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AGRICULTURAL POLICY ANALYSIS PROJECT, PHASE II

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Project Office 4800 Montgomery Lane, Suite 500, Bethesda, MD 20814 • Telephone: (301) 913-0500 • Telex: 312636

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Under contract to the Agency for International Development, Bureau for Science and Technology, Office of Agriculture
Project Office Hampden Square, 4800 Montgomery Lane, Suite 500, Bethesda, MD 20814 • Telephone (301) 913-0500
Telex 312636 • Fax (301) 652-7530 • Fax (301) 652-7791

PAKISTAN ANIMAL FEEDSTUFFS POLICY STUDY

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Authors: **Malcolm Hall, Harvard Institute for International Development**
Maliha H. Hussein, Enterprise and Development Consulting (Pvt.) Ltd.

Prime Contractor: **Abt Associates Inc.**, 55 Wheeler Street, Cambridge, MA 02138 • (617) 492-7100

Subcontractors: **Harvard Institute for International Development,** Harvard University, One Eliot Street, Cambridge, MA 02138 • (617) 495-2164
Food Research Institute, Stanford University, Stanford, CA 94305-6084 • (415) 723-3941
North Carolina State University, Department of Economics and Business, Box 7645, Raleigh, NC 27695-7645 • (919) 737-7187
Abel, Daft & Earley, 1410 King Street, Alexandria, VA 22314 • (703) 739-9090
International Science and Technology Institute, 1129 20th Street, NW, Suite 800, Washington, D.C. 20036 • (202) 785-0831
International Food Policy Research Institute, 1776 Massachusetts Avenue, NW, Washington, D.C. 20036 • (202) 862-5600

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ACRONYMS

ADB	Asian Development Bank
cif	cost, insurance, and freight
CSE	consumer subsidy equivalent
DC	Deputy Commissioners
DM	dry matter
DP	digestible protein
FAO	Food and Agriculture Organization of the United Nations
FAS	Foreign Agriculture Service
GCP	Ghee Corporation of Pakistan
GDP	gross domestic product
HYV	high-yield varieties
IRRI	International Rice Research Institute
MEPS	minimum export prices
NPC	nominal protection coefficient
PARC	Pakistan Agricultural Research Council
PASSCO	Pakistan Agricultural Storage and Services Corporation
PSE	producer subsidy equivalents
SNF	solids-not fat
TCP	Trading Corporation of Pakistan
TDN	total digestible nutrients

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EXECUTIVE SUMMARY

Introduction

This report reviews livestock production in Pakistan, with emphasis on the role of livestock feeds and how the supply of these has been influenced by government policy. It discusses the future supply of feedstuffs and examines alternative policy options that could support increased livestock production by improving the feed situation.

With milk and beef now accounting for around 56 percent of the total gross value of livestock production in Pakistan, the study concentrates upon the nutritional situation concerning cattle and buffaloes. It focuses upon the arable areas where they are kept and examines key crop/livestock interactions. Because of its importance in meeting future human demand for animal protein, the poultry industry has also been included in the study. While commercial poultry units cannot be considered as an integral part of Pakistan's farm-household systems, the industry depends upon cereals and oilseeds that are produced mainly within these systems.

The study documents the growth in supply and consumption of animal products (Chapters 2 and 3), and examines the expansion of supply and sources of livestock feeds (Chapter 4), as well as the evolution of feed consumption (Chapter 5). In the subsequent chapter, a brief overview is given of the feedstuffs industry. This is followed by a description of the instruments and mechanics of agricultural pricing policy (Chapter 7) and by a discussion of the impact of current price levels in comparison to the likely cropping equilibrium if parity pricing was to be applied (Chapter 8). The final two chapters of the study deal with future supply and demand conditions for livestock feeds (Chapter 9) and with possible adjustments and policy issues (Chapter 10).

Adjustments and policy issues for future supply and demand of livestock feeds

Using adjusted 1985/86 data on sources of feed supply (Table 2), estimates for the Year 2000 were made by projecting production increases for the crops involved (Tables 9-11). It was assumed that feed from grazing and range sources will not expand during the period in question. This leaves the crop sector to bear the burden of domestic production of the extra nutrients required to maintain Pakistan's ruminant and poultry population at the turn of the century. Demand for livestock feed was also estimated, using two distinct scenarios (Tables 12-13 and Annex 3).

The first, based upon the assumptions adopted by the National Commission on Agriculture, could be called the "intensive technology option" since the animal population grows slowly and production increases rely mainly on yield improvements. The second option represents a continuation of past trends, with most production growth being derived mainly from higher livestock populations. Production is higher in the "intensive technology" scenario and, since each forecasts similar levels of nutrient need, it represents a more efficient use of feed.

Despite the benefit of further changes to the gender structure of the cattle herd that will further increase the percentage of adult females (Figure 2), it is highly dubious whether any of the Commission's production targets will be attained without very strong incentives in the form of steep price rises in real terms.

A comparison between the feed demand indicated by both production scenarios, and estimates of the likely output of total digestible nutrients (TDN) and digestible protein (DP), indicates an emerging nutrient gap (Table 14). The original Commission assumptions show a slight surplus in terms of TDN and a 7% deficit of protein. The adjusted assumptions result in a gap of more than 9% for TDN, but less than 4% for DP. The gap is not enormous in view of the margin of error inherent in this type of calculation, but it does indicate a continuation of the precarious balance noted with respect to the situation in 1986.

Assumed rates of production increase for all ruminant products are lower than the estimated growth in demand. In the absence of government interventions to stabilize food costs (eg. subsidized imports of meat and milk powder), real prices for meat and milk would therefore rise, even without a shortage of animal feedstuffs. Price rises for livestock products will, however, provide an incentive to move the equilibrium position towards the second (and more feed efficient) livestock production scenario—the higher yield and lower animal population option.

It can be expected that a combination of intensified animal husbandry and lower ruminant populations, together with expanded use of green fodders and cereal grains (mainly wheat) will close the *feed* gap. The *food* gap—the difference in demand and supply of livestock products—will be closed by a combination of more efficient technology producing outward shifts of the supply curve (better husbandry) and a move up the supply curve in response to higher product prices (more intensive feeding and higher yields) together with lower levels of demand increase caused by the same price rises.

Livestock product prices will not increase to the same extent if crop production levels can be raised. One policy change that could offer the sort of incentive to raise the total production of most crops would be the adoption of trade parity pricing for traded agricultural products.

Parity pricing would assist the attainment of national targets for wheat and rice production, thus producing more straw and rice bran for use in animal feed rations. It would increase the growth in cotton production by an much higher rate than current official estimates. This would result in a boost to supplies of high quality protein concentrates (cottonseed cake and meal) with important consequences for the dairy industry.

Specific recommendations arising from the report include:

Policy Adjustments:

- a move towards parity pricing,
- measures to facilitate the import of maize (on the same basis as current arrangements for soybean meal),
- removal of import restrictions on fishmeal, meatmeal, bloodmeal, vitamins, minerals and other feed supplements,
- incentives for the expansion of the solvent extraction industry and measures to expand the use of manufactured ruminant feeds,

Better Data on Feed Availability:

- data on the main production parameters (area, yield and output) for green fodders should be included in official statistical series,
- the USAID-assisted, crop-cutting exercises would incorporate weighing of straw and chaff when measuring grain yields,
- Price series for different types of fodders should be initiated on a national basis,

Technology Generation and Dissemination:

- extension campaigns to popularize straw treatments (urea and ammonia) and new feed technologies should be launched,
- the application of methods of incorporating urea into the ration as a means of boosting protein intake should be encouraged,
- the use of poultry manure as a ruminant feed should be expanded,
- increase productivity of green manures through improved research and extension efforts,
- breeding programmes for cereals, pulses and oilseeds should focus more on improved by-product production,
- the use of combined harvesters for cereal harvesting should be carefully monitored from the viewpoint of its effect on the availability of straw as fodder,
- combines that can chop straw as finely as static threshers, and then deliver it effectively, should be developed and related research supported,
- improvements to slaughter facilities and slaughtering technology would enhance national production of blood and meat meals, so programmes aimed at this goal deserve support.

1. INTRODUCTION

Livestock production is extremely important in the majority of farming systems found in Pakistan. At present, it accounts for around 33 percent of total value added in agriculture. Milk alone comprises more than 19 percent, although it is produced mainly for family consumption with not more than 45 percent of total production being retailed. Most other activities of the subsector have a large home-use component, which contributes to family nutritional needs plus soil cultivation and transport requirements. Despite its subsistence character, livestock production makes a major contribution to the cash income of a majority of farmers-especially those on small farms. It is particularly important as a means of livelihood for millions of landless people, who are able to utilize grazing and browsing resources that would otherwise be unproductive.

Consumption of livestock products has steadily increased over the past two decades. Figure 3 indicates that, in 1987/88, dairy products constituted the most important category of family food expenditure, accounting for almost 24 percent of the cost of food purchases. Meat and poultry purchases accounted for a further 8.7 percent of food expenditure. In terms of calories, milk overtook rice in the early 1980s, to become the third most important source of nutrition behind wheat and vegetable ghee (See Table A.3). As its importance in food consumption has grown, the deflated price of milk has remained remarkably stable over the past two decades.

