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Assessment of factors affecting performance traits of small holder's dairy farms in Benadir region, Somalia

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Abstract
Livestock is the backbone of Somalia's economy. Generally, Livestock species in Somalia have inherent low productivity. The indigenous cattle breed in Somalia include; Gasara, Surqa, Dawara and Boran. In the advent of emerging small scale dairy farming in Somalia, there are introduction of new exotic breeds in the livestock resources of Somalia and this include: Holstein and jersey breeds. The productivity of these exotic breeds is questionable hence ascribed to be affected by the environmental conditions complimented by disease and poor feeding. Therefore, a cross sectional study assessing the factors affecting performance traits in small holder dairy farmers in Benadir region was conducted in December 2019 to February 2020. The study employed probabilistic and non-probabilistic sampling techniques. Five districts (Daynile, Hodan, Karaan, Dharkenley and Wadajir) were purposely selected due to their concentration of dairy farmers in this region while 100 respondents were randomly selected from the five districts. The sample size of the Study was 100 smallholder dairy farms.

The study found out that the average daily milk production of local, Holstein and jersey were7.23, 18.23 and 11.43 litters respectively. The average lactation length of local breeds, Holstein breed and Jersey breed were found out to be 8.31, 6.11 and 7.10 months respectively. The study also estimated the average sexual maturity of local, Holstein and Jersey breeds and found out to be 38.14, 17.14 and 20.18 months respectively. The local breeds had the longest average age at first calving (48.27), and the second longest was jersey (30.13) and the shortest was Holstein breed (27.73). The study also measured the average calving intervals and days open of local breeds, Holstein breed and jersey breed and found it to be 16.73, 12.15 and 13.05 months for calving interval and 109.97, 70.26 and 93.67 days open respectively.

In conclusion, the study found out that Holstein had the highest production and reproduction performances and local breed were low in productivity. Unfortunately, Holstein adaption in tropical countries is very poor due to high temperature. So that study recommends breed improvement is required in order to improve the reproductive efficiency of local cattle breeds through selection from the local herds and then upgrade genetically with selected sires, and simultaneously improve performances traits.

Keywords: *A breed, Heat stress, Holstein Friesians, Jersey, Production & reproduction.*

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I. Introduction

Generally, Livestock species in Somalia have inherent low productivity. The main livestock species in Somalia are indigenous Cattle breeds, Sheep, Goats and Camels. The indigenous cattle breed in Somalia includes: Gasara that is found in the coastal areas with low productivity, light body weight and small in size. Dawara, is another breed of Somali origin and mostly found in the riverine areas, it a dairy animal, heavier body weight with higher body measurements. Surqo, is the Somali Ngana breed of Botswana and it is trypano-tolerant, dual purpose found in the riverine area (Qoryoley and Jilib area). Boran, is mainly for beef, and has heavier body weights, it is found in Trans- Juba and along the borders with Ethiopia and Kenya (MLFR, 1981). In 1989 estimates of the resources of Somali farm animals were 20 Million Goats, 14 Million Sheep, 7 Million Camels and 5 Million Cattle. Animal husbandry is an important activity throughout the country, large percentage of livestock is produced in the marginal rangelands of Central Regions, Somaliland, Puntland and the Southern regions of Somalia. In the collapse of the Central Government and the followed clan conflict situations in 1991 resulted total destruction of existed supporting infrastructures to livestock sector development, and the government run animal breeding programs and small scale dairy farmers that resulted poor animal performance, which had been aggravated by the lack of extension services, researches and proper animal feeds. (Hassan, et. al, 2003). Besides that, commercial dairy farming is picking up in Somalia and the farmers started stocking a

mixture of jersey breed, Holstein and local breeds. The farmers practice natural mating of cross breed bulls and Artificial insemination of imported semen provided by Somali bovine genetics. The major challenges reported by most of the dairy farmers are insufficient and quality hay which proved to be very expensive (personal communication). Unlike the Somali dairy farmers, dairy farming has a long tradition of recording milk yields as a major source of information for evaluating individual cows and the productivity of herds. With these challenges in mind the study strives to retrieve as much information as possible on the factors affecting performance traits in smallholder's dairy farms of Benadir region-Somalia

II. Research Methodology

Study area

Benadir region is one of the smallest administrative region of Somalia and hosts the capital city. it spans between Balcad and Afgoye districts. The region is in the heart of the dairy corridors of Somalia. It has a population of 3 million people and it consist of seventeen districts. The districts sampled include: karaan, dharkeynley, daynile, wadajir and hodan. These districts were selected due to their higher population of dairy farmers.

3.1.2 Benadir map

Research Design

This study was cross-sectional and was conducted between August 2019 to August 2020 the study consist of qualitative and quantitative studies and covered five districts from Banadir region

Research Population

The study population comprised mainly on smallholder's dairy cattle farms in Banadir region. Farms rearing both local and exotic breeds as subsistence and commercial dairy farms were included in this study. Data was collected from five districts in Banadir region of which at total of 100 respondents were interviewed.

Sample Size

The researcher used Slovene's formula to select the respondents of the study from the population; using the following formula:

$$N = \frac{\mathrm{N}}{1 + N\,(e)2}$$

Where n is the required sample size, N is the target population size and e is the standard error or level of significance, which is popularly known to be =0.05 or 5%. For this study, N = 134 and so the sample size was calculated as follows;

$$n = \frac{134}{1 + 134(0.0.5)2}$$

Sampling Procedure

In this study, purposive sampling technique was used at the districts level. These five districts have high number of dairy farms compared to other 12 districts of Benadir region. Dairy farms within the selected districts were listed on small papers, folded and mixed in a bowl where one person picked randomly. In this way 100 dairy farms were randomly selected for the interview.

