

Livestock Productivity in the Desert Ecologies of Pakistan: Setting the Development Priorities

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Abstract

Crop and livestock are almost equal contributor Pakistan's agricultural economy. Identifying and developing the potential areas of livestock production is part of the overall development strategy for this sector and rural poverty alleviation concerns in Pakistan. Major livestock production systems of Pakistan are grazing, stall-fed and grazing-cum-stallfed based. Grazing based livestock farming is economical and customary system in mountainous, rainfed, salinity affected and desert areas. The livestock herders of desert areas deserve urgent attention of the policy makers because of their most deprived living condition and majority is living below poverty line by all poverty measuring standards. The present study is aimed to generate an updated synthesis based on empirical knowledge about status of livestock farming in desert ecologies.

The results shows that the average herd sizes maintained are fairly large by the herders to cover such losses. The human and physical capital endowments of the farmers are generally poor. Other common characteristics are: major dependence on natural vegetation with limited supply of fodder, more physical exertion of animals during grazing, poor animal health, practicing natural method of breeding, low milk and meat productivity, highly limited livestock and milk marketing opportunities, etc. The stall feeding is mainly composed of dry stalks and straws of different crops along with small quantity of food grains. On marketing side, because of location and lack of infrastructural support, milk marketing opportunities are meager, therefore, it is converted to desi ghee --- a value added and preserved form. In marketing of live animals, the farmers are always exploited by beoparies. On average herd size, the net monthly income in Thal desert from cattle (for milk), sheep and goats farming (for meat purpose) was Rs.457, Rs.454 and Rs.552, respectively. In Tharparkar, the corresponding estimates are Rs.911, Rs.421 and Rs.308, respectively. There is a strong need of designing some regulatory framework for milk and livestock marketing for increasing farmers' due returns of their efforts. Popularizing meat purpose animals' trade on live-weight basis is one of policy measures need to be implemented in livestock markets at the earliest.

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1. Introduction

The livestock sub-sector constitutes an important source of food and means of sustenance for millions of households in Pakistan. This sector shares by 51.8% in total agricultural value added and about 11.3% of national GDP. Pakistan is situated in the neighborhood of world's largest milk producer (i.e. India) and herself is world's 4th largest milk producer. Livestock farming in Pakistan can broadly be classified into grazing and stall feeding based. The grazing based is the peculiarity of the mountainous, rainfed, saline affected and desert areas of Pakistan. The stall-fed livestock farming is mainly found in the irrigated areas of Pakistan.

The total area of Pakistan is 79.6 million ha, of which 70% is arid to semi-arid. About 50.88 million ha (or 63.9%) are rangelands². The ecologies of NWFP and Northern Areas are semi-arid to humid. The Sindh province is primarily arid while Punjab and Balochistan have arid-semiarid ratios as 58:29 and 43:57, respectively. By ecologies, 51.5% of total country area is arid, 36.9% is semi-arid, 5.4% is sub-humid and 6.2% is mixed. About 41 million ha is solely arid including about 11 million ha comprising deserts where mostly the climate is hyper-arid (PCRWR, 1999; Iqbal *et al.*, 2000). The rangelands economy of Pakistan extends from alpine pastures in the northern mountains to temperate and Mediterranean ranges in the western mountains and arid/semi-arid deserts of the Indus Plain. Due to bio-climatic variations, the range vegetation varies from one area to the other. Because of low prospects of crop cultivation and availability of grazing vegetation, livestock farming is an important source of livelihood for the dwellers in rangelands, deserts and marginal lands. For instance, in Balochistan, livestock production primarily depends upon rangelands. Sheep and goats obtain about 60% of their feed obtained from rangelands (Zaffaruddin, 1977) while in Balochistan, 90% of the required livestock feed is provided by rangelands (FAO, 1983). Most rangelands in Pakistan are over-exploited due to uncontrolled nomadic grazing, grazing places being common tribal or village property, declining carrying capacity³ because of little rehabilitation/ regeneration efforts. On the other hand, rapidly increasing demands for livestock products further intensifying the already enormous triggered pressure on these rangelands (GoP, 2007a).

² Pakistan's rangelands are: Western Balochistan ranges (18.50 million ha), Central Balochistan ranges (8.00 million ha), Desert rangelands (7.97 million ha), Eastern Balochistan ranges (5.00 million ha), trans-Himalayan grazing lands (3.50 million ha), Kohistan ranges (2.38 million ha), Alpine pastures (1.68 million ha), Pothwar scrub ranges (1.68 million ha), Suleiman mountain ranges (1.50 million ha) and Himalayan forest grazing lands (0.67 million ha).

³ Carrying capacity means the natural capacity of land and/or rangeland to feed human and/or animal population at given technological level (Tiffen and Mortimore, 2002).

The sandy desert falling districts of Pakistan contain about 8.1% of total buffalo population, 13.5% of cattle population, 15.3% of sheep and 14.4% of goat population in the country⁴ (GoP, 2007b). In a situation when the contribution of livestock sub-sector is more than half of the total agricultural GDP, whereas its only one product (i.e. milk) is worth more than the combined value of wheat and cotton. This sector had never experienced a negative growth rate in the history. It is not plausible to ignore desert economies possessing such as notable proportions of different livestock species.

The livestock farming in the desert economies also deserves special attention of researchers and policy makers on all types of poverty indicators (e.g. income, nutritional, access to or institutional support etc.), and much lagging behind in the infrastructure development (roads, electricity, transport, education opportunities etc.). Before taking any developmental initiative for the livestock sector, it is imperative to have some empirical information on the livestock farming deserts of Pakistan. Generally, the livestock farming in these areas is characterized as low paid and for animal health coverage, mainly due to limited supply of forage and fodder, more physical exertion of animal during grazing, frequent incidence of diseases and droughts cycles, difficulties in getting health services and vaccination, highly limited milk marketing opportunities, non-existence of milk preservation facilities with the herders, and a generally poor institutional support. A highly limited literature was available on livestock farming in deserts of Pakistan till year 2000. In year 2000, a relatively detailed baseline survey was carried out in Cholistan desert of Punjab, but this information was limited to only one desert. Secondly, this study lacked information on various aspects like economic analysis of livestock farming, grazing and stall feeding patterns, feed composition during stall feeding and stall feeding expenditures for small and large ruminants, trading intensity of various age groups of different animal species, etc. This study fills these gaps and expands the scope of the work to other deserts namely Thal and Tharparkar. The major objectives of this exercise are: a) to examine the similarities and differences in socio-economic characteristics, livestock composition, grazing and feeding systems and marketing aspects; b) to carry out economic analysis of livestock farming in desert ecologies; c) to review the socioeconomic, institutional

⁴ The district falling in sandy desert include Cholistan, Bahawalpur, Bhawalnagar and Rahim Yar Khan from Cholistan desert; Bhakkar, Layyah, Khushab from Thal desert; Tharparkar and Umerkot from Thar desert; and Chagai, Awaran and Kharan from Chagai-Kharan deserts.

and policy constraints faced by livestock sector in the desert areas of Pakistan; d) to suggest guidelines for the development of the livestock farming in deserts of Pakistan.

The rest of the paper is organized in to five sections. Second section is devoted to the description of analytical techniques laid under the tile of research methodology. The third section is named as results and discussion. The fourth section is pertained to conclusions and suggestions. The references quoted at various stages in the paper are detailed in fifth section.

2. Research Methodology

Sampling Design and Survey Methods

Sampling is the first step towards empirical analysis after conceiving the problem, literature review and deciding about the study area. Before going for actual sampling, variations in the physical and socio-economic environment were considered. Since the livestock farming is spread over the desert, therefore, geographical area of the desert dominated tehsils/talukas were taken as the basis for research study sampling. The sample villages in these tehsils/talukas were selected after consulting the officials from the Livestock Department, the Department of Agricultural Extension present in the area and the NGOs.

Regarding the respondents selection, a true randomization was not possible mainly because of lack of information about the number of livestock farming households. Even if such information were available, it was again difficult and costly to trace the selected farmers in deserts as they might have left for grazing, migrated to other places. Hence chance meeting method of respondent selection was adopted. Under this method, some resource person or *wadera* or old person from the settlement was first contacted. The survey objectives were explained to him to win his confidence. Later on, based on the composition by herd size, livestock species and herder types, a request for the desired number of respondents was placed to him. This procedure greatly helped in drawing the needed size of the sample.

