Chapter 7

Key Issues on Dairy and Meat Production and Productivity

Chapter 7 Key Issues on Dairy and Meat Production and Productivity

7.1 Overview

Pakistan is well endowed with wide variety of livestock breeds accommodated to its natural and socio-economic environments. Livestock rearing and dairy activities have been practiced traditionally for long time, which has made the country outstanding in terms of the numbers of head of many different breeds and the volumes of livestock, meat, and dairy products. Sindh in particular is the second largest province in these aspects; however, the investment for livestock development has been skewed largely towards Punjab Province. It is assumed by the Project Team that lots of the development potentials in the livestock sector have been still untapped.

The field surveys were conducted by the Project Team to investigate the present situations for understanding the characteristics of the areas and grasp the development potentials. The survey covered the whole value chain of livestock and dairy products, from production to marketing, and also included various cross-cutting issues such as rural society, rural finance, extension, the Department of Livestock and Fisheries and other related institutions, etc. As a result, it has been found there are a great number of the potentials as mentioned in the following chapters.

One of the most important tasks of the Project Team is to analyze those potentials and identify the significance such as impacts, cost-effectiveness, technical and social appropriateness, etc. of each of them. Considering that the livestock development strategies and the master plan are targeting only 10 years ahead, the planning of the effective ways to realize such existing and high potentials is important. In this regard, the limiting factors for the realization of the potentials and their countermeasures have also been identified and described in the chapters.

7.2 Natural Environment

7.2.1 Location and Climate

Sindh Province is located in the southern part of Pakistan, bordered with Rann of Kachh[1] in south, Rajastan (India) in east, Punjab Province in north-east and Baluchistan Province in north and west, lying between 23 and 29 degrees north latitude and 67 and 71 degrees east longitude. Sindh is also bounded by the Thar Desert to the east, the Kirthar Mountains to the west, and the Arabian Sea in the south.

Sindh is situated in the subtropical arid or semi-arid region. According to the data at the 4 stations in Karachi, Hyderabad, Nawabshah (Shaheed Benazirabad) and Rohri, the mean annual rainfall ranges from 82mm to 163mm, falling mainly between July and August (Table 7-2-1 and Figure 7-2-1). Figures 7-2-2 and 7-2-3 indicate mean maximum and minimum temperatures. The mean maximum temperatures rises about 45°C during May to June, especially at the inland districts like Nawabshah and Rohri, and the mean minimum temperatures is about 5°C in January in Nawabshah. Although the lowest falls below minus sometime, but the minimum temperature hardly falls below 5°C, which is an indicative lowest temperature for plant growth, even during December and January.

[1] Rann of Kachh or Rann of Kutch is a seasonal salt marsh located in the Thar Desert in the Kutch District, Gujarat State, India and the Sindh Province, Pakistan.

Table 7-2-1 Mean Annual Rainfall for the Period of 1961-2009

Station	Annual Rainfall (mm)
Karachi	163.0
Hyderabad	136.1
Nawabshah	114.0
Rohri	82.1

Source: Meteorological Department

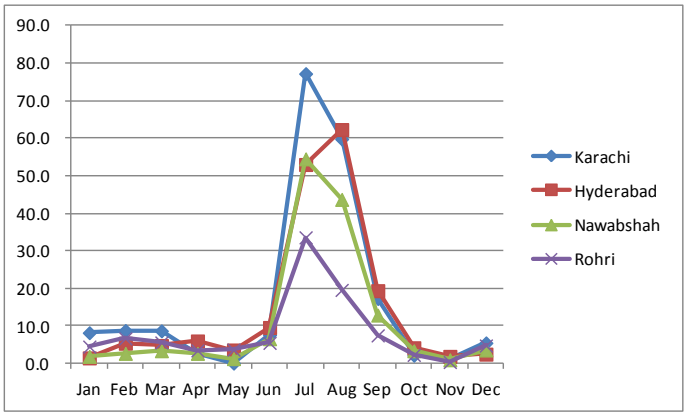


Figure 7-2-1 Mean Rainfall for the Period of 1961-2009 (mm)
Source: Meteorological Department

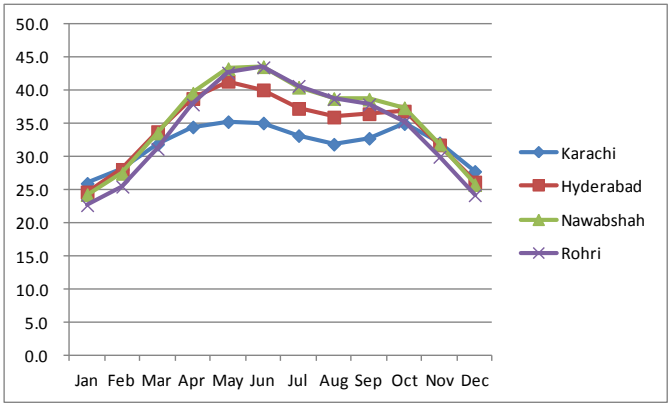


Figure 7-2-2 Mean Maximum Temperature for the Period of 1961-2009 (°C)
Source: Meteorological Department

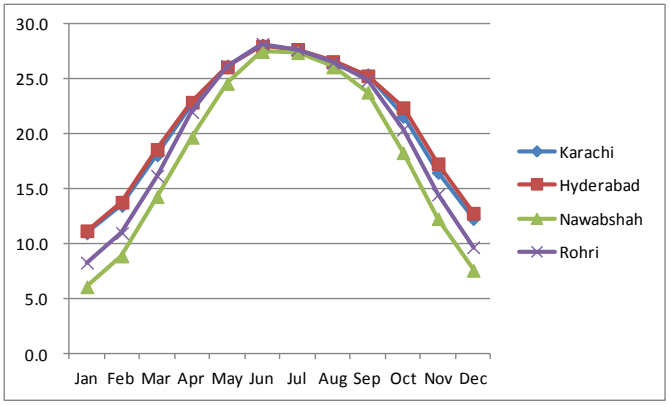


Figure 7-2-3 Mean Minimum Temperature for the Period of 1961-2009 (°C)
Source: Meteorological Department

7.2.2 Agro-ecological Zone

Historically, the province has been divided into 3 areas; *Siro* (the upper region, centered on Jacobabad), *Wicholo* (the middle region, centered on Hyderabad) and *Lar* (the lower region, centered on Karachi)[2]. The Agriculture Department of Sindh uses almost the same classification; upper Sindh, middle Sindh and Lower Sindh[3]. In summer, maximum temperatures are highest in the upper and lowest in the lower Sindh. Rainfall is highest in the central. Seasonal differences in temperature are large in the upper and central Sindh while the lower Sindh is relatively warm thanks to the influence of the monsoons.

[2] Burton, Richard F. (1851) *Sindh, and The Races That Inhabit The Valley of The Indus*, Wm. H. Allen & Co., London. Reprint, 1992, Asian Educational Services.

[3] The boundary between Middle and Lower is rather northern side since the whole Hyderabad district is included in Lower Sindh according to the zoning by the agriculture department.

Besides the above classification, Khoso (1992)[4] suggests the Agro-Ecological Region, in which Sindh is divided into the following 4 zones (see Figure 7-2-4):

I. *Kohistan* (hilly areas in the western part of Sindh),

II. Deltaic Plain (at the mouth of the Indus River),

III. Central Alluvial Plain (along the Indus River)

IV. Desert (at the eastern part of Sindh bordered with India).

By taking into consideration such existing land classifications as well as the different developmental characteristics of irrigated and non-irrigated areas, the whole province can be divided into 5 areas as the agro-ecological zones. The more details are shown in Figure 7-2-5 and Table 7-2-2.

