Milk production in dairy cows and goats – a case study in the Nyando district in South-Western Kenya

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ABSTRACT

Water is an essential factor for both people and animals, and access to water is therefore of great importance. The water access also largely determines the availability of food for people and feed for animals. The aim of this study was to survey the affect of water access on milk production from dairy animals. The study included nineteen farm visits that were made in the Nyando district in Kenya between February and Mars 2011. Farm visits included interviews with questions about for example number of dairy animals, milk production, water access, feed and water routines. Visual and practical measurements were performed. The selected farms represented both cow and goat keepers with exotic breed, local breed and crossbred animals. Water access differed between the farms. Some had unlimited access to water while others had restricted access. Milk production differed between breeds and between farms because of diverse conditions. The study indicated that people in general have little knowledge about the physiology of their animals and that the animals receive what is available not what they actually require, sometimes they get more and sometimes they get less. People in the Nyando district and others in the same situation are in need of more food and water, both for themselves and their animals. By increased information, knowledge and better technique it would be possible to increase the milk production and through that generate more food and improved living conditions for people.

SAMMANFATTNING

Vatten och vattentillgång är viktig för både människor och djur, och vattentillgången påverkar även tillgången till mat och foder. Syftet med denna studie var att kartlägga hur vattentillgången påverkade mjölkproduktionen från kor och getter. Studien inkluderade nitton gårdsbesök vilka gjordes under perioden februari till mars 2011 i Kenya, Nyando district. Bönder som levde på landsbygden intervjuades. Frågorna handlade bland annat om antal mjölkproducerande kor och getter, mjölkproduktion, vattentillgång samt foder och vatten rutiner. Uppgifter samlades även in visuellt och genom praktiska mätningar. Besöken omfattade gårdar med getter och kor av varierande raser, lokala och höglakterande raser samt korsningar av dessa. Vattentillgången skilde sig åt mellan gårdarna, en del hade obegränsad tillgång medan andra hade mycket begränsad tillgång. Mjölkproduktionen varierade mellan olika raser och även mellan gårdar med olika förutsättningar. Studien synliggjorde människors bristande medvetenhet om djurens fysiologiska behov. Djuren fick vad som fanns tillgängligt, inte vad de egentligen behövde. Under perioden studien pågick var det extrem torka i området och det fanns ett stort behov av mer vatten och foder. Både människor och djur led av bristande resurser. Det är därför viktigt att lösa problemet med otillräcklig tillgång till vatten. Genom ökad information, kunskap och bättre teknik kan jordbruket utvecklas och ge människor bättre levnadsvillkor. Bättre vattentillgång kan leda till en ökad mjölkproduktion, som i sin tur kan generera i mer mat och en ökad välfärd.

CONTENTS

1 INTRODUCTION

Kenya is situated in East Africa and is classified as the poorest country in Africa (FARM-Africa, 2009). A large part of the population in Kenya lives in rural areas and 48 percent live in poverty, which means that a large part of the Kenyan people is poor or not able to achieve their required daily intake of food. The income for most people relies on agriculture, mainly on smallholder agriculture, which is the base of the country's economy (IFAD,2011).

The population in Kenya is the fastest growing in the world which increases the need of resources that the country can provide. Lack of resources and widening income gaps lead to less successful progress within education, employment, food security and income (IFAD, 2011). The environmental degradation has a big impact on poverty for example through soil erosion, land degradation and poor water management. Declining yields within the agricultural sector due to drought, leading to insufficient water supply, has become a recurrent problem in parts of Kenya. Lately, this situation is getting more serious both in Kenya as in other African countries. In addition to insufficient water supply, the water contains waterborne diseases, which along with other diseases such as malaria and HIV affect families in many ways, both in terms of health and economy (IFAD, 2011).

Livestock is very important in developing countries, especially for the poorest people. The animals can both be a source for food and a financial instrument. Keeping animals can act as insurance in times of emergencies or financial stress and it also has a cultural and social importance in many parts of Africa (Thornton, 2010). Animal welfare is an increasing global issue as a consequence of for example international trade and globalization. However, in many developing countries animal welfare is more related to values of an investment, insurance or a source of food and manure. Animal welfare could for example be improved and have positive effects through breeding for other properties than only milk yield, since milk yield is negatively correlated with health and fertility characteristics (Thornton, 2010). In Kenya a low number of cattle can often be a consequence of a small and inadequate access of pastures and/or fodder crops followed by reduced farm sizes (Musalia et al., 2007). Having many animals indicates wealth which can result in farmers having too many animals to handle. Some farmers should have fewer animals, since they do not have access to sufficient land for producing feed (personal communication, Omune, 2011). A major portion of the world's livestock suffer from nutritional stress, permanent or seasonal. In Africa poor nutrition is a central cause having a negative influence on the production among animals kept by smallholder farmers (Thornton, 2010). Another aspect to consider is farmers' opinion that it is better to earn money by selling milk rather than giving it to newborn calves. This often results in a less productive dairy cow later in life and in the eastern Africa 25 to 33 percent of calves die before weaned each year (Kitalyi et al., 2005b).

In Kenya as in many other countries the possibility to keep animals is important for the household. Animals kept in Kenya are in general dairy animals to produce milk, poultry for eggs and meat, bee for honey, sheep for mutton, goat for chevon and in a small extent pigs for meat. The most common cause of death among animals is lack of either water or feed. The cows and goats living in Kenya are exotic breed, local breed and crossbred cows and goats. Local breed meaning original indigenous breeds, exotic breed meaning imported high-yielding breeds and crossbred meaning crosses of the two first mentioned. Sometimes, exotic breed and crossbred cows and goats are called upgraded animals. The most prestigious livestock to hold is cows (personal communication, Omune, 2011). Lack of knowledge about for example supplementation of concentrates, and the genetic potential of the animals, contributes to limiting the development in livestock production. To be able to optimize the

potential of the dairy animals, information about factors that affects the milk production need to be offered to farmers. This would hopefully result in a more efficient dairy production with better profitability (Musalia et al., 2007).

1.1 Objectives and hypotheses

Water access among dairy farmers is the main subject in this study performed in the Nyando district in South-Western Kenya between February and March 2011. The study is divided into two parts. The part presented in this report focuses on how the water access in general affects the lactating dairy animals, the relationship between milk production and water consumption, as well as feed consumption, and differences between exotic breed, local breed and crossbred of dairy cows and goats. The other part focused on water sources and water management strategies and was reported by Erika Näslund.

Hypotheses

1. Water availability is a limiting factor for milk production in dry areas (or areas with poor access to water).
2. Milk production from upgraded breeds requires more water per litre of milk than milk production from local breeds.
3. Upgraded dairy animals have higher milk yield than local dairy animals.
4. The water and feed quality and quantity correlate with the amount of milk produced.
5. The animals produce more milk if they have access to concentrates.
6. Goats are well used and of significant importance for milk production.