Regarding sample composition, 122, 120 and 120 livestock farmers/herders data were gathered from Cholistan, Tharparkar and Thal deserts, respectively. In this way, the results discussed in subsequent section pertain to total sample of 362 livestock farmers. The primary level data were formally gathered through a field survey in the three deserts by using a pre-tested questionnaire. The survey team was consisted of Economists, Agricultural Economists,

Statistician, Agricultural Extensionist and Rural Sociologists. The survey was cordially facilitated by the staff of the provincial animal Husbandry/Livestock and Dairy Development Department, the Department of Agricultural Extension and the local NGOs.

The data for these studies pertains to year 2000 for Cholistan, year 2006-07 for Thal and year 2007-08 for Tharparkar desert.

Analytical Procedures

Conversion Factors Used for Various Livestock Species

Because of large variations in age, sex and type composition, the livestock were expressed in equivalent adult animal units for comparison purposes. The weights assigned to various livestock species by age and sex for the computation of adult livestock units are taken from Iqbal *et al.* 2000.

Method of Scoring the Priority Orders/Objectives/Development Needs

In the questionnaire, the respondents were asked to delineate and prioritize the objectives of keeping various types of animals in their herds. For instance, the feedback of the respondent farmers was recorded by using Likert scale. For instance, the priority order was recorded as '0' if 'not important', '1' as 'least important' and '4' if 'most important'. The recorded scores for each quarry type were transformed into percentages by using the following transformation.

$$W_i = \frac{X_i}{\sum_{i=1}^n X_i} \cdot 100 \quad (1)$$

where

- W_i = Percent weight of the *ith* objective of keeping a specific type of animal.
- X_i = Score of the *ith* objective of keeping a specific type of animal.
- $\sum X_i$ = Total sum of the scores of all included objectives of keeping that animal.
- i = 1, 2, 4 are the objectives of keeping a specific type of animal,

Livestock Breed Diversity

The livestock breed diversity was simply measured in terms of the number of breeds of an animal species present on the sample livestock farms.

Livestock Trading Intensity

The livestock trading intensity on sample farms was estimated as follows:

$$\text{Trading intensity} = ((\text{animals bought} + \text{animals sold})/\text{total population}) * 100$$

Economic Analysis of Livestock Farming

As livestock farming in the deserts is consisted of grazing and stall feeding components. The grazing cost is estimated on the basis of number of animal heads a grazer can manage easily and the prevailing wage of grazers (or monthly salary) during the survey period. For estimating inputs costs, the value of purchased items are directly considered on the cost side whereas the imputed costs/shadow prices were used for home-contributed items like family labor, grazing labor, self-grown feed items (dry fodders, grains etc.), domestically consumed milk and dairy products, interest on the capital invested, as these items are weakly marketed. For other cost items, various assumption (also narrated in the foot notes of the tables) based on informal discussion with the knowledgeable farmers of the area were also used. For estimating animal quality depreciation, various methodologies are available in the literature, but in this study for cattle, we assumed that 5-7 pregnancies per working life and salvage value at the end of working life were considered. In this way, the annual animal quality depreciation allowance came about 10% per annum. Among sheep/goats, the average productive life is 4 years but the salvage value is very low and there is also a high probability of suffering from diseases in small ruminants. Considering these factors, the animal depreciation allowance considered was again 10% per annum.

On the returns side, the value of milk produced/annum, value of infant born and value of the animal at the end of the year (because females are kept for further reproduction) were summed to estimate gross value of output. In case of small ruminants the male sheep became marketable as slaughter purpose animal at the age of 9 months and goats at one year of age. For drawing inferences, net profit per adult animal, returns per month per animal and average monthly income per herd were estimated for both ruminant types.

3. Results and Discussion

3.1. Socioeconomic Profile of Livestock Farmers

The average age of the household head ranges from 36 in Tharparkar to 48 years in Cholistan. Their mean crop experiences vary from 15 years in Cholistan to about 22 years in Thal. The mean livestock farming experience vary from 19 years in Tharparkar to 32 years in Cholistan. Large variations in possession of formal education were observed across deserts, the lowest in Cholistan and almost primary level in Thal and Tharparkar deserts. Likewise, the proportion of sample respondents able to read and write was also lowest in Cholistan desert (Table 1).

Table 1: Socioeconomic profile of sample livestock farmers in three deserts of Pakistan

Items	Cholistan	Tharparkar	Thal
Age (Years)	48.09	36.36	43.5
Crop farming experience (Years)	15.44	17.95	21.5
Livestock farming experience (Years)	32.45	19.18	21.2
Livestock trade experience (years)	n.a.	4.98	10.1
Formal education (Years)	1.05	5.45	4.8
Can read and write (% Yes)	4.85	69.20	61.7
Family size (#)	13.36	11.56	12.6
Living pattern (% Joint)	61.50	85.00	71.7
<u>Family composition (Nos.):</u>			
- Old males (> 60 years)	0.49	0.38	0.6
- Old females (> 60 years)	0.49	0.32	0.6
- Adult males (16-60 years)	3.18	3.12	3.6
- Adult females (16-60 years)	3.18	2.80	3.0
- Boys (upto 16 years)	3.01	2.73	2.5
- Girls (upto 16 years)	3.01	2.22	2.3
<u>Children acquiring education (Nos.):</u>			
- Boys in primary school	n.a.	1.34	1.2
- Girls in primary school	n.a.	0.93	0.6
- Boys in high school	n.a.	0.30	0.5
- Girls in high school	n.a.	0.06	0.1
- Boys in college/university	n.a.	0.06	0.2
- Girls in college/university	n.a.	-	0.1
<u>Household labour distribution (Nos.):</u>			
- Adults in crop farming	1.30	0.71	1.30
- Adults in livestock farming	2.40	1.35	1.20
- Adults in off-farm activities	0.18	0.16	0.20
- Adults in non-farm activities	0.18	1.03	0.80
<u>Farm and herd size per labourer allocated:</u>			
- Farm area per person (acres)	10.45	40.97	56.08
- Animal units of livestock per person (#)	26.80	16.70	14.53
<u>Family contact methods (%):</u>			
- Mobile	n.a.	23.30	43.50
- Messenger	46.50	1.70	21.70
- Telephone/V-Phone	n.a.	65.80	21.70
- Mobile + Telephone	n.a.	6.70	-
- Other	54.50	2.50	13.00
<u>Fuel source for cooking/heating (%):</u>			
- Firewood	29.70	46.70	35.00
- Firewood + Dung cakes	39.90	18.30	49.20
- Firewood + Dung cakes + Kerosene oil	24.60	27.50	13.30
- Firewood + Dung cakes + LPG/other	0.80	-	2.50
- Other	5.90	6.60	-

The average family size of the respondent families was about 13 persons, comprising approximately 1 old person, about 6 adult persons and 6 children. Joint family living pattern is dominant in all three deserts. The education acquiring efforts were examined by the proportion of students at various stages in education. Out of six children per family, nearly two were in primary

schools and about 0.5 children or one child in every second household was in middle/high schools. A negligibly small number of children were in colleges/universities. In Thal desert, relatively more number of children in college/university. While examining allocation of adult male family labor, variations across deserts were observed. For instance, the number of adults doing livestock farming was higher in Cholistan than other two deserts.

The number of standard animal units or “sau” managed per person was about 26.8 sau in Cholistan, 16.7 sau in Tharparkar and 14.5 sau in Thal. The mean operational holding managed per person was about 10.45 acres in Cholistan, 40.97 acres in Tharparkar and 56.08 acres in Thal desert (Table 1). Less per person land allocation in Cholistan is because of their agricultural lands are lying in Lesser Cholistan where seasonal canal irrigation facilities are available and at least one person on full time basis needs to be present there for caring crops and other household members. In other two deserts, the livestock and crop farming activities operate simultaneously, therefore, livestock farming labour also assist crop farming labor during peak season.

For communication with family members and relatives, the use of wireless telephones (V-Phone) and cellular/mobile phones was more common in Thal and Tharparkar deserts and about same may be prevailing in Cholistan because the information presented in Table 1 about Cholistan desert pertains to year 2000 when the communication facilities were not so developed as it is now-a-days. In conclusion, least heterogeneity across deserts may be prevailing regarding utilization of communication facilities. About sources of energy for cooking and heating, firewood and dried animal dung cakes (firewood separately and with dung cakes also) are main sources of energy for cooking among sample households (Table 1).

