured by the local communities (with the intention of hurting that specific individual rather than passively, which was defined as elephants caught in snares and similar) (Mijele *et al.*, 2013). Methods of hurting the elephants were with sharp objects and poisoned arrows (Mijele *et al.*, 2013). J. Kaigil (personal communication, Ol Pejeta Conservancy, March 22, 2015) says that a common method of deterring crop raiding elephants is using spears. Spearing leaves elephants wounded and they sometimes die from the injuries but often far away from where injuries were inflicted (Graham, 2007). Indian farmers trying to prevent crop raiding incidents have been met with aggressive behaviour from elephants (Thuppil & Coss, 2012). Early-age trauma for elephants has shown to produce symptoms similar to post-traumatic stress disorder later in life (Bradshaw *et al.*, 2005). Jachowski *et al.* (2012) studied chronic stress in elephants and were able to see a connection with stress when compared to historical data of human fatalities.

3.1.3 Economic consequences

The GDP per capita in Kenya for 2013 was 1246 US dollar (10 464 Swedish crowns 13 February 2015, 1 USD = 8.40 SEK) (World Bank, 2015). GDP is defined as the added gross value in the economy by Kenyan residents including taxes of products and not including potential subsidies (World Bank, 2015). Including PPP (Purchasing power parity) the value for Kenya in 2013 was 2780 USD (World Bank, 2015). Compared to countries with better financial situations from the same source this barely corresponds to an average month's salary (2013 year's GDP per capita in Sweden: 60430 USD = 507 710 SEK). The average Kenyans financial situation (World Bank, 2015) reveals an important explanation for why the raiding of a field of crops is a large economic loss (Ngene & Omondi, 2008).

3.1.4 Predictive solutions for the human-elephant conflict

Using seasonal patterns in nutritional quality in forage one could predict more frequent crop raiding through tracking precipitation and thereafter shift prevention methods depending on the crop raiding risk (Osborn, 2004). This will be an even more current matter due to the predicted increase in precipitation because of climate change (Kabubo-Mariara, 2009). Further predicting crop raiding is by keeping track of following factors: it is more likely to be crop-raided if you have been raided before, live close to the forest, or lack effective preventive methods as an early warning system with communal guards (Sitati *et al.*, 2005).

There is a general notion that increasing human population is negatively correlated with the abundance of certain wildlife (Lamprey & Reid, 2004; Lee & Graham, 2006) even though it is affected by more fine-scale factors (Hoare & Du Toit, 1999). According to Hoare and Du Toit (1999) there is a threshold affect showing that there is a balance between the human density and the density of the African elephant. A connection was seen between low elephant density or absent with an area that had undergone heavy transformation from natural land cover to agricultural land (Cumming & Lynam, 1997;

cited in Hoare & Du Toit, 1999; Hoare & Du Toit, 1999). The elephant extinction point seemingly corresponds with the transformation of land-cover of 40-50 per cent or 50 per cent of available habitat lost and the rest fragmented in combination with a density of 15-20 persons per square kilometer (Hoare & Du Toit, 1999).

Integrating affected communities is a way of creating long-term conservation efforts for both elephants and people; in community-based wildlife management one of the important steps is to determine the ecological carrying capacity for a particular species (Du Toit, 2002). Therefore, by predicting elephant density it is easier to counteract the effect of human density and decreasing habitat (Hoare & Du Toit, 1999). It is crucial to successfully monitor abundance since without efficient and regular monitoring there is higher risk of missing drastic declines in species (Brashares & Sam, 2005). A proposal has been to promote community-based management by contributing with scientific research supporting communities to make well-founded conservation decisions (Du Toit, 2002).

Predictive solutions can be combined with direct measures such as different types of fencing described below.

3.1.5 Chili fence

One of the more recent measures of preventing crop raiding by elephants is chili plants (Sitati & Walpole, 2006; Graham & Ochieng, 2008; Harich *et al.*, 2013). Elephants dislike chili and some measures leads to them leaving the farmland unraided (Sitati & Walpole, 2006). Despite this scientifically studied method only 13 percent of farmers answered that they used chili which was probably due to the related costs (Harich *et al.*, 2013). A negative aspect with this method is the need for re-application of the fences on a weekly basis and the cost of chili (Sitati & Walpole, 2006). When compared with other measures such as watchtower and torch use or cowbell fence, the chili method had lower labour requirements; which is advantageous for farmers (Graham & Ochieng, 2008).

3.1.6 Beehive fence

The stinging from African bees can penetrate and hurt an elephant through thinner parts of their skin (Vollrath & Douglas-Hamilton, 2002). The pain inflicted from bees is proposed to give a more unpleasant experience for elephants than other non-painful methods (Vollrath & Douglas-Hamilton, 2002). Therefore the authors believe this to be a more suitable long-term option than solutions which elephants are more easily habituated to e.g. electric fencing (Thouless & Sakwa, 1995). It is confirmed through the prevalence of unoccupied beehives that created a significant difference in crop raiding elephants' frequency, thereby probably having long-term effects (King *et al.*, 2009). This idea is popular since the use of beehives is very cost-effective (Vollrath & Douglas-Hamilton, 2002). The construction costs of building beehives are balanced by the income of selling honey products (Vollrath & Douglas-Hamilton, 2002).

