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9. ABSTRACT

Although the livestock population of Pakistan contributes some 38 percent of the total gross production value of agriculture, the production and marketing of livestock and related products has largely been neglected. The per capita consumption of meat in Pakistan is among the lowest in the world. From July through September of 1973, a four-man team of U.S. livestock production and marketing specialists requested by the government of Pakistan conducted an investigation in Pakistan to identify the causes of the inadequate quantity and low quality of livestock products reaching consumers, and to outline programs that would lead to significant improvements. The basic problem found with milk and milk by-products is the lack of all-weather roads and rail links, coupled with a lack of refrigerated means of transporting milk. Government and private investment in these, along with development of cooperative marketing organizations, would have a high payoff. Problems in the sheep and goat industry can be solved by reducing livestock numbers, assuring that rotational grazing is practiced, and that a more even distribution of grazing is obtained. Allowing the prices of mutton and goat meat to rise would divert much of the illegal trade in sheep, goats, and wool into legal lands, benefiting the whole of Pakistan. Problems with beef production can be solved by introducing government incentives for expanding the capacity of existing feed mills and constructing additional ones. The same applies to feedyards, slaughterhouses, and transportation systems. An effective disease and pest control program also needs to be established, as well as a system of grading and pricing meat to denote differences in quality. Finally, the system for collecting and analyzing livestock data needs to be greatly expanded, so that the data can be used in formulating policies and developing programs to improve the livestock industry. These data would include annual estimates of production, birth and mortality statistics, feed supplies, forage conditions, and other valuable information for identifying problems and investment needs.

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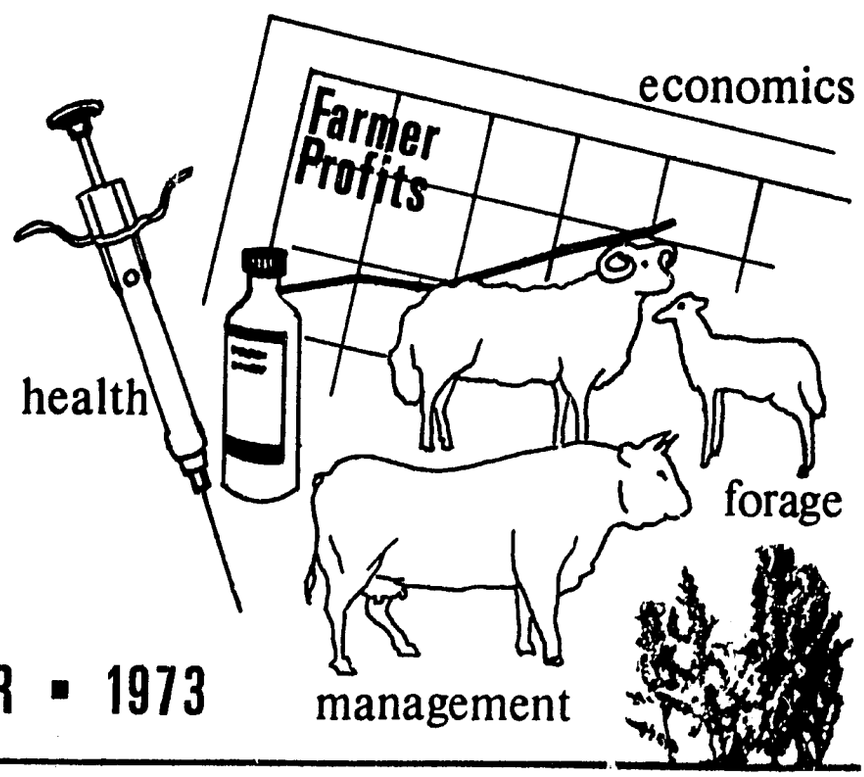
PRELIMINARY REPORT



OCTOBER • 1973

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
MISSION TO PAKISTAN

FOREWORD

At the request of the Government of Pakistan, USAID assembled a consultant livestock team with international experience to make a preliminary survey of the production and marketing of livestock and their products. The resulting report concerns the four major meat and milk producing kinds of livestock--cattle, buffaloes, sheep and goats. The scope of the report covers feed and forage livestock diseases and pests, livestock nutrition and management, and economics of production and marketing.

The USAID Livestock Team, in reporting the results of its study, acknowledges gratefully the support and assistance of numerous officials of the Provincial and Central Governments, university and extension administrators and workers, USAID officials, and individuals in the private livestock sector.

The Team is grateful particularly to Mr. S.A. Chughtai and Mr. James Unti, USAID, Islamabad, who successfully coordinated the Team's travels and appointments in various places within the four provinces of Pakistan during the period of August 1-17, 1973.

Calvin C. Boykin
Herbert L. Chapman, Jr.
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October, 1973

Second printing July 1974. This issue contains minor editorial revisions over October 1973 printing.

INTRODUCTION

While Pakistan is one of the few developing countries which has attained an annual agricultural growth rate of over 4 percent during the last decade, these gains have been made largely by the non-livestock sector. Although the livestock population contributes some 38 percent of the total gross production value of agriculture, the production and marketing of livestock and their products have largely been neglected.

In spite of the relatively large numbers of livestock the diet of Pakistan's population is grossly deficient in animal protein. While per capita consumption of milk apparently is relatively high, per capita consumption of meat is among the lowest in the world. In consideration of the apparently deteriorating quality of meat and milk and growing shortages despite an export embargo, the Government of Pakistan requested the services of a team of U.S. livestock production and marketing specialists to assist in carrying out a preliminary study of the livestock industry.

A four-man team began arriving in Pakistan July 29, 1973 and travelled together within the four provinces during August 1-17, seeking information and evaluations of problems in livestock production and marketing from persons in both the public and private sectors of the livestock industry. On completion of this report, the last member of the team departed September 9, 1973.

The principal objectives of this report are: (1) to identify, at least tentatively, the root causes of the inadequate quantity and low quality of livestock products reaching consumers; and (2) to outline programs for possible public and private investments leading to significant industry improvements with a target of meeting domestic needs and also entering in a modest way into foreign markets.

Attention in this study is given to:

1. Evaluation of livestock management practices;

2. Development of forage and fodder resources;

3. Evaluation of livestock health practices;

4. Economic aspects of production and marketing.

TABLE OF CONTENTS

Chapter 1

EVALUATION OF LIVESTOCK MANAGEMENT PRACTICES IN PAKISTAN

Herbert L. Chapman Jr.

General Information

This particular report deals with livestock management. Specific objectives are as follows:

1. appraise current livestock management practices that are followed on farms, ranches and itinerant herds, including adequacy of feed and forage supply, drinking water, sanitation and breeding practices;

2. appraise public program of research, extension and other livestock-oriented activities;

3. make recommendations;

4. estimate costs of recommendations and increased return expected;

5. determine technical and economical feasibility of commercial meat production in Pakistan;

6. estimate price levels required to make different practices pay.

While in each province, the Team visited with a number of people and traveled widely by automobile. The majority of the people with whom we had meetings were provincial officials, university or livestock experimental station personnel. We did not have an opportunity to visit many actual producers, but we did get to talk with enough sheep herders, dairy operators, marketing people and other people to give us some insight on their management procedures.

While visiting the different provinces, pertinent but general information about management variables was summarized and this information is presented in Table I. Of special significance is the last item in the table (Problems Listed by Various Officials). The people we talked with were well-qualified individuals with an accurate, in-depth evaluation of the problems they were facing in livestock production in their provinces. In addition considerable research data were available that provided some immediate guidelines on steps that can be taken to improve livestock production. A list of these references is attached and will be discussed further in this report.

TABLE 1- SUMMARY OF INFORMATION COLLECTED DUR.NG EVALUATION OF LIVESTOCK INDUSTRY IN PAKISTAN

	N. W. F. P.	Punjab	Baluchistan	Sind
Areas visited	Peshawar Mardan Malakand Saidu Kohat Landi Kotal	Lahore Lyallpur Bahadurnagar	Quetta Ziarat Loralai Hindubagh	Karachi
Mode of travel	Traveled by car from Islamabad and used car transportation until we left by air for Lahore.	Traveled by car to outlying towns. Flew from Lahore to Multan enroute to Quetta.	Flew to Quetta and traveled by car to places visited.	Flew to Karachi and traveled by car afterwards.
Roads and other means of transport	Existing roads good. In flying from Peshawar to Lahore there was an apparent lack of farm to town roads noted from the air. Airport and rail facilities available.	Due to flooded conditions it was not possible to evaluate road system from the air. Maps of West Pakistan indicate Punjab has a good network of main roads. Farm to town roads seem deficient. Airport and rail facilities available.	Main roads were good. There was a lack of farm to town roads. Airport and rail facilities available.	Main roads good but there was a lack of farm roads. Airport, rail and seaport facilities available.

TABLE 1 - (continued)

	N.W.F.P.	Punjab		Baluchistan	Sind
Rainfall (inches)	Peshawar	Rawalpindi	Multan	Quetta	Hyderabad
January	1.4	2.5	0.4	1.9	0.2
February	1.5	2.5	0.4	2.0	0.2
March	2.5	2.8	0.4	1.7	0.2
April	1.8	1.9	0.3	1.0	0.1
May	0.8	1.2	0.3	0.4	0.2
June	0.3	2.3	0.5	0.2	0.4
July	1.3	8.1	2.0	0.5	3.0
August	2.0	9.2	1.8	0.3	2.0
September	0.8	3.9	0.5	0.0	0.6
October	0.2	0.6	0.1	0.1	0.0
November	0.3	0.3	0.1	0.3	0.1
December	0.7	1.2	0.2	1.0	0.1
Total:	13.6	36.5	7.0	9.4	7.1

TABLE 1 (continued)

Temperature	N. W. F. P.	Punjab		Baluchistan	Sind
(Ave. - F°)	Peshawar	Rawalpindi	Multan	Quetta	Hyderabad
January	52	50	55	39	63
February	55	53	60	42	68
March	64	63	70	51	78
April	73	73	83	60	87
May	84	83	91	68	93
June	91	90	96	75	93
July	91	87	94	80	90
August	88	80	91	77	87
September	83	81	88	68	87
October	74	73	79	67	84
November	63	61	67	49	73
December	54	52	57	42	66
Area(sq. m)(2)	28, 773	79, 284		134, 050	54, 407
Population (2)	8, 400, 000	37, 370, 000		2, 410, 000	13, 960, 000
Major population centers	Peshawar Mardan Malakand	Islamabad Lahore Multan		Quetta	Karachi Hyderabad

TABLE 1 - (continued) Major Agricultural Enterprises

		N. W. F. P	Punjab	Baluchistan	Sind
Rice	(Ton)	65,000	976,000	34,000	1,094,000
Wheat	(Ton)	326,000	4,870,000	75,000	1,103,000
Maize	(Ton)	343,000	335,000	3,000	13,000
Sorghum	(Ton)	14,000	128,000	55,000	111,000
Millet	(Ton)	13,000	230,000	1,000	110,000
Chick pea	(Ton)	199,000	1,524,000	12,000	502,000
Cotton	(Bales)	2,200	2,229,000	0	819,000
Cottonseed	(Ton)	800	780,000	100	286,700
Sugarcane	(Ton)	3,327,000	15,070,000	2,000	2,801,000
Buffalo		600,000	7,600,000	100,000	1,700,000
Cattle		2,000,000	13,000,000	800,000	4,200,000
Sheep		1,400,000	10,200,000	5,000,000	3,400,000
Goats		2,000,000	7,400,000	3,800,000	6,800,000
Cattle breeds		Achai Lohani Mixed breed	Sahiwal Sindhi Thari Lohani Dhanni	Bhagnari Australian Drought Master	Red Sindhi Bhagnari Thari

TABLE 1 - (continued)

	N. W. F. P.	Punjab	Baluchistan	Sind
Sheep breed	Balkhi Waziri Damani Hastitnagri Kaghani Michni Some Rambouillet rams being used	Lohi Kachhii Awassi Hisserdale Damani Balki Kaghani Baghdali Some Rambouillet rams being used.	Harnai Bebrit Baluchi Rakhshani Awassi	Kachhi
Buffalo breeds	Nili Ravi	Nili Ravi	Nili Ravi	Kundi
Goats	Hairy goat Angora	Hairy goat Angora	Hairy goat	Kamori
Average farm size on irrigated area	10-20	Ibid	Ibid	Ibid
Market outlets	Very little formal marketing done by producers. There are a number of middle men that travel through the countryside buying livestock, produce. This may pass through a number of banks, before reaching the local livestock market.	Ibid	Ibid	Ibid

TABLE 1 - (continued)

	N. W. F. P.	Punjab	Baluchistan	Sind
Estimated operating costs - these figures could not be pinned down to my satisfaction.				
Land costs Taxes Vet (free) Fertilizer Feed Fodder Fuel Labor	0	0	0	0
Fertility of native soil	Specific data no obtained. Observation indicates inherent productivity is good and that the major limiting factors are nitrogen, phosphorous and water. Where irrigation is available and fertility adequate, crops look good.	Ibid	Ibid	Ibid
Research program (livestock and fodder)	No formal system. Some being done by Vet. Res. Inst.	Quite active research program on livestock. Very little on fodder crop.	Some research being done, but not enough. No fodder crop research.	4 government centers, no formal research on fodder crops.
Extension	Limited to disease control and artificial insemination	Ibid	Ibid	Ibid
Teaching (University level)	None	Yes	None	Yes

TABLE 1 - (continued)

	N. W. F. P.	Punjab	Baluchistan	Sind
Available Fertilizer Materials	Urea Ammonium nitrate Ammonium sulfate Superphosphate	Ibid	Ibid	Ibid
Major pasture-forages	Pasture on irrigated lands and lands with adequate rainfall is not grazed in the way normally found in many other countries. It is cut by hand and fed as green fodder. Roads stubbles and other waste areas are grazed by livestock, but this is a minor amount. Primary fodder crops are:			
	Berseem Sorghum Maize Luccine	Ibid	Ibid	Ibid
Major disease	(This is a critical problem)			
	Tuberculosis Brucellosis Foot and mouth disease Enterotoxemia Hemorrhagic septicemia Blackleg Anthrax Rinderpest Bovine pleural pneumonia Leptospirosis	Ibid	Ibid	Ibid

TABLE 1- (continued)

	N.W.F.P.	Punjab	Baluchistan	Sind
Parasite (External)	Ticks Lice Mites Warble	Ibid	Ibid	Ibid
(Internal)	Flukes Gastro-intestinal	Ibid	Ibid	Ibid
Estimated % of total livestock that are contacted by veterinary service	15-25	15-25	20-30	75-80
Management practices followed:				
Castration	Some done on undesirable genotypes, but this appears very limited. Burdizzi used.	Ibid	Ibid	Ibid
Dipping	Some			
Spraying	Some			
Vaccination	To combat disease outbreak. No routine prevention.			
Cow/bull ratio	Uncertain			
Supplemental conc.	Some (very limited)			
Mineral,Fertilizer	No			
Breeding season	Continuously			
Irrigation	Where possible.			

TABLE 1 - (continued)

Problems listed by people in different provinces

N. W. F. P.	Punjab	Baluchistan	Sind
1. Deficient feed supplies	1. Inadquate fodder production	1. Marketing system	1. Need programs to develop livestock in unirrigated areas.
2. Inadequate facilities to market	2. Farmer is uninformed on economics of livestock	2. Deficient feed supplies	2. Producer not educated to livestock economics
3. Smuggling, i.e. mutton sells for 7-8 Rs. in Pakistan and about 39 Rs. in Tehran. Same relative picture on beef.	3. Price structure on beef	3. Limited transportation to markets.	3. Slaughtering of dry cows.
4. No research on fodder or animal nutrition	4. Lack of fodder research	4. Meat price is too low.	4. Shortage of technicians.
5. Breeds are thought to be deteriorating	5. Byproducts are being used for purposes other than livestock	5. Need producer incentives	5. Credit (Lack)
6. No clearcut livestock program objectiv s.	6. Need to use unwanted calves	6. Differences of opinions exist on question of range being overstocked	6. Inadequate use of excess fodder
7. Need info on cross-breeding	7. Marketing system	7. Smuggling	7. Inadequate livestock research
8. Need a system of milk collection and distribution	8. Need info on cross breeding	8. Middleman	8. No fodder research
	9. Need a formal training program for technicians	9. Marketing system	9. Need broader extension services goals
		10. Water	10. Need a program for milk production

TABLE 1 - (continued)

N.W.F.P.	Punjab	Baluchistan	Sind
9. No controlled range management.	10. Low salaries for technicians and research people	11. Need to control range-land use.	11. Marketing system
10. Need to develop pasture lands	11. Milk handling system	12. Inadequate health management	12. Inadequate nutrition
11. Inadequate disease control	12. Estimated 64% of buffalo die without being salvaged for meat	13. Lack of credit	
12. Need more trained people	13. Need better health management		
13. Poultry sector poorly organized	14. Meat production is incidental to milk production		
14. Lack of credit	15. No team effort among Punjab personnel.		

TABLE 1 - (continued)

WHOLESALE MEAT PRICES 1/

		N.W.F.P.	Punjab	Baluchistan	Sind
Buffalo	(Rs./seer)	Meat @ 3.5-4	Ibid	Ibid	Ibid
Cattle	" "	Meat @ 3.5-4			
Sheep	" "	Mutton @ 6-7			
Goats	" "	Meat @ 6-7			
Poultry	" "	Meat @ 8-9			
Milk	(Rs,/md)	45			

LOCAL FEEDSTUFFS (maunds) 2/

Molasses	1,102,054	Information was not obtained for other three provinces.	
Sorghum			
Maize			
Bagasse			
CS Cake			
Blood meal	600		
Urea	0		
Wheat bran	15,000		
Rice husks			
Corncobs			
Wet beet pulp	1,414,700		
Dry beet pulp	190,800		
Bone meal	33,600		
Corngluten meal	50,000		
Available minerals	Very limited supply	Very limited supply	Very limited supply	None available

1/ Inconsistant data received from different sources; confirmation is needed.

2/ Byproducts of crops produced- see list of major crops.

Review of Livestock Management Practices

While there were minor differences between provinces, there were two major situations in so far as livestock management was concerned, nationwide. Namely, these were the irrigated areas vs. the rangelands. In addition, there were some rainfall areas that receive adequate rain to enable cropping. However, in the main, there were the two sets of conditions, each of which would require specific management practices. The irrigated area is more expensive per unit of land and requires more intensive management to maximize return than is the case in range areas, where a more extensive management program has good utility.

Information received about the management practices followed in the various provinces are summarized in Table 1. These are reviewed further below.

Breeding

Indigenous breeds of sheep, goats and cattle predominated throughout the country. The need to improve these animals is recognized by authorities. Programs of artifical insemination and of using different breeds of livestock have been instigated to introduce new germ plasma into the indigenous breeds (1,2,3,4,5,6).

Currently there appear to be two avenues of thinking in regard to the best way to improve meat, wool and milk production through breeding. One school of thought emphasizes the importance of improving the pure lines through selection and exploitation of germ plasm from superior animals. Another school of thinking believes that most progress can be made by crossbreeding. There are programs in progress emphasizing both approaches.

It would appear that little selection pressure is placed on the water buffalo, although information obtained at L.E.S. Bahadurnagar indicated that milk production had been increased over 1,800 lbs. a year and that age of sexual maturity had been reduced from 34 to 30 months during the last 10 years by selection. Also they have classified their buffaloes into slow breeders that have a 500-day interval between calves and quick breeders that have 450 days between calves, which would indicate that progress could also be made in reducing claving intervals, through selection.

Nutrition

The majority of nutrition for all four classes of livestock is obtained from forage. In the irrigated areas this is comprised of green fodder that is cut and fed by hand, of crop residues such as wheat and

rice straw and sugarcane tops, and of miscellaneous grazing on roads and vacant lots. In the rangeland areas, nomads predominate and the livestock obtain practically all of their nutrition from forage as they move from place to place.

Milk cows are fed a small amount of concentrates in addition to the fodder crops. There seemed to be some variation in this but primarily the concentrate consisted of cottonseed cake, wheat bran, and sorghum. No mineral mixture was observed fed to any livestock.

Marketing

Marketing of livestock products was handled by many entrepreneurs. These "middlemen" go into the country and buy produce and transport it to local markets where it is again sold. This may occur a number of times before reaching the butcher who is also the retailer. Reportedly there is considerable smuggling of meat and wool to neighboring countries because of a three or four-fold difference in the prices outside of Pakistan. There seemed to be more of a systematic production pattern in sheep and goats for meat, milk, wool and mohair than in cattle and buffalo for beef. Beef was more of a by-product from a dried-up milk animal or a worn out draft animal and was generally of very inferior quality. On the other hand, mutton and goat meat appeared to be of quite good quality.

