STATUS AND SCOPE OF SMALL RUMINANTS PRODUCTION IN DRY AREAS OF PAKISTAN
- REVIEW -

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Summary

This paper describes small ruminant production systems in dry areas of Pakistan. Formal and informal surveys had identified that poor feed resources, as a result of harsh climatic conditions, is a major factor responsible for low sheep and goats production. In view of their recommendations, use of approaches like supplemental feeding and pasture production through an introduction of improved forage species in the country, are reviewed. The improvement in sheep production and associated socioeconomic benefits, are discussed.
(**Key Words** : Dry Areas, Poor Nutrition, Low Sheep Production)

Introduction

Sixty eight percent of the total land area in Pakistan is dry and is not suitable for cultivated agriculture. Low and erratic rainfall and poor soil fertility caused by erosion, has converted this vast area into ranges with a variable grazing potential. These ranges are distributed throughout the country. Almost the whole of Baluchistan is arid or semi arid. In comparison, 55 percent of the total land area in North-West-Frontier province (NWFP), 47 percent in Punjab, 65 percent in Sind and 50 percent in Northern areas, is arid or semi arid. The whole of Baluchistan, Cholistan and Thal in Punjab, Tharparker in Sind, Dera Ismail Khan (D.I Khan) in NWFP and Northern areas are well known for the production of small ruminants (Khan and Mohammed, 1987). In low lands areas like Cholistan, Thal and Tharparker, agricultural activities also include the cultivation of drought resistant varieties of cereals, food legumes and millets. Wheat, barley, maize and chickpea are most important crops. Lentils, peas and mustard crops are also sown in highly elevated lands of Baluchistan, D. I. Khan and Northern areas.

The objective of this article is to review the on-going husbandry practices and to evaluate the possible approaches that could result in an increase in small ruminant production. This will assist the planners in formulating and adapting strategies for sustainable production of meat, milk and other products, essentially required for the increasing human population.

Agro Ecological Characteristics

Agro ecological characteristics of these rangelands vary considerably. In low land areas like Cholistan, Thal and Tharparker, where soils are sandy, temperature ranges from 20℃ to 52℃ during summer and 3℃ to 25℃ during winter. Temperatures in Baluchistan, D. I. Khan and Northern areas, located at an altitude of 1,200 to 2, 500 meters, range from −14℃ to 30℃. Soils depending upon altitude, vary from loamy to clay, calcarious and silty in texture. Soils in areas of north Baluchistan and adjoining D. I. Khan, are usually calcarious and silty and are inadequate in organic matter, essentially required for optimum crop production. In contrast, soils in southern Baluchistan, are loamy to sandy in texture with a deficiency of phosphorus, which limits crop production. Winds in low lands and high intensity rainfalls in elevated lands, are major causes of erosion, leading to poor fertility of soils (MART/AZRI, 1987). These climatic conditions have led these areas to be described as arid and semi arid rangelands. Salient features of various range areas in Pakistan are given in table 1.

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TABLE 1. AGRO ECOLOGICAL CHARACTERISTICS OF DRY LAND AREAS IN PAKISTAN

Parameters	Baluchistan	Cholistan	D.I.Khan	Thal	Tharparker
Temperature(℃)	−12-45	22-52	3-42	20-50	22-51
Rainfall (mm/annum)	75-150	120-250	150-300	100-250	175-250
Soil texture	Calcarious, silty, loamy and sandy	Sandy to loamy	Silty, clay, loamy and calcarious	Sandy	Sandy
Type of range	Mediterranean	Tropical	Mediterranean	Tropical	Tropical
Major crops	Wheat, barley, millets and legumes	Millets, sorghum, legumes and wheat	Wheat, barley and millets	Millets, sorghum and legumes	Millets, sorghum and legumes.
Sheep breeds	Baluchi, Bibrik, Hamai and Rukhshani.	Sipli, Kodali and Bucchi	Damani	Thali, Kajli and Bucchi	Kooka and Kacchi.
Diseases	Enterotoxaemia, Pleuroneumonia, Anthrax and Liver fluke	Anthrax, Enterotoxaemia and Haemorrhagic septicemia.	Pleuroneumonia, Enterotoxaemia and Foot and mouth disease	Anthrax, Haemorrhagic septicemia and Foot and mouth disease	Black quarter, Foot and mouth disease and Surrah