Farming Profile of Livestock Farmers

The average farm size (consisted of 2-3 parcels) was smallest in Cholistan followed by Tharparkar and Thal, and majority was owner operators. Animal muscle was mainly used as traction power for plowing in Tharparkar while tractor plowing is common in Cholistan and Thal. Being desert ecology, the soils of the area were mainly sandy followed by sandy loam. On irrigated parcels, well or tubewell irrigation was applied in Cholistan and Thal deserts whereas, in Tharparkar, the sample farms were mainly rainfed type. In Thal, 95% farmers reported low to medium levels of brackishness in under ground water, 70% in Tharparkar whereas a high degree of brackishness in under ground water is generally reported in Cholistan (Table 2).

Table 2: Farm characteristics of livestock farming households in three deserts of Pakistan

Items	Cholistan	Tharparkar	Thal
Total operational holding (acres)	13.58	28.68	72.90
Own land (acres)	12.00	25.92	67.20
Tenancy status (% owners)	81.80	73.30	71.40
Number of parcels	n.a.	2.18	2.90
Source of power for plowing (% farms):			
- Animals	3.90	70.30	-
- Animals + Tractor	1.30	27.00	6.70
- Tractor	94.00	2.70	93.30
Soil type of major parcel (% farms)¹:			
- Sandy	81.00	66.70	77.30
- Sandy loam	-	31.50	16.80
- Loam	2.00	1.80	4.30
- Sandy + sandy loam	-	-	1.60
- Saline sodic	17.0	-	-
Tubewell as irrigation source (% farms)	68.30	5.40	68.30
Brackishness in ground water (% farms):			
- Low	n.a.	43.60	72.41
- Medium	n.a.	26.40	22.99
- High	n.a.	30.00	4.60

3.2. *Livestock Ownership, Composition and Livestock Farming Objectives*

The average herd size was much larger in Cholistan than Tharparkar and Thal. This may be because simultaneous operation of crop and livestock farming in Tharparkar and Thal, while in Cholistan livestock farming is carried out by family members staying in Greater Cholistan and crop farming by the family members staying in Lesser Cholistan. Cattle are the most important animal of all three deserts. In Cholistan, goats were present in two, out of three herds while camels and sheep are kept by almost every second herder in the area. In Tharparkar, almost every farmer has kept goats along with cattle while camel and sheep were present in about half of the farming households. Buffaloes were reported at only 5% sample farms in Tharparkar desert. In Thal desert, majority of the households found keeping cattle and goats simultaneously, whereas, sheep were present on 77% farms, buffaloes on about 54% farms and camels on 48% farms (Table 3).

Considering the composition of different livestock species, in large ruminants, the average number of cattle per farm was the largest in all three deserts. Camel was the second most kept animal in Cholistan and Tharparkar deserts while the average number of camels per household in Thal is quite low. The total number of small ruminants per household in Cholistan was highest followed by Tharparkar and Thal deserts. Regarding composition of sheep and goats, the average number of sheep per household were much higher than goats in Cholistan, while opposite was true

in Tharparkar desert. In Thal desert, the difference in the number of sheep and goats per household was quite narrow. Donkey is pack animal in all three deserts, however, their number per herd was the highest in Tharparkar compared with other two deserts (Table 4). These findings are almost similar to the results reported by earlier studies carried out in the area.

Table 3: Animal species kept by sample herders in three deserts of Pakistan

(Percent Yes)

Animal species	Cholistan	Tharparkar	Thal
Buffalo	20.5	5.0	54.2
Cattle	95.1	76.7	95.8
Camels	45.1	48.3	48.3
Sheep	50.0	54.2	76.7
Goats	67.2	95.0	95.8
Animal species/farm (#)	2.2	2.8	3.8
Total animal units (#)	63.62	22.54	17.44

Table 4: Animal types and composition by farm types in Cholistan desert of Pakistan

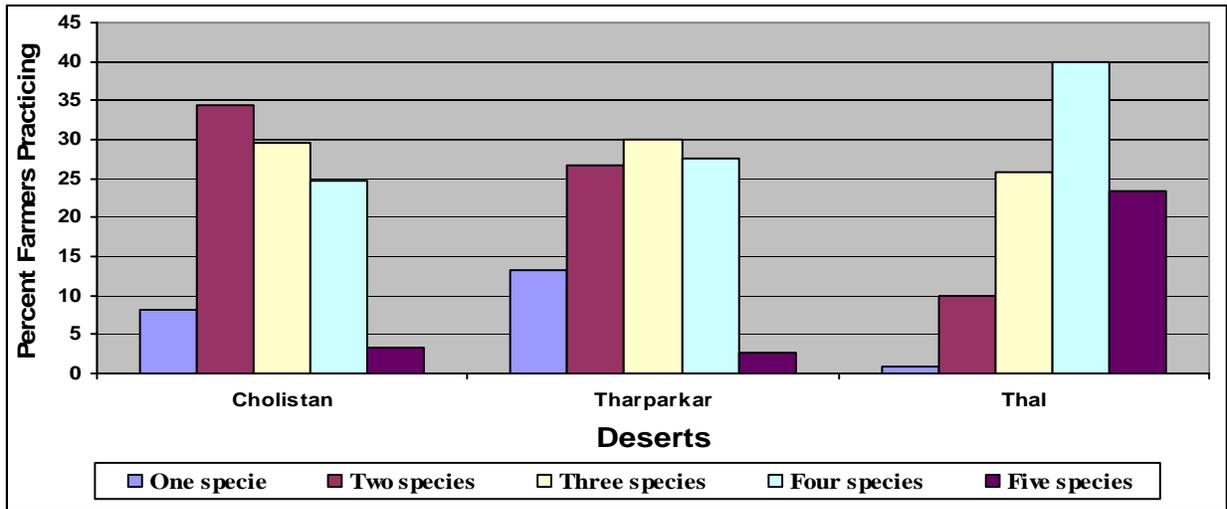
Animal types	Cholistan	Tharparkar	Thal
<u>Cattle (No. of heads):</u>	<u>51.01</u>	<u>9.37</u>	<u>7.00</u>
- Cow	33.53	6.59	4.21
- Bullocks/bulls	0.05	0.18	0.09
- Heifers	8.70	1.84	0.87
- Sires	0.82	0.05	0.12
- Young stock	7.91	1.84	1.72
<u>Buffaloes (No. of heads):</u>	<u>1.12</u>	<u>0.31</u>	<u>2.52</u>
- Buffaloes	0.79	0.18	1.46
- Male buffaloes	0.00	0.01	0.05
- Heifers	0.10	0.08	0.35
- Sire	0.00	0.01	0.03
- Young stock	0.23	0.04	0.06
<u>Camels (No. of heads):</u>	<u>4.31</u>	<u>1.60</u>	<u>0.89</u>
- Female camels	2.69	1.08	0.48
- Male camels	0.70	0.39	0.22
- Heifers	0.43	0.03	0.03
- Sires	0.01	0.01	0.00
- Young stock	0.48	0.09	0.16
<u>Sheep (No. of heads):</u>	<u>60.76</u>	<u>17.83</u>	<u>16.55</u>
- Adult sheep	49.63	13.31	14.37
- Young stock	11.13	4.52	4.88
<u>Goats (No. of heads):</u>	<u>19.45</u>	<u>43.23</u>	<u>22.81</u>
- Adult goats	14.84	33.23	16.36
- Young stock	4.61	10.01	6.65
Donkeys (No. of heads)	0.42	2.13	0.21
Mules (No. of heads)	0.00	0.04	0.06
Other animals (No. of heads)	0.00	0.08	0.08
Total livestock heads (Nos.)	136.65	72.33	49.76
Total animal units (#)	63.62	22.54	17.44

It was found that 2 - 4 species are commonly kept in Cholistan and Tharparkar, while in Thal, 3 - 5 species are commonly present on sample farms (Figure-1). On two species farms, cattle-goats is relatively more commonly available combination in all deserts. Among three species farms, cattle-sheep-goats combination is relatively more common in all deserts. In Tharparkar, cattle-camels-goats combination is also common. Amongst four species, relatively more common combination is cattle-camel-sheep-goats. In Thal, cattle-buffalo-sheep-goats combination was also almost equally popular in addition to cattle-camels-sheep-goats. Having all five animal species was least practiced except Thal where it was found on nearly one-fourth of the sample farms (Table 5). It is also worth mentioning here that on almost all two or more species farms, both small and large ruminants were present. Perhaps the reasons of keeping small with large ruminants are: i) the non-significant additional labor, feed and/or grazing expenses involved; and, ii) small ruminants are easy to sell for fulfilling urgent household monetary needs.

