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Management and Breeding Activities of Goat Farming in the Islands of Jaffna District

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Abstract

The study was carried out during the period of January to June 2017. A total of 199 goat farmers (20% of the total farmers) from three veterinary divisions of Islands of the Jaffna district of Sri Lanka were interviewed using a structured questionnaire. Data was analyzed using proc frequency and Proc glm in SAS. Livestock farming was the main occupation of goat farmers (40.51%). Around 43.88% of the farmers reared goats for meat and milk purpose. Women's contribution for goat farming was around 95.39%. The average herd size of goats in Velanai, Kayts and Delft were 6.00±5.50, 4.45±2.31 and 21.53±3.22, respectively. Goat breeds found in the study area were: Indigenous (90.36%), Exotic (3.05%) and crosses (6.60%). Nearly 89.29% of the farmers adopted semi-intensive system of management. Majority (92.31%) of the farmers adapted natural service. Among the veterinary divisions Delft Veterinary divisions and semi intensive system of managements recorded more profit. Increasing herd size up to thirty increased profit thereafter there was a decline in profit. The major constraints listed by the farmers were lack roughages and concentrates, theft and predator problems. Making use of the findings of the current study which was absent previously in the study area and addressing the constraints mentioned by the farmers will improve overall productivity of the goats and contribute for poverty alleviation in the farming communities.

Keywords: Constraints, Crosses, Islands of Jaffna, Management System, Productivity

Introduction

Worldwide goats and sheep are among the most popular and beneficial livestock for those with very limited resources (Devendra, 2006). Goats and sheep are omnipresent, and contribute significantly to the subsistence, economic and social livelihoods of a large human population in low-input, small scale production systems in developing countries. Escalating human population, urbanization and incomes, coupled with changing consumer preferences are creating more demand for these animals and their products (Kosgey and Okeyo, 2007).

Goat farming is a famous livelihood activity which ensures food security for small and marginal farmers, landless labourers and rural folk in Sri Lanka. A larger proportion of goats are kept in the dry zone of Sri Lanka (Thakshala and Marapana, 2011). Goat production is still considered as a traditional form of livestock production among farmers particularly in the dry zone. Goat population in Sri Lanka in the year 2015 was 316,860, out of which major part is concentrated in the dry and intermediate zones. The highest population of goats (52,630) was reported in the Jaffna district (Department of Census and Statistics, 2016). Domestic mutton production of 1.35 (‘000 MT) along with the importation of 0.5 (‘000 MT) resulted a per capita availability of 0.09kg of mutton products in the year 2015, (Department of Animal Production and Health, 2016). The very low per capita availability of mutton in Sri Lanka urges substantial improvement in the productivity of goats. The demand for goats and their products can effectively be met by substantially increasing the productivity of these animals. Integrated approach in terms of management, health, genetic improvement and product technology to enhance production and decrease wastage is, therefore, desirable (Kosgey and Okeyo, 2007).

The Islands of Jaffna district were affected by both the civil disturbances prevailed in the country and the natural disaster, Tsunami in 2004. People in the Islands lost almost all of their belongings including livestock and poultry. There has been reemergence of goat farming with the assistance of Government and Non-Government organizations. In the Islands of Jaffna peninsula, the studies on goat farming was scarce. Therefore, current study was planned to do a detail study on demographic characteristics of goat farmers and housing, feeding, breeding, health issues, constraints and economics of goat farming in the Islands of Jaffna Peninsula.

Materials and Methods

The Study Area

Present study was carried out in three veterinary divisions of Islands of the Jaffna district *viz.* Velanai, Delft and Kayts (Co-ordinate of Jaffna district is 9.6930° N, 80.1652°) during the period of January to June 2017. The total land area of Velanai, Kayts and Delft are 85.08, 32.52, 48.09 sq. km, respectively. The total human population of Velanai, Kayts and Delft was 18,655, 10,564, 4562, respectively in 2016 (Chief Secretary’s Secretariat, Northern Province, 2017).

Sampling Procedure

From the total goat farmers in each veterinary division, 20% of the farmers were selected. A total of 199 farmers were selected for the study through stratified random sampling procedure using Table of Random Numbers. Number of farmers selected from the veterinary divisions Velanai, Delft, and Kayts were 92, 33, and 74, respectively.

Data Collection

A pre tested structured questionnaire was used to gather information from the selected goat farmers on demographic characteristics, feeding, housing, production, reproduction, breeding, health issues, constraints and economics of goat production. Personal interview was conducted with each farmer to collect information.

Data Analysis

The information collected via questionnaire was fed on MS Excel 2007 spread sheet and data analysis was performed with MS Excel 2007 and SAS 9.1.3 (©2002-2003). In the cost benefit analysis for the fixed cost only annual depreciation was considered, in addition the changes in cost and benefit associated with veterinary divisions,

management systems and herd size also were studied. For the effect of herd size on cost, income and profit total number of goats in each household was considered.