TABLE 2. PLANT SPECIES COMPOSING VEGETATION IN DRY AREAS OF PAKISTAN

Plant species	Dry areas				
	Baluchistan	Cholistan	D. I. Khan	Thal	Tharparker
Grasses	*Pennisetum orientale Saccharm ciliaris* and *Chrysopogon aucheri*	*Cenchrus ciliaris* and *Cympogon jawarancus*	*Solsola sp, Lolium persicum* and *Poa bulbosa*	*Dactylocanium* and *Eleusine flagellifera*	*Dactylocanium segyptium, Panicum turgidum, Cenchrus setigerus* and *Panicum antiaotal*
Forbs	*Laliemontia roleana*	–	–	–	–
Shrubs	*Ebenus stellatus, Ephdedra intermedia, Artimisia maritinia* and *Holoxylon griffithi*	*Alhagai camelrum,* and *Elionurus hirsutus*	*Phalamis stewit, Salvia cabulica* and *Marrubium valgare*	*Lasirus hirsutus, Artemisia sp* and *Holoxylon griffithi*	*Capparis decidua, Euphorbia caudicifolia, Typa augustata* and *Indigofera pancifolisa*
Trees	*Pistacia khinjuk Segeratia thea* and *Olea ferruginea*	*Prosopis speciagera Chslligonum polygonoides, Holoxylon salicornium* and *H. recurvum*	*Segeratia thea, Olea ferruginea* and *Pistacia khinjuk*	*Calligonum polygonoides, Acacia jacquemoti, Ziziphus nummularia* and *H. recurvum*	*Acacia arabia, Grewia populifolia, Gymnosporia, Acacia Senegal* and *Zizyphus jujubapud*

Characteristics of Rangeland Vegetation

The low rainfall and poor soil fertility, results a coarse and drought resistant vegetation. As shown in table 2, vegetation in arid areas of Cholistan and Thal (GOP, 1970) and Tharparker (Illahi and Sharif, 1966) is dominated by shrubs and trees which have browsing potential for goats and camels. Vegetation found in southern Baluchistan, is shrubby. On the other hand, vegetaion in northern Baluchistan is composite-grassland on lower range and mixed shrub land on higher land with Chrysopogon and Cymbopogon being the major grass genera (GOP, 1978; Nasir and Ali, 1979).

At present these rangelands are being grazed by many types of livestock. However due to ecological and physiological reasons, sheep, goats and camels are major species found (Valencia and Gonzales Padilla, 1983). As reported by FAO (1983) and Khan and Mohammed (1987), these ranges supply 60-75 percent of nutritional requirements of livestock, lower than values reported by Javed et al (1993). Table 3 demonstrates the extent of nutritional requirements supplied by ranges to various classes of livestock in Baluchistan which constitutes more 40 percent of the total land area of Pakistan.

TABLE 3. ANNUAL STATUS OF DEMAND AND SUPPLY OF DRY MATTER (DM, MILLION kg) FOR RANGE LIVESTOCK (MILLION) IN BALUCHISTAN (JAVED ET AL., 1993)

Livestock species	Population	DM demand	DM supply by ranges	Percentage of DMI supplied by ranges
Sheep	11.1	2,100.0	1,890.0	90
Goats	7.3	1,200.0	1,140.0	95
Cattle	1.1	3,000.0	1,200.0	40
Camel	0.3	600.0	570.0	95
Donkey	0.4	600.0	570.0	95
Horse	0.03	90.0	9.0	10
Total	20.23	7,590.0	5,379.0	70

Figure 1 shows the seasonal changes in liveweight with animals losing weight in summer and autumn and gaining it in spring (Rafiq et al., 1990b) which are in line of early findings of Birrell (1981, 1989). These workers observed that when feed quality is low, grazing time is increased which along with poor condition of animals, produces a poor response to a large intake. On the other hand when good quality feed becomes available in spring, the animal's liveweight response to intake is better than at the lower stocking rate.