Data collection tools

A questionnaires was developed and administered to the managers of the selected dairy farms, the information collected in the questioner included: information about factors affecting performance traits in smallholder's dairy farms in Benadir region. The dairy farmers' record was also studied and data retrieved were analyzed.

Pretesting was done on the data collection tools in order to ascertain the ability of the tools to ask for the relevant responses. The justification for establishing the reliability of the instruments is determined by the consistency, relevancy and clarity of the instruments.

Data Analysis

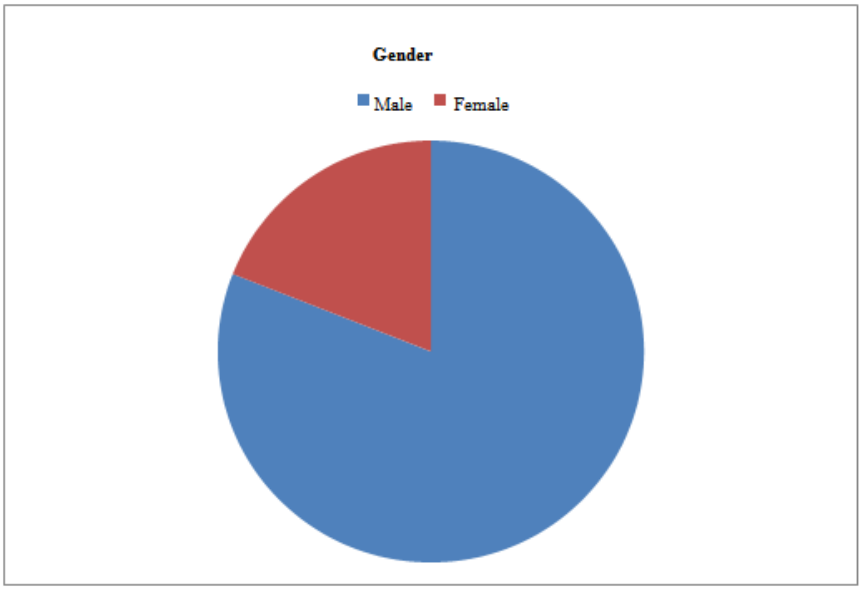
The data collected were entered in Excel and transferred in to SPSS where analysis was conducted.

Ethical Issues

Under this study, the respondents were informed that participation is voluntary so that they can make informed decision to participate or not. The researchers also went with an introductory letter Protecting respondents through data confidentiality also minimizes links between answers and identifiers, to avoid putting respondents in trouble. In addition, the researcher avoided racial or tribal remarks, which are not gender sensitive.

