A Case Study of Brachiaria Grass for Improving Dairy Cattle Production in Kenya

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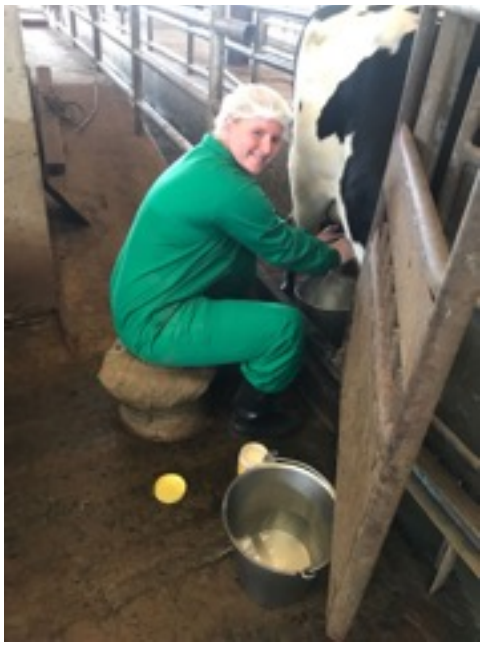

Acknowledgment

This research project has helped me to grow significantly as an individual. I encountered several challenges while doing my research, the main one being my age. Due to safety regulations, the International Livestock Research Institute does not allow anyone under the age of eighteen to do any research in their labs. This leads to me deciding to focus my research on something that I was able to do in the field. I had not really considered all of the work and research that can be done in the field and this helped me to develop a better understanding for what field research is and how invaluable this type of research can be. By having to deal with this challenge I have developed a much more flexible mindset that will help me with whatever my future may hold. Another challenge that I faced was that the person in charge of the Brachiaria program at ILRI was traveling for most of the time that I was at ILRI. This absence lead to significant delays in several parts of my research. While at the time this challenge was extremely stressful, it allowed me to develop more patience as a person. I am very grateful for all of the things this opportunity has allowed me to learn, I was truly able to grow as a person this summer.

I have put a lot of effort into this project, but it would not have been possible without the help of many organizations and people. I am extremely grateful to the World Food Prize and the International Livestock Research Institute for their guidance and supervision as well as their support in helping me to complete my project. I would also like to express my gratitude towards my parents and also Crystal Harris, for their encouragement of my project and I. Without them, none of this would have been possible. I would like to give special thanks to Dr. Wellington

Ekaya, who helped mentor me and guided me in my research. Last, but not least, I would like to thank Ambassador Quinn for providing me with this wonderful experience and opportunity.

Abstract

Milk production of dairy cattle in Kenya is a very important aspect of Kenya's agricultural sector. The increasing demands for more milk and dairy products have to lead to the need for ways to improve dairy cattle milk production. One of the ways to achieve higher milk yields per head is by improving the quality of feed that the dairy cows are fed. Brachiaria grass is one of these high quality feeds that can help to improve milk production. It is drought resistant and high in nutritive value. With all of the research done on this grass, the results show that Brachiaria grass has indeed helped to significantly improve milk production in dairy cattle everywhere it has been implemented in Kenya. Typically this improvement is by around 15-40%, while also being more tolerant to long-term droughts, and having a larger biomass than that of some of the more popular forages that farmers use to feed dairy animals. (Njarui, D. M., & Gichangi, E. M., N.D.) From researchers to farmers, everyone has been able to see the difference that Brachiaria grass has made.

Introduction

Agriculture is a very important part of Kenya's economy 26% of their GDP is attributed to agriculture. Another 25% of their GDP is indirectly related to agriculture. (Njarui, D. M., & Gichangi, E. M. N.D.) Even though farming makes up such a large percentage of Kenya's economy, most of the farms that are located in Kenya are smallholder farms. These farms almost always operate using a mixed farming system, where the farmers grow crops and raise livestock. This practice of small-scale mixed farming has to lead to the problem of there not being enough land for families to grow enough feed for both the livestock and themselves.