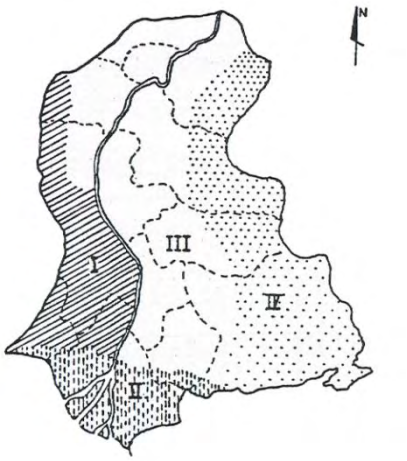


Figure 7-2-4 Agro-Ecological Regions of Sindh

Source: Khoso, A.W.(1992)

Zone		
Irrigated area		Upper (right bank of the River, upper reaches)
		Middle (left bank of the River, upper and middle reaches)
		Lower (deltaic plain)
Non-irrigated area		Thar desert
		Kohistan

Figure 7-2-5 Agro-Ecological Zone

Source: The Project Team

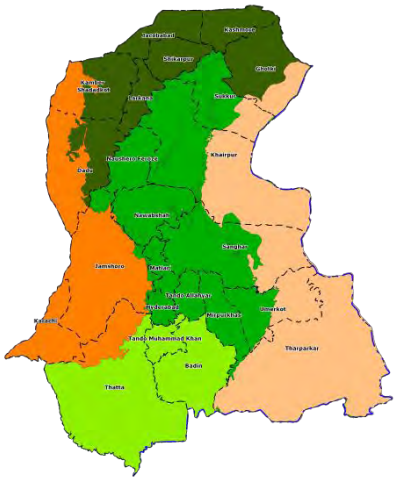


Table 7-2-2 Districts and Talukas in Each Agro-ecological Zone

	Agro-ecological Zone	District and Taluka
Irrigated areas (Central alluvial plain)	Upper	Shikarpur, Larkana, Jacobabad, Shahdadkot, Kashumore
	Middle	Sukkur, Khairpur, Sanghar, Matiari, Ghotki, Mirpurkhas, Tando Allahyar, NaushehroFeroz, Hyderabad, Nawabshah
	Lower	Thatta, Badin, Tando Muhammad Khan
Non irrigated area	Thar Desert	Tharparkar, Umerkot district, Khiprotaluka (Sanghar), Nara taluka (Khairpur)
	Kohistan	Karachi, Dadu, Jamshoro, a part of Thatta

[4] Khoso, A.W.(1992) *Crops of Sindh*. Published by Mohammad Ismail Khoso

7.3 Agriculture

7.3.1 Land Use and Main Crops

As mentioned in 6.1, the whole area of Sindh is 140,914 km^2, about 35% of which is the cultivated area. Nevertheless, 20,000 km^2, about 42% of the cultivated area, is the fallow land at present (Table 7-3-1).

Table 7-3-1 Land Utilization

(ha)

Province	Geographical area	Total cultivated area		Forests	Culturable waste	Not available for cultivation.
		Net area sown	Current fallow			
Sindh	14,091,172 (100%)	2,807,074 (19.92%)	2,062,050 (14.63%)	1,034,106 (7.34%)	1,416,114 (10.05%)	6,771,784 (48.06%)

Source: Agriculture Department

The main crops in each agro-ecological zone are as follows:

Irrigated area

(a) Upper Zone: This zone, right bank of the River, is the major production area of rice. Double cropping agriculture is common in this area, cultivating paddy in summer, and wheat, chick pea, field pea, lentil and mustard in winter.

(b) Middle Zone: The main cropping pattern at the upper and middle reaches of the Indus River plain (left bank) in summer is cotton, and wheat and mustard in winter. In the central area sugarcane and fodder crops are also widely grown. The large scale date palm plantations, where mango, banana, rice and berseem are intercropped, are found in the north side.

(c) Lower zone: The lower reaches of the Indus River is the delta plain, and the cropping there is characterized by sunflower production which has been increasing in winter. Rice is grown in summer and wheat in winter. The combination of this double cropping and sugarcane cultivation is common..

Non-irrigated Area

(a) Thar Desert Zone: Tharparkar is located in the south part of the Thar Desert. The land is sandy ridge undulating 20 to 50 meters in height and 1 to 3 kilometers in distance. The ridge tops and hill sides are used as grazing land since it is not suitable for farming while the lowland valley between the ridges is used for farming. Crops can be harvested only when there is rainfall. Drought resistant crops such as Bajra (*Pennisetum americanum*), Guwar (*Cyamopsis psoralides*), Mung (*Vigna radiate*), Moth (*Vigna aconitifolia*), Groundnut (*Arachis hypogaea*) are grown.

(b) Kohistan Zone: This area is a dry mountainous zone with plateaus and basins, which consists of a series of herbaceous and sparsely woody plants lands. Along the ephemeral streams that flow into the Indus plains there are evergreen forests. The main crops are sorghum, green gram and sesame cultivated under rainfed agriculture. On the other hand, around ThanoBula Khan (center of taluka) irrigated agriculture with groundwater from tubewell is practiced.

Table 7-3-2 shows the productions of the main crops in each agro-ecological zone during both *Kharif* and *Rabi* seasons[5]. In Figure 7-3-1, the cropping patters of those crops are indicated.

[5] The Kharif crop is the autumn harvest (also known as the summer or monsoon crop) in India and Pakistan. Kharif crops are usually

Table 7-3-2 Main Crops Grown in the Agro-ecological Zones

Season	Crops	Irrigated area						Non-irrigated area			
		Upper		Middle		Lower		Thar		Kohistan	
		Production		Production		Production		Production		Production	
		('000' t)	(%)	('000' t)	(%)	('000' t)	(%)	('000't)	(%)	('000't)	(%)
	Cereal & Cash crop										
Kharif	Rice	1,855.1	73.1	146	5.8	535.6	21.1	0	0	0	0
〃	Cotton	73.8	14.6	398.3	78.6	21	4.1	S.A		S.A	
〃	Maize	0.1	7.1	1.3	92.9	0	0	0	0	0	0
〃	millet	0.1	0.2	2.9	6.4	0.7	1.6	40.6	90.2	0.9	2
〃	Sorghum	3	9	8.2	24.7	0.7	2.1	16.8	50.6	4.6	13.9
Rabi	Wheat	946.3	26.7	2,321.10	65.6	167.7	4.7	0	0	S.A	
〃	Barley	1.9	52.8	0.2	5.6	1.4	38.9	0	0	S.A	
〃	Sugercane	428.4	3.2	6,889.20	51.8	5,897	44.3	0	0	0	0
	Pulses										
Kharif	Green gram	0	0	0.92	15.8	0.03	0.5	4.83	82.8	0.05	0.8
〃	Bluck gram	0	0	0.09	25.4	0.06	17.7	0.17	48.7	0.03	8.3
〃	Kharif pulses	0	0	0.07	10.5	0.05	6.6	0.51	75.1	0.02	2.8
Rabi	Chick pea	28.2	89.2	2.6	8.2	0	0	0	0	S.A	
〃	Lentir	2.91	81.9	0.44	12.3	0.11	3.1	0	0	0.05	0.1
〃	Field pea	35.7	97.2	0.92	2.5	0.05	0.1	0	0	0.05	0.1
〃	Rabi pulses	0.13	64.6	0.04	17	0.03	15.5	0	0	0.01	2.9
〃	**Oil seed**										
Kharif	Sunflower	2.5	0.9	63.9	22.2	221.5	76.8	0	0	0	0
〃	Groundnut	0	0	0	0	0	0	4.68	100	S.A	
〃	Sesame	0	0	0.57	16.5	0.01	0.2	1.8	51.9	1.09	31.4
〃	Guar	0	0	2.2	6.3	0.12	0.3	31.54	91.4	0.45	1.3
Rabi	Rape & Mustard	20.4	39.9	25.6	50.1	4.1	8	0	0	0	0
〃	Linseed	2.5	96	0.1	3.9	0	0	0	0	0	0