2 BACKGROUND

Several aspects are included when smallholder farmers in the Kenyan highlands decide how to hold their livestock. According to a study performed by Bebe et al (2002a) the most important factor for keeping cattle are milk production to generate feed and income for the family. When farmers are going to establish dairy farming it is important to think of several aspects. First of all it is important to think about type of housing, grazing or zero-grazing. Secondly, the animals' nutrition matters, concerning what demands they have as well as the availability when it comes to roughage, concentrates and other supplements like salt and minerals. The feed quality should also be taken to account. The third aspect is disease control. It may be necessary to prevent different pathogens by using insecticides. Next is to decide breeding strategies, if you are going to use artificial insemination or a bull and how to execute this. The fifth and last aspect is how to market the milk in order to make people buy it (personal communication, Omune, 2011).

2.1 Physiological demands and needs

Both cows and goats are ruminants, which are able to consume a large amount of feed and water. The microbes in their rumen have the capacity to break down fibrous feed. It is essential that ruminants consume fiber since it contributes to normal rumen function. However, too high amount of fiber can have a negative effect on intake of protein and energy, resulting in low milk production. Milk production involves high demands on energy and protein intake. Therefore feed of good quality is necessary. Energy, protein, fiber, minerals, vitamins and nutrients are found in the dry matter in forage. For that reason, it is important to make sure that the animals receive sufficient amounts dry matter. The required energy is determined in relation to amount of milk produced and the fat content in the milk. For

example, milk from Jersey cows requires more energy than the same amount of milk from Friesians, because of the higher butterfat content in milk from Jersey cows (Kitalyi et al., 2005a).

Lactating animals need to be able to support their requirements for maintenance and provide the calf or kid with nutrients. Nutrient content of feed is therefore very important. Available land and management-system affect the quality and quantity that the farmers can offer. For example, many farmers do not have access to sufficient land or capital to produce feed that is suitable for their animals, which affects the animal's capacity to have an optimal growth and milk production. This can though partly be supplemented by alternative feed for example by giving forage containing tree legumes, such as Calliandra and Leucaena (Kitalyi et al., 2005a).

2.1.1 Water

Animals get water through drinking, by feed and through metabolism (water produced by the oxidation of hydrogen in the cells). Water in feed is often forgotten but is of major importance. Water is lost from the body through the body surface, respiration, feces and urine. Furthermore water is lost through milk in lactating animals. An important factor to maintain fluid balance is the intake of salt, especially sodium. Lactating animals have a high water requirement because of their extra loss. For example, a milk production around 35 L requires 60 L more water above the basic need (Sjaastad, 2003). Earlier studies on the Ethiopian Somali Goat, looking at their water requirement, shows that inadequate water intake causes the animals to constantly struggle between different needs. For example can this appear between the use of water in their body and the part that is necessary for milk production. This can influence the survival of their offspring (Mengistu, 2007).

Water is affecting all body functions including growth and milk production. Milk contains as much as 85 percent water and the remaining 15 percent are made up of milk protein, fat, sugar and minerals. The water access is therefore central for milk production. In addition, if the animals are to be able to eat dry feed they must have sufficient access to water, otherwise they will eat a smaller amount and as a consequence produce less milk (Kitalyi et al., 2005a).

2.1.2 Concentrates

Concentrates has a higher digestibility and often a higher concentration of energy and protein compared to forage. But according to studies made in countries around Kenya, few smallholder farmers gave their animals concentrates mainly depending on lack of capital (Kitalyi et al., 2005a). Amount energy required for milk production varies among breeds due to differences in milk yield and the fat content (Kitalyi et al., 2005a). In a study by Rufino et al (2009) a cow that got concentrates both during growth and during the beginning of the lactation could triple the produced milk yield during a lifetime. When giving concentrates as a supplement to the basic pasture-dominated diet, milk yield can increase due to a stabilized body weight and good body condition (Rufino et al., 2009, Musalia et al., 2007).

2.2 Management-system

Animal management has a strong effect on production results (Kitalyi et al., 2005a). The grazing systems in the Nyando district are free grazing, semi-zero grazing and zero grazing. With free grazing the farmers graze their animals on public or private pastures at daytime and are bringing them home during the night. In a semi-zero grazing system the animals are partly

free grazed and partly fed at the farm, depending on the availability of feed. Finally zero grazed animals are fed at the farm, farmers cut the feed and bring it to the farm (Bebe et al., 2002b). Zero grazing is more time consuming and more expensive than free grazing, but have several benefits. The benefits with zero grazing, and also semi-zero grazing, compared with free grazing are for example reduced overgrazing, better disease control, reduced soil erosion, controlled breeding and possibility to use manure as fertilizer. Further, the farmer can control both amount and quality of the feed given to the animal. If the animal is offered feed several times per day, but in smaller rations, the total dry matter intake over the day increases (Kitalyi et al., 2005a).

2.3 Breeds and breeding strategies in Kenya

In Kenya as in many other eastern African countries people keep high-yielding cows, such as Friesian, Ayrshire, Guernsey and Jersey. Crosses of these with local zebu cattle also occur. But if the production from these animals is going to be optimal, they need to be fed properly with feed of good quality and quantity throughout all stages of life (Kitalyi et al., 2005a). According to a study made by Musalia et al (2007) in Butere/Mumias and Kakamega in Western Kenya farmers kept few dairy animals. The milk yield was between 5 to 10 liters per animal and day and just over half of them (52%) were given over 2 kilo concentrates per day. The most frequent breeds were Friesian and Ayrshire plus their crosses with local breeds. The study also showed that by supplementing with two or less kilogram concentrates the milk yield increased.

Mainly breeds of Friesian (Holstein-Friesian) and Ayrshire are present in the area around Kisumu. Jersey and Guernsey, which are small breeds that have a low production, are decreasing in this area. Goats of exotic breeds at hand are Kenya alphine, Sannen and Toggenburg. Kisumu demands together with the area around 35 000 000 liters of milk per year, out of which 2 000 000 liters are produced by local zebu cattle. Central provinces with exotic breed are those who produce most of the milk. Since animals belonging to local smallholders do not produce an adequate amount of milk to send it away to dairies, is that milk used in the household or sold only locally to neighbors (personal communication, Omune, 2011).