Table 5: Livestock enterprise combinations (% farms) practiced in three deserts of Pakistan

Species combinations	Cholistan	Tharparkar	Thal
<u>Single Species:</u>	<u>8.2</u>	<u>13.3</u>	<u>0.8</u>
- Cattle only	8.2	0.8	-
- Buffaloes only	-	-	-
- Camels only	-	-	-
- Sheep only	-	2.5	-
- Goats only	-	10.0	0.8
<u>Two Species:</u>	<u>34.4</u>	<u>26.7</u>	<u>10.0</u>
- Cattle and Buffaloes	2.5	-	-
- Cattle and Camels	11.5	0.8	-
- Cattle and Goats	13.1	19.2	6.7
- Cattle and Sheep	3.3	-	1.7
- Buffalo and Sheep	0.8	-	-
- Buffalo and Goats	0.8	-	0.8
- Camels and goats	-	1.7	-
- Sheep and Goats	2.4	5.0	0.8
<u>Three Species:</u>	<u>29.5</u>	<u>29.9</u>	<u>25.8</u>
- Cattle, Sheep and Goats	14.8	11.7	15.0
- Cattle, Buffaloes and Goats	1.7	0.8	5.8
- Cattle, Camels and Buffaloes	1.6	-	-
- Cattle, Camels and Goats	8.2	12.5	2.5
- Cattle, Camels and Sheep	1.6	0.8	-
- Buffaloes, Sheep and Goats	0.8	0.8	-
- Camels, Sheep and Goats	-	3.3	1.7
- Cattle, Buffaloes and Sheep	0.8	-	0.8
<u>Four Species:</u>	<u>24.6</u>	<u>27.5</u>	<u>40.0</u>
- Cattle, Camels, Sheep and Goats	16.4	26.7	16.7
- Cattle, Buffaloes, Sheep and Goats	5.7	0.8	15.0
- Cattle, Buffaloes, Camels and Goats	2.5	-	6.7
- Cattle, Buffaloes, Camels and Sheep	-	-	1.7
<u>All Five Species:</u>	<u>3.3</u>	<u>2.6</u>	<u>23.3</u>
- Cattle, Buffaloes, Camels, Sheep and Goats	3.3	2.6	23.3

Figure – 1: No. of species commonly present on sample farms in three deserts of Pakistan



Since cattle and sheep/goats are major animals in all three deserts, the objectives of keeping these animals reported by sample farmers in terms of percent scores is given Table 6. Overall, home consumption of milk and selling the adult and young stock (particularly male adults of sheep/goats) are the primary objectives of livestock farming in these deserts. A very small proportion of households reported producing animals (cattle, camels, sheep and goats) for selling on *Eid-ul-Azha*, when the prices are higher than the normal days. This is mainly because the ecological conditions of desert do not permit the farmers to produce premium quality animals for obtaining better prices. It is also equally possible that livestock traders may not be offering significantly higher prices for better quality animals to the farmers as livestock markets in the desert ecologies are at very far distant places.

Table 6: Objectives of keeping different animal species in three deserts of Pakistan

	(Percent Score)		
Animal species/objective types	Cholistan	Tharparkar	Thal
<u>Cattle:</u>			
- Home consumption of milk	15.6	37.5	44.5
- Sale of young stock	33.4	22.5	18.7
- Sale of adult animals	18.1	17.3	12.3
- Sale of dairy products	29.5	9.7	2.5
- Sale as sacrificial animals	0.4	5.7	12.5
- Status symbol	0.8	4.5	3.8
- Sale as breeding animals	0.7	1.1	4.6
- Draft animal for plowing	-	0.4	-
- Other	1.5	1.3	1.2
<u>Sheep/goats:</u>			
- Home consumption of milk	6.7	30.8	16.6
- Sale of young stock	43.8	22.0	29.1
- Sale of adult animals	25.2	21.0	20.4
- Sale of sacrificial animals	9.3	9.8	18.2
- Sale of wool/hairs	11.1	7.8	6.9
- Status symbol	0.5	3.7	2.1
- Sale of dairy products	-	3.0	0.5
- Sale as breeding animals	0.6	1.1	4.4
- Other	13.2	0.8	2.0

3.3. Livestock Grazing and Stall Feeding Practices

Both separate as well as combined grazing of small and large ruminants are reported a common practice. Separate grazing is dominant in Cholistan while it was practiced by 2/3rd of the farmers in Tharparkar and Thal. In Tharparkar and Thal, mixed grazing was also practiced by one-third and 27% farmers, respectively. It was also observed that separate grazing was generally practiced by farmers having larger herd sizes, which is according to *a priori* expectations (Table 7).

Table 7: Livestock grazing methods (% farmers) practiced in three deserts of Pakistan

	(Percent farmers)		
Items	Cholistan	Tharparkar	Thal
No grazing or only stall feeding	-	-	4.2 (13.7)
Separate grazing of small and large ruminants	91.5 (n.a.)	66.3 (28.7)	65.8 (18.2)
Mixed grazing of both small and large ruminants	8.5 (n.a.)	33.7 (18.0)	26.7 (12.5)
Both separate and mixed grazing	-	-	3.3 (26.3)

Figures in parentheses are herd size estimated in standard animal units.

Since livestock farming in Cholistan is mainly grazing based and herders frequently travel between Lesser and Greater Cholistan, their movement patterns are given in Table 8. In desert ecologies, sometimes herders travel to distant places for grazing and return home after 2-3 days. Both family and hired labor were used for grazing. Two systems, i.e. monthly salary (excluding food, clothes and shoes) and payment per animal basis, prevail in the area. The salaries also vary

across deserts, but fairly homogenous rates prevail for cattle, camel and sheep/goat grazing. For instance, the cattle, camel and sheep/goat grazing charges per animal per month in Tharparkar desert were Rs.115, Rs.200-250, and Rs.30 respectively in 2007.

Table 8: Movement schedule and activities of herders between lesser and greater Cholistan

Months	Location/Movement and Livestock Production Activities Carried Out
July - August	Migration from irrigated areas of Lesser Cholistan, canal and riverbanks to the owned <i>tobas</i> . Livestock generally grazes on the vegetation around <i>tobas</i> .
September - October	Depending upon the size of <i>tobas</i> and water available, generally, movement to temporary encampments at <i>tobas/kunds</i> started. Livestock grazes distance from <i>tobas/ kunds</i> increases.
November - December	Movement to <i>tobas/kunds</i> in search of water and vegetation continues. Livestock grazes relatively at very distant places around <i>tobas/kunds</i> .
January - February	Movement to <i>tobas/kunds</i> in search of water & vegetation continue with slow retreat to Lesser Cholistan. Livestock grazes relatively at very distant places around <i>tobas/ kunds</i> .
March - April	Return to irrigated fringes of Lesser Cholistan increases as wheat harvesting period arrives closer. Livestock grazes relatively at very distant places around <i>tobas/kunds</i> .
May - June	Stay in villages/settlements and temporary congregation on wastelands. Livestock is fed by grazing and stall feeding of purchased or self-planted fodder.

Source: FAO/ADB (1993) and some survey observations.

The stall-feeding practices were investigated by ruminant type by recall memories of respondents about feed types, their feeding periods and approximate quantities fed. In Tharparkar, ten different types of fodders were fed to large ruminants. In various calendar months, 6-9 types of fodders were fed. Among them sorghum/millet straw followed by guar seed straw remained dominant throughout the year while minor quantities of food grains were also fed to lactating animals (Figure 2). In feed composition, again sorghum/millet straw remained dominated around the year and its maximum proportions were fed in December-January (Fig. 3).