One industry that is on the rise in Kenya is the dairy industry. Milk is a very important part of the diet in Kenya; it provides many necessary nutrients and vitamins that are very beneficial to those who consume them. In Kenya, there are about four- billion liters of milk produced every year. This number is just barely large enough to meet the ever-growing demand for milk and dairy products in Kenya. That is why it is important that new ways of increasing milk production be explored. One of these ways is through superior feeds and forages.

Many dairy farmers in Kenya face the problem of a lack of adequate and quality feeds and forages to feed their animals with. The feeds that these farmers use do not meet the nutritional requirements that their dairy cattle need in order to meet their full milk production potential. It is recommended that dairy cattle consume a feed that contains around seven percent crude protein and many of the feeds fed to dairy cattle do not contain this amount of protein.

Even when these feeds are purchased in a store, the cost to purchase them is often too great for the farmer to be able to make a profit off of the extra milk they would be able to sell. This is actually a problem for all Kenyans, not just farmers. With increasing demands for more animal products, prices for said products have already increased. This has caused a need for more nutritious and productive feeds and forages.

There are many feeds and forages that farmers feed their dairy cattle in Kenya. One of these feeds is Napier grass, this is the most common forage that farmers in Kenya use to feed their cattle. Napier grass has a lot of biomass, which means there is a lot of leafy material grown in a small space, with very limited space for growing feed for their livestock this makes Napier grass a preferred grass among the farmers. Then there is Rhodes grass, this grass is mostly grown to be turned into hay for the cattle. Rhodes grass has a very good nutritive value but does not have the biomass that Napier does and so it is less popular. Then there is Brachiaria grass, this grass is originally from Kenya, but Brazillian scientists took some plants and improved them for use in South America. Scientists in Kenya brought this type of grass back and have been reintroducing it to farmers in Kenya, with the hopes that it will improve their livestock production. Brachiaria grass is a grass that is native to Kenya, but is underused as a forage throughout the country. However, in South America Brachiaria grass has become extremely popular as a forage and even as a grass for animals to graze on. Much of the grass used in South America has actually been developed and bred to perform better than the original varieties of the grass. The success of Brachiaria grass in South America is what spurred the need for more research to be done on the grass in Kenya. This led to a collaborative research project between the Kenya Agricultural Livestock Research Organization (KALRO) and the International Livestock

Research Institute (ILRI). Their goal was to explore superior feeds resources to increase animal productivity and for the generation of income from smallholder farmers through the use of Brachiaria grass.

After carefully reviewing the work and research that has been done on Brachiaria grass in Kenya, by ILRI and KALRO, it can be deduced that the introduction of the improved Brachiaria grass in Kenya has led to an increase in the milk production the dairy cattle that are consuming Brachiaria grass. It can also be deduced that this is helping the dairy industry within Kenya to grow to meet the increasing demand for more dairy within the country.

Method

An interview was arranged with Dr. John Mugambi from the Kenya Agricultural Livestock Research Organization (KALRO), the purpose of this meeting was to help develop a background of knowledge about agriculture in Kenya. The interview lasted an hour and was spent discussing several topics of agriculture in Kenya; including how agriculture affects the economy, the dairy industry within Kenya, the issues facing farmers, and the different feeds and forage farmers use to feed their livestock. The following is a summary of Dr. Mugambi's answers to a series of questions.

The economy of Kenya relies on agriculture, 26% of the country's GDP is made up of industry related directly to agriculture and another 25% is related indirectly to agriculture. Of the people employed by the industry of agriculture, 80% of the employees work in the field. Many of the farms in Kenya are smallholder farms; very few farms would be considered large scale

operations. The main strategy used on these farms is mixed farming. This is a system of farming where farmers raise cattle and grow crops. The biggest cash crop within Kenya is tea, but coffee is also commonly grown as a cash crop.

The dairy industry within Kenya is also very important to the country. Around four-billion liters of milk were produced last year, which is barely enough to meet consumer demands for milk within the country. The most common breed used to produce this milk is the Friesian, although other breeds are used throughout the country. One of these breeds is the Zebu, which is the local breed of cattle and is also well adapted to the climate of Kenya, but does not produce a large quantity of milk.