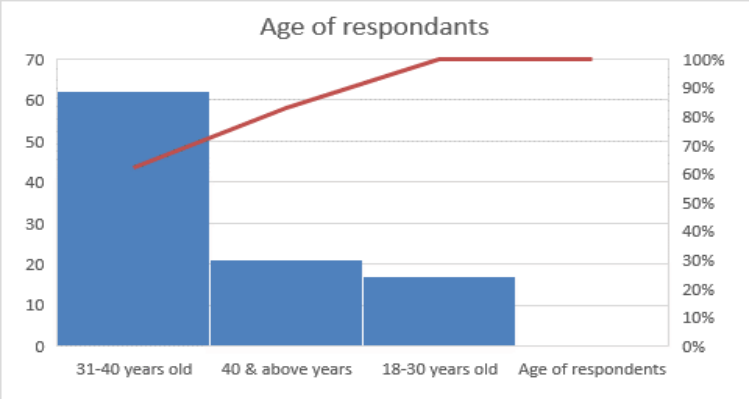
III. Results

Gender categories of the dairy farmers



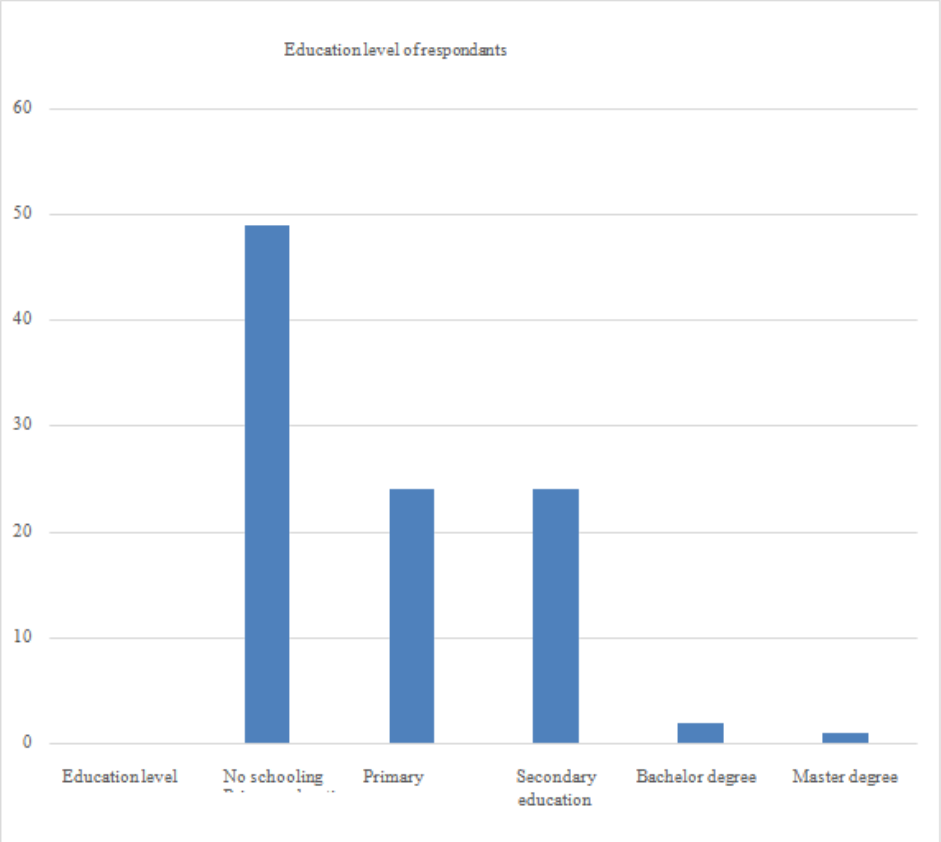
The above pie chart summarized demographics in gender characteristics and shows that 81% of the respondents were male while 19% were females. This indicates that the most respondents of the questionnaire were male, because most farm owners and employees were male due to cultural inequalities of livestock owner ship that exists inSomalia.

Chart 4.2 Age of respondents



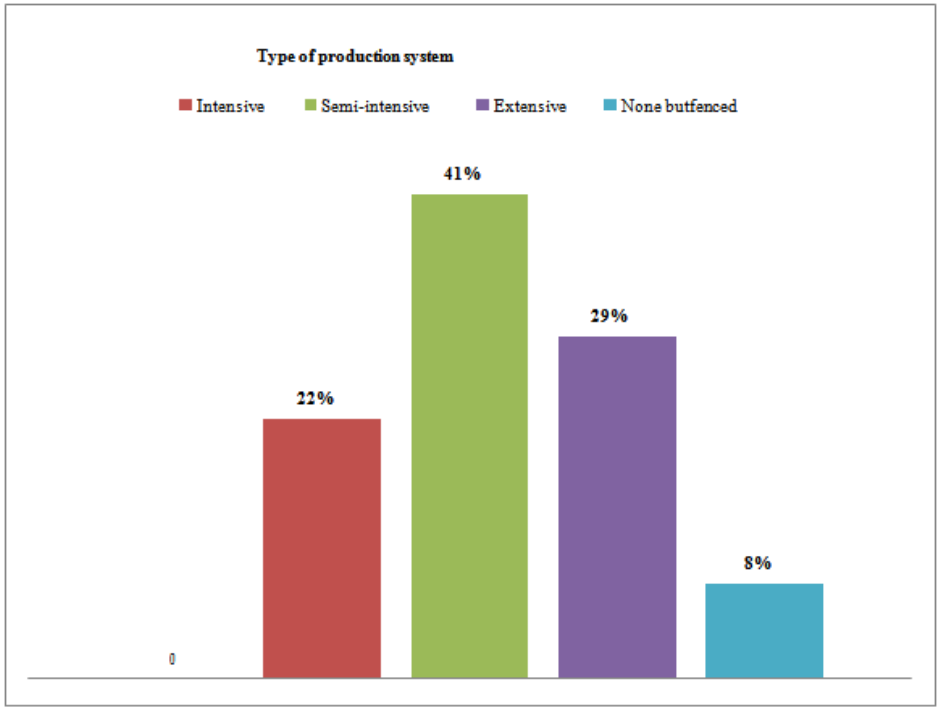
According the above histogram, the majority,sixty-two percent (62%) of the respondents were between 31-40 years old, while twenty-one percent (21%)were above 40 years old, and seventeen percent(17%) of the total respondent aged between 18-30 yearsold.

Chart 4.3 Education levels of responders



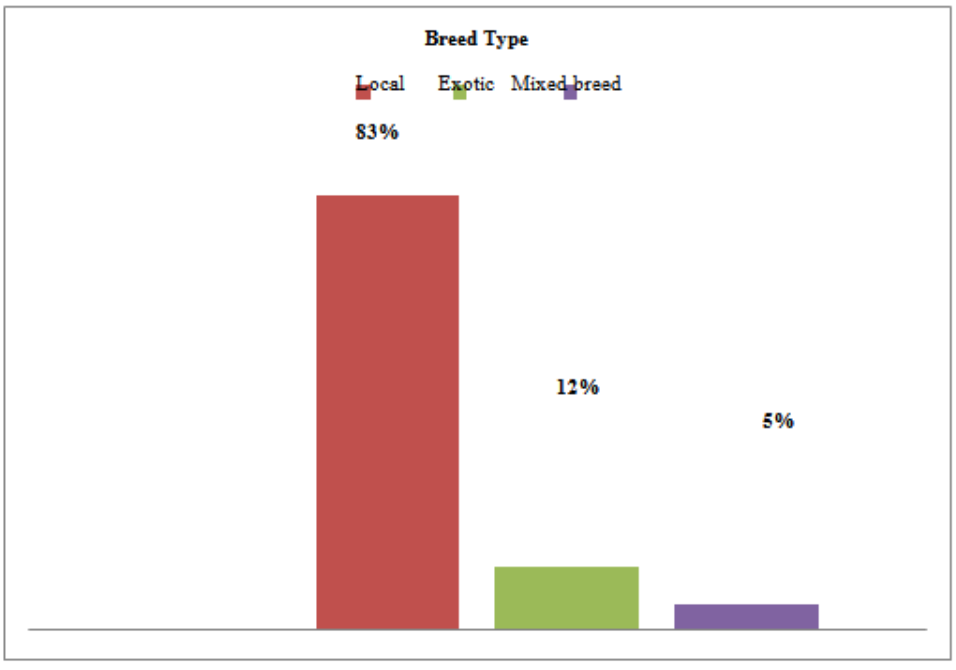
The chart above shows that the researchers classified the levels of education of the respondents into five parts. The majority of respondents forty-nine percent (49%) have not gone to school, while twenty-four percent (24%) had primary education, and twenty four percent (24%) had secondary education and two percent (2%) were of bachelor's degree and finally one percent (1%) master's degree. This shows that most of the respondents were not educated and not professional.