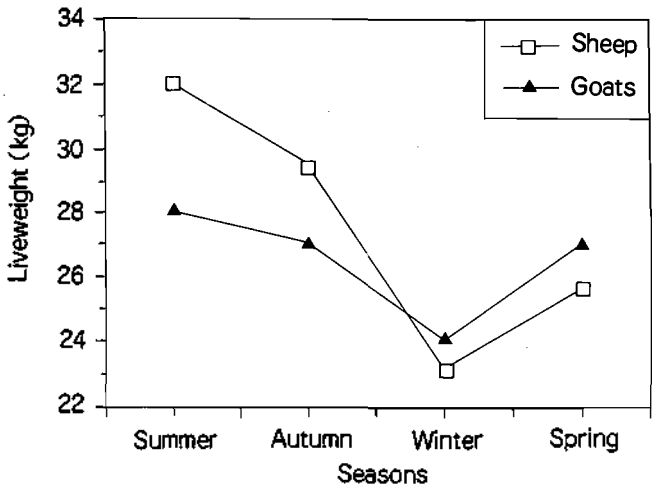

Figure 1. Changes in liveweight of sheep and goats grazing on ranges of Baluchistan.

Production Systems

The production systems in these areas, characterised by harsh climatic conditions, are based on an innate desire to exist and to complete the life cycle. Depending on the altitude, availibility of pasture and water during various seasons, production systems are nomadic, transhumant and house-hold.

The Nomadic system is prevalent in low land areas of Cholistan, Thal, Tharparker and southern Baluchistan. Due to low rainfall, sandy soils and high temperatures, agricultural activities are limited. People are nomads and remain mobile along with livestock in search of pasture and water through out the year. Size of a flock owned by a nomads, varies from 60-300 head and is dominated by goats, sheep, camel and cattle (Swidler, 1972).

The Transhumant system is charcterised by movements for seasonal utilization of vegetation. This system is usually prevalent in elevated lands like northern Baluchistan, D. I. Khan and Northern areas. During winter (October-November) flocks are moved from upland to low land pastures in adjoining areas of Punjab and Sind provinces. At the start of summer (March-April), flocks come back to high altitude areas, where due to rainfall, pastures have regrown. Transhumant flocks are usually smaller in size and belong to farmers who are settled and own some agricultural land. The majority of the transhumant flocks graze permanantly on ranges, which is their sole feed source. Flocks living in the vicinity of crop

producing areas, may have access to the post-harvest crop residues. Transhumant flocks are mainly dominated by sheep and goats with camels and cattles being of lesser importance. This composition makes the system more efficient where rangeland production is declining day by day (GOP, 1973 and Nyerges, 1980).

The House-hold production system is practised in areas where agricultural activities are widespread and permanent. These areas include central Punjab, Indus Valley of Sind and some green pockets of Baluchistan and NWFP where facilities of artificial irrigation, are available. The size of flock varies between 15-30 and is mainly composed of sheep and goats. In addition to fodders, crop residues, orchard and road side grazing are a major source of feeding.

Distribution of Sheep and Goat Breeds

Physical, physiological and morphological characteristics of sheep and goat breed are function of altitude and this primarily determines their relative distribution. Sheep breeds found in high elevated areas of Baluchistan, D. I. Khan and Northern areas, are fat tailed where as goats are smaller in size with compact bodies. In contrast, breeds of sheep and goats found in low land areas of Cholistan, Thal and Tharparker, are thin tailed and larger in size. These breeds of sheep and goats have attained a morphological, physiological and functional adaptation to the rough environment through evolutionary and selective breeding. Due to repeated exposure to climatic stresses, disease challenges and poor quality vegetation, these breeds of sheep and goats, have developed some hardiness characteristics. However the same evolutionary process, while providing the nomad sheep with hardiness, has also exerted some negative effects on traits of economic importance such as growth rate, feed conversion ratio, delayed maturity, fleece weight and prolificacy (Sharafeldin and Shafie, 1965).