These achievements have occurred despite statements by some livestock specialists that feed resources were inadequate to maintain current livestock population. They have also taken place despite the relative neglect of government support services that have focussed mainly on the crop subsector. Moreover, there has been a virtual absence of imports of livestock products and few government price policies have been specifically directed towards the expansion of livestock production; the subsector is relatively free from this type of intervention. Government trade and pricing policies designed to influence crop prices and control the imports of certain livestock feedstuffs have, however, had a significant impact on livestock production.

The aim of this report is to review the evolution of livestock production in Pakistan, with emphasis on the role played by the availability of livestock feeds. The report also examines how this availability has been influenced by technological and policy changes. In particular, it attempts to assess likely future changes in the supply of feedstuffs and to examine alternative policy options that could improve the nation's supply of livestock products.

The demand for feedstuffs is largely derived from the size and composition of the livestock population, and this in turn is dependent upon the conditions of demand for livestock products. The study has, therefore, considered the past, current and likely future situation of the livestock sector as a whole. The majority of livestock nutrients are derived from the food crop subsector as by-products or crop residues but, in the case of grains, there are areas of direct competition with human food needs. This being the case, the study has also had to concern itself with food crop policies.

After discussing the expansion of domestic livestock production over the past two decades, trends in household consumption and the evolution of the prices for major livestock products are examined. The main parameters of the livestock feed situation are then analyzed in terms of sources of nutrition and price trends. This is followed by a review of the feed industry and market structure. The next part of the report concerns the instruments and mechanics of direct pricing and trade policies that affect the feedstuffs' situation, together with a review of trade parity pricing issues affecting crops that provide both human food and animal feed. The final part of the document concentrates upon future supply and demand conditions for animal feedstuffs. It commences with an analysis of estimates of livestock feed supplies for the year 2000 and progresses to an analysis of future demand levels for livestock nutrients via an examination of the likely growth in supply of selected crop and livestock foods for human consumption. The size of the projected feedstuffs nutrient gap is estimated using a range of assumptions concerning prices and technology levels. Alternative policy options for closing the gap are then reviewed and policy recommendations are made.

With milk and beef now accounting for around 56 percent of the total gross value of livestock production in Pakistan, the study concentrates upon the nutritional situation concerning cattle and buffaloes. It also focusses upon crop-livestock interactions in the arable areas where most cattle and buffaloes are kept. An attempt has also been made to incorporate the situation concerning feed resources for range-fed cattle, goats and sheep. These are of paramount importance to the livelihood of the inhabitants of non-irrigated areas, but lack of data poses a particular problem in rangeland areas. Because it is the most dynamic element in the livestock subsector and is destined to play a key role in meeting future human demand for animal protein, the poultry industry has also been included in the study. While commercial poultry units cannot be considered to be an integral part of any of Pakistan's farm household systems, the industry depends for its feedstuffs upon cereals and oilseeds that are produced mainly within these systems.

The authors have had to contend with a very weak data base for the livestock subsector in Pakistan. Before the publication of the 1986 Livestock Census, the most authoritative estimate of livestock numbers was found in the 1987 Pakistan Livestock Sector Study carried out by FAO/ADB. The publication of the census results revealed that a huge underestimate of buffalo and cattle numbers had been made by the authors of the study. This in turn threw doubt on the study's feed calculations. This particular calculation is constrained by the fact that there are no official data on fodder production, for neither green fodders, hays or cereal straws. The only price series that exists on fodder crops is for the Punjab.

Key technical coefficients such as various cereal grain:cereal straw ratios are subject to much debate and guesswork. Although the nutrients derived from the various sources of grazing and browsing, such as fallows, stubbles, riverine pastures and range constitute a important component of livestock feed, data are extremely weak. Given this situation, the authors have sometimes had to resort to advancing hypotheses instead of making authoritative statements.

2. EXPANSION AND SOURCES OF SUPPLY OF LIVESTOCK PRODUCTS

2.1 Production Systems

Most livestock products in Pakistan are generated within three distinct categories of production system:[1]

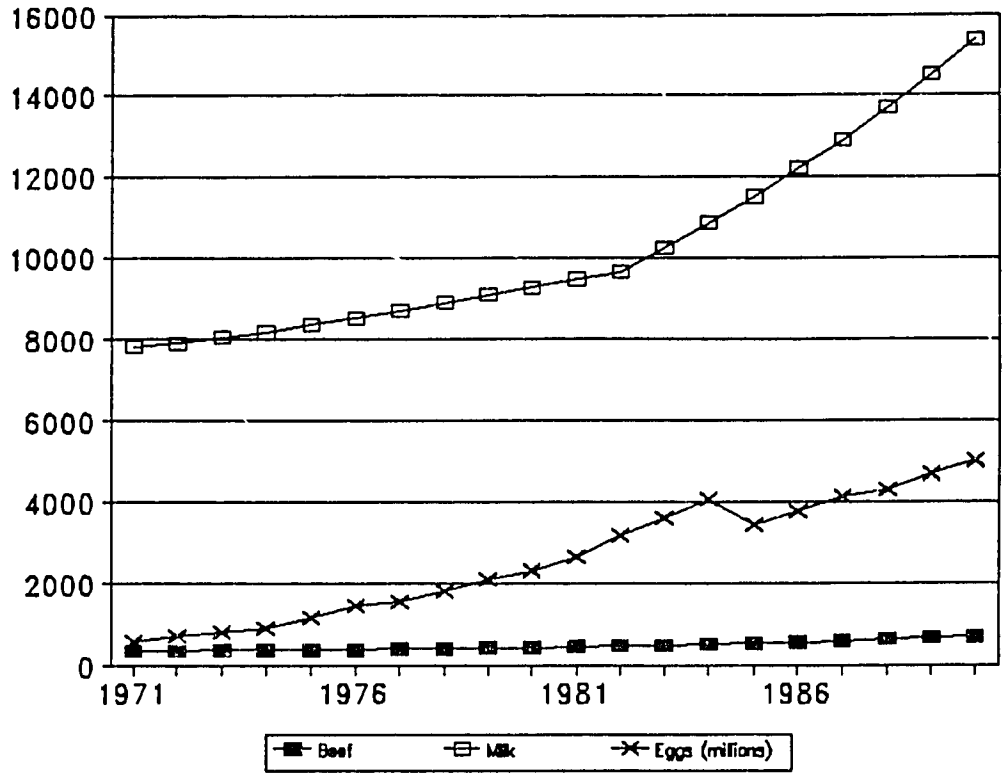
- ruminants on mixed-cropping smallholdings,
- ruminants on rangelands,
- commercial poultry flocks.

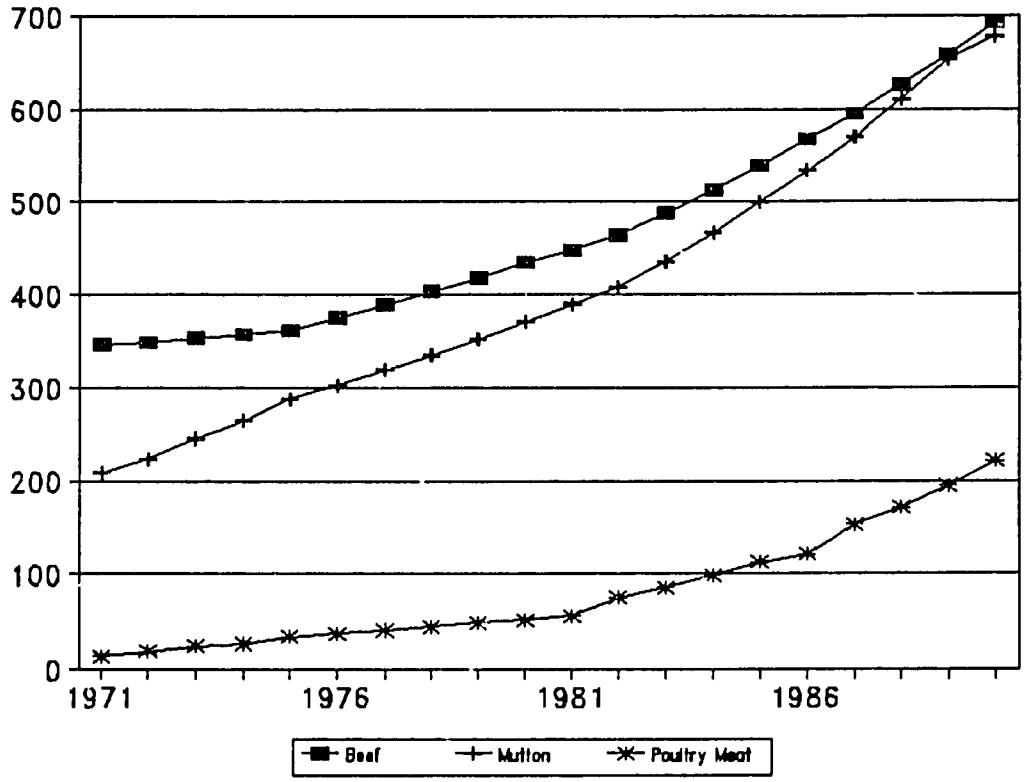
Supplies of milk and beef are produced mainly by cattle and buffaloes that are kept on smallholdings, where they form an integral part of a mixed farming system.[2] These animals compete for land with cash and food crops, because they require grazing and forage resources. However, they simultaneously depend upon the by-products and residues of a wide range of crops for a substantial proportion of their feed needs. In contrast, most eggs and poultry meat are produced under factory conditions from birds fed entirely upon purchased processed foods. They are not integrated into a particular farm system and do not compete with crops for land. Their articulation with the rest of the agricultural sector derives from their dependence upon cereals and oilseeds as the major ingredients of their feed.