Figure 2: Stall-feeding patterns (% farmers) of large ruminants in Tharparkar desert

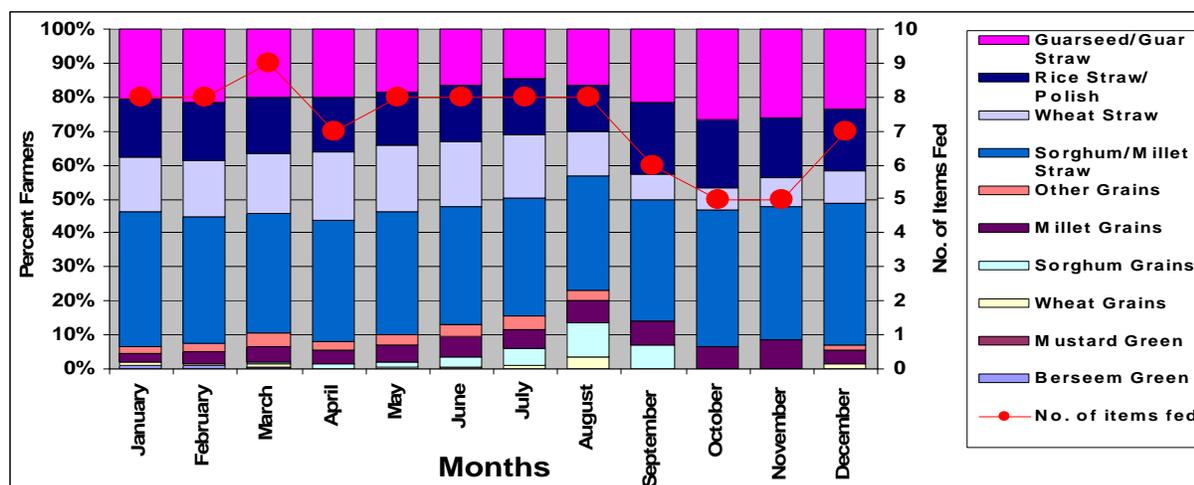
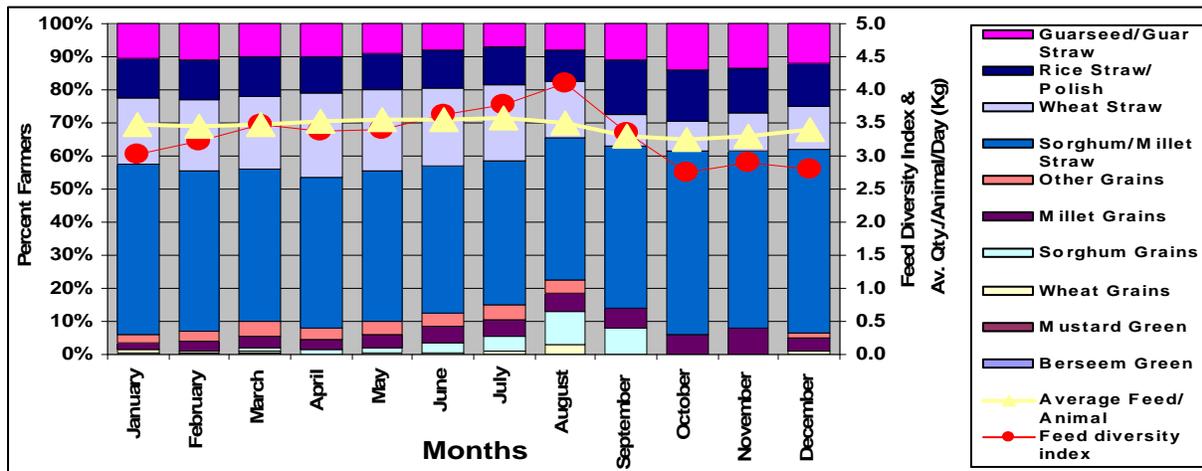


Figure 3: Stall feed composition (% share) of large ruminants in Tharparkar desert



Like Tharparkar, in Thal, ten different types of fodders and crop by-products were fed by sample respondents to large ruminants. These were wheat straw followed by lucern, other green fodder, other dry fodders, mustard, green wheat, green and dry stalks of sorghum and millet, and gram straw. In various calendar months 6-9 types of fodders were used. Among them, wheat straw and other dry fodders remained dominant all over the year while lucern was increasingly fed during December to April, March whereas gram straw was utilized from May to September (Figure 4). Regarding feed composition, again wheat straw remained dominated ingredient throughout the year and its maximum quantity was fed in June-July months (Figure-5). The share of lucern was highest in February and March. The average quantity of feed during stall feeding varied from 23.3 kg/day/animal during June to 15.8 kg/day/animal during February-March months. The feed diversity index was as low as 1.5 in June and as high as 2.8 in December.

Figure 4: Stall-feeding patterns (% farmer) of large ruminants in Thal Desert of Pakistan

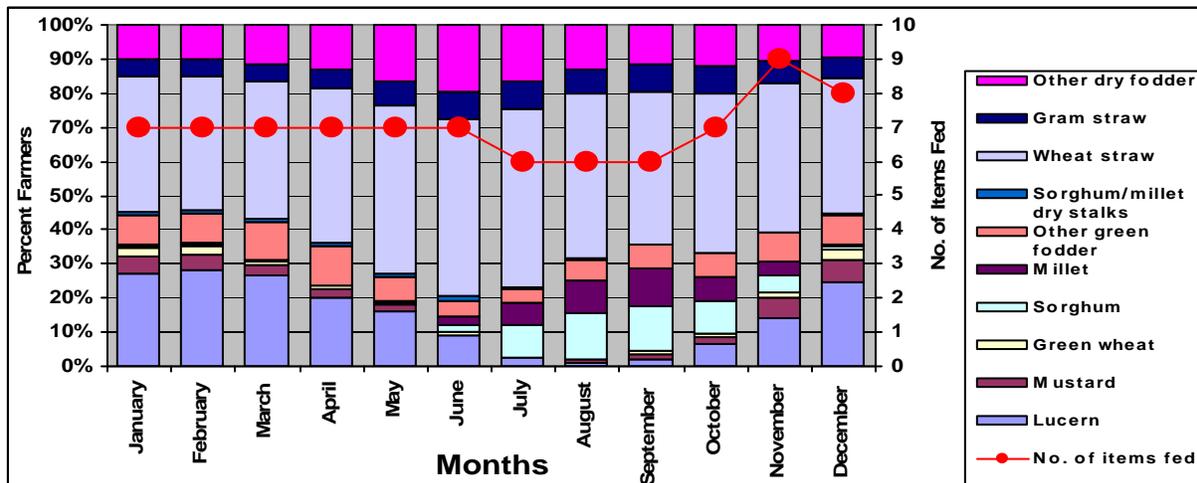
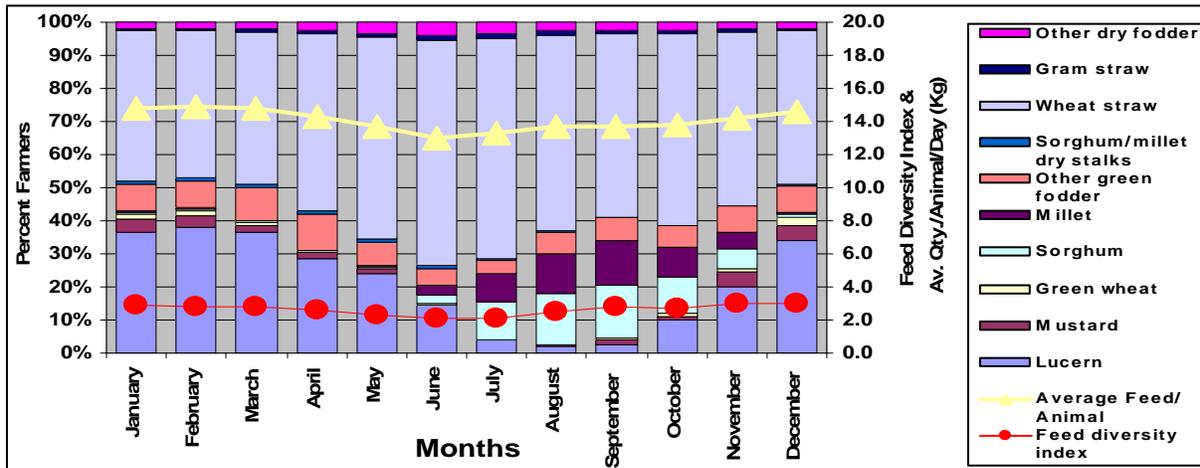


Figure 5: Stall feed composition (% share) of large ruminants in Thal Desert of Pakistan



Considering stall-feeding to small ruminants, in Tharparkar, again the longest fed item was guar seed straw followed by millet straw, fruit plant leaves and rice straw. A highly limited use of food grains like millet, mung bean/moth beans and wheat grains was also reported (Figure 6). In Thal desert, ten types of fodders were fed during stall feeding, i.e. wheat straw, gram straw, dried hay, berseem, wheat grain, gram grains, green leaves of the plants/trees and stalks of maize, sorghum and millet. Wheat straw was the most frequently fed item followed by gram straw, hay, berseem/lucern, wheat grain, maize, green leaves, sorghum and millet stalks (Figure 7). The above discussion leads to conclude that the crop byproducts/dry straws are main stall-feeding items of both small and large ruminants. The use of food grains is very small and limited to lactating and sale purposes small ruminants. Khan *et al.* (1993) also reported same for Thar.