Results and Discussion

Demographic Characteristics of Goat Farmers

Demographic characteristics of goat farmers in the study area are summarized in Table 1.

Table 1: Demographic characteristics of goat farmers in the study area (%)

Descriptors	Veterinary Divisions			
	Velanai	Kayts	Delft	Overall
Gender				
Male	55	72.6	81.2	65.8
Female	45	27.4	18.8	34.2
Civil status				
Single	1.1	0	0	0.5
Married	98.9	100	100	99.5
Age (years)				
≤18	0	0	0	0
19-40	29.7	23.3	15.6	25
41-65	63.7	67.1	81.3	67.9
>65	6.6	9.6	3.1	7.1
Education				
Illiterate	0	0	0	0
Up to Primary	24.2	26	15.6	23.5
Up to Middle	71.4	69.9	81.3	72.5
Up to high school	0	1.4	3.1	1
Above high school	4.4	2.7	0	3
Experience				
01-10	93.4	89	75	89
11-20	4.4	11	22	9.5
21-30	2.2	0	0	1
31-40	0	0	3	0.5
41-50	0	0	0	0
>50	0	0	0	0
Main source of income				
Crop farming	11.2	16.4	18.8	14.4
Livestock farming	49	39.7	18.8	40.5
Government job	3.8	2.7	15.6	5.3
Private	0	4.1	0	1.5
Business	11.2	11	9.4	10.8
Other	24.8	26.1	37.4	27.5

Around 66% of the goat farmers were males. Ninety-nine percent of the goat farmers were married. Majority of the goat farmers were under the age group of 41-65 years. The literacy rate of respondents in the study area was 100%. Majority of the farmers were with the experience of 1-10 years while more than 20 years were around 1.52%. Around 41% of the goat farmer's main source of income was livestock farming.

Family Background of the Goat Farmers

Table 2 summarizes the family background of goat framers in the Islands of Jaffna district. Among the respondents 96% had men headed families. This percentage was equally distributed among the veterinary divisions. Comparatively higher percentages of farmers (57%) had the family size of 3-5 members. Family members of the

respondents with above middle level education were 19%.

Table 2. Family background of the goat farmers in the study area (%)

Descriptors	Veterinary Divisions			
	Velanai	Kayts	Delft	Overall
Household head				
Men headed	95.6	95.9	96.9	95.9
Women Headed	4.4	4.1	3.1	4.1
Family size				
Up to 3	30.8	17.8	12.5	23
3-5	50.6	63	62.5	57.1
6-8	18.6	19.2	25	19.9
>8	0	0	0	0
Age of family members				
≥18	31.7	36.8	37.8	34.7
19-40	36.6	32.8	27.6	33.6
41-65	28.9	28	34	29.5
>65	2.8	2.4	0.6	2.2
Education level				
Illiterate	0	0	0	0
Up to primary	18.5	19	7.9	16.8
Up to middle	63.5	64.2	67.1	64.4
Up to high school	11.8	13.7	23.7	14.6
Above high school	6.2	3.2	1.3	4.2

Goat breed distribution, sources of capital and goat breeds are presented in Table 3. The summary of purpose of rearing, breed distribution, type of breeds, source of animals and source of capital in the study region is given in Table 3.

Table 3: Purpose of rearing, breed distribution, type of breeds, source of animals and source of capital by veterinary division (%)

Descriptors	Veterinary Divisions			
Purpose of rearing	**Velanai**	**Kayts**	**Delft**	**Overall**
1	15.4	31.5	34.4	24.5
2	0	0	3.1	0.5
12	42.9	41.1	53.1	43.9
13	3.3	11	0	5.6
14	5.5	5.5	0	4.6
123	29.7	6.9	9.4	17.9
124	3.2	2.7	0	2.5
1234	0	1.3	0	0.5
Breed Distribution				
1	6.1	0	0	3
2	89.7	91.7	100	90.4
3	4.2	8.3	0	6.6
Types of breeds				
1	88.6	91.7	100	89.9
2	4.2	8.3	0	6.6
3	0.6	0	0	0.5
4	6.6	0	0	3
Source of animals				
Own purchase	95.6	93.1	100	95.4
Assistance	4.4	6.9	0	4.6
Source of capital				
Own	91.2	95.9	100	94.4
Credit	3.3	0	0	1.5
Own and credit	5.5	4.1	0	4.1

Purpose: 1- Meat, 2- Milk, 3- Manure, 4- Other; Breed distribution: 1- Exotic, 2- Indigenous, 3- Cross; Types of breeds: 1- Local, 2 - Jamnapari×Local, 3 - Sannen and 4 - Jamnapari

The main reason for keeping goats was meat purpose. Keeping goats for milk purpose was the least across the veterinary divisions. Majority of the farmers (90%) had indigenous goats. In the Delft veterinary division exotic and exotic crosses were completely absent and all the goats were indigenous. The sources for goats were mainly through purchase by the farmer from other farmers and private sources (95 %) and assistance through government and non-governmental organizations (5 %). The main source of capital for goat farming was farmer's own capital (94%).