Source: 「Crop Area and Production (By District) 2007-08 & 2008-09」 *S.A= Small Amount
Government of Pakistan, Ministry of Food and Agriculture (Economic Wing) 2010

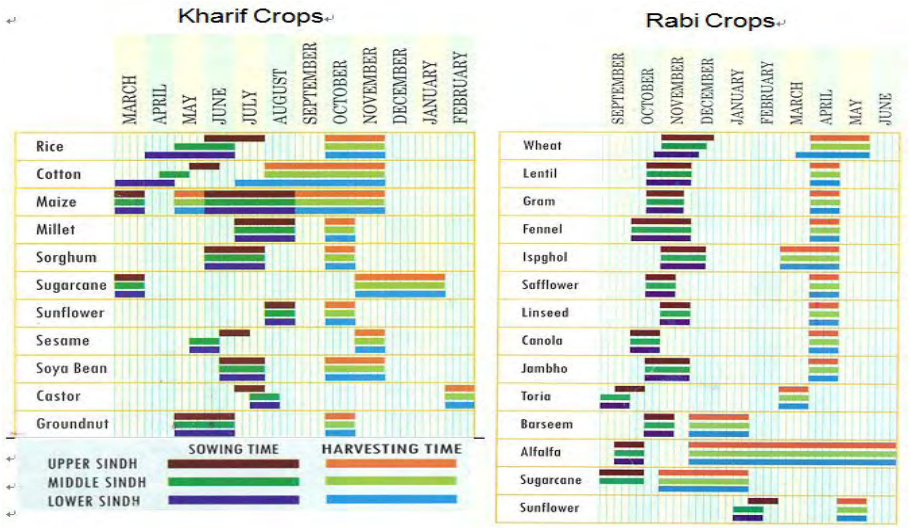


Figure 7-3-1 Cropping Patterns of Major Crops in Sindh
Source: Agriculture Research Institute, Tando Jam

sown with the beginning of the first rains in July, during the south-west monsoon season. The Rabi crop is the spring harvest (also known as the "winter crop").

7.3.2 Water

Agriculture and land uses in Sindh vary significantly depending on the availability of water since the province extends to arid and semi-arid areas. Rainfall is erratic, and thus people often face drought and shortage of natural grasses at their grazing areas[6]. In fact, there was very severe drought in the rain-fed areas, such as *kohistan* and desert, from the late 1990s to early 2000s. According to FAO/WFP (2001), livestock affected during that time was 3.08 million (66% of total animal) and direct livestock loss was Rs. 161 million[7].

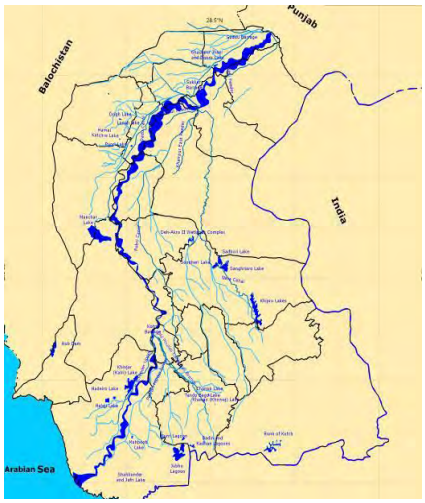


Figure 7-3-2 Irrigation Network in Sindh
Source: The Project Team

(1) Irrigation Network

As shown in Figure 7-3-2, irrigation network has been built since 1930s, covering considerably the wide areas of Sindh along the Indus River. The total net area sown in Sindh is about 2,800 thousand acres, 85% of which is irrigated as it is indicated in Table 7-3-3. The sources of irrigation in Sindh are divided into three; government canals, wells, and tubewell[8]. Government canals were built in the Upper, Middle, and Lower zones, and more than 70% of the area sown is irrigated by the governmental canal.

Table 7-3-3 Sources of Irrigation and Coverage

Government Canals	Wells	Tubewells	Un-irrigated	Total
1,968,625 (70.13%)	426 (0.02%)	412,202 (14.68%)	425,821 (15.17%)	2,807,074 (100%)

Source: Agriculture Department

Channels of the governmental canal in Sindh are off taking from three barrages, which are Guddu, Sukkur and Kotori (from north to south) constructed on the Indus River and completed (started operation) in 1962, 1932 and 1955, respectively. Table 7-3-4 shows the list of canals off-taking from these three barrages.

[6] According to the perception of the people inhabit in the rain-fed area, drought repeat usually every 2-3 years. [Qureshi, Asad Sarwar; Akhtar, Mujeeb. 2004. Analysis of drought-coping strategies in Baluchistan and Sindh Provinces of Pakistan. Colombo, Sri Lanka: IWMI.vi, 33p. (IWMI working paper 86 / Drought series: Paper 4) http://www.iwmi.cgiar.org/ Publications/Working Papers /working/WOR86.pdf]

[7] FAO/WFP (2001) Crop and Food Supply Assessment Mission To Pakistan. http://www.fao.org/docrep/004/y1260e/y1260e00.htm

[8] Though it is not listed in the statistics, it is worth-mentioning that "spate irrigation" is predominantly being practiced in *kohistan* area.

Table 7-3-4 Canals in Sindh

	Bank (Right or Left)	Water Allowance per 1,000 acres (cusecs)	Design Discharge (cusecs)	Culturable command area (acre)	Intensity (%)			
					Design intensity*			Actual
					Total	Kharif	Rabi	
GUDDU BARRAGE :-								
1 Begari Sindh Feeder	R	15	14,767	958,857	75	75	--	54
2. Desert Pat Feeder	R		13,275	380,827				
a) Desert Canal		6			75	75	--	64
b) Pat Feeder Canal		10			60	60	--	
3. Ghotki Feeder	L	6	8,490	855,231	60	60	--	80
SUKKAR BARRAE :-								
1. North Western Canal	R	2.7	5,152	940,014	81	27	54	62
2. Rice Canal	R	17.6	10,658	519,660	88	88	--	144
3. Dadu Canal	R	2.7	3,150	550,963	81	27	54	83
4. Nara Canal	L	2.8	13,649	2,240,186	81	28	53	81
5. Khairpur Feeder East	L	3.2	2,094	369,596	80	32	48	125
6. Rohri Canal	L	2.7	10,887	2,601,213	81	27	54	94
7. Khairpur Feeder West	L	3.2	1,940	322,000	80	32	48	100
KOTRI BARRAGE :-								
1. AkramWah	L	6.1	4,100	487,347	80	44.5	35	66
2. Fuleli Canal	L	14	14,859	929,358	71	71	--	67
3. Pinyari Feeder	L	14	13,636	786,353	71	71	--	39
4. KalriBaghar Feeder	R		9,000	603,741				
a) Perennial		4.44			73	33	40	37
b) Non- Perennial		12.6			67	67	--	45

*Note: if only *kharif* intensity is indicated, the canal is non- perennial.
Source: Irrigation and Power Department. 1993. *History and Irrigation Practices*

(2) Water Balance in Irrigated Area

Water requirement at the head of canal has been calculated based on the cropping areas and the kind of crops actually grown including water losses of the canal, and the intake of irrigation water at the barrage is recorded by the Irrigation Department. Comparing these two data for Rabi and Kharif, it is revealed that the intake water is much less than the required water for both of the cases (Table 7-3-5). These findings indicate there is water shortage at the field, and farmers supplement this shortage by using groundwater, by reducing the cultivation area, or otherwise they suffer from low yields. It means there is less space for expanding cultivation areas of crops or fodders.