3.1.7 Electric fence

Simple fences without electricity have generally no effect in deterring elephants (Fig. 7)(Sitati & Walpole, 2006). However, using electric fences instead does not entirely exclude elephants from fields either (Thouless & Sakwa, 1995). Thouless and Sakwa (1995) conclude that elephants often learn to break electric fences and that they teach this to other individuals. Electric fencing is however better at reducing crop-raids compared to other methods in East Caprivi, Namibia (O'Connell-Rodwell *et al.*, 2000).

Figure 7. Dry-wood fence split by crop raiding elephants approximately a week before the time of the photo at a farm outside of Maasai Mara National Reserve (Photo: C. Öhman, 2015)

3.1.8 Solutions by targeting specific elephants

Detusking elephants is recently proven successful in drastically reducing fence-breaking elephants (Mutinda *et al.*, 2014). Mutinda *et al.* (2014) explain that it is an efficient way of stopping fence-breaking elephants though they continued destroying fences but not as easily. However it might impact a large bull's social status and its ability to forage (Mutinda *et al.*, 2014). Translocating problem elephants is also utilized but the traumatic experience is proposed to take over six years to recover from and cause signs similar to post-traumatic stress disorder (Jachowski *et al.*, 2012).

3.1.9 Economic incentives for farmers

The economic situation for many farmers has resulted in suggestions of compensations for crop raids by both authorities and publications (Tchamba, 1996). For example, recently implemented legislation in January 2014 (5th chapter, 25 §, 5, The Wildlife Conservation

and Management Act, 2013 [Kenya Gazette Supplement no. 181.], Acts no. 47 of 2013) describes that crop raids should be compensated with current market values and only when reasonable preventive methods have been performed. Tchamba (1996) believes that compensation is positive and it will ease the economic loss experienced by crop raiding. Not everyone agrees to implement economic compensation as a solution (Bulte & Rondeau, 2005; Lee & Graham, 2006). A negative outcome could result in pushing the agricultural expansion further (Bulte & Rondeau, 2005). It might seem more economically favourable to cultivate crops than to hold livestock since compensations could be interpreted as subsidies (Bulte & Rondeau, 2005). Bulte and Rondeau (2005) instead propose to give incentives based on specific species' density in the surrounding area.

3.2 Statistic results

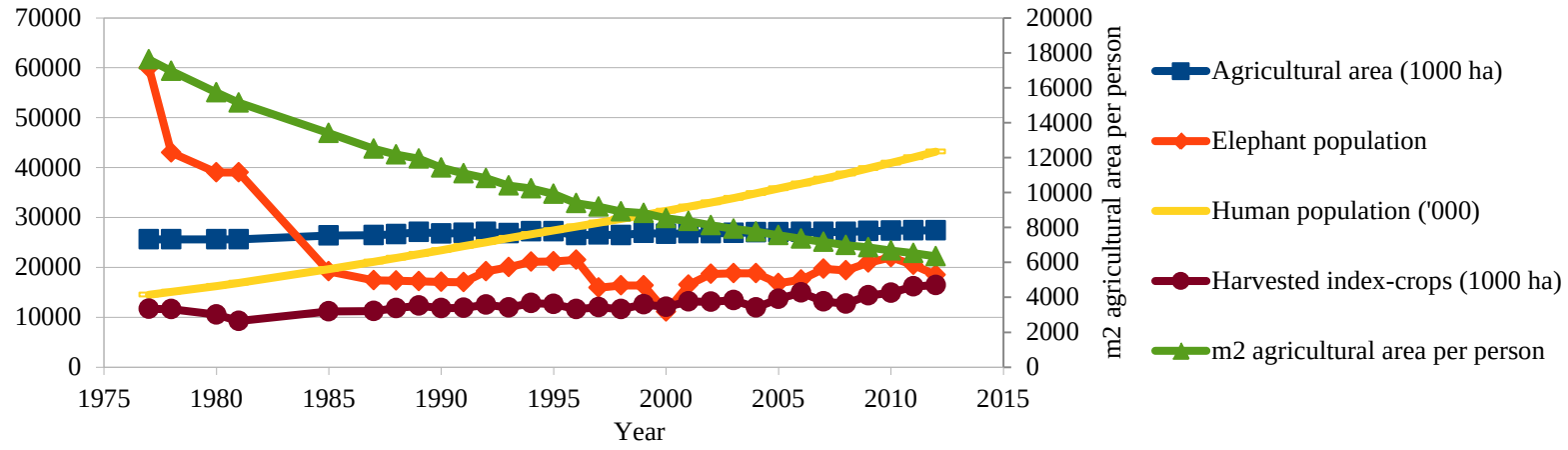

Figure 4. Trends in agricultural area, human population, square meter agricultural area per person, and the African elephant population in Kenya between 1977-2012

The human population is gradually increasing while agricultural area and harvested index-crops are increasing (Fig. 4). Agricultural area have increased by 7.5 per cent since 1977 and harvested index-crops have increased by 40.4 per cent. Elephants declined rapidly during the 1980's; this decrease stopped almost simultaneously with the time of the implementation of the ivory trade ban in 1989 (Lemieux & Clarke, 2009).