According to a study performed in the Kenya highlands by Bebe et al (2002a) the most usual way of mating among cows is by using a bull in the area around the farm. But this has consequences; bulls may often mate with close relatives. The lack of information about the ancestry of the animal increases inbreeding which has a negative impact on the genotype (Bebe et al., 2002a). Artificial insemination (AI) is more unusual than natural mating regardless breed, according to the same study performed by Bebe et al (2002a). This can be explained with high costs. AI is more expensive when it comes to transport costs and rural roads and this is not expected to change rapidly. Therefore natural mating will probably continue to be the usual way of mating among smallholder farmers (Bebe et al., 2002a). The cost per insemination is 1500 to 2000 shillings in Kisumu (personal communication, Omune, 2011).

3 MATERIALS AND METHODS

3.1 Study area

The study took place in the Nyando district in the Nyanza province in Western Kenya. The capital city in the province is Kisumu, a large urban centre. The vegetation surrounding the

city is mainly shrub and grassland (Ong'or et al., 2007). The climate includes two periods of rain, one short and one longer. The longer rain period ranges between February and June, with a peak in April, and the shorter period begins in August and continues until November. The temperature is 20°C to 35°C, the lowest from April to June and highest from December to February (Baseline Survey Report, 2006). According to Kenya Food Security Meeting (2010), a network organization linked both to the United Nations and the Kenyan government, Nyando is included in the Nyanza province among twelve other districts. Nyando is thereafter divided into five administrative divisions. The main rivers in the area are called Sondu Miriu and Nyando which forms a boundary line between land and water of about 11 kilometres and lies adjacent to Lake Victoria. Roads are in poor condition which contributes to difficulties with transport of water and other products for example from the farms in the countryside to markets. This area as well as the rest of the country has agriculture livelihood as employment. The dominant animals used are breeds of Zebu cattle and small stock of goats and sheep (Kenya Food Security Meeting, 2010).

3.2 Vi Agroforestry

This study was performed in collaboration with the organization Vi Agroforestry in Kisumu, Kenya. Vi Agroforestry is a Swedish Non-Governmental Organization which is working against poverty. The organization offers education to improve farming techniques and agroforestry. They plant trees and crops as a way to change people's possibilities and hopefully make them self-sufficient (Vi Agroforestry, 2011). People working within this organization, including our supervisor at site, contributed to the performance and outcome of the study presented in this report, by putting us in contact with field officers, an interpreter and other local organizations.

3.3 Fieldwork

The fieldwork included four different parts, semi-structured interviews, visual analysis, weighing and measuring of milk and water and laboratory work. The study mainly built on the interviews. The visual analysis included inspection of water tray, water storage, milk bucket, milk storage, feed storage and feed tray. The weighing and measuring part was mainly done to confirm some of the information that had been gathered during the interviews. The laboratory work involved determination of dry matter content of collected feed samples. In addition, personal communication with an expert within animal production in Kenya was made. The study was performed during a time of extreme drought and the results are presented viewing the dry conditions that were occurring.

3.3.1 Interviews

Nineteen farmers were visited during the study. These were selected with help from four local field officers through the Vi Agroforestry organization situated in Kisumu. Farmers with diverse livestock, management practices and conditions were chosen to be able to see differences and indicate correlations between farms and animals. The visited farms had dairy animals for milk production, either cows or goats and sometimes both, of exotic breed, local breed or crossbred cows and goats. The questionnaire used during the interviews contained three parts, a part with general information, one regarding water and another regarding animals (Appendix). Either the owner or the supervisor on the farm was interviewed with help of an interpreter when needed. When asked about the milk yield the farmers gave the maximum and lowest amount of milk during a year, or the general amount, when they did not noticed any difference during the year.

3.3.2 Visual analysis

Pictures were taken and a visual analysis of fodder tray, water tray, feed storage, water storage, water buckets, milk buckets and milk storage was made. The visual analysis as an inspection, judgement, grading how the things mentioned above was visualized. Basis of judgement were "nice and clean" meaning reasonably clean and without mud, "a bit dirty" meaning containing some mud and "dirty" meaning some mud and unclear/dirty water. The visual part of the study was done to get an impression of how well taken care of the farms were. A visual evaluation of the water used, the milk and the source of water were also done.

3.3.3 Weighing and measuring

Amount of water, feed and milk were weighed if possible. A GPS was used to measure the distance between the farm and the source of water.

3.3.4 Laboratory work

Feed samples for determination of dry matter content were collected at all farms. The samples were feed of either grass from the ground, tree leaves or cut feed of for example calliandra, napier grass and maize. Samples were taken from the feed available and the samples varied therefore in amount since it in some cases were an extreme lack of feed. If the animals were kept grazing, the sample became a bundle of grass from the ground. Small plastic bags of defined weight were used for transport and storage, before dry matter determinations were carried out. The laboratory work was done at the World Agroforestry Centre (ICRAF) laboratory in Kisumu. Dry matter content calculations were based on the weight of the sample including the plastic bag before and after drying at 70°C for about four days.

3.3.5 Personal communication

An interview was made with a local expert within animal production, Tobias Omune at the Department of livestock production, in Kisumu. Information about the local conditions, problems and situations around the study area was gathered. The interview gave information necessary to understand how the community operated and the role of the farmers. The questions were regarding distribution of the farmers' milk, what price they had to give for different products, living conditions and community thinking. No questionnaire was used, general and follow-up questions were asked.

4 RESULTS

4.1 Animals

All nineteen farmers that were visited kept dairy animals. Some kept either cows or goats while others kept both. Twelve farmers kept lactating cows, one kept only lactating goats and six kept both lactating cows and goats. Most of the farmers had non-lactating goats, which means not used for dairy production. These goats were of local breed and were kept as an insurance to generate money or as a source of meat. There were eight farms that had non-lactating goats beside their production from lactating cows. Three farms had both lactating and non-lactating goats. Four farms did not have non-lactating goats, only lactating goats.
Four of the included farms had no goats at all. Number of livestock varied among the farmers. One farmer kept seventeen cows in total while another kept one cow and one farmer kept nine goats in total while another kept one goat. This information is presented in Table 1.

Table 1. Number of livestock, local and upgraded cows and goats, at each farm visited

Farm number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Local cow	5	0	11	8	1	10	12	0	0	1	4	0	3	4	3	0	5	3	3
Local goat	0	5	0	1	3	0	0	3	3	3	3	0	0	0	6	0	4	7	3
Upgraded cow	0	2	0	0	0	7	0	3	2	3	1	0	2	0	0	3	0	0	0
Upgraded goat	0	0	0	0	0	0	0	0	0	0	0	7	1	7	3	3	2	2	0

None of the visited farms kept the calf or kid together with the cow or goat. All calves and kids were separated from their mother after birth. But after that they were allowed to take milk during or in connection with milking or allowed to drink milk from a bucket with no contact with the mother.