Table 7-3-5 Supply and Demand of Water for Cultivation (in Million Acre Feet)

	2008-09 Rabi	2009 Kharif
Intake of Irrigation Water at Barrage	10.1660	29.5940
Water Requirement at Head	12.9528	37.4757
Percentage Against Requirement	78.5	79.0

Source: Agriculture Department

(3) Salinity and Groundwater Depth

The major issues for irrigated agriculture in Sindh are salinity and waterlogging, called as "twin menace" in Pakistan. Salinity and waterlogging are mainly related to the followings:

- Capillary rise of salt in the areas where evapo-transpiration exceeds precipitation under the sub-tropical arid and semi-arid climates.
- Raising groundwater depth due to seepage from earthen canal bed and mismanagement in irrigation practices.
- Poor natural drain because of relatively flat topography and lack of drainage system
- Use of brackish groundwater

(i) Salinity

The situation related to surface salinity in the irrigated area was surveyed by SCARPS[9] Monitoring Organization (SMO) 3 times in the past (early 1950s, late 1970s and early 2000s). Table 7-3-6 shows the result of the latest survey conducted during 2001-04. It indicates that in Sindh about a half of the lands are saline, out of which more than 20% are "strongly saline". The situation is the worst among the 4 provinces.

Table 7-3-6 Surface Salinity Status in the Period 2001-2004

Province	Total Acreage	Salt Free (S1)	Slightly Saline (S2)	Moderately Saline (S3)	Strongly Saline (S4)	Misc. Land Types
Punjab	24,954,966	21,754,266	913,426	444,647	398,757	1,443,870
	%	87.17	3.66	1.78	1.60	5.79
Sindh	14,045,599	6,148,594	2,736,729	1,339,110	2,855,168	965,998
	%	43.78	19.48	9.53	20.33	6.88
NWFP	1,859,105	1,632,790	37,580	26,920	7,191	154,624
	%	87.83	2.02	1.45	0.39	8.32
Balochistan	862,214	382,690	252,788	108,699	90,638	27,399
	%	44.38	29.32	12.61	10.51	3.18
Total	41,721,884	29,918,340	3,940,523	1,919,376	3,351,754	2,591,891
	%	71.71	9.44	4.60	8.03	6.21

Note: Criteria of Surface Salinity Classes (ECe: Electric Conductivity of Saturated Soil Extract)

Class	Mapping Symbol	ECe (dS/m) at 25°C	Salt (%)
Salt Free	(S1)	< 4	up to 0.2
Slightly Saline	(S2)	4 - 8	0.2 - 0.5
Moderately Saline	(S3)	8 - 15	0.5 - 1.0
Strongly Saline	(S4)	> 15	> 1.0

Source: Agricultural Statistics of Pakistan 2008-2009

Table 7-3-7 shows that in Sindh more than 30% of the soil is categorized as sodic (saline-sodic or non saline-sodic). Sodic land is hard to reclaim, and again the figure is the worst among the 4 provinces.

[9] SCARPS stands for Salinity Control and Reclamation Projects. A series of SCARPs was started in 1959, under which publicly owned tubewells were constructed all over Pakistan in order to lower the groundwater level, and SCARPS Monitoring Office was established in 1960.

Table 7-3-7 Profile Salinity/Sodicity Data for the Period 2001-2004

Province	Total Profile	Profile Salinity				
		NS-NS	S-NS	S-S	NS-S	Misc
Punjab	17,050	11,555	956	2,776	1,763	0
	%	67.77	5.61	16.28	10.34	0.00
Sindh	12,349	4,759	3,680	3,104	804	2
	%	38.54	29.80	25.14	6.51	0.02
NWFP	1,277	1,072	115	71	19	0
	%	83.95	9.01	5.56	1.49	0.00
Balochistan	542	247	168	99	28	0
	%	45.57	31.00	18.27	5.17	0.00
Total	31,218	17,633	4,919	6,050	2,614	2
	%	56.48	15.76	19.38	8.37	0.01

Note: NS-NS = Non Saline - Non Sodic S-NS = Saline - Non Sodic
S-S= Saline - Sodic NS-S = Non Saline- Sodic

Source: Agricultural Statistics of Pakistan 2008-2009

Table 7-3-8 shows the surface salinity of the command areas of irrigation in Sindh. It indicates that more than 20% of the 9 canal command areas are "strongly saline (S4)", being particularly severe for the command areas of Nara and Pnyari canals. The saline areas indicated as S2, S3 and S4 are shown in Figure 7-3-3. The right bank of Indus in upper Sindh, deltaic plain and the area near the desert are mostly affected by salinity.

Table 7-3-8 Surface Salinity in Canal Command Areas

No.	Canal Command Area	Total Acreage	Salt Free (S1)	Slightly Saline (S2)	Moderately Saline (S3)	Strongly Saline (S4)	Misc. Land Types
1	Pat Feeder	648,000	317,520 49%	213,840 33%	71,280 11%	25,920 4%	19,440 3%
2	Desert	433,000	134,230 31%	116,910 27%	60,620 14%	112,580 26%	8,660 2%
3	North West	1,002,594	348,642 35%	182,397 18%	173,508 17%	255,447 25%	42,600 4%
4	Beghari Sindh Feeder	1,088,000	413,440 38%	217,600 20%	163,200 15%	272,000 25%	21,760 2%
5	Rice	601,713	188,156 31%	154,550 26%	127,953 21%	101,754 17%	29,300 5%
6	Dadu	601,581	366,757 61%	88,068 15%	60,283 10%	69,133 11%	17,340 3%
7	Ghotki	984,795	716,850 73%	61,064 6%	26,476 3%	90,405 9%	90,000 9%
8	Khairpur West	300,000	216,000 72%	39,000 13%	12,000 4%	12,000 4%	21,000 7%
9	Khairpur East	506,000	308,660 61%	86,020 17%	35,420 7%	30,360 6%	45,540 9%
10	Rohri North	1,390,713	758,436 55%	365,465 26%	70,049 5%	115,523 8%	81,240 6%
11	Rohri South	1,537,000	907,650 59%	279,000 18%	100,000 7%	173,500 11%	76,850 5%
12	Nara	2,431,394	709,611 29%	567,039 23%	243,139 10%	793,605 33%	118,000 5%
13	Fuleli	1,045,651	456,930 44%	218,865 21%	106,560 10%	212,296 20%	51,000 5%
14	Gaja	113,514	34,696	29,704	15,162	26,852	7,100