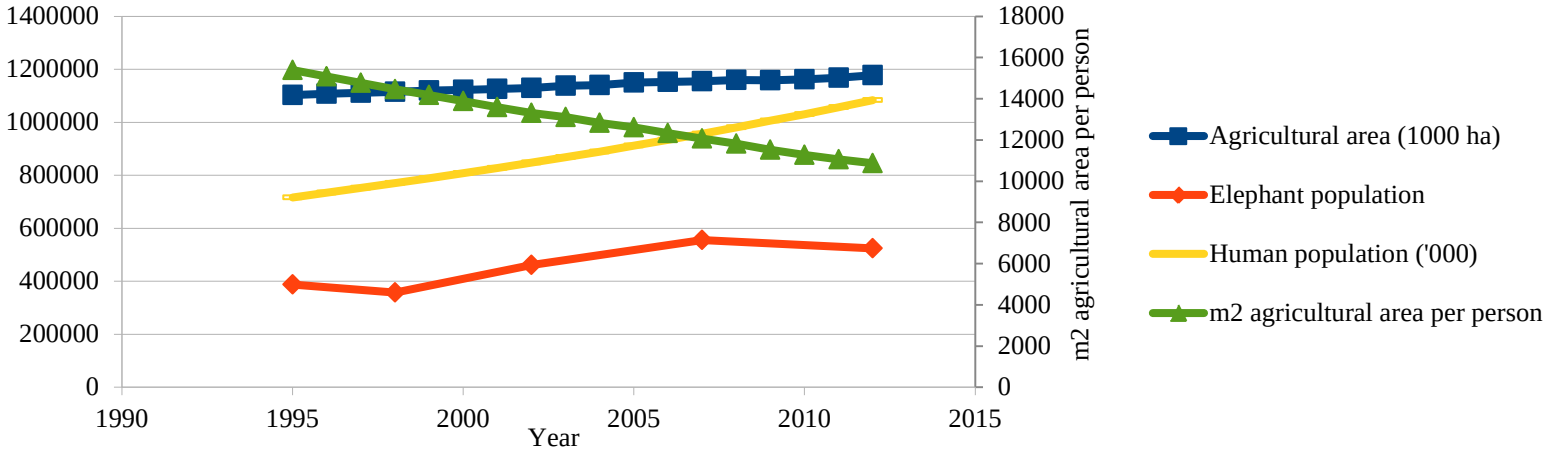

Figure 5. Trends of the human population, agricultural area, elephant population, and square meter agricultural area per person in Africa between 1995-2013

The diagram of Africa is displaying similar trends except with the African elephant population which is increasing (Fig. 5).

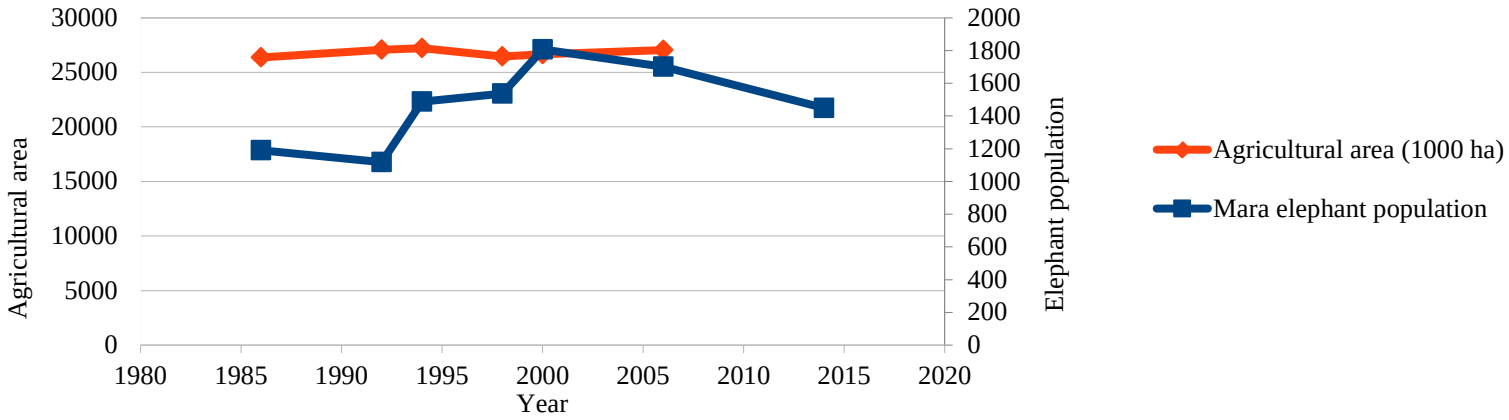

Figure 6. Trend of Kenya's agricultural area and elephant population in the Northern Mara region (Maasai Mara) between 1986-2014

3.2.1 Conclusions

By looking at the data there is a trend of increasing agricultural area and harvested index-crops continentally and nationally whilst the elephant populations have fluctuated but decreased in all areas after 2010 (Fig. 4; Fig. 5; Fig. 6).

3.3 Interviews

If not stated otherwise, all opinions and facts presented in the interviews below are originated from the interviewed person and is not the opinion of the author.

Interview 1

An anonymous farmland owner belonging to the Maasai tribe has 15 acres (6.1 hectare) of cropland consisting mostly of maize because it is less raided by wildlife than e.g. cabbage. Elephants perform most crop-raids on this farm. Both a barbwire fence and an extra barrier of acacia branches surrounding the field are used to prevent crop raiding. Three people take turns sleeping in a hut with a fire lit beside it to keep wildlife away when guarding the fence at night.

The prevalence of crop-raids is more frequent during harvest times. It is common for people to get hurt and sometimes also elephants. It is illegal inflicting injuries upon wildlife by the government but the farmer states that minor injuries are performed on elephants in cases when KWS has been repeatedly contacted and no action is seen. KWS is Kenya's environmental authority dealing with matters regarding nature and wildlife (KWS[a], 2015).

