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Fakulteten för veterinärmedicin och husdjursvetenskap

Swedish University of Agricultural Sciences
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Transition from nomadic pastoralism to livestock based agro-pastoralism - The case of animal husbandry in West Pokot, Kenya

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Övergång från nomadisk till en mer bofast boskapsskötsel i West Pokot, Kenya

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ABSTRACT

West Pokot County is located in North Western part of Kenya where the previous lifestyle was nomadic pastoralism. However, in recent years the semi-arid county has been under dramatic developments and a sedentary agro-pastoral lifestyle is now growing. This is a major change in production systems and there is a big knowledge gap especially for the livestock based agro-pastoral systems. The main objective of this study was to investigate the current situation of animal husbandry in West Pokot. Twenty farmers were interviewed in Chepareria Division, using semi-structured interviews to investigate if the use of enclosures have had any effect on animal husbandry in West Pokot and if so, how have this method affected the animal husbandry? The results of the study indicated that there is a difference in animal husbandry between farms using enclosures and farms not using enclosures. There was a significant positive association between number of years with enclosures and total number of animals ($p<0.05$). Those farmers that had been using enclosures more than 12 years had considerable more animals compared to the other categories of farmers. There was a negative correlation between the use of enclosures and the use of migration ($p<0.01$). Only one of the farms using enclosures also migrated with the animals, while four of the five farms not using enclosures migrated. To be able to draw further conclusions about these differences, more detailed research needs to be done of the animal production in West Pokot County. The focus should be on pasture management and the supply of water and feed to animals.

Keywords: animal husbandry, animal production, enclosure, fencing, pastoralism, agro-pastoral, semi-arid, ASAL, Kenya, West Pokot

SAMMANFATTNING

West Pokot ligger i nordvästra delen av Kenya, där den tidigare livsstilen var nomadisk boskapsskötsel. På senare år har den halvtorra regionen genomgått en dramatisk utveckling och en mer bofast agro-baserad pastoral livsstil växer fram. Detta betyder en stor förändring i de produktionssystem som används i regionen och det har uppkommit en stor kunskapslucka, särskilt för agro-baserade djurproduktionssystem. Syftet med studien var därför att undersöka den nuvarande djurhållningen i West Pokot, Kenya. Tjugo bönder intervjuades i Chepareria Division med hjälp av semi-strukturerade intervjuer för att undersöka om användningen av inhägnader har haft någon effekt på djurhållningen i West Pokot och i så fall, hur denna metod har påverkat djurhållningen. Resultaten visade en skillnad i djurhållning mellan gårdar som använder inhägnader och gårdar som inte använder inhägnader. Det fanns ett signifikant positivt samband mellan antal år med inhägnader och det totala antalet djur ($p<0.05$). De bönder som använt inhägnader mer än 12 år hade betydligt fler djur än de andra kategorierna. Samband hittades också i frekvens av migrering mellan gårdar som använder inhägnader och gårdar som inte använder inhägnader ($p <0.01$), där gårdar med många års användning av inhägnader hade mindre frekvens av migration. Endast på en av gårdarna som använder inhägnader migrerade bonden med djuren, medan fyra av de fem gårdar som inte använder inhägnader migrerade. För att kunna dra ytterligare slutsatser om dessa skillnader behöver mer detaljerad forskning göras om djurproduktionen i West Pokot. Fokus bör ligga på skötsel av betesmark samt ranson vatten och foder till djuren.

Nyckelord: djurhållning, djurproduktion, stängsling, inhägnad, pastoralism, agro-pastoralism, Kenya, West Pokot

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GLOSSARY

In the following paper, some terms are defined and used based on previous literature but also from oral references collected during the field study.

Enclosure	Pasture with fences around to keep animals inside enclosed area of land. Fencing material can be dead branches, live fencing material (e.g. cactus plants) or barbed wire.
Exclosure	Enclosed area to keep animals outside fenced land.
Maize stover	After harvesting the grain, farmers keep the dried stalks and leaves of the maize and store it to use as animal feed.
Waste material	Vegetables, fruit, crops and other waste material from the family's household is stored and used as animal feed during the dry season.
ASAL	Arid and Semi-Arid Land.
Pokot people	A group of people, who live in West Pokot County in western Kenya, speak Pokot language and usually living as pastoralists.
Pastoralism	When herd owners depend on livestock for 50 % or more of their income. Natural forage creates most of the fodder available to animals. Can be divided into nomadic, transhumant and agro-pastoralists
Nomadic pastoralist	Have established routes which they move around, depending on rainfall, feed availability and diseases.
Transhumant pastoralist	Move their livestock between fixed points to ensure feed availability for their animals.
Agro-pastoralists	Are considered as "settled" pastoralists, with crop production and permanent homesteads.
Triple L initiative	A multidisciplinary research initiative and platform investigating Land, Livestock and Livelihood Dynamics in drylands, with focus on biophysical and socio-economic changes in West Pokot during the past three decades.
Improved breed	In this study, the term "improved breed" is referred to as a pure (or crossbred) exotic (imported) breed, e.g. *Bos Taurus* cattle or exotic sheep/goats.
Indigenous breed	In opposite to "improved breed", the term "indigenous breed" means breeds with local origin, e.g. *Bos Indicus* cattle or local sheep/goats.

1 INTRODUCTION

In Kenya, 48% of the total land consists of agricultural land (World Bank, 2012) and 75% of the population are dependent on agriculture (FAO, 2012). The country, with its 582 650 km^2, is located in sub-Saharan Africa, and approximately 83% of the total land consists of semi-arid and arid areas (FAO, 2005). The sub-Saharan dryland serves as home to many of the poorest people on earth (Stringer et al., 2012) and poverty is still significantly high in Kenya. The total population is 43.2 million people and out of them, around 38% still live below poverty line (World Bank, 2013).

Pastoralist systems are estimated to account for about 10% of Kenya's total GDP (The Ministry of Agriculture, 2013), but experts believe the contribution to the national economy could be even higher if indirect benefits were included (IRIN, 2012). At the same time, livestock-dependent pastoralists belong to the most marginalized and poor people in Kenya as well as in other countries (IRIN, 2012). Pastoralism can be defined as "*when herd owners depend on livestock for 50 % or more of their income and that natural forage constitute most of the fodder available to the animals"* (Sanford, 1983). The location of this study, West Pokot County, is located in North Western part of Kenya, where the previous lifestyle was nomadic pastoralism. However, in recent years the semi-arid county has been under dramatic developments including an increase in agricultural infrastructure and the previous pastoral lifestyle is now slowly changing to sedentary agro-pastoral lifestyle (Mukoya, 2007).

The Swedish, non-governmental organisation Vi Agroforestry (Vi-skogen) started working in West Pokot County during the beginning of the 1980s. They introduced methods to prevent soil erosions by planting trees and later also promoting enclosures (Makokha et al., 1999). Several years of work by Vi Agroforestry together with the community in the county have shown that enclosing the land has many benefits, for example to avoid and prevent soil erosions (Kitalyi et al., 2002; Makokha et al., 1999). The project "*Triple L - Land, Livestock and Livelihood Dynamics in Dryland Systems, West Pokot Kenya*" was established in 2013 with the main goal to study, analyse and understand the causes, processes and consequences of the changes from a pastoral lifestyle to a more agro-pastoral lifestyle.

A transition from nomadic pastoralism to a more settled farming system that is still livestock-based has been seen in Kenya and other countries in Africa. This is a major change in production systems and there is still a big knowledge gap in management especially for the livestock based agro-pastoral systems. Even though the farmers in West Pokot County have experienced drastic changes during the past twenty years, the livestock sector in West Pokot County is still facing many challenges. Among these challenges are low livestock productivity, insecure land tenure systems, poor breeds and breeding practices and endemic livestock diseases (Akoyo and Songkok, 2012). In order to meet future market demands, with a growing population and higher request of food, the livestock production systems needs to be more effective to increase their production. To be able to provide thorough and useful training and support to the Pokot people during this change of lifestyle, more detailed knowledge and descriptions of the enclosure management is therefore needed (Verdoodt et al., 2010). Furthermore, policy makers need more scientific research and information for their work to be able to make new policies in the county.