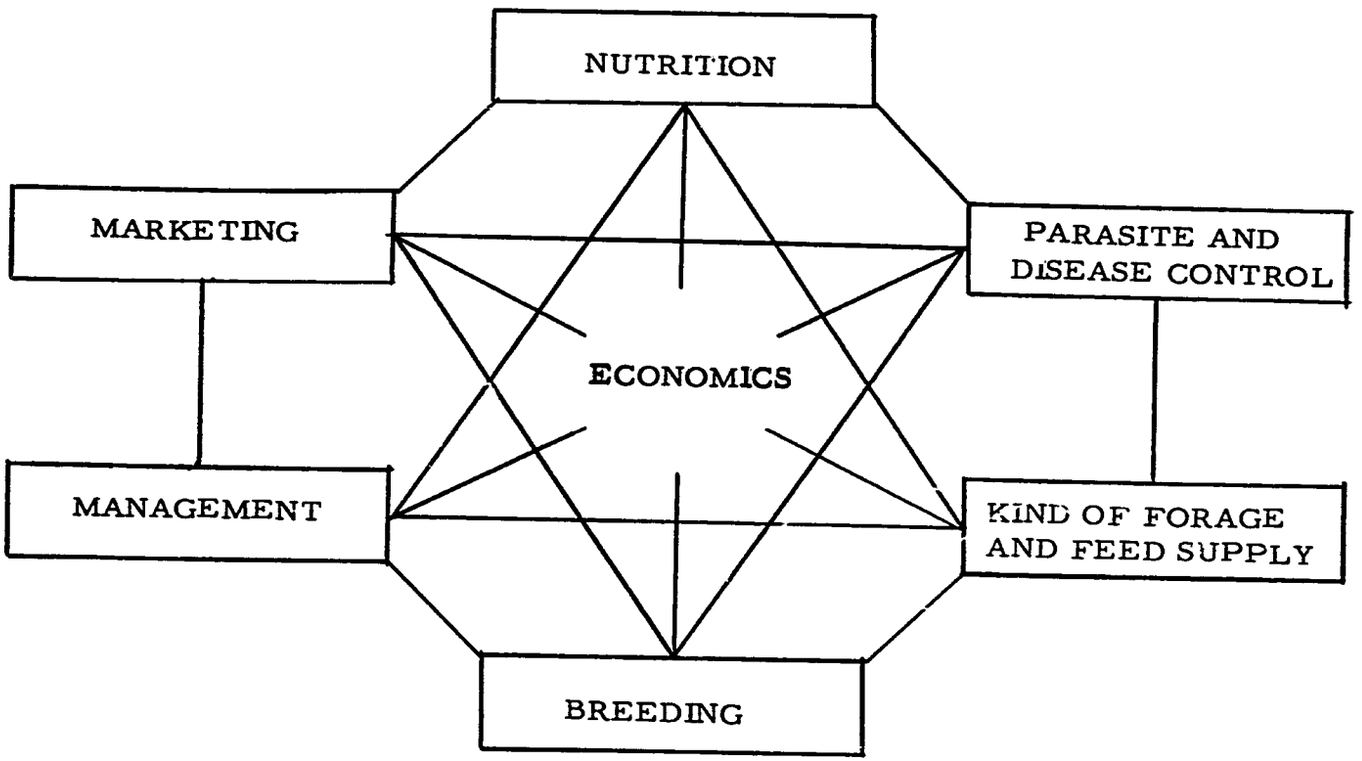
Animal husbandry practices

Generally the major emphasis in animal husbandry practices was on vaccination. In most cases this involved a program of putting down disease flare-ups, except for the Sind area where 75-80% of the livestock are reportedly vaccinated annually for hemorrhagic septicemia and every other year for rinderpest. In other provinces, estimates of the total animal population reached by the veterinary extension service ranged from 15 to 30%. Reportedly there was some castration of genetically undesirable males, but observations made during travels indicated this to be a very small percent. Some dipping and spraying is done for external parasite control. Breeding occurs throughout the year. No mineral mixtures are used.

Discussion of Livestock Management

The production of livestock involves a number of factors that are interrelated. Some of these factors are presented in Figure 1. All are important to any successful livestock enterprise although their relative importance may vary among localities depending upon emphasis, marketing conditions, or other variables that may occur from place to place.

Figure 1. IMPORTANT FACTORS IN CATTLE, BUFFALO, SHEEP AND GOAT PRODUCTION



It is difficult to build a successful livestock enterprise on only one or two of these factors. They all need to be considered at the same time, and this must be done in an economical manner so that the sum of the inputs will produce a profitable output. The economic discussion of the overall report will be handled elsewhere, but this overall concept is important.

One of the impressive factors encountered during this trip was the insight that most of the people interviewed had on their livestock management needs. These are emphasized by numerous research reports that have been published during the past ten years, by the many schemes on diversified problems that have been prepared by various research, public and private sector people and by the long lists of problems that were obtained while talking to the many people interviewed during the visit through the provinces. It would be presumptuous to ignore the understanding that Pakistanis have about their problems. Instead a summary of available information is presented with the hope that additional comments may be of some value.

Breeding

All of the indigenous buffalo, cattle, sheep and goats of Pakistan are products of many centuries of environmental adaptation. They have evolved to the point that they are particularly well-suited to Pakistan and can withstand the stresses of weather, nutrition, disease, and parasites. They are capable of reproducing at a level to maintain or increase their population under Pakistani conditions, and of producing some meat, milk and wool for human consumption.

However, the very factors that make them ideally suited for the many conditions they meet also are limiting when these animals are put into an intensive-management scheme.

There have been a number of schemes developed during recent years to improve meat, milk and wool production of Pakistani livestock and some have emphasized the relatively low production level obtained from the indigenous breeds. (1) It will be necessary to increase this genetic potential and the quickest way will be by crossbreeding. Rambouillet rams have been used in an attempt to improve wool and mutton production (1,4,6). Awassi rams are being used with the indigenous sheep of Baluchistan and Punjab. Crossbreeding work is being done, or is planned with Angora and indigenous goats in various parts of the country. Crossbreeding work is also being done by crossing Red Sindhi or Sahiwal cattle with other breeds. The need for crossbreeding has been recognized in numerous reports. (1,2,3,4,5,6,7,8).

To partially implement these needs an ongoing program of artificial insemination is also being carried out to introduce superior gern plasm among the livestock in Pakistan and superior sires are being distributed in different localities. This program should continue as it offers the best way of getting a broad injection of superior germplasm.

Advantage can be taken of cattle crossbreeding results throughout the world. Innumerable reports have been published during the past 20-30 years that can provide many clues as to the best path to follow in Pakistan. For example:

1. More hybrid vigor will usually be obtained in cattle by crossing Brahman X European cattle than by crossing European X European breeds or Brahman X Brahman.

2. If about one-third of the genetic make-up of the animal is from Brahman breeding, the animal will maintain hybrid vigor and be resistant to disease, insects, humidity, hot weather, etc.

3. Crossbreeding Brahman X European breeds produces an F_1 that is superior to either parent. Subsequent F_2 and F_3 generations will begin to lose this hybrid vigor unless the breed of sire is criss-crossed or a third breed of sire brought into the picture.

It is suggested that more immediate benefit can be realized in Pakistani cattle by breeding the Sahiwal and/or Sindhi females with one of the European breeds such as Holstein-Freisan, Guernsey or Jersey. The indigenous breeds should first be bred to the Sahiwal or Sindhi to increase the size of these cattle, after which this cross should be bred to the Holstein, Guernsey or Jersey breed. It is also possible that straight bred European breeds would thrive in the higher altitudes, such as Swat valley, if proper nutrition and management were provided.

Similarly, crossbreeding will produce hybrid vigor in sheep and goats. Both quality and quantity of meat, milk, wool and hair production can be increased by crossbreeding. This has been demonstrated in research in Pakistan during recent years and more emphasis should be placed on this program.

Nutrition

One pitfall in attempting to improve the meat, milk, wool and hair production, via crossbreeding, is that an animal will be produced which will require better nutrition than currently is available to the

indigenous breeds. The genetic benefit from crossbreeding will not be realized unless adequate nutrition is provided.

Forage should continue to provide the bulk of nutrition for livestock in Pakistan. This should be complemented with Pakistani-produced by-products to provide nutrients lacking in the forage, particularly energy and minerals. These low-cost by-products should be used to produce a higher-value export product, such as meat or cheese. More attention should be given to furnishing minerals to all classes of livestock.

Reports from Pakistani researchers have shown that currently-used fodder crops are not producing to their maximum capabilities (9, 10, 11, 12) because of inadequate fertilizer treatments, varieties and management practices. Research done in other tropical areas of the world would indicate that there are a number of other forage varieties that will yield more fodder per acre on irrigated land than those now used in Pakistan. Research has also suggested that fodder grown on well-fertilized, well-managed, irrigated soil may produce more TDN, protein and economic returns than any other cash crop.

Forage will be the most economical source of nutrition for Pakistani livestock for a number of years to come. This is the major reason for the need to provide some mechanism for managing rangelands to maximize forage production (13, 14). This is an essential need and has been well documented by earlier reports. Also consideration should be given to preserving high quality forage, either as hay, or silage.

Research reports on the composition of various Pakistani forages and other materials strongly suggest that livestock may not be obtaining adequate phosphorus (15, 16, 17, 18). This was further substantiated by a recent research report from the Punjab Directorate of Livestock Farms (1) which showed the rate of gain of Sahiwal heifers increased 10 to 39% by feeding 20 grams of bonemeal per head per day. The report also showed that supplemental copper increased the weight gain, homoglobin, red blood cell count and hematocrit level in sheep and goats.

These reports stress the importance of further studies to evaluate the economic merit of providing minerals to the local livestock, It is very possible that considerable increase in economic return could be realized from a small investment in minerals.

Protein supplements demand a very high price today. Cattle, sheep, goats and buffaloes are ruminants and have the ability to convert non-protein-nitrogen (NPN) to protein nitrogen which will release plant proteins for other uses.

Ruminants manufacture protein nitrogen from NPN sources. They have a unique stomach consisting of four compartments. The rumen, the largest compartment, contains millions of bacteria and protozoa. When NPN is eaten by cattle it goes into the rumen where it is broken down by microbial enzymes. For example, urea and biuret, two of the more commonly used NPN compounds, are broken down into carbon dioxide and ammonia by the enzymes urease and biuretase. The rumen bacteria use the ammonia to form their own body protein. It is important that the bacteria be able to use the ammonia as fast as it is released. The ideal NPN compound is one that releases ammonia at a rate that can be utilized by the microbes. If it is released too slow the production of microbial protein will be reduced and if it is released too fast the ammonia will be absorbed from the rumen into the blood stream before the bacteria can use it and this is toxic to cattle. In order for the microbes to efficiently utilize NPN it is necessary to provide the other nutrients that the microbes need. Whatever helps the growth of the NPN-utilizing microbes will help the nutrition of cattle. After the microbes synthesize their body protein, cattle in turn will digest and use the microbial protein to grow and develop to lactate, to work or to reproduce.

There are a number of NPN compounds presently used in livestock feeds. Urea is currently the most widely used material. It was recently reported that 50 to 90 percent of the protein equivalent in supplements was from urea. in 1970 over 300,000 tons of urea were used as feed in the United States and its use is increasing rapidly each year.

Biuret, a derivative of urea, is another NPN compound that is becoming more widely used in livestock feeds. This compound is also broken down into ammonia and carbon dioxide but the breakdown is slower than urea and this may be an advantage. It is possible that this material is less toxic because of its slower release of ammonia. More information is needed concerning how it compares with urea, but the use of biuret as a NPN compound for ruminants is rapidly increasing and appears to have considerable potential.

Numerous people have stressed the importance of using by-products in livestock rations (19,20,21,22,23,24,25). A report published in the Punjab in 1959 emphasized the value of blackstrap molasses in livestock feeding. A more recent publication is also available. Molasses can be mixed with other materials to make nutritionally balanced liquid feeds. (25) These and other by-products should continue to form the basis of any concentrated feeds fed to livestock in Pakistan. Products that cannot be used in human or poultry rations can be used by ruminants to produce protein that can then be used by people. A good example of this kind of product is sugarcane bagasse.(24)

One by-product that is currently not being used in Pakistan is the refuse from citrus. When this material is dried, it makes an excellent, high-energy feed that is an outstanding feed for milk cows. It is also a product that can be sold for export. It is suggested that a study be made to determine the feasibility of producing dried citrus pulp in Pakistan. A review of research with dried citrus pulp is attached. (23)

Marketing

A different marketing system is urgently needed for all livestock products. The producer needs incentives that will encourage him to be more efficient and also which will reduce the benefits derived from smuggling meat and wool to other countries. Also the current price structure on beef gives no encouragement to produce more beef and is actually not representative of what it costs to produce a pound of beef. It is costing the economy of Pakistan more to produce a pound of beef than it does a pound of chicken and yet beef is sold for less than half the price of chicken. There is also a great potential for improving the economy of the country by exporting beef at world prices and producing more poultry for domestic consumption.

Animal Husbandry Practices

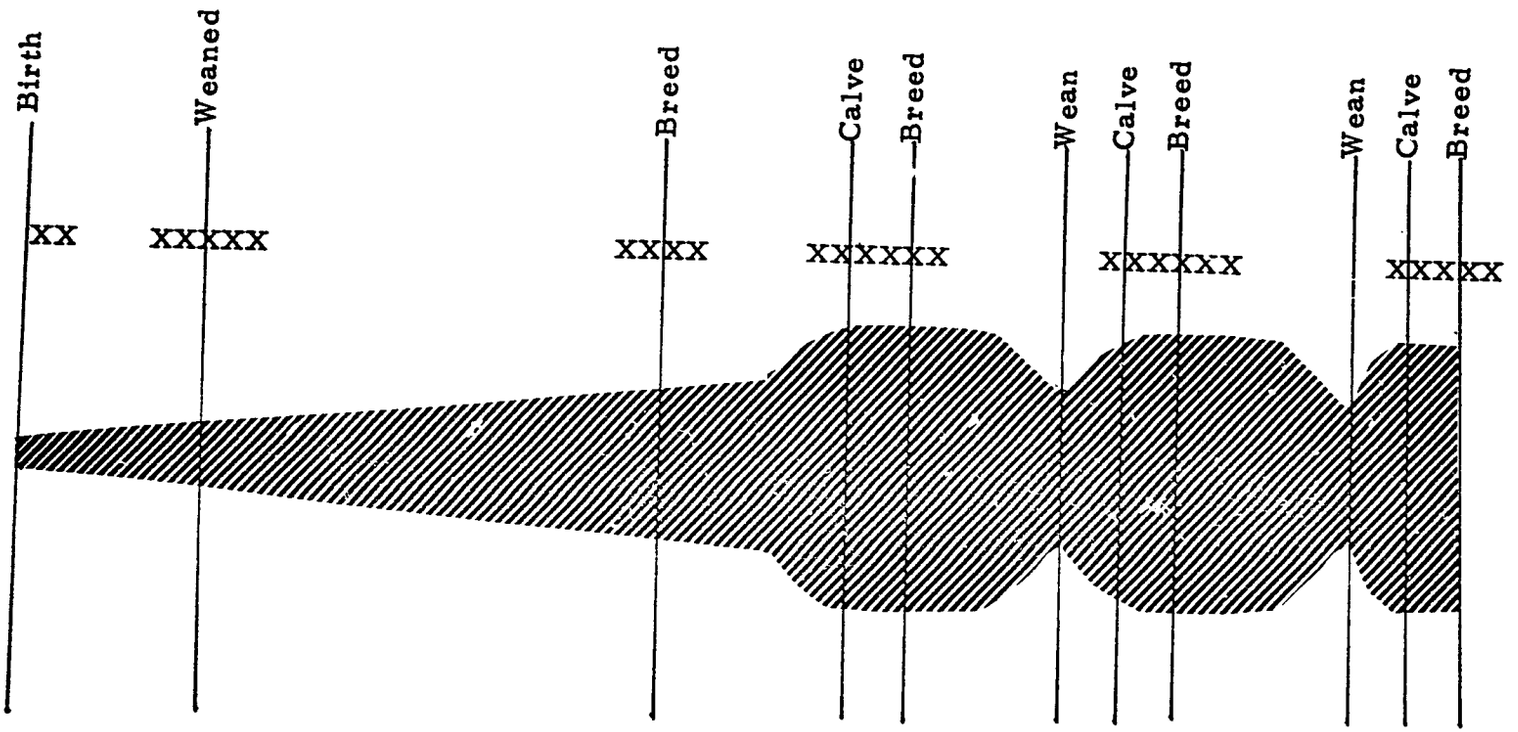
Many of the needed practices are already carried out in Pakistan to a limited extent. A primary need is to educate and train all of the farmers how to worm, spray, castrate, vaccinate, and select for production, so that they can handle many of the tasks that are presently being done by veterinarians. This would release considerable time that veterinarians could use in disease control, rather than doing simple jobs that any layman could do.

Another practice that could add a great deal to the production of meat and milk is to have a season for breeding, rather than breeding all year long. The production of good quality forage is cyclic in Pakistan with the best forage available in spring and summer. As shown in Figure 2, the nutritional requirements of breeding livestock are also cyclic. Nutritional requirements increase between 65-100 percent just before giving birth and for 3-5 months afterward.

In order to maximize reproduction--to have the best offspring, the shortest interval between birth and first oestrus, the best cow, the most milk--reproduction cycle of livestock needs to be matched with the time of best forage production. Seasonal breeding creates the problem of caring for the sires during the off-breeding season, but the benefits should far outweigh the disadvantages.

It is suggested that a study be made to determine the advantage of a controlled breeding season for all four classes of livestock.

FIGURE.2 SCHEMATIC PRESENTATION OF RELATIVE LIFE CYCLE NUTRITIVE REQUIREMENTS OF CATTLE AND BUFFALO 1/ 2/



1/ Critical nutritional periods are indicated by XXXX

2/ The wider the cross-hatched has the greater the nutritional requirements.

Appraisal of Public Programs of Research, Extension and Related Livestock-Oriented Activities

Extension

Livestock extension has emphasized disease control for some twenty years. In recent years it has added artificial insemination to the programs; these are both very worthy programs. However, one thing that was repeatedly emphasized by people we interviewed was the need for an extension program that would cover all aspects of livestock production.

Such a program is urgently needed to teach the farmer how to perform tasks such as worming, culling, marketing, breeding, spraying, fertilizing and all other tasks involved in livestock and fodder production. The farmer should be kept informed on new developments, new products, and new techniques, and an extension service with broader duties could do this.

Another advantage would be that this type of extension service could keep research people informed concerning production problems in the field, and as a result, research efforts should continue to be related to the livestock producers' needs.

Research

At the present time the majority of research programs are located in Punjab and Sind provinces. These programs are staffed by very capable people who have good insights on the problems they are facing. However, there are inadequate numbers of research faculty. Most physical plants appeared adequate, but some units were having difficulty filling vacant research positions.

Most of the present research facilities are rather large in scope. There appears to be a need for a number of small, strategically located research centers in various locations throughout the country to deal with specific commodity, geographical or socio-economic problems.

These do not need to be large units. They should be staffed by competent researchers who understand experimental design, who can properly interpret results, and who will be able to transmit their results to extension and research personnel, as well as to the public. Preferably during the initial stages these research people should not be assigned teaching or extension duties, but this will come about as a natural course, with time. High priority on their time should be given to conducting simple, pertinent experiments that will have the greatest potential for maximizing return to Pakistan at an early date.

Administration of Research and Extension Resources

These resources are fairly limited in Pakistan and it is essential that maximum utilization and minimum duplication of effort be obtained. Also there are areas of the country that do not have adequate research efforts available.

It is suggested that research and extension efforts, along with teaching functions, would be most efficient if under an administrative arrangement such as that presented in Figure 3. It would also appear that there might be merit in having the program administered from the national level rather than within each province, but this needs more in-depth consideration.

The arrangement presented in Figure 3 presents a media for interchange of ideas and coordination of efforts by a single administrator. This approach has proven to be most effective in other locations.

Suggested locations needing small research centers

As mentioned earlier there is a need for additional, small research centers to be located in Pakistan. Needed research areas are as follows:

NWFP - research is needed on fodder and sugarcane production, on irrigated lands.

- a poultry research center is needed. This could be done in the existing government farm facilities.