Production Practices and Potential

Animals are polyoestrous and this combined with a poorly defined breeding policy (FAO, 1987), results in year round mating. However maximum oestrous activity in high elevated areas e.g Baluchistan, D. I. Khan and Northern areas is observed from the end of August till October when ranges start declining in their productivity. Vegetation material during this season is mainly composed of lignocellulose with inadequate metabolizable energy and cannot support the animals in maintaining their liveweight as per figure 1. This period of low productivity of ranges, coincides with the breeding season when optimum liveweights are required for desirable conception rates and birth weights of lambs (Degen et al., 1987 and Thomson and Bahhady, 1988). Low liveweight of sheep and goats maintained on these arid or semi arid rangeslands, is also reflected in poor conception rate which varies from 40 to 55 percent. This is due to poor nutrition of ewes and does, which are not subjected to any flushing treatment before the start of breeding season (Rafiq et al., 1990c). Malnutrition during late pregnancy becomes more critical when metabolizable energy requirements due to developing foetus, are increased (ARC, 1980). As 70-85 percent of foetus development takes place during the last 4-8 weeks of gestation, it is logical to expect a relationship between plane of nutrition of ewes and birth weight of lambs (Robinson, 1982).

Recent experiences with various breeds of sheep, as well as goats, in Baluchistan, where 93 percent of area is rangeland dominated by Atrmisia martimia and Holoxylon griffthi, have revealed that ewes as well as does continued losing bodyweight at a rate of 15-25 g/day during whole gestation. Data showed that before the start of last quarter of gestation, ewes and does had lost 30 percent of liveweight recorded at mating (Rafiq et al., 1990c). In elevated areas, a further constraint to productivity are the severe winters when temperature ranges from $-12℃$ to $-5℃$. As reported by Young (1983), metabolic activities during severe winters are increased. Energy generated during metabolism, is liberated to the atomsphere for the maintenance of an equilibrium between an internal and external temperature. The energy meant for productive functions is thus lost, leading to the mobilization of body reserve tissues, hence losses in body weight. As a result, emaciated ewes becomes more susceptible to various infestation and infections. This results in 10-15 percent of offspring being prematurely, many of which can't survive cold conditions. Where pregnancies last the full term, ewes deliver lambs of poor birthweight with low immunity to enteriotoxaemia. When exposed to severe winter conditions, lambs become more susceptible to pneumonia leading to a mortality of 15-25 percent. Findings of Rafiq et al. (1990c) have shown that the survival rate can be increased from 15 to 25 times if lambs possess adequate immunity at birth through supplementing dams during late gestation. In an experimental study these workers found a significant ($p < .01$) increase in conception, lambing and survival rate (%) of lambs when Baluchi ewes were flushed during premating, late gestation and early lactation. Conception, lambing and survival rate in lambs was increased from 64 to 75 and 86; 47 to 60 and 77 and 56 to 74 and 82

percent when ewes were flushed and supplemented with barley grain and cotton seed cake (Rafiq et al., 1990c). It was also realized that supplementation during late pregnancy, not only improved birth weight of lambs and milk yield but also mothering abilities of the dam at lambing-an observation consistent with the early findings of Oddy (1978). In these areas lactating ewes and does are supplemented with conventional sources of barley grain but on a limited scale. However in certain areas where sowing of early varieties of wheat and barley is practised, crops are either grazed or harvested at vegetative stage, preserved as hay (called khaseel) and used as a source of roughages during severe winters. Use of leguminous crops, especially pulses and fodder e.g. guar, as a source of roughages is not uncommon. These roughages of cereal, harvested at the vegetative stage and leguminous straw, containing adequate energy and nitrogen, are helpful for animals in maintaining their liveweight during gestation and lactation.

The nutritional status of these valuable small ruminants in low land areas, is different. Due to rainfall occuring in both the monsoon and winter seasons, ranges are comparatively in better condition. In addition to grazing on ranges, crops residues and road side grazing contributes significantly in the daily feed intake of ewes and does and subsequently their productive and reproductive performance. Moreover, house hold items such as wheat bran, dry breads, weeds and similar other products are often used as a source of supplementation.

