Fodder commercialization as strategic solution for increased ruminants' productivity and reduced land use conflicts in Tanzania: A review

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Abstract
Forage is the major input in livestock production whose adequate quality and quantity makes it a key component for increased livestock productivity. Natural pastures have been used to feed ruminants in Tanzania over years. Steady growth of human & livestock population, climate change prevalence, and encroachment of pastures through conversion of communal grazing land to wildlife conservation, expansion of crops farming land and areas for construction threaten adequacy and sustainability of pastures. Scarcity of pastures is widely documented as a cause of land use conflicts between farmers and livestock keepers in Tanzania. Measures to address inadequate pastures have been focused on ratification & enforcement of land laws, fair land use plans; and strengthening traditional conflicts resolution mechanisms. Despite the aforementioned efforts, the land use conflicts are still existing. Likewise, livestock are affected more during the dry season that leads to low productivity parameters. Therefore, this review paper advocates commercialization of fodder production to improve productivity of ruminant animals and mitigate land use conflict in Tanzania. The paper employed scoping literature review approach of Arksey and O'Malley (2005) to map the present literature by using four search queries namely; declining Tanzanian communal range lands, land use conflicts, fodder production technologies & profitability of fodder production from reliable sources. The review study shows that there is massive

potential to produce fodder commercially with promising profit margins which can significantly contribute to improved ruminants' productivity and reduction of land use conflicts. However, further pasture production research for cost-benefit analysis and market need to be done to ascertain the commercial pasture business concept in Tanzania.

Background

Forage based ruminant production system has long been practiced among small-holder livestock farmers in Tanzania due to its affordability as it provides animal feeds from nature compared to other animal production systems. However, steady growth of human & livestock population, climate change prevalence; and encroachment of pastures through conversion of communal grazing land to wildlife conservation, crops agricultural land & expansion of areas for construction threaten adequacy and sustainability of natural pastures.

Human population in Tanzania was projected to increase from 57.6 million in 2020 to 77.5 million in 2030 and 89.2 million in 2035 (URT, 2021). Based on Beghin (2015) estimation of per capita food demand requirements of 187kg grains equivalent per annum; the nation will require 16,680,400tons/year grains equivalent in 2035. This will necessitate Tanzania to expand its agricultural land from 5,151,549ha in 2020 to 10,803,367ha in 2035 based on World bank (2018) yield of 1544kg/ha in Sub Saharan Africa context. The increased area for agricultural expansion is equivalent to 376,787ha per annum. Apparently, this is huge amount of land that will reduce pasture land in communal grazing land. In turn the increased human population will demand more of animal foods which are needed to serve the growing human population. Meanwhile livestock population has increased at annual growth rate of 2.7% for the last five years (URT, 2021,

2018) URT, 2021, 2018; MLFD, 2017-2021) that necessitates more pastures to feed the increased animal population.

Climate change vagaries have aggravated the challenge of pastures availability. Livestock death due to drought accounted for 30.6% of the herd value among livestock keeping communities in northern Tanzania (Ahmed et al., 2019). Number of days for 'long rain season' in northern Tanzania declined from an average of 100 days in 1960 to 63 days in 2010 (Kihupi et al., 2015) that in turn lessen available pastures. Tanzania's annual rainfall varies spatially among different agroecological zones. Hamisi (2013) indicated mean rainfall across regions ranging between 750 -1750mm/year. The general trend of rainfall is projected to decrease in south west and west regions of Tanzania (Luhunga et al., 2018) and along coastal regions (Mahongo and Francis, 2012). Borhara et al. (2020) also revealed the declining pattern of rainfall during rainy season (March, April and May). The estimated dry season amounts to six months per annum. The national rainfall declining trend seasonal variability signify the importance of fodder crops farming rather than depending on natural pastures.

Equally important, encroachment of pastures by conversion of communal grazing land to wildlife conservation, crops agricultural land and/or private ownership for agricultural land increases reduction of communal grazing land (Archambault, 2016). The Tanzanian game reserve expansion and appropriation of customary land for small - and large-scale crops farming contributed to shortage of grazing land (Martin 2010; Mwambene et al., 2010).