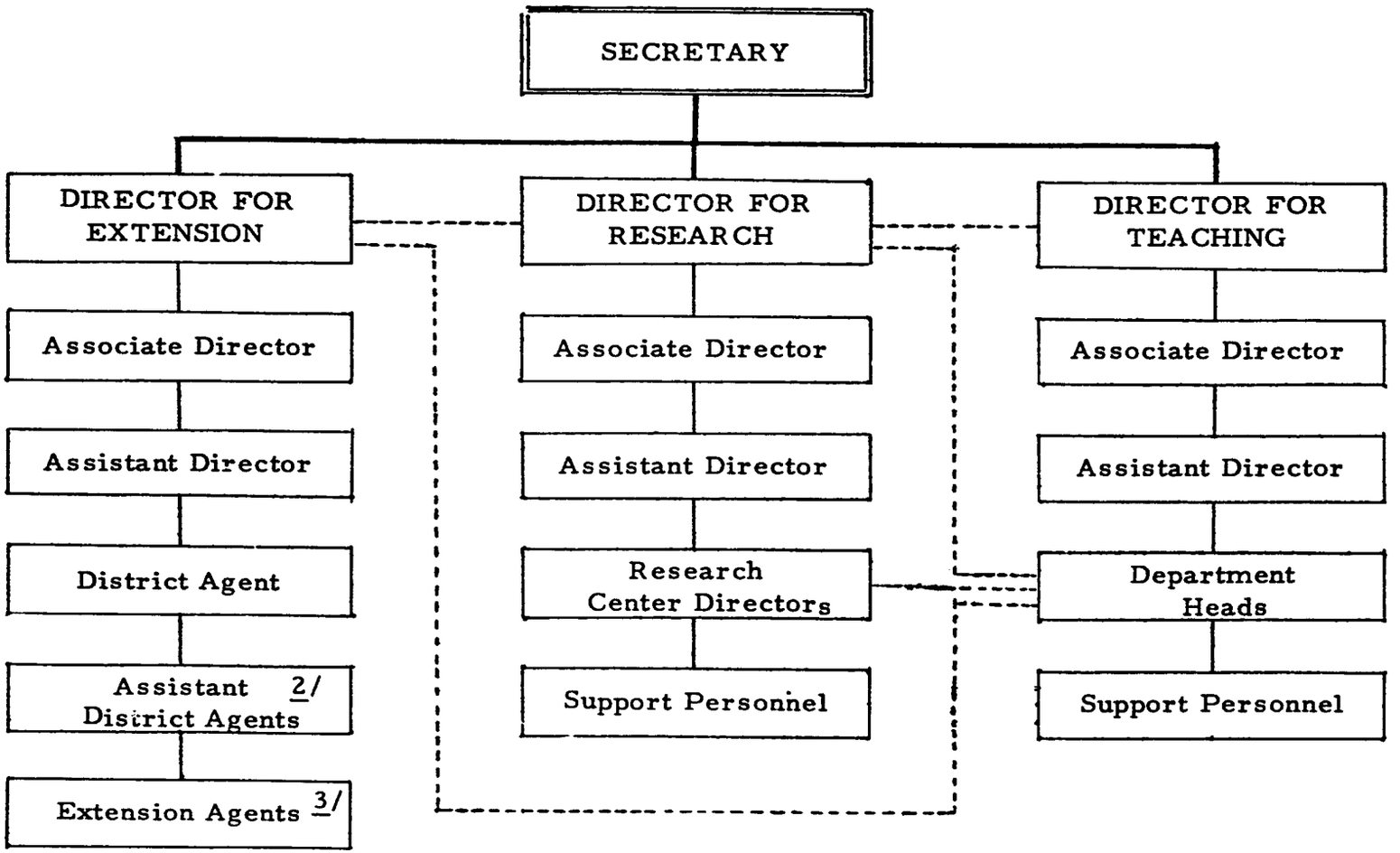
- a sheep and goat research farm to evaluate cross-breeding, nutrition and management variables.

Baluchistan - a sheep and goat research farm to evaluate cross-breeding, nutrition and management variables.

- poultry research center (there are already facilities established).

- range management research on arid lands.

FIGURE 3. RELATIONSHIP OF EXTENSION, RESEARCH AND TEACHING FUNCTIONS 1/



1/ All functions are administrated within one system, in order to have complete inter-communication and inter cooperation.

2/ Assistant District Agents should be specialists in a particular area, i.e., Animal Science, Veterinary Science, Sugarcane, Rice, etc.

3/ Live in area he is responsible for.

Punjab - by using existing facilities it is important to:

- establish fodder research program.

- more emphasis on buffalo selection.

Sind - establish fodder research program.

Suggested Action Programs Needed for Pakistan's Livestock Industry

The action programs can be classified into two categories: those with potential for providing fairly quick results; and those that require a long period of time to produce results. The management - related programs that should be undertaken are listed below:

Action Programs that could yield quick results (1-3 years)

Establishment of forage research centers in each province. This should have a very high priority and should include variety tests, fertilizer and management tests, etc.

Develop forage extension programs to accelerate increased forage production with known tested varieties, fertilizer and management practices.

Establish compulsory control of brucellosis and tuberculosis. A test and slaughter program would quickly eliminate perhaps 10 to 15 percent of the current animal inventory, thus reducing the overstocking problem, and also would eliminate a serious human health problem.

Develop program for salvaging milk cows and bullocks for meat production.

Develop program for growing out unwanted buffalo and cattle calve

Evaluate biuret-mineral supplements for each class of livestock.

Utilize foreign demand as a price incentive for improved production of livestock and livestock products.

Action programs that will require more time to yield results (3-5 years or more)

Train young people for positions in research, extension and industry. This appeared to be a real, serious need, but more in-depth study may be needed to be sure about this.

Expand extension program to include all aspects of livestock production.

Develop marketing systems for meat, milk and wool that will provide more incentive to the producers.

Investigate the merits of seasonal breeding programs for livestock.

Evaluate the economics of feeding supplemental concentrate to each kind of livestock.

Expand crossbreeding programs with sheep, goats and cattle.

Develop ways for the small farmer to have access to low-cost inputs.

Utilize low-cost by-products at home to produce higher-priced export products.

Investigate the feasibility of producing dried citrus pulp.

Conduct a study to determine the feasibility of expanding poultry production for domestic use and channeling beef and mutton into export.

Investigate the feasibility of preserving good quality fodder as silage and/or hay.

Feasibility of Commercial Meat Production in Pakistan

The principal constraints currently limiting commercial meat production in Pakistan are:

1. low production capabilities of indigenous livestock;
2. lack of systematic animal replacement system;
3. lack of understanding of fodder crop potential and failure to employ improved fodder and range management practices;
4. inadequate nutrition for livestock;
5. inadequate disease and parasite control;
6. lack of adequate marketing and slaughtering facilities;
7. lack of an understanding of economic inputs in relation to potential outputs;
8. price structure of beef, mutton, goat and poultry;
9. lack of a good production system geared primarily for meat;
10. small size of operating units in respect to livestock.

While the cumulative effect of the above factors are very formidable, the potential for commercial meat production in Pakistan is outstanding, even with the indigenous breeds, and will be more outstanding if improved germplasm is introduced. However, if this potential is to be reached, it will require firm action to reduce and/or eliminate the effect of each of the above constraints. This will not be a simple undertaking, will require a massive education program and a major shift in thinking of people

For example, steps that could be taken, immediately, that would provide quick meat production include:

1. initiating improved production procedures on fodder. This could increase amount of available fodder 2 or 3 times present yield.

2. replacing 20 percent of adult buffalo and cattle females each year, on the basis of reproduction, milk performance and health;

3. selling bullocks after the 4th or 5th year for meat replacing them with younger males;

4. replacing 30 percent of adult sheep and goat females annually, based on reproduction, milk yield and health;

5. growing buffalo calves out to one year of age and sell for beef;

6. feeding a mineral mixture.

The simple step of culling cows and bullocks before they die would let these animals be salvaged for meat and add a great deal to the meat supplies and economy of Pakistan. Tables 2 and 3 present so some estimates of the amounts of meat that could be generated simply by selecting animals for sale, before they die. Actually these figures are conservative.

A very important side benefit from this practice will be that culling the poor producers will cause the average production of cows and buffaloes to increase and mortality will be greatly reduced because the animals will be salvaged instead of being allowed to die. The beef from these animals will not be as good as that from young animals but will still be quite satisfactory for specialty items.

Similar results can be obtained by properly culling goats and sheep and this will further increase meat production with no capital outlay.

However, a cow or buffalo should not be culled merely because she has tried up, between calves. She should be culled only because she is over 8 years old, or because she gives a low milk yield during the last lactation, or because she fails to conceive. Outstanding females may be lost if they are slaughtered simply because they have dried up, preparatory to having another calf. Be sure to breed milking buffaloes and cattle so they can calve on a regular basis.

Another step that could add a considerable amount to Pakistan beef production would be to grow out the buffalo male calves to about 12 months of age. The calves would weigh about 600 pounds at that age. It is estimated that there are 1,000,000 of these calves a year, but it would appear there should be around 1,400,000. If a million could be raised it would add about another 300,000,000 pounds of carcass beef per year.

TABLE 2 - ESTIMATED MEAT PRODUCTION POSSIBLE FROM CURRENT CATTLE INVENTORY BY CULLING POOR PRODUCING ANIMALS

Cattle - Total 1972 population, 20 million (2)

Estimated make up of current cattle population

Adult Cows	6,000,000
2-3 year old females	1,000,000
1-2 year old females	1,200,000
Female calves	1,300,000
Bullocks	10,400,000

Assuming a 70% calf crop, 5% animal death less and 20% replacement of both adult cows and bullocks the above inventory should produce the following animals for sale.

Cows - 6,000,000 x .15 = 900,000 sold for beef/year

Bullocks - 10,400,000 x .15 = 1,560,000 sold for beef/year

Assuming 50% carcass yield this would produce the following amounts of carcass beef

900,000 x 600 x .50 =	270,000,000 lbs.
1,560,000 x 800 x .50 =	624,000,000 lbs.
Total	894,000,000 lbs.

TABLE 3 - ESTIMATED MEAT PRODUCTION POSSIBLE FROM CURRENT BUFFALO INVENTORY BY CULLING POOR PRODUCING ANIMALS

Buffaloes - Total 1972 population, 10 million (2)

Estimated make up of current buffalo inventory

6,000,000	adult cows
1,200,000	2-3 year old females
1,300,000	1-2 year old females
1,400,000	female calves
100,000	miscellaneous

Assuming 50% calf crop, 5% annual death loss, 20% replacement of adult animals, the above inventory should produce the following animals for beef use:

6,000,000 x .15 =	900,000 cows sold for beef/year
1,500,000 males x .95 =	1,425,000 yearling male calves sold/year

If the sale animals yielded 50% of carcass this would provide the following carcass beef:

900,000 x 1400 x .50 =	630,000,000 lbs.
1,500,000 x 600 x .50 =	450,000,000 lbs.
Total	1,080,000,000 lbs.

These examples are presented as three, relatively easy steps that could provide about 2,000,000,000 pounds of beef per year without a great deal of expense. As the constraints listed earlier are removed the amount will increase. There are a number of other factors that will increase meat production such as increased fodder production increased livestock quality, supplemental feeding in conjunction with fodder, etc. These factors will follow as a natural cause if the other suggestions are carried out.

In closing it is important to reemphasize that the future potential for meat production in Pakistan appears to be almost unlimited--providing the constraining factors can be modified or eliminated.

CHAPTER 2
DEVELOPMENT OF FORAGE AND FODDER RESOURCES

Howard W. Ream

General Information

As a result of the initiation and support of programs for high-yielding varieties of wheat and rice, Pakistan has experienced a remarkable development in cereal grain production. Such a concerted effort is also required in the livestock area if such a breakthough is to be made in increasing production of meat, milk, wool and hides. The contribution animal agriculture can make in helping solve the world food problem, and Pakistan's as well, is effectively stated by the President's (U.S.A.) Science Advisory Committee on the World Food Problem (26) which made the following recommendations:

> "The unique contribution that animals make to the world food supply should be taken into account in the development of world food plans and action programs to reduce the world food deficit. Programs to increase animal production, based upon long-range plans conceived after careful evaluation of each nation's total agricultural resources, and designed to exploit unique attributes of animals to contribute to that nation's food supply, should be instituted. Programs to develop optimum genetic stocks of livestock for local conditions; measures to increase forage production and improve range and water management; steps to improve livestock nutrition and utilize local feeds and feedstuffs, particularly wastes and by-products; means to improve animal husbandry and the industries and services that support livestock production, as well as disease control programs, should be included."

Basic to the development of productive livestock is adequate feed. High quality fodder (forage) is, in most cases, the cheapest form of feed for ruminants. Young and/or thin, older, beef animals can gain 1-1/2 lbs. or more per day, and reasonably productive dairy cattle can produce 15 to 20 lbs. of milk per day on good quality forage alone. Higher, daily production will necessitate the feeding of concentrate feeds or non-protein nitrogen feeds, such as urea, or energy producing feeds such as molasses. Sheep and goats can make satisfactory gains and attain satisfactory finish on good quality forage alone.

There is inadequate knowledge regarding the quantity of fodder and the actual TDN's available to livestock in Pakistan. Some estimates are that total fodder production is less than adequate to supply even the

TDN requirements for maintenan ce of the livestock population. Animals on "barani" lands suffer much more from undernourishment than those on irrigated lands, and those on rangelands are in even worse condition.

Pakistan already has soil resources and climatic conditions on sub-humid and irrigated lands which are suitable for very high production of quality fodder crops. Likewise there is considerable potential for improvement of production from arid and semi-arid rangelands. Research, and technical experience in similar tropical and sub-tropical areas of the world, have, in recent years, demonstrated the tremendous potential that exists for improving the quality and the quantity of livestock and its products through the introduction, culture and management of improved forage grasses and legumes. A possible deterrent to widespread development of forage and livestock programs has been the great emphasis placed on producing grains and other crops for direct human consumption. Planners have generally disregarded the possible role that a forage based, animal agriculture might play in providing as much, or more, as well as better quality, food from a given area of land than food grain crops. Their argument is that the yield in energy from animal products is only 10 to 30% as much as the energy fed; hence it would be better to produce food that people could consume directly. However, there is substantial evidence that in areas with year-round, favorable growing conditions, a forage-based, animal agriculture might produce more nutritious, good quality protein human food than several feed grain crops grown annually on the same area of land. Further, on areas where rainfall is inadequate for producing grain, suitable forage crops would result in some forage production even when rains are very erratic.

Below are some examples of the great potential for fodder and livestock production that exist on sub-humid and irrigated land in tropical and sub-tropical areas.

Possibilities for Dairy Production

The Taiwanese Experience

In Taiwan, two irrigated farms, each 3.5 hectares in size (8.75 acres) were recently visited. Each farmer was feeding a milking herd of 80 cows. Records were kept of the green chop of well fertilized elephantgrass (Pennisetum purpureum) fed as the only fodder to these cows. Production was 500 tons per hectare (200 tons per acre) per year. This was sufficient fodder to provide a year's supply for 23 milking dairy cows per hectare (10 cows per acre). The only other feeds used were rice bran, wet brewers grains, pineapple waste, and molasse--all by-product feeds.

Production, per cow, averaged 7,700 lbs. per year. Yield of milk per acre thus averaged 70,840 lbs. per year. Total protein in the milk produced per acre amounted to 2479 lbs. (assuming a protein content of 3.5 percent in the milk). The average yield of two crops of rice grown each year in the same country on similar irrigated land was 5800 lbs./acre. Even if the farmers were able to obtain 8,800 lbs. of polished rice per acre for the year (11-13,000 lbs./acre of paddy) the total protein produced would be only 880-1000 lbs. per acre (assuming a protein content of 10 percent for cooked polished rice). The International Rice Research Institute reports an average paddy production of 17,800 lbs. per acre, per year. For some new paddy rice varieties from three crops of rice produced in the same year, the yield would be 984 lbs. of protein per acre as compared to the 2479 lbs. of protein produced on each acre by the dairy cows. In this case, energy would be 21 million calories for the milk and approximately 9 million calories for rice.

The Columbian Experience

Similar results have been reported by Crowder et. al. from the Tulio Ospina Station in Columbia where an average of 5.7 milking cows per acre were maintained on green cut Elephant grass forage. The cows received a concentrate ration of 2.2 lbs. per 8.8 lbs. of milk and produced an average of approximately 16 quarts of milk per cow per day. Assuming a year round production at this rate, milk production would be about 9,900 lbs. of milk per cow per year or 56,400 lbs. per acre. The production of total protein per acre then would be 1975 lbs. and 6,825,000 calories respectively.

At the Tibiatata Experiment Station in Columbia (elevation 2,680 meters) on rainfed pastures containing a mixture of Kikuyugrass (Pennisetum clandestinum) and white clover(Trifolium repens) grazed the equivalent of 1.08 Holstein milking cow per acre per year and they produced an average of 29.5 lbs. of milk per day, or about 8,800 lbs. per cow annually. Annual milk production per acre was 9504 lbs. and total protein was 332.64 lbs. It would take a yield of about 4048 lbs. of rice per acre to produce as much total protein as this.

It is recognized that these calculations do not take into account the concentrates fed to the dairy cows nor the feed required for replacement animals. However, the concentrates fed were all by-product feeds which would require no additional land to produce and were materials which could not be consumed directly by humans. On the other hand no credit was given to the calculations for the protein and their nutrients which would derive from the cows culled and sold from the herd each year.

In addition, in the dairy operations there would be a need to include the value of the manure produced. This could be done in terms of increased yields of crops, on other land, or in reduced costs of forage production on the areas producing Elephant grass.

Possibilities for Beef Production

Scientists in Puerto Rico have developed intensive management systems for high-yielding Pangolagrass (Digitaria decumbens) which carried more than 2 cattle per acre throughout the year. They also state that more than 1,000 pounds of beef can be produced per acre annually on highly eroded soils on 50 percent slopes.

Similar results have been obtained in tropical sections of Australia. At the Beerwah Station, in the coastal lowlands of Southeast Queensland, over a 2-year period, mean annual liveweight gains of 1139 lbs. and 1215 lbs/acre were obtained from annual application 400 lbs. and 800 lbs of nitrogen per acre on Pangolagrass (Digitaria decumbens) pastures. In other experiments with this same grass with 150 lbs of nitrogen a liveweight gain of 610 lbs/acre was obtained at a stocking rate of 1.5 animals per acre. With 400 lbs. of nitrogen and a stocking rate of about 3 animals per acre the liveweight gain was 1049 lbs per acre.

In the Cauca Valley, Columbia (elevation 3300 feet) agronomists found that Signalgrass, (Brachiaria decumbens), when fertilized and irrigated as needed, carried about 2.5 two year old, crossbred Brahman heifers per acre for the entire year. They gained 1.62 lbs. per day or the equivalent of about 1500 lbs. per acre of beef, liveweight, annually. In this test, four, 0.14 acre paddocks were rotationally grazed (10 days on 30 days off). Initially 88 lbs. of nitrogen per acre was added, then 44 lbs./acre after each grazing or every 40 days.

With productive fodder species, adequate fertilizer, and proper management, similar results would be possible in Pakistan.

Present Fodder Research and Extension Programs in Pakistan

The Status of Fodder Research

Fodder crop investigations have been carried on in the Agricultural Department to some extent in West Pakistan since 1925. The work was first started in Lyallpur at this time when a fodder botanist was appointed. Later the Fodder Section was shifted to Sirsa (district Hissar). In 1944 two substations were added at Dera Ghazi Khan and the Hill Grasses Experimental Station, Murree Hills, Rawalpindi District. The station at Sirsa went to India

in 1947 and the work was started anew at the New Seed Farm, Sargodha.

Notable among accomplishments have been:

1. the development of improved varieties and cultural and management practices for Jowar. The new varieties JS-1 and JS-26 can be cut as much as 6 times in a season. When harvested in this manner and fertilized with 40 lbs. of N/acre after each cutting, they have yielded over 1200 maunds/acre per year of green fodder;

2. the development of a Bajra (Pennisetum typhoides)- Napiergrass (Pennisetum purpureum) hybrid which, when cut 6 to 8 times and adequately fertilized and irrigated, will produce over 2000 maunds green weight, per acre, per year;

3. the selection of improved varieties of berseem: development of better cultural, management and seed production methods and extension of this most important legume to the majority of farmers in Pakistan;

4. the testing and selection of Lucerne varieties and development of better cultural practices.

Some work has also been done with maize, sudangrass, teosinte, cowpeas, guar, moth, rape, oats and field peas. Observations are being made on a number of grasses at the Murree Hill Station. Among the more promising grasses at this station are Bothriochloa pertusa, Chloris gayana, Pennisetum orientiale, Dicanthium annulatum, Heteropogon contortus, Cynodon plectostachyum Themeda anathera and Kudzu, Pueraria thunbergiana.

The Status of Extension Services

This work has contributed a great deal to livestock development in Pakistan. However, considering the size and importance of the livestock industry and the enormous potential that exists for increasing fodder production, the input for research is minimal, and, for extension of fodder crops, almost non existent.

There does not seem to be an organized system nor any concerted effort to see that research results reach the farmer. As far as could be ascertained there is only one fooder botanist in all of Pakistan, Niaz Ahmad, at the Punjab Agricultural Research Institute, Lyallpur, devoting full time to fodder research. One other scientist at Tarnab Agricultural Research Institute has been working part time on fodder crops but he is retiring very soon. Others have worked on various phases of fodder crop production for short periods of time, but then are shifted to do research on some other crop.

There has been a lack of continuity in the fodder research effort, which is necessary to insure the continued improvement of varieties and concurrently the management practices needed to produce optimum yields of these.