Herd Structure

Average number of kids, young stock, buck, doe in the veterinary divisions were given in Table 4. Delft veterinary division had the highest herd size and the overall herd size in the Islands was around 11. Average number of bucks was less than one in Velani and Kayts veterinary divisions (Table 4).

Table 4: Average herd composition of goats in the study area (Mean ± SD)

Veterinary Division	Kids		Young stock		Buck	Doe	Overall
	Male	Female	Male	Female			
Velanai	0.79±1.02	1.54±2.18	0.18±0.44	0.21±0.52	0.46±0.89	2.71±2.22	5.92±5.51
Kayts	0.90±0.91	0.63±0.79	0.15±0.40	0.25±0.46	0.21±0.42	2.31±1.19	4.45±2.31
Delft	4.28±4.83	3.03±6.08	1.50±5.56	2.84±8.98	1.81±5.75	8.00±9.55	21.47±39.24
Overall	1.99±2.46	1.73±2.98	0.61±2.29	1.10±3.72	0.83±2.43	4.34±4.61	10.61±18.49

Breeding, Housing and Management Systems

Management systems and breeding methods adopted by the goat farmers in the Islands of Jaffna district are given in Table 5.

Table 5. Management systems and breeding by veterinary division (%)

Descriptors	Veterinary divisions			
	Velanai	Kayts	Delft	Overall
Breeding methods				
NS	92.3	98.6	100	95.9
NS and AI	7.7	1.4	0	4.1
Source of buck (NS)				
Own	4.4	0	3.1	2.6
Neighbours	8.8	8.2	18.8	10.2
Own and neighbours	86.8	91.8	78.1	87.2
Management system				
Extensive	0	0	0	0
Semi intensive	85.7	90.4	100	89.3
Intensive	14.3	9.6	0	10.7
Housing Types				
Open space	49.5	53.4	81.2	56.2
Cement floor housing	47.2	37	18.8	38.8
Elevated shed	0	1.4	0	0.5
Earth based shed	3.3	8.2	0	4.5

NS – Natural Service; AI – Artificial Insemination

Majority of the farmers adopted natural service to serve the goats. Farmers relied on own and neighbor's bucks to serve the females. Goats were kept mainly under the semi- intensive system of management (89%). Majority of the farmers used open space (no sheds) to confine or to tether goats.

Feeding Management

Grazing

Table 6 summarizes the duration of grazing hours of in different veterinary divisions of Islands of the Jaffna district. In dry season main way of feeding was through grazing (81%) the naturally available grasses which are of poor quality and inadequate due to lack of water in contrast in the rainy season around 48% of the goats were not allowed for grazing and cut and fed feeding system was adopted mainly with fodder tree leaves, rest of the animals were allowed to graze only 1-2 hrs.

Table 6: Grazing period (hours / day) adopted by Goat farmers by veterinary division in dry season and rainy season (%)

Descriptor	Veterinary Divisions			
	Velanai	Kayts	Delft	Overall
Dry Season				
No grazing	14.2	9.6	0	10.2
1-2	2.2	0	0	1
2-4	15.4	0	0	7.1
4-6	41.8	16.4	31.3	30.6
6-8	16.5	43.8	53.1	32.7
>8	9.9	30.2	15.6	18.4
Rainy Season				
No grazing	76.9	53.4	12.5	47.6
1-2	20.9	46.6	81.3	49.6
2-4	0	0	6.2	2.1
4-6	2.2	0	0	0.7
6-8	0	0	0	0
>8	0	0	0	0

Concentrate Feeding

Level of concentrate feeding for different stages of exotic, indigenous and crossbred goats are presented in Table 7. Concentrates were not fed to all stages of animals, only a selected stage of animals *viz.* lactating and pregnant does in both seasons and buck in the dry season were fed with small quantity of concentrates (Table 7).

Table 7: Level of concentrate feeding in the dry and rainy season (kg/animal/ day) by type of animal in the study area

Type of Animal	Kids	Young stock	Lactating doe	Pregnant doe	Buck
Dry Season					
Exotic	0.04±0.10	0	0.70±0.25	0.12±0.20	0.12±0.20
Indigenous	0.08±0.69	0.03±0.11	0.10±0.23	0.31±0.41	0.02±0.07
Cross	0.11±0.29	0.01±0.06	0.15±0.24	0.28±0.22	0.08±0.12
Rainy Season					
Exotic	0	0	0.00±0	0.08±0.20	0
Indigenous	0.02±0.03	0	0.01±0.07	0.11±0.27	0
Cross	0.08±0.27	0	0.03±0.14	0.11±0.16	0

Differences in reproductive and lactation performance of indigenous, exotic and crossbred goats in the study area are given in Table 8. Productive and reproductive performances of different goat breeds are shown in Table 8. Indigenous goats tend to have shorter age at first kidding than crosses and exotics. Exotic goats had the longest kidding interval than the crosses and indigenous. Indigenous goats milk yield ranged from 0.4 to 0.7L which was

the lowest compared to exotics and crosses (Table 8).