4.2 Breeds in the area

The farmers had different breeds of both cows and goats. The most common dairy breed was local cow (74%), next came the upgraded (exotic breed and crossbred) cows (42%). Local goats was kept more frequent (58%) than upgraded (exotic breed and crossbred) goats (37%). The cows of exotic breed were either Friesian or Ayrshire and the goats of exotic breeds were either Kenya alphine, Saanen or Toggenburg. The crossbred animals were all crossed in different combinations with one of the exotic breeds mentioned above and one local breed. Figure 1 show the mean value for the maximum milk yield, the highest production noted, among the lactating cows of exotic breed, local breed and crossbred cows. Figure 2 show the mean value for milk yield produced at maximum production for exotic breeds and crossbred animals among the lactating goats. None of the farms included in the study milked goats of local breed.

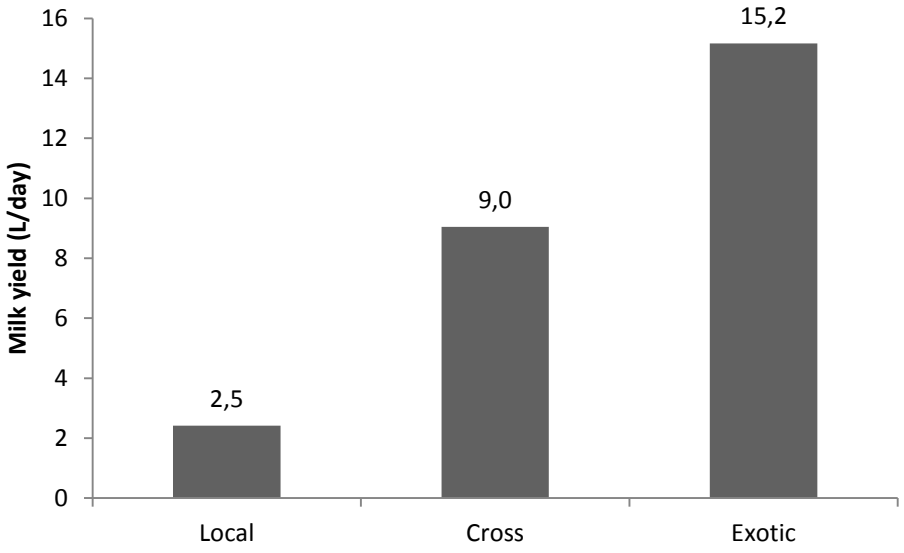

Figure 1. Mean value of maximum milk yield (L/day) for lactating cows of six exotic breeds, twenty local breeds and five crossbred cows. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

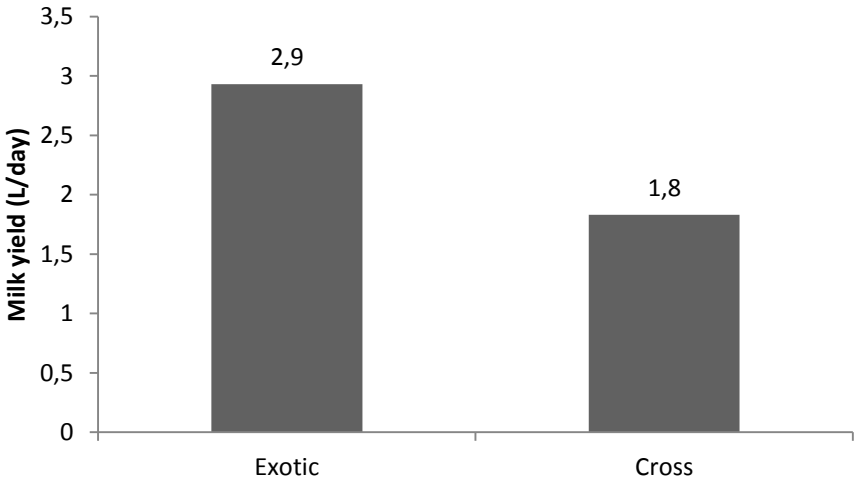

Figure 2. Mean value of milk yield (L/day) for lactating goats of ten exotic breeds and six crossbred goats. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

Figure 1 and 2 shows mean values of milk yield for the lactating cows and goats of different breeds. The calculated values are taken from maximum amount of milk noted or average amount when maximum value was not available.

4.3 Water availability

Farmers had diverse methods of collecting water. Some had to go several kilometres each day to collect water in jerry cans that they carried on their heads. Others had one or a number of donkeys that could help them carry buckets with water, or a bike for the same purpose. Another group of farmers had a source of water on their farm. The different water sources were; tap water, rivers, rainwater tank, shallow wells (boreholes less than 30 feet deep), ponds and mountain pipes (water from up the hill led through a pipe to a more reachable place). More information regarding water management, see Näslund, 2011.

4.3.1 Distance to source of water

The farmers that had water available on their farm and the farmers that had the longest distance to the water both kept upgraded (exotic breed and crossbred) animals.

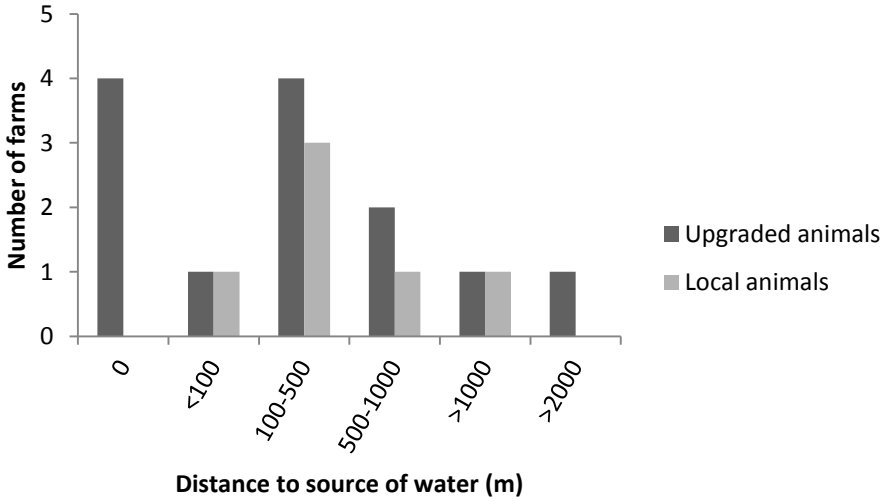

Figure 3. Number of farmers with upgraded or local animals compared to distance to source of water. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

Distance to source of water and milk yield for cows and goats are presented in Figure 4 and 5. The individual among the cows that generated the highest milk yield lived at a farm with over two thousand meter to their source of water. The goat that milked the most lived, on the other hand, at a farm that had their source of water on the farm. Thereafter it is a big variation comparing distance and milk yield, both for cows and goats.