The main objective of this study was to investigate the current situation of animal husbandry in West Pokot, Kenya. Three research questions of certain interest for the study were developed:

Q1: have the use of enclosures had any effect on animal husbandry in West Pokot and if so, how have this method affected the animal husbandry?

Q2: is there any difference in whether migration is used or not between farms using enclosures and farms not using enclosures?

Q3: is there any difference in land size between farms using enclosures and farms not using enclosures?

The hypotheses were that:

- the use of enclosures have affected the animal husbandry in West Pokot
- farms using enclosures will have fewer animals than farms not using enclosures
- a higher share of animals of improved breeds will be used on farms using enclosures
- the milk production will be higher on farms using enclosures
- farms using enclosures will not migrate as frequent as farm not using enclosures
- the total land size will be smaller on farms using enclosures

2 LITERATURE REVIEW

Sub-Saharan Africa has the largest number of pastoralists of all continents. At the same time, the rapid increase of human population is putting a high pressure on rangeland and livestock production (FAO, 2012). Pastoralism is the extensive grazing of rangeland for livestock production (Blench, 2001). The pastoral lifestyle is varied and includes several production systems. However, these different systems can be generally categorised, dependent on movement of herds; *nomads* with established routes which they move along, depending on rainfall, feed availability and diseases; *transhumant pastoralists* who move their livestock between fixed points to ensure feed availability for their animals; and *agro-pastoralists* who are considered as settled pastoralists with crop production and permanent homesteads (Blench, 2001).

For both pastoralists and agro-pastoralists, the responsibilities on the farm are clearly divided amongst the genders. The men are responsible for herding, including taking the animals to feed and water sources every day. They are also in charge of veterinary services and the animal health, including taking the animals to the cattle dip[1] when required. Selling and buying livestock, castration and farm economy is also included in the men's responsibilities. The women, on the other hand, are in charge of milking the animals and selling excess milk and other products. They are also responsible for taking care of newborn calves and lambs, pregnant animals and sick or injured animals that are close to the homestead. Children are also supposed to help out on the farm in pastoral and agro-pastoral households, and are usually herding the animals and taking care of daily housework (Tangka & Jabbar, 2005).

Even if agro-pastoralists do not have migration as a tradition, they can be forced to migrate with their livestock if there is not enough feed available, especially during severe drought (Blench 2001). The migration usually occurs during the longer dry season between December and April. During the migration, women are left at home to take care of children and small animals. They harvest and store maize stover and fodder trees to have when the men return with the cattle in April (Makokha et al., 1999).

In West Pokot County, 45% of the farmers are pastoralists, 29% are agro-pastoralists and 26% have mixed farming (Akoyo & Songkok, 2012*).* In a study made by Nyberg (2013) a diversification of livelihoods can be seen between 1980 and 2013; from nomadic pastoralism to agro-pastoralism. The farmers have started to own more land and have increased their production in relation to increased prices at market (Nyberg, 2013). The land in West Pokot is either private or communal. Private, individual tenure occurs in areas with a high agricultural potential and communal, shared tenure is to be found in areas with dry, infertile soil (Makokha et al., 1999).

2.1 Enclosures

Fencing of land has been used by the pastoral Pokot before the colonial period. By using dead, thorny branches, women built exclosures where animals where kept outside land, to keep crops safe from livestock. As the families moved on, these plots were abandoned and

[1] Cattle dip is a "cattle bath", used as prevention for ticks and other parasites that can cause problems on the livestock. This can also be used for other animals, such as goats and sheep (MSD Animal Health 2013, http://www.msd-animal-health.co.za/).

new ones established in the next settlement area (Makokha et al., 1999). Later on, enclosures where introduced and animals are now also kept inside enclosed or fenced areas. Before, dead branches were the common fencing material to use for both enclosures and exclosures, but when a project by Vi Agroforestry introduced methods to prevent soil erosions in the 1980s, live fence material was introduced (Figure 1) (Makokha et al., 1999). The living fence can be made of plants such as the cactus plants *Eurphorbia tirucalli*, *Sesal* or *Agave*. Barbed wire is now also promoted, preferably with 8 strings (Mukoya et al., 2007

Figure 1. Soil erosion and gullies in Pserum, Chepareria.

According to a field study in Kenya, by Makokha et al. (1999), fencing land have resulted in more grass for livestock, land degradation has reduced and the biomass production of the pasture is higher inside enclosures than outside. Furthermore, milk yields have increased and the animal health is improved with lower animal mortality rates and higher fertility rates (Makokha et al., 1999). Walking shorter distances with the cattle also decreases the energy costs and increases time available for grazing (Butt 2010).

However, enclosures require a substantial investment in time, labour and material, costly factors that can be a difficulty for farmers. Another aspect is the limitation of available grass that occurs when animals are fenced inside a smaller area. By using enclosures, animals are usually allowed to graze on smaller areas than when using free grazing. Although these are major difficulties for farmers, the benefits of using enclosures usually outweigh the costs. After a few years most farmers agree on the benefits of improved pastures (Table 1) and higher production (Kitalyi, 2002).

Table 1. *Pros and cons of using enclosures (Kitalyi, 2002; Makokha et al., 1999).*

Pros	**Cons**
Control of animals and crops	High material costs
Reduced risk of overgrazing	Labour requirements
Easier water accessibility if enclosure is close to water source	Need constant maintenance
Enable regrowth and rehabilitation of grass	Limited feed inside enclosure
Increased milk yield	More difficulties of getting water if enclosure is far away from water source
Decreased frequency of cattle rustling	

Reduced walking distances (decreased energy losses and increased grazing time) Provide pastures even during dry season	

2.2 Animal husbandry

Livestock is very important in developing countries, especially in rural areas where the animals serve as food, for income, and as safety buffer during drought when crop production is limited (Otte & Upton, 2005). The main types of livestock, and numbers, in West Pokot County are cattle (400 000), goats (450 000) and sheep (450 000) (KNBS, 2009; Musalia et al., 2007). Bulls, goats and sheep are commonly sold at markets to get cash for hospital bills, school fees and food expenses (Makokha et al., 1999). Poultry is common (400 000) and used for its production of eggs and meat, but not highly valuated and is seen as women's responsibility only (KNBS, 2009; Makokha et al., 1999). Camels are also present, used mainly for milk and meat, as well as beehives for their honey (KNBS, 2009). A high number of donkeys are also seen the area and these animals are used for transportation, especially in areas where all roads are lacking.

2.2.1 Breeds and breeding

The most highly valued livestock in Kenya is cattle, and high-yielding *Bos taurus* cows such as Friesian, Ayrshire, Gournsey and Jersey are kept (Kitalyi, 2005). However, in the semi-arid areas of West Pokot, the *Bos indicus* cattle, such as East African Zebu and Sahiwal, are common. Crosses between indigenous cattle and genetically improved, high-yielding cattle also occur. The Zebu cattle are recognized by a prominent hump and can be of various colours. It has a low milk production and mature late, but is also known as a very tolerant and stable animal. The Sahiwal, also originated from Africa, are bigger than Zebu cattle and are known for their light brown colour and large ears. The milk production of Sahiwal cattle is still relatively low (Musalia et al., 2007; Nafis, 2014). Among the improved breeds, Friesan and Ayrshire are the most common breeds seen in western Kenya. Friesian has a black and white colour and is large in body size. The milk and meat production is high, but so are also the feed requirements and housing management. Ayrshire is smaller than Friesian and has a dark brown body colour. The milk production is still high and the meat production fair, but the feed requirements are almost the same as for Friesian (Musalia et al., 2007; Nafis, 2014).

Goats are of both local, indigenous and exotic origin. The indigenous, East African goat is common throughout East Africa and varies in both colour and size. Up to 30% of the total population have toggles and both sexes have horns that sweep backwards. The coat is short and fine, with a mane usually present on males. Goats of improved breed are mainly Galla, Kenya Alphine and Toggenburg. The Galla goat is highly valuated in Northen Kenya and is known as the "milk queen" in arid and semi-arid areas. The goats are white haired with black skin, easily observed on their muzzle, feet and underneath their tail. The Kenya Alphines originates from the French Alps and are known for being tolerant animals, thriving in many climates. The colour varies, with shades of grey, brown and black, and horns can occur on both sexes. Toggenburg goats originate from Switzerland and Great Britain, with the British breed being bigger in size. They are brown or greyish brown with distinctive white stripes on the face and legs, and horns may occur on both sexes. The Toggenburg goats may also have toggles. Their body is long and the animals are not very tolerant to heat (Nafis, 2014).