Lambs and kids in these areas are usually weaned at an age of 120-180 days. Due to low milk production of ewes and does grazing on poor ranges, the growth rate in lambs and kids is low, especially during the first 4-8 weeks. Although rumen development is completed during the first 6-8 weeks, lambs and kids start grazing or taking solid food but they cannot cover long distances along with their dams due to weakness and cold weather. As creep feeding is rarely practised, the liveweight gain of lambs from birth to weaning is poor and varies from 75-100 g/day and liveweight at at an age of 180 days is not more than 16 kg. Our investigations also revealed that weight gain in lambs during early lactation can be improved through supplementing (Rafiq et al., 1989) or through feed -lot feeding of ewes (Rafiq et al., 1992). When lactating Harnai ewes were maintained on lucerne hay only or supplemented with conventional sources e.g barley grain or with balanced ration during winter, liveweight gain of lambs was further increased from 148 to 180 and 207 g/day respectively.

Milking of ewes and does starts after 6 weeks of lambing/kidding. Milk yield varies from 400-900 ml/day. This low milk yield leads to lambs of lighter liveweight at maturity compared with corresponding ones in low land areas. Palatability trials conducted by Rafiq et al. (1991) have indicated that grazing on improved pastures of *Vicia dasycarpa* can help the farmers in improving growth in lambs to an optimum rate of 93 to 138 g/day during post weaning period. Similarly Four wing salt bush (FWSB) has been reported to offer a promising potential for a sustained supply of nutrients either through direct grazing or under cut and carry methods (Atiq-u-Rehman et al., 1988 and Warren et al., 1990). The use of non conventional nitrogenous supplements like urea molasses blocks or fishmeal also offer means of improving liveweight of lambs during the post weaning period (Mirza et al., 1988 and Hussein and Jordan, 1991). Table 4 shows production performance of various sheep breeds found in respective dry areas.

TABLE 4. PERFORMANCE OF SHEEP BREEDS OF PAKISTAN DURING VARIOUS PHYSIOLOGICAL STAGES

Breeds	LW of ewes at mating (kg)	LW of ewes at lambing (kg)	LW of ewes at weaning (kg)	LWG of ewes (g / day)	BW of lambs (kg)	LW of lambs at weaning (kg)	LWG of lambs (g / day)	References
Baluchi	31.3	23.2	25.7	30.0	2.0	10.0	90.0	Rafiq et al (1990c)
Harnai	34.5	30.5	32.2	20.0	2.6	16.0	148.0	Rafiq et al (1989)
Sipli	31.0	25.5	27.0	45.0	3.0	17.0	135.0	Rafiq et al (1990a)
Kajli	33.0	26.0	29.0	40.0	3.5	16.0	155.0	– do –
Damani	30.0	24.0	26.0	55.0	2.7	17.0	128.0	Hasnain (1985)
Kooka	28.0	22.0	25.6	58.0	3.5	21.0	140.0	Issani (1988)
Kacchi	31.6	27.2	29.3	45.0	2.5	16.0	115.0	– do –

Marketing Systems

Animal off-take from nomadic/transhumant flocks, is quite low. However in order to purchase basic necessities of life, nomads sell wool, male, unproductive animals and milk or milk by-products. For the sale of these animals or their by-products, there is no well defined marketing system. The available marketing system is dominated by middlemen. Almost 30-40 percent profit directly or indirectly goes to middlemen or the agents of marketing agencies (Siddiqui, 1982; Hasnain, 1985). Due to lack of communicational facilities in production centres, farmers are unaware of the price situation in markets and depend on middlemen for the sale of their products (Akhtar and Pervaiz, 1987). A recent study by Mohamood and Rodriguez (1993) has shown that services of intermediaries in the marketing chain represented 30-35 percent of the prices of sheep and goats paid by consummers.