Chart 4.4 production systems and breed type



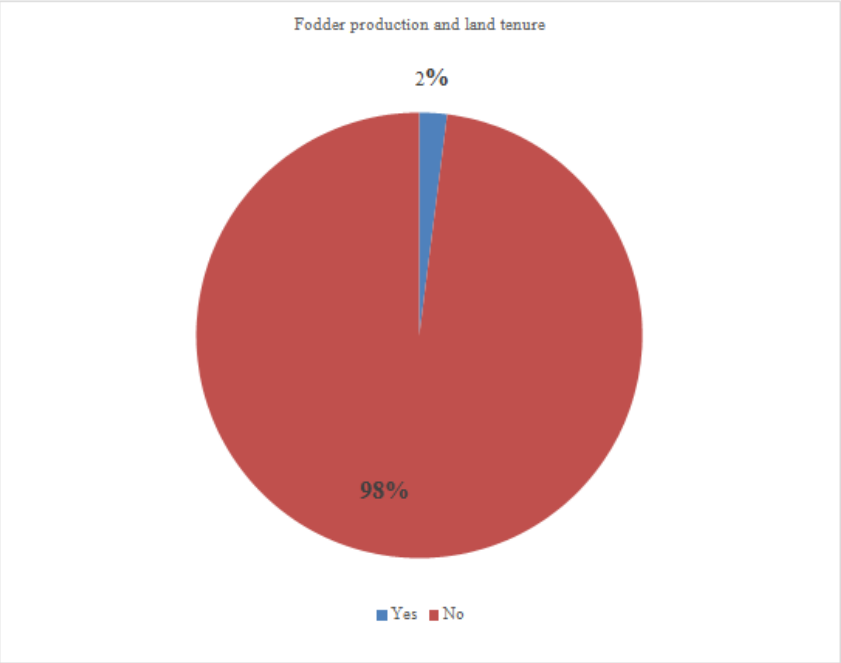
The chartshows that majority of farmers practiced semi-intensive farming (41%), whileextensive farming (29%) followed by intensive farming (22%), only fenced were noticedof (8%) respectively.

Chart 4.5 Breed Type



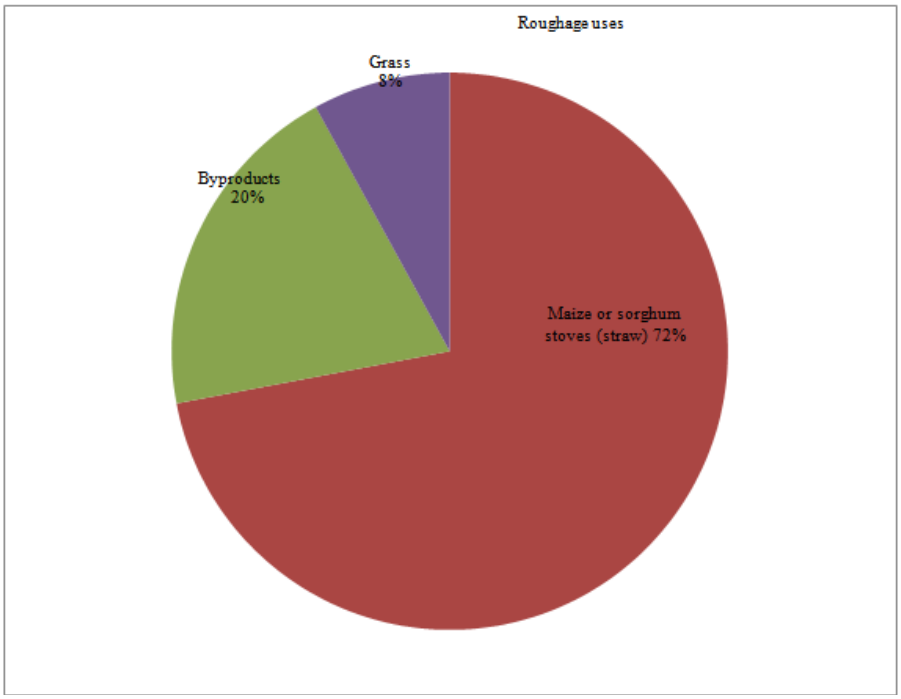
The above chart shows that most farmers eighty three percent (83%) reared local breed, twelve percent (12%) exotic breed while five percent (5%) had mixed breed. The most households were reared indigenous cow while little of commercial dairy farmers reared exotic breeds commonly Holstein and Jersey breeds.