The sheep breeds commonly used in north western Kenya are the indigenous Red Maasai sheep, together with the improved breeds Dorper and Merino. Red Maasai sheep are recognized as small, red-brown sheep with flappy chins and a fat tail. The animals are highly tolerant to harsh environments and are known for being good milker and have a high fertility. Dorper are also included in the fat tailed hair sheep and are easy to recognize with their black head on a light brown body. The sheep are tolerant and produce quality meat in harsh environments. The Merino sheep, developed in Spain, are also very easy to distinguish with a fine fur, produced mainly for wool production (Nafis, 2014).

Poultry is increasing within the livestock sector in north western Kenya and improved breeds are starting to be presented for farmers in the area. However, so far indigenous breeds are the ones dominating the market, even though crosses of indigenous and improved breeds occur.

The breeding decisions of smallholder dairy producers in the Kenya highlands conform to producers' multiple objectives. These include the need for increased milk production, adaptability to local feed conditions and diseases, and the provision of non-market production (e.g. manure, and the insurance, financing and social roles of cattle) (Bebe et al., 2003). According to Bebe et al. (2003), the most common breeding procedure is to use a bull from a neighbouring farm. Artificial insemination (AI) is not commonly used in the Kenyan highlands and can be explained by high costs, but also due to lack of heat control which is an important factor when using AI (Bebe et al., 2003). Also culture and traditional methods should be taken into account; Pokot people have been using natural mating for a significant period of time and the method is still the most common in West Pokot (Musalia et al., 2007).

2.2.2 Animal production

Genetics, energy intake and animal health are only some of all factors that can affect the milk production (Bonfoh et al., 2005). The management of livestock also has a high impact on the animal production, where especially the housing and feeding management affect the health and possible production of the animals (Kitalyi et al., 2005). In general, smallholder farmers have two to five dairy cattle that produce about five kg milk per cow/day (Bebe et al., 2003; Musali et al., 2007). Since the milk production is fairly low, it is a constant competition between the human and the calf concerning the milk supply. The milker must therefore balance human consumption with calf growth (Degen, 2007). The cows are in general milked two times per day and the excess milk, after fulfilling the family needs, are sold to neighbours or on surrounding dairy farm cooperatives (Staal, 2008).

2.2.3 Animal health

According to Bebe et al. (2003), the mortality rates were high in the Kenyan highlands regardless of grazing system and diseases were responsible for most part of animal death. In free grazing and semi-grazing systems, East Coast Fever (ECF) and anaplasmosis were the most common diseases. Pneumonia, milk fever, mastitis and feet problems were common regardless of system. Farmers keeping *Bos Indicus* cattle mentioned tick-borne diseases as well, since they can cause big problems in areas with a high frequency of ticks (Butt, 2010). To prevent tick-borne diseases, cattle dips are used (Brightwell et al., 1998). The dip can be referred to as "cattle bath", even though it is used for other animals as well,

such as goats and sheep. The method is used as prevention for ticks and other parasites (Moyo & Masika, 2009).

2.2.4 Feed and feeding strategies

Three feeding systems are used among livestock farmers in Kenya, including both pastoral and non-pastoral animal keepers: free grazing, semi-zero grazing and zero grazing (Bebe et al., 2003). In free grazing systems, the animals are grazing freely on private or public land at daytime and are then taken home to the farm during the night. Semi-zero systems are a combination of free grazing and the animals fed at the farm. This system is usually varied over season and the rate of free grazing versus feed at farm is dependent on availability of feed. Zero grazing systems means that the animals are always on the farm and the farmers collect or buy the feed to the farm (Bebe et al., 2003). The free grazing system is the traditional way of keeping cattle in pastoral systems, but with the change to agro-pastoralism new abilities are found. Many of the ruminants in traditional pastoral farming systems suffer from permanent or seasonal nutritional stress due to lack of enough natural fodder available (Bruinsma, 2003). With a more settled household and increased crop production, mixed crop-livestock systems are now developed among agro-pastoralists. Crops are being used for multiple purposes, both as vegetables for human and residues for animals. By using alternative fodder, except from grass, the farmers reduce the risks of nutritional stress, especially when the natural forage is not enough (Bruinsma, 2003).

Romney et al. (2004) showed that in areas with a low population density, grazing is the most dominant fodder source together with crop residues such as maize, cabbage and potatoes. With a higher population density, the feeding strategies changed in relation to the change of available feeds. Grazing was then replaced by zero-grazing systems, where planted fodder such as Napier grass was used instead. The benefits of zero-grazing, and in some extent semi-zero grazing, are many. For example, the risk of overgrazed land is highly reduced and soil erosions can be better controlled and avoided. Furthermore, zero grazing gives better disease control and decreases the risk of spreading diseases (Bebe et al., 2003; Kitalyi et al., 2005). However, zero-grazing systems require a lot of labour, and collecting feed for the animals can be challenging for the farmer. The availability of buying feed may also be limited and costly for the farmer.

A study by Musalia et al. (2007) found that free grazing is still the most common system in the Kenyan highlands and western Kenya (57%) followed by semi-zero grazing as the second most common feeding system. A study by Njarui et al. (2011) demonstrated how farmers in semi-arid regions were dependent on natural pastures, Napier grass, maize stover and residues from pigeon pea, crops and legumes. Napier grass were harvested at the farm and given directly to the animals. Some farmers saved the Napier grass for dry season if other feed was available during the wet season. During dry season, maize stover was given among 80% of the farmers. However, maize stover has a low nutrient content with a low content of crude protein (2.5% of dry matter) and a high content of fibre (exceeding 70% of dry matter), which makes it undesirable or livestock. Poor storing methods, such as storing the maize stover in trees and not protecting it from rain or sun, contribute to an additional decrease in nutrient content (Njarui et al., 2011).

Fodder trees and shrubs are good resources in grazing lands and can be used as alternative livestock feed, especially during dry season. Some trees can also be used to prevent erosion (Paterson et al., 1999). Several indigenous trees and shrubs are valuable for enclosures in

West Pokot. One of these trees, commonly used in West Pokot, is "Desert date" (*Balanites aegyptiaca*), known for its valued fruits and leaves used for livestock feed. Another tree is the "Umbrella thorn" (*Acacia tortilis*), which gives both shade and fodder to the animals (Kitalyi, 2002). Lactating animals need to be able to support their requirements for maintenance, as well as provide their offspring with important nutrients, whereby a high content of nutrients is of high importance in the animal feed. In arid and semi-arid areas, this can be difficult during dry seasons and fodder trees can then be the solution (Kitalyi et al., 2005). Therefore, the fodder tree *Calliandra calothyrus* is a good supplement instead of commercial dairy meal. Three kilograms (kg) of *Calliandra* can replace one kg of commercial dairy meal (Paterson et al., 1999).

2.2.5 Water

Animals can obtain water from different sources. By drinking, the animals can fulfil their need, but water from feed can also be a good supplement if enough drinking water is not available. Salt is also important to maintain the fluid balance (Sjaastad et al., 2010). The fluid is lost through the body surface, during respiration and in faeces and urine (Sjaastad et al., 2010). Lactating animals have an even higher water requirement and a high yield of water is lost from the body during the milk production. Milk contains 85% water and to produce 35 litres of milk, 60 litres above the basic need of water is required (Sjaastad et al., 2010). In West Pokot County, as well as in many other semi-arid and arid regions in the world, water may not be available daily and the source is strictly dependent on rainfall (Thornton et al., 2002).

3 MATERIAL AND METHODS

The study was performed as a survey to get baseline information of the animal husbandry in West Pokot and was done in collaboration with Vi Agroforestry in Kitale, together with the Triple L initiative.

3.1 Study area

The study was done in West Pokot County, in north-western Kenya (Figure 2). The county covers an area of 9,169 km^2 and has a population of 512,690 (KNBS, 2009). It is divided into nine divisions, including the division of Chepareria.