The farmer is struggling with the personal opinion of elephants because wild animals are naturally of great importance for the Maasai people. Even though they should be highly valued the farmer says that it is difficult to see any benefit from them because of losses caused by elephants; not only by crop raiding but also by diseases spread to livestock. According to the farmer the government sees people as of lesser worth than the wild animals. This since when a person gets killed by an elephant they get five million shillings (approximately 500 000 Swedish crowns and 53 635 USD) in reimbursement. This is lower than the 20 million shillings you owe the government if you kill an elephant.

There have been two general changes in recent years regarding the human-elephant situation. One is a social-economic and cultural one while the other one is an ecological change. Previously when Maasai people would herd their cattle they would accept some casualties among both people and livestock because it was their way of life. Nowadays casualties are less accepted because money has become a higher priority for Maasai people. This is due to the country's overall development and this is intertwining them with more money-focused parts of the society. Maasai people have to stand back when wildlife demands space but revenues from actually co-existing with wildlife are often never seen or not enough to compensate losses. The ecological change is the expansion of cultivation among the Maasai people. Livestock is their primary source of livelihood but people are realizing the money to be made in agriculture.

The farmer's prediction for the future is not optimistic. Wildlife is increasingly harming people, destroying crops, and killing cattle. The farmer also sees no potential change in how the government handles the situation and has no hopes of increased compensation for crop raids.

Interview 2

This farm consists of almost 20 acres (8.1 hectare) of cropland and cultivates mostly maize. The farm is exposed to crop raids and a majority is elephants mainly raiding at night. The two main methods of crop-raid prevention is a surrounding dry-wood fence in combination with five people patrolling. The farmer states that electric fence would be preferable but it is too expensive. It is common that people get hurt and encounters sometimes end fatally. The most frequent conflicts with elephants occur in March and September due to harvest times. Elephants are not harmed in the encounters, instead they make loud noise to try and scare them away. KWS are also contacted for assistance.

The farmer's opinion of the African elephant is not clear; with the explanation that since they are Africans they do not want to kill wildlife because they are perceived as of the same high value as livestock. The problem is that only few benefits from wildlife while they get no income from surrounding national parks, reserves, or conservancies. The farmer has seen no change in the amount of crop raiding in the last years but there have been less fatal human casualties in the encounters. There has neither been an increase in actions taken by KWS. In the future the farmer believes that if the government takes action and solves the problem by for example compensating crop raids then the situation might be less strained between authorities and the local farmers. If no further action is taken to ease peoples' losses there will be no reason for farmers to keep living in close range of elephants.

Interview 3

This farm consists of three acres (1.2 hectare) of cropland and belongs to a Maasai farmer. The current crop produced is maize because it is less frequently being crop-raided. Examples of prevalent crop raiding animals are dikdik, zebras, elephants, and cape hare. The preventive methods used against crop raiding are patrolling by people and acacia-branch fences. The most successful preventive method is people patrolling the cropland. During crop-raids fire torches and loud noise are used but if the animal persists they leave it alone in risk of being injured. Elephants are however never injured.

The farmer's opinion of the elephant is negative since the farmer sees no gain and only loss from them. The encounters with elephants have become more frequent nowadays but the frequency also changes with season peaking at harvest in July and August. The farmer believes that there will be an increasing number of encounters that will be devastating for the farmers. This is because they cannot control a crop raiding elephant due to the risk of being arrested if they expose it to injuries. They report crop raiding incidents to KWS but get no response from them. The farmer's proposed solution is for the government to act and translocate problem elephants towards the reserve for both their benefit.

Interview 4

The fourth interviewed is a Maasai farmer with cropland of nine acres (3.6 hectare) who is growing a diverse range of crops. They grow maize when there are good conditions for it e.g. not too dry. They sometimes grow cabbage, kale, tomatoes, beans or onions. They have trouble with crop raiding and during a single night last year the entire maize field got raided by elephants. Surrounding the field is a wooden fence and by night there are two people on guard and the latter is most successful in preventing crop raids. The farmer would presume electric fence is better but that it is not used. It is common for people but not elephants to get hurt when hindering a crop raid. They try to scare them away but if they hurt elephants they will be reported to KWS by community scouts in the village.

The farmer has seen an increase in the amount of elephant-encounters. The farmer has noticed a change in the elephants' behaviour when meeting people. Nowadays elephants react quicker and charge with less motivation. Before, elephants only charged people when the wind was in their favour. During the 1970's and 1980's there was more trophy hunting taking place in Kenya. This led to elephants being more fearful of people. Nowadays trophy hunting is prohibited so therefore they have less fear. The farmer explains that elephants want revenge for past actions, lack fear of people, and consequently has a quicker reaction. In the future the government needs to continue educating people. The farmer hopes for a change in farmers' views since the insertion of the Wildlife Act Bill (The Wildlife Conservation and Management Act, 2013) that enacts reimbursement for fatal or semi-fatal animal encounters.

The farmer sees a theoretical solution in fencing but explains that it would not work since fencing Maasai Mara would force fencing of Serengeti and also hinder migration to

surrounding conservancies. The area is also not big enough to sustain wildlife. They need corridors to allow movement between areas.

Interview 5

This Maasai farmer has three acres (1.2 hectare) of cropland where they grow maize, beans, tomatoes, and kale; the latter is a kind of cabbage known as *sukuma wiki* in Swahili. They are exposed to crop raiding by a wide range of animals including elephants. Elephants are present in the area all year round but most crop raiding is performed during harvest in July and August.