2.2 Production Trends of Livestock Products

Over the past two decades, domestic production of all major livestock products has risen at a pace markedly faster than population growth (Figure 1). During the period 1971/72 to 1989/90, milk and beef production has grown at an average annual rate of 3.3 percent and 3.7 percent respectively.[3] Within the same period, mutton production rose by 6.0 percent per annum. The expansion of poultry production has been considerably more rapid than ruminant production. The volume of eggs has increased at an annual rate of 11.7 percent and poultry meat at the rate of 13.5 percent. Despite the impressive growth of poultry production, milk still accounted for approximately 47 percent of the total gross value of production in the livestock subsector in 1988/89. Red meat (beef plus mutton) comprised almost 22 percent, whereas poultry meat and eggs together contributed just under 14 percent. The residual is accounted for mainly by hides and skins and other by-products of the slaughtering process.

FIGURE 1: Production of Major Livestock Products: 1971/72 to 1990/91





Source: Livestock Division, Ministry of Agriculture

2.3 Growth in the Livestock Population

The growth in the supply of livestock products has been fuelled by increases in both the number of ruminants and the size of the national poultry flock. A boom in the production of poultry started in the mid-1970s,[4] and the total number of all poultry rose at the rate of around 10.5 percent per annum in the 1980s. During the same period, total commercial poultry numbers rose at the annual rate of 17.3 percent. Broiler production grew at an annual average of 20.1 percent. Commercial layers increased more slowly at 3.6 percent annually due to the low profitability of egg production. The total population of rural poultry rose at only 3.1 percent annually during the same period. The number of commercial poultry overtook the total of rural poultry in 1984, and by 1988/89 they constituted over 65 percent of the national flock.

Despite forecasts of a decreasing cattle population and slow growth in the numbers of buffaloes, sheep and goats,[5] the 1986 National Livestock Census revealed a quite different situation.[6] The cattle herd had *grown* by approximately 17.5 percent in the ten years to 1986. Within this increase, the number of adult cows rose by over 48 percent from a total of 4.6 million to 6.8 million. Over the same period, the buffalo herd grew at a much faster pace than the cattle herd, increasing by almost 48 percent in total (a 3.9 percent annual growth rate.)

Although the proportion of female buffaloes remained roughly the same at around 83 percent, the total number rose from approximately 6.0 million to 9.0 million. Adult female animals actually in milk (cows plus buffaloes) increased at a 4.3 percent annual rate. In addition, the total number of sheep and goats grew by 31 percent during the inter-censal period—an annual rate of 2.7 percent. The sheep population grew at the average rate of 2.1 percent annually and that of goats at 3.2 percent.

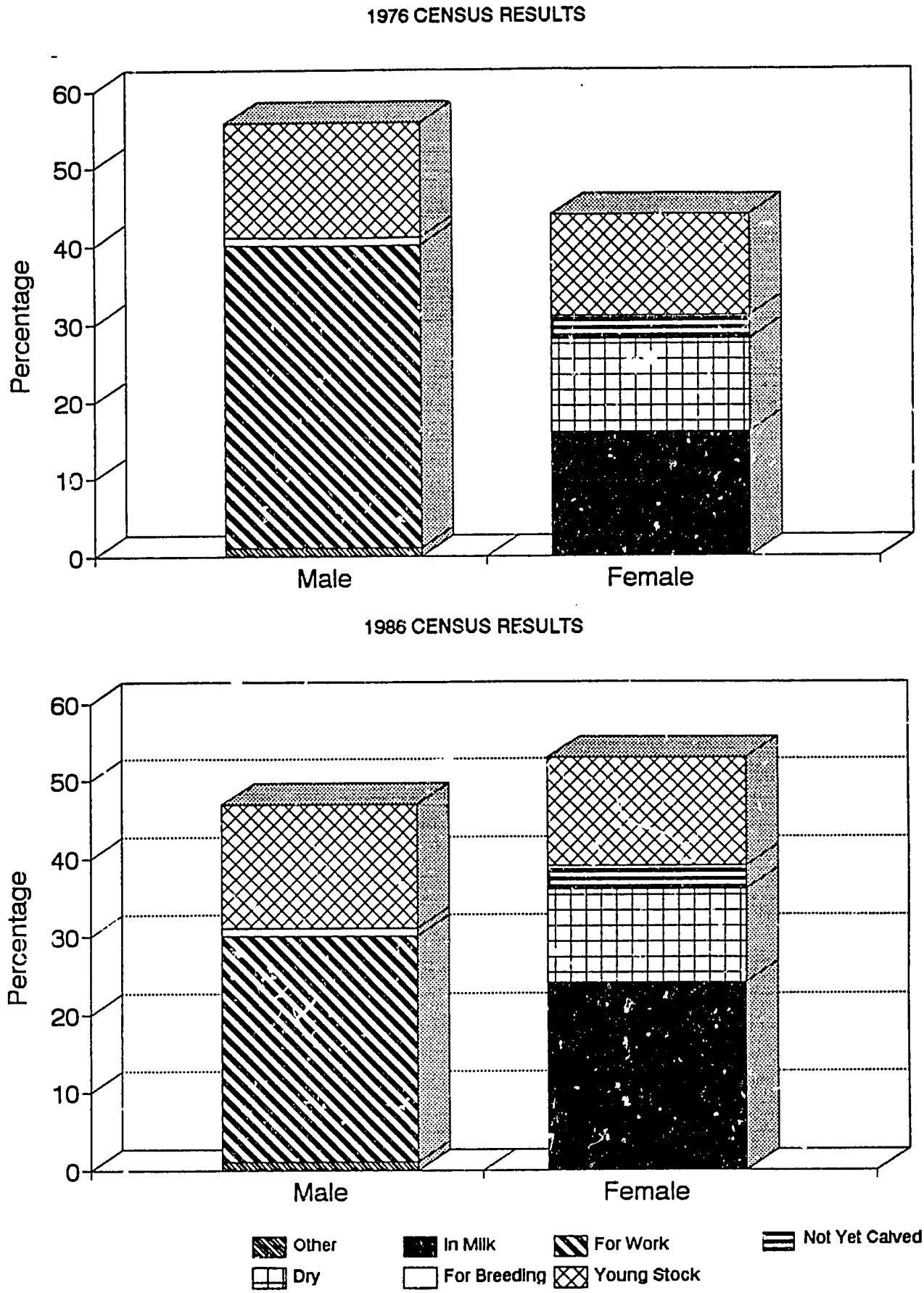
The increase in domestic milk production was largely a result of the growth in numbers of cattle and buffaloes. Within this trend, there is another which will continue to support the growth of liquid milk production in coming years: the changing gender structure of the national herd.

2.4 Herd Gender Structures

Figure 2 indicates that, whereas the number of all male cattle increased by a total of only 1.9 percent between 1976 and 1986, the total number of female cattle (adults plus young stock) increased by 45.7%. Just over one third of this increase was due to the overall growth of the cattle herd, i.e. the growth in total cattle numbers would have produced this rise without any change in herd structure. However, almost two thirds of the increase in adult females was generated by their rising percentage within the herd.

This change has been stimulated by the growth in the use of tractors and the concomitant decline in the number of bullocks kept for traction. Tractor registrations have risen by over 5.7 percent annually during the past decade, from a total of 79,407 tractors in 1981 to an estimated 217,708 in 1990.

FIGURE 2: Composition of the National Cattle Herd: 1976 and 1986 Census Results



Judging by the official figures for tractor registrations, the rate of substitution of bullocks by tractors has declined in recent years. This is probably due to rising tractor costs relative to crop prices,[7] but the mechanization process has not yet been completed. As land becomes more scarce and the opportunity cost of bullocks continues to rise, it is possible that dry cows will be used for some of the lighter tasks now being performed by bullocks and that tractors will be hired for most of the heavier work such as plowing. Even though some draught bullocks will be retained by smaller farmers, the proportion of females in the national cattle herd in 1986 was still only 53 percent, whereas in the buffalo herd it was 84 percent. While it is not expected that the cattle herd will have an identical structure to the buffalo herd, the proportion of females will eventually be much higher than at present. The potential rate of growth of the cattle herd is rising because of the increasing percentage of breeding females. As this percentage approaches that of the buffalo herd, the growth in cattle numbers has the potential to outstrip the rate of expansion seen in the buffalo herd during the inter-censal period (i.e. 3.9%), since cattle tend to have shorter calving intervals than buffaloes.

The effect of this rise in the percentage of female cattle is extremely important from the viewpoint of the increased amounts of livestock feed needed for future milk production. It represents extra production obtained for little or no increase in the volume of nutrients.[8]

2.5 Imports and Exports of Livestock Products

Growth in national demand for livestock products has been met almost solely from domestic production. The only significant imports of a foodstuff of animal origin into Pakistan relate to milk. This is imported in the form of both whole milk powder and skim milk powder.

Table 1 indicates that these imports have never exceeded a liquid milk equivalent of more than 415,700 tons in recent years. Even in 1982/83, when imports reached a peak, they did not attain much more than a 4 percent share of total milk production. In most years their share has actually been closer to 2 percent. With the exception of exports of wool, and hides and skins, external trade in other livestock products has been negligible over the past twenty years.