Chart 4.6 Land tenure and fodder production



The data in the above pie chart shows only two percent (2%) of the households in the schemes grew more than 20 hectares of fodder, while ninety eight percent (98%) had no land to engage in fodder production. This result indicates the majority of farmers doesn't produce their animal feed and relay on crop residues. Without fodder production dairy farmers don't maintain their inputs and outputs.

Chart 4.7 Type of roughage uses



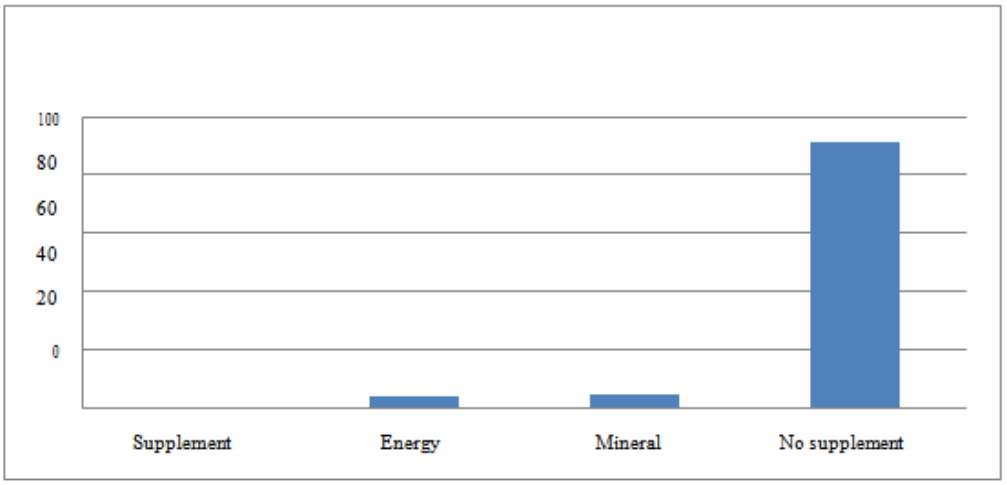
The above piece chart indicates that, the majority seventy-two percent (72%) of farmers used sorghum or maize stoves (straw) as roughage, twenty percent (20%) of farmers used by products as source of roughage while eight percent (8%) of farmers used grasses as roughage feed. The major reason of householders feed their animal for straw is low cost and they prefer sorghum straw. They believe is highest animal feedforever.

Table 4.1 Type of concentrate uses

Concentrate uses	Percent (%)
maize, bran and sesame cake	11
sorghum, bran and sesame cake	16
bran and sesame cake	73

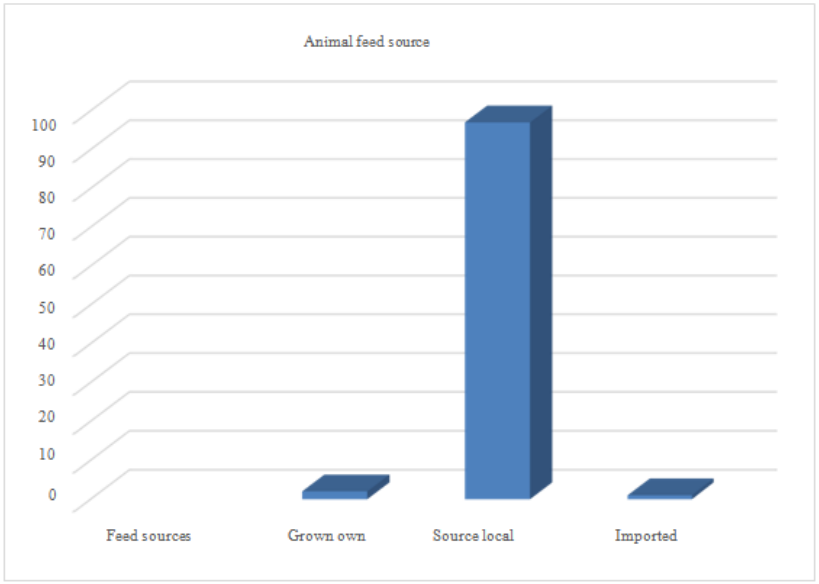
The data in table 4.1 shows the majority seventy-three percent (73%) of farmers' used bran and sesame cake as concentrate, and sixteen percent (16%)of dairy farmers used sorghum, bran and sesame cake as concentrate while eleven percent (11%) of the dairy farmers used maize, bran and sesame cake as concentrate feed.