Limitations to the Fodder Program in Pakistan

Present Situation

Some of the limitations to fodder production on sub-humid and irrigated lands in Pakistan are:

1. fodder crop varieties are outmoded resulting in low yields. Few new varieties have been developed in the last 20 years;

2. present fodder varieties and cultural and management practices do not result in a continuous supply of forage throughout the year. There are two periods of fodder shortage in April-May and November-December;

3. yields of existing fodder varieties are far below the potential because virtually no fertilizer is used and little attention is paid to other management practices, such as timely sowing or planting, pest and weed control, stage of plant development at harvest, cultivation practices, curing and storage;

4. little attention is paid to quality of fodder with the amount of green weight being the criteria of measurement rather than the feeding value, i.e. protein and TDN content;

5. lack of sufficient viable, high quality seeds of adapted fodder varieties which farmers can readily procure;

6. poor water management with too little water, in some cases, for kharif fodders and too much for some rabi fodders, particularly alfalfa;

7. insufficient fodder supplies for the numbers of livestock, which results in overgrazing and too frequent harvesting of fodder with attendant low yields and loss of stands;

8. lack of an effective organization for carrying out the research, extension and training programs essential to the success of an effective fodder program, and of integration and coordination of these programs with those of range management and livestock production;

9. lack of leadership and trained personnel.

Analysis by National Range Management Committee

Similarly the limitations to effective management of rangelands on the arid and semi-arid lands have been enumerated by the National Range Management Committee: (14)

1. erroneous and defective range concepts which considered range synonymous with desert or arid lands has led to the neglect of high potential range areas;

2. absence of a national range policy which defined range management objectives and provided the means to achieve them as well as suitable legislation to provide a legal framework for the enforcement of regulatory measures;

3. lack of organization to carry out the program;

4. defective range management strategy with incomplete planning of projects, lack of extension activities, and failure to obtain participation and cooperation of stockmen;

5. lack of trained personnel;

6. lack of range management and other surveys as planned criteria for development of range plans and projects;

7. lack of range management and other surveys as planned criteria for development of range plans and projects;

8. overgrazing, wrong season of use, and improper management;

9. lack of water facilities for livestock and for proper range management;

10. seasonal deficiencies in feed availabilities;

11. wrong species of livestock on certain ranges;

Realizing the Full Potential from Fodder Production in Pakistan

Pakistan's fodder resources are derived both from permanent grasslands and from forage production on cropland. Permanent grasslands in Pakistan are largely on arid or sub-arid land with smaller acreage on some of the foothills and mountain lands in the sub-humid zone. These are considered rangelands and occupy about 60% of the total land area. Fodder raised on cropland is found on land mostly in the sub-humid zone or on irrigated lands. In order to have efficient livestock production and to realize the full potential from fodder production these two sources must be developed to their maximum and blended together in a system in which

one complements or supplements the other. Dr. Omer Kelley has pointed out this interrelationship of these two major sources of feed supply for ruminant livestock -- (27)

> "The principal effective use of grasslands is support of ruminant livestock. The permanent grasslands may provide the principal source of feed for livestock during the growing season, but these herds and flocks may be moved to croplands whenever desired to utilize crop wastes and by-products, or to consume forage grown in rotation with harvested crops or arable lands. The dual sources of feed from the combined crop and range farming systems provide a far more stable and adequate feed support for livestock enterprises than permanent grasslands alone, or croplands alone. The livestock enterprises may become more productive as they become more stable, with reproduction, growth, and yields of milk (or power), when continuously supported by adequate feed throughout the year. The ruinous cycle of feed abundance followed by near starvation that commonly occurs with livestock on either grasslands or croplands managed separately, can be largely corrected by joint management of both cropland and grasslands. This is a logical and effective way ofmaking dryland farming more productive, even though there is no change in total rainfall."

Forage Production Potential on Sub Humid Barani Lands and Irrigated Cropland

Sound recommendations for the development of both rangelands and of fodder production on cropland have been made by a number of scientists both Pakistani and foreign. They have recommended an effective program for research improvement and management of rangelands and changes in policy and institutions that would be needed to carry it out. Recommendations for an accelerated fodder improvement and production program have also been presented. This provides for the development of a long range program and would be what is needed to provide farmers with the information and inputs necessary to maximize their fodder production.

In order to mesh these two phases of fodder production together so they can contribute the maximum to an efficient livestock production system in Pakistan, the government should give wholehearted support to an orderly and permanent development of both.

No attempt will be made here to further refine or modify the basic programs in either of these fields. The Range Management Committee's recommendations are sound and every effort should be made to carry them out as rapidly as possible if accelerated deterioration of the arid and semi-arid grazing lands are to be avoided.

Likewise the program proposed by Crowder (12) is well conceived and merits immediate attention. It is in the area of increased fodder development on sub-humid barani cropland and pastureland and on irrigated cropland that the greatest immediate impact can be made in providing feed and expanding livestock production.

This report, therefore will concentrate on this aspect and will attempt to outline some immediate steps that should be taken to augment the program outlined by him.

An estimation of what might be accomplished simply by extending some of the newer fodder varieties and improved practices to farmers on land in Punjab province is shown in Table 1. This is an example which might equally well apply to other provinces. Here the area and production figures of rabi and kharif green fodders were available for 1971-72 and these were then compared with the following two alternative extension plans:

Alternative 1- Apply TSP 0-45-0, at 220 lbs./acre on 25% of the Lucerne, Berseem, and Shaftal acreage resulting in an estimated doubling of yield, and on applying urea at 110 lbs. or 1 bag per acre on 25% of the jowar and maize acreage. The increase in yield of green fodder is estimated to be four times the present yield on these areas.

Alternative 2- The same fertilizer applied on the same 25% of the Lucerne, Berseem and Shaftal acreage and on 25% of the jowar and maize acreage, but, in addition 25% of the original jowar acreage will be planted to Bajra-Napier Hybrid and fertilized with 220/lbs. of urea annually, producing 50 tons/acre (1250 maunds) of green forage.

Production of green fodder in alternative 1 would be 8,615,578 tons more respectively per year in 1971-72. This would be enough to feed 430,800 more animal units (A.U.) annually. Assuming a liveweight gain of 400 lbs./animal unit/year or 172,320,000 lbs., which at 1 rupee per pound liveweight would amount to Rs 172,320,000. With 0-45-0 fertilizer at 34 rupees and urea at Rs 55 per 100 lbs. bag the fertilizer costs would be Rs 44,492,475. Assuming this to be the only out of pocket cost to the farmer, there would be a net gain of Rs 127,827,525.

TABLE 1- PRODUCTION OF FODDER IN PUNJAB PROVINCE 1971 AND SEVERAL ALTERNATIVES FOR INCREASING FODDER AND LIVESTOCK PRODUCTION

	1971-72 Production		Alternative 1	Alternative 2
Rabi Fodders	Acres	Total tons	Total tons	
Lucerne	300,100	2,873,600	3,589,947	3,589,947
Berseem	1,000,100	10,242,400	12,801,536	12,801,536
Senji	38,700	254,100	254,100	254,100
Juvi	73,400	509,000	509,000	509,000
Shaftal	370,500	2,698,900	3,373,625	3,373,625
Rape & Mustard	23,600	169,300	169,300	169,300
Others	491,500	3,200,300	3,200,300	3,200,300
Total	2,287,900	19,947,600	23,897,808	23,897,808
Kharif Fodders				
Bajra-Napier Hybrid	0	0	0	13,112,500
Jowar	1,049,000	5,562,700	9,729,475	5,559,700
Maize	121,100	667,900	1,166,495	1,166,495
Guara	512,700	2,329,600	2,329,600	2,329,600
Moth	14,800	80,300	80,300	80,300
Bajra	150,000	606,700	606,700	606,700
Others	458,300	1,890,900	1,890,900	1,890,900
Total	2,310,900	11,138,100	15,803,100	24,742,195
Total		31,085,700	39,701,278	48,639,893
Additional green fodder-tons			8,615,578	17,554,193
Number of additional A.U. @ 125 lbs./ day or 20 tons/year of green fodder			430,800	877,700

Using the same assumptions as in Alternative 1, additional liveweight gains would be 350,800,000 lbs. in alternative 2 or a value of 350,800,000 rupees. Fertilizer costs would amount to Rs. 73,339,975 or a gain of Rs. 277,461,025.

Thus it appears that by applying what is already known about fodder production to barani as well as irrigated lands is not only good economics but could be easily applied by farmers utilizing present cropping systems. Additional livestock needed could be female calves or water buffalo bull calves; or young cattle, sheep or goats could be bought from range lands. This would relieve the pressure on these latter overgrazed grasslands. Either of these alternatives could also be fitted into a buffalo or cattle dairy proposal.

Recommendation for Starting an Extension Program in Fodder Crops

Utilizing presently available knowledge and materials, it is recommended that a start be made immediately to establish demonstration areas using simple methods to increase fodder production on farmers fields and on government livestock farms.

Suggested demonstrations to be carried out during the rabi and kharif seasons in the next several years are:

Rabi Season on Irrigated Lands

1. Demonstration of increased yields that can be obtained through the use of phosphate fertilizer on berseem clover. This would involve a simple trial comparing: (1) a check with no fertilizer; (2) one bag 110 lbs. per acre of 0-45-0 triple superphosphate (TSP); and (3) two bags per acre of the same fertilizer on parts of a field.

2. Demonstration of the use of oats as a winter forage alone and in combination with berseem clover. Local varieties of oats would be used and planted in the same field with berseem. A comparison would be made of: (1) berseem alone; (2) oats alone; and (3) berseem seeded with oats.

Kharif Season on Both Barani and Irrigated Land

1. Demonstration of increased yields that can be obtained through the use of nitrogen fertilizer on jowar, bajra and maize. Suggested is a simple trial using either of these crops and applying one bag of urea per acre prior to planting or about two weeks after the planting and comparing the growth with that of an unfertilized area. On soils where phosphorous is known to be deficient, one or two bags of DAP-18-46-0 can be applied in addition to the urea. A comparison of manure and urea could also be made by applying manure at 10 to 12 tons per acre on a strip with a part of the field fertilized with urea and part unfertilized.

2. Demonstration of the potential for increased yields of fodder by planting a permanent stand of Napier-bajra hybrid. Research at the Punjab Agricultural Research Station has shown that Napier-bajra hybrids can be cut 6 or 8 or more times per season and can produce more than double the amount of green forage produced by jowar, maize or bajra. Suggested is a demonstration in which a farmer would set aside 1/10 of an acre for the next four or five years on which he would plant the Napier-bajra hybrid. This would be planted from cutting in rows, 36 inches apart so the field can be cultivated as necessary to keep out weeds or to inter-plant a rabi crop. Twenty-two lbs. of DAP 18-46-0 should be applied in the row, prior to planting the cuttings, and 4 lbs. of urea after each harvest of green forage thereafter.

In order to establish these demonstrations in the next kharif (1974) season, it will be necessary to have available sufficient cuttings of the Napier-bajra hybrid. One to two acre plots for the production of these cuttings should be established immediately at the following locations: Lyallpur, Tandojam and Tarnab; Agricultural Research Institutes; the Rawalpindi Experimental Farm; Punjab Livestock Research Institute and Bahadurnagar Livestock Farm; the Dahni Livestock Development Farm, and the D.I. Khan Livestock Farm.

3. Demonstration of increased productivity from lucerne. This should include selecting better drained fields and/or fields that have been levelled, planting the alfalfa in rows 18 to 20 inches apart so weeding can be done as necessary, and fertilizing with one bag per acre of TSP 0-45-0 each year. The aim should be to try to maintain productive stands for at least four or five years.

Demonstrations should be established in selected Integrated Rural Development Project Areas and carried on by project agriculturists. Selected livestock assistants working in the field for the Provincial Livestock Extension Service should also be asked to set up demonstrations on several farms in their areas. Several weeks field training at a central location should be given these men, and follow-up supervision provided in the field to insure that demonstrations are carried out in a statisfactory manner.

Personnel Requirements

It will be absolutely essential that competent personnel be assigned to this project. A national fodder project leader for both the extension and research phases should be appointed to head the entire forage effort. He should be selected from among the scientists already trained in agronomic phases, such as some of the personnel now working on jowar or maize programs. A national extension fodder specialist should also be selected from among such personnel. His duties would be to organize and train the field workers, and work with the provincial fodder extension specialist. One of the latter should be appointed to organize, supervise, and train the Integrated Rural Development workers and livestock assistants in each province. A fodder specialist should be appointed at each livestock

farm and research institute to insure the production of adequate green fodder, hay or silage on each installation and to demonstrate efficient fodder production to farmers on surrounding farms.

Adequate supplies of fertilizer should be supplied for these demonstrations. Likewise a sufficient amount should be available at all times on government livestock farms so that these serve as models of optimum fodder production.

Recommendations for Starting an Accelerated Research Program

Most of the productive grasses and legumes presently used in the semi-arid, sub-humid and humid areas of the tropical and sub-tropical world are introductions from other countries. Of these only a few, and those only very recently, have come from an organized breeding program. Species and variety introduction, evaluation and testing should thus be the first steps in the development of a fodder research program. Utilizing the results and experiences from other parts of the world with similar ecological conditions, grasses and legumes can be chosen for trial which may prove suitable for similar areas in Pakistan.

Selected Areas-Gardens

Recommended species for trial in the arid, semi-arid, sub-humid and irrigated areas of the country are shown in Table 2. There are many varieties in some of these species of grasses and legumes. A wide variety of these should be included in the preliminary observations since experience has shown that some are adaptable and others are not. A list of some of the varieties of different species and the sources where these may be obtained is included in Table 3. These should be introduced and evaluated in observation gardens. Within each area it may be necessary to establish several of these gardens particularly where elevation, or climatic conditions vary, in order to test adequately the adaptability of each variety.

In these gardens, one, two, or three rows of plants, about 15 or 20 feet in length, should provide a plot of sufficient size for preliminary evaluation. An organized system of note taking should be instituted. Information to be collected might include date and method of establishment, seedling vigor, habit of growth, leafiness, ground cover (trailing or low growing types), days to flower, seed setting capacity, plant height, disease and insect prevalence, and recovery after cutting and aftermath. Many of these items can be rated on an arbitrary 1 to 10 scale.

TABLE 2- RECOMMENDED GRASSES AND LEGUMES FOR TRIAL IN PAKISTAN

Arid Zone — Up to 10" of Rainfall

Regulated grazing to promote reseeding of native species of grasses, legumes, forbs and browse. Some reseeding trials may be made on favorable sites where rainfall is above 8".

Grasses

Cenchrus ciliaris
(Try various cultivars)
Elyonurus hirsutus.
Cenchrus setigerus.

Semi Arid — 11-20" Rainfall

RANGE LAND

Mostly 11-15" rainfall

Grasses

Cenchrus ciliaris
Eragrostis curvula
Eragrostis superba
Elyonurus hirsutus

Legumes

Stylosanthes humilis (A)
Desmanthus virgatus
Calapagonium mucunoides

BARANI CROPLAND

Mostly 15-20" rainfall

KHARIF

Grasses

Jowar varieties (A)
Bajra varieties (A)

Legumes

Indigofera hirsuta (A)
Crotalaria juncea (A)

RABI

Grasses

Oats, Rye (A)

Legumes

Vicia dasycarpa alone and with oats. (A)

Perrenial Grasses

Panicum maximum
Cynodon dactylon
Cynodon plectostachyum
Sorghum almum
Cenchrus ciliaris

Sub Humid — 21-40" Rainfall

TO 3500' ELEVATION PERMANENT PASTURES

Grasses	Legumes
Hyparrhenia rufa	Stylosanthes humilis (A)
Panicum maximum	Stylosanthes guayanensis
Panicum coloratum	Phaseolus atropurpureus
Melinus minutiflora	Glycine javanica
Chloris gayana	Indigofera hirsuta (A)
Cynodon dactylon	Leucaena leucocephala
Cynodon plectostachyum	Medicago sativa
Digitaria decumbens	Lespedeza striata (A)
Digitaria pentzii	Lespedeza stipulacea (A)
Digitaria swazilandensis	Desmodium uncinatum
Digitaria diversinervis	Desmodium intortum
Brachiaria decumbens	
Brachiaria brizantha	
Dicanthium aristatum	
Setaria sphacelata	
Paspalum notatum	

BARANI CROPLAND

Pennisetum purpureum (35-40")	Medicago sativa
Setaria sphacelata	Stylosanthes guayanensis
Panicum maximum	Phaseolus atropurpureus
	Desmodium intortum and uncinatum.

KHARIF

Jowar varieties		
Bajra varieties	(A)	Indigofera hirsuta
Sundangrass		Dolichos lab-lab
Maize		with maize or jowar (A)

RABI

Oats (A)	Berseem
Rye (A)	Vicia dasycarpa (A)
	Vicia villosa
	Vicia atropurpurea

ABOVE 3500' ELEVATION

Pennisetum clandestinum	Madicago sativa
Cynodon plectostachyum	Lotus corniculatus
Cynodon dactylon	Lotus uliginosus
Phalaris tuberosa	Trifolium repens
Festuca arundinacea	Trifolium pratense
Lolium perenne	Lotononis bainesii
	Trifolium subterranean (A)

Irrigated Areas

PERMANENT PASTURES AROUND IRRIGATED LANDS

Test grasses and legumes recommended for sub-humid areas to 3, 500' elevation or if very dry areas those for semi-arid areas. For saline areas Cynodon dactylon and Cynodon plectostachyum and Chloris gayana varieties should be tested.

IRRIGATED LANDS

Grasses	Legumes
KHARIF	Medicago sativa
	Stylosanthes guayanensis
Bajra Napier hybrids	Glycine javanica
Pennisetum-purpureum (Test many elephant grass varieties)	Indigofera hirsuta (A)
	Dolichis lab-lab (Also in combinations with maize, jowar or bajra) (A)
Sundangrass (A)	Crotalaria juncea (A)
Sorghum-Sundangrass hybrids (A)	Sesbania aejyptica (A)
Bajra varieties (A)	Centrosema pubescens
Jowar varieties (A)	Desmodium intortum and uncinatum
Maize varieties (A)	
RABI	berseem
	Vicia dasycarpa
Oats	Vicia villosa
Rye (A)	Vicia sativa (A)
Winter Barley	Pisum arvense
	Astragalus sinicus

A = Annual - all other grasses and legumes are perennial.

TABLE 3 - VARIETIES AND SOURCES OF SEED AND PLANT MATERIAL FOR GRASS AND LEGUME OBSERVATIONS IN PAKISTAN

Following is a list of the seeds and plant material recommended in this report, together with the source from which small quantities of these materials might be obtained for initial plantings and multiplication.

Australia

The Central Scientific and Industrial Research Organization, Division of Tropical Pastures, The Cunningham Laboratory, Mill Road, Sta. Lucia Queensland, 4067, Australia, maintains a plant introduction section which has available small samples of a wide variety of tropical and sub-tropical grass and legume material. It is suggested that requests be made to Mr. Ron Williams at the above address for the following:

Grasses

1. Brachiarias, Brachiaria brizantha - CPI 15890, Brachiaria sp. - Tanner's grass

2. Chloris gayana - CPI nos. 17757, 16710, 16059, 18708, 16267, 28708, 34508. CV Pioneer and CV.Callide, CV. Samford.

3. Cenchrus ciliaris, CV. Nunbank, CV. Tarewinnabar, CV. Molope, CV. Niolela, CV. Gayndah, CPI 18019.

4. Phalaris tuberosa, CV. Sirocco, Phalaris hybrids Siro 1146, 1A and 7.

5. Panicum maximum - CPI nos. 16003, 27630, 16721, 6563, 30825, 17-78, 28275, 16723, 16724, CV. Makarikari CV. Hamil, CV. Petrie (Green Panic), CV. Bambasti.

6. Panicum coloratum - CPI nos. 16796, 16789, 14375, 18022, 31987, CV. Kabulabula, Var. Makarikariense.

7. Setaria sphacelata - CPI nos. 16729, 16343, 15898, 17795, 19912, 32714, 32848, 32930, 33452, 33453, CV. Nandi CV. Kazungula.

8. Sorghum almum, CV. Crookie

Table 3 (continued)

Legumes

1. Glycine javania - CPI 25423, 25332, 16673, 27834, 23411, 18419. CV. Tinaroo, CV. Cooper, CV. Clarence.
2. Desmodium intortum - CPI 18383
3. [illegible] lium uncinatum
4. [illegible] os Lab-Lab CPI 16883, CV. Rongai
5. Lo[illegible]onis bainesii - CPI 16833.
6. Phaseolus atropurupureus - CV. Siratro.
7. Stylosanthes guyanensis (or S. Gracilis) - CPI 30029, 5630, 9215, 11,493. CV. Schofield.
8. Stylosanthes humulis CPI, 33502, 40271, 25B, CV. GORDON CV. Lawson.
9. Centrosema pubescens C.Q. 730.
10. Calopogonium mucunoides C.Q. 562.

Appropriate inoculants should be requested for legumes ordered.

Taiwan, Republic of China

The Joint Commission on Rural Reconstruction in cooperation with the Provincial Department of Agriculture maintains a collection of tropical and sub-tropical grasses and legumes which have been previously introduced and from which some very productive selections have been made. It is suggested that requests for these be made to Mr. Huang Chia, at Joint Commission on Rural Reconstruction, 37 NanHai Road, Taipei, Taiwan, Republic of China, for the following:

1. Andropogon nodosus, A29 Alabagn X
2. Andropogon Sp. - A36, A51.
3. Axonopus scoparius - A64
4. Digitaria decumbens - A23, A62, 63, 72.