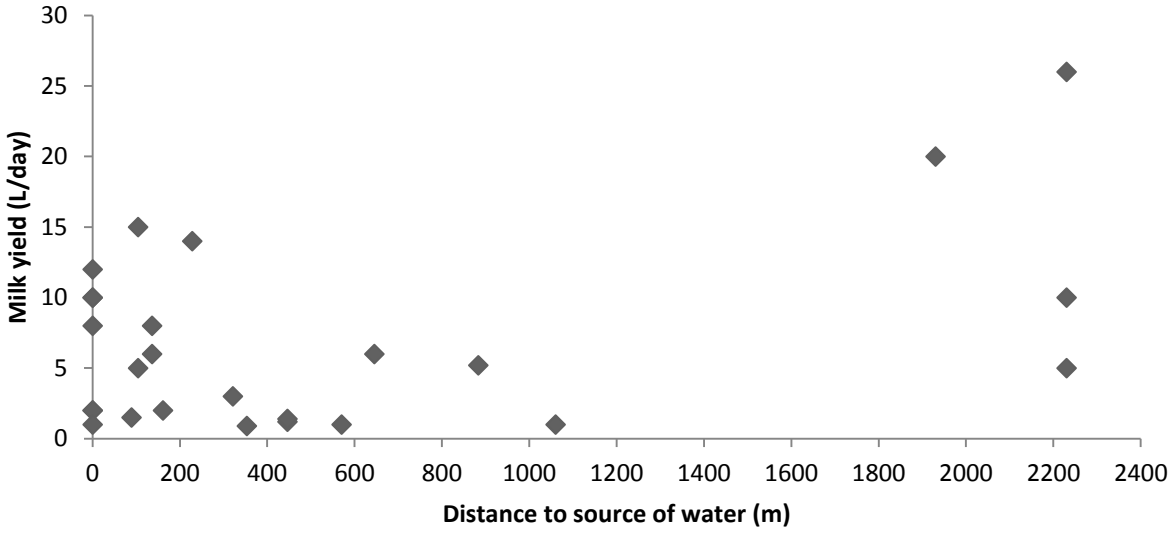

Figure 4. Distance to source of water compared to milk yield for cows. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

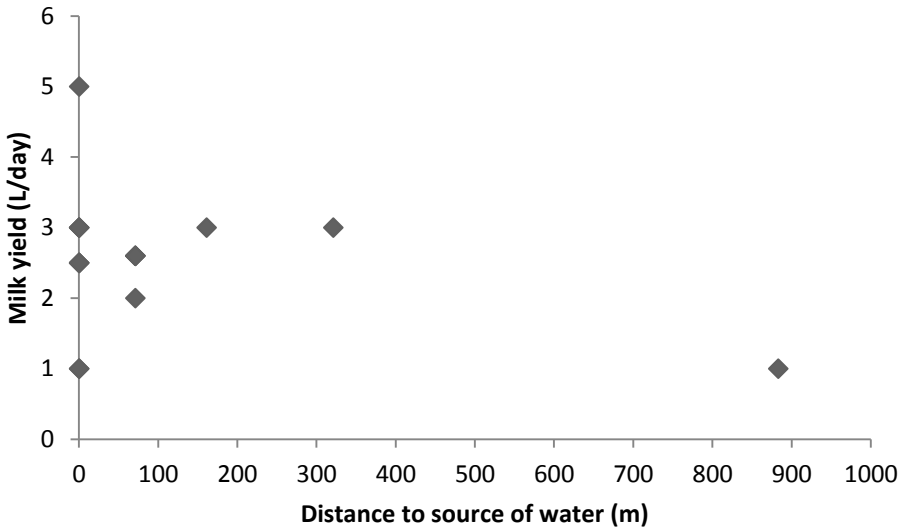

Figure 5. Distance to source of water compared to milk yield for goats. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

4.3.2 Water consumption

It was difficult to collect information about the dairy animals' consumption of water. Many people gave incorrect or unrealistic answers which made the result less reliable. If people gave the animals water on the farm they could in most cases tell the part of the total amount of water collected per day that was given to the animals, but not for each animal specifically. Unfortunately, these answers were often contradictive and unrealistic and in most cases

valued as not reliable. Since the farmers often kept several types of animals, cows, goats, sheep, donkeys and chickens, no general amount received by the cows or goats could be calculated. Some farmers brought their animals to drink from the river or ponds in the area while grazing. This made it impossible to measure true water consumption. In general the farmers had little knowledge and awareness of how much water they offered their animals. Several farmers did not know how much water the animals required (except that upgraded animals required more than local animals) or in what extent water effects milk production.

4.4 Feed and water quality and quantity

4.4.1 Dry matter content

Dry matter content of grass samples ranged from 16 to 92 percent. The dry matter compared with milk yield produced on different farms is visualized in Figure 8 for cows and in Figure 9 for goats.

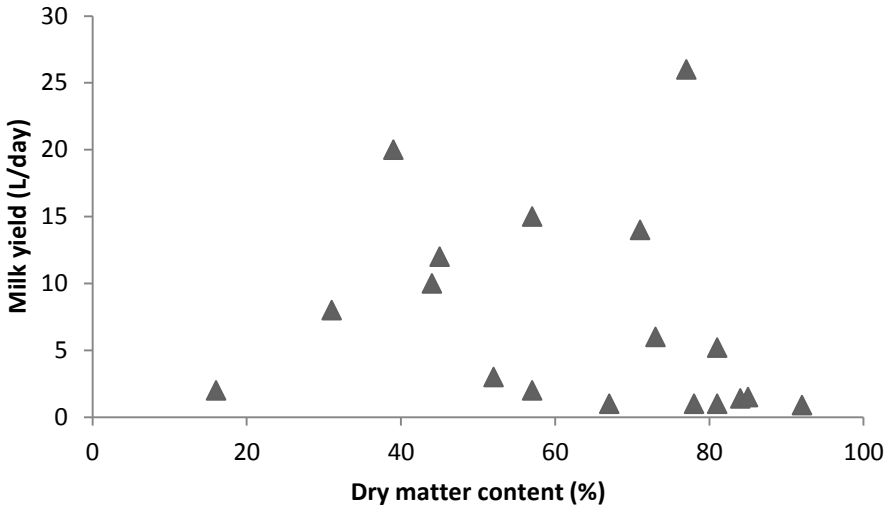

Figure 8. The dry matter content compared with the maximum, or general, milk yield on each farm keeping cows. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

