Forage adoption and gaps in Kenya- a review

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Summary

Generally, livestock production has remained low in sub-Saharan Africa. One of the key areas with potential to contribute in reversing the situation is use of feeds and feeding. While there are various forages that scientifically have potential to increase productivity, in practice their use has remained low. This short review assesses the current forage adoption in Kenya and the potential to close the gap by use of improved forages. In effect, translates to forage seeds and/or planting materials easily accessible by livestock producers. Equally, there is need of capacity building and awareness creation for the livestock producers to stimulate, harness and bolster forage cultivation for increased livestock productivity.

Background

About 60% (approx. 1,900 MT) of total milk production in Kenya takes place in less than 10% of the country's total landmass (569,140 km^2), and in the central regions of the Rift-Valley and Central Provinces, where 80% of exotic and cross-bred dairy cattle are found. All these areas fall within humid and sub humid areas, and mostly have fertile volcanic soils. Other areas with significant dairy production include Western Kenya, and Kisii and Meru counties (Omore et al 1999).

Kenya covers a total land area of 56.9 million hectares of which 90% is classified as "agricultural land" based on average annual rainfall. High to medium potential agricultural land amount to about 10 million hectares, of which 60% is devoted to crop and dairy (milk) production in mixed farming systems. In these areas also, most forage production takes place. About 42.1 million hectares are of low potential and used for extensive livestock production systems on mainly natural grassland, including ranching and (agro-) pastoralism. The area is also home to most of Kenya's national parks and conservancies and wildlife population. These Arid and Semi-Arid Lands (ASALs) cover over 80% of the country (GoK/FAO, 2019).

The stock size of dairy cattle industry in Kenya estimated at 7.2 million animals (TIAPD 2017), mostly located in Central Kenya and North Rift, while the country cattle population stand in excess of 20 million (FAO and IGAD, 2019). The estimated number of small holder dairy farmers (1-5 cows average) ranges from 0.8 – 1.8 million farmers, producing 56% of the total milk supply whereas the number of medium and large-scale farmers (15-30 cows and more) ranges from 3-4,000 producing 44% of the total milk supply. In Kenya, dairy cattle are kept as either stall-feeding or extensive grazing. Most of the animals are however under stall-feeding as result of land unavailability constraint. Feeding system notwithstanding, dairy animals largely produce below their potential attributable to a large extent, to low quality forages and forage shortages especially during dry periods (Mwendia et al., 2017).

Therefore, feeds and forage play crucial role in success or failure of livestock productivity. While farmers are generally aware of the link between feeding and production, they are compromised by a myriad of challenges ranging from awareness, skill and technologies, access to forage technologies, limited finances to invest and small land holdings leading to competing agricultural activities. However, market-oriented dairy farmers as opposed to subsistence tend to embrace forage technologies better, attributable to market pull for dairy products. We therefore set out to review the current situation regarding forage adopting and gap in high potential areas in Kenya.

Approach

The review uses reports, institutional documents or journal articles available narrowing on the coverage of forage demand and production in Kenya, synthesizing and making inferences.

Literature and inferences

In seeking to understand why production of quality forages in Kenya is still deficient, a recent survey by (Jos and Aranguiz, 2019) gave the reasons with the ratings (Table 1). These reasons and/or their interactions may explain the underlying low forage technologies uptake in the view of the farmers many involved in agriculture. Even with the market–oriented dairy farmers, the level of forage technologies adoption appear limited (Table 2), with most relying on traditional ones that have been there for some time especially Napier grass especially and Rhodes grass. Both grasses have a history i.e. Napier grass that was introduced in Kenya as a mulch crop in coffee farms in early 60s' but farmers were quick to discern was better fed to cattle, and Rhodes grass which benefited from forage breeding that was active in the early 60s and not thereafter (Boonman 1993).