TABLE 1: Imports of Milk Powder - 1981/82 to 1986/87
('000 tons)

Year	Whole Milk Powder	Skim Milk Powder	Liquid Milk Equivalent
1981/82	1.89	21.00	249.5
1982/82	5.82	33.40	415.7
1983/84	10.40	12.40	221.2
1984/84	15.90	10.30	243.7
1985/86	15.10	9.91	232.6
1986/87	18.20	5.31	206.9

Source: Gary Ender (1989) Producer and Consumer Subsidy Equivalents (PSEs and CSEs) for Important Crops and Livestock Products in Pakistan. Economic Research Service, USDA.

3. CONSUMPTION AND PRICES OF LIVESTOCK PRODUCTS

3.1 Food Consumption

The most recent data concerning consumption of livestock products are contained in the 1987-88 Household Income and Expenditure Survey (HIES). In terms of monthly per capita calorie consumption related to all income groups, dairy products (milk, butter, yoghurt and desi ghee) are second only to wheat. They comprise 9.6 percent of total calorie consumption, as opposed to the 58.4 percent provided from wheat and flour products.

Figure 3 illustrates the shares of the various major categories of foodstuffs in terms of calories and percentage of total food expenditure. Neither beef, mutton nor poultry products are important sources of calories, but in terms of total expenditure on food they are more substantial.[9] They comprised 8.7 percent of total per capita expenditure on food, averaged over all income groups in 1987/88. In comparison, 23.9 percent of total expenditure went on dairy products, which constitutes the most important category of food expenditure in Pakistan. Despite their dominance in terms of calories, only 16.6 percent of food expenditure was allocated to wheat and flour products.

Figure 4 depicts trends in the per capita consumption of the five major livestock products over the period from 1968/69 to 1987/88, during which time a series of HIES were completed at irregular intervals. Values have been converted into index numbers to facilitate interpretation.

The basic trend is upwards in most cases, with milk and poultry meat consumption increasing particularly rapidly and steadily throughout the period in question. From 1979 to 1987/88, milk consumption per capita increased by a total of 29 percent, and over the final four HIES (from 1984/5 to 1987/8) the rate of increase has averaged 1.66% per annum. Consumption of poultry meat per capita rose 40 percent from 1979, and over the last four HIES grew 11.64% annually. Per capita consumption of mutton increased over the period from 1970 by an aggregate amount of 12.2 percent, but consumption appears to have declined after 1979.[10] The reduction (-4.68% annually) since this date, is almost at an inverse rate to the expansion noted for poultry meat consumption during the same period (4.21% annually).

Consumption of beef increased by a total of 22.3 percent over the period under consideration. However, per capita growth in consumption came to a halt during the 1979 - 1987/8 period and over the past four HIES showed a slight annual decrease. Egg consumption per capita also increased until 1986/87, but the results of the latest HIES show a fall. This is possibly the result of a sharp price rise for eggs in that year.

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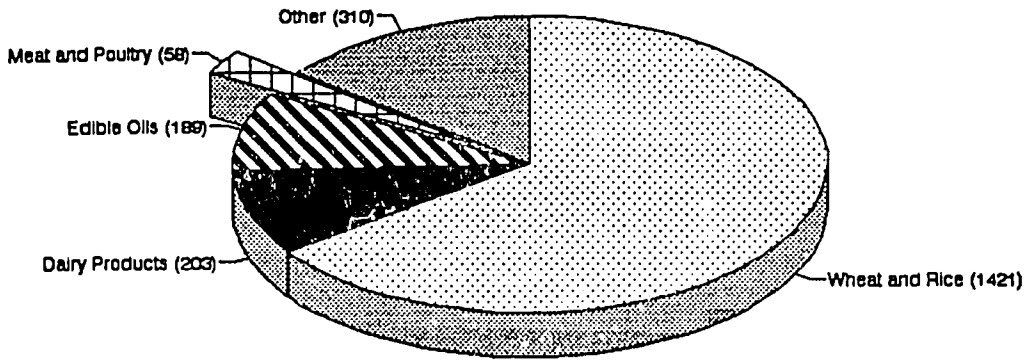
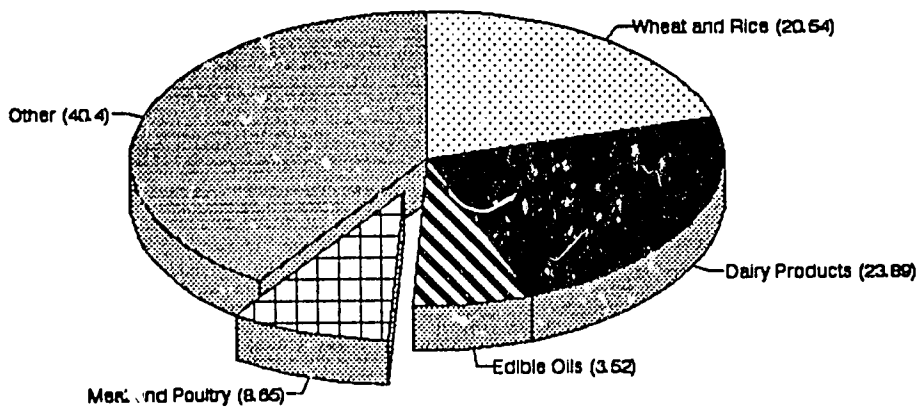
FIGURE 3: Dietary Importance of Major Foodstuffs in Terms of Calories and Food Expenditure

CALORIES

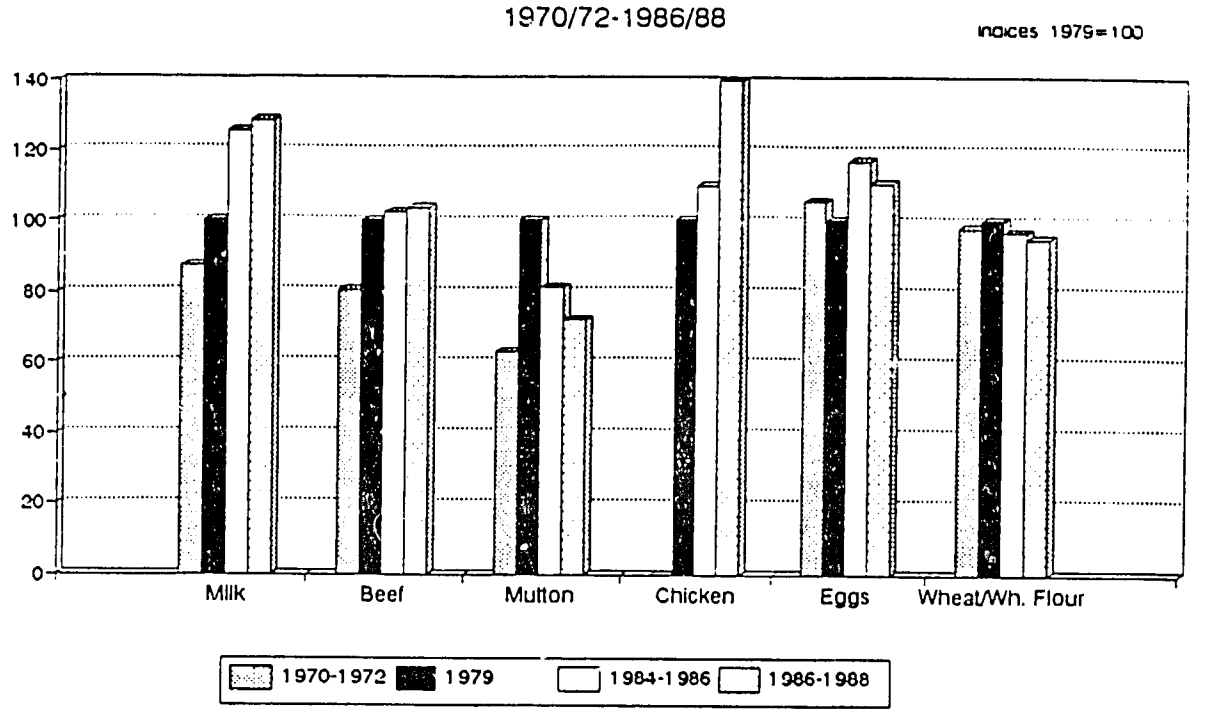


FOOD EXPENDITURE (%)



Source: Food and Agriculture Organization of the United Nations, "Supply Utilization Accounts, 1984-86" (unpublished)