Socio Economic Aspects of Sheep Production

The size of the population involved (about 3-7 percent) gives no indication but number of livestock owned or herded by this relatively small population is of immense importance (Thomson et al., 1986).

Small ruminants, especially sheep, have been widely used by landless farmers to build and store wealth until cash is needed to meet any emergency (Dhal and Hijart, 1976). References to small ruminants as a "Living bank" are often used to describe this function (Sabrani and Knipscheer, 1982). The small ruminants, in addition to making an efficient use of marginal or waste lands, are sharing significantly in the contribution made by the livestock sector (8 percent) to gross domestic product (GDP) from agriculture sector of the country. The activities of this sub-sector account for 10 to 25 percent income of small and landless livestock producers depending on the accessibility of the market.

Table 5 indicates that in spite of various biological, environmental and socio economic constraints, a growth rate of 4 percent has been maintained in the livestock sector during the last decade (GOP, 1992/93). This growth rate led to a significant contribution of sheep and goats in home consumption, cash income and foreign exchange earned through the export of raw wool, woolen products (carpets and ruggs), leather and leather garments. During an economic analysis of a transhumant flock of 100 head (85 ewes and 15 does), FAO (1983) reported that each ewe and doe has been contributing 8-10 US $/ annum in cash income of the family.

TABLE 5. CURRENT POPULATION OF SHEEP AND GOAT AND THEIR PRODUCTION IN PAKISTAN (GOP, 1992-93)

Parameters	1982	1992
Population (million heads):		
Sheep	23.5	27.7
Goats	27.7	40.2
Milk (000 tonnes):		
Sheep	36.0	42.0
Goats	401.0	566.0
Mutton (000 tonnes):		
Sheep	166.0	272.0
Goats	223.0	441.0
Skins (million no):		
Sheep	12.4	12.1
Goats	16.4	21.8
Raw wool (000 tonnes)	42.7	50.5
Hair (000 tonnes)	5.8	8.5

Foreign exchange contributed through an export of by-products produced by 68 million heads of sheep and goats are shown in table 6.

As mentioned earlier, environmental conditions particularly malnutrition and health hazards, have exerted negative effects on the performance of small ruminants. The contribution of small ruminants in gross agricultural products (GAP) in Baluchistan, has declined from 40 to 25 percent (FAO, 1983).

TABLE 6. FOREIGN EXCHANGE (RS MILLIONS) EARNED THROUGH THE EXPORT OF SMALL RUMINANT PRODUCTS IN PAKISTAN (RS 30 = 1 US $)

Parameters	1980	1990
Raw wool[1]	95	283
Carpets and ruggs[2]	2,198	4,445
Leather[1]	1,264	4,255
Foot wear[2]	247.7	365.4
Hides and skins	NA	1

[1]Agricultural statistics of Pakistan for 1989-90, Ministry of Food, Agriculture and Cooperatives, Islamabad, Pakistan.

[2]Economic survey 1989-90. Finance Division, Economic Advisor's Wing, Government of Pakistan, Islamabad.

NA : Not available.

Conclusions

Based on the findings of survey and experimental

work reviewed, it can be concluded that a production potential is existing in dry areas of the country. Production of sheep and goats, can be increased by 25-40 percent by increasing conception rate through an improved nutrition during mating season, late gestation and lactation. This will be possible only if the concerned departments focus on:

- a system of cooperative societies for the management and better utilization of ranges, the availibility of credit and marketing of livestock and their by products,
- the dissemination of scientific information from research to farm level,
- an introduction of better fodders and forage species suitable for local climatic conditions,
- an availibility of adequate veterinary services throughout the year,
- an improvement in nutrition of ewes and does through an increase in carrying capacity of ranges, flushing during breeding season and supplementation during late gestation and lactaion.

Literature Cited

Akhtar, A. S. and A. Pervaiz. 1987. On farm animal research relevant to Mixed Farm System of Pakistan. Proc. Workshop on Livestock in Farming System Research, held on 8-15 April, 1987 at Islamabad, Pakistan. p. 9.

ARC. 1980. The nutrient requirements of ruminant livestock. Farnham, Farnham Royal, Slough, SL-2 BN, UK.