Chepareria Division consists of six locations and fifteen subdivisions, with an area of approximately 500 km^2 (KNBS, 2009). The area is semi-arid and included in the Arid and Semi-Arid Lands (ASAL) with fragile infertile soils and an average rainfall of 300-800 mm per year (FAO, 2006). The climate varies with temperatures ranging between a minimum of 10°C to a maximum of 30°C (Jungerius et al., 2002). The heavy rain season start around March and continue until May – June, with a short rainy season between October and November (Huho et al., 2011).

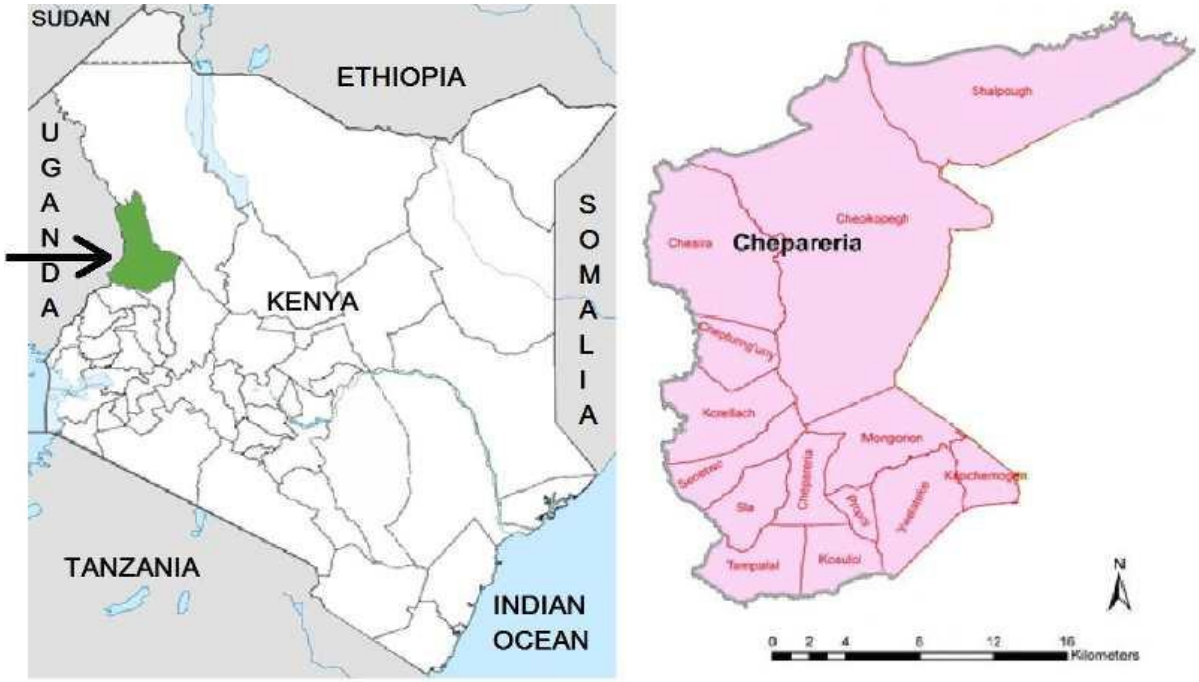

Figure 2. Left map: location of West Pokot County in Kenya (shaded area) (Google Maps, 2014). Right map: Chepareria Division with its 15 subdivisions (IEBC, 2012).

3.2 Data collection

Twenty farmers in Chepareria were semi-randomly chosen from 300 farms previously involved in projects within Vi Agroforestry and the Triple L Initiative. The selection was done by an extension officer at Vi Agroforestry, who also lives and works in Chepareria. One of the criteria for being selected was the ability to reach the farm during the field study, but it was also a requirement of having livestock on the farm. Furthermore, it was important that the farms had been using enclosures of different number of years. The farms

were divided, depending on if and how many years they had used enclosures, in the following four categories (five farms in each category)

1. No enclosures (open areas)
2. Enclosures ≤ 4 years
3. Enclosures 5 – 11 years
4. Enclosures 12 – 24 years

During a total of nine weeks, between October 1st and November 30th 2014, data was collected (Figure 3). Different participatory methods were used and selected as suitable for the people to be interviewed. Participatory methods (PMs) include the informants in the interview by actively engaging all participants in the dialogue, with the desire to get a bigger picture, wider knowledge and understanding of the studied issue (McIntyre, 2008). By using this method, people are not just listened to, but also heard and the ability to communicate with farmers in the area can be improved (PPSC, 2015).

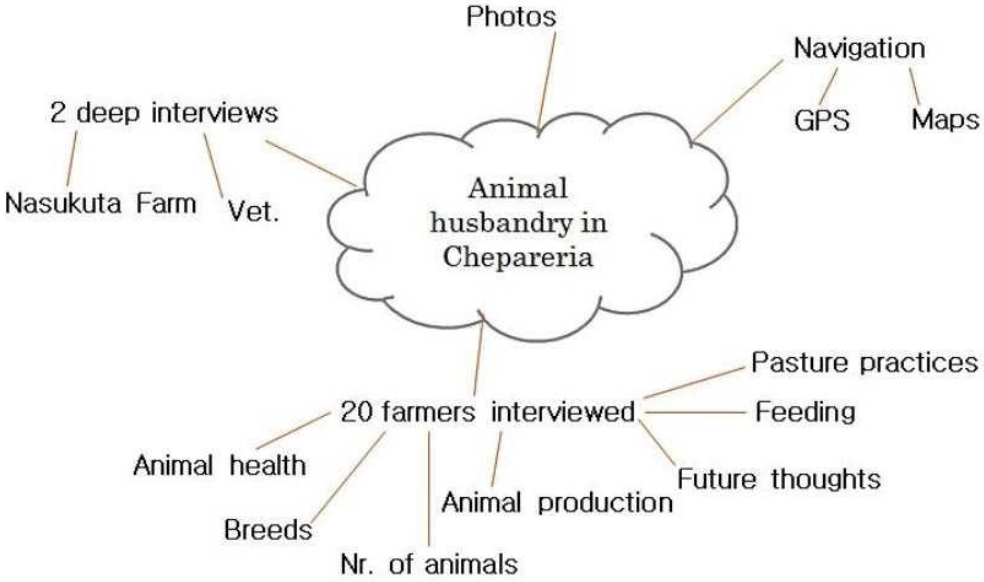

Figure 3. Data collection of the study in West Pokot.

When arriving in West Pokot, a pilot study, during three days was carried out. The focus was on understanding the situation, landscape and the people living in Chepareria, but also to test and adjust the methods selected for the survey before the actual data collection started.

The farmers were interviewed using semi-structured interviews with two questionnaires collecting both quantitative and qualitative data (Appendix 1 & 2). The aim was to collect data about the present situation, but background history and farmers' future plans were also included. Throughout the interviews, a local translator was present and the conversations were usually done in Pokot language (16), but English (3) and Kiswahili (1) did also occur. Every interview lasted between 55 and 95 minutes. During the farm visits, the livestock on each farm were also observed, (e.g. cattle, goats, sheep and poultry).

During the study, photos were taken. A Garmin GPS, of model type eTrex Legend® HCx, was used, in order to map all farms visited in Chepareria and get the land size on each

farm. In Appendix 3, all twenty farms visited are presented on a map printed from the Garmin GPS used during the study.

Two deep interviews were also performed, one at the governmental Nasukuta farm and one with a veterinarian in Chepareria. The farm manager at Nasukuta farm was interviewed to get more information about the situation of the animal husbandry in Chepareria. The manager had been working on the farm for 16 years and had great experience of agricultural in the area. Nasukuta farm, with its 1200 ha, nearly 80 Sahiwal cattle, 200 Dorper sheep, 120 Galla goats, 26 dairy goats and 8 camels, was focusing on trade market of livestock to farmers in Chepareria. Besides trade marketing, the farm also offered education to farmers, leasing of machines and had several locations for dipping of animals. The veterinarian (Livestock Health Officer) was interviewed mainly to get a better understanding of the animal health in the area. When interviewed, the veterinarian had been working in Chepareria for 20 years and was, along with another veterinarian, responsible for the entire Chepareria Division. The office, situated in Chepareria Trading centre, provided services including disease control, treatment and meat inspection. A study visit was also done to a new slaughter house in Chepareria, currently under construction.