Table 8: Reproductive and lactation performance of goats by veterinary division (Mean ± SD)

Veterinary Division	Breed	Age at first kidding (Months)	Kidding interval (Months)	Lactation length (Months)	Lactation yield (liter/day)
Velanai	Indigenous	12.72±1.29	6.15±0.30	3.93±0.20	0.77±0.30
	Cross	16.20±1.64	7.10±0.22	4.15±0.22	1.05±0.32
	Exotic	17.50±1.22	12.0±0.00	4.84±0.24	1.16±0.66
Kayts	Indigenous	13.24±1.58	6.13±0.27	3.96±0.21	0.44±0.16
	Cross	16.71±1.60	7.14±0.24	4.07±0.88	1.00±0.00
Delft	Indigenous	13.50±1.52	6.17±0.32	3.91±0.24	0.60±0.15

Facts related to meat production in summarized in Table 9. Average weight at sale was low for indigenous animals (Table 9). Considerably higher percentages (49%) of animals were sold to neighbors. Middlemen involvement was around 28%. On average one animal per year was sold except in Delft where 6 animals per year were sold.

Table 9: Aspects of meat production (Mean ± SD)

Descriptors	Veterinary divisions			
	Velanai	Kayts	Delft	Overall
Age at sale (Months)				
Buck	10.50±2.05	11.88±2.02	12.35±1.60	11.58±2.11
Average weight at sale (kg)				
Exotics	33.40±5.94	-	-	33.40±5.94
Indigenous	22.79±2.88	23.30±3.08	25.42±2.20	23.84±2.99
Crosses	31.0±1.41	32.42±2.50	-	31.71±2.16
Average number sold/yr.				
Exotics	1.0±0.00	-	-	1.0±0.00
Indigenous	1.23±0.51	1.04±0.21	6.10±13.18	2.79±5.64
Crosses	1.0±0.00	1.0±0.00	-	1.0±0.00
Source of sales (%)				
1	65.5	40.6	21.4	49.5
2	8.1	46.4	42.9	27.7
3	18.4	13	0	13.6
4	1.2	0	0	0.5
12	2.2	0	32.1	6
13	3.4	0	0	1.6
23	1.2	0	3.6	1.1

1 – Neighbors, 2 – Middlemen, 3 – Whole sale/Butcher shops, 4 - Others 12,13, and 23 are combinations

Cost Benefit Analysis

Cost

Variable Cost

Annual average variable cost per animal is given in Table 10.

Table 10: Average variable cost per animal/year by veterinary division (Rs)

Variable cost	Veterinary Division		
	Velanai	Kayts	Delft
Feed	2104.44±1689.97	2728.16±1887.50	829.75±1302.32
Breeding	2.56±21.21	0.00	0.00
Medicine	22.35±54.44	8.79±35.89	0.14±0.80

Changes in variable cost with management system are presented in Table 11.

Table 11: Average variable cost/animal/year by management system in the study area (Rs)

Variable cost	Management system	
	Semi-intensive	Intensive
Feed	1989.30±1730.74	3354.80±2160.83
Breeding	1.33±15.26	0.00
Medicine	14.20±45.53	9.0±23.69

Variable cost was the least in the Delft veterinary division and the highest variable cost was recorded for the intensive system of management where extensive system of management did not exist, (Tables 10 and 11). It could be noted that the breeding cost was zero for the veterinary Kayts and Dalft.

Fixed Cost of Goat Farming

Annual average fixed cost per animal for the veterinary divisions are given in Table 12.

Table 12: Average fixed cost/Animal/year by veterinary division in the study area

Fixed cost	Veterinary division		
	Velanai	Kayts	Delft
Housing	289.03±336.54	252.49±367.47	40.02±98.77
Animal	389.36±243.79	293.06±166.15	229.12±201.40
Bucket	17.53±34.59	8.76±19.25	0.00
Rope	35.84±29.00	73.17±24.62	16.91±28.08

Changes in annual average fixed cost per animal with management systems are given in Table 13. For fixed costs only depreciation was considered. The fixed cost was the least in the Delft veterinary division and the fixed cost was more or less equal for both semi - intensive and intensive system of management (Tables 12 and 13).

Table 13: Average fixed cost/animal/year by management system in the study region

Fixed cost	Management systems	
	Semi-intensive	Intensive
Housing	245.91±340.20	158.50±279.94
Animal	320.25±221.71	375.74±201.53
Bucket	12.53±28.56	3.66±9.42
Rope	45.76±34.36	52.75±36.67

Income

Table 14 and 15 summarizes the changes in annual average income with management systems and veterinary divisions.