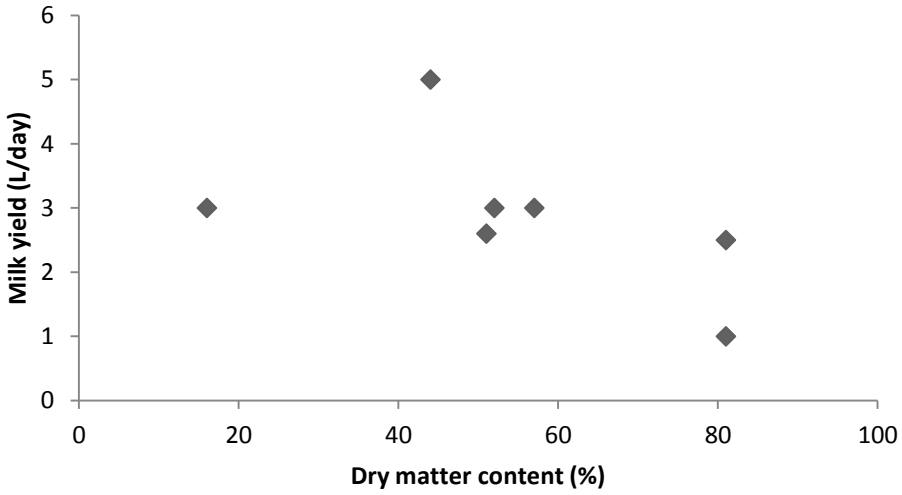

Figure 9. The dry matter content compared with the maximum, or general, milk yield on each farm keeping goats. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

4.4.2 Effect of concentrates

Most farmers gave concentrates to their upgraded animals. Figure 6 shows the maximum milk yield for individual cows, which breed (exotic breed, local breed or crossbred animals) and if they received concentrates or not. All cows of exotic breed received concentrates and therefore the category of exotic breed with no concentrates was excluded. In this study cows that produced the highest milk yield also received concentrates.

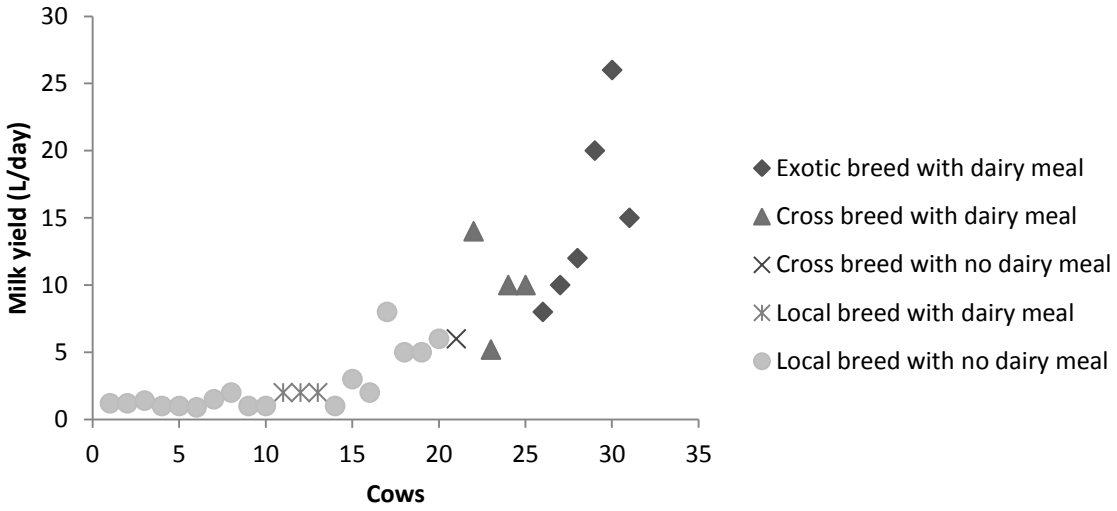

Figure 6. Milk yield for the individual lactating cows visited and if they received concentrates or not. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

Most of the cows were given salt but six cows, all of local breed, were not given salt. Lower milk yield could not be proved due to lack of salt. Salt was given to all lactating goats.

Figure 7 shows maximum milk yield, concentrates supplementation and breed for all individual goats. One farm had a non-lactating goat but with purpose to generate milk in the future. Therefore the farm was also included since the predicted milk yield was given. Goats that received concentrates also gave among the highest milk yield.

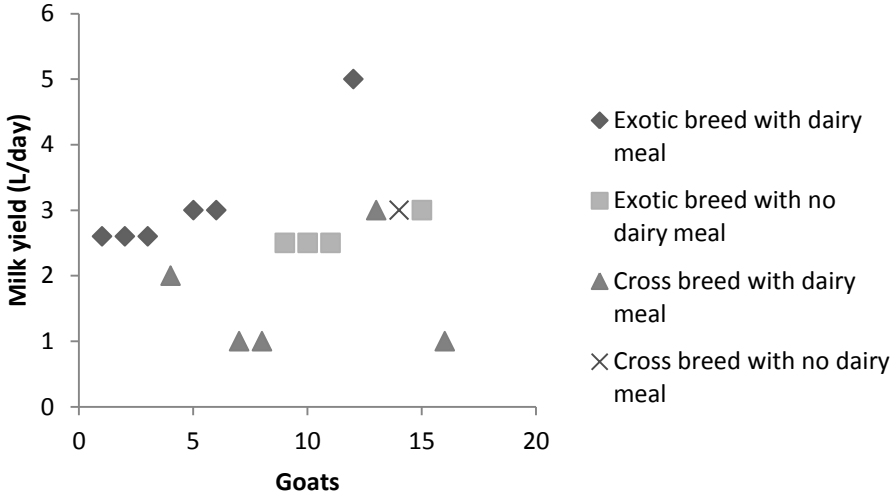

Figure 7. Milk yield for the individual lactating goats visited and if they received concentrates or not. Data based on interviews with nineteen farmers in the Nyando district in Kenya.

4.4.3 Visual analysis of feed, water and milk trays and storages

The analysis made on water tray, water storage, milk bucket, milk storage, feed storage and feed tray gave in general a positive impression. These analyses have been categorized into different groups and this is presented in Table 2. Only one farm (number 5) was categorized with a dirty water tray, otherwise all were nice and clean except some that were a bit dirty and had some muddy water. Farmers stored water only during the day, only four farmers stored for longer periods. These storages were all categorized as nice and clean. All milk buckets and storages looked very nice and clean. Feed storages were also overall nice and clean except for some that were a bit dirty. The farmers that had some kind of feed tray were all nice and clean as well. Except the water that in some cases was muddy, the water, feed and milk used at the farms were evaluated as nice and clean.

Table 2. Visual analysis of feed, water and milk trays and storages at the visited farms and number of farms in each category

	Nice and clean	Ok, a bit dirty	Dirty	Outside
Water tray*	15	2	1	
Water storage*	4			
Milk bucket	19			
Milk storage	19			
Feed storage*	5	3		8
Feed tray*	13			

* All farmers did not have water tray, water storage, feed storage and feed tray.