Table 3 (continued)

5. Digitaria pentzii A24, A32, (var. Stolonifera), A82, A83.

6. Digitaria swazilandensis - A80.

7. Digitaria scalarum - A81.

8. Digitaria diversinervis A79.

9. Brachiaria mutica (Panicum purpurascens) A45, A52.

10. Eriochloa polystachya - Caribgrass - A99.

11. Dicanthium annulatum, A70, A133.

12. Pennisetum purpureum - Elephantgrass A25, A26, A121, A143, A144, A145, A146, A147, A148, A171.

13. Setaria sphacelata - A68, A71, A88, A135.

14. Astragalus sinicus - Taiwan strain and inoculant. (For use as a green manure and green rabi forage seeded in rice before harvest.)

Brazil

The following can be ordered through the USAID Mission, Brazilia, Brazil:

1. Pennisetum purpureum - Minheiro.

2. Stylosanthes guayanensis - IRI 1022 and 2870.

3. Centrosema pubescens IRI 1282.

4. Lotononis bainesii IRI 1270.

5. Glycine Javanica, IRI 1284, 1287, 1301.

6. Calopagonium mucunoides

7. Phaseolus atropurpureus

8. Desmodium intortum IRI 1611

Table 3 (continued)

9. Teramnus uncinatum IRI 1286.

U.S.A.

The following can be ordered from the U.S. Department of Agriculture;

1. Cynodon dactylon 0 Bermudagrass - Coastal, Suwanee, Coastcross and any other promising material from Tifton, Georgia.

2. Digitaria collection from Dr. S.C. Schank, University of Florida, Transvala, Slenderstem and vegetative material of 10 or 15 introductions which have performed well in Florida and Brazil over the past 5 years.

3. Cenchrus ciliaris (Pennisetum ciliare) USDA, Collection from SCS Plant Materials Center, Maui, Hawaii.

4. Chloris Gayana - USDA collection

5. Phalaris tuberosa - USDA collection

6. Panicum maximum - USDA collection

7. Pennisetum purpureum - Napier, Merker, Puerto Rican selections, and any other promising material.

8. Paspalum notatum - Bahiagrass - Pensacola, Tifhi, Argentina, Venezuela and other promising material.

9. Paspalum dilatatum - USDA collection

10. Medicago sativa - cultivars from Columbia, Brazil, Chile, India Southern U.S., including Mesa Sirsa, Moapa, Zia, Calverde, Cody Lahontan, Buffalo, Hairy Peruvian and African.

11. Trifolium subterraneum, Mt. Barker, Clare, Yarloop, Tallarook, Bacchus, Marsh and Nano.

12. Leuceana leucocephala - Varieties K4, K6, K8, K28, K62, and K67 - from J.L. Brewbaker, University of Hawaii.

Suggested locations for these gardens could be:

1. in Peshawar at the Pakistan Forest Research Institute, the Range Management Branch, for arid and semi-arid rangelands;

2. in Lyallpur, Tarnab, and Tandojam, at the research institutes there, as well as at the Murree Hills and Rawalpindi stations, for semi-arid cropland, and sub-humid and irrigated areas.

The fodder botanist at these institutes should also work with the fodder specialists at the Livestock Farms and Research Institutes in establishing and observing appropriate species and varieties at these locations. Gardens should be located on irrigated lands at the Punjab Livestock Research Institute and on the Bahadurnagar Livestock Farm and on both irrigated and semi-arid or sub-humid areas on the Dhani Livestock Farm and on the D. I. Khan Livestock Farm.

The next step in the development of an effective forage program in Pakistan is a stepped-up, applied research effort. As the observations of legumes and grasses established in the gardens begin to indicate species and varieties of promise, research along some of the following general lines should be started:

1. make a collection of native grasses and legumes and include promising accessions in observation gardens and subsequent future trials;

2. establish replicated small plot experiments to determine the relative productivity of the most promising grasses and legumes by cutting or simulated grazing;

3. study of various methods of establishing and managing grasses and legumes in permanent pastures, including time and rate of seeding;

4. conduct green or screen-house pot tests to determine the nutrient status of major soils and the nutrient requirements of the promising forage legumes and grasses. These should be followed by field fertilizer trials;

5. study forage seed and plant materials production to establish effective means of multiplication and distribution;

6. study the performance of combinations of grasses and legumes for various soil and climatic conditions and determine how best to manage them;

7. evaluate animal performance and utilization studies with the recommended fodders.

8. develop better fodder crops through varietal improvement of plant breeding.

It is also imperative that recommencations for an organized seed production, multiplication, processing, storing and dissemination program be developed simulaneously with the start of the introduction and testing of legumes and grasses. This applies to plant material, such as cuttings, as well as seed.

Personnel Needed

One well-trained agronomist should be placed in charge of the research program at the national level under the direction of the national fodder project leader. Under his technical orientation should be a fodder botanist, working full time on this phase, at each of the agricultural research institutes. Several assistants should be provided for each institutions. These positions should be established immediately with additional staff added as the various phases of the project develop.

Future Extension Activities

As the research program produces improved fodders and better management techniques, extension activities should be intensified to include such projects as:

1. demonstrating improved fodders, for grazing, green chop hay and silage;

2. assisting local committees in improving grazing lands controlled by the village and in enforcing grazing regulations;

3. assisting local committees or key farmers in establishing "sod banks" for propagation and distribution of improved grasses that are normally planted from cuttings, roots and stems;

4. conducting demonstrations of hay and silage making;

5. cooperating with livestock workers in villages where dairying is a major enterprise in demonstrating better forage production and feeding methods;

6. holding result demonstrations and field days to show farmers the better ways of producing quality fodder.

The orderly development and maintenance of a continuing, vigorous, fodder research, extension and training program will provide the base for the attainment of an efficient and profitable livestock program in Pakistan.

CHAPTER 3

EVALUATION OF LIVESTOCK HEALTH PRACTICES IN PAKISTAN

Fred Maurer, DVM

Available Institutional Instruction

College of Veterinary Medicine - Lahore

The Veterinary College has been in operation since its founding in 1882. The buildings are spacious with apparently ample space for each department and for the veterinary hospital, the library and a large museum. The buildings and interiors are very old with minimal old furnishings and equipment of ancient vintage.

They offer a D.V.M. degree and recently have undertaken the graduate training to M.S. in pathology, parasitology, microbiology, nutrition, medicine and surgery.

They have about 55 students per class who qualify for admission by having had two years of pre-medical science or agriculture. The curriculum for the under graduate four years consists of about 40% animal science and 60% veterinary medicine.

In view of the fact that essentially all graduates work for the Pakistan Government on livestock disease prevention and control they emphasize preventive medicine and animal management and largely omit companion animals and laboratory animal medicine.

There is now roughly 51,000 head of livestock per one veterinarian. In order to try and reduce this ratio to 25,000 to 1 the government offers veterinary scholarships to a high percentage of the veterinary students. Students come from each of the provinces.

Very little research is done by the veterinary faculty.

The Dean and his librarian both expressed serious need for American standard veterinary text books. The need is for large enough numbers for their classes i.e. 55 each. They also need the major veterinary journals from the U.S. at least if they are to do any relevant

research. They have not had AVMA journals since 1967. They once had a Ford grant which provided texts and journals but not since about 1967; apparently they can't get dollars for the purpose nor can PL-480 funds be used.

The College was in recess for vacation so I did not get to meet but one or two faculty nor see the college in operation making if difficult to give an appraisal. The Dean appeared competent and dedicated to his task.

Veterinary Research Institute Lahore (Punjab)

This Veterinary Research Institute is the key veterinary institution of Pakistan in that it provides all of the vaccines for the livestock and poultry for the country; operates the central diagnostic laboratory; conducts most of the research needed to assure the effectiveness of their biologics; and conducts a training program for field veterinarians. Graduate students from the Veterinary College participate in the research and training.

The Director Abdus Salam Akhtar has a graduate degree in bacteriology from London and a Ph. D. from Washington State University.

There are ten departments each headed by senior veterinarians. They are bacteriology, mastitis and anthrax, serology, disease investigation and zoognoses., parasitology-pathology, virology, avianleucosis, helminthology, biochemistry, and poultry pathology. These departments each appear to participate in the diagnosis, research, training and vaccine production that fall in their field.

The laboratory has a staff of 67 technical people plus laborers. They produce some 38 million doses of vaccine annually, 25% of which is for hemorrhagic septicmia and 15% against rinderpest. They produce a long list of vaccines and diagnostic reagents. The principal ones are for the following diseases:

Hemorrhagic septicemia bacterin;
Foot and mouth, types Asia I, O&A;
Anthrax Spore;
Listeriosis;
Black leg;
Enterotoxemia - Clostridium welchi B&D
Braxy in sheep, clostridium septicum;

Canine distemper;
Rabies (Sheep brain - post exposure.)
Simple Fowl cholera;
Blue tongue;

Diagnostic antigens for:

Brucella aborties and melitensus;
Mallein for glanders;
Salmonella pullorum;

Issued as freeze dried products;

Lapinized Nakamua III type;
Caprine pleuropneumonia;
Rinderpest attenuated goat virus vaccine;
Sheep pox;
Spirochactosis;
Rabies (Flury) vaccine;
African Horse sickness;
New castle;
Fowl pox.

A new isolated laboratory for the manufacture of foot and mouth disease vaccine has been built on 25 acres of land. The laboratory has however not yet been activated for lack of major equipment and technically qualified personnel to operate it. The Dean expressed a serious need for outside support to obtain essential equipment.

Although the buildings, furnishings and equipment are old, they appear serviceable and adequate for the work being done and for most of the vaccines being produced. They are fixing up a new tissue culture laboratory with essential hoods and equipment for the production of Plowrights' Tissue culture rinderpest vaccine. Further they have an experienced team, one of whom has been working with Cunningham's group at Maguga to make the vaccine, which will be preferable to the attenuated goat virus now being employed in Pakistan.

Dr. Akhtar expressed a special need for aeration culture equipment of automatic continuous flow type for the preparation of the hemorrhagic septicemia bacterin. Such equipment will provide about a five fold increase in growth of the pastorella organisms per c.c. so that with such a formalized culture absorbed on aluminim hydroxide, they can prepare

a vaccine as effective in a 1 c. c. dose as now provided from 5 c. c. The more concentrated product would make for great economy in bottling, shipping and time saved in administration of the vaccine. Since hemorrhagic septicemia is the most serious disease in terms of mortality in the country, he places a very high priority on the need for this equipment.

While this more concentrated vaccine would save considerable money and time it would still need to be administered to the buffalo twice a year before the rains which start in May and November. Consequently they are continuing research to try and develop a vaccine which will provide year long immunity. They are using Roberts Type I capsulated P. mutocida for this bacterin. This request for continuous automatic aerated culture appears justified in view of the importance of the disease and the annual production of 9.5 million doses of the bacterin which constitutes over 25% of the production of the Institute.

I am most favorably impressed by the Director, staff and productivity of the Institute and especially by the Director's efforts through research to evaluate and improve the vaccine they produce to assure their effectiveness in the field. On him rests the major responsibility for the vaccine which can control the disease of the country's livestock and he appears to be fulfilling it very well. Without effective control of the many contagious and infectious diseases there would be no chance of improving livestock production, for the number of diseases which threaten each animal species would soon cut down the number and productivity of the livestock and poultry. In general all governments, pressed with current problems, fail to appreciate the significance of disease control as long as it is maintained; only when a new disease appears which is not controlled is there an awakening to the potential of the many held in check.

Support is urged for the personnel equipment and operation of this Institute and especially for the equipment needed for the more efficient production of the hemorrhagic fever vaccine and for the new foot and mouth disease laboratory.

Veterinary Service in the Field - Punjab

A visit was also made to Lyallpur with opportunity to visit an artificial insemination station to talk with service veterinarians, to tour some veterinary hospitals and the agricutural university where we had discussions with the Vice Chancellor for agriculture Dr. I. Haq and with Dr. M.B. Sial, Dean of the Veterinary Faculty, Agriculture University, Lyallpur. The Veterinary College was closed because of

vacation so we only saw the exterior of the buildings which appeared to provide ample space. They have about 45 students per undergraduate class in a four year program for the DVM degree. The program includes courses in animal science and animal nutrition although it is predominantly in veterinary science. There was reported to be invovement of the faculty in research but no opportunity for specifics.

From the above visits, I gained the following impressions about the veterinary service in the province.

The hospitals visited had minimal equipment and appeared primarily concerned with case treatment of animals brought in from the adjacent territory primarily on foot. While I am convinced the hopitals and the assigned veterinarian render a valuable service to the relatively few livestock owners who live close enough to obtain their services, there are a great many people whose livestock are not accessible for treatment at the hospitals.

There is a relatively more serious need for veterinary service in the rendering of preventive medicine in the field than for the treatment of individual animals. According to different estimates, only 25 to 40% of the livestock is being vaccinated against all of the contagious diseases to which they may be exposed. There is also a need for the field control of internal and external parasites. Rumors of contagious diseases to which they may be exposed. There is also a need for the field control of internal and external parasites. Rumors of contagious disease need to be checked out by field veterinarians. In a country which has only one veterinarian per 51,000 head of livestock, it appears wasteful of his time to be treating individual animals before all the animals are protected against contagious diseases which have a lethal potential. For example, I saw a veterinarian and two assistants, spend several hours on a thin old cow with a necrotic udder - an animal which would never be able to raise another calf and was of almost no value. During the same period those same men could have vaccinated and protected many productive animals.

When asked how much time they spent in the field in preventive medicine, of five veterinarians at one hospital, only two at a time spent two or three days per week in the field. When asked if they did not consider the preventive medicine more important, they agreed that it was, but, that they considered the case work their main assignment and preferred being there because if the supervisor came around and found them away from the hospital he would think they were not on the job.

Obviously there needs to be a change in emphasis from the top down with most veterinarians at such a hospital given specific field assignments. One man assigned to the hospital and four in the field would be a better proportion until all of the animals in the region are protected against the major diseases of F&M, rinderpest, hemorrhagic - septicemia, anthrax, and blackleg at least. Further it is likely that in many areas cattle should also be tested periodically for tuberculosis, brucellosis and Johne's disease and watched for signs of mucosal disease. There is more than enough work to keep several veterinarians in the field for each district in the province.

It would also assist in the national control of contagious disease if every federal veterinarian was charged with the responsibility of reporting any contagious disease occurrence he encounters to a central office in the Veterinary Research Institute at Lahore. Such a national disease reporting system would give the Institute early warning as to the amount of vaccine to prepare in advance of need and help avoid shortage of vaccine in emergencies. Further it is only through a knowledge of the distribution and incidence of priority disease problems that veterinarians can be shifted to major areas of need, or that there can be national planning for disease control. With relatively few veterinarians, national planning for disease prevention and control is vital.

If a national disease reporting system was established with reports promptly submitted to a central office say at the Veterinary Research Institute at Lahore - then:

1. They could be better prepared to assist in disease control.

2. The Institute could promptly pass incidence and distribution reports to Dr. M. Y. Bhatti's office in the Central Government, and to the Secretary responsible for veterinary services in each province so that they could best meet disease situations in their areas.

In view of the fact that the veterinary research institute at Lahore already plays a key role in the national prevention of disease through vaccine and reagent production, and through research and training, it is recommended that the Institute b e declared a national institute with some support from the Central Government so that no future political differences between provinces could possibly cut off its service to any province. Further we heard talk, in the small diagnostic laboratory in Quetta of their interest in vaccine production locally in order always to have what

they need. This is a noble interest, however it appears far more economical and practical for the Institute at Lahore which is already producing vaccines to be supported to provide ample vaccines to the whole country. With one laboratory producing the vaccines, standards can better be met and quality control assured than if many laboratories are trying to do it.

National Meat Inspection Service

From visits made to several slaughterhouses and markets, there is a great need for standardization of higher sanitation levels for those facilities and for the meat. Such standards would not only improve the safety and quality of the meat but would greatly improve its keeping qualities.

The killing, skinning and dressing of animals on a filthy floor covered with entrails, blood and dirt so contaminates the meat with putrifying and disease producing bacteria, fungi, viruses and parasites that it will only keep for a few hours without putrefaction and would frequently cause infections in the people who eat it if it were not thoroughly cooked. Furthermore food handlers, cooks and housewives, as well as food stocks, are exposed to contamination during meal preparation.

Obviously, no meat should be processed on a floor but should be hung. Further, clean meat cannot come out of a dirty packing house wherein the employees practice unsanitary methods. For these reasons it appears essential to put well trained veterinary inspectors in all plants who not only can recognize diseased animals and eliminate diseased meat but enforce standards of sanitation. Such practices must come before meat will be acceptable for export. The increased keeping quality of the meat will help justify the expense of inspection.

The above suggestions for an improved inspection service is a necessary initial step toward meeting the requirements for Pakistan's meat products to enter international trade. Preliminary to acceptance of a country's fresh or frozen meat products in world trade are typically preceded by a number of bilateral veterinary agreements between individual countries.

The Food and Agriculture Organization of the United Nations has published a report on the requirements of such bilateral agreements as are in effect in 1973. This report is entitled "Non-Tariff Barriers to

International Meat Trade Arising from Health Requirements" No. 1, supplementary Report to the Animal Health Yearbook, FAO, Rome 1973.

This FAO report also provides proposals for an internationally agreed standard of veterinary services.

It is recommended that the veterinary services of Pakistan seek these reports annually to keep abreast of international requirements for animal products as they move toward more export trade.

Livestock Health Report - Baluchistan

Husbandry and Veterinary Services

Great credit is due the herdsmen and their livestock for their proven ability to survive and be as productive as they are. In like manner the understaffed and inadequately funded animal husbandry men and veterinarians in the government service are to be commended for the good work they accomplish to help maintain the health of the livestock. This is not to say, however, that the work they can accomplish is adequate; much more needs to be done. It is estimated that as presently staffed and funded the veterinary service is able to provide effective disease and parasite control for about 25% of the livestock of the province.

In view of the national shortage of meat and animal products, Pakistan cannot afford to risk the loss of several million head of sheep and goats from uncontrolled preventable diseases. Veterinarians now in the field are seriously handicapped by the lack of a more comprehensive diagnostic service, and by the lack of a supporting research facility.

One diagnostic laboratory with a limited capacity at Quetta is accessible to a small percentage of the livestock because of communication problems. There is a need for sufficient regional diagnostic laboratories, some of which need to be mobile units, to provide an accessible diagnostic service everywhere in the province. Only with diagnostic support can field veterinarians respond promptly and correctly with the vaccines and treatment to control and eliminate serious contagion and infection. Further, at least one of the diagnostic laboratories in the province should be so staffed and equipped with reagents and antisera, experimental animals and tissue cultures so as to be able to diagnose contagious exotic diseases which threaten from neighboring countries.

It must also be recognized that no veterinary service can maintain the normal health of animals which are suffering from malnutrition. A diet reasonably adequate in all of the essential nutrients, vitamins and minerals is necessary for optimal health and no amount of vaccination or therapy can fully compensate. As an example, parasites generally pose little threat to well nourished animals but can kill a malnourished one. It is largely for this reason that this report aimed at health problems has dealt with over grazing and consequent malnutrition.

One research laboratory in the province to conduct applied research in the fields of preventive medicine and reproduction would be a good investment providing they confine their activity to the solution of practical problems. A valuable adjunct to such a research laboratory would be a veterinary extension staff whose objectives would be to make new information promptly available to the field staff, and to conduct short courses in continuing education to keep the field staff current on the best methods of disease prevention and control for the diseases presently being encountered and the new ones which threaten.

World wide research in medicine and veterinary medicine provides a constant flow of new information, new immunizing agents, new drugs, and new diagnostic and control methods. To be most efficient, a nation's veterinary service must be so organized as to have at least one research team which keeps abreast of developments in areas of national need - ideally a research group which will try promising new methods, and, if they prove more effective, will instruct the field service in their use. Such research methods not only assure progress but save money through elimination of old methods which may be continued by custom rather than proven effectiveness.

The results of research and livestock practices from other arid regions of the world such as East Africa, in breeding, nutrition, range forages, range and livestock management could also be made available, where appropriate, to Baluchistan through an animal science extension service, such as an extension service which would provide continuing education courses for the staff that works in the field with tribal herdsmen.

The people of Baluchistan are to be greatly admired. They have thrived in an arid rangeland of which only 15% has more than 10 inches of annual rainfall. Through constant movement of their flocks to harvest every edible blade and leaf, they are now maintaining some 7 million head of sheep and goats on lands which are estimated capable of carrying only 1/6th as many. Concerned however with daily survival their efficiency

in utilization of the vegetation for past centuries has so denuded the landscape that erosion has removed most of the topsoil and the watershed, so that there are now vast mountains and hills of barren rock with only seasonal moisture in narrow valleys providing some 2% of the area suitable for crops.