Pastures inadequacy leads to limited animal production potentials and land use conflicts. Low production coefficients for cattle were noted by Kamugisha (2015) with elongated calving intervals of 30 – 40 months, calving mortality rate of up to 20% and slaughter age of 6-7 years. These coefficients are relatively low compared to the national recommended production coefficients of calving interval of 18-24 months, calf mortality rate of less than 10% and slaughter age of 2-3 years. Similarly, insufficient pastures are acknowledged to be a main cause of land use conflicts among crops and livestock farmers in Tanzania (Thornton, 2010; Mandara et al., 2012; Mwamfupe, 2015; Mwasha, 2016; Rweyemamu, 2019).

A number of studies on fodder industry in Tanzania exists. Nevertheless, the present studies are aligned to fodder patterns for dairy farming (Lukuyu et al., 2016; Maleko et al., 2018; Waziri and Uliwa, 2020), patterns/trends of fodder availability in natural and communal pastures (Njau et al., 2013; Babune and Mshuda 2018; Ruvuga et al., 2021) and associated negative effects of fodder variability in dry seasons (Paul et al., 2020). To the author's knowledge, there is no research that established commercialization of fodder production commercialization to improve animals' productivity coefficients and/or resolve conflicts among crops and livestock farmers. Therefore, this paper bridges this knowledge gap by assessing economic viability of fodder sector commercialization in order to contribute in meeting forage demand, improve livestock yields and contribute in reducing land use conflicts between farmers and livestock keepers in Tanzania. The information from this paper caters for informed decision making to policy makers, investors and other stakeholders who are interested to invest in the fodder industry.

Methodology

A scoping literature review using Arksey and O'Malley approach of 2005 was used to map evidences regarding the research questions at hand. Inclusion criteria was based on the research questions at hand. The reviews involved study search queries including: declining communal range lands, land use conflicts, fodder/forage production technologies, profitability of fodder production. Actually, literature review consulted between 1998 to 2022. Four search engines used to search literature namely google scholar, PubMED, Science Direct and JUSTOR to locate the relevant literature on journal articles, book chapters and diverse reports, policies and regulatory framework on forage industry. These bibliographic databases are known for their status in scientific communities.

Projections of forage demand assumed that forage daily requirements are 2.5%, 3.5% and 4.0% of the live body weight for cattle, sheep and goats respectively (Lyons et al., 2011). Furthermore, body weight for cattle, sheep and goats were based on the average weight of 300kg, 20kg and 27kg for cattle, sheep and goats respectively (Shirima et al., 2012; Hyera et al., 2021). Then, projection of forage demand requirements was done using simple demand regression projections technique.

Literature review

Challenges of inadequate pasture in Tanzanian livestock industry can be traced back to 1980s resulted from increasing livestock population (Kidunda et al., 1988). A number of initiatives to address scarcity of forage resource base were devised by different stakeholders. The government has enacted various laws and guidelines to govern feeds and pastures; and devised numerous

programs to improve the forages subsector. NGOs and other development partners in cooperation with governments also run different programs on forage industry to improve animal production. Likewise, scientists came up with different technological innovations to improve availability of forage for sustainable livestock production.

The government initiatives include: The Livestock Modernization Initiative of 2015 that identifies improvement of feeding livestock through forage production and management as the priority areas. This is further stipulated in Tanzania Livestock Master Plan 2017/18 – 2021/22 (URT, 2017) whereby fodder production has been itemized as important area of private investment. The plan welcome investment to 150 farms of at least 50ha to stabilize the dairy sector. Moreover, within the same Livestock Master Plan, increased meat production was projected to be associated with promotion of fodder production to at-least 5% of the pasture requirements. Other initiatives include various policy and regulatory frameworks established to govern the forage sub-sector. These regulatory frameworks include (1) Grazing Land and Animal Feed Resources Act 2010. In its part III, Caps 16-19, the Act establishes grounds of safeguarding, developing and managing demarcated village grazing land. National Livestock Policy (2006) emphasizes sustainable utilization of range lands to meet quality and quantity requirements of livestock mainly in the dry season through establishment of livestock infrastructures in range land areas, formation of livestock farmers' associations and promotion of inventorization and management of rangeland resources. (2) To set aside pasture land in various parts of the country. As of 2020, three million hectares had already been set for pastures in different districts of the country (URT, 2021). In