Three men guard the field at night and regular fence surrounds the fields and the latter has no effect in deterring elephants. People patrolling is the most effective method to prevent crop raiding. Elephants are considered a threat for peoples' safety and the farmer explains that once on the farm they are difficult to scare away and they often leave them be. They are not allowed to perform any injuries on the elephants but they try to hold them off themselves as long as possible without doing this. If they are unsuccessful they call KWS.

The farmer's personal opinion is that elephants are of no benefit for people and that they are only responsible for losses. In the last years the farmer has seen an increase in human-elephant conflicts and explains this by the increasing population of elephants in combination with a decrease in hunting and poaching by people. The farmer has no optimistic view of the future because of the belief that the population will continue to increase.

3.3.1 Summary of the interviews

All farmers are sometimes raided by elephants and most state an increase at harvest. Methods of deterring elephants are commonly dry-wood fences with one farmer complementing with a barb-wire fence. All used patrolling at night as the main method of prevention and all stated that this was the most successful one.

Attitudes from farmers are generally negative towards elephant and most see no purpose of having elephants in close proximity. Four out of five have seen an increase in human-elephant encounters with one farmer saying that more people are killed. Their visions for the future are skeptical and 80 per cent have no hopes for increased compensation or support from the government.

4. Discussion

4.1 Results: interviews, statistics, and literature review

The general trend of the elephant population since 1977 is negative but the population has increased again since 2000 (Fig 4.). The diagram shows a stable increase of the human population and agricultural area in Africa and Kenya (Fig. 4; Fig. 5). This result partially

confirms my prediction. It is not encouraging for the situation between people and elephants, which is still infected by the sound of the farmers who predict that the situation will get worse. Only one farmer did not explicitly state that there was no need for the elephant in area and that it only caused losses. The attitude regarding elephants and the perceived increase of them confirms what Granados & Weladji (2012) found.

Some farmers mentioned the need for economic compensation as a resolution. The results of the implementation of crop raiding compensation is yet to be evaluated (5^{th} chapter, 25 §, 4-5, The Wildlife Conservation and Management Act, 2013 [Kenya Gazette Supplement no. 181.], Acts no. 47 of 2013). However, considering the proposed consequence of further increasing the expansion of agriculture (Bulte & Rondeau, 2005) I believe this should be thoroughly evaluated soon to investigate the potential changes this legislation could induce.

The most effective method according to the interviews is patrolling at night but this seemed time-consuming and labourious, which could decrease peoples' motivation and optimism. However, it is the closest thing the interviewees' have to an early-warning system. The conclusion of Sitati *et al.* (2005) was that early warnings in combination with deterring measures before entering cropland was most effective. The possibility of early warnings is facilitated by increased availability of mobile phones which acts as communication between farms (Graham *et al.*, 2012). Studies on Asian elephant explain that direct solutions from the result section, such as fences, work best when combined and at a random schedule since elephants easily become habituated (Zimmermann *et al.*, 2009). The interviewed farmers do not use most examples of fences mentioned in the literature review. This could show that the preventive methods are in beginning phase and are not used extensively yet. Research of the effects of for example beehives has only been done on small sample sizes; though the results are promising, there is a need for more extensive studies on larger samples. However, one might argue of the ethical standpoint regarding this since elephants are harmed during the studies (Vollrath & Douglas-Hamilton, 2002).

The interviewed farmers' ways of deterring elephants are common; with smaller farms using dry vegetation as fence and with larger farms equipped with barbwire fence (Sitati et al., 2005); the majority do however use guarding which also 78 per cent of farmers around Kibale National Park in Uganda did in 1997 (Naughton-Treves, 1997). The mainly negative attitude is also representative since 53 per cent in a questionnaire saw no benefit of the elephant (Granados & Weladji, 2012). However, the drive from Maasai Mara National Reserve towards the closest available farm resulted in talking to farmers whose cultivation was close to wildlife from the reserve, corridors, and Nyakweri forest. Since elephants are migratory species and move over large areas (Demeke *et al.*, 2012) distance is relative. With 90 per cent of all crop-raids being performed within 160 meters from a forest edge (Naughton-Treves, 1997) this could affect the attitude towards elephants.

4.2 Methodological issues

4.2.1 Statistics

The choice of using agricultural area to display an increase in area of crops is debatable. Within the term everything from pastures to cropland was included. I searched exclusively

for crop area but when scanning through FAO[a] (2015) the numbers under crop area could only be projected as harvested area and not the entire crop area, harvested or not. Therefore I chose to use agricultural area instead. Since livestock farms also likely have to expand with the increasing human population this was an acceptable choice.

Also wild prairie and grazing land are included within the term agricultural area that is open to both wildlife and livestock. It was not possible to search for only open access grazing land and extract from agricultural area, which would have been preferable. With the current values it is difficult to know which type of agricultural area that is increasing or decreasing. Agricultural area have had a 7.2 per cent increase in 35 years. If for example grazing land has transformed into cultivated cropland this is not displayed by the data. Therefore there is a possibility of an either larger or smaller increase in crop area than displayed.

