



MAASAI AND FEEDING THEIR CATTLE

HOW CAN THE MAASAI RESTORE THE SAVANNAH ECOSYSTEM SO THAT THEIR CATTLE AND WILDLIFE HAVE SUFFICIENT AND HEALTHY FEED ON THE MIDDLELONG- AND LONG TERM.

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PREFACE

This piece of work before you is my graduation thesis about the recovery of the savannah ecosystem in the Masai Mara region where the Maasai live. I'm writing this thesis because it will help the Osotua foundation. The Osotua Foundation helps the Maasai. This graduation thesis will be a piece of aid to their work. Our contact with the foundation is Dieke Geerling. Our contact with the Maasai in the Masai Mara region is Nelson.

I would like to thank Dieke for the information and the opportunity to write this thesis for her foundation. I also would like to thank Nelson for his aid in Kenya. Further I would like to thank Robinson Njapit for the translation during the interviews and the translation of the summary into the Maasai language. And at last but not least I would like to say thanks to my graduation teacher/coach Jojanneke Zandvliet for her input and coaching.

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TECHNICAL TERMS

Boma: The place where the cattle is kept at night, usually made of wooden poles, iron and corrugated iron. People also use the word “boma” to refer to the place where they live.

Conservancy: An area designated to conserve and protect natural resources. But in comparison to the national reserves, conservancies are privately owned.

Manyatta: A group of people living together in different houses and with different bomas to keep their livestock in.

NCDO: Nkoilale Community Development Organisation. The organisation which helps the Nkoilale community. The NCDO consists of the wealthier local people.

ABSTRACT

The aim of the research is to help the Maasai to restore the ecosystem in order to get more feed for their livestock, but also for wildlife. This has become an issue mainly because of the droughts, erosion, dividing of land and overgrazing. These circumstances are different comparing with the past. The main question is: How can the Maasai restore the savannah ecosystem so that their cattle and wildlife have sufficient and healthy feed on the middellong- and long term? To answer this question several sub-questions were used. Interviews and literature were used to answer these sub-questions. There has been looked at the restoration of the savannah, alternative feeds, getting less livestock and the conflicts between livestock and wildlife.

The most important result is that the savannah keeps getting harmed as long as the sheep are still around, also the goats do harm the savannah but less than the sheep. There are multiple ways to restore the savannah, but first the damaging needs to stop, otherwise these restoration methods won't be effective. But getting less of the sheep and goats is a hard task because of their value to the Maasai. The only way to reduce them is to give them another way of earning money. The Maasai are only willing to keep less sheep and goats when there is an alternative income.

Most alternatives to obtain alternative feed are also harming the savannah and its members. There's only one method to obtain enough feed which can be stored during the droughts. This method is making hay from untouched grazing fields during the rainy season. Another possibility is being aware of the eatable waste from human food, this could help the livestock.

The livestock-wildlife conflicts are common for the area because livestock and wildlife live and feed in the same area. The best prevention against these conflicts is to place electric fences around the boma for protection during the night. Wildlife cannot go through this fence. During the day an electric fence around the grazing field could prevent these conflicts but these fences are harming the wildlife.

The recommendations are first to reduce damage to the savannah, before the restoration will be effective. Try to get equipment to make hay, this could be done in an expensive or cheap way depending on the amount of labour available. And at last make electric fencing around the bomas to prevent livestock from the wildlife at night.

SAMENVATTING

Het doel van dit onderzoek is om de Maasai te helpen met het herstellen van hun ecosysteem om op deze manier meer voedsel te verkrijgen voor het vee en de wilde dieren. Dit is namelijk een probleem geworden door voornamelijk de droogte, erosie, verveling van land en overbegrazing. Dit was in het verleden anders. De hoofdvraag is: Hoe kunnen de Maasai hun savanne ecosysteem herstellen zodat het rundvee en de wilde dieren genoeg en gezond voer hebben op de middellange en lange termijn? Om deze vraag te beantwoorden zijn diverse deelvragen gebruikt, om deze te beantwoorden is gebruikt gemaakt van interviews en literatuur. Er is gekeken naar de herstel van de savanne, alternatieve voedingswijze, verminderen van vee en de conflicten tussen wilde dieren en het vee.

Het belangrijkste resultaat is dat de savanne beschadigd blijft raken wanneer de schapen aanwezig blijven, ook de geiten beschadigen de savanne maar minder dan schapen. Er zijn meerdere manieren om de savanne te herstellen maar eerst moet het beschadigen stoppen anders hebben de manieren van herstel niet zoveel zin. Maar het houden van minder geiten en schapen is moeilijk vanwege hun waarde voor de Maasai. The enige manier om minder geiten en schapen te krijgen is door middel van het genereren van een alternatief inkomen. Maar de Maasai zijn bereid om minder geiten en schapen te houden wanneer er een alternatief inkomen beschikbaar is.

Veel van de manieren om alternatief voer te krijgen zijn niet goed voor de savanne en zijn bewoners, dit betekend dat er maar 1 manier is om genoeg voedsel opgeslagen te krijgen voor tijdens droogte. Dit is het maken van hooi van de niet aangeraakte begrazingsvelden tijdens het regenseizoen. Ook de bewustheid van het eetbaar afval van humaan voedsel voor het vee kan het vee helpen.

De conflicten tussen het vee en de wilde dieren zijn normaal voor het gebied omdat het vee en de wilde dieren op de zelfde plek leven en voeden. De beste preventiemethode tegen deze conflicten is om elektrische hekken rond de bomas te plaatsen voor bescherming in de nacht omdat wilde dieren deze niet kunnen passeren. Tijdens de dag kan een elektrisch hek rond de begrazingsveld de conflicten voorkomen maar dat is slecht voor de wildlife.

Het advies is om eerst minder schade te veroorzaken aan de savanne, daarna wil het herstel effect hebben. Probeer om materiaal te krijgen om hooi te maken, dit kan in een dure of goedkope manier afhankelijk van het aantal arbeid wat beschikbaar is. En als laatste maak elektrische hekken rondom de bomas om het vee 's nachts te beschermen tegen de wilde dieren.

1. INTRODUCTION

In this chapter the following issues are discussed: the subject, the reason, the theoretical framework, the knowledge gap and the demarcation. In addition, the relevance is also discussed.

1.1 Subject and reason

This section deals with the writing of the graduation paper. This discusses the subject and the reason for the subject. It also gives the location of the research.

LOCATION

The location of the research is in the southern part of Kenya, close to the Masai Mara National Reserve, Naboisho Conservancy and Tanzania. In figure 1 the overall location of the research area has been showed.



FIGURE 1 THE OVERALL LOCATION OF THE RESEARCH

In figure 2 is the black square shown. This gives an idea on the location of Nkoilale and on how close the conservations and game reserve are. The Naboisho conservancy is shown in green. The Masai Mara National Reserve is not displayed in a different colour but the entrance is at the place where it said Masai Mara National Reserve.

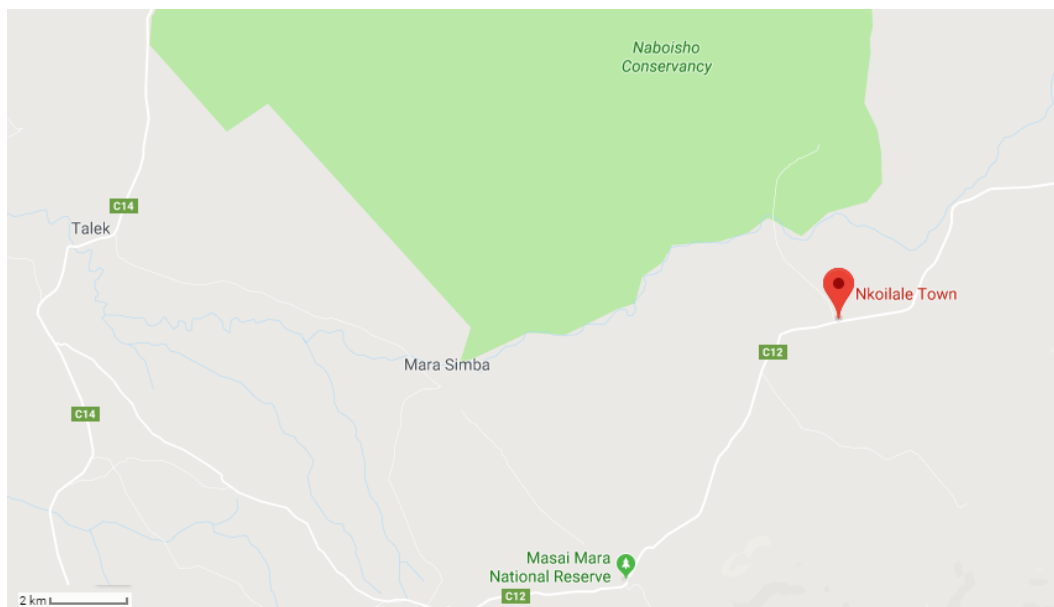


FIGURE 2 LOCATION OF NKOILALE TOWN AND NABOISHO CONSERVANCY AND THE GATE OF MASAI MARA NATIONAL RESERVE

SUBJECT

The subject of this thesis are the problems of feeding the cattle faced by the Maasai community in Nkoilale (which is in the Maasai Mara region of Kenya). This topic emerged through the Osotua Foundation. This is a foundation dedicated to the wildlife, the Maasai and their livestock in the eastern Mara region of Kenya. A typical feature of the region is that it is a semi-dry area, where the rainfall varies in time and place. In addition, there is a thin nutrient rich soil topping. This makes migration of animals and people the only possibility to live long-term and sustainably in this area. Furthermore, there is only one permanent water source in the eastern Mara region, which is the river Talek and there is a high dependence on temporary natural water sources. (Becking & Luchtenbelt, Olosinko project; Analysis of site, 2017)

The Osotua Foundation sees that the savannah as an ecosystem is under serious pressure, as a result of which people and animals in the area have more and more difficulty living and surviving (Osotua, 2018) There are several reasons regarding this area as under pressure. The Maasai can use less land due to the increasing reserves around the Masai Mara National Reserve. The increasing use of land for agriculture and urbanization in the north and the modernization of the lifestyle of the Maasai. In addition, the increased fencing of land through the introduction of individual land rights and the resulting change in land use is a problem for wildlife and cattle. The foundation tries to improve this by creating buffer zones where animals can freely pass through. The increasing human population adds to these problems. The growing population of the Maasai, the overgrazing of available soil and the keeping of the same number of animals on less land puts a lot of pressure on the ecosystem. Climate change also causes an increase in these problems because, instead of once every 15 years, there is a large drought almost every year. (Kirkbride & Grahm, 2008)

The foundation has set itself the following goal:

Working on providing food / feed safety and safety for the three "stakeholders" Maasai, Cattle and Wildlife according to holistic and eco-friendly principles. To provide a window for a sustainable way of living in a restored Mara ecosystem.

They try to achieve this through various projects. Two of those projects are: a 3-day course on good permaculture and the Olosinko project. With the Olosinko project, 3 experimental grazing grounds are being created with grazing management, protection against wildlife in a way that is good for both. This makes an alternative source of income for the Maasai in the Nkoilale community (Osotua, 2018)

REASON

The Maasai people living in Kenya and Tanzania, traditionally form a nomadic tribe. As nomads they were adapted to the living conditions in the savannah. Because of this and the better balance in the ecosystem, they were able to recover more easily from drought. Because during the drought the Maasai lost a lot of cattle, any excess quantities of cattle were brought back into balance and the ecosystem could recover itself. But due to modernization and the growing area of nature reserves where the Maasai are not allowed to graze livestock, they have largely established themselves permanently. (Rutten, 2016)

The problems with the food supply for livestock have several causes. The biggest cause is the shortage of water in the wet season. In addition, erosion of the soil also plays a role. Furthermore, the Maasai partly switched to goats and sheep because of the faster money (Becking & Luchtenbelt, Olosinko

project; Analysis of site, 2017), which then accelerated the process of degrading the soil. In addition, the Maasai have lost cattle through cattle-wildlife conflicts. The Maasai mostly aren't doing any agriculture, some families have a small plot (one of the bigger plots was around 200m²) where they grow human food.