Figure 6: Stall-feeding patterns (# of days) of small ruminants in Tharparkar dert

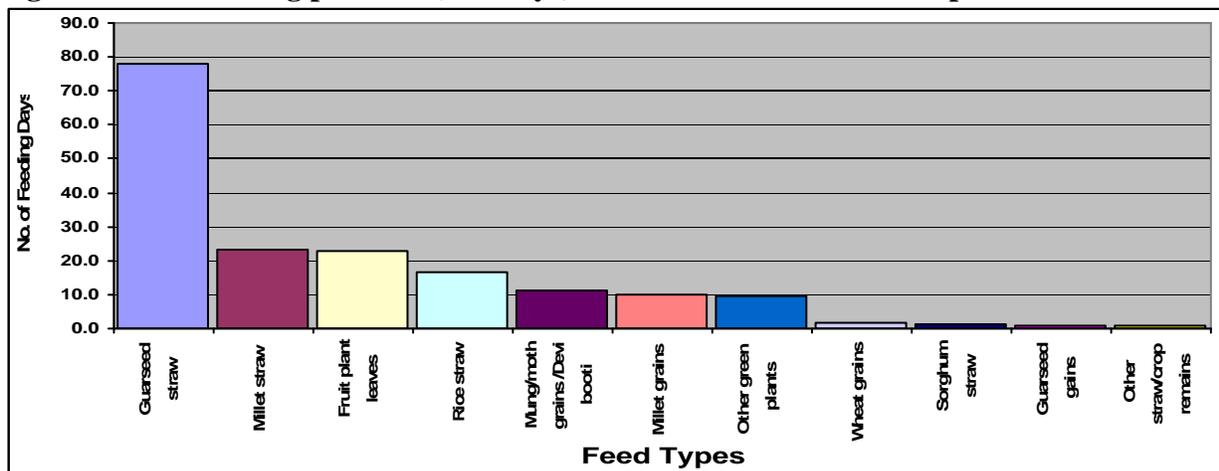
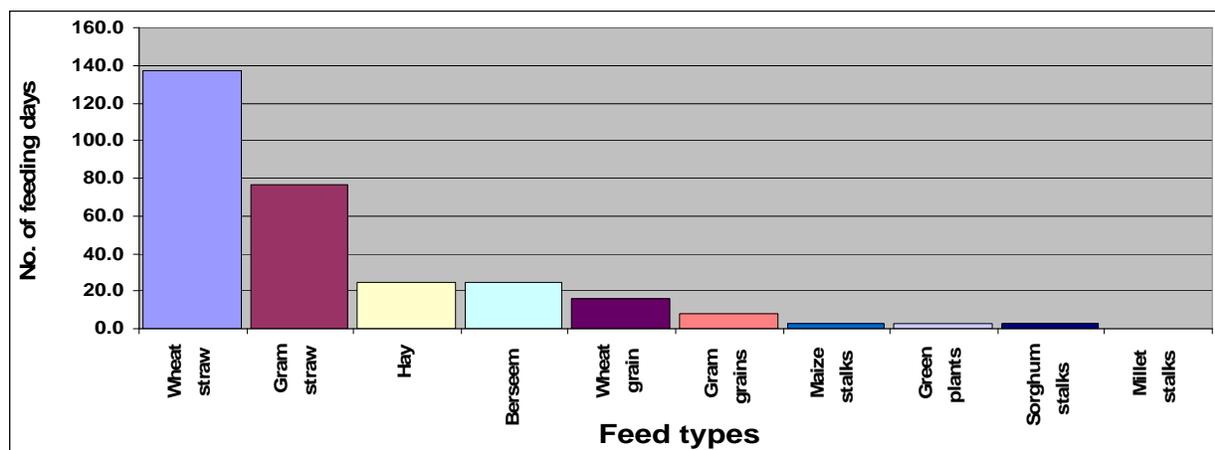


Figure 7: Stall-feeding patterns (# of days) of small ruminants in Thal desert



3.4. *Livestock Reproduction and Health Management*

Natural breeding is predominantly practiced in all desert ecologies with due ethical considerations⁵. Male young stock of large ruminants are usually sold before reaching to the stage of their sexual maturity, therefore, castration in large animals is rare. In small ruminants, males are castrated by traditional method by using knife while, veterinary staff uses castrators. The sires remain with the herds during grazing but livestock breeding seasons are reasonably well defined as majority of births take place in spring. In good seasons, sheep and goats also have second breeding during September-November. Small size herders usually do not have their own sires, hence, are dependent on other herders' for sire services. The sires (from own herds and other herds) are usually selected on the basis of characteristics like better milk yield of the offspring and its mother, colour, physical health, better conceiving rate and its beautiful look. Sometimes the sires of other herds incidentally mates as herds get mixed during grazing in an area. In this way, both controlled and uncontrolled natural breeding methods found practiced in all three deserts. The chances of uncontrolled natural breeding are relatively high in small ruminants. It was found that natural breeding is dominant in all three deserts. Between natural controlled and uncontrolled methods, natural controlled is dominant in Thal and relatively more adopted in Cholistan. In Tharparkar, practicing natural uncontrolled is more common than natural controlled method, mainly because of dominance of one breed (i.e. Thari) and frequent mixing of herds having breeding bulls with other herds during grazing (Table 9).

⁵ In large ruminants, the services of a sire are utilized by a herd for 3-5 years because by the time his daughters attain sexual maturity. Therefore, the owners of breeding bull either sell it out or exchange with other owners in the area. In small ruminants, sires are replaced in 2-3 years.

Table 9: Livestock breed diversity on sample farms in three deserts of Pakistan

Breeding methods	(No. of breeds)		
	Cholistan	Tharparkar	Thal
Natural controlled	54.9	35.8	60.8
Natural uncontrolled	45.1	47.4	6.7
Artificial insemination	-	1.8	10.0
More than one from the above	-	15.0	22.5

About disease incidence, in Cholistan, frequent disease epidemics were reported among both small and large ruminants. The common diseases of large ruminants were Haemorrhagic Septicaemia, Black Quarter, Foot & Mouth Disease, Anthrax, Mange, Sura, Camel Pox, Endo- and Ecto-parasites, etc. The small ruminants' common diseases were Enterotoxaemia, Pleuropneumonia, Sheep & Goat Pox, Anthrax, Liver Fluke, and Endo-/Ecto-parasites, etc. Only a small fraction of camel herders (5.5%) reported incidence of disease(s) among the camel at their farms. The disease occurrence on about 46%, 59% and 34% of the sheep, cattle and goat farms, respectively.

Similarly in Tharparkar, the common diseases of large ruminants were Black Quarter, Foot & Mouth Disease, Enterotoxaemia, Anthrax, contagious Caprine Pleuro-Pneumonia, Sura and Mange. Diseases like Haemorrhagic Septicemia, Sheep & Goat Pox, Mastitis and abortion were relatively less prevalent. Black quarter in cattle and Enterotoxaemia and Anthrax in sheep/goats are more common (Mahmood *et al.*, 1987). In Thal, highest incidence was reported for Foot & Mouth followed by hemoglobinurea, Enterotoxaemia, Haemorrhagic Septicaemia and Pneumonia.

3.5. Marketing of Livestock and Livestock Products

Information about livestock trade on sample farms shows that in Cholistan and Tharparkar, the adult animals trading intensity was lower than the young stocks whereas in Thal, the trading intensity of all age groups was almost same. In Cholistan, the adult animals trading intensity varied from 5.3% in cattle to 9.5% in goats, in Tharparkar from 2.7% in cattle to 15.7% in goats, in Thal from 7% in buffaloes to 15.5% in camels. On the other hand, the young stock trading intensity varied from nearly 15% in cattle to nearly 24% in camel, in Tharparkar from 22.1% in goats to 46.4% in cattle, in Thal from 7.3% in buffaloes to 15.8% in camels (Table 10).