No.	Canal Command Area	Total Acreage	Salt Free (S1)	Slightly Saline (S2)	Moderately Saline (S3)	Strongly Saline (S4)	Misc. Land Types
			31%	26%	13%	24%	6%
15	Tando Bagho	418,451	110,301 26%	93,620 22%	64,464 15%	87,299 21%	62,767 15%
16	KaIari	824,200	322,489 39%	91,302 11%	67,044 8%	176,165 21%	167,200 20%
17	Pnyari	981,207	220,916 23%	185,073 19%	50,651 5%	390,967 40%	133,600 14%
	Total	14,907,813	6,531,284 44%	2,989,517 20%	1,447,809 10%	2,945,806 20%	993,397 7%

Source: SMO, Lahore

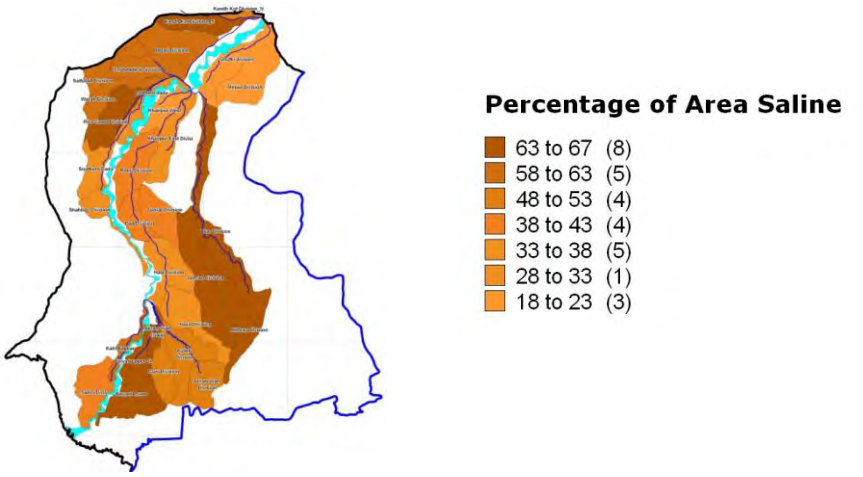


Figure 7-3-3 Surface Salinity in Canal Command Areas

Source: SMO, Lahore

(ii) Groundwater Depth

SMO also measures the groundwater depth twice a year in pre-monsoon period (June) and post-monsoon period (December). According to the SMO's definition, if the depth of groundwater is less than 300cm, such areas are categorized as waterlogged. If the depth is 0 to 150 cm, it is considered as disastrous. Table 7-3-9 shows the areas where the groundwater table is "disastrous". The data reveals that in post-monsoon period 57% of the lands is disastrous. In the non-irrigated areas, groundwater depth is generally deeper than that in the irrigated areas. It sometimes reaches more than 30 meters in Tharparkar although it becomes less than 900cm in certain places between sand dunes. Figure 7-3-4 shows the groundwater depth in pre monsoon period in the irrigated areas.

Table 7-3-9 Groundwater Depth

(ha)

Barrage	Total Command Area	Area of groundwater table with 0 to 150cm			
		Post monsoon (Dec 2009)		Pre monsoon (June 2010)	
Guddu	932.80	787.30	84.40%	11.3	1.21%
Sukkur	3,495.10	1,532.69	43.85%	289.22	8.28%
Kotori	1,308.00	957.13	73.18%	22.54	1.72%
Total (Sindh)	5,735.90	3,277.12	57.13%	323.06	5.63%

Source: SMO, Hyderabad

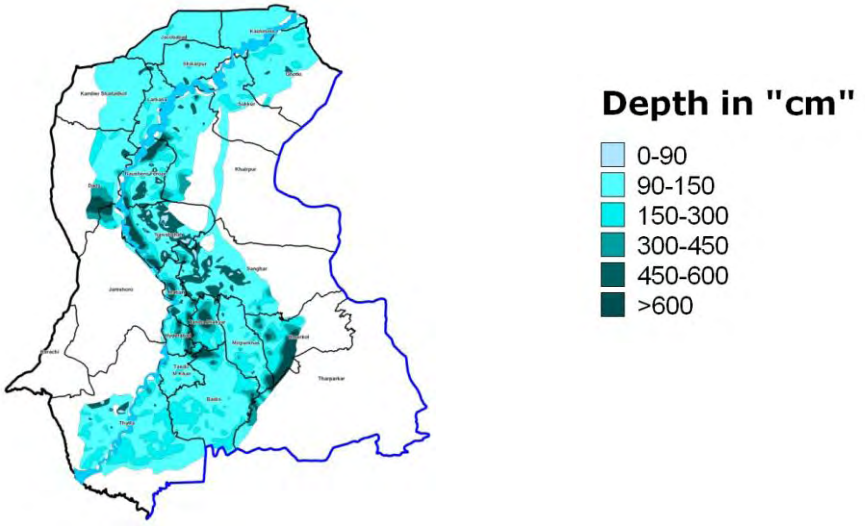


Figure 7-3-4 Groundwater Depth in the Irrigated Areas (Pre-monsoon 2010)

Source: SMO, Hyderabad

It is said that more than two thirds of the groundwater in Sindh is brackish. Figure 7-3-5 shows that the quality of groundwater is better, i.e. salt content is less than 1000mg/l, near the Indus River, but that it gets worse in the inland areas. Groundwater is generally brackish in the non-irrigated areas as well as the deltaic plain because of intrusion of seawater.

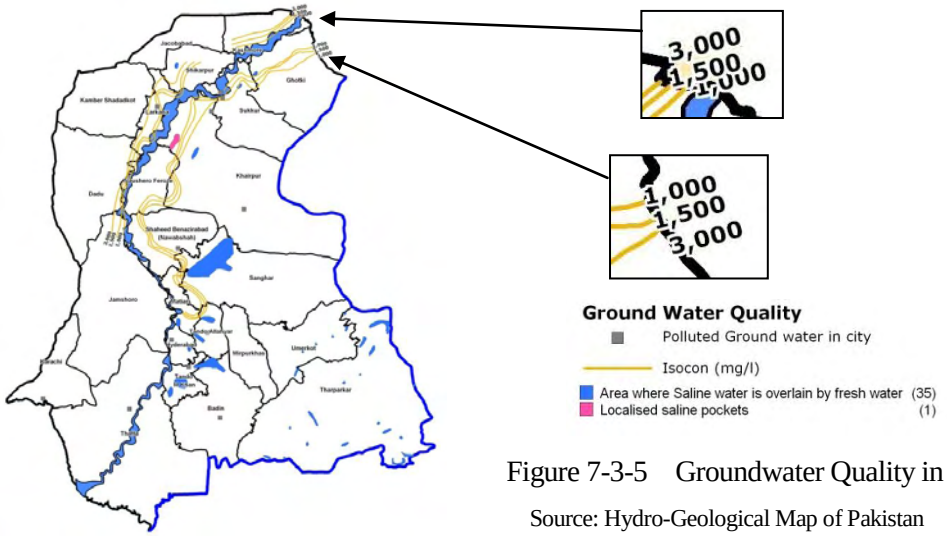


Figure 7-3-5 Groundwater Quality in Sindh

Source: Hydro-Geological Map of Pakistan

(4) Livestock and Salinity

Livestock is tolerant of saline water to some extent. They can survive with water which cannot be used for irrigation (Table 7-3-10).This fact is valuable for the development of livestock sector in Sindh since it is said that about two third of the groundwater in Sindh is brackish[10].