Table 14: Average income/animal/year by management system in the study area (Rs)

Management system	Milk	Meat	Manure	Total
Semi-intensive	1470.19±3174.88	3857.82±8143.52	214.26±273.48	5542.27±9397.52
Intensive	535.71±1792.84	2357.14±5359.90	245.70±331.77	3138.55±7093.34

Table 15: Average income/animal/year by veterinary divisions in the study area (Rs)

Income	Veterinary division		
	Velanai	Kayts	Delft
Milk	1663.08±3395.52	140.41±863.00	3341.95±4018.70
Meat	3590.27±5566.93	2013.70±3804.21	7840.77±15624.05
Manure	310.33±312.13	100.15±205.52	222.00±229.59

Semi intensive system of management recorded more income than the intensive system of management; more income was recorded in the Delft veterinary division than Kayts and Velani. Low income from meat in the Velani and Kayts area may be due to middlemen involvement than Delft veterinary division.

Total Income, Total Cost and Profit

Table 16, 17 and 18 reveal the changes in annual total income, total cost and profit per animal with management systems, veterinary divisions and herd size.

Table 16: Average total income, total cost and profit/animal/year by management system in the study region (Rs)

Descriptor	Management system	
	Semi-intensive	Intensive
Total income	5542.00±9397.52^{a}	3139.00±7093.34^{a}
Total cost	2597.70±1935.54^{b}	4146.50±2149.52^{a}
Total profit	2944.30±9792.25^{a}	-1007.50±7399.96^{a}

Means bearing different superscripts within a raw are significantly ($p<0.05$) different

The negative profit in the intensive management system may be due to high cost of production and middlemen involvement.

Table 17: Average total income, total cost and profit/animal/year by veterinary division (Rs)

Veterinary Division	Total income	Total cost	Total profit
Velanai	5564.00±7061.83^{b}	2861.10±1828.53^{a}	2702.90±7225.34^{b}
Kayts	2254.00±3853.38^{b}	3364.50±2102.29^{a}	-1110.50±4410.02^{c}
Delft	11405.00±17084.04^{a}	1116.00±1344.26^{b}	10289.00±17111.31^{a}

Means bearing different superscripts within the column are significantly ($p<0.05$) different

As far as Islands as a whole is considered profit was high for semi-intensive system of management while intensive system recorded negative profit or loss. Among the veterinary divisions Delft recorded the highest profit followed by Velani and Kayts where Kayts recorded a negative profit. When the herd size increased from 1 to 30 there was an increase in profit thereafter the differences in profit was not significant with increasing herd size.

Table 18: Average total income, total cost and profit/animal/year by number of animals in the study region (Rs)

Herd size	Total income	Total cost	Total profit
1 to 10	3638.00.00±5851.51^{c}	2933.00±2006.85^{a}	705.00±6072.09^{c}
11 to 20	15131.00±14616.02^{b}	1627.00±821.06^{a}	13504.00±14966.74^{b}
21 to 30	29183.00±23897.75^{ab}	1045.00±1658.81^{a}	28138.00±23414.14^{a}
31 to 40	17562.00±16615.26^{b}	109.00±1.05^{a}	17405.00±16550.03^{ab}
>50	20652.00±8182.72^{ab}	987.00±1613.48^{a}	19665.00±9679.06^{ab}

Means bearing different superscripts within the column are significantly ($p<0.05$) different

Interest in Goat Farming

Tables 19 to 21 summarize the framers' willingness to expand the herd size, interest to gather more knowledge on goat framing and the fields in which they need assistance to improve goat production. Most of the farmers around 73% willing to expand the herd size (Table 19).

Table 19: Farmer's willingness to expand the herd size in future by veterinary division (%)

Veterinary Division	No	Yes	Total
Velanai	16.48(15)	83.52(76)	100(91)
Kayts	52.05(38)	47.95(35)	100(73)
Delft	0.00(0)	100(32)	100(32)
Overall	27.04(53)	72.96(143)	100(196)

Table 20: Farmers willingness to gather knowledge regarding goat farming by veterinary division (%)

Veterinary Division	Yes	No	Total
Velanai	30.77(28)	69.23(63)	100(91)
Kayts	10.96(8)	89.04(65)	100(73)
Delft	0.000)	100(32)	100(32)
Overall	18.37(36)	81.63(160)	100(196)

Percentage of farmers expressed willingness to gather more knowledge regarding goat production was less. Higher percentage of farmers did not show interest gather knowledge regarding goat farming in the study area (Table 20). Most of the farmers want to gather knowledge regarding feeding of goats, management and maintenance (Table 21).

Table 21: Fields of knowledge wanted by farmers by veterinary division (%)

Field of knowledge	Velanai	Kayts	Delft
Management and maintenance	7.69	0	0
Disease	5.49	0	0
Feeding	14.29	1.37	0
Suitable breeds	2.2	1.37	0
Artificial insemination	7.69	16.44	0

In the study area though farmers want to expand the herd size they did not express their willingness to gather knowledge in goat farming. This reflects the farmer's attitude to exploit goats giving nothing to them. This finding warrants the need for the attitude change of the farmers which is vital for goat industry development and sustainability of goat farming.