Table 1. Reasons why quality forages production in Kenya is still deficient

Reason for low adoption/ production	Percentage (%)
Unavailability of forage seeds or plant material	27.7
Lack of awareness, knowledge and skills	20.8
Low mechanization level	6.9
Land competition for food crops	5.4
Financial constraints- farmers	6.9
Limited entrepreneurial skill- farmers	6.2

(Creemers and Aranguiz, 2019)

Table 2. Forage species and percentage use in intensive and semi intensive systems in Kenya

Forage	Percentage (%) use	
	Intensive	Semi-intensive
Napier grass	33.3	5
Chloris gayana	20.7	33.3
Maize	17.2	-
Lucerne	8.0	-
Star grass	-	8.3
Kikuyu grass	3	7.3
Panicum maximum	-	6
Brachiaria	3	6

(Creemers and Aranguiz, 2019)

In a more distance past compilation of natural pasture versus cultivated forages (Table 3) in the districts (now counties) in humid and sub-humid area indicated reliance mostly on natural pastures followed by Napier grass and other fodders. It is unlikely this has change much; given the recent findings presented in Table 1. Further, Napier grass in the year 2003 came out as the most adopted forage especially in dairy intensified areas contributing up to 40 % of the forage in central Kenya (Mwangi and Wambugu, 2003) which is not far from the value presented in (Table 2). What is presented as improved pasture (Table 3), therefore, most likely include Rhodes grass following also the recent survey (Table 1).

Table 3: Area of natural and planted fodders in some districts.

Province/ District	Natural pasture ('000 ha)	Improved pasture ('000 ha)	Napier + other fodder ('000 ha)	Fodder Trees ('000)	Legumes (ha)
Rift Valley					
Nakuru	261	32	5	-	170
Trans Nzoia	64	10	2	<1	-
Uasin Gishu	91	14	5	1	-
Nandi	88	<1	1	<1	-
Central					
Kiambu	-	4	14	-	-
Nyeri	18	3	5	<1	154
Muranga	7	-	11	-	-
Kirinyaga	<1	<1	2	-	
Nyandarua	110	58	<1	-	1,025
Other areas					
Machakos	114	4	<1	<1	-
Kakamega	-	-	3	41	-
Vihiga	<1	<1	1	64	23
Kisumu	-	<1	1	37	3

MoA (1996) district annual reports

Land pressure and high dairy cattle density are important factors influencing adoption of planted forages. It is therefore reasonable to infer that adoption of forage cultivation follows the dairy cattle density pattern as shown (Fig 1). The areas are largely in Western, Central and Coastal Kenya, where further looking at representative known dairy areas e.g. Githunguri (central Kenya) and Transnzoia (western Kenya) show that dairy gross margins have feeds and forages take 70.3 and 27 % of the expenses respectively (Wambugu et al 2011).

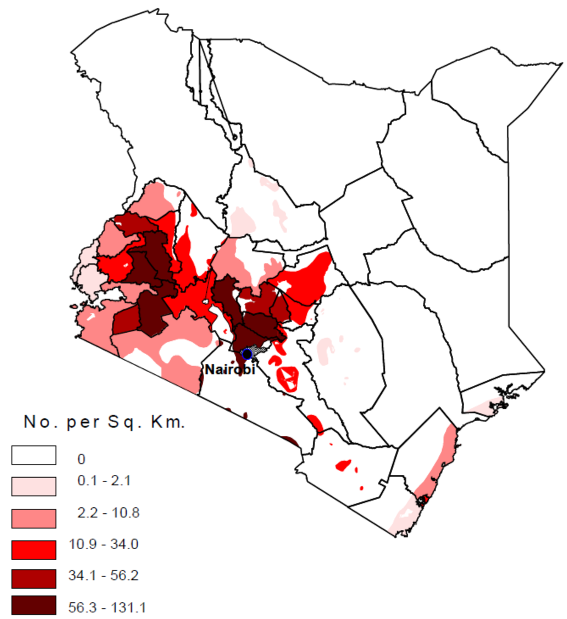

Figure 1. Dairy cattle density in Kenya. Adopted from (Omore et al., 1999)