Table 10: Livestock trade intensity by age group of animal species in three deserts of Pakistan

(Percent animal population traded)

Animal species	Cholistan	Tharparkar	Thal
<u>Adults:</u>			
- Buffaloes	n.a.	0.00	7.03
- Cattle	5.32	2.69	11.70
- Camels	3.76	5.01	15.48
- Sheep	7.41	13.71	9.29
- Goats	9.54	15.73	10.44
<u>Heifers:</u>			
- Buffaloes	n.a.	0.00	14.63
- Cattle	n.a.	3.17	11.54
- Camels	n.a.	25.00	50.00
<u>Young stock:</u>			
- Buffaloes	n.a.	0.00	0.00
- Cattle	14.96	46.43	7.28
- Camels	23.97	27.27	15.79
- Sheep	22.18	22.07	8.52
- Goats	19.17	22.07	8.52

Cattle are the major milk producing species and wide variations in average milk yield/animal were observed during summer and winter seasons. In Cholistan, the average daily milk yield/cow was 3.99 and 2.35 liters in summer and winter, respectively. The average summer season daily milk production was over 42 liters, whereas, the winter milk production was about 23 liters. In summer, about 9% of the daily milk production was used for domestic consumption, 56% processed into *desi ghee*, 6% was fed to infants/young stock (for quick and better growth) as a feed supplement and about 29% was sold as fresh milk. In winter despite decline in total milk production, the proportions of milk consumed at home and marketed increased (i.e. from 9% to 16% for home consumption and from 29% to 31% for marketing purpose), whereas, the percentage of milk in other uses (processed for *ghee* making and fed to young stock) steadily decreased. In Tharparkar, the average daily milk production per household was about 26 liters, more than half of which was from sheep/goats. Approximately, one-fifteenth of total milk produced is sold within or nearby villages and remaining is consumed at home as liquid milk, yogurt, and/or converted it into butter or *desi ghee*. The average production of *desi ghee*/household was around 3 kg/household/month. A small part of *desi ghee* is domestically consumed and remaining is sold to shopkeepers in the villages and nearby towns. In Thal, the average daily milk production per household was 13-14 litres, of which sheep/goat milk constitutes about 36%. About 15% - 50% of total milk produced is sold within or nearby villages and remaining is consumed as liquid milk,

yogurt, converted to butter and *desi ghee*. The average production of *desi ghee* per household was about 6.50 kg/month. The produced *desi ghee* is sold to village shopkeepers and nearby towns.

3.6. *Economic Analysis of Livestock Production*

Economic analysis of livestock farming is a dire felt need of policy and development circles in Pakistan because such information is highly scarce in general and for desert ecologies in particular. To fill this gap, an economic analysis of livestock farming in Thal and Tharparkar deserts was carried out, while such information for Cholistan is not available. The livestock farming in both Tharparkar and Thal deserts is grazing-cum-stall feeding type. As feed composition varies during a calendar year, therefore, monthly information on quantities of different items fed by animal type was used for cost estimation.

For Tharparkar desert, the economic analysis of cattle and sheep/goat farming is given in Tables 11 and 12, respectively. Various assumptions (narrated in footnotes of the tables) based on informal discussions with knowledgeable farmers of the area were also used during economic analysis of cattle and sheep/goats farming. From economic cost accounting perspective, the net income per adult cattle was Rs.1176 per annum (Table 11), whereas, sheep and goats farmers earned Rs.210 and Rs.93 per adult animal, respectively (Table 12). On average herd size bases, the net income per month of keeping cattle (for milk) and rearing sheep and goats (for meat purpose) were Rs.911, Rs.421, and Rs.308, respectively. In Thal desert, for cattle production, the net income per adult cattle was Rs.783 per annum (Table 11) whereas sheep and goats farmers earned Rs.255 and Rs.288 per adult animal, respectively (Table 12). On average herd size basis, the net income/month from cattle (for milk), sheep and goats farming (for meat purpose) were Rs.457, Rs.454, and Rs.552, respectively (Table 11 and 12).

Table 11: Economic analysis of cattle farming in Tharparkar and Thal deserts of Pakistan

Items	Tharparkar (Rs./animal head)	Thal (Rs./animal head)
Cost s side:		
- Stall feeding expenses	8457.03	6477.72
- Grazing and livestock management ¹	3600.00	2400.00
- Value of the cattle	25000.00	25000.00
- Health management expenses	412.19	350.00
- Animal quality depreciation allowance ²	2500.00	2500.00
- Interest on capital invested ³	3856.92	3832.77
Total cost	43966.14	40400.49
Returns side:		
- Income from the sale of milk ⁴	16141.92	12183.50
- Value of infant born	4000.00	4000.00
- Value of the cattle ⁵	25000.00	25000.00
Total value of output (live animal + milk produced + baby born)	45641.92	41183.50
Net Returns:		
Net profit per adult animal	1178.78	783.01
Returns per month per animal	97.98	65.25
Average monthly income/herd (Rs.) (using sample average of 9.3 animals in Tharparkar and 7 in Thal desert)	911.23	456.76

¹ From the informal discussions with the farmers in Tharparkar and Thal deserts, it was found that keeping in view the localized conditions like availability of grazing vegetation and mean grazing hours, one man can easily manage grazing and other tasks of 20 cattle in Tharparkar and 25 cattle in Thal. The prevailing mean opportunity wage rate (in the forms of cash and kind) for the livestock grazier were Rs.6000/= per month in Tharparkar and Rs.5000/= per month in Thal.

² There are various methodologies available in the literature for working out animal depreciation allowance. Based on 5-7 pregnancies per working life and salvage value at the end of working life, the annual animal quality depreciation allowance came about 10% of the total value of the animal at beginning of the year.

³ Interest on invested capita was calculated @ 10% per annum.

⁴ According to Iqbal *et al.*, 2000, average milking days of cattle in Cholistan are 236 days/annum. In Tharparkar, the average milk yield per cattle was 4.82 liters/day and average milk price in the area was Rs.14.63/liter. The value of one day old cattle baby was taken as Rs.3500/=. In Thal, the average milk yield per cattle was 3.5 liters/day and average milk price in the area was Rs.14.75/liter. The value of one day old cattle baby was taken as Rs.4000/.

⁵ Here, the value of animal was taken as such because the animal quality deterioration is already taken care of in the item on interest on capital invested on the cost side.

Table 12: Economic analysis of small ruminants' production in Tharparkar and Thal deserts of Pakistan

Items	Tharparkar		Thal	
	Sheep ¹ (Rs./head)	Goats (Rs./head)	Sheep ¹ (Rs./head)	Goats (Rs./head)
Cost s side:				
- Stall feeding expenses	339.29	452.39	500.72	667.63
- Grazing and livestock management ²	825.00	1100.00	900.00	1200.00
- Infant value	466.40	559.03	500.00	600.00
- Health management expenses	109.57	66.03	179.08	108.12
- Animal quality depreciation allowance	233.20	279.51	279.10	350.70
- Interest on capital invested ³	148.01	245.70	176.92	292.65
Total cost	2121.47	2702.66	2535.82	3219.10
Returns side:				
Average sale price per adult animal	2332.00	2795.14	2791.00	3507.00
Net Returns:				
Net profit per adult animal	210.53	92.48	255.18	287.90
Returns per month per animal	23.39	7.71	28.35	23.99
Average monthly income/herd of 18 sheep and 40 goats (the sample average)	421.05	308.28	453.65	551.82

¹ The mean animal raising period in sheep was 9 months and one year in goats, before it becomes ready for sale.

² There are various methodologies available in the literature for working out animal depreciation allowance. In case of small ruminants, the average productive life is 4 years, however, the number of babies born during productive life is quite high, but the salvage value is very low and there is also a high probability of suffering from diseases. In order to take care of these factors, again an annual animal quality depreciation allowance for sheep/goats was taken as 10% of the total value of the animal at beginning of the year.

² In Tharparkar desert, the average herd size of farmers raising more than 10 adult animal equivalents was 59.4 animals per herd. Based on discussions with local farmers, one person can easily manage grazing etc. of a herd of 60 sheep/goats. The monthly salary of shepherd was Rs.5500/month. In Thal desert, the average herd size of farmers raising more than 10 adult animal equivalents was 45 animals per herd. Based on discussions with local farmers, one person can easily manage grazing etc. of a herd of 60 sheep/goats. The monthly salary of shepherd was Rs.5500/month.

³ Interest on invested capita was calculated @ 10% per annum.

3.7. Socioeconomic, Institutional & Policy Constraints to Livestock Productivity

From the economic analysis of small and large ruminants farming, it is clear that returns from livestock farming are quite low. A number of socio-economic, institutional and policy related constraints are associated with it. The discussion in the subsequent sub-sections is based on already discussed findings, literature review and observations during the survey.

Socioeconomic Constraints

Relatively more peculiar socioeconomic problems in Cholistan include limited supply of forage and fodders, poor health of the animals, more physical exertion of animals during grazing,

frequent incidence of diseases and droughts, difficulties in getting health services and approaching all herders in vaccination campaigns, least opportunities of getting children's education as the herders keep moving from one *toba* to the other, low milk productivity per animal, highly limited milk marketing opportunities, non-existence of milk preservation facilities with the herders leaves few options like early consumption of milk, feeding to young stock, and/or processing for making *ghee*. Since marketing of live animals mostly takes place in summer on arrival of herders in Lesser Cholistan, therefore, the benefits of sudden rise in animal supply are harvested by livestock traders or *beoparies* and butchers. This leads to sub-optimal returns to the year long hard work of the herders (Iqbal *et al.*, 2000).