Atiq u Rehman, K. N. M, M. Khan, M. Asghar and M. Sultani. 1988. Four wing salt bush as a feed compared with conventional feeds by yearling sheep. MART/AZR Research Report No. 16, ICARDA, Quetta, Pakistan. p. 14

Birrell, H. A. 1981. Some factors which affect the liveweight change and wool growth of adult Corriedale wethers grazed at various stocking rates on perennial pasture in Southern Victoria. Aust. J. Agric. Res. 32:353-70.

Birrell, H. A. 1989. The influence of pasture and animal factors on the consumption of pasture by grazing sheep. Aust. J. Agric. Res. 40:1261-75.

Degen, A. A, R. W. Benjamin and E. Eyal. 1987. A note on increasing lamb production of fat-tailed Awassi and German Mutton Merino sheep grazing in semi-arid areas. Anim. Prod. 44:169-172.

Dhal, D. and A. Hijart. 1976. Having herds: Pastoral herd growth and house economy. Department of Social Anthropology. The University of Stokholm, Sweden.

FAO. 1983. Report of the Assistance to rangeland and livestock development survey in Baluchistan. TCP/Pakistan/0107, FAO, Quetta, Pakistan.

FAO. 1987. Pakistan Livestock Research: Agricultural Research 11. Project report Annex 3. FAO, Islamabad, Pakistan.

GOP. 1970. Integrated Reconnaissance Survey of soils and vegetation of Thal. Institutions of Government of Pakistan assisted by UNDP and FAO. Preliminary edition. Lahore, Pakistan.

GOP. 1973. Rangelands of Pakistan. A study of National Range Management Committee, Government of Pakistan, Islamabad, Pakistan. p. 136

GOP. 1975. Reconnaissance soil survey of Cholistan. Preliminary edition. Ministry of Food, Agriculture and Cooperatives, Lahore, Government of Pakistan.

GOP. 1978. Reconnaissance soil survey of Quetta and Pishin districts. Ministry of Food, Agriculture and Cooperatives. Soil survey of Pakistan. Preliminary edition. Lahore, Government of Pakistan.

GOP. 1992/1993. Agricultural Statistics. Ministry of Food, Agriculture and Cooperatives, Government of Pakistan, Islamabad.

GOP. 1993. Economic survey. Finance divison, Economic Advisors' Wing, Government of Pakistan, Islamabad.

Hasnain, H. U. 1985. Sheep and goats in Pakistan. FAO Animal Production and Health Paper No. 56, FAO, Rome, Italy. p. 135

Hussein, H. S. and R. M. Jordan. 1991. Fishmeal as a protein supplement in ruminants diet: a review. J. Anim. Sci. 69:2147.

Illahi, C. I. and C. M. Sharif. 1966. The vegetation and range flora of Thar desert. The West Pakistan Forest Department, Hyderabad, Pakistan.

Issani, G. B. 1988. Production potential of sheep breeds in Sind province. Annual research report of nationally coordinated project on "Improvement of sheep and wool in Pakistan" at University of Agriculture, Tandojam.

Javed, A., A. S. Alvi and S. N. Mirza. 1993. Potential for rehabilitation of degraded rangelands of Baluchistan. Pak. J. Forestry. 4:99-106.

Khan, C. M. A. and N. Mohammed. 1987. Rangelands in Pakistan. Proc. Workshop. on "Arid lands Development and Desertification Control" held on Jan, 9-15, 1986 at Islamabad, Pakistan.

Mahmood, K. and A. Rodriguez. 1993. Marketing and processing of small ruminants in highland Baluchistan, Pakistan. J. Small. Rumi. Res. 10:93-102.

MART/AZRI. 1987. High elevation research in Pakistan. Annual research of MART/AZRI project, Quetta,

Pakistan.

Mirza, I. H., J. K. Jadoon, M. A. Naqvi and A. Ali. 1988. Performance of lambs fed urea molasses blocks vs concentrates. A. A.J. Anim. Sci. 1:27-31.