Table 7-3-10 Water Quality Guide for Livestock and Poultry Uses*

Water Salinity (EC) (dS/m)	Rating	Remarks
<1.5	Excellent	Usable for all classes of livestock and poultry.
1.5 – 5.0	Very Satisfactory	Usable for all classes of livestock and poultry. May cause temporary diarrhea in livestock not accustomed to such water; watery droppings in poultry.
5.0 – 8.0	Satisfactory for Livestock	May cause temporary diarrhea or be refused at first by animals not accustomed to such water.
	Unfit for Poultry	Often causes watery feces, increased mortality and decreased growth, especially in turkeys.
8.0 – 11.0	Limited Use for Livestock	Usable with reasonable safety for dairy and beef cattle, sheep, swine and horses. Avoid use for pregnant or lactating animals.
	Unfit for Poultry	Not acceptable for poultry.
11.0 – 16.0	Very Limited Use	Unfit for poultry and probably unfit for swine. Considerable risk in using for pregnant or lactating cows, horses or sheep, or for the young of these species. In general, use should be avoided although older ruminants, horses, poultry and swine may subsist on waters such as these under certain conditions.
>16.0	Not Recommended	Risks with such highly saline water are so great that it cannot be recommended for use under any conditions.

* Adapted from National Academy of Sciences (1972; 1974).

Source: Ayers, R.S. and Westcot, D.W. (1985) *Water quality for agriculture*, 6. WATER QUALITY FOR LIVESTOCK AND POULTRY. FAO, Rome. http://www.fao.org/docrep/003/t0234e/T0234E07.htm

7.4 Fodder and Feed Management

7.4.1 Issue of Feed Shortage

Although Pakistan has one of the world's largest livestock holdings, its productivity is quite low compared to other countries. A major reason, which has been pointed out, is the nutritional deficiency of the feed[11].

Feed resources and their rates of utilization in the whole of Pakistan are shown in Table 7-4-1. Among the feed resources, 51% is provided by crop residues and forage crops while grazing on pasture grasses and shrubs provides 38% of the total. In addition, grazing on crop stubble and native grasses provides a further 3%, food crop by-products 6% and meal from oil seeds a further 2% (Gill et. al. 1996). These calculated feed resources and rates of utilization concur with the actual findings of the survey carried out by the Project Team in Sindh.

[10] According to the measurement by the Project Team, EC of groundwater was 2.3dS/m at Moosa Khatian village in Tando Jam; 4.38dS/m and 6.21 dS/m at Mithrio Bhatti village and Pabuhar village in Tharparkar. All of them have no problem as drinking water for livestock according to the FAO standards.

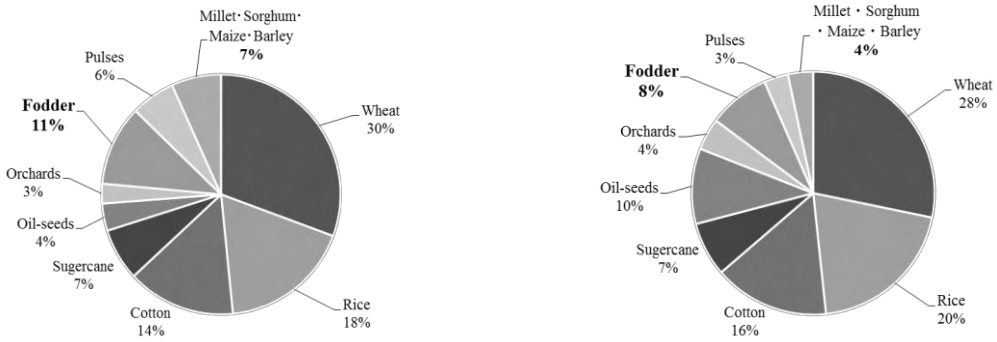
[11] see 6.3.3 for the details

Table 7-4-1 Feed Resource and Contribution Rate in Pakistan

Feed resources	Contribution (%)	Forage (Self-supplying feed)		Concentrate (Purchased feed)
		Dry	Green	
Crop residues & Fodder	51	Wheat・Rice straw, Millet・Maize・Sorghum stover, Pulses haulms, Sugercane leaves	Rice straw, Millet・Maize stover, Pulses haulms, Sugercane top, Sorghum, Sada Bahar, Maize	
Forage/Grazing	38		Naturally grawn grasses, forbs, shrubs, trees (leaf・fruit)	
Post harvest grazing	3	Wheat・Rice stubble, Sugercane trash	Rice regrowth, Cotton leaves	
Cereal by-products	6			Wheat・Rice bran, Crushed bean, Broken rice
Oilcakes & meals	2			Oil-seed cake

Source: Extracted from Gill et al. "Economics of Fodder in Milk Production and Drought Animal Management" Fodder Production in Pakistan, Pakistan Agricultural Research Council, Food and Agriculture Organization, Islamabad

As shown in Chapter 6, the numbers of livestock have been constantly increasing. From a nutritional perspective, livestock mainly raised by forage grazing and forage crop residues are thought to suffer from malnutrition as a result of poor feed intake. However, while livestock numbers are increasing, food and cash crops are receiving planting priority due to limited arable land (see Figure 7-4-1). In this situation, the planting of fodder crops is not able to keep a pace with the increases in livestock numbers. This could be the biggest reason for the above mentioned malnutrition.



1995/1996 (Total Cultivated Acreage 3,611,800 ha)

2008/2009 (Total Cultivated Acreage 3,652,500 ha)

Figure 7-4-1 Distribution of Cropped Area in Sindh in 1995/96 and 2008/09

Source: Agricultural Statistics of Pakistan 2008-2009, Government of Pakistan, Ministry of Food and Agriculture (Economic Wing), Islamabad 2010

7.4.2 Overall Livestock Nutritional Demand and Possible Uptake of Nutrition from Feed Resources

(1) Livestock Nutrition Requirements

As there are no feeding standards for buffalo being reared in tropical conditions, reference is made to Sarwar (2002) from the University of Agriculture, Faisalabad. Taking data of Sindh from the Pakistan Livestock Census 2006, the nutritional requirements were estimated to be as follows.

According to the Pakistan Livestock Census 2006, a total of 43,467,694 litres of milk per day is being collected in Sindh. Of this 14,180,469 litres per day (6.6 litres/head/day) is being collected from 2,143,036 cattle, 27,164,112 litres per day (8.9 litres/head/day) is being collected from 3,051,119 buffalo, and 2,123,103 litres per day (1.7 litres per head/day) is being collected from 1,235,080 goats. The amount of estimated nutrition required to produce this volume of milk was calculated based on this data. Moreover, the nutritional requirement for the drafting animals not included in this production, such as 295,466 bullocks, 122,466 camels, 32,296 horses, 599,060 asses, and 14,000 mules, is calculated. The total maintenance energy of livestock in Sindh is calculated according to whether the animal is for milking or meat. The calculation is based on a per animal unit for the main livestock; buffalo, cattle, and goats. This livestock includes calves, young animals, and breeding bulls. As the nutritional requirement of livestock raised in irrigated and non-irrigated areas differ, the calculation is carried out for both areas. The results of the calculations are shown in Table 7-4-2.