FIGURE 4: Pakistan: Per Capita Consumption of Wheat and Major Livestock Products



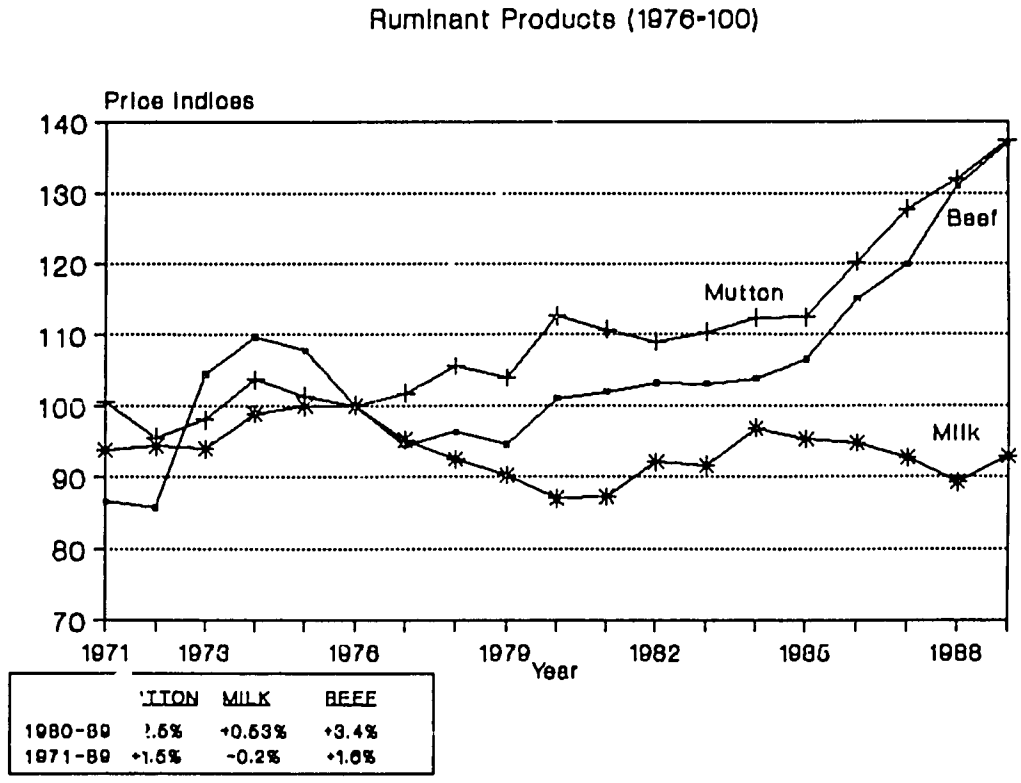
Source: Federated Bureau of Statistics, Household Income and Expenditure Surveys (various years)

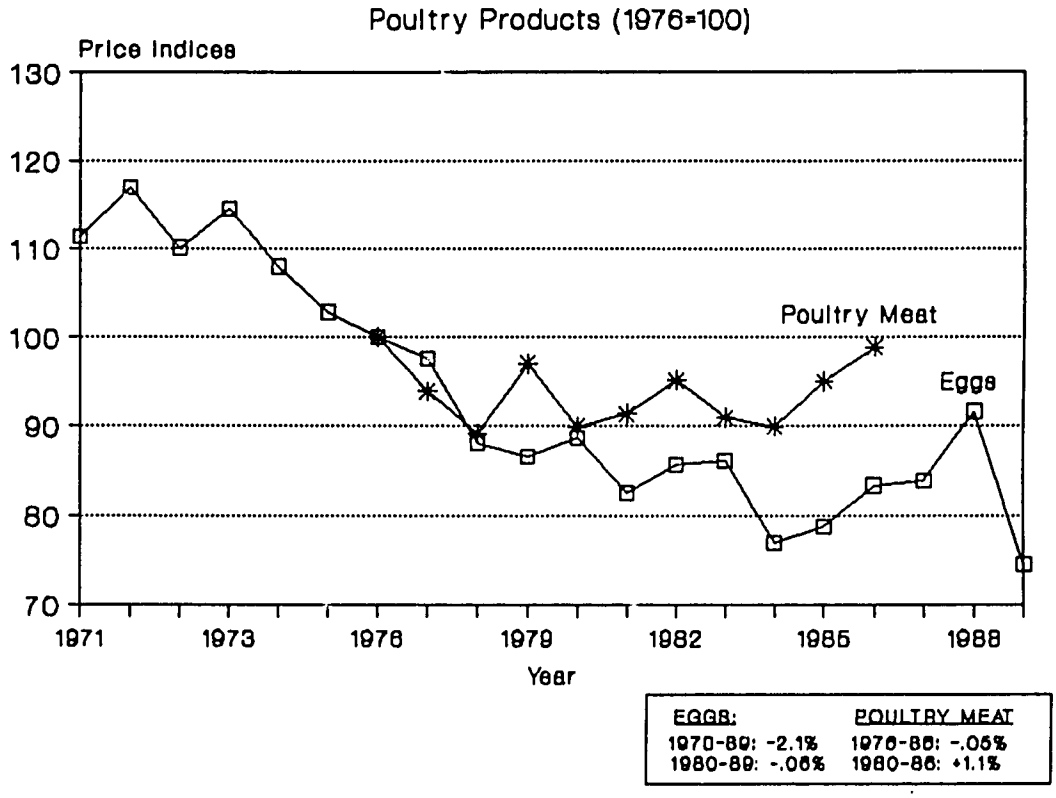
3.2 Food Prices

Figure 5 (and Table A.4) summarize movements in retail prices of major livestock products between 1971/72 and 1989/90, using the official Consumer Price Index as a deflator. Both mutton and beef prices have risen over the period; at an annual rate of 1.7 percent and 1.6 percent respectively. Price rises during the 1980s have been steeper, with mutton rising at an annual rate of 2.5 percent and beef at 3.4 percent. These rises have occurred despite strong production increases; 6.4 percent annually over the past decade in the case of mutton and 4.7 percent for beef. They reflect the high rate of population growth in Pakistan, its 5 percent annual growth of GDP and high income elasticities of demand for both products.

Between 1971 and 1989, real milk prices declined by -0.25% annually. During the past decade, milk production has grown at a faster rate than beef (5.3% as opposed to 4.7%). Since the mid-1970's fluid milk availability has been augmented by the extensive substitution by consumers of vegetable ghee for desi ghee (a butterfat product). Each kilogram of desi ghee not produced releases much more than this amount of milk for liquid consumption. As consumers shifted out of desi ghee and into dalda, it facilitated a 20 to 1 potential supply expansion in fluid milk.[11] More recently, and with greater implications for future supply growth, the growth of the cattle herd and the rising proportion of female cattle has stimulated supply growth equal to expanding demand.

FIGURE 5: Pakistan: Real Retail Price Indices for Livestock Products, 1971/72-1989/90





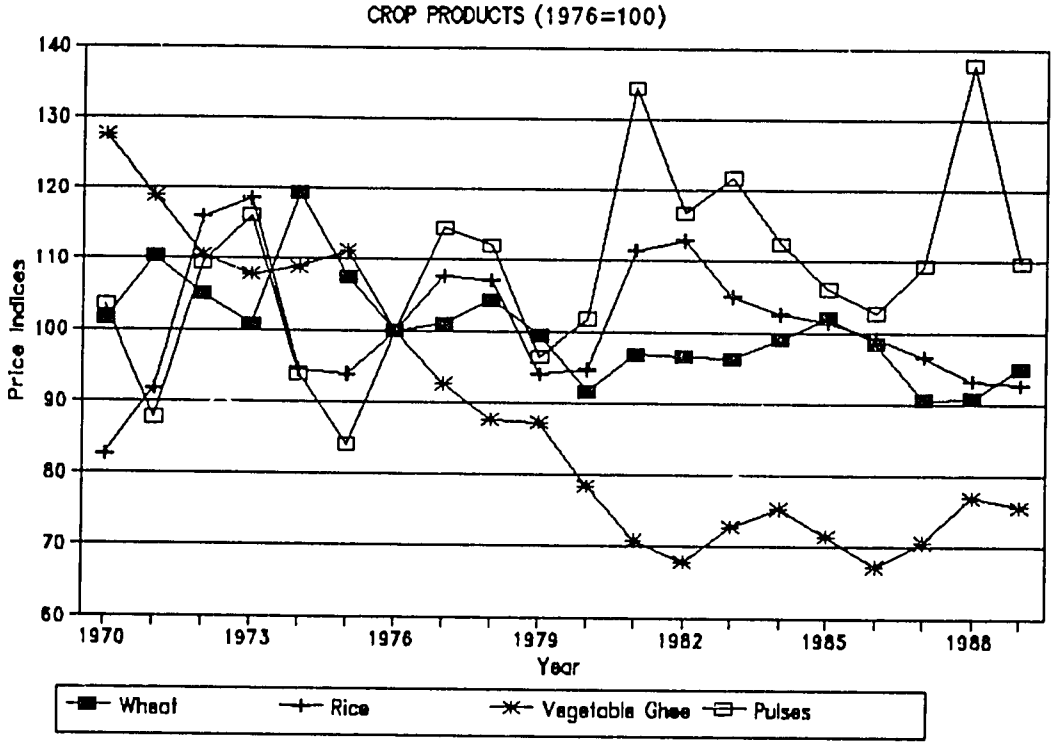
Source: Economic Survey of Pakistan, 1990-91

Over the past decade, egg prices adjusted for inflation have fallen at an average annual rate of 0.62 percent. Over the past two decades the decline has averaged 2.1 percent annually. Despite this overall decline, since 1981 the trend in prices has changed to a weakly positive growth rate of 0.14 percent.

As indicated by Table A.5, both mutton and beef prices are increasing relative to broiler prices (2.5% and 3.4% as opposed to 0.14% respectively during 1976-1989). Current prices of mutton and commercial broiler meat are about equal and are almost double that of beef. It is probable that, as incomes rise, consumers forced to restrict purchases of mutton because of rising prices, will increasingly turn to poultry, as it becomes comparatively cheaper. This change has already been documented in successive Household Income and Expenditure (HIES) Surveys.

Figure 6 presents trends in deflated retail prices for major non-livestock foods from 1971 to 1989. This shows that only the price of pulses, growing at 1.1 percent annually, shared the rising trend of beef and mutton prices over the same period. Rice, wheat and vegetable ghee prices all trended downward (at -0.04%; -0.09%, and -3.4% per annum respectively). They therefore, joined milk, eggs and poultry meat in the category of foodstuffs whose prices, adjusted for inflation, have either remained stable or become cheaper in recent years.