Chart 4.8 Supplements



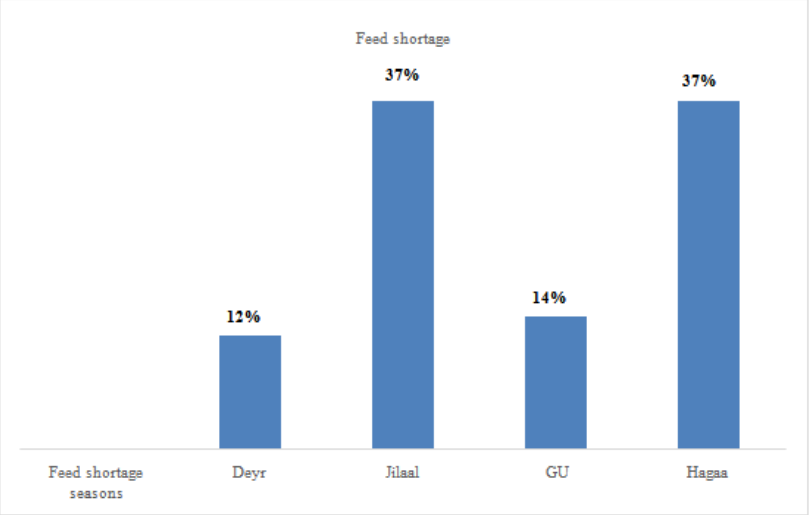
The above histogram shows the majority of farmers ninety-one percent (91%) use no supplement for their dairy cows, five percent (5%) of farmers fed mineral as supplement, four percent (4%) of farmers fed sugar (energy) as supplement. This result indicates the major householders don't use supplement because they don't know the meaning of supplement.

Chart 4.9 Feed sources



As shown in above histogram, the majority of farmers ninety-seven percent (97%) source feed from local producers, two percent(2%) Grow own feed, while one percent (1%)of the dairy farmers imported feed from other countries. Both small householders and commercial dairy farmers buy animal feed in local farmer as by product. They buy animal feed when the farmer harvested the grain commonly maize andsorghum.

Chart 4.10 Seasonal Feed shortages



The above histogram shows that the majority of dairy farmers thirty-seven percent (37%) facedfeed shortage during jilaal and Hagaaseasons while fourteen percent (14%) and 12% of dairy farmersfaced feed shortage in GU and Deyr seasons respectively. Due to the limited crop production practices and increased intensive dairy farming in Benadir region resulting shortage of animal feed and increase in price.

Table 4.2 Impacts of Seasonal feed shortages on dairy farm

Seasonal feed shortages impact on your dairy farm	Percent (%)
Milk Yield	43
Milk Price	25
Body Condition	25
Feed Cost	7

The data in table 4.2 shows the majority of farmers (43%) responded that Seasonal feed shortages impact on milk yield, twenty-five percent (25%) of farmers said Seasonal feed shortages impact on milk price, twenty-five percent (25%) of farmers said Seasonal feed shortages impact on body condition while seven percent (7%) of farmers said Seasonal feed shortages impact on feed cost. This result indicates feed shortage has direct negative impact on dairy cows.

Table 4.3 Herd size and composition of local breeds that corresponds almost 83% of the total population.

Herd size	Total	Percent (%)
Lactation cows	490	21.25
Dry cows	1298	56.29
Heifers	321	13.92
Bulls	197	8.54
Totalherd	2306	100

The data in table 4.3 above shows the herd composition of the total local cows in Benadir region, 21.25% were lactating cows, 56.29% Dry cows, 13.92% Heifers and 8.54% bulls. This excludes the exotic breeds in Benadir region.

Table of 4.4 herd size and composition of Holstein breeds

Herd size	Total	Percent (%)
Lactation cows	98	24.87
Dry cows	118	29.95
Heifers	107	27.16
Bulls	71	18.02
Totalherd	394	100

The data in table 4.4 above shows the herd composition of the total Holstein cows in Benadir region, 24.87% were Lactating cows, 29.95% Dry cows, 27.16% Heifers and 18.02% bulls. This result was collected from 17 small householders and commercial dairy farmers in Benadir region. These 17 farmers were reared both mixed and exotic cattle.

Table 4.5 herd size and composition of jersey breeds

Herd size	Total	Percent (%)
Lactation cows	3	15
Dry cows	6	30
Heifers	11	55
Bulls	0	0
Totalherd	20	100

The data in table 4.5 above describes the herd composition of the total jersey breed in Benadir region, 15% were Lactating cows, 30% Dry cows, 55% Heifers.This result was collected 17 small householders and commercial dairy farmers in Benadir region. These 17 farmers were reared both mixed and exotic cattle.

Table of 4.6 Mean Production and reproductive Parameters of local and exotic breeds

Breeds	Milk L/d/cow	LL(months)	maturity (months)	AFC(months)	CI (months)	Days open
Local	7.23	8.31	38.14	48.27	16.73	109.97
Holstein	18.23	6.11	17.14	27.73	12.15	70.26
Jersey	11.43	7.10	20.18	30.13	13.05	93.67

LL (Lactation Length), AFC (Age First Calving), CI (Calving Interval)

Average milk production and lactation length

The data in table 4.6 shows the meansof daily milk production of the local cattle; Holstein and Jersey breeds were 7.23, 18.23 and 11.43 litters respectively. Lactation lengths of the local cattle, Holstein and Jersey breeds were 8.31, 6.11, 7.10 months of lactating period respectively. The average daily milk production of the local breeds differ greatly(7.23 litre), from the exotic Holstein and Jersey(18.23 and 11.43 litre) respectively, although Jersey is somehow close to local breeds in milk production. Jersey is relatively adapted to the hush environmental conditions of Somalia.

Age of Maturity (months)

The data in table 4.6shows the average of age of maturity of local breeds, Holstein breed and jersey breed were 38.14, 17.14 and 20.18 months respectively.

Age of first calving (months)

The result of the age at first calving data gathered during the study (table 4.6) shows that the mean age at first calving of local breeds, Holstein breed and Jersey breed were 48.27,27.73 and30.13 months respectively.