Annual feed resources requirement in Kenyan humid and sub-humid regions

There is dearth of information on estimated annual forage requirements in the areas, and many livestock keeping areas in general, and confirmed by a more recent conference involving policy makers in livestock sector (MoALF, 2017). In the same setting however, an observation was made on large unmet and expanding markets for fodder with 50-90% annual feed deficit - about 53-57 million tonnes dry matter, which is projected to double by 2035. However, on an account of recent general estimation of annual feed requirement across Kenya (humid, sub-humid and pastoral areas), by FAO and IGAD (2019), we attempt to extract an estimate for humid and sub humid areas based on livestock numbers and daily requirements as in Box 1

Box 1

- Cattle population in Kenya- **20,529,190** (FAO and IGAD, 2019)
- Dairy cattle population in Kenya- **7,200,000** (TIAPD, 2017)
- Therefore, the annual feed requirement for dairy cattle = **16,425,000** tonnes dry matter (DM) (6.25*365*7,200,000)
- Estimated annual forage roughage scarcity (humid and sub humid areas,) is **46%** following various Feed Assessments done with farmers in Kenya high potential showing 54% availability (*Annex 1*)
- Therefore, annual tonnes DM deficit of **7,555,500** = 16,425,000*0.46
- The annual deficit/gap from roughages/forages 70%, (concentrates take 30%) (tonnes DM) = 7,555,500 * 0.7 = **5,288,850 tonnes DM**

Note: *Annual feed requirements are calculated by converting daily requirements into annual (365 days) using the TLU (250 kg body weight) @ 2.5% of body weight per day = 6.25 kg DM per day (70% hay/straw and 30% concentrate),*
I.e. 4.4 kg hay/straw and 1.85 kg concentrate per day.

With growing cattle population, small landholdings and competing cropland allocation, it is apparent innovations, concerted effort and planning are overdue in addressing the already dire situation of cattle feeds requirement. It is unlikely with the forages that have been in use for decades, will on their own bridge the gap. Possibility of using forages that are more efficient in productivity per unit area and quality attributes stand a good chance to complement and close the deficit.

A more recent estimation of fodder deficit in Meru county in Kenya, a county that part of it is good for dairy and is being practiced, while some parts are more dry and therefore semi-arid returned negative livestock feed balance. Based on actual feed availability, the balance (%) stood at -67.9, -78.4 and -91.9 for DM, crude protein and metabolizable energy respectively (Matere et al 2019). For the total actual dry matter (tonnes) availability of 285,038, only 10,162.1 come from cultivated fodders and the rest from other roughages, concentrates, acacia and prosopis pod and grazing.

Closing the feed deficit/gap

Given the low use of cultivated forages, it is apparent increasing forage cultivation could contribute to addressing the livestock feeds short fall. This is more so if use of improved forages is considered, embraced, and put into practice. Improved forages present advantages including better utilization i.e. digestibility coupled with better-feed conversion efficiency and increased dry matter yield. For example, use of *Brachiaria* that is gaining popularity in Kenya as a basal roughage and constitutes hybrids, cultivars and accessions is a case. Within the region *Brachiaria* produce comparable dry matter yields (Table 4).

Table 4. Potential dry mater production from improved forage grass Brachiaria hybrid Mulato II

Brachiaria hybrid (Mulato II)	t/ha/year	Reference
Ethiopia	8.4-10.1	Wubetie et al 2019
Rwanda	12.42	Mutimura et al 2016
Kenya	10.64	Njarui et al 2016
Kenya	7.5-9.8	*Unpublished data*
Overall average	10.2	

To bridge the dry matter gap using Mulato II Brachiaria hybrid would require forage seeds and land (ha) as stipulated below. Assumption is that Mulato II is harvested 5 times in a year.