Table 7-4-2 Estimated Annual Nutrients Requirements of Livestock in Sindh

Nutrient requirments	('000' t)	Irrigated area	Non-irrigated area
Maintenance	TDN	11,092	2,580
	DCP	1,113	259
Milk production (4% FCM)	TDN	6,108	537
	DCP	1,707	150
Work	TDN	207	125
	DCP	19	12
Total	TDN	17,407	3,241
	DCP	2,839	420

TDN: Total Digestible Nutrients, DCP: Digestible Crude Protein

Source: Surveyed by the Project Team

(2) Estimation of Available Nutrition from Local Resources

Next, as a potential feed resource, the estimated annual amount of green fodder, crop residues, and agricultural by-products available are calculated for Sindh, including the nutrition contained in this resource. Crop residues and agricultural by-products production are estimated using conversion factors taken from Kossila (1988). From this, using the feed analysis tables attached, dry matter yields, as well as TDN, and DCP are estimated. The results of the calculations are shown in Tables 7-4-3 and 7-4-4. The main crop residues and agricultural by-products have the potential to contribute significantly to TDN supply. On the other hand, when cotton is exempted from calculations, the contribution to DCP is extremely low. This signals the important role of cotton residue usage.

Table 7-4-3 Estimated Annual Availability of Nutrients from Fodder and Crop Residues in Sindh

Category	Crops		Dry matter yield	TDN	DCP
			----------	'000' t	----------
Green	Maize & Sorghum	Fresh	193.3	113.3	11.7
Fodder	Lucerne	Fresh	254.0	157.5	46.0
	Berseem	Fresh	495.4	327.0	83.7
Cereal &	Wheat	Straw	4,234.2	1,532.8	0.85
Cash crop	Rice	Straw	3,093.7	1,290.1	7.4
	Maize	Stover	3.5	2.0	0.07
	Millet	Stover	170.1	77.1	0.47
	Sorghum	Stover	124.4	68.8	1.5
	Barley	Straw	4.3	2.0	0.28
	Sugercane	Tops	964.6	478.4	22.2
	Sugercane	Trash	866.1	323.1	5.3
	Cotton	Leaves	2,026.4	1,088.0	308.0
Pulses	Mung	Haulms	24.7	13.6	1.6
	Chick pea	Haulms	126.4	46.8	1.1
	Field pea	Haulms	146.6	70.5	9.5
	Other pulses	Haulms	17.8	8.6	1.2
Oil seed	Groundnut	Haulms	9.4	6.4	0.59
crops	Cluster bean	Haulms	69.0	46.6	4.5
	Sunflower	Leaves	86.5	49.8	12.5
Total			12,910.5	5,702.4	518.5

Source: Surveyed by the Project Team

Table 7-4-4 Estimated Annual Availability of Nutrients from Fodder and Crop Residues in Sindh

Category	Crops		Dry matter yield	TDN	DCP
			----------	'000' t	----------
Cereal &	Wheat	Bran	255.5	187.3	32.2
Cash crop	Rice	Polish	185.1	148.5	19.6
	Chick pea	Churi *	3.6	2.6	0.28
	Mung	Churi *	0.7	0.4	0.08
	Field pea	Churi *	4.1	2.7	0.39
	Other pea	Churi *	0.5	0.3	0.05
	Sugercane	Molasses	384.6	280.8	10.0
Oil seed	Cotton	Seed cake	132.3	103.9	26.1
	Sunflower	Seed cake	176.6	125.6	48.2
	Groundnut	Meal	2.5	1.9	0.79
	Sesame	Meal	2.2	1.4	0.84
	Cluster bean	Meal	22.1	16.8	9.60
	Linseed	Cake	1.7	1.4	0.63
	Rape & Mustard	Seed cake	32.7	21.5	10.7
Total			1,204.2	895.1	159.5
*Broken bean with hull					

Source: Surveyed by the Project Team

(3) Nutritional Shortage

The livestock nutritional requirement in the irrigated areas of Sindh is shown below. The

estimated nutritive value of agricultural products (green fodder, crop residues, and agricultural by-products) is 6,598,000 tons TDN, and 678,000 tons DCP. This equates to 38% of TDN and 24% of DCP nutritional requirements (see Table 7-4-5). When the nutritive value of the agricultural products is subtracted from the nutritional requirements, that leaves 62% of TDN, and 76% of DCP to be obtained from grazing on native grasses in fallow or harvested fields in surrounding farmlands (see Table 7-4-6).

Table 7-4-5 Balance between Annual Nutrients Requirements and Nutrients Availability from Crops in Irrigated Area of Sindh

Nutrients requirements		Availability	Balance
TDN ('000' t)	17,407	6,598 (38%)	10,809 (62%)
DCP ('000' t)	2,839	678 (24%)	2,171 (76%)

Source: Surveyed by the Project Team

Table 7-4-6 Feed Resources and Contribution Rate in Sindh

Feed resources	Contribution rate (%)	
	TDN	DCP
Crop residues & Fodder	32	19
Ceral by-products	4	2
Oil seed cakes	2	3
Grazing/Forage/stubble	62	76

At present, considering the balance between local feed resources and livestock numbers is difficult. At a very minimum, taking into consideration the above livestock numbers, milk production, and traction, more than 60% of nutritional requirement (as the above table indicates) will need to be obtained from such activities as grazing, cut and carry, and stubble grazing. The small farmers, at least, are highly dependent on grazing. This is exemplified in the household survey results, where most farmers noted a shortage of feed prior to the monsoon and after the crops have been harvested in November and December. Since this period coincides with the start of farmland cultivation and crop growth, there is little grass in the fields and surrounding area to be harvested. As these agricultural practices remove weeds, there is a shortage of natural grasses at this time of the year.

7.4.3 Basic Forms of Feeding Management

The forms of animal feeding management are thought to have come into shape within the mixed farming system of agriculture and livestock, regardless of the scale of livestock rearing. The basic feeding management forms can be divided into the following two:

One of them is “house yard cut and carry stall feeding and grazing complex”, which can be seen in the irrigated areas of central alluvial plain along the Indus River. For this feeding form, the farmers do not have specific areas for grazing and cutting grasses. However, they use such areas as crop fields, road

sides, banks of watercourses, orchards, crop stubbles, post-harvest cropland, and fallows flexibly for grazing and cutting whenever it is available. The resources of feed are mainly composed of the native grass and crop residues.

Grazing of buffalos after the harvest of cotton

Grazing of goats at fruits garden

Grazing at fallow land

Grazing at the plain of the Indus River

The other form is the one that is mainly constituted by grazing in the dry areas located in the both sides of the great plain along the Indus River. In these areas, there is vast range of grazing land called “Open Land” where woody and herbaceous plants grow. The livestock raised in these areas are mainly goats, sheep, and cattle. Donkeys and camels are also raised as draft animals for cultivation, drawing water from wells, and transportation. Yet the number of camels raised is small as they are costly. As agriculture in these areas depends on rain water, the yield is strongly affected by the amount of rainfall of the year. However, even if the grain yield is small, dried stalks and leaves are conserved as important sources of feed for animals. Thus, the agriculture is valuable even under the unstable supply of water, and the combined engagement of agriculture and livestock, i.e. mixed farming, will stabilize the livelihood of farmers. Some communities avoid the risk of drought by moving their large animals to irrigated areas.