additional to that, the government through National Ranching Company has set aside 122 plots Equivalent to 59,290 acres of land for livestock renting on short term and long-term bases. As of 2019; 92 plots were rented whereby 31,356 livestock equivalent units were fed (MLFD, 2019/20). However, the existing initiatives to improve rangelands suits more on communally owned grazing land and little is said on commercializing pasture farms. This might be due to the fact that commercializing fodder production is just like other private investments and is regulated through private investments or rather, there is inadequate experience of pasture commercialization to be regulated in the country.

Scientists and researchers have come up with number of innovations to address scarcity of pastures. The scientific innovation include promotion of establishing private pastures among beef producers (Rudel et al., 2015; Ates et al., 2018); utilization of crop residues during the harvest season (Alphonce, 2017; Bogale et al., 2018;); fodder conservation and improved feed technologies (Maleko et al., 2018); and harvesting and conserving hay and silage during the rainy season to be used during the dry season (Alphonce, 2017). However, a number of authors have documented low rate of adoption of the innovation application among livestock farming communities (Ndah et al., 2017). Other innovations include controlled grazing & introduction of improved seeds to the communal pastures (Kenfo, et al., 2018; Tadesse et al., 2015; Nziku et al., 2017) and supplementation of animals with other feeds (Mayberry et al., 2018; Nampanzira et al., 2017). However, these practices meet the feed requirements during the rainy season or they are expensive for smallholder farmers to afford given small pieces of land owned (Ndah et al., 2022).

Actually, utilization of crop residues is limited by the fact that availability of residues is seasonal to sustain profitable ruminant production all the yearlong. Meanwhile, conservation of harvested pastures is limited by the huge amount of capital to be invested in the technology.

The recommendations to address land use conflicts from various authors focused on ratification and enforcement of land laws, sustainable and fair land use plans among crops and livestock farmers and strengthening traditional conflicts resolution mechanisms (Mwasha, 2016; Saruni et al., 2018; Rweyemamu, 2019). As a matter of fact, specialization in economic activities with competitive advantage would yield robust results among economic agents than one economic agent be involved in several activities as suggested by several authors. Therefore, this review paper sheds light on fodder commercialization investment potential to address inadequate pastures for sustainable meat production in Tanzania.

Actually, fodder farming has proved to be profitable in other tropical regions mainly Sub-Saharan Africa (Table 1). Paul et al. (2020) noted that introduction of new herbaceous legumes, managing of planting methods & application of fertilizers; intercropping of forages with food crops; and supplementation of herbaceous legumes improved household economic status by tripling household revenue; increased crops & stover yield in SSA by 60% & 33% respectively. Authors further noted that introduction of legumes improved milk yield, dry matter intake and nitrogen content of manure quantity by 39%, 25%, 24% and 12% respectively among dairy farming communities. Similarly, the fodder business in Kenya revealed to be profitable with the Cost Benefit Ratio of 1:1.73 (Ouma, 2017). In Ethiopia, Rhodes

grass production was found to be more profitable by 4 times, 1.25 times 1.27 times compared to barley, tomato and wheat production respectively under irrigation schemes (Tolera, 2017). In Tanzania, forage production has been observed to be profitable amounting to 15% profit margin which is equivalent to USD0.18/kg in northern Tanzania (Waziri and Uliwa, 2020).

Table 1: Profitability indicators of fodder production in Sub Saharan Africa

Author	Country	Profitability indicators
Paul (2020)	Sub-Saharan Africa	Tripled farmers' income, increased crop yield by 60% and raised stover yield by 33%
Ouma (2017)	Kenya	The cost benefit ratio of 1:1.73
Tolera (2017)	Ethiopia	Rhodes' production is profitable by 400%, 125% and 127% compared to barley farming, tomato farming and wheat farming respectively
Waziri and Uliwa (2020)	Tanzania	Gross margin of 15%