Forage	Type	Seed rate (kg/ha)	Potential yield (t/ha/yr.)	Land required (ha)	Forage seeds required (tonnes)
Brachiaria	Perennial grass	5	10.2	518,514.7	2,592.6

The 2593 tonnes of seed assume that if the amount is planted in a year, and for simplicity, only Mulato II, but in reality several improved forages could be adopted simultaneously overtime at varying proportions. Mulato II is a perennial grass that with good management can remain productive up to 10 years. If 10% of the seeds are planted annually would mean 259.3 tonnes of seed, that would need to be sustained for 10 years, after which regeneration would be necessary. Clearly, there is a huge gap and effort needed to bridge livestock feeds deficit in the high potential area in order to increase productivity

Conclusion

Huge livestock roughage deficit exist in high potential areas in Kenya given the prevailing conditions of livestock production. Increase in use and adoption of cultivated improved forages has the potential to close the gap and contribute to increased livestock productivity as shown here. However, capacity building, awareness creation and functional forage seed system are key requisites to make it a reality. The interplay of relevant government institutions and the private sector in sustainability of this endeavor is paramount.

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Annex 1. Mean feed availability ratios between 0-1 from various cattle feeds assessment in various counties in humid and sub-humid regions of Kenya

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	yearly mean	county	Reference
0.28	0.20	0.10	0.20	0.40	0.57	0.56	0.80	0.73	0.65	0.62	0.50	0.47	Women in Oljoro Orok- Nyandarua County	Mwendia et al 2015
0.27	0.23	0.22	0.28	0.47	0.60	0.75	0.78	0.62	0.61	0.58	0.44	0.49	Men in Oljoro Orok- Nyandarua county	Mwendia et al 2015
0.20	0.18	0.32	0.56	0.76	0.73	0.67	0.70	0.50	0.52	0.48	0.38	0.50	Nasewa area, Busia county	Muyekho et aI 2014
0.14	0.13	0.45	0.74	0.74	0.58	0.56	0.59	0.48	0.45	0.20	0.23	0.44	Township , Busia county	Muyekho et al 2014
0.18	0.18	0.41	0.82	0.85	0.72	0.55	0.60	0.58	0.65	0.51	0.30	0.53	Lwanya, Busia county	Muyekho et aI 2014
0.31	0.32	0.59	0.61	0.80	0.80	0.83	0.80	0.72	0.60	0.62	0.50	0.63	Sabatia, Vihiga county	Muyekho et aI 2014
0.30	0.31	0.58	0.62	0.71	0.80	0.91	0.90	0.70	0.71	0.82	0.70	0.67	Wodanga, vihiga county	Muyekho et al 2014
0.41	0.47	0.41	0.65	0.70	0.79	0.88	0.79	0.79	0.73	0.75	0.65	0.67	Sensi ward, Kisii county	Muyekho et aI 2014
0.27	0.22	0.50	0.67	0.55	0.62	0.60	0.63	0.65	0.63	0.60	0.58	0.54	Mwagichana ward, Kisii county	Muyekho et aI 2014
0.41	0.32	0.48	0.58	0.63	0.62	0.55	0.65	0.50	0.43	0.42	0.48	0.51	kisumu North west, Kisumu county	Muyekho et aI 2014
0.33	0.20	0.32	0.67	0.31	0.25	0.29	0.55	0.48	0.49	0.41	0.34	0.39	kisumu central, Kisumu county	Muyekho et aI 2014
0.75	0.70	0.68	0.85	0.82	0.65	0.45	0.35	0.33	0.48	0.75	0.86	0.64	Women in Githongo- Meru county	Mwendia et al 2020 https://hdl.handle.net/10568/110838
0.59	0.58	0.59	0.55	0.62	0.49	0.50	0.34	0.35	0.45	0.63	0.70	0.53	Men in Githongo- Meru county	Mwendia et al 2020
0.35	0.32	0.21	0.44	0.35	0.35	0.36	0.40	0.45	0.44	0.43	0.43	0.38	Women in Riokindo- Kisii county	Mwendia et al 2020 https://hdl.handle.net/10568/110839
0.42	0.43	0.58	0.82	0.83	0.76	0.64	0.75	0.84	0.72	0.75	0.63	0.68	Men in Riokindo- Kisii county	Mwendia et al 2020
0.35	0.32	0.43	0.60	0.64	0.62	0.61	0.64	0.58	0.57	0.57	0.51	0.54		