Since the growing capacity of the land has long passed a point of diminishing returns, it must be given an opportunity to regenerate vegetation. Unless regeneration is accomplished and the livestock populati reduced, it will become an unproductive wasteland.

Some obvious requirements are:

1. The livestock population must be reduced to the conservative carrying capacity of the land. Ideally this will be done through a voluntary culling of non-productive animals, and through a greater annual offtake to reduce the flocks. The institution of government sponsored, supplemental feeding programs, and, sheep marketing centers, improved disease control, and education in management through expanded extension and veterinary services wi ll help increase offtake. The only alternative in the long run would be periodic and tragic die offs from drought and starvation.

2. Health protection by an expanded veterinary service is essential for a comprehensive disease prevention program. Reasonable levels of nutrition are vital to health but well nourished animals can also die from a variety of infections and contagious diseases unless they are protected by immunization and disease control programs. For the veterinary service to be fully effective, they must have enough personnel and financial support to serve the entire livestock population wherever they are. Coverage is now about 25%. The veterinary staff must also be backed up by an adequate diagnostic service accessible to all field veterinarians. Ideally, there will also be a research station in the province to assure that the methods used on the veterinary and animal husbandry services are effective. In cooperation with the research facility should be an extension staff to teach the field staff and stockmen in application of effective methods.

Other countries with similar range and livestock problems have managed to overcome them. With the help and guidance of the central and provincial governments. The people of Baluchistan can save their land

and improve their production. They are a very hardy, intelligent people who can respond and benefit from help and guidance.

Livestock Health Situation - Northwest Frontier Province

Through discussions with Dr. Sultan Ali Khan, Director of Animal Husbandry and Veterinary Service, the Officer-in-Charge of the Veterinary Research Institute, Dr. M.A. Beg and their professional staff members the following information was obtained during 19-21 August.

There are stimated to be 8 million head of livestock and nearly 9 million poultry. The livestock consist of:

Cattle	3,143,000
Sheep	1,445,000
Goats	1,299,000
Buffalo	782,000
Donkeys	180,000
Camels	87,000
Horses	28,000
Mules	12,000

The total value including annual offtake is estimated at $250 million. The annual loss from disease and parasites is estimated at $15 million or a loss of 6% annually. This loss arises not only from deaths but from reduced productivity of meat, milk, wool, hair, and damage to hides and skins.

There are 93 veterinary officers in the Veterinary Service for both the field work and research institute operation. Based upon the livestock and poultry populations of the NWFP, they should have 48 more veterinarians to have the one veterinarian to 51,000 head of livestock which is the national ratio.

The veterinary service strives to vaccinate all the animals in the province yearly, estimating that they get from 80-90% coverage. The service has been able to convince the people of the province of the importance of vaccination so they get their cooperation. This is a much better coverage than is being achieved in Punjab or Baluchistan.

The major infectious diseases encountered in the province are:

1. Hemorrhagic septicemia - which is more serious in buffalo than in cattle;
2. Foot and mouth disease;
3. Anthrax;
4. Black-leg;
5. Caprine pleuropneumonia;
6. Enterotoxemia in sheep and goats;
7. Sheep pox;
8. Brucellosis;
9. Tuberculosis;
10. Mastitis;
11. Newcastle disease;
12. Leucosis - Mareks disease;
13. Leptospirosis;
14. Babesiosis;
15. Anaplasmosis

Major parasitic diseases include the following:

Lung worms in sheep and goats;	Ticks which carry:
Warble fly larvae;	
Liver flukes;	babesiosis;
Tapeworm cysts;	anaplasmosis
Memonchus;	

Both the laboratory and field staffs agree that these parasites cause much more damage to those animals which are malnourished than to those which are well nourished.

Though the floods have not involved the NWFP personnel they will undoubtedly slow progress in all areas because less funds will be available to develop agriculture, livestock production and its ancillary services while rehabilitation takes first priority elsewhere.

Veterinary Research Institute - Peshawar established in 1949.

Director, Dr. Sultan Ali Khan - Officer in charge, Dr. M. K. Beg

The Institute has the following staff.

8	Research Officers	3 vacancies
11	Asst. Research Officers	8 vacancies
13	Research Assistants	
17	Laboratory Assistants	
22	Laboratory attendants	
18	Administrative and clerical people	

The Institute has 13 technical sections.

The disciplines in veterinary medicine and animal husbandry function to support the clinical hospital and field service by providing a diagnostic service and applied research. Much of the research is to help solve diagnostic problems and confirm the value of vaccines [illegible] used. These services are seriously weakened by the vacancies in the technical staff.

The Director expresses a serious need for veterinarians with advanced technical training in the following subject areas;

Microbiology;
Pathology;
Parasitology;
Biological production;
Reproductive physiology and pathology;
Artificial insemination;

also animal scientists with special training in:

Animal nutrition;
Breeding and genetics;
Livestock management and production;
Livestock economics and marketing;
Sheep husbandry and wool technology;
Dairy technology and processing;
Poultry husbandry.

If possible he would like to have some of his present staff and others receive specialized or graduate training elsewhere in these specialities.

Appraisal of the Veterinary Resrearch Laboratory - Peshawar

The personnel are mostly young men with basic DVM training and limited experience. While they are eager and apparently working hard under a good Director and Officer in Charge of the laboratory, they need to be working with more highly trained, experienced people who can help continue their education. It would be encouraging if several of the vest of these men could be sent for graduate work. An alternative would be the addition of 6 highly qualified people from abroad. These persons would have to be innovative and adaptable to cope with the lack of laboratory facilities and professional journals.

It is obvious that the country has a problem supporting one good vaccine production laboratory. The vaccines would no doubt be better from one really good production facility with proper equipment and personnel than from two mediocre laboratories. If emphasis for vaccine production is to be at one laboratory, it must produce quality products, in bulk, on time, and should be stockpiled in proper storage in each province.

A new building is now under construction to house the Peshawar Veterinary Research Laboratory. If, as intended, this laboratory is to provide the diagnostic and applied research service required to properly support the field staff in the control of disease, it will definitely need sophisticated equipment and highly trained and specialized personnel to operate it. This is not to imply that there is anything wrong with the present staff or the Director. They do a fine job with what they have, but they do need more support, more modern equipment, and more specialized training. In the present situation they would also get a great deal of help from some modern text books in veterinary medicine and from some pertinent veterinary medical research journals from the USA, Europe and South Africa.

The laboratory has a big job to do in supporting a vigorous field service in a preventive medicine campaign without being involved in vaccine production. So, if they can get good vaccine from Lahore in quantity, as needed, fine; if not, then by all means they should be supported in their desire to make their own in Peshawar. However, if they are to be made in Peshawar, then there must be a parallel back up of research to evaluate the vaccines for proper standards of effectiveness.

Once the national productive capacity for essential vaccines is operational, and the trained personnel available, a national board of experienced veterinarians should decide which diseases constitute such a national hazard as to require vaccination of all susceptible animals. Then the government could make the vaccination compulsory, where the risk justifies its requirement. Then, since vaccination is free, the board can require every animal owner to bring his animals for the required immunizations. Many diseases have been eradicated by vaccination, providing better than 90% of the animals were immunized, and providing there are good controls at the borders so that no infected or non-vaccinated animal is permitted in the country.

This process and its continuation is a necessary first step toward eradication of a disease.

Appraisal of Health Problems in Three Provinces

I have tried to report on the health problems observed in the three provinces visited and suggest solutions in each instances, so that some answers to the specific questions raised are presented in the province report sections. The answers to questions presented below will be an attempt to briefly suggest solutions on a national basis not presented thus far in the report.

Question

Appraise public and private efforts to identify and control parasites, serious disease and reproductive problems, including production and application of vaccines, medicines and other control measures.

Answer

The public, i.e. the Government of Pakistan, operates its animal health program through the Animal Husbandry and Veterinary Services of the provinces. I have commented on these services and made specific recommendations for the three provinces visited: Punjab, Baluchistan and Northwest Frontier. Private efforts are very minimal; there are no private veterinary practitioners, a high percentage of the livestock procedures are illiterate and many are out of communication with the few government extension people trying to teach them about animal management and health. An unfortunately high percentage of livestock people will not voluntarily bring their animals to a field vaccination point to have their animals vaccinated until they start to have significant losses. Consequently it takes intensive extension efforts to educate the people to utilize preventive medicine to protect their animals.

An appraisal of the production and application of vaccines is found in the section on the Veterinary Research Institute.

Reproductive problems are very important because the reproduction rate is very low, being roughly 35% for buffalo, 45% for cattle, and under 50% for sheep and goats. In the arid areas like Baluchistan, the low rate is primarily due to malnutrition, and supplemental feeding will offer prompt improvement.

In areas where there is adequate nutrition, reproduction is better but handicapped by poor management. Breeding is usually left to chance by the first convenient male which may or not be fertile or of good type. Artificial insemination in cattle and buffalo raises the reproductive rate by about 10% and with semen from better bulls the breeds are much improved for both meat and milk production.

There has apparently been very little research or diagnostic work done to identify infections or specific nutrient or mineral deficiencies that undoubtedly handicap reproduction. Brucellosis certainly causes some abortions and it will be surprising if vibriosis and trichomoniosis are not present.

A research team to identify, specify, and provide solutions for reproductive problems in each livestock species would surely be rewarding.

As for therapy research on animal disease and parasite control, only the Veterinary Research Institute at Lahore is currently involved. All the veterinary colleges find it difficult to keep up to date without current journals or textbooks available. Since they do not have much research activity in Pakistan, it is imperative that they have access to current literature if they are to benefit from world progress.

Reference export requirements for meat products--comment has already been made under National Meat Inspection Service. A minimal requirement is the elimination of infections and contagious diseases not present in importing countries and establishment of grade and health standards acceptable in a bilateral agreement with each importing country. Pakistan's meat products are presently several steps away from qualifying for entry in the more developed parts of the world.

Cost estimates, to be realistic, will need to be made after a more detailed study of all the factors involved and with knowledge of the government's pricing policy. The smuggling of animals and their products out of the country for higher prices will have to be controlled before Pakistan's markets will receive potential supplies.

National benefits from improved animal health will be of major importance if the diseases which now limit production and reproduction are controlled. A fully comprehensive health service could probably increase production by 25%. Adequate nutrition plus disease control with good management should improve production by 50%. Add

the marketing suggestions presented herein and production could jump another 25%. However, considering the need to educate producers and train technical people to assist in these programs, the need to provide supplemental feed plus the need to improve the ranges, at least a 5-15 year program will be necessary to accomplish these ends.

Human illness will be reduced in proportion to the elimination of malnutrition and control of zoonotic diseases.

Recommendations

In view of the above situation recommendations are summarized briefly as follows:

For improved control of animal health and therefore increased productivity:

- encourage the Director Dr. S. A. Khan to continue his policy of putting emphasis on preventive medicine;

- help him accomplish his objective of immunizing all animals by increasing financial support for the veterinary service, by providing more veterinarians for the field service in preventive medicines, by improving the capacity of the veterinary research laboratory to back up the field service with diagnostic and research assistance;

- to provide better support, the laboratory definitely needs current veterinary text books and journals, more technically trained personnel in serology, virology, pathology, tissue culture and immunology and biological production.

The question of how much vaccine production should be done in Peshawar could be decided by the central government after consideration of such factors as:

1. Can the Veterinary Research Institute at Lahore supply all of the vaccines needed to satisfy the needs of the NWFP also?

2. Can Pakistan provide the financial support, equipment and technical personnel to operate two biological production facilities (current-Lahore, Peshawar) and assure the maintenance of quality from both?

It is recommended that:

- effective vaccines be made available for all provinces in such quantity as to permit compulsory vaccination against the major contagious diseases of livestock and poultry as a first step toward eventual eradication of these diseases;

- all borders be closed to the entry of animals until they are proven by competent veterinarians to have been immunized against contagious diseases;

- all meat packing and slaughter plants have veterinary inspectors assigned to assure the health of animals slaughtered for human consumption, to enforce sanitary standards, from all contaminated, diseased meat to point of origin and alert field personnel accordingly. For such veterinary inspection to be followed by grading of meat products is a second step toward acceptability for eventual export to other countries.

Apart from direct involvement of the veterinary service those factors which influence animal nutrition are also vital to animal health.

CHAPTER 4

ECONOMIC ASPECTS OF PRODUCTION AND MARKETING

Calvin C. Boykin

Introduction

Pakistan's agriculture is the single most important industry, contributing some 44.8 percent to GNP. In addition, agriculture provides 75 percent of the Nation's population with employment and accounts for 75 percent of foreign exchange earnings. Pakistan is now one of the few developing countries which has attained an annual agricultural growth rate of over four percent during the last decade. Behind this growth rate have been investments in extensive water development, including tubewells, the greater use of fertilizers, improved seeds and pesticides, the provision of subsidies, and support prices for key crops, increased credit facilities and improved marketing and storage facilities.

At the same time, the livestock sector contributes 38 percent or more of the total gross production value of agriculture. It provides almost all the motive power for agricultural operations, all the meat and milk for the human population, and by-products, such as hides and skins, wool, hair, bones and manure for local use and industry. The livestock sector contributes largely to export earnings of hides, skins, wool and animal hair

The Government of Pakistan now has turned its attention toward the livestock sector, searching for ways and means of obtaining increased responses in the production of milk, meat and other livestock products. Responses of a magnitude that would equal those achieved by the agricultural economy as a whole would go a long way toward total economic development.

Problem Identification

Currently, livestock have no separate identity as a sub-sector of agriculture; for this reason production and marketing of livestock and their products have long been neglected. For the most part this is understandable, for the livestock of Pakistan are dual purpose animals and the total agricultural sector's need for bullock power has taken precedence over other purposes with the exception of milk production.

Meat production, except in the case of sheep and goat enterprises, is secondary and at most a by-product of the work-milk scheme.

The production of livestock and their products occur among many and scattered units, under many different resource and land tenure situations. From all accounts, the livestock sub-sector has several common attributes, whether in the arid or semi-arid rangelands of Baluchistan or in the irrigated and intensely farmed cropland of the Punjab. One is that the number of livestock exceeds the available supplies of feed and forage; another is that the rangelands and croplands produce forage and fodder crops at much below their potentials. Thirdly, the genetic potentials of the livestock breeds have degenerated, and breed crosses have been diluted by the attempt to upgrade animals for multi-purpose and thus conflicting requirements.

On the marketing side, the scattered and small production per unit producers of livestock all over the country has resulted in the creation of a chain of marketing intermediaries, which consequently has increased marketing costs. Marketing channels are long, transportation inefficient, with result that marketable surpluses are diminished. Producers, being in a weak bargaining position because of low production, have little incentive to make the effort to produce more, and even the available potential is not fully exploited. Milk collection and processing facilities and slaughter-houses are inadequate in number and quality.

Given the rather low consumer income of Pakistanis their traditional tastes and preferences and the inadequacy of animal protein in the average diet, the problem becomes one of how to create an effective demand that will stimulate the production and marketing of increased quantities and increased qualities of livestock products without inordinate increases in consumer prices.

Purpose of Report

The purpose of this report is to further define specific problems and needs of the livestock industry preparatory to major feasibility studies leading to increased private and public investment. Herein considered are the production and marketing aspects of cattle, buffaloes, sheep, goats, and of their products.

Livestock Production

Except for Baluchistan, where a definitive report on livestock was issued by the Agricultural Census Organization in 1972, no census of

livestock in Pakistan has been made since 1965-1966. The most recent report fixes the livestock population nationally at 20.0 million cattle, 10.0 million buffaloes, 20.0 million sheep, 20.0 million goats, 1.5 million camels, and 1.5 million horses, mules and donkeys. Subsequently, in this report, the total livestock numbers are apportioned among the provinces with the result that Punjab is considered to have 62.3 percent of the cattle, 76.2 percent of the buffaloes, 60.7 percent of the sheep, 29.6 percent of the goats, 46.6 percent of the camels, and 59.3 percent of the other animals, (see Table I). Baluchistan is considered to have the largest proportion of the total number of goats at 39.4 percent. On the basis of the percentage of total animal units the rankings among the provinces in livestock are the Punjab, Sind, Northwest Frontier Province, and Baluchistan. The human population per animal unit of livestock ranges from a low of .6 in Baluchistan to a high of 2.0 in NWFP, an average of 1.3 for Pakistan. (see Table 2).

Calculations from a recent estimate of the total livestock population reveal that, on an animal unit,basis, there has been little change in proportions among the nation's inventory of cattle, buffaloes, sheep, goats and other livestock since 1955, (see Table 3). At the same time, except for a slight decline in goat numbers between 1955 and 1965, all kinds of livestock have increased in numbers periodically between 1955 and 1972 (see Table 4). In animal units, livestock numbers increased 8 percent nationally between 1955 and 1965, and 19 percent between 1955 and 1972. Although the total numbers of livestock reported here differ somewhat from the numbers reported in Table I, they nevertheless portray a rather large build-up of livestock numbers.

Systems and Structures of Livestock Production

The production of livestock and their products occur under numerous systems and structures encompassing a multitude of resource situations. Definitive identifications and economic appraisals of these various types of producing units have not been made. One can speculate safely that the producers' response to changes in relative crop-livestock prices would vary greatly, depending upon specific production resources.

Crop farmers, because power requirements are furnished by animals, are automatically in the livestock business. For subsistence reasons, most farmers keep milk cows or buffaloes, while many farmers keep breeding stock for raising bullocks. Other farmers may

TABLE 2 - PROVISIONAL POPULATION OF PAKISTAN, 1972 1/

	Area Sq. Miles	Livestock Population (Mil. AU)	Human Population (Mil.)	Human Population per Sq. Mile	Human Population per AU of Livestock
Punjab	79,284	30.19	37.37	471	1.2
Sind	54,407	10.59	13.96	257	1.3
N.W.F.P.	27,773	4.11	8.40	292	2.0
Baluchistan	134,050	3.85	2.41	18	.6
Tribal Areas (Centrally Adm.)	10,510	-	2.51	239	- 2/
Islamabad	350	-	.24	671	- 3/
Pakistan	307,374	48.74	64.89	211	1.3

1/ Human population figures are from Population Census of Pakistan 1972, Provisional Tables, Census Bulletin 1, January 1973. Livestock population from Table 1.

2/ Included in N.W.F.P. estimate.

3/ Included in Punjab estimate.

TABLE 3 - PROPORTION OF TOTAL ANIMAL UNITS BY 1/ SPECIE OF LIVESTOCK, PAKISTAN, 1955-72

	1955	1965	1972
	Percent		
Oxen	43	44	44
Buffaloes	37	37	37
Sheep	6	6	6
Goats	8	7	7
Others	6	6	6
AU Equivalents	100	100	100

1/ Based on figuresprovided by Dr. M. Jamil Qureshi, Professor and Head, Faculty of Animal Husbandry, University of Agriculture, Lyallpur.

TABLE 4-

ESTIMATED CHANGES IN LIVESTOCK POPULATION IN PAKISTAN 1955-1972 [1/]

	1955	1965	1972	Percent Change 1955-1965	Percent Change 1965-1972	Percent Change 1955-1972
	.....	Thousands	.....	Percent	Percent	Percent
Oxen	15,900	17,800	19,500	+ 12	+ 10	+ 23
Buffaloes	9,300	9,900	10,900	+ 6	+ 10	+ 17
Sheep	11,600	12,400	13,700	+ 7	+ 10	+ 18
Goats	9,800	9,600	10,900	- 2	+ 14	+ 11
Others	2,300	2,400	2,600	+ 4	+ 8	+ 13
AU Equivalents [2/]	37,410	40,410	44,460	+ 8	+ 10	+ 19

1/ Based on data provided by Dr. M. Jamil Qureshi, Professor and Head, Department of Livestock Management, University of Agriculture, Lyallpur.

2/ Animal Unit equivalents: Cattle = 1.0, Sheep = 0.2, Goats = 0.3, Camel = 1.7, Buffaloes = 1.5, Other = 1.0

have sheep and goats in addition to cattle or buffaloes to supplement their needs for meat and milk. Few livestock enterprises of a commercial nature exist among these types of farmers, for reasons of their being small in total land operated and responsive to prices that favor cash crop enterprises.

Other cropland farmers have access to grazing on rangeland, and to some extent, again depending on size of operation, these operators may rely more on income from livestock production. Because of crop-livestock-price ratios, often favoring crops, the livestock are forced onto the ranges for a greater and greater share of their nutritional needs. Thus rangelands, in these situations particularly, appear to be overstocked and severely overgrazed.

In and among the cropland areas appear producers with migratory herds of livestock, some belonging to farmers with cropland, many belonging to producers with no cropland. These herds, primarily of sheep and goats, graze along highway rights-of-way, irrigation ditches and canals, and abandoned or salted croplands. These operators may purchase some crop after-math grazing, although essentially they are on their own, getting whatever grazing their herds can scavenge.

As these operators are basically livestock producers, so are the sheep and goat producers of the arid and semi-arid areas of Baluchistan and of the NWFP. These provinces contain the tribal areas where grazing rights have long been established and where the production of livestock takes on a more commercial nature, for animal livestock offtake approaches that of modern dynamic livestock systems. In addition, the fattening of lambs occurs in many instances on nearby croplands. However, the practice of grazing excess numbers of livestock, often at the wrong season of the year for particular ranges, has resulted in overgrazing and a deterioration of rangeland resources.