Drought

At the end of the dry season there is a shortage of grass, but with the persistent drought during the wet season there is more and more a shortage of food. This ensures that there is more and more competition with the wildlife in the wet season, because the wildlife migrates when there is no feed. The little precipitation can be seen in the climate chart in figure 3.

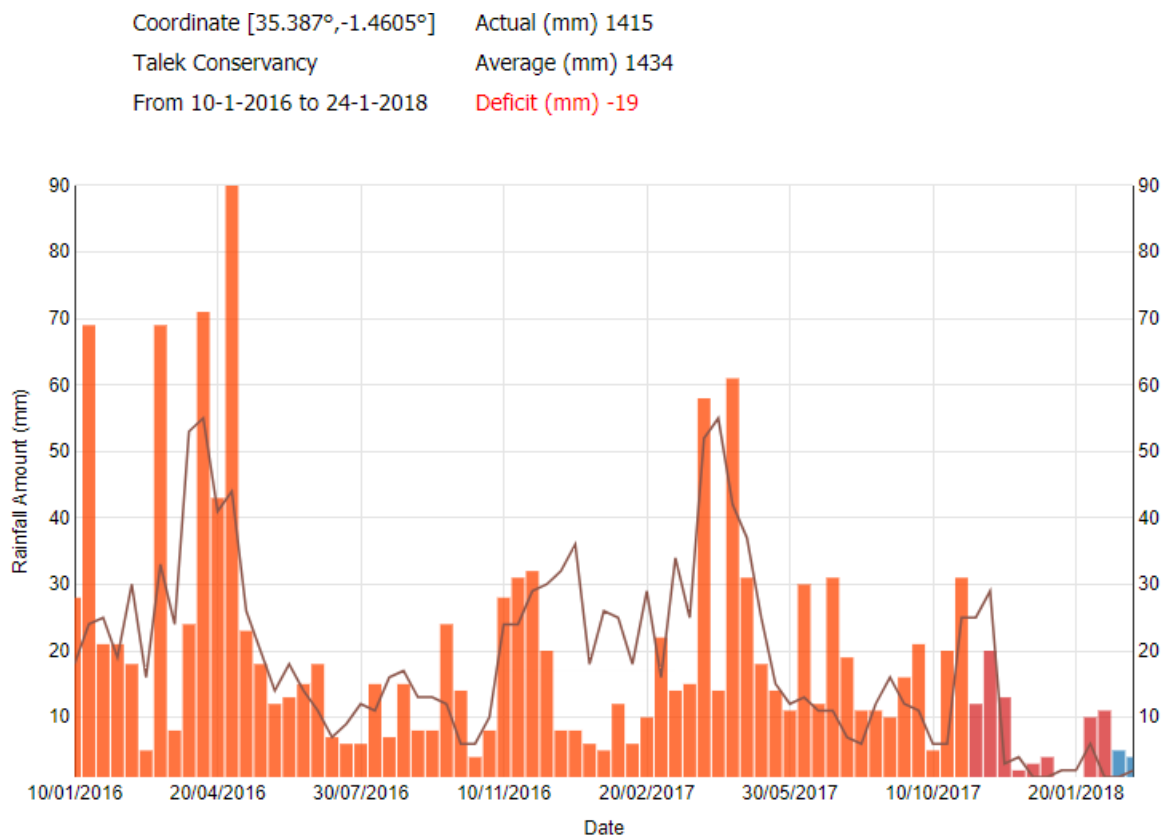


FIGURE 3 FALLEN RAIN AND AVERAGE RAIN. TAKEN FROM THE MARIS TOOL. (MAMASE, 2018)

Erosion

The soil suffers from gullies caused by erosion. These gullies are caused by multiple types of erosion. The type of erosion which harms the place the most is water erosion. When it rains the water will go down towards the lowest point. The water creates gullies to get there. One of those gullies is seen in figure 4. The gullies are also caused by car tracks and deepen under the influence of drought and wind. In addition, there is also top erosion, caused by the grasslands having become bare by the goats and sheep grazing there. Sheep and goats graze closer to the ground than cattle.

(Undersander D. , 2014) Because of this the soil is no longer held by the roots and the thin top layer which is rich in nutrients is blown away by the wind. (de Lijster, 2017)

Culture of the Maasai

In the culture of the Maasai, the number of cows that someone owns, together with the number of children and women, indicates the person's esteem. The cows that someone owns are also his savings account. For example, many cows are sold when the school of the children has to be paid, as a result of which a surplus of cows is on the market at the time of the collection of the school fees and the price falls. Figures from the NCDO show that the average family has 3 to 4 cows. (NCDO) However, more and more sheep and goats are coming because they are more affordable. In addition, the poverty that is known to the Maasai which has many influences, must be taken into account. According to Wishitemi's research, 67% of respondents say how they see their own current economic situation as poor. (Wishitemi, Momanyi, Ombati, & Makonjio Okello, 2015)

Cattle - Wildlife conflicts

The Maasai have a loss in cattle due to the number of cattle-wildlife conflicts. This means that livestock is killed by the wildlife. According to (Vissia, 2015), hyenas and leopards are the main causes of cattle wildlife conflicts in the Masai Mara region. In the months of May and June several conflicts were reported in the area around the village of Nkoilale. (Becking & Luchtenbelt, Olosinko project; Analysis of site, 2017) These conflicts will increase as a result of the drought, especially at the water sources. Because of the lack of feed during the droughts the Maasai will let their cows graze during the night in the national game reserve and conservancies. They will do it in the night because of the fact that livestock isn't allowed inside these areas. The conflicts will continue when the night grazing in the national park is continued. This is why it's important to find out what can be done against these conflicts.

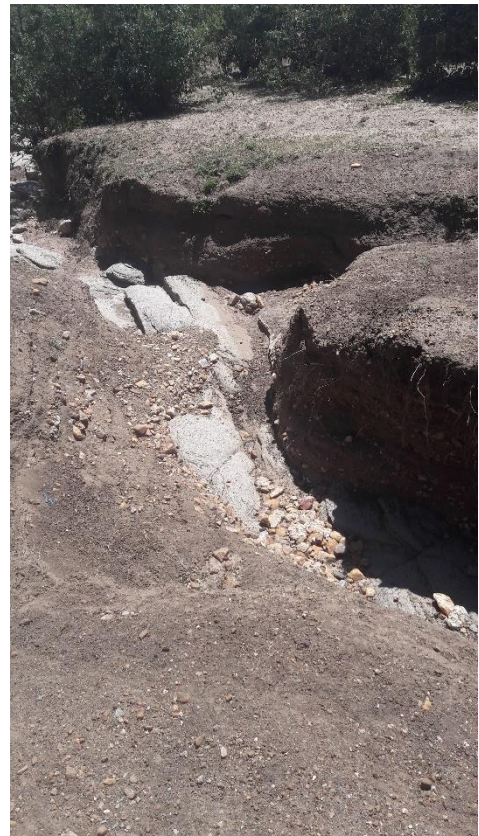


FIGURE 4 GULLY CREATED BY WATEREROSION

1.2 Motive

This section is about the known literature, the knowledge gap and the demarcation.

LITERATURE

Various reports have been made available by the Osotua Foundation. These reports are also presented as sources. These reports deal with, for example: climate changes in the area, culture and the ecosystem. In addition, various other reports and books are available from Agromisa, CABI and the Food and Agriculture Organization of the United Nations. New literature will be found using references of found reports, searching on keywords like: Maasai, livestock, restoring savannah etcetera.

KNOWLEDGE GAP

This research is about how to get more healthy feed for the livestock which the Maasai keep. The results needs to have no negative influences on the livestock, the Maasai and the livestock. Because all 3 are needed in the area. The area of this research is unique because of its geographical situation (surrounded by the national parc and conservancies, amount of rainfall). Most research in surrounding area's is not 1 on 1 copiable to this area because the differences in climate, wildlife and culture. It's known that the Maasai changed from keeping cattle to keeping more sheep and goats because they survive the droughts better. Its not known why this change gives more damage to the savannah. The Maasai are only used to let the livestock graze. In surrounding areas they started with harvesting crops to feed it during droughts. It's not known if it could be an option in Nkoilale.

DEMARCATATION

This workpiece deals mainly with the feeding of the livestock, where the following words are central to the study: recovery of the savannah, alternative feed and reduction of livestock. In the recovery part of the savannah, only the components of the ecosystem that affect the nutrition of animals are examined. The other components of the ecosystem will not be examined because they don't influence the outcoming of the research.

1.3 Main- and sub-questions

In this chapter the main- and sub-questions are being displayed.

MAIN-QUESTION

The main question of the graduation thesis is:

How can the Maasai restore the savannah ecosystem so that cattle and wildlife have sufficient and healthy feed on the middellong- and long term?

SUB-QUESTIONS

To answer the main-question the sub-questions, need to be answered. The sub-questions are the following.

- How can the savannah be restored to feed the livestock and the wildlife?
- Which other raw materials can be used to feed the cattle with?
- What could stimulate reducing the amount of livestock?
- How can cattle-wildlife conflicts be prevented?

1.4 Objective

The objective of the report is to help the Osotua foundation to achieve their goal of improving the living conditions of the Maasai, cattle and wildlife. The research will also be shared with the partners from Osotua Foundation in the Maasai community (like the NCDO). In addition, the report contains methods which the Osotua Foundation can use to help the Maasai.

2. METHODS

This chapter describes how the sub-questions are answered and what is required to answer them. In addition, the interviews are discussed. Also the searchplan of the literature study is shown.

2.1 Sub-questions

Each sub-question has its own paragraph where they are discussed.

2.1.1 HOW CAN THE SAVANNAH BE RESTORED TO FEED THE LIVESTOCK AND WILDLIFE?

To know how to restore the savannah to get sufficient and healthy feed for the livestock, first has to be know how damaged the savannah is and how to recover it and what the consequences are? This is the subject of this sub-question.

To answer this question, sub-questions are used, these are described below. To answer the question, the sub-questions must be merged.

Sub questions:

- What does the original savannah look like?
- What are the possibilities for savannah recovery?
- Can enough nutrition for livestock and wildlife be created with these possibilities?
- What consequences do these options have for wildlife, livestock and the Maasai?

The answers to these sub-questions have been found by studying and comparing literature. In addition, these questions have been discussed with various experts in this area. These experts can be professors in this area as well as members of the Maasai tribe. An interview was held during these discussions. These interviews were semi-structured, the format used for the interviews is shown in the appendix.

2.1.2 WHICH OTHER RAW MATERIALS CAN BE USED TO FEED THE CATTLE WITH?

To get more sufficient and healthy feed for the cattle on the long term there could be looked at other ways to feed their cattle. Because there could be ways to feed the cattle which is available but not used. The current way of feeding livestock is to let them graze on area's where grass is available.

This question will be answered by using sub-questions. In this context, a number of alternative foods are explained in the first sub-question, and the other questions are then also answered for each alternative food item. These alternative food items are found by studying literature and an visit to an comparable area in Tanzania where they have more agriculture.

Sub questions

- Which alternative feeds could possibly be used?
- What are the consequences of these feeds in the long term?
- What must be done to use these feeds?
- Is a feed suitable for both livestock and wildlife?
- How can we ensure that no invasive flora is used as an alternative feed?

2.1.3 WHAT COULD STIMULATE REDUCING THE AMOUNT OF LIVESTOCK?

To get more sufficient and healthy feed an option is to reduce the amount of livestock.

This question was answered by using reports from our predecessors and other sources, like the interviews and literature. In which it is discussed. In addition, certain ideas for reducing livestock are discussed, indicating why the idea does or does not work in practice. For example, the ideas Mr. Slootweg mentions in his research.

2.1.4 HOW CAN CATTLE WILDLIFE CONFLICTS BE PREVENTED?

In the area are a lot of conflicts between livestock and wildlife, the wildlife lives there and is necessary for a healthy ecosystem which can provide healthy feed.

This question was answered by the use of literature and discussions with various experts in this field. An interview was also held during these discussions. These interviews were semi-structured.

2.2 Interviews

Part of the information was obtained through interviews. In addition, there were meetings with people having different perspectives. There were conversations with the older members of the Maasai, younger members of the Maasai, nature conservationists, reserve managers, government, villagers, etc. The questions were asked in a semi-structured way. The questions asked at the various perspectives were mostly the same. The answers were often coloured by the function of these people. So the relevance of these answers has to be discovered. The questions had to be asked multiple times in different words to get an useable answer because someone could give 5 different answers when a question was asked 5 times. The answers which were closest to each other are usually the right one. In the appendix the used questions can be found.