There is a wide variety of forages grown within Kenya to feed cattle and other livestock. One of these is Napier grass, it is the most popular forage within Kenya and has a large amount of biomass. It is, however, susceptible to stunting disease and is mildly intolerant to drought. Another forage commonly grown is Rhodes grass, it is most commonly grown to make hay and has a good nutritive value. Brachiaria grass is a grass that was originally from Kenya, but Brazilian scientists took the grass and improved it. This grass was the brought back to Kenya and is being reintroduced to farmers.

There are several challenges that occur when it comes to feeding these dairy cattle. Small-scale farming happens on a small amount of land. This makes it difficult for farmers to grow enough food for both the cattle and their family. One solution to this is that farmers can obtain a government permit that allows them to graze their cattle on land owned by the government. However, this permit comes at a cost and cuts into a farmer's bottom line. Another problem with feeding dairy cattle is that it is hard for farmers to make a profit if they are to

purchase feed at a store. The quality of these store-bought feeds is also questionable: there is no set way to ensure these feeds contain the nutrition requirements that they should. Many farmers in Kenya also do not know that they should balance the diets of their dairy cattle. Some farmers think that they can feed their animal one type of feed and that it will be able to produce as much milk as if it had been fed a mixed and balanced diet.

After the meeting with Dr. Mugambi, it was arranged to have an interview with a typical dairy farmer, who had connections to KALRO. This farmer's name was Kiaria and his farm was located in Kanji, Kenya. Kanji would be classified as a rural area. This interview was arranged to get a farmer's perspective on agriculture in Kenya. The interview lasted approximately one hour. The following is a summary of his responses to several key questions.

Kiaria's farm had twenty cows on it, of which twelve were producing milk, five were bred heifers, and three were young calves. All of the animals on Kiaria's farm were kept in pens; none of them were grazing freely. Instead, Kiaria feeds them in troughs. The younger animals that are not yet producing milk are fed a mix of chopped Napier grass and store-bought feed is mixed in with this to help supplement the grass. The dairy cattle that are producing milk get fed a better more expensive feed to help them produce more milk.

Milk is a very expensive commodity and many Kenyans are unable to afford it, particularly those who live below the poverty line. Buying packaged milk from a store is also very expensive and not an option for many people living in Kenya. Dairy farmers often keep little to no milk for themselves or their family: they find that selling the milk and getting money is more beneficial to them.

Dairy farmers in Kenya do not get paid on the butterfat quality within their milk; they only get paid for how much milk they are selling. This means that breeds that have high butterfat content, but produce less milk are often not as desirable as the breeds with lower butterfat content and higher milk production. Jerseys, Guernseys, Ayrshires, and Friesians are the most popular dairy cattle breeds. In that order they go from least desirable to most desirable, this is because Ayrshires and Friesians produce much more milk than Jerseys and Guernseys. All of the cattle on Kiaria's farm were Friesian's.

Kiaria was also a member of a dairy cooperative, which is a relatively new concept within Kenya. Everyday Kiaria brings the milk he has collected from that day to the cooperative. At the end of every week Kiaria is paid for how much milk he has brought in to the cooperative. The collection center that Kiaria brings his milk to collects around 6,000 liters of milk every day. There are also other collection centers within the cooperative and in total, the cooperative collects around one quarter million liters of milk every single day. This concluded the interview with Kiaria.

Next, a meeting with Dr. Wellington Ekaya was arranged to develop a better understanding of Brachiaria grass and how it is grown, harvested, and fed to dairy cattle. The meeting lasted approximately one hour. The meeting took place on the ILRI campus next to one of the Brachiaria grass plots. The following is a brief summary of the information that was shared about Brachiaria grass.