Observations

Tanzanian Fodder Industry

In Tanzanian context, livestock are fed in communal lands whereby during the dry season, pastures become scarce and animals are poorly fed which in turn impair their productivity potentials. Lukuyu et al. (2016) noted a small proportion of population engaged in fodder supply chain in the dairy production regions of Mwanza, Morogoro and Tanga. Indeed, Mbwambo et al. (2016) noted a serious scarcity of feeds whereby, currently the

feed production in the country meets only 26% of the national feed requirements. The study also projected that in 15years to come, if no interventions are made, our business-as-usual feeding production systems will be able to produce only 15% of the livestock feed requirements (Table 2)

Table 2: Estimation of national feed requirements

S/N	Feeds parameters	Average per year
1	Current feed available (tones DM)	20,964,780 ± 12,206,277
2	Current feed requirements (tones DM)	80,557,716 ± 0
3	Current feed balance (tones DM)	(59,592,936 ± 12,206,277)
4	Proportion of current feed requirement available (%)	26 ± 15
5	Projected feed requirements in the next 15 years (tones DM)	139409,651 ± 0
6	Projected feed balance in the next 15 years (tones DM)	(118,444,871 ± 12,206,277)
7	Proportion of future feed requirement available under Business-as-Usual scenario (%)	15 ± 8.5

Source: Mbwambo et al. (2016).

Apart from communal grazing land, Tanzanian livestock farmers also feed their animals with fodder crops in terms of hays and silage. However, the hays & silage production is practiced by large scale farms including parastatal organization and private sector farms. These farms do not farm fodder as their main business but rather, they produce for their dairy farms and sell surplus of their farms' requirements. A number of government and private farms exists (Waziri and Uliwa, 2020). Appendix 1 and Appendix 2 indicate the hays production for the last five years. It is estimated that more than 1,000,000 bales of hay are

produced annually from government and private fodder farms (MLFD speeches, 2016/17-2021/22). Yet, in the last two years hay production has declined significantly mainly in the private farms to about 500,000 bales per annum (Appendix 2). The national forage supply amounts to 1,000,000 bales per annum (Appendix 2). Yet, the fodder industry in Tanzania is still infant. Limited number of fodder value chain actors in the upstream nodes are concentrating to supply the dairy sector in northern and Lake zones. For example, Lukuyu et al. (2016) found that substantial (57%) proportion of fodder market actors were consumers, whose one-third depended entirely on purchased fodder. Fodder traded in Tanzania were found to have been collected/gathered from open communal land and were meant for dairy farming businesses. Meanwhile, fodder producers are small scale who sell fodder as surplus to what they produced for their animals' consumption. Waziri and Uliwa (2020) noted that only one commercial producer of fodder exists in North-Eastern Tanzania known as KIKULETWA FARM Ltd specialized in fodder production as her main business. The farm had a capacity to produce five MT per day of maize hay though she still under utilizes the farms' capacity to the tune of less than ten percent of its installed capacity. Actually, this presents an opportunity for investors in the sector to reap the benefits.

Waziri and Uliwa (2020) noted that fodder supply chain is composed of *six nodes* in the country. The first node is composed of international companies (Heifer international, ILRI and CIAT) which import forage seeds and sell them to various forage producing farms. The second node of the chain contains Research & Development; and input supply performed by Tanzania Livestock Research Institutes (TALIRI). In the course of their

roles to conduct research, TALIRI also produce forage to feed the downstream actors. Likewise, these farms are also involved in dairy farming such that most forages produced are mainly used for internal farm use. The third node entails TALIRI, commercial ranches and other small & medium forage scale farms who are involved in the hay production. These farms either supply hay to local consumers (domestic dairy farmers and live animal exporters) or export forages to the exporting countries such as Algeria and Saud Arabia; which forms the fourth, fifth and sixth nodes of fodder supply chains. Similar findings were found by Lukuyu (2016) who found that less than 10% of fodder markets were composed of fodder producers. Accordingly, 57% of fodder market actors are composed of consumers which signify the growing demand of forage in Tanzania.