Calving interval (months) and Days open

The mean of calving interval of local breeds, Holstein breed and Jersey in Benadir were 16.73, 12.15 and 13.05 months respectively and days open 109.97, 70.26 and 93.67 days respectively.

Table 4.7 Heat stress, Management of HS and challenges

Heat stress	Type ofbreed	Percent (%)
Yes	Exotic breed	18
No	Local breed	82
Management of HS		
Proper housing	Local breed	86
Automatic or manual bathing	Exotic breed	14
Particular seasons experience HS		
Deyr		13
Jilaal		83
GU		3
Xagaa		1
Challenges		
Diseases		37
lack of knowledge		50
high cost of feed		13

Heat stress

The date in table 4.7 describe that the majority of farmers 82% reared local breed and are not affected by heat stress while 18 % of farmers reared exotic breed that suffer heat stress.

Particular seasons experience HS

The data in table 4.7 the majority of farmers 83 % experience heat stress in jilaal season due to high temperature, 1 % of farmers experienced heat stress in Hagaa, 3% of farmers experience HS in GU season, while 13% of farmer experienced heat stress in Deyr Season.

Management of Heat Stress

The data in table 4.7 shows that the majority of farmers 86% mange heat stress using by a proper housing while 14 % of farmers mange heat stress using by Automatic or manual bathing.

Challenge face both local and exotic breed

The data in table 4.7 shows that the majority of farmers 50% had lack of knowledge, 37% of farmers reported Disease as a challenge while 13 % claim high cost of feed as a challenge.

IV. Discussion

During this study 100 smallholder's dairy farms in Benadir region were interviewed usingquestioners. Thus; in this study only 2 % of the smallholder's dairy farmers grew fodder for their dairy farms, while 98% depended on fodder purchased from markets. The present study reports less than to that report by (Lewa, 2013)who found that 14 % of small scale commercials dairy farmers in Rusitu resettlements areas grew morefodder than their dairy requirement.

In the present study the majority 72% of farmers used straw as roughage, 20% of farmers used by-products as source of roughage while 8 % of farmers used grasses as roughage feed. The study is in line with what was reported by (Kamal et,al., 2019) which indicates that 61.3%farmergaveroadsidestrawandgrassasthesourceofroughagewhile30%gavecultivated fodder as the source of roughage. However, the present study is similar to the report in Somalia by(Hassan, et al, 2019)that the respondents mostly (67%) used roughage as straw and concentrate together, only concentrate feeds were (12%),while those used grass for feeding were(15%) and those use combinations of all ingredients were (6%).

The majority, 73% of farmers' used bran and sesame cake as concentrate, 16% used sorghum, bran and sesame cake as concentrate while 11% of exotic farms used maize, maize bran and sesame cake as concentrate feed. This study is in line with the study reported by (Togtokhbayar, 2015), which indicated that Treatments were fed as a total mixed ration consisting of 25.4% corn silage, 23.1% grass silage, 11.6% grass hay, and 39.9% concentrate on a dry matter basis. The majority of farmers in this study 91 % used no supplement for their dairy cows, 5% of farmers fed mineral as supplement, 4% of farmers fed sugar as energy supplement. Unlike to this BojanStojanovic, 2014 reported that milk production of high producing grazing dairy cows in early lactation increases linearly as the amount of concentrate increases to 10 kg DM/day with a milk response of 1 kg milk/kg concentrate. In late lactation, increases are with a lower milk response per kilogram of supplemented concentrate.

This study also found out that 97 % farmers source animal feed from local producers, 2 % of farmers feed from Grow own animal feed, while 1% farmers imported from other countries. Similarreport by (Muhammad, 2014) indicate that, crop residues (26.5%) and natural pastures (26.5%) as the most common feed resources across the three grazing system followed by elephant grass.

In the present study the averages of daily milk production of the local cattle breed, Holstein breed and Jersey breed were 7.23, 18.23 and 11.43 litters respectively. And lactation lengths of the local cattle breed, Holstein breed and jersey breed were 8.31, 6.11, 7.10 months of lactating period respectively. The present study is similar to that report (Hassan etal, 2019) that the averages mean of milk production and lactation length of the local cattle breeds were 8 litters and 7.7 months respectively. On other hand; in tropical region Holstein and jersey breed milk production range between3463.71 and 2187.51kg/ yr. respectively and lactation length were 205.95 and 321.28 days respectively (Areias, 2013). This wide gap in milk yield was partly due to the management under which the animals were kept and partly due to the harsh environmental conditions common in tropics and subtropics rendering the milk yield lower. Lactation milk yield of Holstein under temperate environmental conditions ranged from 8153±1949.24 kg to 10069 kg (Seykora, A.J.and B.T. McDanial,, 1983), (Campos etal, 1994), (Gonzalez, R.O. and R. Alenda, 2005). Under tropical and sub-tropical conditions, the lactation milk yield ranged from 2772.76±65.00 kg to 7454±2134 kg (Preez, et, al.1990) reported that Milk yield decreased about 10 to 40% in exotic breeds during the summer as compared to the winter. This is evident from the fact that milk production is widely different even under the same environmental conditions but different management system. Beside inadequate environment, substandard nutrition including poor roughage

quality, low concentrates feed inputs and the high incidence of disease and parasites which are common under these conditions predisposes the animals to low profitgeneration (Singh etal, 1997).