Brachiaria grass has three main growing stages; the leafy stage, the seeding stage, and the dry stage. When the plant has first sprouted it is in the leafy stage. In this stage, it is high in both protein content and water content, while containing very low dry matter. As the plant continues

to mature, the dry matter within the plant increases. While dry matter within the plant increases, protein content within the plant decreases. This leads the plant into the seeding stage, which is also the plant's mature stage. The seeding stage occurs when the plant is between ten and fifteen weeks of age. At this stage, the plant contains a crude protein level of around 7%, which is the ideal crude protein that should be fed to dairy cattle. (Mutimura, M., Ebong, C., Rao, I. M., & Nsahlai, I.) This is the stage where the plant would ideally be harvested and fed to the cattle. If the plant is not harvested during this time period it will reach the dry stage. As the plant ages, the amount of dry matter within the plant continues to increases and the amount of crude protein within the plant continues to decreases. The protein within the plant when it reaches the dry stage is around only 3%, which is not a viable amount of protein for an animal to be able to meet the necessary nutritional requirements that it needs. (Mutimura, M., et. al., 2018) After the grass has been harvested, the plant will resprout on its own and the growing cycle is able to begin again. Brachiaria grass can be used to make several types of feeds. The most popular way of feeding Brachiaria grass is to simply harvest it from the field and then chop it up and feed it to the animals when fed in this way it can be mixed with other feeds to help supplement the grass. Another method of feeding Brachiaria grass is to harvest it and let it dry on the ground. Then farmers will take the dried grass and bale it into hay. The last way to feed Brachiaria grass, that was discussed, is to use it to make silage. The practice of making brachiaria grass into silage is not very common.

There are a couple of challenges that can occur when Brachiaria grass is being grown. Weeds can be one of these challenges. When a plot of Brachiaria grass contains too many weeds, the Brachiaria grass is unable to grow properly and this results in less of the Brachiaria being grown.

A fungus is another one of these challenges. One of the main fungi that affect Brachiaria grass is rust. When the fungus gets into the plant it can lead to stunting and lack of productivity within the plant. Finally, the last main challenge that occurs when growing Brachiaria grass is that the seeds of the plant often are infertile and unable to grow into another plant. This means that using the seeds to plant brachiaria grass is not a viable option. In order for the plant to be planted, it has to be broken into splits. This is the process in which sections of an already mature plant are broken into smaller plants. These smaller plants are then planted and eventually grow into mature versions of the plant. This concluded the meeting.

It was then arranged for an interview to be conducted with two farmers who have grown Brachiaria grass for several years. The first farmer has grown the grass for four years and the second farmer had grown the grass for two years. A questionnaire was also designed to help facilitate the interview of each of the participants.

The last step in understanding Brachiaria grass production and how effective it is as a forage was to conduct a nutritional analysis on four varieties of the grass. These varieties were MG4, Basilisk, Marandu, and Piata. The plants were collected and harvested on the same day and at the same growth stage. Each of the plants harvested was cut approximately five centimeters from the ground. Wheat bran and soybean hulls were also sent in for analysis for comparison. The plants were sent to KALRO for analysis, as ILRI did not have the proper equipment to run the tests.

Results

The result of this case study is that it can be confirmed that the introduction of improved Brachiaria grass has led to the increase in milk production of dairy cattle who are consuming it.

Dairy cattle that are fed Brachiaria grass have improved milk production compared to dairy cattle that are not fed Brachiaria grass. Dairy cattle that were fed feed other than Brachiaria produced on average around 11.8 liters of milk a day per cow in the highlands, 6.9 liters in the eastern mid-altitude region and 7.8 liters in the eastern mid-altitude region. (Njarui, D. M., & Gichangi, E. M. N.D.) The low production of milk is attributed to poor nutrition and a lack of supplementation with high protein feeds. When these animals are fed Brachiaria grass, their milk production increased tremendously. Low yielding animals often had an increase in their milk production of about 15%, while already high producing animals had an increase in production of around 40%. This is caused by Brachiaria grasses high nutritive value. When harvested at the ideal stage, around 10-15 weeks old, the plant contains 7% crude protein. This is the recommended amount of protein that dairy cattle be fed and so no protein has to be added to the feed in order to meet the amount required.