2.3 Search plan

This searchplan consists out of 3 parts: an analyse of the research topic, formulation of search queries and the type of information needed.

Analyse of the research topic

There are multiple research topics, they are: savannah restoration and alternative feeding resources.

The topic savannah restoration is about how to restore the savannah on the long-term. The information needed is how the savannah could be restored, what has changed in the system, which damage is being done and how can it be solved.

The alternative feeding resources topic is about how to feed the livestock using alternative feed resources. The information needed is which alternative feeding resources could be interesting and what are their effects on the Maasai, livestock and wildlife. But because of the area with its wildlife not everything which is common practise in other area's could be used in Nkoilale.

Formulation of search queries

The search queries are formulated as following:

Savannah, restoration, Kenya or surrounding countries or Eastern-Africa.

Alternative feeding, Kenya, Maasai, feeding crops.

The type of information needed

The type of information which is needed are: research results about the topics and their backgrounds like place, ecosystem and surrounding area's of the research to compare if it could be used in Nkoilale.

3. RESULTS

In this chapter all the results of the interviews and relevant literature are shown. Each paragraph has its own sub-question where the results are displayed.

3.1. How can the savannah be restored to feed the livestock and wildlife?

Four sub-questions were used to answer this question. The information found for each sub-question is shown here.

CHANGES IN THE SAVANNAH

To answer the question about the changes in the savannah part literature part interviews are used. Both will be handled separately. The interviews support the information from the literature and proof that it's also in Nkoilale or show that's the areas of the research are not similar.

Literature

The literature says a lot about what changed in the past, the changed subjects will be handled separately.

Wildlife

The information found in literature was mainly about the Masai Mara national Reserve. It is a fact that the non-migratory wildlife in the Mara national reserve declined by 58 % between 1977 and 1997. This means there is 58% less wildlife in the reserve in 20 years. (Ottichilo, De Leeuw, Skidmore, Prins, & Said, 2000) The decline of the wildlife in the Masai Mara ecosystem may have been influenced by a combination of the following factors: climatic effects, habitat changes, competition for forage resources and poaching.

Settlements

Over the last 30 years clearing of the tsetse fly infested bushlands in the Mara enabled il-Purko Maasai to settle throughout the northern Mara plains. In the early 1970s the group ranch system formalized their land tenure. Many Maasai have also moved into the Mara from the areas of Mau Narok as more areas were leased for commercial wheat production. Since 1967 Maasai have occupied the more outlying areas of Koyake (an Maasai ranch) through waves of expansion. The main factor which influences the establishment of bomas and manyatta's is the distribution of permanent water sources. The first wave of expansion, between 1961 and 1967, was towards the Talek river which is a permanent water source. The second wave occurred in the early 1970 with an increase in settlements at Talek and the new occupation of Mara Rienta close to the Mara River. In the third expansion wave from the early 1980 till present suitable areas in Enkikwe and along the Olare Orok and Ntiakitiak streams were occupied. (Lamprey & Reid, 2004)

Rain

The Talek Conservancy has had a shortage of rain the last couple of years. According to the MARIS TOOL seen in the figure 5 the average rainfall in the past 20 years has been 813 mm a year. The same figure shows that the total rainfall was 737 mm in 2016. That means that there was 76 mm less rain than the average of the last 20 years.

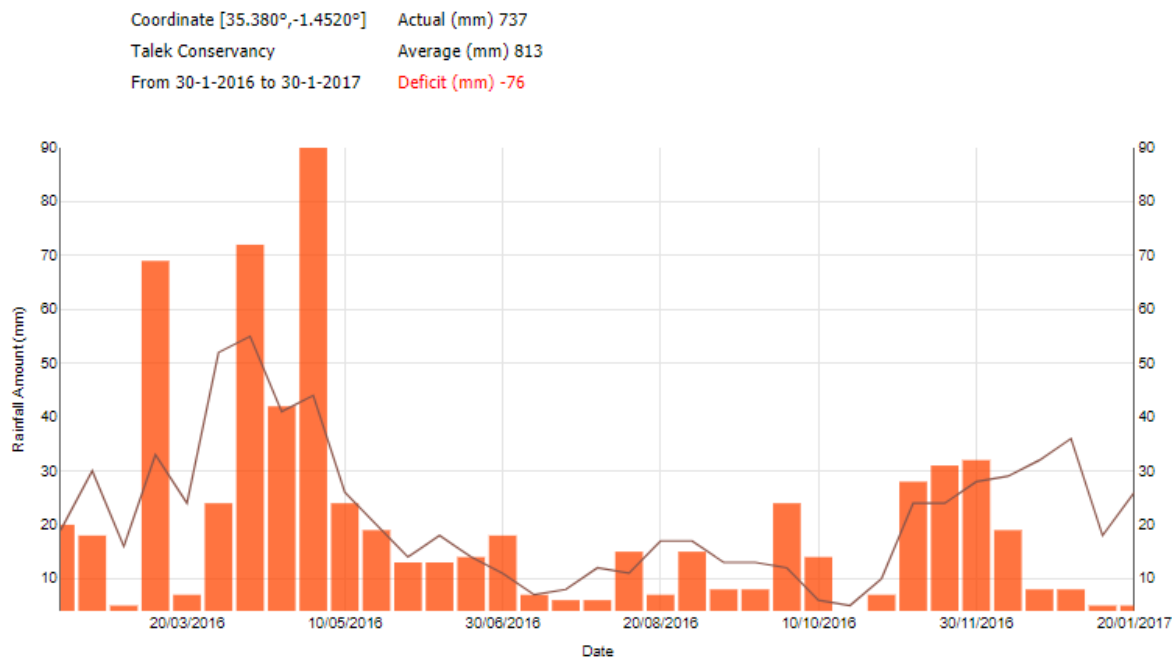


FIGURE 5 AVERAGE AND ACTUAL RAINFALL IN A YEAR TIME (MAMASE, 2018)

During the last couple of years, the rain has fallen more in peaks and the dry period has become longer and dryer, this is visible in figure 6. The soil cannot take up all the water that falls during the peaks. The excess water runs down to the lowest point, causing gullies. This means there is less water available for the grass to grow on.

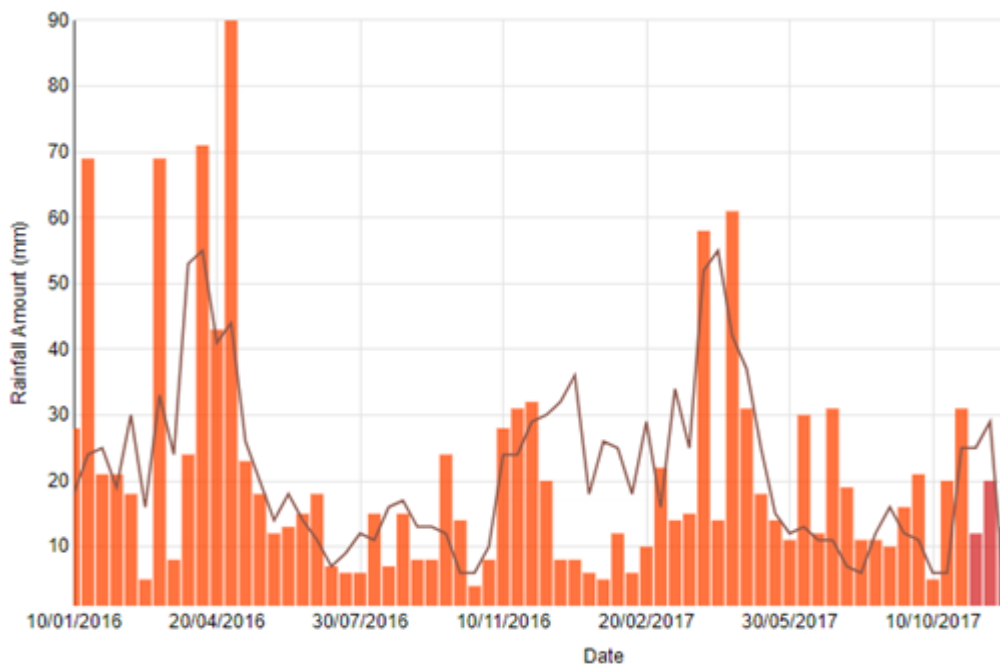


FIGURE 6 AVERAGE AND ACTUAL RAINFALL IN 2 YEARS TIME (MAMASE, 2018)

Fencing

Because of the privatising of the land the Maasai put fences on their land, this secures them of more feed when there is a drought. The Maasai first graze in communal grounds till there is no food left and

then they will let their cattle graze on their own land. In that way the Maasai makes sure their cattle survives the dry period when the grass can't grow. These fences are a threat to the roaming space of wildlife. However, they also help to restore overgrazed grounds, because the livestock of other Maasai and wildlife can't graze on that area and eat all the new grown parts of the grass.

Goats and sheep

Because of the grazing habit of goats and sheep it will take longer for the pasture to recover and produce feed again. This is because of how the goat and sheep graze compared to cattle. Goats and sheep bite the plants of close to the ground, while cattle tear off large mouthfuls of forage. By biting the plants off close to the ground they can also eat the growing point of the grass away. In that case the alternative growing point that is below the ground will take over the growing, but it takes longer to restore. (Oregon State University Forage Information System, 2018) This may lead to overgrazing. Also, the overgrazing in combination with their sharp hoof action may lead to erosion problems. (Undersander, Albert, Cosgrove, Johnson, & Peterson, 2014) This erosion takes place because the grass is eaten away and the bit that's left is demolished by their sharp hoof action. Then the bare soil can be blown away by the wind or taken away when the rain falls to the riverside. Goats prefer the leaves and stems of woody plants over grass. (Undersander, Albert, Cosgrove, Johnson, & Peterson, 2014) This means they also feed on the small bushes and trees. These trees may have positive effects on grass growth, because it brings soil enrichment under these trees. A study of Stuart-Hill et al. demonstrated a consistent pattern of grass production around isolated Acacia trees. Higher yields were recorded under and immediately to the south of the tree canopy. (Stuart-Hill, 1987) The higher yield can be caused by the influence of the trees to the microenvironment like the deposition of leaf litter, shading and the reduced water input because of the physical redistribution of rainfall by the tree. This is shown in figure 7.



FIGURE 7 HIGHER GRASS YIELD AROUND TREES

Interviews

During the interviews a couple of things came forward like the lack of rain and the longer drought periods, the availability of feed for the livestock and the herdsize. These subjects all influenced each other. And the Maasai people can't do anything about it most of the time.

Lack of rain

A lot of people said that the drought period gets longer and the rain period gets shorter. For example, Nelson Kamakia said about the changes in the last 20 years. *[The thing that changed a lot is the climate, we now have had a long drought for almost 2 years and less rain.]* (Kamakia, 2018) Because of the longer drought periods the availability of feed for the livestock during that period becomes an issue.

The last couple of years it became worse according to Ole Naurori it killed a lot of cows and even the sheep, which are supposed to do better during droughts, were struggling.

Lack of feed

According to the interviewed people the amount of feed available decreased. Part of it is because the distribution of land. The big impact on the Maasai of the distribution of land is explained by Naitaiyang Njapit, she said: *[The distribution of land is a big change, we used to live in common land and didn't stay at one place for a long time. And we always lived in plain land. But with the distribution of land you can find families living inside the bushes because that is their land. We now have less place to let our cattle graze.]* (Njapit, 2018) Also, the conservancies were created. So, families were not allowed to use the land as temporarily land anymore and were forced to go to their own land to live and could not move around anymore. The creation of conservancies also meant that they could not access a lot of the grazing lands anymore. To get enough grass for their livestock a lot of people fenced their land to make sure it is not eaten by wildlife or livestock from other people. Also, to get enough feed they secretly went into the conservancies and national reserve to let their cows graze there. So, the lack of feed is produced by the distribution of the land in combination with the less rain.