5 DISCUSSION

There was an obvious difference in milk production between different breeds among both cows and goats. This can be seen in Figure 1 and 2 where the mean value of the milk yield from local breed, exotic breed and crossbred cows and goats are presented. It was an increasing difference with the local breeds, well adapted to the hot living conditions, producing the least and the exotic breeds producing the highest amount of milk. Farmers in a study performed in Burkina Faso by Millogo et al (2008) reported that the Zebu cows in restricted suckling systems produced between one to two liters of saleable milk per day. This corresponded quite well with the results from the local cows included in this study. Animals of exotic breed and crossbred animals require more care and are more sensitive to diseases and parasites. So even if they produce more, keeping them has some drawbacks. But with for example structured documentation of diseases that strike these animals it could be possible to collect statistics to chart and prevent these in the future.

The water availability could be seen as a factor that limits the milk yield. If exotic breed and crossbred animals would have lived under better conditions with more appropriate water and feed, the differences would probably have been more pronounced. Many of the farmers did not have knowledge about in what extent, the animals that they kept, really required in water to produce a certain amount of milk. Only that upgraded animals needed more water than local animals. The water that was available was simply the amount they received. On the other hand no obvious link between water availability and milk yield could be drawn since upgraded breeds produced well regardless distance to source of water. Not between distance to source of water and choice of breed either. As shown in Figure 3, both farmers that had the source of water on their farm and farmers that had over 2000 m to the source kept upgraded

breeds. The farmers who had a source of water on their farm can though be assumed to be able to collect more water than the ones with a long distance to the source, but was not proved from the data in this study. The milk production from the animals compared with distance to water is presented in Figure 4 and 5. There was a quite big variation among both cows and goats comparing distance to source of water and milk yield, this depends of course also on what breed it was. Some of the farmers kept both local and upgraded animals. But still; it did not seem to be the distance to the source of water that determined what breed the farmers had or the animals milk yield, rather the management at the farm and how much water the farmers were willing and had the possibility to collect. It is worth noticing that among the famers that had over 700 m to their source of water four out of five had donkeys or a bike for collecting water (Näslund, 2011). Three of these four kept upgraded breeds. The fifth famer with this distance to the water kept upgraded animals and did not have donkeys or other device to make the collection easier.

According to Thornton (2010) it is more beneficial to use crosses with local Zebu cattle since they have the capacity to cope with local environmental conditions, which corresponded with the opinion among people at site. As mentioned earlier, farmers were aware of that upgraded animals demanded more water, but they had no possibility to offer any more water to them. Replacement with high yielding breeds or crosses of high yielding breeds with local breeds could be an alternative to provide a higher production, in order to meet increasing request of livestock products. But the animals various needs must be taken to account. The animals must be able to live and produce in an African environment and function with limited resources, such as feed and water, and be able to handle other challenges, like diseases. Use of Friesians has for example showed negative effects considering heat stress and energy deficits. This makes it unsustainable for smallholder farmers to keep Friesians and it would be more beneficial to keep crosses of European breeds with local zebu cattle that are used to the environment (Thornton, 2010).

People had to practice some work to collect water and they collected the amount they considered possible during a day. It would have been interesting to know how much water they would give their animals if they had unlimited access to it and if they did not have to work as hard to collect it. This could partly be seen among the farmers that had their source of water on their farm. The water amount given to the animals among these farmers had though a quite big variation. Water offered varied between 20 L to 240 L. This variation along with uncertain results made the information unreliable. Information about the amount of water offered to the cows and goats were often contradictive and sometimes the farmers did not know the amount, only the amount in total for all the animals living on the farm. Amount of water could sometimes be measured but not always. If the animals were grazing or partly grazing it was impracticable to determine the consumed amount of water. Follow up interviews and observations may have clarified this. More research would therefore be of interest to explore this area.

The dry conditions result, not only in lack of water, but also in less feed. Drought leads to scarcity of feed and feed of good quality. There were no clear relationship between the dry matter content in feed and milk yield in this study (Figure 8 and 9). This could be explained by the fact that the samples for dry matter calculations could not be taken with as high specificity as wanted. It was difficult to collect representative pasture sample. Many of the farmers had limited amount of feed and therefore a small sample was taken. According to the farmers there was a large variation during the year in feed offered, depending on environmental conditions. The feed intake depends on many factors, for example dry matter

and fiber content. Even if the dry matter values are correct it was difficult to evaluate the amount and kind of feed that the animals consumed. Individuals that received feed with lower dry matter may have consumed a larger amount feed than the ones that received feed of a higher value of dry matter. The dry matter values were wide spread from 16 to 92 percent. Among the cows (Figure 8) the lowest dry matter value also represented one of the lowest milk yield, but among the goats the lowest value resulted in a average milk production compared with the rest of the goats (Figure 9). It would have been interesting to primarily include analyses of hygienic value of water and nutritive value of feed. In order to improve the result it would be necessary to follow the animals during a longer period of time, perhaps for a year and during the whole day. This to see what feed they receive, how the intake of feed varies and then compare this with the milk production during the same period.

Supplementing pasture and cut grass diets with concentrates were in many cases a question of money. It did not matter if the farmers knew that the productivity could increase with concentrates if they did not have the money to buy it. One liter of milk could be sold for about 40 shilling (about 3,00 SEK (Forex, 2011)) and a bag of concentrates that contained 70 kg could be bought for 1 700 shillings in the Nyando district. Further, minerals and salt could be bought for about 500 shillings per month (personal communication, Omune, 2011). These costs are very high if you as a farmer for example are able to sell about 5 liters of milk per day and get about 6 000 shillings per month from your dairy animals.

Animals seemed, as expected, to react positively with higher productivity when they consumed concentrates. Among the cows, all exotic breeds received concentrates and these were also the individuals that generated the highest milk yield (Figure 6). After that came most of the crossbred animals that received concentrates followed by the one with no concentrates and last the local breeds. One local cow was offered concentrates but no distinguished difference from the others could be noticed. The goat that was producing the highest milk yield was an exotic bred who received concentrates (Figure 7). Exotic breed goats that did not receive any concentrates still milked more, with some exceptions, than the crossbred goats. These differences among cows and goats could be explained by individual and breed differences, the fact that animals of exotic breed have higher production regardless of the concentrates. Both for cows and goats it is hard to decide if the differences between individuals are due to individual differences, breed differences, or caused by concentrates. However, one thing that can be stated is that if an animal, cow or goat, is poorly fed it will produce less. Therefore differences between individuals in this study could also, to a large extent, be explained by amount feed and varying nutritional values in that feed. Access to roughage of good quality is probably more beneficial for the farmers, with aim to have a high milk production, than access to concentrates. A study made in Burkina Faso by Millogo et al, (2008) showed that the ways to increase milk production are through better nutrition practice, milking routines and crossbreeding. This should generate a higher production amount, which is the case in this study area as well.