In the present study the average means of age of maturity of local breed, Holstein breed and jersey breed were 38.14, 17.14 and 20.18 months respectively. Similar to what was reported by (Hassan etal, 2019)The result of age at first conception in this study was 37.9month that is higher than 27 months that was claimed by Nuraddis and Ahmed2017 who studied reproductive traits of crossbreed cattle under Ethiopian condition, this mean is also longer than the 24.3-month cross breed age at puberty (Zebu*Holstein) in Jimma town, Oromia State, Ethiopia reported by (Duguma, et, al. 2012).

The mean age at first calving of local breeds, Holstein breed and Jersey breed was 48.27, 27.73 and 30.13 months respectively. Similar to study by (Hassan etal, 2019)the result of the age at first calving from the data gathered illustrates that the mean age at first calving was 49.32,similar to Jersey breed reported by Subramaniam, 2016. Mean age at first calving was 41±10 months. And also Similar to Holstein breed reported by (Sattaretal, 2005)the average age at first calving in 190 Holstein-Friesian heifers was 987.87 ± 9.81 days, ranging from 701 to 1483days.

The mean of calving interval and day's open of local breeds, Holstein and Jersey breeds in Benadir were 16.73, 12.15 and 13.05 months respectively and 109.97, 70.26 and 93.67 days open respectively. Similar report by (Hassan et. al, 2019) reveals the meanofcalvingintervalanddaysopenoflocalbreedsinBenadirwere19.15monthsand98.8 days respectively. Similar Holstein report by (Wondossen et,al., 2018)for calving intervalanddaysopenshowedthatthemeanCalving IntervalandDays Openwere469.2±7.9and179.9 ± 6.8 days respectively. Similar to Jersey report (Subramaniam, 2016)Calving Interval in the present study the overall least square mean of calving interval was 431.41 days and the mean days open was 156±123 days respectively.

Similar study of Holstein (Sattaret, al.2005) the average calving interval for 361 records was505.02 ± 8.28 days, ranging from 317 to 1098 days and the mean days open was 2,773 days respectively.

In the present study the majority of farmers 82% reared local breed that had adopted heat stress while 18 % of farmers reared exotic breed and were affected by heat stress. Similar report by (Misztal, 2002) which indicated the effect of Environment and genetic (G x E) interaction plays an important role in the expression of the full genetic worth.

In the present study the majority of farmers (37 %) face animal feed shortage in jilaal followed by feed shortage in Hagaa season (37 %), feed shortage Gu' (14%), Deyr season (12%). Similar report by (CARP, 2014)indicated that natural forages and crop residues were available in Ilemela district from January to July.

Different types of crop residues were available starting from February to July. In addition, crop residuals were plenty between April and July. Forages and crop residues become scarce as from August to December. Although there were adequate forages during wet season, the respondents noted that feed availability for cattle was obstructed by crop fields.

In the present study the majority of farmers 83 % experienced heat stress in Jilaal season due to high temperature, 1% of farmers experienced heat stress Gu, 3% of farmers experience season Haga, while 13% of farmer experienced heat stress in Deyr Season. Similar report by (Vale, 2007). However, air temperatures above 20-25°C in temperate climate and 25-37°C in a tropical climate like in India, it enhance heat gain beyond that lost from the body and induces heat stress. Similar report by (West, 2003), which indicate modifications including shade, barns which enhance passive ventilation, and the addition of fans and sprinklers increase body heat loss, lowering body temperature and improvingDMI.

New technologies including tunnel ventilation are being investigated to determine if they offer cooling advantages. Genetic selection for heat tolerance may be possible, but continued selection for greater performance in the absence of consideration for heat tolerance will result in greater susceptibility to heat stress.

The nutritional needs of the cow change during heat stress, and ration reformulation to account for decreased DMI, the need to increase nutrient density, changing nutrient requirements, avoiding nutrient excesses and maintenance of normal rumen function is necessary.

Maintaining cow performance in hot, humid climatic conditions in the future will likely require improved cooling capability, continued advances in nutritional formulation, and the need for genetic advancement which includes selection for heat tolerance or the identification of genetic traits which enhance heat tolerance.

V. Conclusion and recommendation

This study investigated factors affecting milk production of smallholder's dairy farms in BenadirRegion-Somalia, and found out that the most breed types that farmers in Benadirregion reared were local breed, Holstein breed, jersey breed and mixed breeds (local and exotic breed), and their purpose of keeping cattle were milk production, the herd size were between 5-70 heads in Benadir. The lactation length and milk production of exotic breeds reduced due environmental stress. And it is recommended that Farmers should be

encouraged to keep few high producing dairy animals to allow for easy management to increase production per animal and thereby increase smallholder dairy farmers 'profits. It is also recommended that awareness rising in proper planning and management, site selection for all the different classes of livestock, buildings & facilities to avoid any mistakes that may lead to poor housing design and resulting loss of production as well as economic inefficiency.

Conflict of interests

The authors have declared there is no conflict of interest

Others contribution

The authors contributed towards the research and writing the manuscript as follows:

Hassan Mohamed Hassan: Conception of the research problem, literature review, research design, data collection, analysis and drafting the manuscript.

Abdirahman Bare Dubad: Literature review, research design, data analysis and revising the manuscript.

Osman Ahmed Mohamud: Research design, data collection, literature review interpretation of data and revising the manuscript.

MaryamaKhalifMohamud: Conception of the research problem, literature review, research design, data collection, analysis and drafting the manuscript.

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