Herdsize

The herdsize has also changed a lot. This was said by multiple people, for example by Jackson Sayagie and Ole Mpo. They said that Maasai used to have large amounts of cattle but now have less of them. Oloshipa Josphat explained why they have fewer cattle. He said: *[All the land was communal land but now because of the distribution of land we don't have it anymore. But since the distribution of land we need to have less animals because the land doesn't provide enough feed anymore. So that's also why the number of cows decreased.]* (Josphat, 2018)

POSSIBILITIES FOR SAVANNAH RECOVERY

There are multiple possibilities to recover the savannah, some will be mentioned below.

Less goats and sheep

The current number of cattle, goats and sheep is: 20.000 cattle, 45.000 sheep and 20.000 goats. This is an estimation because of the culture of the Maasai, they believe when they count their livestock it will bring bad luck, so they don't count their livestock. The estimation is based on the interviews and literature. In figure 8 is a graphic shown about the estimate amount of cattle and sheep/goats in the Koyake area (Lamprey & Reid, 2004), this area is near to the area of Nkoilale.

According to the graphic the

amount of cattle fluctuates more than the amount of sheep/goats. This is caused by the lack of feed during the dry period. Also, in the end of the measured period the estimate amount of sheep/goats rose quite a bit from around 30.000 to over 60.000. (Lamprey & Reid, 2004) Also during interviewing it

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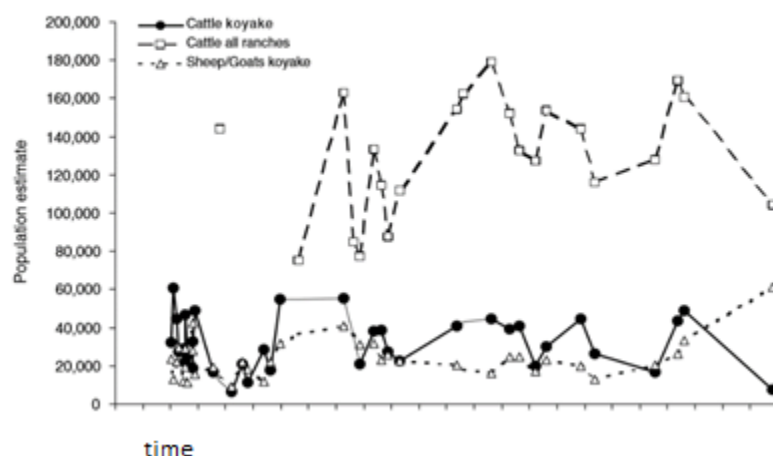


FIGURE 8 ESTIMATE AMOUNT OF LIVESTOCK IN KOYAKE

seemed that a lot of people really doesn't know the amount of livestock in the area. when asked for an estimation a lot of them came with answers between 5000 and 15000 for cattle, 10000 and 20000 for sheep and 1000 and 10000 for goats. When the abnormal amounts (answers like 5.000.000 for cattle) are taken out, the estimation of the total amount of cattle is 10803, for sheep it's 23667 and for goats it's 7946. But the 51-interviewed people had a total amount of 2042 cows, 4930 sheep and 1577 goats.

As mentioned before the goats and sheep harm the restoration of the pastures and the ecosystem by their way of grazing. Goats harm the system less than sheep because of they prefer the small bushes and trees. These trees can give a higher grass yield. But the sheep eat all the grass so it can't recover itself as fast. The Maasai won't get less the goats and sheep because for them it is an income, so getting less livestock will mean there is less income. Beside the income the Maasai experience in the drought period the cows will die due to the lack of feed and water while the sheep and goats will survive it. So, on the shortterm the sheep and goats will provide more income but on the longterm the damaged land will give problems with providing feed for the livestock and the income will decrease because there is no feed left for the livestock.

Knowledge of grassland

The knowledge on how the grassland recovers isn't sufficient, most people that have been spoken to do not know how grass grows and what happens when the growing point of grass is being grazed or cut away. The only thing they know is that rain makes it grow and fencing helps get more grass. David Purrenkoi has said the following thing about it. [The only thing about grass growth what I know is the rain makes it grow and fencing means taller and more grass.] The answer which was always given was that it needs rain and around half of the times the fencing is also mentioned.

When asked on how they graze and when they change the area they graze, most answers were on the place they graze, which is mainly public areas including the conservancies when allowed. They go from the conservancies when it's not allowed. When there is no grass left at these places they go for their



FIGURE 9 MANMADE SWELL

own acres which are fenced. When during a drought there is also no grass left at their fenced areas they go secretly into the conservancies or the national game reserve at night. Only 9 of the 51-asked people didn't use the conservancies or public areas when there wasn't a drought. With a (severe) drought they will also go to the conservancies or national reserve. This is why it can be said that with increased knowledge of grassland, they will not graze until everything is gone, which will help the grass to recover faster.

Making small gullies to prevent water from running downhill.

The making of small gullies or swells on small hills in the direction that is flat is a way to prevent the water from running downhill without penetrating the soil and creating large gullies. These small gullies stop the waterflow and gives the water the chance to penetrate the soil. This will help the soil to moisturize which will help the grass to grow better and also recover better after it has been grazed. In the fenced area of the Oloip Innovation Hub these small gullies have already been created and the better state of the soil is visible. This is visible in figure 9. Also in the interviews it became clear that was helpful. Out of the 51-

interviewed people 35 have seen the manmade small gullies or swells, and only 15 people could not say the positive effects of them. The positive effect which is told the most is that it gives taller grass. Of the 51-interviewed people only 2 gave a negative effect of the gullies. Also, some people said they use them to prevent water from flowing through the buildings or other structures. The data of the interviews is visible in table 1.

Answers	Seen them	%	Answers	Positive effects	%	answers	Negative effects	%
Yes	35	69%	prevents flooding buildings	6	12%	no negative effects	1	2%
No	16	31%	taller grass	27	53%	expand with rain	2	4%
			prevents erosion	3	6%	no answer	48	94%
			no answer	15	29%			
Total	51			51			51	

TABLE 1 ANSWERS MAN MADE GULLIES

Fill large gullies

Currently there are a lot of large gullies which run to the river, when these are filled the water can't use this path anymore. By using the small gullies to prevent water from running downhill, the large gullies will no longer be created and wash the fertile soil away. Also, by filling up these large gullies roads will be better accessible.

Secure trees

When there are more trees the grass yield around these trees will higher. This means the existing trees have to be protected from dying or being cut down. This can be done by making sure the goats don't eat them away. Also, the trees shouldn't be cut down by men to make charcoal. Narok County has also banned the burning, transporting and selling of charcoal (Kirui, 2018). This means there will be less cutting down of trees for charcoal for business purposes. In that way the existing trees will make sure there is more grass available around them. Also, planting new trees in areas where there aren't any trees or small bushes and protecting them so that they can grow will provide a better grass yield on the long term. Trees can attract more rain, which makes the grass grow even more. (trees and the water cycle, 2018) They also provide shade to the livestock. Which they mostly use to rest and rechew their feed. The shade will also help the livestock which have issues with heat stress, like for example the cattle which were bred with European breeds, because they aren't constantly in the sun and it will give them less sunburn.

Removing plants which are dangerous for livestock

In the area of the health centre there were some thistles. Thistles are dangerous plants for the livestock because they are poisonous. (The Rural, 2013) The thistle mainly affects the health of cattle but the health of sheep is also affected by it. Beside the toxicity of the thistle it is also a very invasive non-native species which takes the place of other grasses.

Also, some species of Acacia are poisonous for the livestock and especially for sheep and goats. This is because the bark of these species contains a very strong poison that causes Colic, muscle weakness, paralysis and finally cardiac arrest. (Nelis, 2012)

The livestock, mainly goats, will eat it during periods of drought because there is usually not much other feed left. As Ole Mpoe said it's during droughts when his livestock eat them. [When there's a drought and a lack of other feeds my livestock will feed on it.] (Mpoe, 2018) And Koliao Lemart said it's mostly the goats who eat them.

NUTRITION CREATED WITH THE POSSIBILITIES

In the former part the possibilities are shown which can be done to get the savannah restored and get more feed for the livestock. The effects on the amount of available feed is shown in this part. This is discussed for every possibility separately. Also, it is discussed whether these effects are long or short term.

Less goats and sheep

Sheep and goat are 2 different types of animals and their effect on the savannah is also different.

The amount of sheep is not compatible with the amount of land available for them. By reducing the amount of sheep, the land gets more chance to recover after been grazed. Also, sheep will eat continuously and it's hard to get them satisfied and let them stop eating. The Maasai will not reduce their amount of sheep because it's their spare. But they are willing to get less sheep if it provides them a better future, they also are willing to get less sheep if they get another way to earn money. More of this will be explained in the chapter about getting less livestock.

Goats are not as big of a problem as the sheep are because they won't eat as much grass because they feed on the bushes and leaves of trees. But the number of grown-up trees and the number of goats feeding on them should be in balance. Right now, this is not the case. For example, on the property of Nelson Ole Kirrokor, he fenced an area and within a couple of years the trees started to regrow because the goats weren't able to eat them away anymore. Right now, that area gets so dense with trees and bushes that he wants to reduce the number of small bushes. So, when an area is left alone by the goats the trees are able to regrow. The effect of more trees is discussed before and will again be discussed with the part about the securing of trees in this paragraph.

The balance between the amount of sheep and goats and the amount of land available for them is disrupted, there are too many sheep and goats. This will damage the savannah even more. Keeping less sheep and goats is a must to get less damage to the savannah, this solution is more about reducing damage then restoring savannah. But because the sheep and goats are an important way of getting money it's more for the longterm then for the shortterm.

Knowledge of grassland

When the Maasai know when to stop grazing on a place to make it recover faster it gives them more feed. However because the sheep, which cause the most of the overgrazing, are usually kept on the public areas and not in the fenced areas. It is hard to get the faster recovery of grass by getting more knowledge about grassland to the Maasai. This is because the public areas where sheep and goats graze are used by everyone and not all of them are willing to keep their sheep off a place that is being restored. An example are the ranches that officially don't allow sheep and goats, but where still some people let their sheep and goats graze because of the fact that these places have more grass then the

other public places. This could result into conflicts within the community. This solution can be done on shortterm but it takes times to see the effects because of the fact that not everyone in the community will cooperate.

Making small gullies to prevent water from running downhill

Making small gullies to prevent water from running downhill has big advantages, the soil will not be flushed away, the soil will be more moistened and there will be less erosion. The more moistened soil makes the grass grow better and longer. As became clear in the interviews it gives greener and taller grass. There are not many negative effects. The only thing needed to create this solution is labour. However people don't use this solution yet in their fenced areas.

They'll have to see the effects for themselves and then they will use it. This means that some people need to do it and others need to see it work, because of this it will take a while before a lot of people use it. But it could be the cheapest solution, with the most effect.

Fill large gullies

This solution is more of a measure to prevent more damage, also it helps to travel easier by car. Many roads have gullies and when they get to big it is hard to travel on them. In figure 10 the road to the hospital is shown. Currently it is hard for normal cars to get there because of the gullies created by trucks and water. Filling the large gullies will also help to prevent the soil being flushed away to the river. Even through this is not a way to get more feed it is necessary to restore the savannah. It can be done on the short term.

Secure trees

With getting more trees the grass yield will also grow. But it's not supposed to be too dense that it becomes a bush because the grass will not grow as well in there. This is a solution for the longterm because growing trees takes a long time but to secure the existing trees can be done on the shortterm.

Removing plants which are dangerous for livestock

By removing the dangerous plants, the livestock could have less problems with their health. Also, some of the dangerous plants like the thistle are invasive, which means that it will spread rapidly if it's not removed. This solution is not to get more feed but to provide safer feed and get less invasive species in the savannah. It can be done on the shortterm by checking the grazing area's for dangerous plants and remove them manually.

THE CONSEQUENCES OF THE POSSIBILITIES FOR WILDLIFE, LIVESTOCK AND THE MAASAI.

In this part the consequences of the possibilities for the wildlife, livestock and the Maasai are discussed. This will be done separately for every possibility.

Less goats and sheep

Wildlife: The effects less goats and sheep on wildlife is that there will be more grass available for the herbivore wildlife. The wildlife benefits from having less goats and sheep.

Livestock: The effects of having less goats and sheep on livestock is that there will be more grass available for the remaining livestock. The livestock benefits from having less goats and sheep.