The visual analysis made on water tray, water storage milk bucket, milk storage, feed storage and feed tray all gave a good impression. All farmers seemed to be very careful with their equipment (buckets) for milking and it appeared that people seemed to be strict with keeping all things as nice and clean as possible, with the conditions that they had. The visual evaluation of water, feed and milk was positive except for the muddy water at some farms. This was though expected since they did not have the possibility to use any other source of water than a dirty one.

According to Omune (personal communication, 2011) many people do not milk their goats due to lack of kids and also because people in general by tradition do not like milk from goats, mainly because of the smell. But Omune (personal communication, 2011) believes that people are willing to change with money as the working factor. Goats of local breed that are not used for milking but are living on the farm, eating the grass, drinking the water and so on could be an important source of milk if they were handled in a different way. To reform this, farmers must be aware of the productivity these animals possess and what they can contribute to the dairy production if used differently. Even if local breeds generally can be expected to produce quite small amount of milk compared to upgraded breeds, it would most likely be more effective to use them than not use them at all. The farmers that milked their upgraded goats seemed pleased and said that many people in the area are beginning to rethink how they value milk from goats, which is positive for the future.

6 CONCLUSIONS

Milk is central for many people in Kenya and by increasing the production people could improve their living conditions compared with today. The result from this study showed that upgraded dairy cows had higher milk yield than local dairy cows. None of the local goats were milked but the goats of exotic breed were proved to milk more than the crossbred goats. Many farmers did not know the amount of water that was given to the animals; the animals simply received the amount water that was available, not what they required. Further, it did not seem to be the distance to source of water that determined the choice of breed, rather the management at the farm and how much water the farmers were willing and had the possibility to collect. However, farmers knew that upgraded breeds needed more water than local breeds which are more adapted to the environment. Many of the famers had limited amount of feed but according to the farmers it was a quite big variation during the year as well, depending on environmental conditions. There were no clear relationship between the dry matter in feed and milk yield. It was also hard to determine the amount of feed that the animals consumed. It would be necessary to follow the animals during a longer period of time to see how the intake of feed varies during a year and what feed they receive. The result from this study indicated that the animals had a higher milk yield if they had access to concentrates. However, the higher milk yield can also be explained by breed and individual differences, as well as different nutrient values in the feed. Goats were not well used and of significant importance for milk production, above all due to that people by tradition do not milk goats. All farmers, except four, kept goats but none of the farmers milked their local goats. These animals could be a source to higher the amount of milk to the farmers. The farmers that milked their upgraded goats seemed pleased and people in the area were beginning to rethink how they valued milk from goats. Water access and usage are the essential factors for continuing development in the Nyando district.

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Personal communication

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APPENDIX

Questionnaire

Date:_____

Farm-name/-number:_____

Owner:_____
Supervisor (who takes care of the farm):_____
How big is the farm?_____
What school background do you have (supervisor)? _____

If you got 100 000 shillings for improving your farm, what would you like to do?
_____
_____
_____

1a.How many children are living/taken care of on the farm?_____
1b. How many of them are girls and how many are boys? Girls:_____ Boys:_____

2. What do the children living on the farm do?

	In school	At home	In school and at home
Boys			
Girls			

3. How many people are helping out on the farm?_____

Farmliving boy	Farmliving girl	Farmlivingwoman	Farmliving man	Other person

If other person:_____

4. How many animals do you have? (separate paper)

5a. Do you have all your animals together? Yes: _____ No: _____
5b. If no, how do you keep them?_____
_____
_____
5c. What do you do with the calves? (feed, age when not nucking)_____
_____
_____

6. How do you decide what male you will use? Access to males? _____
_____
_____

_____

7a How many and what times of the day do you milk your animals?_____
_____

7b. What do you do with the milk after milking?
Use it directly:____ How?_____
Store it:_____ If yes, how? Where?_____
Sell it:_____ If yes, to whom?_____

8. Do you milk all the time between the offspring? Yes: _____ No: _____
If no, how long are they not milking?_____

9a. What feed do you give them? (ask until they don't answer any more) _____
_____
_____
_____
9b. Any dairy meal?_____
_____
9c. How often and what time of the day?_____
_____
9d. How much/each time?_____

10. What distance do you have to walk to reach feed for your animals? (With or without animals?)
Kilometres:_____ Time:_____ Around the farm:_____

11. Do you store feed? Yes:_____ No:_____ If yes, how and where?_____
_____
_____

12a. Do you give your animals salt? _____
12b. Do you know if there is any salt in their feed? _____
_____

13a. How do you get your water?_____
_____
_____
13b. Do you use the same water resource for animals and people/everyone on the farm?
Yes:_____ No:_____ If no, what are the differences?_____
_____
_____
13c. If collecting, how does this work?_____
_____
_____
_____

Water resource:_____
How often/day:_____
How many collect each time: Man:_____ Woman:_____ Girl:_____ Boy:_____

Other methods to collect water (rainwater):_____

What do you do with the water:

Household (food, wash etc.)	**Part:**
Crops	**Part:**
Animals	**Part:**

14a. Do you store water? (for drier periods) Yes:_____ No:_____ If yes, how?_____
_____
_____

14b. Do you reuse water in any way? (washing hands, vegetables)_____
_____

15. Do the access to water vary between the seasons? (show on the calendar)
Yes:_____ No:_____ If yes, how?_____
_____

16. Would you be able to collect water for another animal? Is water limiting?
_____
_____
_____

17. Would you be able to collect water for another animal? Is water limiting?
_____
_____
_____

18. Water history? How has the wateraccess changed over the past ten years?_____
_____

19. Biggest problem?_____
_____
_____

Our own measurements:

1. Weighing feed/animal:_____
_____
2. Collect feed (about 1 kilo).
3. Weighing the milk amount:_____
_____
4. GPS-positions.

GPS-positions: Farm:_____ Water:_____

5. Wright down the distance between the farm and water resource:_____

Visual analysis:

1.Watertray:_____
_____
_____

2.Milkbucket:_____
_____
_____

3. Milk storage:_____
_____
_____

4. Feed storage:_____
_____
_____

Take pictures of:

1. Watertray
2. Milkbucket
3. Milk storage
4. Feed storage
5. Water resource + other water resource
6. Animals

How many animals do you have?

	Cow	Goat	Chicken	Age	Gender (F/M)	Pure breed	Local breed	Cross breed	Fenced	Unfenced	Partly fenced	Milk amount/liter/time	Last calf/month	Birthrate/year	Stable	Comments
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
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