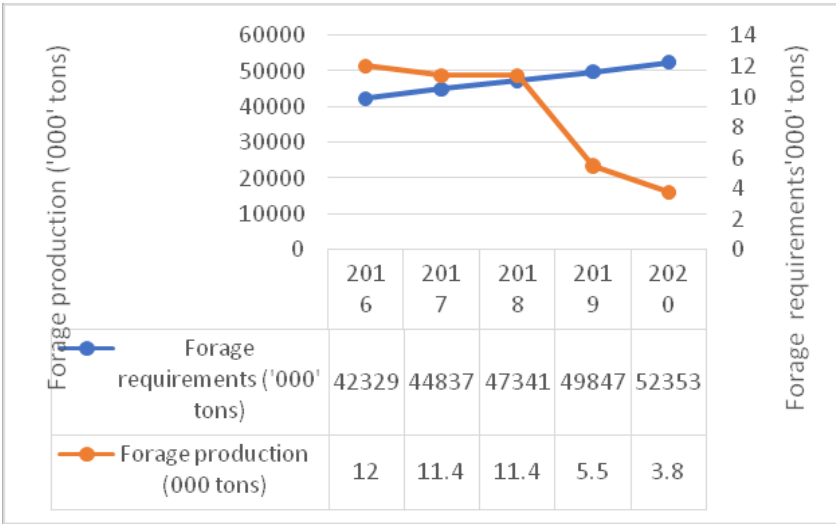
It can be concluded that the fodder industry in Tanzania is still at its infancy stage compared to other East African countries such as Kenya whereby fodder producers are smallholder farmers owning less than 10acres of pastures practicing range reseeding (48%), fencing of natural pastures (36%) and practicing both range reseeding and fencing of natural pastures (16%) (Ouma, 2017). Fodder market in Kenya is still underdeveloped as they use blunt technology since hay balling, seed harvesting & drying, bulking and packaging are being executed manually. Yet, the relative development in the sector signifies that, Tanzania can also commercialize the fodder industry and reap benefits out of the investment endeavors.

Estimation of Forage Requirements for Tanzanian Livestock Industry

Forages are acknowledged to be most resource feed base for ruminants among scientific communities. The forages contain cell wall constituent which enables microbial digestion in ruminants (Wilkins, 2000). It is estimated that dairy forage ruminant requirements commands 2.5%, 3.5% and 4% for cattle, sheep and goats respectively (Lyons et al., 2011). Based on Lyons' ruminant forage requirements and number of main domesticated ruminants available in Tanzania (Kamugisha, 2015; Shirima et al., 2012; Hyera et al., 2021; MLFD, 2017-2020), the annual forage requirements have been developed (Appendix 3). The current forage demand deficit is projected to increase (Figure 1). Indeed, availability of pastures throughout a year is still a fundamental challenge in Tanzania (Waziri & Uliwa, 2020).

Actually, forage demand requirement is projected to increase in the next 15 years given the 'Business as Usual (BAU)' situation. The current forage production and demand requirements suggest the widening gap as time elapses (Figure 1). Mbwambo et al. (2016) projected that in year 2032 the forage production systems only will meet 15% of the ruminant fodder requirements. Coupled with increasing population that shall put pressure on natural pastures, it is high time for investors to tap opportunity in forage production endeavor. Figure 1 depicts the current widening gap which is projected to be widened in future. The prevailing widening gap necessitates deliberate efforts for the forage industry to meet the national fodder requirements in future.

Figure 1: The national fodder production and fodder requirements 2016 -2020



Conclusion and recommendation

Commercialization of sustainable forage resource base is the foundation of intensive livestock production system in urban and peri-urban settings, to smallholder farmers with constrained land in rural areas and serve intervention schemes during scarcity and add foreign currency through exports. Given that ruminants animals are herbivores in nature such that forages commands largest part of their feeds, commercialization of forages to both dairy and beef production systems is a necessity. Insufficient natural pastures to meet national animals' feed requirements is evident. This is due to episodes of climate change vagaries, expansion of agricultural lands to meet the growing human population, the increasing livestock population and conversion of communal grazing lands into other investment portfolios.

The current fodder production is done to address inadequate pastures in the dairy subsector. The fodder market lacks inclusion of entire ruminant sub-sector. Actually, the fodder production is mainly done by large scale farms as a surplus to other economic investments. Smallholder livestock farmers are not involved in procurement and consumption of fodder crops that in turn leads to deterioration of animals' health, and even deaths mainly during the dry season. The hampered animal health condition leads to low animal production parameters and hence economic loss to livestock farmers. In the course of looking for solutions to losses, livestock keepers feed their animals on farmers' crop fields; which becomes a source of quarrels and conflicts between crops and livestock farmers.