Constraints

Constraints for goat farming are given in Table 22.

Table 22: Constraints for goat farming in the Islands of Jaffna Peninsula by veterinary division (%)

Constraints	Velanai	Kayts	Delft
Lack of fodder	43.96	1.37	0
High cost	1.1	12.33	0
Lack of	42.86	5.48	0
Concentrates			
Theft problem	14.29	23.29	34.38
Goats killed by dogs	24.18	1.37	0
Lack of credit facilities	14.29	1.37	0
Disease problem	4.4	0	0
Lack of land	12.09	6.85	0
Flooding	4.4	0	0
No proper housing	36.26	16.44	0

Discussion

Males were mostly involved in goat farming compared to females. The percentage of male framer participation in goat farming ranged from 55 to 81%. Studies on goat farming in Southern province by Thakshala and Marapana, (2011) said, herding to grazing areas and marketing were the main responsibilities of men, Valikamam area by Kajani and Sinniah, (2013) disclosed, the male female participation in goat farming was more or less the same (1:1) and Kilinochchi district by Kunarathinam and Sinniah, (2019) said males were mostly involved than females (35.42 to 73.98%). In a study in Bharatpur district of Rajasthan, India, Kumar *et al.* (2018) reported the women participation of 90.2% for goat production. Considerably good participation of women in goat production will lead to an increase in female economic autonomy and bargaining power within the households (Dossa *et al.,* 2008).

In the study area more than 98% of the farmers were married. Studies on goat farming in Kopay area by Nanthini and Sinniah (2006), Valikamam area by Kajani and Sinniah (2013) and Kilinochchi district by Kunarathinam and Sinniah (2019) revealed, around 40%, 85.37 to 100%, and 95.77 to 100% of goat farmers were married, respectively. Higher percentage of goat farmers fell into the age group of 19-40 and 41-65 years (92.86%). None of the farmers within the age group ≥ 18 was involved in goat farming. From the results potential age group for goat farming could be considered as 19-65 years. Studies in Valikamam area by Kajani and Sinniah (2013), Kilinochchi district by Kunarathinam and Sinniah (2019) also says, potential age group was 19-65 years and percentage under 19-65 age group was 71.32 and 87.62%, respectively.

The illiterate rate was 0% and educational level up to middle level ranged from 69.86 to 81.25% are good indications for high potential to improve goat farming in the study area in terms of management ability, record keeping, and accessing of market information. In Delft area none of the goat farmers have studied above high school. Studies on goat farming in Valikamam area by Kajani and Sinniah (2013), Kilinochchi district by Kunarathinam and Sinniah, (2019) disclosed, illiterate rate of 1.96 to 10.28% and 1.41 to 2.44%, respectively and up to middle level was 38.32 to 48.67, 50.74 to 67%, respectively. Training of farmers on profound record keeping will empower them and enhance the potential success of breeding programme (Kosgey and Okeyo, 2007).

Among the goat farmers 11 to 18% of the farmers had crop farming as their primary occupation. Eighteen to forty - eight percentages of the farmers had animal farming as their primary occupation. In Valikamam area by Kajani and Sinniah (2013), Kilinochchi district by Kunarathinam and Sinniah, (2019) said crop farming was primary occupation of higher percentage of the farmers 23.81 to 57.69% and 18.75 to 52.11%, respectively. The dependency of rural livelihoods on crop and livestock production is a common phenomenon in developing countries and is also seen as an opportunity for efficient use of resources (Kosgey and Okeyo, 2007).

Women headed families (3-4%) considered goat farming as one of the sources of income generation may be due to less capital requirement and easy management. The percentage of women headed families in the Kilinochchi district ranged 12 to 15, Kunarathinam and Sinniah (2019). Helping the poor and especially women to successfully raise goats can have a very significant impact on their income, social status and even on the local environment (Sinn *et*

al., 1999). Higher proportion of the farmers (57.14%) had the average family size of 3-5 members. Studies on goat farming in Kopay area by Nanthini and Sinniah (2006), Valikamam area by Kajani and Sinniah (2013) and Kilinochchi district by Kunarthinam and Sinniah (2019) said, nearly 43%, 50% and 43.99% of goat farmers had the family size of 4-5 members, respectively.

Age group of farming family members under 19-40 years and above 40 years were 33.56% and 31.75% in the study area. These groups could be considered as active members as they could contribute to the development of goat farming. For genetic improvement programs to be fully embraced, the farmer/the community should be able to recoup the investments made. More often, it is the service providers, especially the livestock traders and not the farmers who benefit most. Market-oriented and multi-disciplinary approaches are required in which genetic potential, market access, health delivery services and feeding are concurrently addressed (Ahuya *et al.,* 2003; Baker and Gray, 2004 and Kosgey *et al.,* 2006). Socio-economic developments that add value to the products of small ruminants are increasingly becoming apparent and producers and investors need to respond accordingly. Kunarthinam and Sinniah (2019) said, age group of farming family members under 19-40 years and above 40 years were 34.55% and 28.68%, respectively.