To counteract this potential margin of error the decision was made to include harvested index-crops. Percentage increase in harvest between 1977 and 2012 was 40 per cent, which is more than the 7.2 per cent increase of agricultural area. The increase in harvest could be explained by a productivity increase but considering that Kenya's maize productivity has decreased this might not be the case (Ray *et al.*, 2014). Instead the discussion points mentioned above could be true. Grazing land transformed into cultivated land is not displayed by changes in agricultural area but could be displayed by an increase in area harvested. This could prove farmer number one's observation about the ecological change for Maasai farmers from livestock keeping to cultivation to be correct. However, fallow crop land is not included in the term harvested index-crops but I believe that it better displays an increase in crop land exclusively than agricultural area.

Elephant counts can be misleading. According to the African Elephant Status Report 2007 from IUCN counts are done in protected areas and areas in close proximity of protected areas (Blanc *et al.*, 2007). This leads to ambiguous results regarding the range of the elephant and consequently the count as well. Both total and sample counts have shown to be acceptable census methods in areas of open plains such as Maasai Mara (Ottochilo, 1999). However, counts only performed in certain areas while excluding others might cause bias due to the choice of that specific area where we know for a fact there are many elephants (Blanc *et al.*, 2007). Although performing census over larger areas is more time-consuming and technically difficult it is preferable when collecting trustworthy census data.

The Mara elephant report from 2014 concluded after a total aerial count that there was an increase of elephants within the reserves boundaries (WWF, 2014). This could correspond to what the African Elephant Status Report explained (Blanc *et al.*, 2007). The increase within the Mara region (both Serengeti and Maasai Mara) could give us incorrect results displaying an increase of the African elephant population when this does not have to be the case outside of protected areas. The displayed increase started in 1986 but this could be explained by the ban on ivory trade in 1989 and that there were substantial losses of the African elephant before this (Lemieux & Clarke, 2009).

The Economic Surveys (1983, 1991-2003, 2006, 2008-2014) by the Kenya National Bureau of Statistics was the source for the elephant population data used in the comparative statistics. The census method was not always stated but referred to DRSRS (The Department of Resource Surveys and Remote Sensing)(Economic Survey, 2014).

According to Thouless *et al.* (2008) DRSRS performed sample counts between late 70's and 2008, and that this type of count cannot be used for national trend data since DRSRS only survey rangelands and not forests. Elephants residing in forests will therefore not be counted. Also, wildlife is more congregated during droughts and easier to perform total counts on, but sample counts give a risk of over- or underestimating counts depending on where the sample plot is (Ottochilo, 1999). However, looking at the Maasai Mara trend (Fig. 6; WWF, 2014) it could display more correct trends in at least protected areas; since trends are somewhat similar with DRSRS' data this might be enough for a glimpse of the direction for the African elephant population and also the focus of future conservation efforts.

4.2.2 Interviews

Because interviews were carried out with a translator, the actual facts have gone through two peoples' interpretations, the translator's and my own. Therefore details could likely disappear along translations. For example, in interview number five the farmer stated that there were more trophy hunting in the 70's and 80's but this sport was banned in 1977 (Kock, 1995) making the statement confusing. This quote might therefore be a translation error. Questions asked were sometimes of delicate nature and answering these could result in them admitting a crime. One's answer to whether or not elephants got hurt in the encounter was at first "no". When asked a second time the farmer admitted to wounding elephants slightly when they persisted on the cropland and KWS was unresponsive. The others did not admit to injuring elephants but judging by this interviewee this could mean that the farmers felt uncomfortable admitting this due to risk of being reported.

Other questions should have been rephrased. The question on whether the interviewed had seen a change in the human-elephant conflict should have been phrased with better detail. I should have asked for a specific interval of years rather than leaving the interviewee to decide from where in time the change was taking place.

4.3 Future scenarios

4.3.1 Agriculture

As already mentioned, targeting the crop-production quality could counteract the agricultural expansion explained in the results. The study by Ray *et al.* (2013) divided their results into continents and then further stated the results for some individual countries. This markedly distinguishes countries where there is need to focus more specifically on productivity increase. However, Ray *et al.* (2013) based their yield increase rate on numbers from 20 years back since some values were lacking from some countries. They explain that some yield change data was accessible from 1961 but that they chose to compare data from 1989-2008. Even though the result was significant the choice to exclude data might affect the yield change. There are regional differences in yield change that could have been closer examined with the use of a larger time-span sample. For example, Ray *et al.* (2013) gave Kenya as an example of where maize yield was actually decreasing; to use a wider time-span would make it easier to find connections between crop yields and other factors.

Another suggestion is for farms to learn to utilize the recommended amount of fertilizer per hectare to increase production (De Groote *et al.*, 2005). Fertilizing is necessary to produce sufficient yields due to the lack of nitrogen in the Sub-Saharan soil (Mucheru-Muna *et al.*, 2010). However, if Scheiter and Higgins (2012) are correct, increased CO^2 levels due to climate change enhances the ability for vegetation growth and to withstand wildlife foraging, therefore it might counteract the lack of nitrogen.

Maize is one of the major staple-foods for the people of Kenya (World Bank, 2009) and also all interviewed people farms mostly maize. The total percentage of this crop of the daily calorie intake of the average Kenyan is at 36 per cent (Short *et al.*, 2012). Maize is a palatable crop for wildlife according to Naughton-Treves (1997) in Kibale National Park, Uganda. As mentioned, an issue is how to produce larger amounts of maize to sustain the increasing human population (Cairns *et al.*, 2013). With maize having an already 30 per cent coverage of Kenya's arable land (FAO[a], 2015) an expansion results in even higher availability of maize. Therefore I predict that a likely consequence is increased contact between elephants and people because of the palatability (Naughton-Treves, 1997) and availability of maize. A solution could be to research crops potentially less palatable for elephants but retain the taste for people.