To address the above challenges, it is recommended to conduct trials on different forage/fodder cultivars' production & estimate their respective profitability performance and; survey research on awareness & perception of willingness to buy fodder crops among ruminant farmers in different agroecological zones of Tanzania.

Trials of producing different forage cultivars will demystify respective profitability performance measures for each fodder type produced. At this point, economic analysis of forage production using irrigation technology compared to a technology which would harvest & preserve abundant feeds during the rainy season and use them during the dry season is necessary. Initially, a combination of three fodder species can be done through agroforestry farming system. This would combine Rhodes & alfaalfa grasses intercropped with Leucaena leucocephala as a tree component in the farm. Actually, forage legume leaf meals have been reported as a rich protein content that could substitute

oilseed meals. Information from these researches will yield investors' guidance to make appropriate decisions for which investment option to venture in. The private sector can be encouraged to invest and formalize the fodder sector and do some inclusive business by employing smallholder farmers in fodder farming by engaging them in out grower schemes. The investments of this kind will contribute to creation of employment for young generation in Tanzania.

Besides, research surveys on awareness & perception of willingness to buy fodder crops among livestock farmers will provide knowledge on what is currently hindering these farmers to engage in purchase of fodder crops during the dry season. It is currently unknown as to why do livestock farmers face pasture scarcity during dry periods, yet they don't go for soliciting hays from the market. Is it because hays are too expensive to purchase given the nature of the business (livestock farming) whereby it lacks frequent/cash flow compared to dairy farming businesses? Or their herds are too huge to afford the daily forage requirements. Is it that hays are not available such that even if they need the fodder, the forage does not exist in the market? Coupled with economic analysis of diverse fodder production, trials would help to get information for commercialization of fodder sub-sector to improve livestock production and reduce conflicts between farmers & livestock keepers contributing to making Tanzania a peaceful and economically vibrant nation.

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Appendix 1: Hay production in Tanzanian Government farms between 2015/16 – 2020/21(Bales).

S/n	Name Government farms	Location	Land size (ha)	Hay produced (Bales)				
				2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**
1	Langwira	Mbeya	50	12,600	10,000	16,500	16,830	18,124
2	LMU - Mabuki	Mwanza	85	24,500	9,050	27,000	27,270	27,000
3	LMU-Sao Hill	Iringa	25	15,300	10,000	17,100	22,230	27,400
4	LMU - Mivumoni		85	24,000	25,500	26,400	39,600	-
5	LMU-Ngerengere	Morogoro	5	-	1,350	1,320	1,432	-
6	LRC - Tanga		30	7,500	9,000	10,500	11,550	120,000
7	PRC - Kongwa	Dodoma	75	21,000	22,500	24,000	26,400	4,197
8	Vikunge		115.3	105,000	17,301	26,000	28,080	35,000
9	Kizota		43	12,500	12,900	13,500	-	-
10	TALIRI Mpwapwa	Dodoma	123	42,000	49,200	50,000	55,000	6,687
11	TALIRI Uyole	Mbeya	52	17,500	18,200	19,250	21,175	11,189
12	TALIRI West Kilimanjaro	Kilimanjaro	55	15,000	16,500	18,000	19,800	36,336
13	Magereza Farm	Pwani	295	130,500	132,750	134,100	107,280	-
14	Ngorongoro	Manyara	125	42,000	43,750	44,450	-	-
15	Mkata Ranch		98	33,250	34,300	35,000	39,200	-
16	Mzeri Ranch		125	42,000	43,750	45,500	49,140	-
17	LITA – Tengeru	Arusha	40	-	-	-	16,129	17,899
18	LITA – Madaba	Iringa	10	-	-	-	1,244	4,470
19	LITA -Buhuri	Tanga	20.7	-	-	-	2,375	4,755
20	LITA - Mpwapwa		6	-	-	-	700	
21	NAIC – Usa River	Arusha		-	-	-	-	12,708
22	TALIRI - Tanga			-	-	-	-	890
	Sub -Total			**544,650**	**456,016**	**482,246**	**550, 919**	**326,655**

Appendix 2: Hay production in Tanzanian Private farms between 2015/16 – 2020/21(Bales).