The interview with each of the farmers also yielded some information about how the grass is spreading and growing in popularity throughout Kenya. The first farmer that was visited lived on about fifteen acres of land. On this land, they grew several varieties of Brachiaria for their own personal use and also to sell the leftover grass as a hay. This particular farmer also sells splits of the grass to other farmers and this is an added source of income for the household. The second farmer we visited was located relatively close to the first farmer. This farmer learned about Brachiaria grass from the first farmer and even bought splits from the first farmer. This shows how the grass within the country has spread from one farmer to the next. Both of the farmers that were interviewed were pleased with the grass and said that they would recommend it to a neighbor or friend.

The results of the research were that on average the variety Basilisk had a wet crude protein content of 14.37 g/ 100 g., Piata 15.14 g/ 100g., MG4 13.00 g/ 100g., and Marandu 16.52 g/ 100g. This is compared to the 11.02 g/ 100 g. that is found in soybean hulls and 14.53 g/ 100g. in wheat bran. The dry crude protein of these was, Basilisk was 13.11 g/ 100 g., Piata 13.96 g/ 100 g., MG4 12 g/ 100g., and Marandu 15.12 g/ 100 g. That is compared to the dry crude protein content of soybean hulls, which is 9.89 g/ 100 g. Wheat bran's dry crude protein content, which is 13.16 g/ 100g.

Another portion of the results of my research was the moisture content of each of the varieties of the grass. On average Basilisk contained 8.81 g/ 100g., Piata 7.83 g/ 100g., MG4 12 g/ 100g., Marandu 15.12 g/ 100g. That is compared to the 9.47 g/ 100g., that is in wheat bran and the 10.21 g/ 100g. that is in soybean hulls. This means that the varieties of Brachiaria have less moisture in them, which in turn means that they have more dry biomass than soybean hulls and wheat bran.

Discussion

The success of the research done on Brachiaria grass has led to many more farmers using the grass as their main source of feed for their dairy cattle. This is good news for the dairy industry in Kenya. Having dairy cattle that are able to produce more milk will help the dairy industry in Kenya to grow and meet the growing demand for more dairy products in Kenya. The results of my case study help to confirm how effective Brachiaria is as forage for dairy cattle.

The interview that was conducted with the farmers also helps to show that the farmers are impressed with Brachiaria grass as a feed and forage for their livestock. The grass initially was

only available to farmers through either ILRI or KALRO, but now other farmers are growing splits and selling them for an extra source of income. The effects that this grass has had on the lives of farmers who grow it has been extremely impressive. Now their dairy cattle are producing more milk and they have new sources of a potential extra income.

Even though wheat bran does have higher protein content than the varieties MG4 and Basilisk, Brachiaria plants are better suited for drought resistance and some of the other challenges that plants growing in Kenya's face. The biomass of Brachiaria is also typically larger than that of the typical wheat plant, meaning that you are able to get more growth from each individual plant.

Brachiaria grass has not only helped the farmers that are growing it to increase milk production within their dairy cattle, but also helped them to develop another added source of income. This has helped to improve the quality of life among the farmers that are now growing Brachiaria grass, while also helping to improve the dairy industry within Kenya. It is not too farfetched to say that Brachiaria grass has benefitted everyone in the dairy industry of Kenya has benefited from this grass in some way or another.

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Appendix

Appendix 1

sample	Rep	Crude protein (Before moisture content correction) (g/100)	Mean Protein content (g/ 100g)	Standard deviation	Moisture content	Mean Moisture content	Crude protein g/ 100g expressed on dry weight basis (dwb)
Basilisk	a	14.56	14.37	1.26	8.53	8.81	13.11
	b	13.02			8.60		
	c	15.53			9.30		
Piata	a	16.98	15.14	1.74	7.60	7.83	13.96
	b	13.53			8.80		
	c	14.92			7.10		
wheat bran	a	13.66	14.53	0.91	9.40	9.47	13.16
	b	14.47			9.60		
	c	15.48			9.40		
Soy bean hull	a	11.12	11.02	0.09	10.48	10.21	9.89
	b	10.96			9.90		
	c	10.97			10.26		
MG4	a	14.24	13.00	1.21	7.78	7.74	12.00
	b	11.82			7.93		
	c	12.95			7.52		
Marandu	a	16.04	16.52	0.82	8.64	8.43	15.12
	b	16.04			8.40		
	c	17.47			8.24		