A likely possibility is that current Maasai pastoralists will lose their cultural livestock traditions (J. Kaigil, personal communication, March 23, 2015). At the same time I believe that traditional livestock could possibly turn to more industrialized livestock husbandry due to the GDP increase of 5.4 per cent of 2014 (World Bank, 2015), which subsequently will increase the demand for animal feed i.e. cropland. That economy changes husbandry is confirmed by (Thornton, 2010) which show that economic growth pushes development countries towards industrialized livestock systems with increased efficiency.

4.3.2 Reserves: Fenced or not?

With the diminishing natural habitat for elephants (Hoare & Du Toit, 1999) a conservation matter is to investigate where we can sustain wildlife in the future.

There are three different kinds of wildlife parks: fenced (e.g. Aberdare National Park, semi-fenced (e.g. Ol Pejeta Conservancy), and non-fenced (e.g. Maasai Mara National Reserve)(personal observation). The fenced parks will naturally make people outside of the area both feel safer and less likely to injure elephants. However, when keeping wildlife fenced in we at the same time "fence out" everything else and also the ability to migrate (Lamprey & Reid, 2004). Elephants require a heterogeneous habitat since they reside in different habitats in different seasons (Loarie *et al.*, 2009) and fencing in smaller more homogenous areas reduces this possibility. Brashares *et al.* (2001) tested reserve size and found that the studied reserves in Ghana were too small to sustain wildlife. Extinction rate correlated positively with human population and negatively with reserve size (Brashares *et al.*, 2001).

A recent article published a long-term assessment on the effect of a fenced park (Aberdare National Park) and displayed an increase in the wildlife population along the inner fence after the establishment of the fence. They also stated that one year after the wildlife population significantly declined along with species richness and that trend has continued since (Massey *et al.*, 2014). At the center of Aberdare wildlife abundance has been

increasing steadily while populations have been decreasing along the park's edges (Massey *et al.*, 2014). Therefore, measuring reserve size might not be a preferable method displaying actual available area for wildlife since the edges are clearly less used by many species. Scheiter and Higgins (2012) simulation showed that 1.5 elephants per square kilometer are the maximum density that can be sustained by a conservation area in a hypothetical African savanna park. The simulation also provides information on the ecological carrying capacity for future climate changed environment; the ability for vegetation to sustain elephants is heightened because of the higher availability of CO^2 in the air (Scheiter & Higgins, 2012). A positive aspect is that it included many factors in the model as habitat selectivity, other grazers' affects, and probability of uprooting or bark stripping etc., which gives weight to the prediction. However, it did not take the closing human settlement in consideration. Expanding human settlement is a factor determining abundance (Lamprey & Reid, 2004) since reserve edges have been shown to decrease wildlife population likely because of human impact (Massey *et al.*, 2014). They also counted other grazers' impact at a constant number, which in reality probably would fluctuate more in my opinion.

There is also a specific risk of having elephants contained within an area (Cumming *et al.*, 1997). High density of elephants has shown to significantly decrease species diversity; birds, bats, and woody plant species had significantly lower species richness in elephant-dense areas (Cumming *et al.*, 1997). However, methods of comparing the two areas are questionable. They simply recorded vegetation differences and counted wildlife in two areas where the study resulted in that one had significantly high tree cover and tree density, whereas the other had significantly lower (Cumming *et al.*, 1997). Since for example more birds prefer more dense woodland (Pomeroy & Tengecho, 1986) the comparison between bird richness and elephant density is disputable. The difference in species richness could simply be a result of different habitat preferences; that birds reside within more dense woodland since it is a more suitable habitat.

The increase within the reserve is our likely future not only in the Mara region but everywhere due to the expansion of agricultural land and human population (Fig. 4; Fig. 5). The projected increase of Kenya's human population in 2050 is more than double of today's population (FAO[b], 2015). For entire Africa the increase is a little less but still more than twice of today's population (FAO[b], 2015). Wildlife will have nowhere to go except onto protected land where human settlement is not allowed. An article concluded that the end of human-elephant conflict is either done by containing the animals or containing the farms and the people within and that none of these solutions are preferable (O'Connell-Rodwell *et al.*, 2000). This statement shows the likelihood of completely eradicating the conflict.

4.4 Future research

Further proving that the conflict is difficult to solve is that when interviewing the farmers more than one said that many researchers had been in the area before but that results were nowhere to be seen. This had made farmers pessimistic about the future and most saw no positive change in the future. Though a complete removal of the human-elephant crop raiding conflict is improbable since farmland will continue increasing (Bajželj *et al.*, 2014); I believe that the local communities need to have more insight on current discussions and actions taken in the situation. Political decisions seem to have trouble reaching smallholder farms. To encourage good relations between farmers and authorities there is a need for proper communication between the two.

I propose to collect science, political decisions, plans of future conservation efforts, and plans regarding agricultural expansion into a database that can be easily accessed by affected parties.