3.3 Statistical analysis

The interviews were transcribed into text and converted into Excel spreadsheet where variables were categorised. Means were calculated and used for describing the frequency of different variables and factors. By using the means, data was also tested for linear correlations and it showed not to be normally distributed.

Using Minitab 17, the variable "years of enclosures" was correlated with five different variables, to see if there were any significant association present. The following variables were tested;

1. Years with enclosures, versus;	No of observed farms
a) Total nr of animals	20
b) Land size[2]	17
c) Migrating (yes or no)	20
d) Breeds (indigenous and improved)	20
e) Milk yield[3]	19 (cattle), 13 (goat, sheep)

Since the data was not normally distributed, one-way ANOVA and Pearson correlation could not be used. Instead, data was tested using three different methods:

- Kendall's tau was calculated to measure and test concordance, to see if there was any monotone association between variables
- Kruskal-Wallis was tested in order to check whether samples originated from the same distribution or not
- Chi-Square Test was done to determine whether there was any significant association between variables

Kendall's tau and Kruskal-Wallis was tested on all variables, whereas Chi-Square test was only used for variable c and d.

[2] Three farms had uncertain "hectare of land" and these farms were not included in the statistical analysis.
[3] Only farms that had cattle, goat or sheep that were milked daily were included in the correlation tests.

4 RESULTS

The results are summarized in Table 2 below. The length of time enclosures were used on each farm varied from 0-24 years. There was no significant association between the land size on farms and number of years with enclosures ($p=0.674$). All farmers interviewed had access to private land. There was a negative correlation between the use of enclosures and migration ($p<0.01$). Only one of the farms using enclosures also migrated with the animals, while four of the five farms not using enclosures migrated.

Table 2. *A summarized table over different variables measured in the study with mean values (m) of cattle (c), goat (g) and sheep (s). 1: No enclosures; 2: Enclosures ≤4y; 3: Enclosures 5-11y; 4: Enclosures 12-24y*

Category	Land size private	Land size communal	Migrating	Indigenous breeds	Improved breeds	Milk yield
1	m = 4.16	0	4 yes 1 no	m (c) = 0.75 m (g) = 0.75 m (s) = 0.67	m (c) = 0.25 m (g) = 0.5 m (s) = 0.33	m (c) = 0.9 m (g/s) = 0.24
2	m = 2.24	0	0 yes 5 no	m (c) = 0.8 m (g) = 0.75 m (s) = 0.67	m (c) = 0.4 m (g) = 0.5 m (s) = 0.33	m (c) = 2.7 m (g/s) = 0.2
3	m = 4.48	m = 0.2 0 – 1	0 yes 5 no	m (c) = 0.2 m (g) = 0.33 m (s) = 0.5	m (c) = 0.8 m (g) = 1 m (s) = 0.5	m (c) = 2.3 m (g/s) = 0.24
4	m = 1.1	0	1 yes 4 no	m (c) = 0.6 m (g) = 0.8 m (s) = 0.2	m (c) = 0.4 m (g) = 0.2 m (s) = 0.8	m (c) = 1.55 m (g/s) = 0.23

4.1 Livestock

The type of animals present on each farm varied (Figure 4). Poultry was the most common type of animal with a total of 741 individuals (not included in Figure 4), and least common was cattle with 145 animals, including young animals. The herd size varied from 7 to 105 animals per farm, with an average number of 37 animals per farm. There was a significant positive association between number of years with enclosures and total number of animals ($p < 0.05$), with Kendall's tau = 0.33. Looking at the figure 4 below shows that this is mainly found in category 4 where goat and sheep are considerable more than in the other categories.

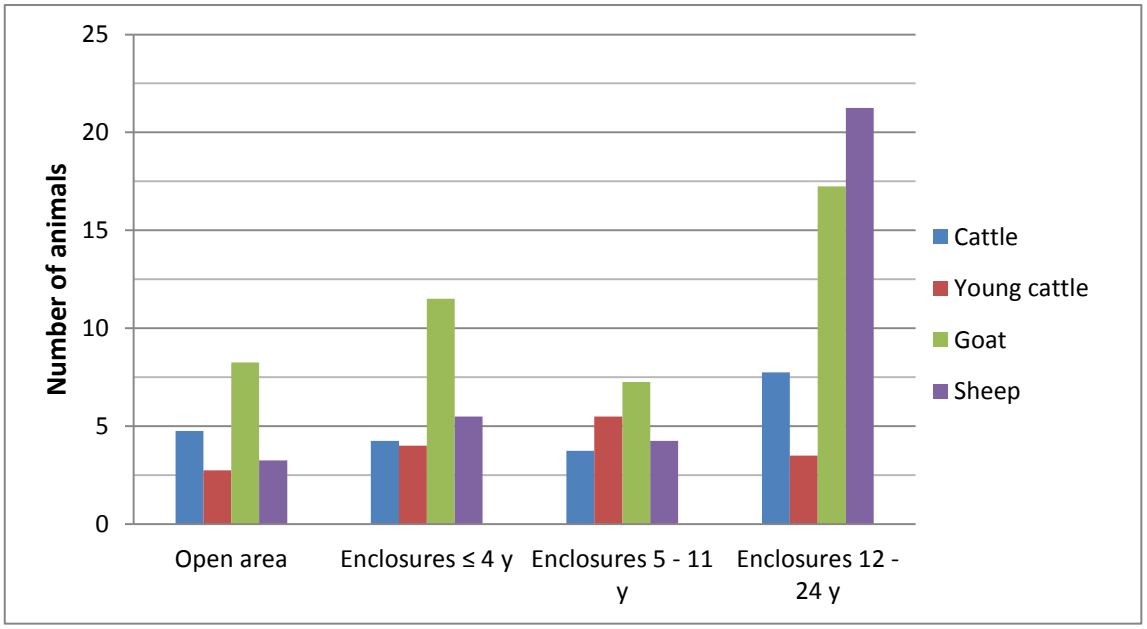

Figure 4. Average number of animals on the 20 farms visited.

4.2 Breeds

No significant associations were found between number of years with enclosures and improved cattle breeds (p=0.23) or improved goat/sheep breeds (p=0.92). Of the cattle observed, eight cattle were of indigenous breed and eight cattle were improved crossbred. No pure improved breeds of cattle were found. Indigenous goats dominated with only four crossbred and two pure improved breeds. The sheep were divided more equally on different breeds, with five indigenous breeds, four crossbred and three pure improved breeds. Poultry had a dominating group of indigenous animals and only one farm was found to have crossbred hybrids. The most frequently used breeds among the 20 farms are shown in Table 3. Most of the farmers used natural mating, usually by borrowing the male from a neighbour. For goats and sheep, a ram or billy-goat was bought directly from market to use for breeding.

Table 3. *The most common breeds observed in Chepareria at the 20 visited farms.*

	Indigenous	**No of farms**	**Improved**	**No of farms**
Cattle	Zebu	8 indigenous	Sahiwal, Ayrshire, Friesian	0 pure, 8 cross
Goat	East African	9 indigenous	Galla	2 pure, 4 cross
Sheep	Red Maasai	5 indigenous	Dorper	3 pure, 4 cross

4.3 Animal health

Common health problems in Chepareria have been summarized in Table 4, were tick-borne diseases were reported to be the most common health problem among livestock. All farmers interviewed were using some kind of prevention against ticks; 9 dipping, 8 spraying and 3 spreading chemicals directly on the skin. All farmers were deworming their animals, between 1 and 5 times per year, with an average of 2.4 times per year.

Table 4. *Common health problems among livestock in Chepareria, results from the 20 farms visited*

	Prevention
Tick-borne diseases	
East Coast Fever, ECF	
Annaplasmosis	
Heartwater	
Babesia	
Black quarter	
Cattle	Spray or animal dip, every week
Foot and Mouth Disease	Vaccination
Goat and sheep	Deworming every three months
Pneumonia	Fenced animals (avoid spreading of diseases)
PPR	Stop migration (avoid spreading of diseases)
Poultry	
New Castle Disease	
Thyfoid	
Coccidiosis	

4.4 Animal production

The animals were of multipurpose use, where cattle were mainly for milk production, but also by selling live animals to markets to pay hospital bills, school fees and other services that required cash. Meat production did occur, but meat was used during special ceremonies and holidays. Only three farmers were keeping records of their animal production, recording for example daily milk production. The 17 farmers not recording their animal production could only estimate the daily milk production. All animals observed were marked and according to three farmers, the common procedure of marking animals is by cutting the ear, usually when animals are two weeks of age.