S/n	Name private farms	Location	Land size (ha)	Hay produced (Bales)				
	Private farms			**2015/16**	**2016/17**	**2017/18**	**2018/19**	**2019/20**
1	Idrisa Farm	Tanga	67	19,500	20,100	21,000	-	-
2	Filsin Cope	Tanga	25	6,000	7,500	9,000	-	-
3	Katrin Farm	Pwani	105	45,000	47,250	33,000	-	-
4	Kibaha Farm	Pwani	28	10,000	11,200	9,000	-	-
5	Kibwe Farm	Pwani	57	16,500	17,100	18,000	-	-
6	Laila Agro. Ltd	Tanga	33	9,000	9,900	10,500	-	-
7	Life Service Farm	Pwani	32	9,000	9,600	10,500	-	-
8	Manyara Farm	Arusha	55	15,000	16,500	18,000	-	-
9	Manyara Ranch	Manyara	65	18,000	19,500	21,000	-	-
10	Mbelekelo	Tanga	34	9,000	10,200	12,000	-	-
11	Adam Farm	Tanga	59	16,500	17,700	19,500	-	-
12	Loid farm	Mkuranga	165	64,000	66,000	51,000	-	-
13	Swar Farm	Arusha	75	35,000	37,500	24,000	-	-
14	Msoga Farm	Pwani	120	40,000	48,000	37,500	-	-
15	Nalukwa	Tanga	40	7,000	12,000	12,900	-	-
16	Pingo Farm	Pwani	207	80,000	82,800	65,100	-	-
17	Shempemba	DSM	7	1,5000	2,100	3,000	-	-
18	Tanga Dairy Farm	Tanga	35	9,000	10,500	12,000	-	-
19	Tesha Farm	Pwani	24	6,000	7,200	9,000	-	960
20	Tewa Farm	Pwani	33	9,000	9,900	10,500	-	-
21	Tujikomboe Group Farm	Pwani	25	6,000	7,500	9,000	-	-
22	Umoja Group Farm	Pwani	25	6,000	7,500	9,000	-	-
23	Upendo Group Farm	Pwani	15	3,000	4,500	6,000	-	-
24	Vikawe Farm	Pwani	63	6,000	18,900	19,500	-	-
25	Mafinga Farm	Pwani	25	6,000	7,500	9,000	-	-
26	Farm Base	DSM	55	15,000	16,500	18,000	-	-
27	DED Mbinga	Ruvuma	15	4,000	6,000	6,000	-	-
28	DED Maswa	Shinyanga	30	7,500	9,000	9,900	-	-
29	Hassan Mazirai	Pwani	34	9,600	10,200	10,800	-	-
30	Shoo Farm	Tanga	35	7,500	8,400	12,000	-	-

31	Mtengeti Farm	Morogoro	141	105,000	42,300	43,500	-	-
32	Ana Mkapa Farm	Pwani	145	12,000	43,500	44,400	-	-
33	Msimbichaka Farm	Pwani	23	6,000	6,900	7,500	-	-
34	Kagoma Ranch	Kagera	45	12,600	13,500	15,000	-	-
35	Mabale Ranch	Kagera	45	12,900	13,500	14,400	-	-
36	Sotera Sec. Farm	Pwani	20	4,500	6,000	7,500	-	-
37	Peter Farm	Arusha	34	8,100	10,200	11,700	-	-
38	Magombe	Pwani	-	-	-	-	-	37,500
39	Chabua	Pwani	-	-	-	-	-	500
40	Yahya Mbilu	Pwani	-	-	-	-	-	12,500
41	Malema Farm		-	-	-	-	-	150
	Sub -Total			**656,700**	**684,250**	**659,700**		**54,110**
	Grand total (hays produced in government farms + hays produced in private farms)			**1,201,350**	**1,140,266**	**1,141,946**	**550, 919**	**380,765**

Sources: MLFD reports (2017/18 -2021/22).