FIGURE 10 ROAD TO HOSPITAL

Maasai: The effect of getting less goats and sheep on Maasai is that they have less possibilities to earn money, also the goats and sheep are part of their savings. But the remaining livestock will be able to survive the drought better and will be on average fatter, which means they are worth more. But they aren't worth more than the bigger herd was worth. So, the Maasai don't benefit from getting less goats and sheep.

Knowledge of grassland

Wildlife: The effect of more knowledge of grassland on the wildlife is that when the areas where they can come are managed better, there will be more grass available for the wildlife. But the areas where it will be managed first are the fenced areas and those are harder to access for the wildlife. This means that they will benefit less than the livestock and the Maasai.

Livestock: The effect of more knowledge of grassland on the livestock is that the fenced areas will be managed better and give more feed. This means more feed for them during the drought period. They benefit from the more knowledge of grassland.

Maasai: The effect of more knowledge of grassland on the Maasai is that they can manage the grazing areas better. There have to be some pioneers to try it and then the rest will see it works and will follow. Because of this the fenced areas are the first to get better managed because it will only be grazed by the livestock of 1 person/family. They will benefit from it but only if people can see that better management gives more feed during dry periods.

Making small gullies to prevent water from running downhill.

Wildlife: The effect of making small gullies on the wildlife is small because this will be mainly used in the fenced areas and those are harder to access for the wildlife. They will not benefit from making small gullies but it will also not harm them.

Livestock: The effect of making small gullies on the livestock is that there will be more feed available.

Maasai: The effects of making small gullies on the Maasai is that they have more feed for the livestock, but they need to put labour in there to make them. They are also already being used to prevent water from flowing through the bomas or buildings. They will benefit from making them but not everyone can afford to make them.

Fill large gullies

Wildlife: The effect of filling the large gullies on the wildlife is not that large because it is more for the safety of the Maasai, but when the soil is not flushed away there is more potential for grass growth. They won't benefit and also won't have disadvantages.

Livestock: The effect of filling the large gullies on the livestock is not that large because it is more for the safety of the Maasai, but when the soil is not flushed away there is more potential for grass growth. They won't benefit and also won't have disadvantages.

Maasai: The effect of filling the large gullies on the Maasai is that road can be accessed easier and it gives more safety for them. Also, it prevents the soil from being flushed away which gives a better potential for grass growth. They will benefit from filling the large gullies.

Secure trees

Wildlife: The effect of securing trees on the wildlife is not that large because it will be used mainly in the fenced areas which is hard to access for the wildlife. But when it works and the Maasai see it they might also use it on public areas and then they will profit from more availability of grass. This means they will not benefit as long as it is not used in places where they can access it.

Livestock: The effect of securing trees on the livestock is that there is more grass available around trees and that the trees provide shade for them. The shade area is mostly used to rest and rechew their feed. The livestock which have issues with heat stress will have the most profit of the shade. The livestock will benefit from securing and getting more trees.

Maasai: The effect of securing trees on the Maasai is that places with more trees and not bushy areas will give the livestock more feed. Also, they aren't allowed to cut trees to make charcoal from them and to sell this. This means they have less reasons to cut them down. The Maasai will benefit from securing trees.

Removing plants which are dangerous for livestock

Wildlife: The effect of the removal of dangerous plants on the wildlife isn't that large because when they move, only the dangerous plants are left. So, removing them doesn't affect the wildlife.

Livestock: The effect of the removal of dangerous plants on the livestock is that they will not eat the dangerous plants and they will not get sick of them. So, it's a benefit for them.

Maasai: The effect of the removal of dangerous plants on the Maasai are that their livestock won't get ill because of eating dangerous plants and that it can give more surface area for grass to grow when invasive species are being removed. So, it's a benefit for them.

3.2 Which other raw materials can be used to feed the cattle with?

To answer this question sub-questions were used. All the results of the answers are given for each alternative raw material. The alternative raw materials discussed are feeding crops, fodder feeding, hay and the use of human food waste. These alternative raw materials are already being used in other parts of Kenya or at the northern part of Tanzania.

WHICH ALTERNATIVE FEEDS

In this part a description of the different alternative foods will be shown. In the end there will be a part about the differences in the amount of surface area they need and how many cows they can sustain/feed.

Feeding crops

There is a variety of crops which can be harvested to feed to cattle during droughts. One of these crops is also used in other parts of Kenya. The crops which is explained is Cassava.

When Cassava is planted the leaves can be harvested and fed to the cattle, in addition the Cassava roots can be harvested and sold. It's already used in the coastal area of Kenya. As long as it has had rain twice in a timespan of a few weeks when it was planted, it can grow even if the rain fails to continue. (Irimu, 2018) It has to be planted just in front of the rain season in a spacing of 1.0 x 1.0 meter apart from each other. After around 4 months it is ready to harvest and it can be harvested monthly or every 2 months. But when harvesting monthly the roots grow less and is less sellable. The

top 30cm of the plant is not harvestable, all the other leaves can be plucked. After harvesting the leaves have to dry to reduce poisoning and avoid spoilage. Then they can be stored until they're used as feed. The leaves are a good source of protein because they contain around 20% of it. (Hahn, Reynolds, & Egbunike, 1988) . But a cow cannot feed on only Cassava leaves, there has to be other feeds around such as grass for grazing or hay. (Kiura, Bimbuzi, & Mwakina, 2008) According to the same source 1 hectare of Cassava from which the leaves are harvested every month can sustain 5 cows during a drought of 3 months. This means that to feed 1 cow for 3 months you need around half an acre. Also, the roots can be harvested, they can be sold or also used as feed.

Fodder Feeding

Fodder feeding is using the leaves of trees to feed the livestock. It should be used as a way to get the livestock fed during the dry season. Most of the information used in this report was received during a visit to Greening Africa (a project of an NGO in Tanzania). Also, some reports of other organisations are used to provide information about fodder feeding.

To use fodder feeding it's a must to have fodderbanks where the fodder can be harvested from. These banks consist of different species of fodder trees to get a variety of feeding materials. The species used at the fodderbanks at Greening Africa are: Centures Seriunsis, Mala Alfalfa, Gliricidia Sepium, Leucaena Diversifolia and Comelina Bengalensis. But the one most often seen was: Gliricidia Sepium. They used different species of trees because livestock has a hard time getting enough nutrients from only 1 species, also some species will cause livestock to get sick if they're not mixed with other species. Most of the species they used are not found in nature in the area but are imported from other continents like Southern America.

The forage trees should be first harvested when they reach 2 meters tall, and again after it grows back 0.5-1 meter. Cutting during rainy season can get as frequent as twice a month, which means around 6-8 times every season. During dry seasons the cutting may be reduced to get better growing conditions. (Trees for the Future) According to the same document with 1 hectare around 50 cows could be sustained for 3 months, but this is not realistic because Greening Africa has been talking about ¼ acre a cow a month.

Hay

During the rainy season there is enough grass, but during the drought it's all eaten away. During the rainy season the places on the grassfields that have not been grazed will stop growing because the plant is at its maximum height. This means that when it's harvested it will grow again. That the regrow during rainy season is fast is visible in the area of the health centre where parts of the grass have been cut down around the walking paths and buildings. (see figure 11) Within 4 days' time it was already visible that it had regrown between 5 and 10 cm.

There are multiple ways to make hay, for example with the use of machines pulled or pushed by tractors, by hand or a combination of them. The disadvantage of machines is that they cost a lot, but they reduce the amount of labour and work faster.

The process of making hay is quite simple. It only has 4 steps: cutting, drying, collecting and storing. A lot of people already have the equipment to do the cutting by hand, because that can be done with a knife. To let it dry only 1 day is more than enough as long as it doesn't rain. Collecting and putting on to heaps can be done by using a rake or by hand. The heaps can be transported to the storage or can be processed into some sort of bale and then be transported to the storage. The bales are easier to handle and to store because they are more compact. The amount of bales an acre could be up to 400 bales. A cow eats 1 bale a day. (A complete guide on boma rhodes production and hay making in Kenya, a smart way to make money, 2018) So 1 acre could sustain 13 cows during 1 month, when it's only harvested once.



FIGURE 11 REGROW GRASS HEALTH CENTRE

Human food waste

The leftover food from human consumption can have nutritious value. Sometimes it's thrown away with the garbage and burned. This could be fed to the livestock. An example are the cows owned by the school. They get the leftovers from the food of the children and parts that are not fit to use for human consumption such as the peels of potatoes. It's not known how much cows can be fed with it, but it can give a bit of extra nutrition to get them fatter or through the drought period.

Land compared to the amount of cows sustained

In the parts above there is shown how much land is needed to sustain a number of cattle (except for the human food waste). In table 2 it's shown how many acre 1 cow needs to get feed for a month.

	acres	number cows	Number months	acres a cow for a month
crops	2,47	5	3	0,16

fodder trees	0,25	1	1	0,25
hay	1	13	1	0,08

TABLE 2 COMPARISON AMOUNT OF ACRES A COW A MONTH

As visible in the table above fodder trees take the most surface area and hay takes the least surface area, the grazing fields which can be used to make hay are already there. Which means this is the cheapest option with the most feed per acre.

THE CONSEQUENCES OF THESE FEEDS IN THE LONG TERM

In this part the consequences of these feeds in the longterm will be shown. These feeds will be handled separately, except for feeding crops and fodder feeding, as they have the same grounds and their consequences are the same.

Feeding crops and fodder feeding

The feeding crops and fodder trees use land which otherwise would be available for grazing. Furthermore the consequent harvesting could become a problem because their culture makes that they won't harvest as long as it doesn't give them a direct income. Also storing the feed has to be done in a secure place where it can't be stolen by other people or eaten by wildlife. The implementation of this is the start of agriculture and growing crops for a profit. The visit to Greening Africa was in an area where during the last 20 years agriculture had grown and now there are no grazing areas left, all the wildlife is gone and cattle are also almost gone. The cattle still there is very underfed. Also, there are a lot of conflicts in areas where some people have agriculture and some have cattle, because the cattle will visit the fields to eat the crops. (Trees for the Future) Even the Maasai people who joined the trip predicted that the part of agriculture could happen to their area, when there are no other ways of gaining more feed or other ways of earning money, to get them to keep less livestock. But more about getting less livestock in the chapter about getting less livestock.

Hay

When only the surplus of the grass is harvested during the rainy season the only effect on grass availability is that there will be more grass available. Only when more than the surplus is harvested or the grass is harvested in the wrong way, it can create negative effects on the grass availability because of the lesser regrow due to the chopping away of the growing point.

Human food waste

The effects of using the waste of human food consumption as feed for livestock doesn't have effects on the area, except that there'll be less re-usable feed being burned.

REQUIREMENTS TO USE THESE FEEDS

To use these alternative foods there are some requirements, which need to be fulfilled before they can be used in the area. These requirements are shown for feeding crops and fodder feeding, hay and human food waste separately.

Feeding crops and fodder feeding

To use feeding crops and fodder feeding the following requirements need to be met: making places to plant the crops or trees and the mindset.

Making places to plant crops or trees: Because wildlife and other animals could also be feeding on these feeds it should be fenced in a way that the wildlife and other animals can't reach them, but there need to be an entrance big enough to let people in. If the Maasai are planning to use machinery or equipment these also need to fit through the entrance.

Mindset: The Maasai aren't used to harvesting feed and storing it in a way that the feed is conserved. Also, they aren't used to giving the animals additional feed except maybe salt or minerals. To use these kind of additional feed the Maasai need to get used to it and harvest when there is enough grass around.

Hay

To use hay as additional feed the following requirements are needed: some sort of equipment, grazing field which hasn't been grazed during rainy season and the mindset.

Equipment: The Maasai have to choose on the equipment they'll use to make hay. It starts with the choice to work with machines, with hand labour or a combination of machines and hand labour. There are ways to make hay without big investments by using the machete to cut grass and a box to make the bales. Like the one in figure 12 where you put dry grass in the hole on top of the device and with the lever you push it together and when it's full, a rope can be put around the bale. Also, there has to be a place where the bales can be stored until they are used during the dry season.



FIGURE 12 DEVICE TO MAKE BALES WITH ONLY MANUAL LABOUR

Grazing field: The grass needs to grow until a good length to be harvested, this cannot be done without making sure there are some fields which are reserved during dry season to make hay from. Livestock isn't supposed to graze on these fields.