In Tharparkar, livestock farming is seriously constrained by low carrying capacity of the rangelands, frequent droughts. On the other hand, the average farm and herd sizes are fairly large creating difficulties in managing their feed, particularly during droughts. Limited crop farming opportunities (mostly confined to kharif season crop cultivation) and high costs of tubewell irrigation, little availability of ground water and its high levels of brackishness, negligibly small proportion of total operational holding is irrigated. This leads to very heavy dependence of livestock farming upon grazing. The average daily grazing hours of cattle and sheep/goats are quite long and grazing is performed within a radius of 4.5 to 5 kilometers. There is a dearth of supply of sires of improved breeds as well as good quality sires. The availability of health facilities, the veterinary hospitals/dispensaries and veterinary medicines' shops are located at very long distances. As only 42% sample villages were electrified, therefore, the households cannot keep refrigerator for chilling milk till it is disposed off to some milk marketing agency. These conditions compel the farmers to either consume the milk immediately or preserve it by heating and then converting into various products. Due to distant location of livestock markets, livestock traders or *beopries* are the only major market intermediary in the area (Farooq *et al.*, 2008b).

Livestock farming in Thal desert has income-supplementing role in total household income, as the mean operational land holdings of farming households are quite large. The average herd size was estimated as about 17 standard animal units (SAU). Wheat and gram straws are main source of animal feeding in stall-feeding. On average, the cattle and sheep/goats graze in the rangelands for 4 and 6 hours/day, respectively. The mean quantity of fodder provided to cattle ranges from 12.3 kg/day to 15.8 kg/day, and 1.16 kg/day to sheep/goats, which

is quite high when compared with stall feeding in Tharparkar desert. This also indicates the death of rangeland vegetation in the desert as well as substantial monetary needs for financing stall-feeding expenditures. This also partially explains the smallest herd size of the Thal desert farmers compared to other two deserts (Ref. Table 4). The stall-feed is mainly composed of wheat and gram straws, thus seriously deficit in minerals and vitamins requirement, i.e. below the Recommended Dietary Allowances. For improving milk and meat productivity, the natural cross-breeding method is mainly used. The farmers on their own are trying to increase cattle milk productivity by crossing them with Sahiwal, Friesian and Jersey breed bulls. For sheep breeding, the rams of *Kajli* breed and in goats the bucks of *Beetle* and *Teddi* breeds are also available in the area, but their supply is quite limited than the demand of the area. On one hand, this signifies the farmers of the area are trying to increase their livestock sector income by increasing milk productivity which may be partly used for financing their stall-feeding expenditure. On the other hand, by better feeding and producing good quality cross-bred animals, they shall be able to earn more from the sale of live animals. However, due to distant location of milk and livestock markets, livestock traders or *beopries* are the only major market intermediary in the area. In general, the farmers have been receiving lower prices of their animals when sold to local *beoparies* (Farooq et al., 2008a).

Institutional Constraints

At present, the agricultural research and extension, water research and development, provincial departments like Livestock and Dairy Development Department/Animal Husbandry, Forest Department/Range Management Circles and Agricultural Extension, and numerous NGOs (the largest number in Tharparkar desert compared to other two deserts), NRSP and development authorities are working in the desert areas. No doubt, the objectives/ functions assigned to these agencies are laudable in their own place, but there is no institutional coordination or coordinating agency presently observed in the area. This is why, despite all the efforts, no significant developments has taken place in these deserts since ages and livestock productivity and rangelands carrying capacity related issues are persistently low in the desert ecologies (Iqbal *et al.*, 2000; Farooq *et al.*, 2008ab).

Policy Constraints

The Prime Minister of Pakistan approved the first livestock development policy on March 1, 2006 (Afzal, 2007). On the other hand, like other parts of the country, no market regulations or regulatory framework were implemented in the study areas. However, the meat price fixing policies of the local governments is more seriously affecting the incentives of producing quality animals. Therefore, a significant proportion of the farmers of the study area opted to keeping *desi* breeds of cattle, sheep and goats. The farmers of the area are attempting to increase their livestock sector incomes on their own by adopting self-devised measures like purchasing good quality animals from co-villagers and using the services of high-repute sires through natural breeding. The non-existence of milk marketing infrastructure is a serious constraint in this regard. In sheep and goats the rams/bucks of improved breeds are present with few farmers in the area. The remote presence of livestock markets and exploitive role of *beoparies* are serious bottlenecks. Strong developmental potential exists in the area, if the strategies delineated in the livestock policy 2006 are also implemented along with provision of market linkages.

4. Conclusions and Recommendations

The desert economies are primarily livestock farming based. Wage earnings opportunities from adjacent irrigated of these deserts provide substantial support in total household income. The livestock farming in Cholistan is mainly grazing based (nomadic type) while of Tharparkar and Thal are grazing-cum-stall fed system falling under sedentary type of livestock production system. Both *rabi* and *kharif* crops are cultivated on agricultural lands in Cholistan and Thal deserts while crop farming is confined to *kharif* season in Tharparkar desert. Other common issues are longer grazing hours, highly sub-optimal stall feeding, periodic occurrence of droughts leading to expansion in bigger average herd sizes as shield against financial/drought shocks, poor health coverage, poor performance of rangeland development institutions leading to low carrying capacity of vegetation, poor animal health. Negligible existence of milk marketing system and poor livestock marketing linkages further reduces farmers' returns to livestock farming. Larger average herd sizes further exert pressures, feed, fodder, heath and other agro-ecological systems of the areas. Live animals, milk and *desi ghee* are the main livestock products of the area and none of these items is produced on commercial lines. Thus, livestock is kept as a mean to social security, a way of saving and a sign of wealth and social status. With this low input – low output type of livestock farming in the area, a highly institution-coordinated comprehensive approach is needed to transform the livestock farming

of the area from low productive and low marketable surplus oriented to a highly productive market oriented and commercial farming system. To rectify this situation, the following suggestions for the overall development of the livestock sector in the area are hereby proposed:

1. Substantially high ratio of primary level students indicates a further need of middle and high schools at close distances to the settlements. It is suggested to either up-grade the existing primary schools as poor families cannot afford sending their children to distant places. The dearth of colleges also a genuine necessity of the area as high education will facilitate successful out-migration of talented youth of the area. The District and Tehsil Nazims are suggested to increase their struggles for developing infrastructures like opening new schools, up-gradation of roads, human and veterinary hospitals, establishing new milk and livestock markets for their respective area.
2. The institutional credit facilities should be provided to the farmers in the areas for installing tubewells where underground water is suitable for irrigation. To improve feed and fodder security, the cultivation of appropriate varieties of fodder crops should be introduced in the area. Local communities should be mobilized for re-plantation of multi-purpose and fast growing fodder trees, shrubs and grasses in order to fulfill the feed, timber and fuel needs of the dwellers of the deserts.
3. For improving the genetic potential of local livestock breeds, artificial insemination should be popularized along with offering the services of sires during breeding seasons. At the same time, the local communities should be trained to learn managing pedigree records of their animals to use it for getting premium prices for their live animals.
4. Interventions suggested for an efficient veterinary health cover for the livestock population of the area including effective control over major fatal diseases through widespread vaccination coverage, prompt provision of health services to affected animals, integrating veterinary assistant level training courses with financial institutions for opening veterinary clinics/hospitals at approachable distances for the livestock herders. The National Vocational and Technical Education Commission (NAVTEC) is also suggested to include Veterinary Assistant courses for agricultural neglected areas in their vocational training programs with appropriate stipend and other incentives.
5. Various incentives may be offered to the veterinary staff posted in the area and the rotation of replacement should be shortened to avoid lowering the morals of those serving in the area as they are generally deprived of various facilities during their posting period. Incentives like providing scholarships to the children of staff posted in deserts, awarding high scores to posting periods in deserts during departmental promotions, etc. are proposed for those posted in hard areas like deserts.
6. There is also a strong need to design some regulatory framework for milk and livestock marketing systems in order to increase due returns to the farmers' effort and attracting investment in livestock farming on commercial lines. Popularizing sale-purchase of animals on their live-weight basis is one of policy measures need to be implemented for slaughter purpose animals as early as possible in livestock markets of the country.

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