On the average, the highest concentration of livestock per unit of land area occurs in the Punjab, where .8 acres of uncultivated land and .9 acres of cultivated land support one animal unit of livestock, (see Table 5). The least intensive livestock concentrations, reflective of climatic, topographic soil and vegetative conditions, is in Baluchistan. Here 21.4 acres of uncultivated land support one animal unit of livestock on the average. The Punjab, with the highest proportion of the nation's livestock, also has the highest proportion of the nation's irrigated cropland, (see Table 6). Similarly, the barani or dryland cropping

areas of the Punjab, Sind and NWFP also support large concentrations of livestock.

Regardless of the livestock system or the resource situation to which such systems are affixed, the dominating structural characteristic of livestock production in Pakistan is the preponderance of small producing units. For example, 92 percent of the farms are 25 acres in size or less, while 58 percent of the total farmland is occupied by these small units, (see Table 7). Similar structural data for livestock are available, except for Baluchistan. Here about 67 percent of the sheep and goat herds consist of 30 animals or less, although these herds represent only 12 percent of the total number of sheep and goats in the Province. Thus, there are a few commercial-sized herds that encompass a majority of the livestock. Contrarily, 94 percent of the cattle and buffaloes are in herds of 10 animals or less, with such herds accounting for 75 percent of the total number of animals.

Except for the larger livestock herds of Baluchistan, and certain larger herds in the other provinces, most of them are very small; they are secondary sources of income to producers, and for a large part, only of a subsistence nature. Meeting family needs for milk and meat necessitates the holding of more animals than the limited resources will support. And as production per animal declines, the tendency among such farmers is to reduce feed and forage inputs. Such operations as these are relatively unresponsive to market demands.

Estimated Production of Livestock Products

According to an official in the Ministry of Health, Labor and Social Welfare the recommended diet per capita, per day in Pakistan, among other foods, amounts to 56.6 grams of meat and fish, and, 226.4 grams of milk, (see Table 8). The adequace of available food supplies to meet these dietary requirements at the time of the 1967 report revealed the percentage sufficiency in milk stood at 88.1 percent, while the percentage sufficiency in meat and fish amounted to only 32.1 percent.

Within the context of these dietary requirements, and the current human population estimate of 64,892,000 people, an assessment is made herein of the ability of the Nation's livestock sub-sector to meet these needs. First, the livestock production rates cited in a 1966 report are applied to the current livestock population estimates. Next, adjustments are made in livestock production and marketing systems to further close the gap between production and the dietary needs of the people. Of course

TABLE 5 - LIVESTOCK DENSITY BY TYPES OF LAND USE 1/

	Total Area	Cultivated Area	Uncultivated Area	Total AU of Livestock 2/	Acres per AU of Livestock		
					Total	Cultivated	Uncultivated
	Million acres			Mil. Head	Acres		
Punjab	50.91	27.10	23.81	30.19	1.7	.9	.8
Sind	37.42	13.67	23.75	10.59	3.5	1.3	2.2.
N.W.F.P.	25.77	3.78	21.99	4.11	6.3	.9	5.4
Baluchistan	85.20	2.90	82.30	3.85	22.1	.8	21.4
Pakistan	199.30	47.45	151.85	48.74	4.1	1.0	3.1

1/ Based on 1968 land use statistics from Yearbook of Agricultural Statistics. 1971-72, August, 1972.

2/ See footnotes Table 1.

TABLE 6- CULTIVATED AREA, IRRIGATED AND NON-IRRIGATED, PAKISTAN 1969-70. 1/

Province	Cultivated Area			
	Total	Irrigated	Barani	Sailaba
	1,000 Acres			
Punjab	25,858	18,784	5,707	1,367
Sind	13,670	7,409	-	-
N.W.F.P.	3,193	1,152	1,946	95
Baluchistan	2,900	1,236	-	-

1/ Second Census of Agriculture, Vol. IV, Part 3, Village Statistics October 1972, and from Yearbook of Agricultural Statistics, 1971-72.

TABLE 7- DISTRIBUTION OF FARMS AND LIVESTOCK BY SIZE GROUPING, PAKISTAN

Farms [1]			Livestock [2]					
Size of Farms	Farms	Farm Area	Size of herd	Herds	Sheep and goats	Size of herd	Herds	Cattle and buffaloes
Acres	Pct.	Pct.	Animals	Pct.	Pct.	Animals	Pct.	Pct.
Under 1.0	15	1	1 - 5	31	2	1 - 2	41	15
1.0- 2.5	18	3	6 - 15	23	4	3 - 4	27	21
2.5- 5.0	16	6	16 - 30	13	6	5 - 6	14	18
5.0- 7.5	12	7	31 - 50	9	7	7 - 10	12	21
7.5- 12.5	16	15	51 - 75	6	9	11 - 15	4	11
12.5- 25.0	15	26	76 - 100	4	8	16 - 20	1	4
25.0- 50.0	6	19	101 - 150	5	14	21 - 30	1	3
50.0-150.0	2	13	151 - 200	3	11	31 - 50	negligible	2
150.0-Over	negligible	10	201 -Above	6	39	51 -Above	"	5
	100	100		100	100		100	100

1/ All of Pakistan, Yearbook of Agricultural Statistics, 1971-72. (4,859,983 farms; 48,929,583 acres).

2/ Distributions for Baluchistan only. Second Pakistan Census of Agriculture, Vol. V, Livestock in Baluchistan, March - July, 1972.

it must be remembered that, these dietary requirements do not in any sense constitute effective demands. Either increases in consumer income, decreases in prices, or both would have to occur before more products would be taken.

Milk

Cattle, buffaloes, sheep and goats each contribute to the total milk supply. As estimated, the proportion of females eligible for breeding in the current total livestock inventory amounts to only 28.8 percent for cattle, 63.7 percent for buffaloes, 69.3 percent for sheep, and 70.0 percent for goats, (see Table 9). Of the resulting number of milk animals only 51.1 percent of the cattle, 46.6 percent of the buffaloes and 33.0 percent each of sheep and goats are lactating. An average annual milk production per dam of 1,870 pounds for cattle, 3,706 pounds for buffaloes, 189 pounds for sheep, and 369 pounds for goats, subtracting out annual milk losses, results in an estimated net annual milk production of 18,183 million pounds.

On the basis of the recommended diet, total milk requirements of the current population is 14,368 million pounds, leaving an apparent milk surplus of 3,815 million pounds. This figure may be misleading, for it has been estimated that one-third of the milk supply is converted into ghee, one-third into butter, curd and sweets, while the remaining one-third is consumed as fluid milk. Unless the consumption of these milk products are distributed uniformly among the population, which because of relatively high prices they are not, one could assume that for much of the population a deficit of milk and milk products exists.

Meat

Using production rates from the same source, applying them to the present livestock inventory, a resulting estimate of Pakistan's meat supply is made, (see Table 10). The estimated annual off-takes differ markedly between cattle and buffaloes as compared with off-takes from sheep and goats. The cattle off-take is only 7 percent, while buffaloes' off-take is only 3 percent. With off-take rates of 30 percent for sheep and 40 percent for goats, it can be said that these animals are kept to a large extent for meat. The turnover of poultry exceeds the inventory because of the short production cycle and the industrial nature of the production process. Poultry meat is included to assist in determining the extent of the meat deficit that is said to exist.

TABLE 8 -

ESTIMATED REQUIREMENTS FOR RECOMMENDED DIET OF AVAILABLE FOOD SUPPLIED, PAKISTAN 1/

Commodity	Recommended per Capita per day	Total yearly requirement (64,892,000 Population)
	gms.	Million pounds
Cereals	339.6	21,554
Roots and tubers	56.6	3,593
Sugar	42.5	2,698
Gram & pulses	56.6	3,593
Meat and fish	56.6	3,593
Eggs	21.2	1,345
Milk	226.4	14,368
Vegetables	169.8	10,777
Fruits	56.6	3,593
Fats and oils	42.5	2,698

1/ Derived from: S.A. Momin -- The Pakistan Times, July 17, 1967, Ministry of Health, Labor and Social Welfare, Government of Pakistan, as quoted in Appendix "B", Livestock Improvement Project. Population figure reported in Population Census of Pakistan, 1972, Census Bulletin 1.

TABLE 9 - ESTIMATED MILK PRODUCTION RELATIVE TO REQUIREMENTS, PAKISTAN 1972

	Livestock 1/	Females eligible for breeding		Animals giving birth		Aver. annual milk production per dam	Total annual milk production	Total annual losses	Net annual milk production
	Mil	Pct. 2/	Mil.	Pct.	Mil.	Pounds 2/	Mil. pounds		
Cattle	20.0	28.8	5.8	51.1	3.0	1,870	5,610	280	5,330
Buffaloes	10.0	63.7	6.4	46.6	3.0	3,706	11,118	556	10,562
Sheep	20.0	69.3	13.9	33.0	4.6	189	869	87	782
Goats	20.0	70.0	14.0	33.0	4.6	369	1,697	170	1,509
Total net milk production									18,183
Total milk requirements									14,368
Surplus or deficit									+ 3,815

1/ National Range Management Committee, Rangelands of Pakistan, May 1973.

2/ Proportionate estimates of milking animals and milk production from Dr. Israr-ul-Haq and Col. M. Masud, Livestock, Poultry, and Their Products, West Pakistan Agricultural University, Lyallpur 1966.

Total meat production is determined by applying off-take rates to the current livestock inventory, the results to the dressed meat per animal slaughtered, then subtracting out the bone, then adding edible offal and dressed head and trotters. From cattle, the estimated meat supply is 232 million pounds; from goats 172 million pounds; from sheep 129 million pounds; and from buffaloes 75 million pounds. Adding in the 38 million pounds produced from poultry results in an estimated total meat supply of 646 million pounds. On the basis of the recommended diet, total meat requirements are 3,593 million pounds. Thus there appears to be a meat deficit in Pakistan of 2,947 million pounds.

Wool and Hair

Wool and hair are important to Pakistan's economy particularly wool; for this product is used in the carpet industries both domestic and foreign.

On the basis of current inventories of sheep and goats, the estimated proportions of adults to young stock, and the average clip per head, minus losses, results in a net clip of 63.86 million pounds of wool and 25.80 million pounds of hair, (see Table 11). In addition, the 1.5 million camels produce an estimated 2.25 million pounds of hair. The relatively low production of hair among goats results from a low average clip per head, and also from the practice of clipping only half of the population each year.

Hides and Skins

Hides and skins contribute greatly to the domestic leather goods industries, and also make a sizeable contribution to the export trade. One the basis of current livestock inventory estimates, hides from current off-takes plus dead animals, less the losses of hides that occur, results in a number of hides for processing which includes 3.39 million cattle hides and 1.30 million buffalo hides, (see Table 12). At the same time, the number of skins amounts to 7.18 million sheep and 9.37 million goat skins.

Value of Production

A listing of wholesale prices of livestock and their products are contained in Table 13 and Table 14. These prices, and those derived from other sources, are used in placing a value on the livestock inventory of Pakistan and on the estimated production of milk, meat, wool, hair, hides and skins, (see Table 15). Not to be neglected are

TABLE 10 ESTIMATED MEAT PRODUCTION RELATIVE TO REQUIREMENTS, PAKISTAN, 1972 1/

	Livestock	Slaughtered		Dressed meat per animal slaughtered	Total Dressed meat available	Total Boneless meat available	Edible Offal		Dressed head and trotters		Total Meat
							Per animal slaughtered	Total	Per animal slaughtered	Total	(5)+(7)+(9)
	Mil. head	Pct.	Mil.	Pounds	Mil. Pnds.	Mil. Pnds.	Pnds.	Mil. Pnds.	Pounds	Mil. Pnds.	Mil. Poun
	(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cattle	20	7	1.4	246	344	179	22	31	16	22	232
Buffaloes	10	3	.3	369	111	58	26	8	30	9	75
Sheep	20	30	6.0	22	132	69	5	30	5	30	129
Goats	20	40	8.6	22	176	92	5	40	5	40	172
Poultry	20	118	23.6	2	47	38	-	-	-	-	38
Total available meat											646
Total meat requirements											3,593
Surplus or deficit											-2,947

1/ Livestock inventory estimates from: National Range Management Committee, Rangelands of Pakistan, May 1973. Poultry inventory estimate from: Dr. M. Jamil Qureshi, University of Agriculture, Lyallpur. Percentage figures of animals slaughtered, dressing percentages and boneless meat percentages from: Dr. Israr-ul-Haq, and Col. M. Masud, Livestock, Poultry and their Products, West Pakistan Agricultural University, Lyallpur, 1966.

TABLE 11- ESTIMATED WOOL AND HAIR CLIP, PAKISTAN, 1972 [1]

Livestock [2]	Head	Average clip per head	Total clip possible	Total losses	Net clip
	Million	Pounds	Mil. Pounds	Mil. Pounds	M. Pound
Sheep	20.0				
Adult males	2.4	3.64	8.74		
Adult females	13.9	3.64	50.60		
Young stock	3.7	1.70	6.29		
Total Wool			65.63	1.77	63.86
Goats	20.0				
Adult males	1.8	2.00	3.60 [3]	1.80 [3]	1.80
Adult females	14.0	2.00	28.00 [3]	14.00 [3]	14.00
Young stock	4.2	-	-	-	-
Total hair			31.60	25.80	25.80
Camel hair	1.5	3.00	4.50 [3]	2.25 [3]	2.25

1/ Average clip per head and losses based on: Dr. Israr-ul-Haq, and Col. M. Masud Livestock, Poultry, and their Products, West Pakistan Agricultural University, Lyallpur, 1966 (30)

2/ Total number of sheep, goats and camels from: Rangelands of Pakistan, 1973. (14)

3/ One-half of the population clipped once a year.

TABLE 12 - ESTIMATED NUMBERS OF HIDES AND SKINS, PAKISTAN 1972 1/

Livestock 2/	Head	Slaughtered		Fallen		Losses	Total hides & Skins
	Mil.	Pct.	Mil.	Pct.	Mil.	Mil.	Mil.
Cattle	20.0	7	1.40	10	2.00	.01	3.30
Buffalo	10.0	3	.30	10	1.00	--3/	1.30
Sheep	20.0	30	6.00	6	1.20	.02	7.18
Goats	20.0	40	8.00	7	1.40	.03	9.37

1/ Average slaughter and fallen animals, and hide and skin losses from fallen animals based on :Dr. Israr-ul-Haq, and Col. M. Masud Livestock, Poultry and Their Products, West Pakistan Agricultural University Lyallpur, 1966. (30)

2/ Livestock number from: Rangelands of Pakistan, 1973 (14)

3/ Less than .01 million.

the values assigned to inedible offal, bones, droppings and urine. Omitted however, are the values attributable to the livestock for draught purposes. Such values could be assigned on the basis of their rental value, or the maintenance costs, or the cost of doing a comparable amount of work using tractors.

All totalled, and inventory of livestock valued at 22,950 million rupees is producing an estimated 13,938 million rupees worth of products, a gross return on livestock investment of 61 percent. The value of milk at Rs. 11,695 million far outranks the value of meat at Rs. 1,292 million, wool at Rs. 138 million, hides and skins at Rs. 664 million and other products valued at Rs. 149 million.

Increasing Production of Livestock Products

The deficit of milk and meat production relative to the nutritional needs of Pakistan's population, a population growing at an annual rate of from 2.5 to 3.0 percent, alarms even the most casual observer. Drastic changes are needed in the systems of livestock production toward increasing production and improving marketing incentives. Many proposals have been made, as evidenced by papers and statements by experts in the fields of animal production and marketing.

Increased Livestock Off-Take

Most observers of the livestock scene agree that the number of animals exceeds the available feed and forage supplies, that is, there are more livestock on hand than Pakistan can afford to carry. Normal off-takes in years past would have prevented such a build-up of animals that, for reasons associated with poor nutrition and poor health, are low producing animals. Stepping up off-takes at this time would be a feasible means of increasing meat supplies in the short run and both milk and meat supplies in the longer run. According to the National Range Management Committee, normal off-take would involve an increase in birth rates, a decrease in death losses, and a stabilization of the number of livestock in the inventory.

Assuming that no change occurs in birth rates or death losses, an attempt is made here to estimate the additional meat that could be produced if culling rates were stepped up enough to arrest any livestock inventory increase. At current production rates and at the same weights of animals slaughtered it would be possible to increase the meat supply from cattle some 183 million pounds, and from buffaloes 575 million

TABLE 13-AVERAGE LIVESTOCK AND LIVESTOCK PRODUCT WHOLESALE PRICES, PAKISTAN FEBRUARY 1973 1/

Item	Description	Unit	Rupees
Milk and milk products			
Milk	Cow	Maund	49
Milk	Buffalo	Maund	55
Butter		Pound	5
Khoa		Pound	3
Cream		Pound	5
Ghee	Punjab	Maund	392
Ghee	Sind	Maund	385
Meat			
Beef		Maund	102
Mutton		Maund	248
Goat meat		Maund	248
Poultry			
Chickens		Pound	3
Buffalo beef 2/	Yielding 4 mds. dressed carcass	Each	354
Oxen beef 2/	Yielding 3 mds. dressed carcass	Each	319
Draught bullocks 2/	3 yrs. old (different breed)	Each	643
Goats	Yielding 12 seers of dressed carcass	Each	100
Sheep	Yielding 12 seers of dressed carcass	Each	87

1/ Derived from: Markets and Prices, Marketing Series A.M.A. 200, March 1973. Prices at Karachi except as noted.

2/ Simple averages of quotations by location.

TABLE 14 - AVERAGE LIVESTOCK & LIVESTOCK PRODUCT WHOLESALE PRICES, PAKISTAN, FEBRUARY 1973 1/

Item	Description	Unit	Rupees
Cattle			
Buffaloes	Yielding 8-10 seers of milk	Each	998
Cow	Yielding 6-8 seers of milk	Each	678
Milk goats	Yielding 2 seers of milk	Each	218
Milk sheep	Yielding 2 seers of milk	Each	87
Wool	Pak colored black to Pak super white	Maund	81-180
Goat hair	Pak short to Pak extra long	Maund	35-53
Cow hides	Wet salted I		46-100
Cow hides	Wet salted II		36-75
Buffalo hides	Wet salted I		46-56
Buffalo hides	Wet salted II		36-40
Goat skins	Wet salted III-I med.		10-22
Sheep skins	Wet salted I med.		22

1/ Derived from: Markets and Prices, Marketing Series A. M. A. 200, March 1973. Prices simple average of country locations except for hides and skins, which are Karachi quotations.

TABLE 15- ESTIMATED VALUE OF LIVESTOCK INVENTORY AND VALUE OF LIVESTOCK PRODUCTION, PAKISTAN 1972 1/

Livestock	Number	Value per head	Total value	Production 1972	Unit	Amount	Price	Tot val
	Mil	Rs	Mil. Rs				Rs.	Mil. R
Cattle	20	593	11,860	Milk				
				Cow	Mil. pound	5,330	.60	3,198
Buffaloes	10	711	7,110	Buffalo	"	10,562	.67	7,076
Sheep	20	84	1,680	Sheep	"	782	.62	485
				Goat	"	1,509	.62	936
Goats	20	115	2,300					
				Dressed Meat				
Total			22,590	Cattle	"	232	1.30	302
				Buffaloes	"	75	1.08	81
				Sheep	"	129	3.02	390
				Goat	"	172	3.02	519
				Wool	"	64	2.15	138
				Hair	"	26	.65	17
				Hides	Mil. pieces	4.69	64.00	300
				Skins	"	16.55	22.00	364
				2/				
				Other	-	-	-	132
				Total				13,938

1/ Inventory values per head derived from notes provided by Dr. M. Jamil Qureshi, Inventory numbers from: Rangelands of Pakistan, 1973. Prices derived from Markets and Prices, February, 1973.

2/ Includes inedible offal, bones, droppings and urine.

TABLE 16 - ESTIMATED ADDITIONAL MEAT PRODUCTION WITH INCREASED LIVESTOCK CULLING RATES AND NO CHANGE IN PRODUCTION RATES 1/

	Livestock Inventory	Livestock slaughtered	Meat per animal slaughtered	Total Meat	Adjusted slaughters	Adjusted total meat	Net additional meat
	Mil. head	Mil. head	Pounds	Mil. pounds	Mil. head	Mil. pounds	Mil. pounds
Cattle	20	1.4	166	232	2.5	415	183
Buffaloes	10	.3	250	75	2.6	650	575
Sheep	20	6.0	22	132	6.0	132	0
Goats	20	8.6	20	172	8.6	172	0
Total additional meat							758

1/ Allowances made for replacement livestock numbers sufficient to maintain the inventories at current levels. Livestock turnoff increase: cattle - 5 percentage points over current 7 percent of total numbers; buffaloes-23 percentage points over current 3 percent; sheep - no change over current 30 percent; goats - no change over current 40 percent. Result: 124 percent increase in meat supply.

pounds, (see Table 16). The off-take rate for cattle would be 12 percent as compared with the current 7 percent, while the off-take rate for buffaloes would be 26 percent as compared with the current 3 percent. The off-take rates for sheep and goats, currently at 30 percent and 40 percent respectively, could not be increased at the present birth rates and death losses without decreasing inventories. The resulting increase in cattle and buffalo meat would be 758 million pounds, an increase of 124 percent in the estimated current annual supply. Despite this increased supply, there would still be a deficit relative to the nation's needs of some 2,189 million pounds.