Most of the farmers attained an education level of up to middle level (64.40%) and illiterate percentage of zero. A study on goat farming in the Kilinochchi district revealed an educational level of up to middle and illiterate of 58.63% and 1.73%, respectively (Kunarathinam and Sinniah, 2019). Level of education will have an impact on production methods, management ability, record keeping and accessing of market information (Kosgey *et al.,* 2006). Training of farmers will therefore empower them and enhance the potential success of breeding programme which depend profoundly on record keeping, Kosgey and Okeyo (2007).

Goats were kept for multipurpose with special emphasize to meat and keeping goats only for milk purpose was the least across all veterinary divisions. Main purpose of rearing goats for meat is agreement with the findings of Thakshala and Marapana (2011), Kajani and Sinniah (2013) and Kunarthinam and Sinniah (2019). Unlike commercial farmers, small scale farmers tend to keep animals for multiple needs, and not only as an economic enterprise, i.e., tangible benefits (i.e., cash income from animal, milk and meat sales and for home consumption, manure, fibre and skins) and intangible benefits (e.g., savings, an insurance against emergencies, and cultural and ceremonial purposes) are important (Kosgey, 2004).

Majority of the farmers (>91%) relied on their own capital for goat farming activities, the findings are in accordance with observation of Kunarthinam and Sinniah (2019) in the Kilinochchi district of Northern province. Generally, the income levels of the small holders are limited and this will have an impact on expenses related to goat production. For the poor a major related constraint is money to purchase goats. Credit for the purchase of goats is generally not available to the meager or they are charged very high interest rates. In general, government services are biased against goat production in favor of large animals, Peacock, (2005) and credit is even more difficult for women to obtain (Oluka *et al.,* 2004).

In the study area adult female goats were higher than male goats. The reason could be that male goats were mostly sold for meat purpose. Similar findings were reported by Thakshala and Marapana, (2011) and Jasinthan and Silva, (2014). The small overall flock size in the study area will not facilitate record keeping and selection. The large flock sizes and record keeping are important for development of breeding programs especially for selection intensity and genetic gain (Shumbusho *et al.,* 2013). However, inefficient sustainable performance recording in livestock has been a major setback in most developing countries (Kosgey *et al.,* 2006).

Relying on natural service (96%) with insufficient number of breeding bucks will lead to inbreeding. Inbreeding is exacerbated by small herd size and absence of record keeping. Similar practices have been reported by Nanthini and Sinniah (2006), Kajani and Sinniah (2013) and Kunarthinam and Sinniah (2019) in the Kopay veterinary division, Valikamam area of the Jaffna district and Kilinochchi district, respectively. Educating the farmers, the benefits of controlled breeding, record keeping, interchanging the bucks among the herds, use of artificial insemination and effects of inbreeding is the way forward to enhance the goat farming in the study area. Uncontrolled mating leads to an absence of fixed kidding seasons and inbreeding, Jimmy *et al.* (2010). Subsequent inbreeding depression leads to decreased fitness (e.g. low reproduction rates and high mortality) as well as small body sizes and poor growth rates (Jimmy *et al.,* 2010). Parturition throughout the year requires high levels of managerial skills, such as timing of dosing and weaning, which is generally lacking in communal production

systems.

In the study area none of the goat farmers used stud centre to service the goats which usually have genetically superior bucks and the service charges are substantially higher than artificial insemination. Majority of the farmers relied on own buck or neighbor's buck for breeding purpose (Uncontrolled breeding) it is evident that it will lead to higher rate of inbreeding as the average number bucks per herd was less than one as observed from the herd structure. The findings are in agreement with the findings of Nanthini and Sinniah (2006) and Kunarthinam and Sinniah, (2019) in the Kopay veterinary range of Jaffna district and Kilinochchi district, respectively. In contrast Kajani and Sinniah (2013) in the Valikamam area of Jaffna district reported that majority of the farmers relied on the stud centres to serve the goats. Uncontrolled mating leads to an absence of fixed kidding seasons and inbreeding, Jimmy *et al.* (2010). Parturition throughout the year requires high levels of managerial skills, such as timing of dosing and weaning, which is generally lacking in communal production systems. Inbreeding is exacerbated by small flock sizes, a lack of animal recording and the long periods that bucks stay in the flocks before they are culled. Subsequent inbreeding depression leads to decreased fitness (e.g. low reproduction rates and high mortality) as well as small body sizes and poor growth rates (Jimmy *et al.*, 2010).