All, but one farmer, were milking their cows two times per day and all farmers were milking their goats once per day. The milk production was higher among both cattle and goats that were crosses of indigenous and improved breeds. The crossbred cattle produced on average 2.6 litres milk per cow/day compared to indigenous cows that produced on average 1.4 litres milk per cow/day. Crossbred goats produced 0.3 litres milk per goat/day, indigenous animals produced 0.2 litres and pure improved breeds produced 0.2 litres milk per goat/day. No significant association was found between number of years with enclosures and milk production for cattle ($p=0.32$) or goats/sheep ($p=0.39$).

Of the 20 interviewed farmers, 11 were males and 9 females. On average, seven people were working on each farm, including children who helped out on the farm. On the farms, a variety of crops, fruit and vegetables were produced (Figure 5).

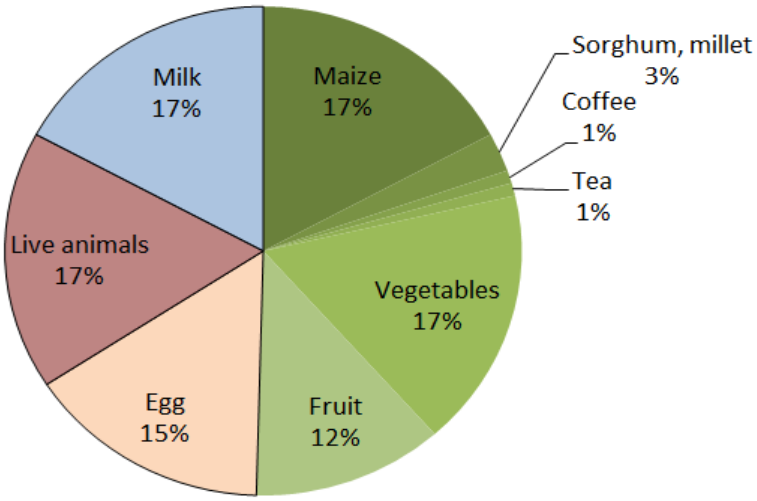

Figure 5. Average of production on the 20 farms visited in Chepareria, West Pokot.

4.5 Feeding management

The animal feed varied between seasons and during the wet season, grazing is the main nutrient source for livestock in West Pokot (Figure 6). During dry season, maize stover is the most common feed (Figure 7). Five farmers mentioned salt as supplementary feed to their animals.

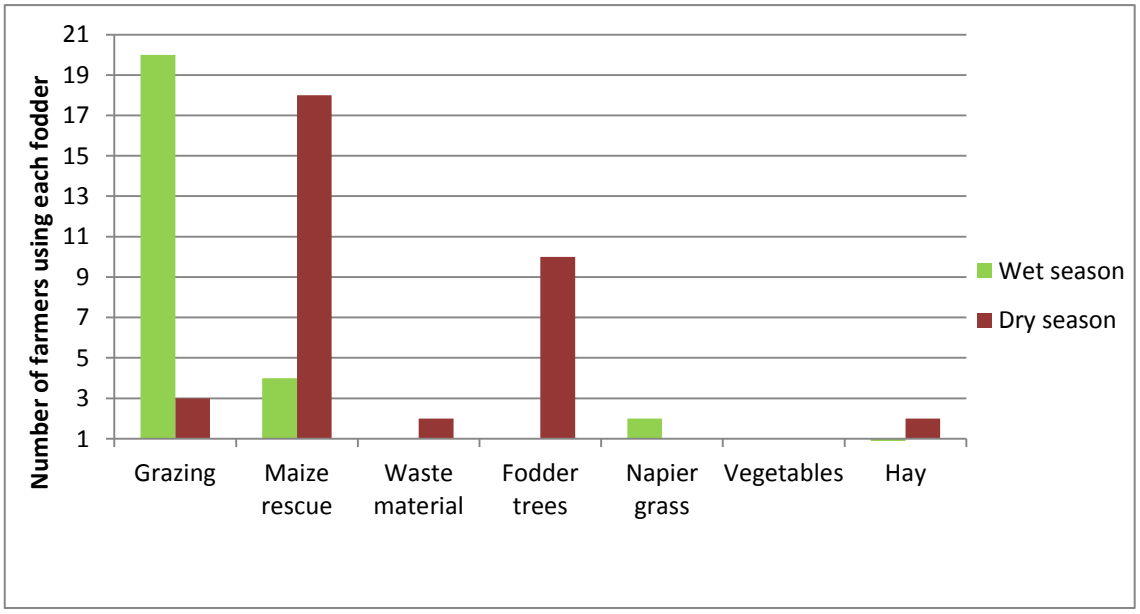

Figure 6. Distribution of feed to livestock during wet, and dry seasons, respectively.

Maize stover was observed to be stored at the top of trees (Figure 8) to avoid animals eating the feed when they were not supposed to. The water was usually provided directly from a river or dam, where animals were taken to drink. Twelve of the farmers provided their animals with water at least ones every day, all year around, and eight farmers were watering their animals every second day.


Figure 7 (left). An indigenous Zebu cow eating maize stover in Chepturnyuny Sub-location, Chepareria.
Figure 8 (right). Maize stover stored in Balanites tree, Chepareria.

4.6 Future plans

All 20 farmers had plans on continuing with their livestock production and 11 of them wanted to increase their number of animals, mainly to be able to pay school fees and as a safety buffer. Most of them also mentioned how they could increase their production, and 15 farmers had plans on using crossbreeding with improved breeds. The farm manager at Nasukuta farm had seen a change from traditional pastoralism to a modern lifestyle, where cash is the main focus. Furthermore, he mentioned that farmers are slowly improving their livestock production and tend to have fewer, but healthier animals. According to the farm manager, the main challenge of livestock production in Chepareria is the lack of water supply. The number of water pipes in the area is low and knowledge on how to use rain water is still lacking. Feed is also a big challenge. Pastures, rotational grazing and conservation of feed must improve in order to maintain a high level of production throughout the year. When asked about his vision of Chepareria 10 years from now, the manager speculated that the farms will be smaller than today, after the children have inherited their share of the land. He talked about how the use of zero-grazing systems will increase, especially in the highlands where there is not enough feed during dry season. The interviewed veterinarian confirms the farm manager's thoughts of future livestock production in Chepareria and stresses the importance of improved pastures and feed conservation. She claimed that without better feed management, no animals will produce more, regardless of the breed.

5 DISCUSSION

The results indicated that the use of enclosures have had effects on animal husbandry in West Pokot. There was a significant negative association between migration and number of years using enclosures, meaning that the more years of using enclosures, the less number of farms migrating. In Murupus, the farmers have been using enclosures for a long period of time (≥12years) and the farmers explained how they had seen healthier animals with a higher production compared to before, when they were migrating during dry season. Farmer in Murupus had also observed a better growth of grass in their pastures. This can be explained with the frequent use of fences preventing overgrazing, results also seen in previous studies in Kenya, where enclosures have been a good way to control animals and grazing throughout the year (Makokha et al., 1999; Mukoya et al., 2007).

According to previous studies, the benefits of using enclosures are higher than the management costs (Makokha et al., 1999). In Figure 9 we can see a good example between two farms; the left one using enclosures and the right one not using any enclosures. By using enclosures, people have been affected in many ways, not only in the case of migration. Bebe et al. (2003) shows in a study, that enclosure may result in an increased animal feed production and higher nutritional intake. Fences around borders also give the farmers a better control of their animals and crops and cattle rustling are noted as decreased.

Figure 9. Difference between enclosed pasture (left) and pasture without fence (right).

So why do not all farmers use enclosures? One farmer in Chepturnyuny subdivision mentioned that *"the animals can graze on all land and people have control of the grazing so I don't see the importance of fences and enclosures*". However, other farmers in the same village complain about neighbouring animals that eat and destroy the crops. How is this possible? The same farmer, who told me it is no use to fence animals in, also discussed last year's problem when the land he usually migrates to had been fenced by the owner. The farmer was then no longer able to let his animals graze there. This year he has been forced to stay at his own farm instead of migrate, due to lack of available land during dry season, and he is now saving maize stover as animal feed for the dry season.