Costs associated with this strategy would be negligible if one discounts the value of having more livestock on hand, although such livestock would produce less and less until improvements in forage and feed supplies were made. The main cost would be the risk to small operators with few livestock who would be hard pressed if they reduced numbers and the remaining ones became sick or died. Similarly, one could argue that a reduction in spare bullocks by stepped up selling rates might hamper the timeliness of necessary farming operations. Perhaps such risks could be averted by the pooling of animals among the very small farmers so that losses suffered by individuals could be made up through the excess capacity of the remaining animals. Not to be overlooked would be the feeding of more and higher quality feeds for improved health and higher production from fewer animals.

Livestock Feeding

According to some livestock specialists there is a real opportunity for making use of the male calves from milk cows and buffaloes for beef production. Male buffalo calves are poorly cared for and most of them die, while the survivors are sent to the slaughterhouse in a debilitated condition. These animals could be fattened for slaughter, as could old cows, buffaloes, and bullocks. Both of these strategies offer real potentials for increasing meat supplies and have thus attracted attention among the private agro-industries.

Calculations of increased meat supply from feeding the number of cattle and buffaloes that would go to market under the stepped-up culling system proposed, plus from the feeding of male buffalo calves that would be otherwise left to die are presented in Table 17. All animals are assumed to be fed a ration of equal parts of cottonseed oil cake, wheat bhusa, and molasses, plus salt. Old cattle and buffaloes are fed from 90-105 days and gain 1.8 to 2.0 pounds per day. For a cost of from

TABLE 17 - ADDITIONAL MEAT PRODUCTION IF ALL CULLED ANIMALS AND EXCESS CALVES FED IN FEEDLOT 1/

Livestock	Head	Additional weight per head	Total Additional	Decreased weight	Net weight 2/
	Mil.	Pounds	Mil. pounds		Mil. pounds
Cattle:					
Old bullocks	1.119	166	185.754	98.450	92.543
Old cows	.621	166	103.086	54.636	51.358
Calves	.717	792	567.864	329.361	309.599
Buffaloes:					
Old bulls	.102	212	21.624	11.461	10.773
Old cows	.573	212	121.476	64.382	60.519
Calves	1.930	792	1,528.560	886.565	833.371
Total net weight:					1,358.163
Deficit prior to feeding 3/					2,947.000
Deficit after feeding					1,588.837

1/ Culling practices allow carry-over for replacements, but no net inventory increase. All livestock fed 33 percent wheat bhusa, 33 percent cottonseed oil cake and 33 percent molasses, plus salt. Old cattle and buffaloes fed from 90-105 days, averaged 19-20 pounds of feed per day, and gaining 1.8 - 2.0 pounds per day. Calves fed the same ratio for 16 months with an average gain of 1.5 pounds per day. Cost per pound of gain Rs.1.6 - Rs.2.13.

2/ Boneless meat, edible offal, dressed head and trotters.

3/ See Table 10.

Rs. 1.60 to Rs. 2.13 per pound of gain, 1,358,163 million pounds of meat could be added to the present meat supply. This represents an increase of 223 percent over current production of all meat except poultry. Yet, will all this increase, Pakistan still would be short 1,588,837 million pounds in fulfilling its population's need for meat. Cost figures used in this analysis, which average about Rs. 844 per head of livestock fed, are distorted to the extent that a large aggregate demand for feeds would raise prices.

This cost is more per pound than beef sells for currently; therefore, feeding for the domestic market certainly would be unprofitable. A system of exporting preferred cuts to countries, with the effective demand for such beef would be the only alternative, it seems, capable of providing sufficient producer incentive.

Increased Livestock Off-Take and Production Rates with Feeding

The lack of experimental or field data concerning increases in birth rates and decreases in death losses associated with improving feed and forage supplies, or in stopping the build-up in livestock numbers makes the following analysis more arbitrary. The position analyzed is that all animals in excess of replacement needs are placed on feed prior to slaughter male calves are fed out as before, only in this case birth rates are increased and death losses are decreased.

Assumptions made are that calf crop percentages increase from 51 percent to 81 percent in cattle, and from 47 percent to 77 percent in buffaloes. For sheep and goats it is assumed that the increase is from 33 percent to 63 percent. Death losses in all animals are assumed to decrease from 10 percent to 5 percent at all stages of production. The off-take of cattle amounts to 22 percent, buffaloes 46 percent, sheep 43 percent and goats 62 percent (see Table 18).

The total additional meat produced from these animals without feeding of old cows, bullocks, buffaloes, and male calves amounts to 1,704 million pounds. With the addition of the feeding activity as presented previously the total meat supply is increased to 3,062 million pounds. These strategies combined reduce the deficit of 2,947 million pounds to a surplus of 115 million pounds.

Milk production would be increased to 20,484 million pounds or 6,115 million pounds above current fluid milk requirements. Even if two-thirds of the milk were used for ghee and other products, enough fluid milk would remain to meet population requirements.

TABLE 18 - ADDITIONAL MEAT PRODUCTION IF ALL EXCESS ANIMALS CULLED, NO INVENTORY BUILD-UP, PRODUCTION RATES INCREASED AND CULLED ANIMALS AND EXCESS CALVES FED IN FEEDLOT 1/

	Livestock inventory	Adjusted slaughter	Meat per animal slaughtered	Adjusted total meat	Additional meat
	Mil.head	Mil.head	Pounds	mil.pounds	mil.pounds
Cattle	20	4.4	166	730	498
Buffaloes	10	4.6	250	1,150	1,075
Sheep	20	8.6	22	189	57
Goats	20	12.3	20	246	74
Total additional meat					1,704
Deficit from Table 10					-2,947
Deficit after adjustment					-1,243
Additional weight from feeding, Table 17					1,358
Net surplus or deficit					+ 115

1/ Culling practices allow carry-over for replacements, but not net inventory increase. Livestock turnoff increase: Cattle up 15 percentage points over current 7 percent; buffaloes: up 43 percentage points over current 3 percent; sheep up 13 percentage points over current 30 percent; goats up 19 percentage points over current percent.

TABLE 19-

ESTIMATED VALUE OF LIVESTOCK PRODUCTION, ADJUSTED CULLING PRACTICES, NO INVENTORY INCREASE, AND INCREASED PRODUCTION RATES 1/

Production	Unit	Amount	Price	Total value
			Rs.	Mil. Rs
Milk				
Cow	Mil. pound	8,789	.60	5,273
Buffalo	"	18,159	.67	12,166
Sheep	"	1,663	.62	1,031
Goat	"	3,247	.62	2,013
Dressed Meat				
Cattle	"	730	1.30	949
Buffalo	"	1,150	1.08	1,242
Sheep	"	189	3.02	571
Goats	"	246	3.02	743
Wool	"	49	2.15	170
Hair	"	40	.65	26
Hides	Mil. pieces	10.49	64.00	671
Skins	"	22.90	22.00	504
Other				254
TOTAL				25,613

1/ See footnotes, Table 15

Value of Production

This last combination of strategies would produce a total value of milk, meat, wool, hair, hides, skins and other products amount to Rs.25,613 million, (see Table 19). This represents a gross return on a Rs.22,950 investment in livestock of about 112%, which is 52 percentage points above the present estimated situation.

Marketing of Livestock and Their Products

In Pakistan, the combined effects of dispersed production, long marketing channels, unregulated markets and market charges,, transport difficulties, and lack of knowledge and of facilities for preparation for market weigh heavily against the producer. Very little incentive is left to the producer for making many of the changes analyzed in the foregoing section. In any case, the markets, processing plants and slaughterhouses would be inadequate for handling such drastic increases in production.

Milk

Milk is taken to consumers directly in cans or other kinds of utensils although the milk processing plants established by the Government at Karachi and Lahore and a few modern dairies supply milk in polyethylene bags and sterilized bottles. The scattered and small production per unit producer has decreased the marketable surplus, since the marginal surpluses are not disposed of by the producers due to complicated channels of marketing and high marketing costs. The producer is compelled, therefore, to convert his milk into ghee, a product less perishable in nature and less costly to transport. As a result he converts about 22 seers of milk into one seer of ghee, with the value of the milk, had the milk been marketed, exceeding the value of the resulting ghee. Similar relationships hold for cream and butter.

Maintaining milk cows and buffaloes inside cities and towns assists the producer in getting milk daily to his customers. However, the keeping of herds on high-valued real estate, the resulting sanitation and health problems, congestion problems, not to mention the higher costs of getting feed to the animals, makes this a dubious practice. The Landhi Buffalo Colony outside Karachi is a step in the direction toward solving these problems, although this has in turn created other problems. For example, feed costs are still high near the city--it would be cheaper to ship the milk by tank rather than haul in buffaloes and feed. Because of transportation costs, many buffaloes at one time were sent on to

slaughter rather than being sent back to the country for breeding, with the result that good producing animals were often culled out of production too early in life.

In most cases, the milk that consumers purchase is unsanitary by modern standards, and moreover it often has been adulterated with water or other materials, estimated in some instances to be as high as 600%. The consumers' practice of boiling milk before using overcomes most of the first problems, but the latter problem has yet to be controlled.

Meat

The village requirements of slaughter animals are met from occasional purchases by the village butchers. For meeting requirements of big consuming centers, itinerant merchants purchase from the producing areas for sale in the secondary markets or for direct disposal in the main consuming centers. Wholesalers purchase in the secondary markets and bring the animals and sell them to wholesale buyers for beef animals or direct to the wholesalers, slaughter their own cattle and then sell the meat to buyers, who in turn do the retail selling. In the case of sheep and goats, the butchers normally slaughter their own animals and sell direct to consumers.

The slaughtering of animals has been regulated under the slaughtering acts which lay down restrictions on the slaughter of young stock, breeding stock and work animals. In addition, two meatless days per week are set aside to preserve animals and the meat supply. The provisions of the slaughterhouse acts apparently are not being fully implemented. While at the same time these slaughterhouses hardly cover 70% of the total slaughterings in the country.

Many of the slaughterhouses appear to lack the necessary requisites of light, water, hoisting arrangements, and proper drainage facilities. The workers, from some accounts, are less than well-trained and much loss of meat and damage to hides and skins result from improper slaughtering. A large part of the by-products, like blood and glands, goes to waste. In towns and cities the slaughterings are regulated in such a way that the meat is sold out at the end of the day. Although few cold storage facilities are available, it is said that some consumers are becoming used to using chilled or frozen meat.

Pakistan has no surplus of meat, therefore no quality standards have been prescribed by the Department of Agricultural Marketing and

Grading. At present only ante and post mortem examinations of animals are carried out at the slaughterhouses by the veterinarians designated as meat inspectors.

Wool

Wool is one of the important exports of Pakistan and earns a substantial amount of foreign exchange for the country. The export of raw wool is subjected to mandatory grading and the wool is classified into three types, namely, "clipped", "pulled" and "mixed". Each type is subdivided into five grades ranging from Pak Super down to Pak Colored.

While the marketing of wool has made tremendous strides in recent years, the quality of wool could stand upgrading, perhaps through further crossbreeding of the domestic breeds with the finer wooled breeds. Losses of wool occur mainly through improper shearing. Improved shearing and grading at the producer level would stand a chance of earning higher returns for the producer.

Animal Hair

About 95% of the production of animal hair in Pakistan comes from goats, while the remaining supply is composed of body hair of camels, tail tufts from oxen and buffaloes, and tail tufts and more hair from horses and other equines. For purpose of grading, Pakistan hair has been divided into different classifications under the Pakmark grades. Nearly half of the potential production of hair is lost every year because a large number of animals remain unclipped. Poor shearing techniques and untrained shearers add to these losses. A stepped-up program to improve shearing and to grade hair at the producer level would enhance producer returns. Now that there is a considerable demand for Angora goat hair, additional crossbreeding of this breed with the local breeds perhaps would upgrade hair quality considerably and result in higher prices to the producer.

Hides and Skins

Exportable hides and skins make a significant impact on foreign exchange earnings for Pakistan, for a grading system has been designed to control the quality of hides and skins exported. At the same time great strides have been made in the domestic tanning industry, which in turn also earns considerable foreign exchange.

The marketing of hides and skins appears to be in much better condition than does their collection. Reports indicate that considerable losses occur annually for reasons of non-collection, faulty flaying and curing, and damages from parasitic diseases of skins.

Program and Project Recommendations

As stated, the purpose of this report is to identify particular problems of and investment opportunities in Pakistan's livestock subsector. In the light of the analysis presented herein, the reports studied, and conversations held with government officials, educators, and people in the private sector of the livestock industry, the following programs appear to be of prime need of feasibility studies, (see Table 20).

Marketing of Milk and Milk By-Products

Although the production of milk per milk animal can stand much improvement, both through improvement in the producing animal and in improvement of feeding, the basic problem at this time consists mainly of getting the marketable milk surplus into the hands of consumers. The dearth of all-weather roads and rail links and refrigerated means of transport are the major factors that have impeded the development of fluid milk marketing from recognized milk pockets.

There have been spradic attempts to organize milk boards composed of producers and technicians. In the Punjab such an organization is being revitalized. This organization collects milk from the producers, pays him on the spot on the basis of quality and butterfact content, chills the milk, then takes it to distribution centers. It seems a combination of investment from government and the private sector to facilitate this program in all provinces would have a high pay-off. Milk plants and the manufacture of milk products would enter into this program at some point in time, but do not now appear to be a prime requisite for a successful distribution of surplus production.

The organization of cooperatives around this marketing process would enable producers to incur low interest rate loans for herd and forage improvement and facilities. Also, qualities and control of milk handling and pricing through this organization would stabilize the milk industry.

Feasibility studies should be undertaken to determine the optimum number and size of chilling and collection centers, distribution centers, and the location of these centers relative to milk supplies, consumer markets, and existing and proposed road systems. The narrowing of the milk price spread between producer and consumers, and the

TABLE 20- PRIORITIES FOR INVESTMENT AND SOURCE OF INVESTMENT

Investment Priority	Type of Investment	Source of Investment	
		Private	Public
1. Milk marketing	Road construction		X
	Chilling center	X	X
	Milk inspection	X	X
	Distribution center	X	
	Cooperative organization	X	X
2. Lamb fattening (Meat export)	Fodder	X	X
	Feed grains	X	X
	Feedyards	X	
	Slaughterhouse	X	
	Packing plant	X	
	Refrigerated transportation	X	
	Veterinary services	X	X
3. Fattening of buffalo calves and old cattle and buffaloes (beef export)	Fodder	X	X
	Feed grains	X	X
	Feed mills	X	
	Feedyards	X	
	Slaughterhouse	X	
	Packing plant	X	
	Refrigerated transportation	X	
	Veterinary services	X	
4. Slaughterhouse improvement	Renovate facilities to meet international trade requirements	X	X
	Veterinary services		

TABLE 20- (continued)

Investment Priority	Type of Investment	Source of Investment	
		Private	Public
5. Range improvement	Deferred grazing		X
	Reduced grazing		X
	Improved seasonal patterns of grazing		X
6. Fodder improvement	Fertilizer	X	X
	Seed-- new varieties	X	X
	Haying and silage -making equipment and storage	X	
7. Livestock improvement	Selective crossing	X	X
	Artificial insemination	X	X
8. Wool and hair marketing	On-farm grading	X	X
	Improved shearing	X	X
	Transportation	X	
	Cooperative organization	X	X
9. Hides and skins marketing	Improved skinning and treating cooperative organization	X	X
10. Livestock data collection and analysis	Field surveys		X
	Data processing		X
	Analysis		X

investment by government and the private sector in milk marketing should result in quality milk, adequate in supply, and at no significant increases in price.

Sheep and Goat Industry Development

An investment area that would appear to have a high pay-off concern the further development of the sheep and goat industry. Despite these enterprises being more modernized in terms of off-take, and in the grading and export marketing of wool, hair and skins, and the production of relatively high quality meat, additional attention paid to certain production and marketing problems would pay dividends.

Birth rates, as mentioned previously are notoriously low and death losses are high, particularly in the range areas where relatively low and uncertain precipitation combine to create unstable forage supplies. It seems imperative to move immediately into a program of reducing livestock numbers, assuring that rotational grazing is practiced, and that a more even distribution of grazing is obtained. Such a program in addition to raising sheep and goat production, would benefit the range resource for prolonged use in future livestock production.

Supplemental feeding of livestock on the range during periods of short supply would maintain or increase production rates, although continued use of overstocked ranges would become detrimental to range resources. Therefore, such a program should be linked to a reduction in livestock numbers.

Whether in the range areas or the cropland areas, sheep and goat production could well be stratified, dividing lamb and kid raising from the growing out and fattening of these offspring. This practice could well increase meat production, while alleviating grazing pressure on rangelands, and making increased use of fodder crops and feed grains on croplands. For such a program to be successful, attention would need to be paid to improving or installing concentrated feedyards, feedmills, centralized slaughter facilities, and refrigerated means of transportation. However, unless mutton and goat meat prices are allowed to rise, such investments could not be made profitably. Therefore consideration may need to be given to foreign markets.

Increased returns to producers through such programs, incorporated into modernized marketing and slaughtering systems,

which could well include the export of meat and earnings of foreign exchange, would divert much of the illegal trade in sheep, goats and wool into legal hands, benefitting the whole of Pakistan.

Beef Production

Getting a grasp on the means of increasing beef supplies is one of the major problems in the livestock sub-sector. The resources committed to supporting large numbers of cattle and buffaloes are great, although lacking are investments in those resources that would enable producers and investors to capitalize on current opportunities to increase beef supplies. And without stepped up production of higher quality beef, this nutritious product may well remain the "poor man's meat."

It has been stated that many countries of the Near East have sufficient technology and trained manpower to permit a viable, industrialized livestock feeding sector to be developed. The absence of a sufficient incentive is the weak link in the production chain which, if properly forged, could revolutionize animal production in the region. These statements are no less true of Pakistan. In addition, the animal and feed producing resources are present in abundance. All that is needed is to sort them out and put them to work.

As pointed out in the previous analysis, there is a great potential for feeding out male buffalo calves and old bullocks and buffaloes that are headed for slaughter. Molasses, bhusa, cottonseed oilcakes, urea and other feeds are available and could be used for this purpose. The capacity of existing feed mills could be expanded to include cattle feeds; new ones could be constructed, while unused mills could be revitalized. Government incentives could and perhaps would have to be used to get these going.

Next, private individuals or companies could be provided incentives to construct feedyards, slaughtering plants, transportation facilities and the like. Incentives here might well take the form of concessions for foreign exporting of meat to countries such as Iran or the Gulf States, where prices are much higher than in Pakistan. These exports would have the capability of earning high rates of return for investors, with considerable returns to Pakistan. Much investigatory work would need to be done to decide optimum location, size and distribution of feed mills, feedyards, slaughterhouses, and transportation systems. Of prime consideration would be the level of investment needed for an acceptable disease and pest control program to meet

foreign import requirements. Also important would be the grading and pricing of meat to denote differences in quality. There would be little reason for the consumers of Pakistan not to benefit from such programs, for eventually higher quality meat would be offered on the market. Then, too, increased supplies could be of such a magnitude that perhaps price increases would not be as great as feared.

Livestock Data Collection and Analysis

A very great need and an opportunity for earning high returns on a rather small investment would be to expand livestock data collection and analyses. Reports, such as Livestock in Baluchistan, were they available for other provinces, would be of great help in formulating policies and developing programs to get the livestock industry moving. These data could be expanded to include annual estimates of production, birth and mortality statistics, slaughterings, marketing statistics, and the like. Similarly, estimates would be made of feed supplies and forage conditions, and other information valuable to the livestock industry.

Of importance also would be investments in research activities that would detail the resource situations, systems and organizations, costs and returns of livestock production and marketing at the important juncture. Farm management analyses would reveal the effects of adjustments on individual farms and with careful sampling, could lead to indications of aggregate responses to changes in technology, prices and policies. Also, such research would enable extension workers to perform their duties more satisfactorily. Examples of these types of analyses appear in the literature about Pakistan's livestock economy, but much more needs to be done. (20, 29, 32). One report concerns the place of livestock in the farming system of Sind farms (33). Another report concludes that there is excess capacity for work among work bullocks to the extent that a sizeable proportion of these animals could be replaced with milch animals (34). Similarly, another report concludes that a considerable amount of draught work can be performed by lactating she buffaloes without adversely affecting production (35). Information contained in reports by Faculty of Agricultural Economics and Rural Sociology, Agricultural University, Lyallpur, illustrate the types of information that producers will be needing as incentives for livestock production.

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