FIGURE 6: Pakistan: Real Retail Price Indices for Non-Livestock Products, 1971/72 - 1989/90



Source: Pakistan Statistical Yearbook, 1991

4. EXPANSION AND SOURCES OF SUPPLY OF LIVESTOCK FEEDS

4.1 Feed Sources and Feed Availability

Domestic sources and amounts of livestock feed supply have been estimated (details are given in Annex B) using official crop production data for 1985/86, the crop year that most nearly corresponds with the timing of the National Livestock Census in the first half of 1986. Results summarized in Table 2 reveal that the crop subsector dominates all other sources of livestock feed. It supplies almost 65 percent of total digestible nutrients (TDN) intake and nearly 59 percent of total digestible protein (DP) supplies. Almost all the remaining nutrients come from various forms of grazing and browsing: from rangelands and from grazing in cultivated areas on fallows, stubbles and riverine pastures. These grazing areas in cultivated zones are a more important source of nutrients than the rangelands, supplying 20.3 percent of total TDN and 22.9 percent of DP from all sources.

TABLE 2: Pakistan: Sources of Livestock Feeds
(million tons)

Source of Nutrients	Feed Energy		Feed Protein	
	TDN	%	*DP*	%
Crops	37.36	64.9	3.07	58.7
Other Feed	0.85	1.5	0.27	5.2
Range	7.65	13.3	0.69	13.2
O. Grazing	11.70	20.3	1.20	22.9
TOTAL	**57.56**	**100.0**	**5.23**	**100.0**

Source: Annex B. "Other Feed" refers to milk to young stock, fishmeal and meals of animal origin, plus non-conventional feed sources.

Figure 7 shows that, within the crop subsector, cereal straws and maize stover accounted for almost 43 percent of TDN from crops and 28 percent from all sources. Straw is much less important as a source of protein, providing less than 12 percent of DP from crops and only around 7 percent from all sources. Conversely, green fodder crops such as berseem and sorghum and maize, provide more than 42 percent of total crop DP (and almost one quarter of total DP from all sources), but only under 24 percent of crop energy.

Cereal brans and grains as a group, seem to act more as protein concentrates than as energy sources. They provided more than 21 percent of crop DP, but only slightly more than 11 percent of the TDN coming from the subsector. Oilcakes and oilmeals (mainly from cottonseed and rapeseed) contributed about 11.6 percent of the DP derived from the crop sector, but even this figure does not fully reflect their importance as the main source of protein in the production rations of milking animals.

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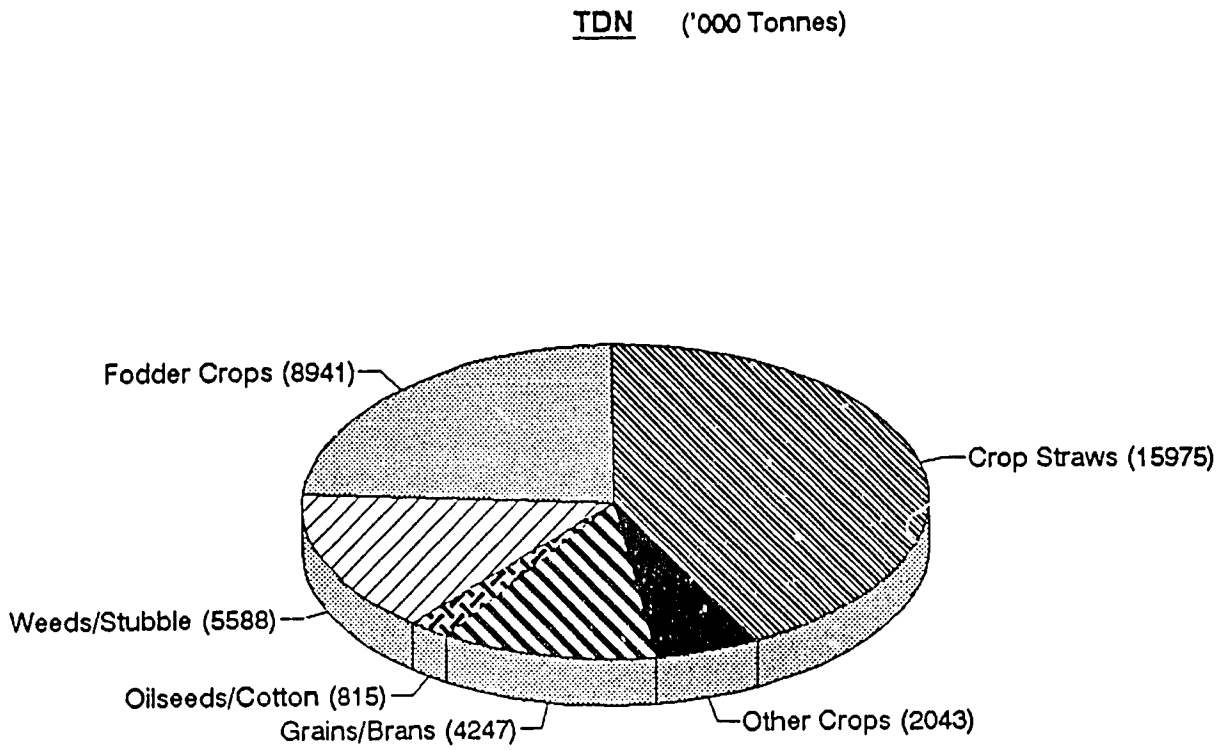
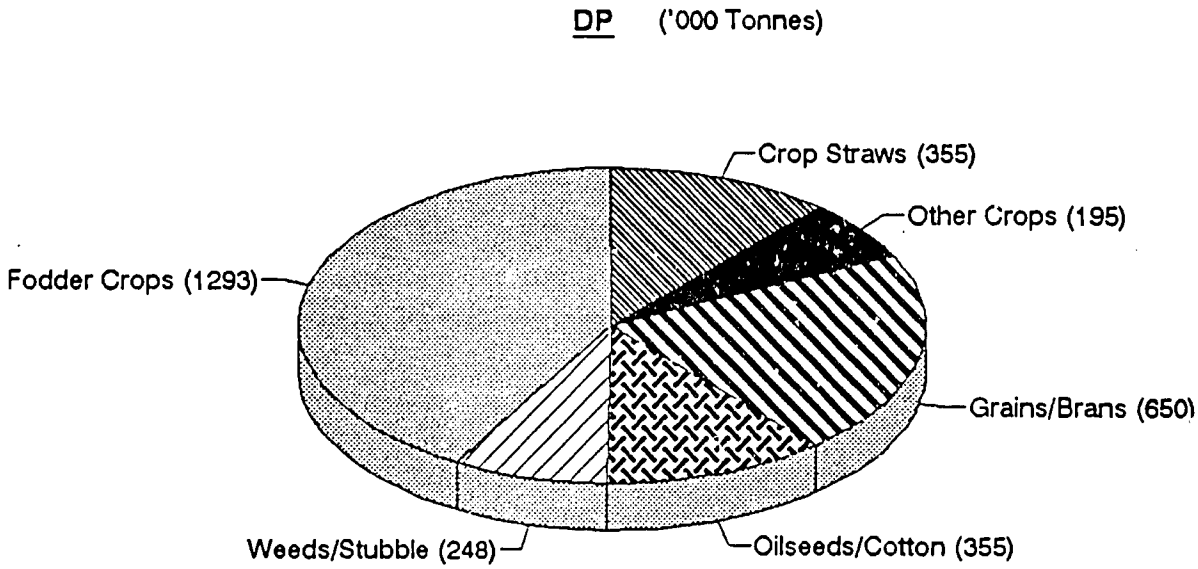
FIGURE 7: Major Sources of Feed Supply from Crops - 1985/86





4.2 Growth of Feed Supply

Since most livestock feed is derived from the production of food crops grown primarily for human consumption, production trends for these crops must be examined in order to understand livestock feed supply conditions.

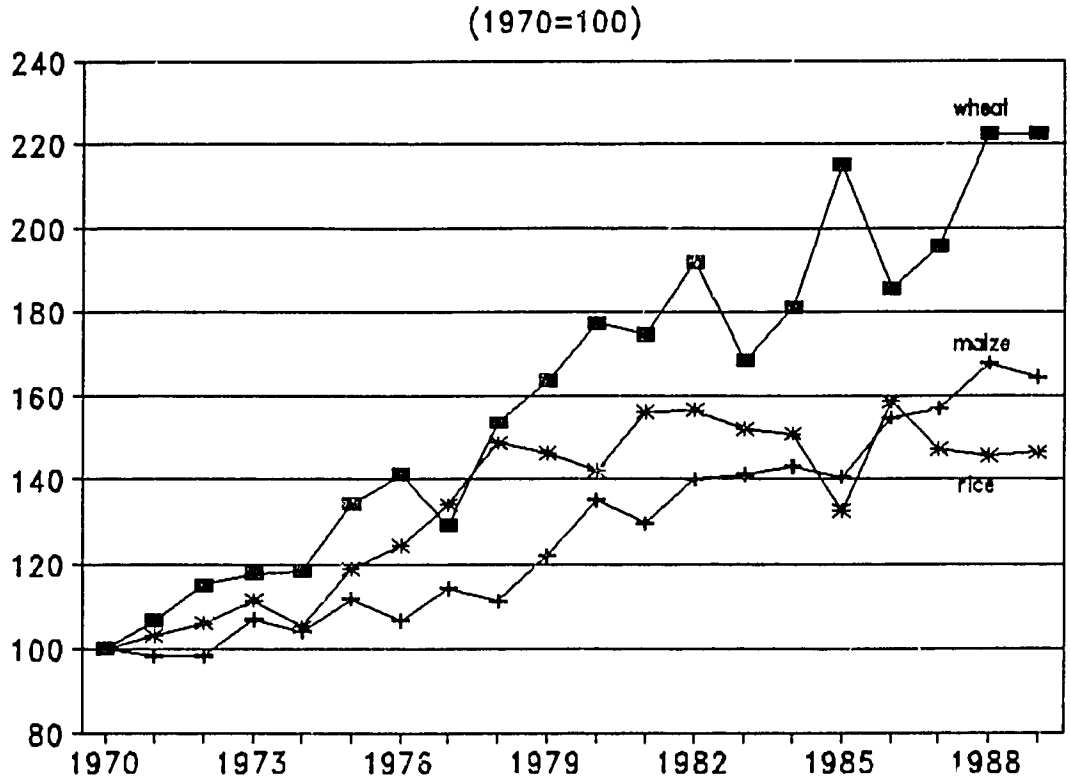
As indicated in Section 4.1, wheat is by far the dominant crop with regard to livestock feeds. It is also the staple food crop of Pakistan, occupying around 70 percent of the total area cropped in the winter (*rabi*) season and constituting about 75 percent of total cereal production in the late 1980s. Figure 8 shows productions trends for wheat and the two other major cereal crops for the period 1970/71 to 1989/90.