Four out of five farmers not using enclosures were located in the same location in the highlands of Chepareria (Chepturnyuny subdivision), where Vi Agroforestry not have been working. These farmers were also still migrating. This can be one factor explaining the apparent difference of geographic locations between farms not using enclosures and farms

using enclosures. Another aspect worth mentioning is the different land tenure systems between Chepturnyuny subdivision and other subdivisions in Chepareria. In Chepturnyuny subdivision, the farmers work as a community where land and labour is frequently used outside each household. However, this cannot be seen as a simple explanation to why farmers in Chepturnyuny subdivision do not use enclosures. Previous studies have shown that different land tenure systems may have the same impact of land rehabilitation when using enclosures. In a study done by Verdoodt et al. (2010) in semi-arid areas in Kenya, private and communal enclosure management had the same success in recovering grass cover.

On contrary to the hypothesis that assumed farms using enclosures would have fewer animals than farms not using enclosures, there was a significant positive association between number of years with enclosures and total number of animals, meaning farmers using enclosures ≥ 12 years had more animals than the rest of the farmers. This may be explained by how the animals are still highly valued, used as cash income, to pay school fees and as a buffer for security reasons. Furthermore, farmers explain how they want to decrease their number of animals to be able to put energy, money and time only on a few animals with improved breeds. However, no significant association was found between more years using enclosures and improved breeds. This may be explained by failures when trying to increase the animal production. To be able to improve the animals for an increased production, it is important to use the tolerant indigenous breeds; the best one at one place is not always the best at another location. Even though the milk production was higher among crossbred and improved animals in this study, it is important to take into account that breeds are not the only factor here. Each farm used different feed and management for their livestock and further conclusions can therefore not be done regarding the effects of breed on milk production. Knowledge should be increased among farmers in Chepareria, about how to keep improved and indigenous animals that has a significantly higher requirement of feed and water intake, as well as good quality of pastures and management (Bebe et al., 2003). Good feed throughout the year is important, especially for improved breeds with a high requirement of energy and nutritional intake. However, the lack of knowledge can be a difficulty among farmers in West Pokot County (Kitalyi, 2002) and this might be another explanation to why farmers have not improved their animals more.

Small farms with limited land and pastures have to be extra careful when planning their livestock production and farms should not have more animals than their land can support. The best feed for livestock is free grazing (Njarui et al., 2011), but since grass is limited especially during dry season and on small farms, other alternatives must be practised. Conservation of feed is a good alternative and should be performed in a sufficient way to reduce as little of the nutrients as possible. Hay is a good option in feed conservation, but the process requires good storage to protect the feed from both sun and rain. Lack of money is another limitation, and building a hay storage may result in big costs for the farmer. The traditional way of storing grass and maize stover in trees is however not a good way of keeping the feed, because of the high risk of losing nutrients by both sunshine and rain (Njarui et al., 2011). Nevertheless, this method being frequently used indicates that farmers know their limitations in the feed supply and that feed conservation is needed to obtain production during dry season. Fodder trees, such as *Calliandra*, is another good source of protein intake and a good supplementary feed for lactating animals (Kitalyi, 2002). Napier grass together with a protein supplement, such as Calliandra, can also increase the milk yield (Paterson et al., 1999).

Furthermore, daily water supply throughout the year is essential for animals and especially high-yielding dairy cows. Irregular access to water affects the milk production negatively and can lead to shorter lactation and decreased animal health (Kitalyi et al., 2005; Sjaastad et al., 2010). Only a few dams are built in the area and more needs to be done, in order for the farmers to provide their animals with water daily, especially during dry seasons. Water pipes are still expensive and few farmers can finance these themselves. Another factor affecting the fluid balance is salt (Thornton et al., 2002) and the use of salt supplementation was only recorded from interviews on five farms. However, salt was observed on more farms than these five and according to the interviewed farm manager at Nasukuta, almost all farmers provide salt to their animals every week.

Tick-borne diseases seem to be the most common animal health problem on farms, as a result of no sufficient prevention, and this can cause severe problems. According to the interviewed veterinarian the farmers are not spraying or dipping their animals often enough usually due to lack of money. Animal dips are highly valued among farmers, but are expensive to use and some farmers cannot afford this method. Spraying is then a good option, but is also more time consuming (Moyo & Masika, 2009). Regardless method, it is important to frequently prevent ticks and according to the veterinarian, at least once a week is necessary. However, the interviewed farmers stressed that once a week was too expensive, especially during dry season when incomes are low. Insufficient hygiene on farms and movement between farms is other factors that cause a high risk of spreading diseases. The interviewed veterinary stresses on the importance of increasing the knowledge among farmers in West Pokot County, as well as the availability to use veterinary services in the county. When the population is growing and the production systems are getting more and more intensified, disease control needs to be enhanced.

For future development in West Pokot County it is important to remember that several steps need to be taken into concern, with genetics and feed management as main factors. Pasture practices together with daily feed and water supply are essential for an improved livestock production and should be maintained before improving the animals with improved, high-yielding breeds. According to the farm manager at Nasukuta Farm, the main challenge of livestock production in Chepareria is the lack of water supply. Feed is also a big challenge, where pastures, rotational grazing and conservation of feed are needed to maintain a high level of production throughout the year. When this is done, animals can be improved and hence the production will increase.

Artificial insemination (AI) can be a good option to improve the production, but this, as for improved breeds, requires good housing management and a high quality of feed. AI also obliges a reliable heat control, record keeping and a change of old traditions where a bull is used. Recordings of animals and the production was not yet common among farmers in Chepareria, but farmers usually had positive attitude towards it even if they did not use it themselves. The ones who actually did had learned from school. The record keeping is not only important for heat control, but also helps farmers to see their results and hopefully the improvement in the livestock production. Each farm should keep their own records of animals and their production. This is also an important step in improving the farm's economy, to see how much the farm produce and what it cost.

In order to meet future market demands with a growing population and higher request of animal products the livestock production systems needs to be more effective to increase

their production. Livestock extension services should be provided by both county and other actors in the region, promoting continuously education and technology uptake for the farmers. The focus should be on pasture management together with the daily supply of water and feed to the animals. The manager on Nasukuta farm stressed the importance of education and supervision from the government as well as NGO's and other organisations working in the area. This should be designed regarding the farmers situations and needs, and reflect the reality in Chepareria and West Pokot County at present. Since Nasukuta farm is one of the largest farms in the study area many farmers get inspired by their systems and hence, the demonstration on the farm is of great importance. The slaughter house is also important for the local livestock production. When ready, the slaughter house will have a daily capacity of 200 cattle and 800 small stocks (including goats and sheep). Both local and national traders will be involved and export to other countries will be of interest.

5.1 Comments on the study

The study method, using participatory tools, was decided according to the farmers' background, lifestyles and previous experiences from other studies found in literature. To get as much information as possible from the farmer, a combination of qualitative and quantitative data was collected and the time consumed for this method limited the total number of interviewed farmers. Although a lot of information was collected, the statistical data from the quantitative sampling was relatively small. However, the qualitative data is of great importance and gives many vital results analysed in the study and as a baseline for further studies. For future studies, it would be of great interest to ask more detailed questions about feeding management, use of animals and how and in what way enclosures are being used.

The possible influence of the local guide and translator used during the field study should also be taken into account when discussing the results. Three interviews were done in English and seventeen interviews were translated to English either from Pokot or Swahili, where information may have been missed or misinterpreted since neither translator nor author had English as mother tongue. Furthermore, the semi-random sampling done when choosing the twenty farms can also be discussed. Farms have been chosen by someone living in the area, with several criteria limiting the available farmers to choose from.

6 CONCLUSIONS

The study indicates that the use of enclosures affects also other parts of the animal management. Farms using enclosures tend to stop migrating and have more animals on their farms'. To be able to draw further conclusions about these changes, more detailed and specific research with focus on genetics and feed management needs to be done of the animal husbandry in West Pokot County.