Though there was adequate grazing land which was not suitable for agriculture was available farmers were reluctant to go for extensive system due to theft and predator problems (Particularly dogs). As a result, majority of the farmers adopt semi intensive system of management with restricted grazing and some sort of confinement. These findings are not in agreement with the findings of Kunarthinam and Sinniah, (2019) where higher percentages of the farmers adopted intensive system of management as a precaution not to damage the neighbors' crops and fields and to avoid predator's problem. Current findings are in consistent with constraints reported elsewhere in Africa (Gwaze *et al.* (2009); Fikru and Gebeyew, 2015).

Performance of crosses compared to indigenous for the traits age at first kidding and kidding interval were not promising. Lactation length and average milk yield of crosses also were lower than the expectation. This is in agreement with previous observations that crossbreds are poorly adapted to the low-input traditional production systems of the tropics, Wollny *et al.* (2002) and Ayalew *et al.* (2003).

In the study region indigenous breeds were sold in higher number than other breeds and also this was higher in Delft veterinary division than in other two veterinary divisions. The reason could be that there indigenous breed population was high. The study of improving goat production in the 'Coconut triangle' of Sri Lanka by Mahusoon and Sivarajah, (1999) revealed, goats were sold based on their live weight. Comparatively, indigenous breeds were sold at low weight than exotic and cross breeds.

In Velanai veterinary division most of the farmers sold their goats to neighbors. But in Kayts and Delft veterinary divisions most of the farmers sold to middlemen. Overall, most of the farmers sold their goats to neighbors. Studies on goat farming in Valikamam area of Jaffna district by Kajani and Sinniah, 2013 and Kilinochchi district by Kunarthinam and Sinniah (2019) said, goats were sold more through middlemen (38.46 to 47.12%) and neighbors (40%), respectively. For genetic improvement programs to be fully embraced, the farmer/the community should be able to recoup the investments made. More often, it is the service providers, especially the livestock traders (middlemen) and not the farmers who benefit most. Market-oriented and multi-disciplinary approaches are required in which genetic potential, market access, health delivery services and feeding are concurrently addressed, Ahuya *et al.* (2003); Baker and Gray (2004) and Kosgey *et al.* (2006). Socio-economic developments that add value to the products of small ruminants are increasingly becoming apparent, and producers and investors need to respond accordingly, Kosgey and Okeyo (2007).

Cost of production was the least in the Delft veterinary division the reason could be in the Delft veterinary division all the goats were indigenous animals and the least care was given to these animals. Semi intensive system of management also recorded least cost this also due to the fact that though the management system was classified as semi intensive as some sort of housing or confinement was provided to the animals to protect the animals from theft and predators all other management systems were similar to extensive system of management where the input allocation was the least. The profit was highest in the Delft veterinary division and semi intensive system of management. The reason for negative profit in intensive system should be probed into and remedial measures should be taken to increase the profit. There was a potential to increase the profit by increasing the herd size up to 30, thereafter there was a sharp decline in the profit because giving individual care to the large herd size may be difficult.

It could be observed that farmers getting output giving least to the animals, milking the animals also not exploited the amount milk they mentioned in the study was the milk used for family consumption and the farmer perceive the quantity drank by the kid. Hence, milking the goats should be encouraged due to its nutritive value and in the urban area there is high demand for goat milk and it can fetch high price as well. Overall improved management practices for both indigenous and improved goats will increase the productivity of individual animals and overall income to the farmers as a result the living standard of the farmers will be enhanced. Markets for goat products, especially milk are very poorly developed in most developing countries despite the fact that generally consumers are willing to pay a premium for goat's milk, James De Vries (2008).

The constraints faced by farmers are shown in Table 8. Major issues were goats killed by dogs, theft problem mainly in Delft veterinary division (34.38%) and lack of concentrates. Disease problem was lower in the study area compared to Kilinochchi district, Kunarthinam and Sinniah (2019). Constraints make huge impact on the profitability and sustainability of the goat farms. It is very essential to take necessary actions to overcome the constraints. A group approach is necessary to overcome many of the constraints farmers face. NGOs can be instrumental in the formation of groups, helping them to develop rules or by-laws, training leaders, developing accounting and reporting systems, and in networking them with other groups, James De Vries (2008).

Conclusion

From the study conducted in the Islands of Jaffna district the following conclusions could be derived. The socio-economic characteristics of the goat farmers and their family members are conducive for development of goat farming, the goat breed distribution of indigenous, exotic and crosses were 90.36%, 3.05% and 6.6%, respectively. Specific breed distribution viz. local, Jamnapari, Jamnapari×local and Saanen were 89.9, 3.03, 6.57, 0.51%, respectively. Higher percentage of indigenous breeds is a negative indication of upgrading programme. Most of the goat farmers adopted semi-intensive system of management (89%). Productive and reproductive performance of goats could be brought to the optimum level by appropriate management practices. Overall goat farming was not a profitable enterprise. Profit of the goat farming was influenced by herd size and management aspects. Hence, expansion of herd size and adopting appropriate management practices will give more profit to the goat farmers.

Conflict of Interests

There is no conflict of interest.

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