Mindset: The Maasai aren't used to harvesting, storing and using the feed later when there's a drought. They're also not used to giving additional feed except maybe salt or minerals. To use hay as an additional feed during the drought period the Maasai need to get used to harvesting and storing feed for when it's needed in another season.

Human food waste

There is just one thing needed to use the human food waste as feed for livestock. This is a change of mindset. Although a lot of people already throw all waste outside for the animals to eat. It is needed that the human food waste is put in certain places without the non-eatable waste. Mixing non-eatable waste with eatable waste is asking for problems because the animals will then also eat the non-eatable waste, which is not healthy for them.

SUITABLE FOR LIVESTOCK AND WILDLIFE

These additional feeds are suitable for livestock and wildlife but they are mostly stored to be used during the dry season, in that way the wildlife will not have any benefit from it because they cannot reach it. These feeds can reduce pressure on the grass availability inside the conservancies and national reserve because the cows which go in there by night don't need to be satisfied during that time.

NO INVASIVE FLORA USED AS AN ALTERNATIVE FEED

2 of the 4 options use the current available source of feed, the 2 remaining options could include invasive plants when they're chosen to be used. There are enough other non-invasive plants available which could be used. This means that when choosing the species, to be used as fodder feeding or fodder crops, their invasive capacity and their origin should also be looked at.

3.2 What could stimulate reducing the amount of livestock?

This question is answered with the use of literature and interviews. To answer the question different sub-questions were used. These questions are:

- Are the Maasai willing to have less animals?
- What do they need before they can have less animals?

The questions will first be answered with the answers from the interview and then with literature some ideas are given.

WILLINGNESS TO GET LESS ANIMALS

In the interviews the question was asked if the Maasai were willing to get less animals if it provides them a better future. As shown in table 3 75% of the asked people were willing to get less animals. It has to be noted that the question was if they were willing to destock if it provides them a better future. So, for a better future they are willing to get less animals. Also 2 people said they already have less animals.

answers	Nb.	%
already tried	2	4%
Yes	38	75%
No	11	22%
total	51	

TABLE 3 ANSWERS WILLINGNESS TO DESTOCK

NEEDED TO GET LESS ANIMALS

As shown above, they're willing to get less animals if it provides a better future. But what do they need to get less animals and a better future. In the interviews they were also asked on this part. The answers of the question are shown in table 4 33% of the answers stated that they needed a better quality of livestock, which can be sold for a higher price. Also 33% of the answers stated that they need another way of earning money. This shows that they want to get the same amount of income, but having less animals gives them a lower income. So, it can be concluded that 66% said that they are willing to get less animals as long as their income also doesn't drop. Also, people said it is necessary to get less animals because the land doesn't support their amount of livestock and there's not enough feed for them.

Answers	Nb.	%
better quality, higher price	17	33%
other way of earning money	17	33%
manageable amount	6	12%
more feed, others feed on my acres	2	4%
no answer	9	18%
Total	51	

This means as long as there is an alternative income they are willing to get less animals, so before there can be less livestock, the alternative incomes have to be prepared and made workable.

LITERATURE

Mr. Sloodweg researched the possibilities for increasing of the income of people in the Ngorongoro District in Tanzania, which is a district close to the Kenyan border. He searched for opportunities to get an increased income for the people who live there. This research is interesting because the area used to be similar to the area of Nkoilale. It is close to the conservancy on the border of the Serengeti national reserve which is connected to the Masai Mara national reserve. He came up with 6 sectors where people could get their income from. These sectors are Livestock, Agriculture, tourism, forestry, mining and energy. (Sloodweg, 2016) It will be discussed why these sectors can be an opportunity .

Livestock

About the livestock the research says that the pastoralist way of keeping livestock can be productive and that it can help to preserve the wildlife and biodiversity. But livestock should be seen as an economic investment instead of primarily a cultural or social value. Currently there is no milk processing and most of the time cattle will be brought to the market when there is not enough food. Often they let cattle perish instead of selling them when they are fat and big.

For the Nkoilale region this is the same, they also don't process the milk but there is also not much milk available to be sold. Most of the milk is for own consumption. About the selling of livestock, the Maasai will rather let their animals die then sell them. They will only sell them if they need money for tuition, medical bills etc.

Agriculture

According to the research agriculture and horticulture should grow in importance. Also, families should specialize in a specific type of work instead of various kinds of work like keeping livestock, growing crops etc. so they won't only sell their surplus when the prices are usually low. The research also goes for more irrigation, mechanisation and intensification.

This isn't the solution for the area around Nkoilale. Because during a visit to this area it became clear that all the wildlife which was there in the past has been gone. The only major source of income was agriculture and the signs of depleted soil were starting to become visible. Also, irrigation will be a big issue because most of the streams and rivers in the area become dry in the dry period. Also drilling big waterholes is not the solution because it's expensive and on the long run they make the groundwater level drop even more.

Tourism

The reports say that tourism and related services are mainly of national importance. Only 20% of the tourist spending remains inside the district economy. Supplies for tourists come from outside the region, the population is only employed in a few craft making and selling services, the employees come from outside the district. The type of tourism inside the district is high-end-short-stay wildlife oriented. And it should stay that way. Also, the local produced products should be part of the food chain for the tourism sector.

Some things are the same for the Nkoilale region except more people are employed in the tourism sector. But a lot of supplies come from outside the area (mainly Nairobi). By investing in for example a slaughterhouse they can provide the tourism sector with meat from the area.

Forestry

According to the research a new forest management approach needs to be inverted to save the indigenous forest and its biodiversity. The current forest needs to expand between 20 and 40%. Woodproduction has to be less for charcoal and more concentrated on furniture and construction.

This is not going to work in the Nkoilale region because the increased use of land for forest gives a couple of disadvantages like more dangerous situations regarding the wildlife and less grazing areas for cattle.

Mining

The report says about the mining of minerals and valuable stones that it can boost the economy. There is already small-scale mining of soda ash, minerals, precious stones, normal stones and sand. The last 2 are for the construction industry. The mining should be well organised and there should be no mining in tourist destinations.

Because Nkoilale is surrounded by conservancies tourist destinations can be found at a lot of places which makes it hard to find a place where there could be mined. Also mining brings serious damage to environment. And the abundant wildlife will be harmed.

Energy

According to the report solar power, water power, wind power, geo-earth energy and bio-gas energy can be created when there is a connection with other economic sectors. The mining sector and the energy sector should be the smallest sectors.

In Nkoilale only few ways of generating power will work. There is a power grid but it is not operational. The only electricity they have is privately generated with solar panels and in rare cases bio-gas or wind. Getting income from energy production will not be an option until the power grid is operational

3.3 How can cattle-wildlife conflicts be prevented?

In the interviews almost, all people said that they have seen cattle-wildlife conflicts, in fact they've said that not only cattle is affected but all of the livestock. Most of the interviews show that the animals causing the most conflicts are the lions, which feed on the cattle. Also the hyenas, which feed on the sheep and goats, are mentioned a lot. Furthermore the following animals were also mentioned to attack livestock: elephants, cheetahs, wolf, buffalo's, wildebeests and leopards. One of the interviewed said that every family of the cat family will attack livestock. Also the situation of cattle being banned from the Masai Mara National Reserve and conservancies when the rain starts to fall and the grass outside starts to grow gives more conflicts because the herbivore wildlife follows the cattle outside and starts to graze there because the grass there is fresh and young (which they like more). But because the herbivore wildlife is outside the National Reserve and conservancies the carnivores also go out and find easier food in the bomas because the livestock is locked in there.

Prevention

When talking about prevention, most of the owners of livestock, who were interviewed, made a difference between day protection and night protection against wildlife, there were also some general comments. Each of these will be handled separately.

General comments

The general comments will make it clear why these conflicts happen and give the opinion of the Maasai people about the conflicts. About the reason why the conflicts happen John Kiu said during interviewing [It's hard to prevent because of the free movement of the wildlife between the national game reserve and the conservancies. And the predators will kill and eat what they will find on their way.] (Kiu, 2018) So the wildlife comes to places where people live when they go from conservancy to conservancy or to the national game reserve. But also, some people have the opinion that the wildlife should stay inside conservancies and the national game reserve because that place is especially for them. A good example of this opinion is the reaction of someone on the question how to prevent the conflicts from happening. The reaction is the following. [The conservancies should prevent the conflicts from happening. The government should take care of the wildlife and make them stay inside the conservancies.] (Gilisho, 2018)

Also, during interviewing it became clear that there was a compensation for livestock lost inside the conservancy due to wildlife. Tinaj Kasoe said the following about it. [In the conservancy there is a mixture of cattle and wildlife so there are always going to be conflicts but the conservancy will give a compensation for lost cattle to wildlife.] (Kasoe, 2018)

Day protection

A lot of people who were interviewed said that the herdsman need to protect the livestock during the day. A lot of people said that one of the tasks of the herdsman is to make sure that the wildlife and livestock don't collide. For example, Ole Naurori said this. But when it does come to a collision there is nothing they can do except to try to scare the wildlife away. In the past it was allowed to kill wildlife if they were threatening the livestock, but that is not allowed anymore by the government.

Also, people said that the grazing in fenced areas helps to prevent wildlife-livestock conflicts. Jackson Sayagie answered the question about how to prevent these conflicts with: [Grazing in well fenced land with a good electricity fence will prevent it.] (Sayagie, 2018) There is a difference between electrical fencing and normal fencing. Wildlife is able to get into the normal fenced areas, in these areas you can find antelopes and wildebeests grazing together with cattle. Predators can also go into there but they're less likely to do so. The electrical fencing makes sure that only the animals which are supposed to be in the fenced area are in there. Neither grazing wildlife nor predators can enter it.

Furthermore when there is an attack and one of the wildlife causes an injury to one of the livestock, the wound will most of the times remain untreated until the animal dies of infections. Multiple animals were seen with untreated wounds caused by wildlife, these wounds were filled with infections and maggots. There are multiple reasons possible for not treating animals with injuries. Most people don't know how to treat it and about the maggots someone not interviewed said they were small organisms healing the wound. Also, the lack of money to buy treatment materials is a reason. They would for example rather lose a cow of 14.000 KES, then get treatment materials and treat it for 1000 KES.

Night protection

During the night, according to the interviewed Maasai, the bomas should protect the livestock. But still the wildlife will try to eat the livestock. They sometimes find ways to enter the boma. The bomas should be well fenced but the fence breaks down sometimes.

4. DISCUSSION

In the discussion the objective and the results for every sub-question are shown. Furthermore there will be a reflection on the research.

Objective

The objective of this research is to help the Osotua Foundation to achieve their goal of improving the living conditions of the Maasai, cattle and wildlife. The research will also be shared with the partners from Osotua Foundation in the Maasai community (like the Nkoilale Community Development Organisation).

Results

The most important results for every sub-question will be shown. This will be done for every sub-question separately.

How can the savannah be restored to feed the livestock and wildlife?

A lot has changed in the area during the past 20 years, there is less wildlife, there are more settlements (which means less moving around with livestock to other areas where there is enough feed), less rain, more fencing and there are more goats and sheep. There are multiple possibilities which can help the savannah to restore but not all of them have the same impact. Also, a lot of them will only help the Maasai and their livestock. The wildlife only profits when the possibilities are also implemented in the public or not fenced areas. What helps to the savannah get less damaged is to get less sheep and goats but mainly sheep because the savannah cannot supply enough feed for their current number. Furthermore there are the possibilities to recover the savannah, such as creating small man-made gullies or swells, securing trees, getting better management of the grazing fields with more knowledge on grass growth and filling the large gullies. The last thing which can help is to remove the dangerous or invasive non-native species.

Which other raw materials can be used to feed the cattle with?

The materials that were discussed are feeding crops, fodder feeding, hay and human food waste. A lot has to be changed to use feeding crops and fodder feeding and there are huge investments involved with this. These alternative feeds also have a large impact on the savannah and wildlife. Feeding crops and fodder feeding can also feed less cows per acre when compared to hay. Most of the requirements to make hay are already there, like the grass and labour. The only investment needed is a way to make the bales, which can be done in several ways. The feeding crops, fodder feeding and hay needs to be harvested when there is enough available and stored until they are needed. For the use of human food waste, the only need is to get the Maasai to separate the eatable and the non-eatable waste.

What could stimulate reducing the amount of livestock?