The graph covers part of the Green Revolution period (1966 to 1977), when high-yielding varieties (HYVs) were rapidly adopted on more than two-thirds of total wheat area. It also covers the post-Green Revolution period, when HYVs continued to spread slowly to cover almost all irrigated areas and much of the rainfed area.[12] Over the whole period—from 1970/71 to 1989/90—production of wheat grew at 4.1 percent annually. Up to 1975/76, however, the rate of growth was 5.2 percent. Most of this growth was obtained through increases in wheat yields, which rose at the very high rate of 4.6 percent annually.

Since 1980/81, however, the rate of yield increase has fallen to only 1.6 percent and as a consequence, wheat production grew only at approximately the same annual rate as maize (2.63% and 2.66% respectively) during the 1980s. Combined harvesters have harvested a small percentage of total wheat area in recent years and they have a tendency to cut high and to scatter the straw they thresh. As a consequence most straw that is combined is simply plowed under in the haste to prepare a seedbed for the following cotton or rice crop.

Rice production, which is currently less than one quarter of wheat production, grew very slowly throughout the period from 1975/76 to 1989/90, averaging less than one percent annual compound growth. During the period, average yields hardly improved (0.01% per annum), so practically all of the production increase came from area expansion. Yields reached a peak at the very beginning of the 1980s and their slow decline has continued (at -1.1% per annum during 1985 to 1990). In the past 5 years production has stagnated (+0.09% annual growth) even with an annual area increase of around 2 percent, and despite the extremely rapid adoption of the new *basmati* variety, B-385.

FIGURE 8: Cereal Production in Pakistan: Wheat, Maize, and Rice (1970/71 - 1989/90)
Cereal Production Indices



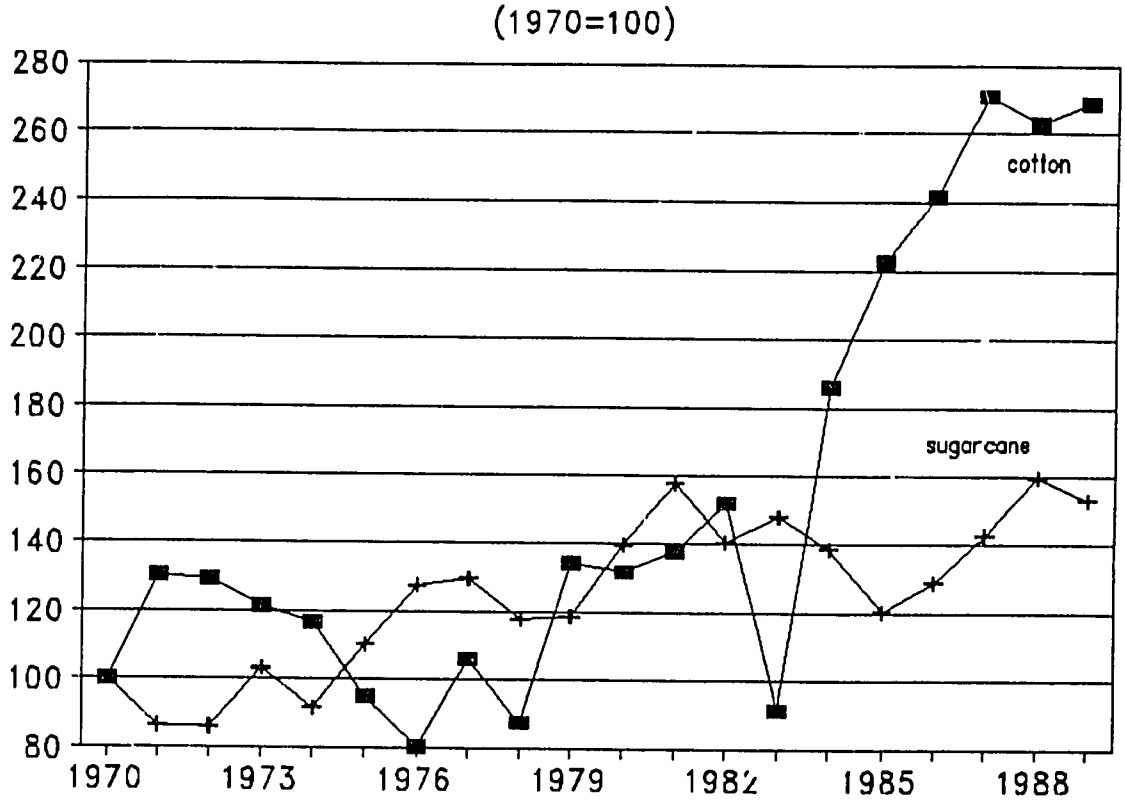
Source: Economic Survey of Pakistan, 1990-91

Although total maize production is only around one third of rice production, its annual growth rate during the past decade (2.66%) is much higher than that of rice. Moreover, it is likely that actual grain yields have risen even faster than the official estimates. The reason for the discrepancy resides in the fact that, unlike wheat or rice, most maize area is actively managed to produce green fodder. Around 17 percent of maize area is cut completely as fodder, without any grain being harvested. As the ruminant population has continued to rise at a rate higher than cropped area, it is likely that the percentage of cut maize has increased. Official production statistics take no account of this practice, and the whole area planted to maize is counted as being totally dedicated to the production of grain. Besides clear cutting of maize forage, almost 70 percent of the total area is gradually thinned throughout the growing period (usually from around 100,000 plants per hectare to a finally harvested 30,000), in order to produce ruminant fodder. This practice is also likely to have been gradually intensified, thus retarding the increase in maize grain yields.

Figure 9 depicts the growth in production of the two most important cash crops—cotton and sugar cane. Cotton is grown mainly for its lint, but approximately two-thirds of seed cotton production consists of cottonseed. Both oil and seedcake are extracted from the cottonseed. The cottonseed hulls which are left are a useful source of roughage for large ruminants, providing

energy but little or no protein. Conversely, cottonseed cake is the major source of protein supplement for milking and work animals in Pakistan. That fraction of cottonseed that is treated by the solvent process of oil extraction produces cottonseed meal, the main source of crop protein for the commercial poultry industry.

FIGURE 9: Cash Crop Production in Pakistan: Cotton and Sugarcane (1970/71-1989/90) Cash Crop Production Indices



Source: Economic Survey of Pakistan, 1990-91

Cotton production has expanded very rapidly in Pakistan. Over the past decade it has averaged an annual growth rate of over 10 percent. By far the most important source of this increase has been improved yields. These averaged 343 kgs per hectare in the first half of the 1980s and 544 kgs per hectare in the final 5 years of the decade. This burst of production has greatly benefitted the livestock subsector. Cake/meal production has increased at a slightly faster rate than lint production since a smaller proportion of total seed production is now needed for sowing the next crop.

In contrast to the above success, the production of sugarcane, whose tops were used for feed, has languished since the latter part of the 1970s. From 1980 to 1989 production growth averaged only 0.25 percent on an annual basis, with slowly increasing yields (just over 1.0% annually) being largely offset by declining area (0.8% annually). Among the reasons advanced

to explain this situation are weak research, delays in processing the cut cane, and the fact that payment is not based upon sucrose content.

5. CONSUMPTION AND PRICES OF LIVESTOCK FEEDS

5.1 Feed Requirements

Most of the feed consumed by animals is used simply to meet maintenance needs, i.e. the nutrition required for basic metabolic functions without growth or milk production being included. The amount and type of feed utilized above the maintenance level is a function of feed costs and product prices. There is considerable scope for substitution between different types of feeds according to relative prices and availability, thus ruminant rations tend to change with season. Nonetheless, there are limits to substitution caused, at one extreme, by the need for enough roughage to ensure efficient rumination and, at the other extreme, by a maximum amount of dry matter that can be included in a diet. Another set of limits is imposed by the need to attain a minimal levels of calories and protein if acceptable production levels are to be reached. Poultry differ from ruminants in that they cannot digest roughages such as straw or hay, and must therefore be fed on concentrates (grains, seeds, brans and meals).