Appendix 2

Questionnaire to assess the adoption and utilization of Bracharia grass species by dairy farmers in Kenyan highlands

1.0 General information

1. Date of interview: ……/……/… ……
2. Questionnaire serial number: ……/……/.....
3. Name of enumerator: ……
4. Division:……..Location:…….Sub-Loc.:……Village:……

Respondent's information

1. Name of respondent: …….
2. Sex:(1) Male…… (2) Female……..
3. Age: (1) Under 30 years…….(2) Between 30 – 60 years……... (3) Over 60 years……

2. Household's head information

2.1. Household head: (1) Male……(0) Female ……Age.....

2.2. Household Size/ Composition: no of male ..... no of female..... Total…….

2.3. Education: (1) None…….(2) Primary……(3) Secondary (4) Post-Secondary ……..

2.4. What is the main occupation? [1] Agro-pastoralist; [2] Pure Pastoralist [3] Fodder trader; [4] Fodder transporter [4] Peri-urban agriculture [5] Crop farming [6] others, specify.....

3. Pasture production activities

3.1. How do you grow your bracharia grass (a) Rain fed (b) irrigated (c) both

3.2. What cultivation practice are you using in Bracharia farm? 1) Grow bracharia alone……. 2) Mixed with other crops…….. 3) Other (specify?)…….....

3.3. Have you been trained on pasture/bracharia production? (1) yes (2) no

3.4. If yes, who trained you (1) Seed companies (2) KALRO (3) ILRI (3) Ministry of agriculture (4)(NGOS) (5) Farmers (6) Others, specify.....

3.5. What were you trained on.....

.....

.....

3.6. What do you use as planting material for bracharia grass (1) Seeds (2) splits

3.7. Where do you get your bracharia planting material (1) Agro-vets (2) Kalro (3) Ilri (3) Ministry of agriculture (4)(Ngos) (5) Farmers (6) Others, specify.....

3.8. How long have you been planting Bracharia.....

3.9. Why did you choose bracharia species as your pasture crop ....

3.10.Do you have other pasture grass species.....1) yes 2 No. If yes, which types, fill table below

Pasture type	**Acreage**	**Yields per acre in harvest season (Kgs)**
Bracharia		
Nappier grass		
Boma rhodes		
Natural pastures		
Others, specify.....		

3.11.What are the challenges have you encountered in Bracharia pasture production.....

3.12.What benefits have you received from bracaria pasture production.....

3.13.What changes have you seen before adopting and after adopting Bracharia grass, fill in the table below;

Parameters	**Before adoption of Bracharia**	**After adoption of Bracharia**
Litres of milk per day per animal (litres/day)		
Number of Months of feed shortage in a year		
Amount spend in animal supplement per month (Ksh)		
Number of animals kept		
Income from milk sale in a month (kshs)		
Amount spend in purchase of grass/ feed in a year		

3.14.How do you use your bracahria 1) fresh after harvest 2) conserved

3.15.Do you practice bracharia pasture conservation? (1) yes (2) no

If yes, fill the table below

Conservation type	**Cost**	**Advantage**	**Disadvantage**
Silage			
Hay			
Others, ...			

3.16.Do you produce and use Bracharia pasture production as a 1) business 2)subsistence use

3.17.Do you sell Bracharia grass? (1) yes……. (2) no……..

3.18. If yes, How much money do you make from bracharia sales in a year from 1 acre? .....

3.19. How much do you spend on bracharia pasture production in a year? .....

3.20. Which classes of livestock do you give preference for bracharia feeding? 1) lactating cows, 2) bulls, 3) heifers, 4) oxen, 5) steers, 6) calves, 9)goats 10)sheep

3.21. How much of Bracharia grass do you feed to an animal in a day in Kgs?

3.22. Do you feed Bracharia as sole forage or supplement to other forages?

3.23. In your opinion, is Bracharia a better grass than other grass types for animal? 1) Yes 2)No.....Give reasons.....
.....