Without knowing if the Maasai are willing to get less animals, there's nothing you can do to stimulate it. Many of them want to get less animals (75%) but most of them will only do it when there is still enough money being earned. There are a couple of things which can be done to get more money from livestock or to get other ways of earning money. For example, using other breeds which get fatter or give more milk. Also, other sectors can be used to earn more money, but not all of them will do well in the area. Examples of these sectors are Tourism, agriculture, mining, energy and forestry. Each of these have also their own effect on the Maasai and the savannah.

How can livestock-wildlife conflicts be prevented?

A lot of people in the area are affected by livestock-wildlife conflicts. Some people said it is part of this area because we live between conservancies and the national reserve which holds a lot of wildlife. During the night a boma should prevent the conflicts from happening, but few bomas are truly wildlife resistant because the wildlife can still enter and kill. A lot of people said that electricity around the bomas should work. During the day the herdsman needs to make sure that the wildlife and livestock doesn't collide. Also, electricity fences around fields keep wildlife from attacking livestock during the day.

Reflection

In the reflection there will be a part on the process and found results.

Process

During the research and interviewing people, a lot of information was gathered, also information which was useful for the Osotua Foundation but not useful for the research. Because of this the focus of the interviews was sometimes not fully on the research but divided between the needed data for the research and the other problems people asked us during the interviews. In a next research the focus during interviewing could be more on the research. Also, because there's a barrier in language (most interviewed people spoke Ma and not English) and the use of a translator (who knew the questions of the interview by heart in the end) some answers can be different than what they meant. This could be reduced by asking the same question multiple times with other words. During the research 51 people were interviewed, this is very few compared to the population. Also, a lot of people which were interviewed were friends or family from people we knew because other people would ask for a payment to do an interview with them. The questioning of the same question in other words was also used to get an true answer because when you ask the Maasai 5 times a question, you could get 5 different answers. The answers that are the closest to each other is most of the times close to the truth.

Found results

On some subjects like fodder feeding a lot of studies were available but they don't share the same conclusion. On other subjects, such as possibilities for other ways of earning money, there were very few studies available. This could have an effect on the results. The used studies on topics which were not in the searchplan came up while searching for those topics. There are also some older studies but more recent studies all reference to these studies as the base on their study.

5. CONCLUSIONS

This research is about the recovery of the savannah ecosystem for the Maasai in the Masai Mara region. And how to get more feed for their cattle.

To answer the main-question the 4 sub-questions are used, first these 4 sub-questions are answered and after that the main-question is answered.

How can the savannah be restored to feed the livestock and the wildlife?

Before restoring the savannah to get more feed for the livestock and wildlife first the damaging of the savannah has to stop. There are multiple things harming the savannah but the most important mankind can do is diminish the amount of sheep and goats. The amount of sheep is too much and they make the grass take longer to recover from grazing, also they create erosion problems. The amount of goats is a smaller problem but there are still too many. They harm the smaller trees in such a way that they cannot grow big and provide shade. This gives various problems such as less grass available for grazing and less rain in the area. This is also part of what can be done restore the savannah, the existing trees need to be secured and new trees have to be protected in a such way that they can grow big. Also making small gullies or swells will prevent water from flowing away. The manmade gullies or swells make the grass to grow better. Other ways to restore could be better management of the grazing field with more knowledge, filling the large gullies and the removal of dangerous or invasive non-native species.

Which other raw materials can be used to feed the cattle with?

The materials that were discussed are feeding crops, fodder feeding, hay and human food waste. A lot has to be changed to use feeding crops and fodder feeding and there are huge investments involved with this. These alternative feeds also have a large impact on the savannah and wildlife. Feeding crops and fodder feeding can also feed less cows per acre when compared to hay. Most of the requirements to make hay are already there, like the grass and labour. The only investment needed is a way to make the bales, which can be done in several ways. The feeding crops, fodder feeding and hay needs to be harvested when there is enough available and stored until they are needed. For the use of human food waste, the only need is to get the Maasai to separate the eatable and the non-eatable waste.

What could stimulate reducing the amount of livestock?

Without knowing if the Maasai are willing to get less animals, there's nothing you can do to stimulate it. Many of them want to get less animals (75%) but most of them will only do it when there is still enough money being earned. There are a couple of things which can be done to get more money from livestock or to get other ways of earning money. For example, using other breeds which get fatter or give more milk. Also, other sectors can be used to earn more money, but not all of them will do well in the area. Examples of these sectors are tourism, agriculture, mining, energy and forestry. Each of these have also their own effect on the Maasai and the savannah.

How can cattle wildlife conflicts be prevented?

A lot of people in the area are affected by livestock-wildlife conflicts. Some people said it is part of this area because they live between conservancies and the national reserve which holds a lot of wildlife. During the night a boma should prevent the conflicts from happening, but few bomas are truly wildlife resistant because the wildlife can still enter and kill. A lot of people said that electricity around the bomas should work. During the day the herdsman needs to make sure that the wildlife and livestock

doesn't collide. Also, electricity fences around fields will keep wildlife from attacking livestock during the day.

The main-question and the answer on it, is stated below.

How can the Maasai restore the savannah ecosystem so that cattle and wildlife have sufficient and healthy feed on the middellong- and long term?

To restore the savannah ecosystem and to get enough feed for the cattle and wildlife multiple things are needed. The first most important thing is to reduce the amount of damage done to the ecosystem before measures to restore it will work properly. There is only one thing which can be done to reduce the damage done to the ecosystem, this is get less sheep and goats. The Maasai are willing to get less animals as long as their income doesn't drop. So, they need other ways of earning money. Several things could be done to restore the savannah ecosystem and get the grazing fields to produce more feed. Securing the existing trees and protecting new trees to get more grass and rain, and making small gullies or swells to prevent water from flowing away and to prevent creating big gullies. The gullies or swells also provide more grass in their area. Furthermore a better management of the grazing field with more knowledge, filling the large gullies and removing dangerous or invasive non-native species could help with the restoration. Multiple things could be an option to get more feed but if they may not harm the savannah only 2 options remain. These are making hay and an enhanced way of using the human food waste. Finally the livestock-wildlife conflicts are harming the livestock and wildlife not only because the livestock is an easy prey for the predators but also because they graze on the same place as the herbivore wildlife. These conflicts will keep happening and it is part of the area. But there are ways to reduce them, for example by using electric fencing around the boma.

6. RECOMMENDATIONS

In the recommendations is shown what is needed to be done in the area to restore the savannah and to get more/better feed. This is described point by point and categorised into 4 categories, which are: less damage, restoring, alternative feeds and preventing livestock-wildlife conflicts. Finally, there will be a recommendation for an follow-up research. The part of getting less damage to the savannah should be implemented before the restoration of the savannah has big effects.

Less damage to the savannah

- Reduce the number of sheep
- Reduce the number of goats

Restoring the savannah

- Secure existing trees and protect new trees
- Make small manmade gullies or swells
- Get a better management of the grazing fields with more knowledge
- Fill up the large gullies
- Remove dangerous or invasive non-native species

Alternative feeds

- Start separating the eatable and non-eatable waste for the livestock
- Start with making hay

Preventing livestock-wildlife conflicts

- Make electric fencing around the boma

Up following research

In following studies the next things should be considered. The size of the interviewed group, which literature is usable because of the different findings in different studies which lead to a huge gap in the results. But also see if there are parts of the literature where hasn't been done a study on in a similar situation. A lot of research is not useable because the situation is different, and not comparable.

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APPENDIX

Appendix 1: Questions from the interviews

Appendix 2: Answers and calculations on acres, estimate and real amount of cattle

Appendix 3: Answers on getting less livestock and kind of feed

Appendix 1 Questions from the interviews

Name:

Age:

Wife(s):

Children:

Boys:

Girls:

Level of the school there in:

Number of

Cows:

Sheep:

Goats:

How did the area look like 20 years ago and what did change?

How does the grass grow and recovers itself?

What is the difference between the way of grazing of cattle, sheep and goats?

Have you seen the effects of small manmade gullies like the ones in Oloip Innovation Hub?

How many cows are there in the Nkoilale area?

How many sheep are there in the Nkoilale area?

How many goats are there in the Nkoilale area?

Do you catch water for own use or prevent water from rushing downhill instead of moistening the soil?

Do your animals sometimes eat toxic plants like thistles or the bark of acacia?

Are there any other feeding materials that are used except grass, shrubs or small bushes?

Where do you let the livestock graze and how is it done?

Are you prepared to destock if it provides a better future?

What is needed to destock?

Which cattle-wildlife conflicts have you seen?

What can prevent the cattle-wildlife conflicts from happening?

How many land do you own? How many is fenced? How many inside conservancy?

Appendix 2 Answers and calculations on acres, estimate and real amount of cattle

	amount of owned			estimate amount			land										
name	cows	sheep	goats	cows	sheep	goats	acres	fenced	Conser-vancy	%fenced	%conser-vancy	acres without conser-vancies	total tlu	tlu/acre without conser-vancy	Acres fenced/cow	acres/cow	
Ole Rinka	12	10	42	10000	20000	9000	10	-	-				13,6			0,00	
Komet Kaleku	4	10	0	7000	2000	14000	20	0	-	0,00%			3,8		0,00	0,00	
Shuel Gilisho	100	150	40	9000	15000	7000	45	-	-				89			0,00	
Jacob Meikwaya	50	36	200	10000	20000	5000	41	-	-				58,6			0,00	
Kim Purrenkei	20	90	10	5000	20000	12000	35	-	-				24			0,00	
Joseph Njapit	150	200	70	200000	400000	100000	47	-	-				132			0,00	
William Njapit	7	50	0	500000	600000	300	50	10	6	20,00%	12,00%	44	9,9	0,23	1,43	6,29	
Tinai Kasoe	150	150	50	5000	10000	8000	80	-	70		87,50%	10	125	12,50		0,07	
Julius Puwenkei	38	120	30	5000	10000	4000	70	42	12	60,00%	17,14%	58	41,6	0,72	1,11	1,53	
Nelson Kamakia	36	150	29	10000	20000	6000	50	25	0	50,00%	0,00%	50	43,1	0,86	0,69	1,39	
Baba Ntimama	200	250	44	8000	10000	3000	30	0	6	0,00%	20,00%	24	169,4	7,06	0,00	0,12	
Ole Mpoe	4	35	2	-	-	-	35	0	6	0,00%	17,14%	29	6,5	0,22	0,00	7,25	
Namura Njapit	10	20	10	5000	10000	8000	35	12	6	34,29%	17,14%	29	10	0,34	1,20	2,90	

Ole Lemurt	100	300	80	-	-	-	75	25	50	33,33 %	66,67 %	25	108	4,32	0,25	0,25
Ole Naurori	40	200	200	-	-	-	60	10	50	16,67 %	83,33 %	10	68	6,80	0,25	0,25
Joel Karia	21	13	27	new	new	new	74	45	0	60,81 %	0,00%	74	18,7	0,25	2,14	3,52
Philip Nkoitoi	30	150	30	1000	2000	500	35	22	13	62,86 %	37,14 %	22	39	1,77	0,73	0,73
Ole Njapit	3	43	10	-	-	-	75	0	6	0,00%	8,00%	69	7,4	0,11	0,00	23,00
Naitayiang Njapit	43	50	31	3000	8000	4000	65	35	14	53,85 %	21,54 %	51	38,2	0,75	0,81	1,19
Naasha Njapit	56	52	30	-	-	-	35	0	6	0,00%	17,14 %	29	47,4	1,63	0,00	0,52
Moses Njapit	60	70	150	4000	11000	2000	53	30	6,5	56,60 %	12,26 %	46,5	64	1,38	0,50	0,78
Ole Musutnkut	30	40	10	-	-	-	28	22	6	78,57 %	21,43 %	22	26	1,18	0,73	0,73
Daniel Tenko	20	40	2	4000	9000	800	18,5	0	6	0,00%	32,43 %	12,5	18,2	1,46	0,00	0,63
Kimpai Njapit	72	180	1	8000	15000	12000	71	25	26	35,21 %	36,62 %	45	68,5	1,52	0,35	0,63
George Sadera	5	30	2	3000	2000	3000	41,5	35	6,5	84,34 %	15,66 %	35	6,7	0,19	7,00	7,00
Solomon Lempayio	10	40	13	-	-	-	48	35	6	72,92 %	12,50 %	42	12,3	0,29	3,50	4,20
Turkei Gilisho	10	30	10	7000	2000	17000	41	10	6	24,39 %	14,63 %	35	11	0,31	1,00	3,50
David Purrenkoi	10	100	0	6000	1000	5000	53	46	7	86,79 %	13,21 %	46	17	0,37	4,60	4,60
John Kiu	25	45	20	3000	1000	2000	69	20	12	28,99 %	17,39 %	57	24	0,42	0,80	2,28
Stephen Sampuara p	5	20	0	3000	5000	700	35	28	6,5	80,00 %	18,57 %	28,5	5,5	0,19	5,60	5,70