Nasir, E. and S. I. Ali. 1979. Flora of West Pakistan. No. 126. Convolulaceae by Danial F. Austin, Florida Atlantic University Boca Ration, USA and Shahina Ghazanfar, Agricultural Research Council, Islamabad, Pakistan.

Nyerges, E. 1980. Traditional pastoralism-an evolutionary perspective. Expedition, 22, No. 4:38-41.

Oddy, V. H. 1978. Milk production in ewes fed high grain diets. Proc. Aust. Soc. Anim. Prod. 12:144-45.

Rafiq, M., K. Mohmood and M. Munir. 1989. Effect of supplementation on the performance of lactating Harnai ewes and subsequent changes in liveweight of lambs. NWFP. J. Anim. Health and Prod. 9(1-2):60-68.

Rafiq, M., K. M. Ahmed and J. K. Jadoon. 1990a. Observations on production traits of sheep breeds in Punjab. Pak. J. Agric. Agric Engg and Vet. Sci. (Accepted).

Rafiq, M., M. Munir, M. J. Afzal and A. Ali. 1990b. Observations on reproduction and production traits of goats maintained on rangelands of Baluchistan. Egyptian. J. Anim. Prod. 27(1):61-74.

Rafiq, M., I. Sultani, M. Munir and A. Arshad. 1990c. Study of reproductive potential of Baluchi sheep on ranges in Baluchistan. A. A. J. Anim. Sci. 3(3):177-182.

Rafiq, M., A. Ali and M. A. Naqvi. 1991. Feed intake and changes in liveweight of Harnai lambs grazing on Vicia dascarpa-a palatability trial. Pak. J. Agric. Agric Engg and Vet Sci (Accepted).

Rafiq, M., A. U. Cheema, M. Munir and M. S. Butt. 1992. Performance of lactating Harnai ewes maintained under feed-lot system. Pak. J. Livestock. Res. 2(1-2):51-55.

Robinson, J. J. K. 1982. Pregnancy in sheep and goats. Vol. C.1 (I. E. Coop, Ed) pp. 103-118. Amsterdam (Elsevier) Netherland.

Sabrani, M. and H. C. Kinpscheer. 1982. Sheep and goats markets in central Java: a profile working paper No. 5. Research Institute for Animal Production, Bogar, Indonesia.

Sharafeldin, M. A. and M. Shafie. 1965. Animal behaviour in the sub-tropics. II: grazing behaviour of sheep. Neth. J. Agric 13:239-247.

Siddiqui, K. A. 1982. Marketing and grading of wool in Pakistan. Proc. Int. Seminar on "Sheep and wool in Pakistan" held on 14-16th March, 1982 at Islamabad, Pakistan.

Swidler, W. W. 1972. Some demographic factors regulating the formation of flocks and camps among the Brahuis of Baluchistan. In: W. G. Irons and N. Dyson-Hudson (Editors), Prospectives on Nomadism. Brill, Leiden, pp. 69-75.

Thomson, E. F., F. A. Bahhady, A. Termanini and M. Mokbel. 1986. Availibility of home produced wheat, milk products and meat to sheep owning families at the cultivated margin of the North West Syrian Steppe. Ecology of Food and Nutrition. 19:113-121.

Thomson, E. F. and F. A. Bahhady. 1988. A note on the effects of liveweight at mating on fertility of Awassi ewes in semi arid North-West Syria. Anim. Prod. 47:505-508.

Valencia, M. and E. G. Padilla. 1983. Pelibuey sheep in Mexico. In H. A. Fitzhugh and G. E. Bradford (Eds). Hairy sheep in Western Africa and Americas- A genetic resource for the tropics. pp. 55-76. A. Winrock International study. Westview press, Boulder, Colorado, USA.

Warren, B. E., C. J. Bunny and E. R. Bryant. 1990. A preliminary examination of the nutritive of four salt bush (Atriplex) Species. Proc. Aust. Soc. Anim. Prod. 18:424-427.

Young, B. A. 1983. Ruminant cold stress: Effect on production. J. Anim. Sci. 57(6):1601-1607.