Grazing goat and sheep in dry area

Paddock and goats

7.4.4 Cases of the Mixed Farming

Taken from the periodical survey conducted, mixed farming can be categorized into 3 typical patterns according to the relationship between cropping and livestock production.

(1) Case 1

Figure 7-4-2 shows the case of a land owning small farmer on 5 acres, with 4 livestock (3 buffalo and 1 cow). Of the 5 acres, 2 acres are planted in sugar cane. Land for sugar cane cultivation is utilized throughout the year. After harvesting the sugar cane, the stubble is allowed to regrow (ratoon), and can be continuously cultivated for a maximum of 5 years. Essentially the land is permanently under cultivation. The remaining 3 acres is double cropped with cotton and wheat. After the cotton crop is harvested (winter), 2.5 acres are planted in wheat and 0.5 acres in beseem. In this way the land is continuously cultivated to produce two crops with three different crop types. The most important relationship between cropping and livestock production is cattle manure. The cattle manure is preferentially applied to the sugar cane production, after this it is used in the cotton fields. The manure from 4 livestock is not enough, so a truck full needs to be brought in.

	Kharif	Rabi		
1st year	3 ac Ctton	2.5 ac Wheat	0.5ac	(3 crops/year)
5 acre	2 ac Sugercane	2 ac Sugercane	Berseem	(1 crop/year)
2nd year	3 ac Cotton	2.5 ac Wheat	0.5ac	
5 acre	2 ac Sugercane(Ratoon)	2 ac Sugercane(Ratoon)	Berseem	
⬇				
5th year	3 ac Cotton	2.5 ac Wheat	0.5ac	
	2 ac Sugercane(Ratoon)	2 ac Sugercane(Ratoon)	Berseem	

Figure 7-4-2 Cropping Layout of Small Scale Crop - Livestock Mixed Farming System (1)

(2) Case 2

Figure 7-4-3 is the case of a commercial dairy farmer. Of the 42 buffalo raised, 8 are being milked, 8 are dry, 1 bull, 9 heifers, 12 young buffalo, and 4 calves. Of the 56 cattle, 7 are being milked, 5 are dry, 1 bull, 6 heifers, 26 young cattle, 7 calves, 4 bullock, and 11 cattle being fattened. This is a typical

example of a commercial farmer. The farmer owns 18.5 acres, of that 8 acres are continuously double cropped with cotton and wheat, another 8 acres is double cropped with sorghum and beseem to produce feed. The remaining 2.5 acres is planted in maize and Jantar to provide feed. Crops of pepper, mustard, and onions are also rotated. About 50% of the farmland is being actively turned over to support livestock feed production. All cow manure is put into the farmlands.

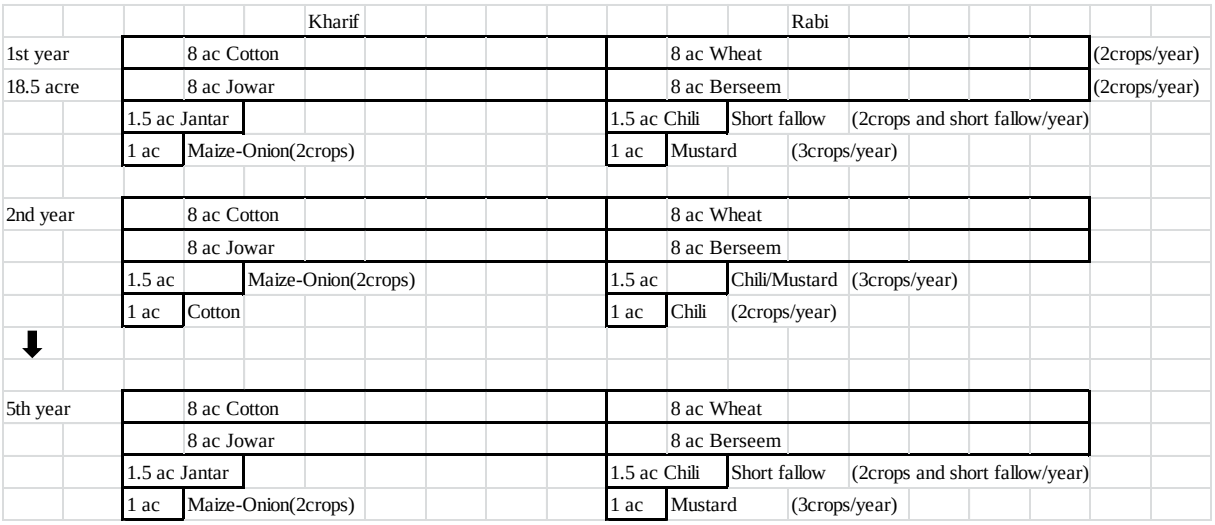


Figure 7-4-3 Cropping Layout of Small Scale Crop - Livestock Mixed Farming System (2)

(3) Case 3

Figure 7-4-4 shown below is for a mid-sized farmer who owns 30 acres of land. The farmer raises 4 adult buffalo, 1 heifers, and 1 heifer cow. On all of the land commercial crops are grown. Two acres of maize are grown for green forage to be sold. The livestock are raised by grazing. All manure is put back into the fields. The manure is insufficient for cropping purposes and the shortfall needs to be brought in.

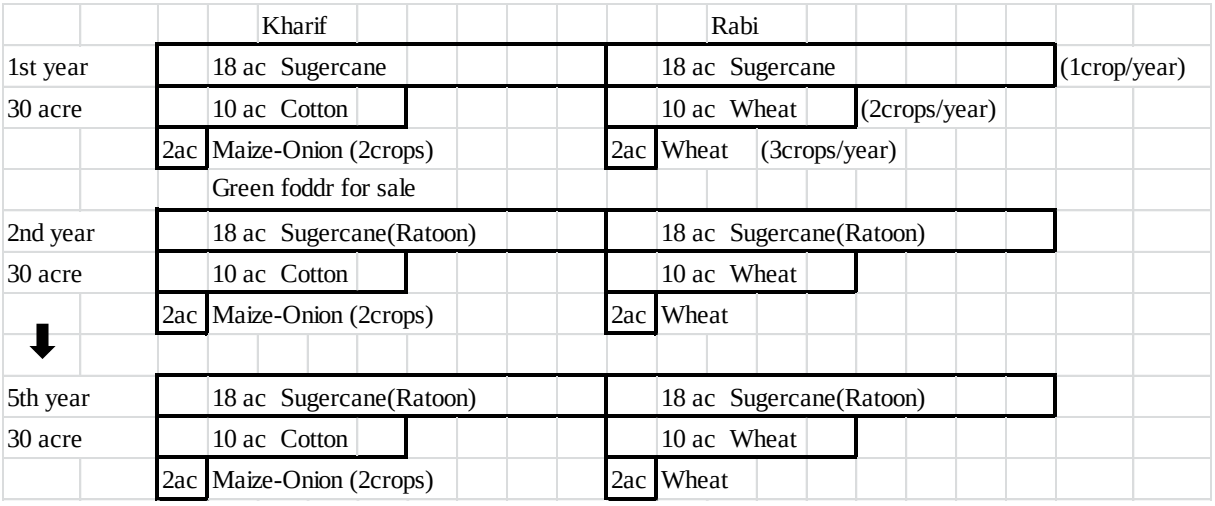


Figure 7-4-4 Cropping Layout of Middle Scale Crop - Livestock Mixed Farming System