Jackson Sayagie	10	20	0	4000	1000 0	3000	4 1, 5	0	6,5	0,00%	15,66 %	35	9	0,26	0,00	3,50
Kunyeri Kaleku	5	40	0	5000	1100 0	7000	1 0 0	0	90	0,00%	90,00 %	10	7,5	0,75	0,00	2,00
William Nchoe	20	100	20	4000	1000 0	7000	4 2	10	6	23,81 %	14,29 %	36	26	0,72	0,50	1,80
Dukunya Kamakia	50	100	0	6000	2000 0	3000	3 0	0	20	0,00%	66,67 %	10	45	4,50	0,00	0,20
Paul Kukaleku	10 0	200	40	5000	1500 0	1000	1 3 0	50	80	38,46 %	61,54 %	50	94	1,88	0,50	0,50
Dere Benson	5	50	0	10000	4000 0	1000 0	1 0	0	0	0,00%	0,00%	10	8,5	0,85	0,00	2,00
Antoni Kirmokov	20	46	10	5000	1100 0	8000	7 5	20	45	26,67 %	60,00 %	30	19,6	0,65	1,00	1,50
Nick Kaleku	20	40	7	1500	5000	1000	4 2	20	22	47,62 %	52,38 %	20	18,7	0,94	1,00	1,00
Benjamin Taki	20	50	5	4000	1000 0	3000	4 2	20	7	47,62 %	16,67 %	35	19,5	0,56	1,00	1,75
Kileri Mpoe	20 0	300	70	8000	1500 0	2000	1 2 0	20	50	16,67 %	41,67 %	70	177	2,53	0,10	0,35
Itukula Nchoe	10 0	100	100	5000	8000	2000	1 0	10	0	100,00 %	0,00%	10	90	9,00	0,10	0,10
Edward Dapash	20	400	30	8000	4000 000	2E+0 6	4 2	10	7	23,81 %	16,67 %	35	57	1,63	0,50	1,75
Joseph Kaleku	10	30	0	7000	1500 0	6000	2 0 0	50	150	25,00 %	75,00 %	50	10	0,20	5,00	5,00
Robin Yenкои	10	100	10	200000 0	5000 000	9000 00	4 2	35	6	83,33 %	14,29 %	36	18	0,50	3,50	3,60
Joseph Letoluo	5	30	10	4000	1000 0	3000	3 6	20	6	55,56 %	16,67 %	30	7,5	0,25	4,00	6,00
Ole Mpoe	10	0	5	5000	1000 0	5000	4 2	0	7	0,00%	16,67 %	35	7,5	0,21	0,00	3,50

Ole Nkoya	20	50	10	-	-	-	4 2	30	6	71,43 %	14,29 %	36	20	0,56	1,50	1,80
Koliao Lemart	10	100	17	8000	1500 0	4000	5 0	25	25	50,00 %	50,00 %	25	18,7	0,75	2,50	2,50
Ole Naurori	30	330	70	7000	2000 0	6000	3 0	10	20	33,33 %	66,67 %	10	61	6,10	0,33	0,33
Oloshipa Josphat	50	70	10	20000	1000 000	5000 00	4 2	35	7	83,33 %	16,67 %	35	43	1,23	0,70	0,70
Florence Sadera	6	100	20	3000	6000 00	4000 00	4 1	0	6	0,00%	14,63 %	35	16,2	0,46	0,00	5,83

Appendix 3: Answers on getting less livestock and kind of feed

name	wildlive					Getting less livestock		man made swells			feeding animals		
	cattle	sheep	daytime	night	general	Prepared?	what needed?						
legenda	Sheep: 1=hyena 2=leopard 3=lion 4=cheetah Cows: 1=lion 2=elephant 3= buffalo 4=wildebeests 5=cheetah 6=hyena					1=yes 2=no 3=already tried		seen them	helps	negative effects?	cows	sheep	goat
Ole Lemurt	1	1			people have to prevent it	1	other ways to earn money	yes	yes		tall grass, not bare	grass, make it bare	bushes
Julius Puwenkei	1	1			cant prevent, need them both	1	other ways of earning money	yes	yes	they expand with a lot of rain.	grass, open fields then bushed fields	grass, make it bare	bushes, scrubs and sometimes top part of tall gras
Stephen Sampuara p	12	1	herdsmen	good boma		1	other ways of earning money	yes	prevent flooding buildings		grass, eat fairly, not bare	grass make it bare	bushes not grass
Itukula Nchoe	12				electric fencing	1	other ways of earning money	yes	yes		tall grass,	short grass,	bushes
Joseph Letoluo	126	13	herdsmen	electric fence		1	other ways of earning money	yes	yes		same as sheep	same as cattle	bushes
Kileri Mpoe	1	1			electric fencing	1	other ways of earning money	yes	yes		grass, dont till bottom	grass till bottem make it bare	leaves of trees or bushes
Namura Njapit	1		herdsmen	good boma		1	other ways of earning money	yes	yes		grass, satisfied faster, not bare	grass, make it bare	bushes, when satisfied only top of tall grass
Ole Naurori	16	13	herdsmen	good boma	electric fencing	1	other ways of earning money	yes	yes		tall grass, satisfied easy	grass, eat more then cows	

Paul Kukaleku	1	3	herdsmen	good boma, lightning		1	other ways of earning money	yes	yes		tall grass, satisfied easy	grass, worst for the land, eat all grass, make it bare	bushes, when no bushes top of grass
Ole Musutnkut	1		herdsmen			1	other ways of earning money	no			grass, not bare	grass, make bare	bushes
Antoni Kirmokov	1	123		good boma	lightning around villages	1	other ways of earning money	no			grass, satisfied faster	grass, reduce in size with only tall grass, make bare	bushes not a problem
Naasha Njapit	1	3				1	other ways of earning money	no			tall grass, not make it bare	grass make it bare	bushes not a problem
Dere Benson	15	1234	herdsmen	good boma	dont graze the same area as wildlife has been seen that day	2	other ways of earning money	yes	yes		tall grass	small gras and a lot	leaves or bushes
Ole Mpoe	126		herdsmen	good boma	electric fencing	2	other ways of earning money	yes	yes		tall grass, satisfied easy	short grass, bottom, long time till satisfied	
Kimpai Njapit	15	1	herdsmen	lightning		2	other ways of earning money	no			grass	grass, eat a lot, worse then cows	dont like grass
Turkei Gilisho	12	1				2	other ways of earning money	no			grass, eat fairly, not till bottom	grass, make it bare, until roots	bushes not on grass
Joel Karia	1	1	herdsmen			difficult	other ways of earning money	yes	yes	prevent water from going to neighbor, then he lacks water.	tall grass, faster satisfied	grass, make bare and destoy it	bushes, not a problem

										Expand gullies			
George Sadera	1				electric fencing	3	more profitable breed	yes	yes	no	tall grass, dont eat much	grass, a lot, more than others	leaves
Joseph Njapit	4				conservancies	1	more money	no			-	-	-
Ole Rinka	1	1			conservancies	1	more milk	yes	prevent flooding buildings		grass, only the top	grass, make it bare	bushes, only tall grass drought
Komet Kaleku	14		herdsmen			1	more feed, others feed on my land	yes	yes		grass, until satisfied	grass, can't be satisfied	leaves
Baba Ntimama	1	1	herdsmen	good boma		1	more feed, others feed on my land	yes	yes		grass, get satisfied, not till roots	grass, make it bare, can't be satisfied	bushes
Jackson Sayagie	1	1			grazing in electricity fenced land	1	managable amount	yes	yes		tall grass	grass, eat till bottom	bushes
Edward Dapash	16	14			no killing anymore, fencing, electricity	1	managable amount	yes	prevent flooding buildings		tall grass	small grass	bushes and grass
Florence Sadera	16	13			fencing	1	managable amount	yes	yes		long grass	short grass	leaves of trees
Joseph Kaleku	16	1	herdsmen	good boma	electric fencing	1	managable amount	yes	yes		tall grass, not till bottom	short grass, till bottom	bushes
Oloshipa Josphat	126	13	herdsmen		electric fencing	1	managable amount	no			fresh and long grass	every grass, bare	leaves sometimes grass
Robin Yenкои	1	23			lightning, barbed wire	1	managable amount	no			grass, not till bottom	grass from root up	mostly leaves
Philip Nkoitoi	12				fenced areas	1	higher price	yes	yes, prevent erosion		top of grass	grass until roots	leaves, twigs and

												sometimes grass
John Kiu	1				free movement wildlife	1	good selling animals	yes	yes, prevent erosion	grass	grass, till bottom, make bare, eat to much	leaves not grass
Naitayang Njapit	1		herdsmen			1	fat cattle to sell	yes	yes	grass, not till bottom	grass, make it bare	same as cows but only on tall grass
Kim Purrenkei	1		herdsmen			1	better quality,	yes	yes	tall grass, some on leaves	grass, make it bare	bushes
Solomon Lempayio	12		herdsmen	good boma		1	better quality animals	no		grass, eat fair	grass, too much, make it bare	bushes
Daniel Tenko	1	1	herdsmen	good boma		1	better quality animals	yes	yes, prevent erosion	grass, only top, not bare	grass, until roots, make bare	bushes, fed up then top of grass but no feeding
Ole Nkoya	1	123			electric fencing	1	better quality animals	yes	yes	tall grass	short grass	bushes
Moses Njapit	12		herdsmen	good boma	wildlife should eat wildlife	1	better quality	yes	yes	tall grass, only top, satisfied faster	grass, till bottom, make bare	bushes
William Njapit	13				human scare them away from the herd	3	better quality	yes	yes	grass, open fields then bushed fields	grass open fields	bushes, when feeding on grass give them bushes
Tinai Kasoe	1	12				1	better prices	yes	yes	used for crops, are eaten by wildlife	grass, not till bottom, no grazing at former sheep pen	bushes, in drought may eat grass
Jacob Meikwaya	1	2		good boma	both important	1	better prices	no		-	-	-

Nelson Kamakia				stronger bomas	1	better breeds	no	yes		grass, in drought leaves of trees	grass, eat till roots	leaves and scrubs
Benjamin Taki	1	12		only looking after them	1	better animals	no			a lot of grass	eat also the smaller grass	bushes and grass
Nick Kaleku	15	1234		hard, same land, create awareness for importance of wildlife	1	better animals	no			tall grass	the remaining grass after cattle been there	trees and sometimes grass
Ole Mpoe	1	4		past kill, now compensation	1		yes	yes		tall gras	grass, not satisfied, bare	bushes
David Purrenkoi	12	1	herdsmen		1		no			grass, only top	grass, till bottom, make bare	bushes not a problem
Dukunya Kamakia	12	1	herdsmen	inside conservancy rangers	2		yes	prevent flooding buildings		tall grass, easy satisfied	eat more grass then cows	bushes
Koliao Lemart	126	124	herdsmen	good boma	2		yes	prevent flooding buildings		tall grass, bushes	grass, bare	bushes
Ole Njapit	12		herdsmen	past kill, not anymore	2		yes	prevent flooding buildings		tall grass, not till bottom	grass till bottom, make bare	bushes
Ole Naurori	1	1	herdsmen	good boma	2		yes	yes		tall grass, satisfied easy	grass, make land bare, cant be satisfied	bushes or top of tall grass
Shuel Gilisho	1	3	herdsmen	good boma	2		yes	yes		grass, not till bottom	grass, make it bare	bushes
Kunyeri Kaleku	12		herdsmen	good boma	2		no			tall grass	short grass, till bottom	bushes and leaves
William Nchoe	12		herdsmen	good boma	2		no			tall grass	short grass, till bottom, make bare	bushes not grass