Many countries practice community-based wildlife management and communities themselves make decisions regarding wildlife (O'Connell-Rodwell *et al.*, 2000; Du Toit, 2002). Du Toit (2002) emphasizes the need for better distributing ecological knowledge to communities to be able to make well-founded decisions. This type of community conservation exists in Kenya as well (KWS[b], 2015). One common issue with community conservation is that many villages and farmers do not work together as a community (O'Connell-Rodwell *et al.*, 2000). A necessity is therefore ensuring that people work as a unity and to resolve how to distribute information to all parties involved. Community-based wildlife management could also promote reducing fatal injuries for both humans and elephants. Since injuries are common in the encounters (Mijele *et al.*, 2013) a feeling of responsibility might decrease their prevalence. Also the understanding of the relationship between traumatic encounters and potential relationship with elephants' future aggression towards people (Bradshaw *et al.*, 2005; Jachowski *et al.*, 2012) should make them less inclined to physically try to injure elephants.

I believe that focusing on communication and integration would help mitigate conflict in a sustainable way that benefits both parties. The increase of mobile phone use (Graham *et al.*, 2012) suggests a technical development that hopefully will promote distributing this collection of knowledge. Until then there will be a need for placing suitable personnel closer to farmers and link the information with the people close to wildlife e.g. communities. This is to ensure that knowledge reaches farmers who can implement it in their everyday life.

In the agricultural sector the focus needs to be on intensification to produce more crops on smaller patches. A solution could also be to breed crop-hybrids less palatable to wildlife specifically for heavily crop-raided areas. If the crop is naturally deterring by taste this could decrease elephants' inclination to crop-raid. However, we do not know how this particular hybrid could affect the surrounding ecosystems as with other GMO crops (Dale *et al.*, 2002).

In the conservation sector I propose to conduct more long-term assessments of elephants within fenced areas and their effect on biodiversity. This will help creating a projection of future challenges and what the current efforts should look like. Performing these long-term studies could however take too long since the human population increases rapidly (Fig. 4; Fig. 5) and such studies demands time.

4.5 Conclusions

The inevitable increasing agricultural expansion (Bajželj *et al.*, 2014), the higher risk of dangerous human-elephant encounters (Granados & Weladji, 2012) as well as farmers' negative attitudes is a threatening sign for the future elephant population. Efforts to decrease the need for agricultural expansion should be of focus as well as continuing with least-harmful deterring methods of crop raiding. My belief is that if elephant counts are executed with regular intervals and suitable actions are being performed when getting close to the elephant density threshold (Scheiter & Higgins, 2012) then elephants will likely

remain on the African savanna in the future. The risk is that we only will see them within fenced areas when the human-elephant conflict reaches an unbearable level. This will hinder normal migration and subsequently necessary genetic exchange between populations (Archie *et al.*, 2007). Therefore, Kenya's African elephant population could survive but likely have less genetic diversity and people will have a minimized risk and chance meeting elephants close to human settlement. The most important aspect is the need for facilitating communities' feeling of responsibility and to integrate villages in actions taken. Without rural communities cooperation I perceive the African elephant's survival as more slim.

These conclusions can be applied on future mitigation procedures where interactions with local communities are a necessity. I believe that my results show the lack of proper communication between authorities, researchers, and farmers. If people continue to ignore the people closest to wildlife this could lead to reduced support from farmers and communities in general. This in turn will lead to an animal welfare problem when farmers' frustration with authorities leads to them taking the matter in their own hands; I quote from one interviewed farmer: "If no further action is taken to ease peoples' losses there will be no reason for farmers to keep living in close range of elephants".

This thesis also provides a knowledge base on the current human-elephant crop raiding conflict. It displays a direction towards where elephant conservation efforts should focus their work. Agricultural expansion is a necessary but unfortunate future and how this is counteracted in elephant conservation might determine the viability of the future African elephant population.

5. Populärvetenskaplig sammanfattning

Konflikter mellan människa och elefant är det största hotet mot populationen av afrikansk elefant (*Loxodonta africana*). Ett exempel av detta är elefanters intrång och plundring av sådd åkermark vilket ibland förstör lantbrukares huvudsakliga inkomst. Försök att förhindra dessa plundringar resulterar ofta i dödlig utgång för både människor och elefanter. På grund av världens ökande befolkning behövs utbredning av åkermark för att tillgodose framtida generationer. Det förödande resultatet av jordbruksmarks utbredning över elefanters habitat och migrationskorridorer fragmenterar viktiga områden för dem. Detta ökar även tillgängligheten av åkermark vilket leder till ökad risk för räder av dessa. Att undersöka relationen mellan jordbruksmarks utbredning och populationen av afrikansk elefant är därför viktigt för att undersöka vad framtida bevarandearbete ska fokusera på. En handfull djupintervjuer genomfördes utanför Maasai Mara National Reserve och visade mestadels negativa attityder gentemot elefanter. Statistik av elefantpopulationsdata, jordbruksdata och mänsklig befolkning sammanställdes från Kenya National Bureau of Statistics och Food and Agriculture Organization mellan åren 1977 till 2012. Trenderna i Kenya visar på ökande antal hektar jordbruksmark och minskande population av afrikansk elefant. Intervjuerna och de redovisade trenderna visar att det behövs en förbättring av den nuvarande relationen mellan människa och elefant samt lantbrukares attityd. Ett förslag är att uppmuntra samhällsbaserad viltvård och stärka kommunikationen mellan lantbrukare och ansvarande myndigheter. Utbredningen av jordbruksmark kommer att fortgå men forskning för att öka odlingsproduktiviteten skulle kunna reducera behovet av ny mark.

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Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science
Department of Animal Environment and Health
P.O.B. 234
SE-532 23 Skara, Sweden
Phone: +46 (0)511 67000
E-mail: hmh@slu.se
Homepage:
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