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Uppsala, 2015
Antonia Grönvall

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APPENDIX I

Basic survey

2014-___-___ **Basic information nr.___**
Language:

Name _____

Male ___ Female ___

Age ____ (years)

Education yes ___ no ___
if yes, what? _____
_____

Have you been involved in VI's work? yes ___ no ___
if yes, for how long? _____

Location West Pokot _____ **(GPS-coordinates)**

Fences? yes ___ no ___

Enclosure yes ___ no ___
if yes, since when? _____
if yes, why did you start? _____

Do you have access to land today? yes ___ no ___
if yes, how much:

farm land ____ (acres) private ____ or communal tenure ____
cultivated land ____ (acres) private ____ or communal tenure ____

Do others have access to this land? yes ___ no ___

Do you use your production for self-consumption? yes ___ no ___ both ___

Do you sell any of your production? yes ___ no ___
if no, why not? _____

what do you produce?_____ do you sell this? yes ___ no ___
what do you produce?_____ do you sell this? yes ___ no ___
what do you produce?_____ do you sell this? yes ___ no ___
what do you produce?_____ do you sell this? yes ___ no ___
what do you produce?_____ do you sell this? yes ___ no ___
what do you produce?_____ do you sell this? yes ___ no ___

Can I take a photo of you and your farm and maybe on some of the animals as well?

APPENDIX II

Detailed survey, page 1

2014-___-___ **Detailed survey nr.___**

How many animals do you have?		**What do you use them for?**		
Dairy cattle	_____	milk _____*1	other _____	
Beef	_____	meat _____*2	skin ____	other _____
Goats	_____	milk _____	meat _____	other _____
Sheep	_____	meat _____	fur _____	other _____
Poultry	_____	meat _____	eggs _____	other _____
Donkeys	_____	transport_____	other _____	
Others	_____	use for _____		

*1 How often do you milk the cows? What is the milk yield you get from one cow per day?

*2 Do you slaughter the animals yourself or sell them alive?

Do you keep any recordings of your production on the farm?

Milk	yes _____	no _____	how? _____
Meat	yes _____	no _____	how? _____
Egg			
Other products?	yes _____	no _____	how? _____

What breeds are your animals?		**what ages are your animals?**
Dairy cattle	_____	_____
Beef	_____	_____
Goats	_____	_____
Sheep	_____	_____
Poultry	_____	_____
Others	_____	_____

2. How are you housing your animals?

- where are your animals kept during the day? _____
- where are your animals kept during the night? _____

3. Pasture practises

- are you using enclosures on your farm? yes _____ no _____
  - if yes:
  - when did you start?
  - how did you do before using enclosures? (are you still migrating?)
  - do you always have your animals fenced nowadays? yes _____ no _____
  - are you using open grazing sometimes during the year? yes _____ no _____
  - do you have problems with cattle rustling? yes _____ no _____
  - why do you think not everyone is using enclosures?
- do you change pasture location between enclosures for your animals? yes _____ no _____
  - if yes, how often do you change location? _____
  - if yes, why do you change location?

4. What labour do you use?

- how many people are working on your farm? _____
- how many of these people are working with the animals? _____
- are all of theese people family members to you? yes _____ no _____

2014-___-___ **Detailed survey nr.___**

5. Tell me about the feeding of your animals

- what do your animals eat? Does this change during the year?
- how much and how often do they eat?
- are you producing the feed yourself or do you buy it from someone else?
- if you buy some feed from someone else, how much do you buy and from where?
- harvesting? (how often? by hand/machines?)
- fertilizer vs manure?
- how often do your animals get water and from where?
- do you store water to have water for your animals during the dry season?

6. Health, diseases and predators

- do you keep any protocol of your animals and their health? yes _____ no _____
- what is the most common health problem on your farm? _____

- what disease can cause most problem if you get it on your farm? _____
- how do you avoid getting this disease? _____

- are you deworming you animals? yes _____ no _____
  if yes, when are you doing that and how often?

- giving your animals any vaccines? yes _____ no _____

- what is the main cause of death among your animals (except from meat production?)
  _____
- do you have problems with predators on your farm? yes _____ no _____
  if yes:
  - what kind of predator? _____
  - how do you avoid these predators? _____

- do you have problems with parasites on your farm? yes _____ no _____
  if yes:
  - what kind of parasites? _____
  - how do you avoid these parasites? _____

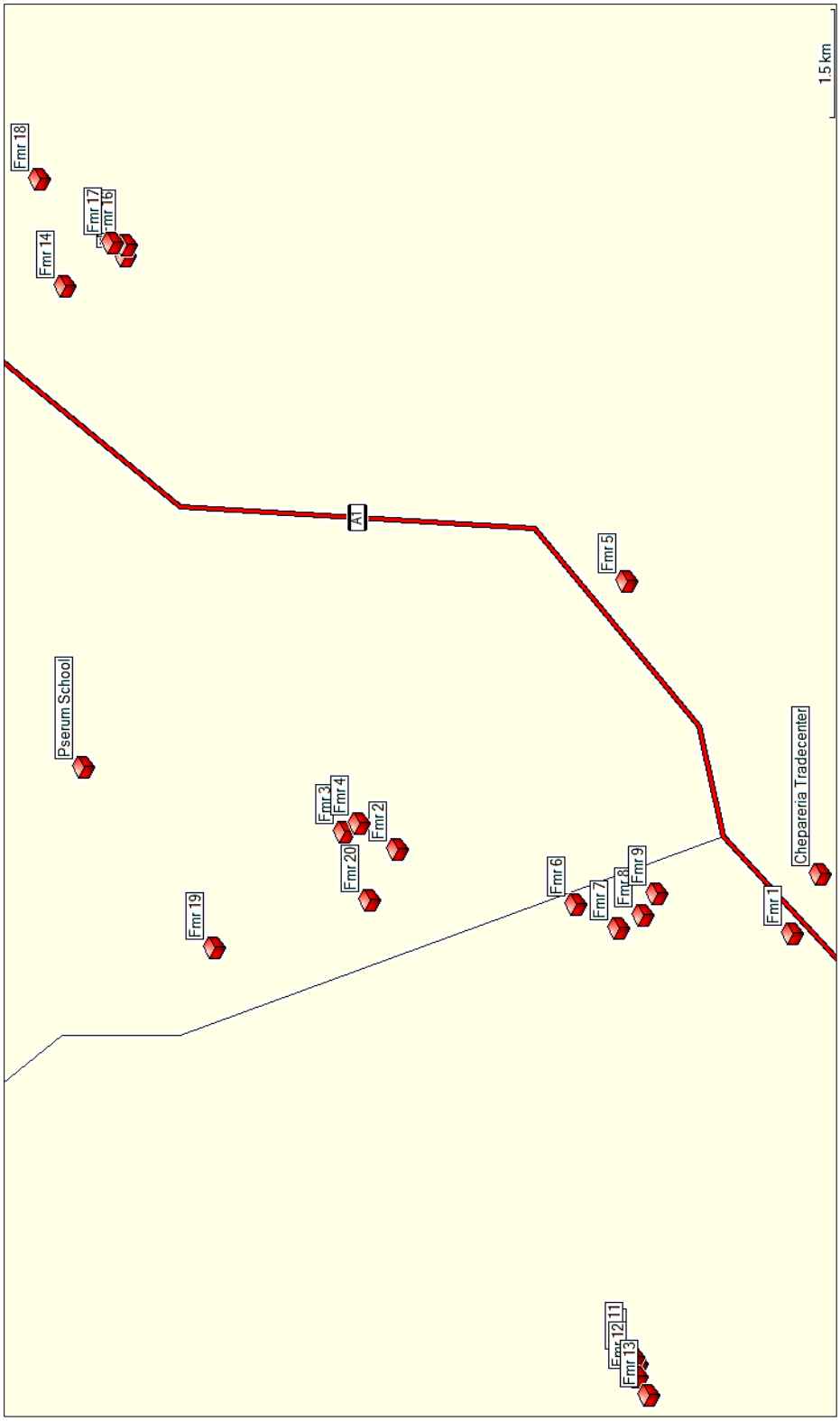
Concluding questions

2. What plans do you have for the future of your farm?

3. Do you want to continue with livestock production?

APPENDIX III

Map over interviewed farmers in Chepareria Ward, West Pokot County (Garmin GPS). The farms are divided into category 1 (farm 5, 10, 11, 12, 13), category 2 (farm 3,4,6,7,9), category 3 (farm 1,2,8,19,20) and category 4 (farm 14,15, 16, 17, 18).



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