Calculations of the nutrient content of animal feedstuffs are based upon the total amount of dry matter (DM), the energy content (TDN) and the digestible protein (DP) content. Cereal straws have a reasonable energy content (TDN 38 - 49%), but protein content is relatively deficient (DP around 3 to 5%). Because of the low content of digestible protein in most straws, voluntary intake is not enough to satisfy the requirements of most ruminants. Lactating and draught animals must receive supplementary feeding in the form of green forage, hay, oilseed cake, cereals or cereal brans. However, the majority of young animals have to exist mainly on cereal straws, maize stover and the scant grazing from stubbles.

In order to test the validity of the above estimates of feed supply, an independent estimate of ruminant plus commercial poultry feed requirements, at the time of the 1986 Livestock Census, is presented in Table 3. Calculations were made on the assumption that animals were only receiving 75 - 80 percent of the nutrients necessary to attain their full genetic potential, i.e., they were adjusted for current production levels (See Annex C for details). It will be noted that in terms of energy needs (TDN), buffalo are slightly more important than cattle, accounting for over 40 percent of total consumption. Cattle and buffaloes together consume almost 79 percent of total TDN and 84 percent of DP. The future trend in numbers of these large ruminants will, therefore, greatly influence the national supply and demand situation for livestock feedstuffs.

Only commercial poultry have been specifically considered in the calculations, as they now dominate total poultry numbers and account for most of the feed used. The typical desi fowl has to scavenge for insects and fallen grains and seeds that would otherwise not be used.

TABLE 3: Estimated National Ruminant and Poultry Feed Requirements: 1986 ('000 tons)

Ruminant Type	Total Digestible Nutrients	Digestible Protein
Cattle	22.69	1.93
Buffaloes	24.10	2.10
Sheep and Goats	8.52	0.90
Equines/Camels	4.02	0.35
Commercial Poultry	0.83	0.18
TOTAL	**60.16**	**5.46**

Source: Calculations based upon FAO/ADB Livestock Sector Study with amended dates

Feed requirements appear to be higher than the estimates of available feed energy and protein, made in Table 2. There is a shortfall of 3.5 percent in terms of TDN and around 7 percent in terms of DP. Considering the margin of error implicit in such calculations, this discrepancy is acceptable. A large proportion of the camel/equine population comprises donkeys and asses that virtually scavenge for their feed. If their theoretical feed requirement were deducted, the data would indicate a slight nutritional surplus. Similarly, goats in irrigated areas are fed mostly on twigs and leaves cut from trees and shrubs, but this source of nutrients has not been recorded in Table 2.

Data on the feeding values of crop residues and straws is often conflicting and does not fully take into account changes in digestibility arising from on-farm treatment of roughages. The most important example of this concerns wheat straw which is commonly stated to have a DP content of less than 1%.[13] In Pakistan, however, this level of digestibility is enhanced by chopping and mixing with wheat chaff to form *bhusa*. If it is assumed that *bhusa* has double the DP content of unchopped wheat straw, the protein gap reported above would be more than halved through this adjustment alone. It is also important to take into account the preponderance of manual crop harvesting and hand feeding of animals in Pakistan. In addition, landless livestock keepers harvest large quantities of grass and hay from the sides of paths and roads, plus patches of waste ground. This intensive level of husbandry prevents waste and raises the percentage of crop residues actually ingested by livestock.

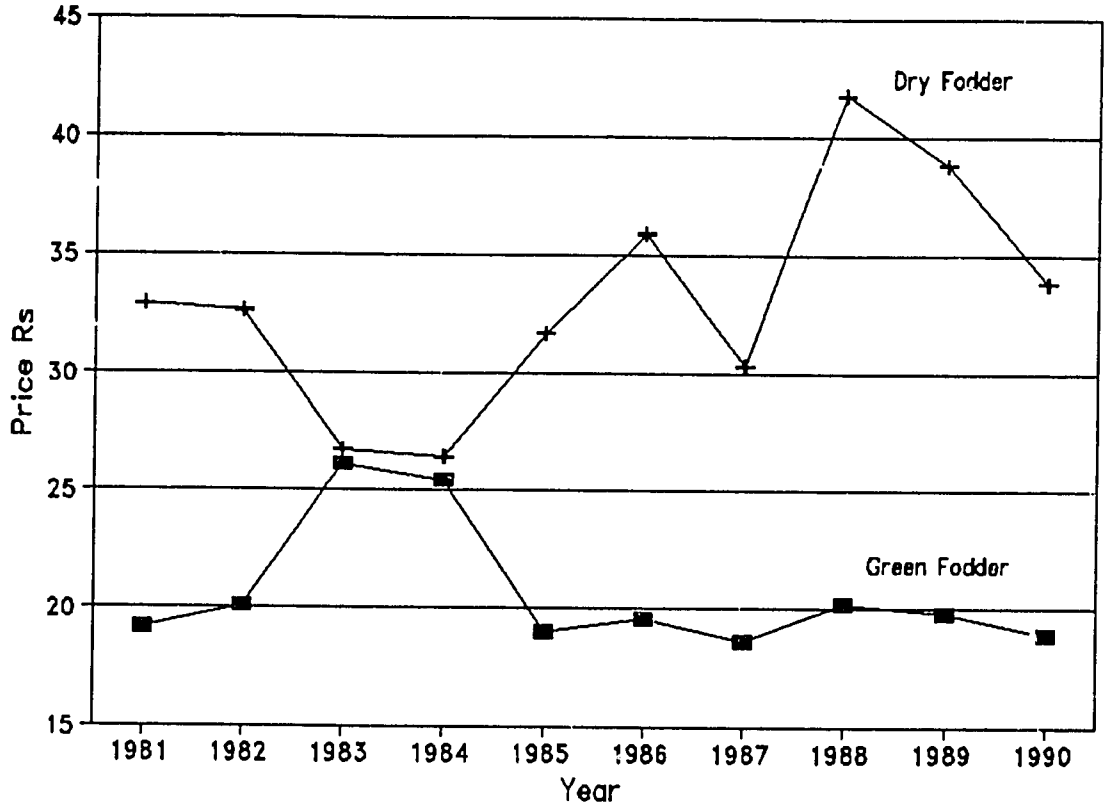
Despite all the positive factors outlined above, it should be noted that problems of local surpluses and deficits, plus unequal seasonal distribution, lower feed efficiency. Moreover, not all the feed that is theoretically available is actually fed. For example, a certain percentage of rice straw is used for manufacturing purposes and nearly all molasses production is exported. Keeping in mind that the requirements estimate was based on a 75-80 percent necessary for achieving full genetic potential, it must be concluded that the comparison of feed needs and feed availability indicates the existence of a precariously balanced feed situation. Protein shortfall may be a more serious issue than energy availability.

5.2 Fodder Prices

Deflated prices of animal fodders are presented in Figure 10. These show that green fodder prices have remained stable in real terms for the past 6 years, after falling for the first part of the decade. Dry fodder prices (mainly wheat and rice straw) have risen throughout the decade.

FIGURE 10: Pakistan: Deflated Fodder Prices

Average Price in 6 Towns of Punjab



Source: Government of Punjab, Department of Agriculture (unpublished).

Neither trend is very dramatic; green fodder prices fell at an average rate of 1.5 percent per annum, while dry fodder prices rose at around 2.6 percent annually. Since both dry and green fodder prices are reported to have fallen in real terms during the preceding period (1971 - 1984),[14] however, new economic forces seem to have emerged since the beginning of the decade to cause a divergence in the two price series.

Most fodder is utilized directly on the holding where it is grown and, as it is a low value product relative to its bulk, only a relatively small percentage of fodder is retailed. Any imbalance of total demand and supply can, therefore, be expected to be amplified in terms of retail price changes. The recent rise should not be interpreted as a sudden reversal of conditions

in the decade of the 1970s when real prices of both dry and green fodder were falling. It would be better to describe the situation as one of gradually emerging imbalance between supply and demand for straw.

The major cause of this trend is the differential between growth in cereal production and growth in livestock numbers in the past decade (below 2.5% for cereals as a whole compared to over 3.2% for cattle and buffaloes). The effect of this divergence has been exacerbated by increased purchases of straw—especially rice straw—for industrial purposes . The straw is used mainly the manufacture of newsprint, fiberboard, strawboard and packing material. The extremely rapid increase in cotton production during the past decade and the resulting fall in the real price of cottonseed cake, has also been an important factor in the demand for straw. Farmers have tended to substitute chopped straw plus cottonseed cake for green fodders in the production ration of milking animals. As a consequence, demand for straw has increased.

5.3 Poultry Feeds

Despite the extremely rapid growth of the commercial poultry industry, it still accounts for less than 2 percent of total animal feed consumption in Pakistan in terms of energy (TDN) and under 4 percent in protein terms (DP). Several types of commercial poultry feed are manufactured, according to age of bird and whether they are layers or broilers. The feeds differ in their exact energy and protein content, but are produced from the same basic ingredients.

Table 4 presents the major ingredients currently used to produce layers' mash, with approximate prices and total costs. Around 40 percent of poultry feed is wheat, which comprises more than one third of the cost of ingredients. In 1989 it was estimated that over 400,000 tons was used in the manufacture of more than one million tons of poultry feed.[15] This figure is likely to be considerably higher if all on-farm mixing, plus direct cereal feeding, is taken into account.

TABLE 4: Proportions and Costs of Ingredients - Layers Mash in 1989

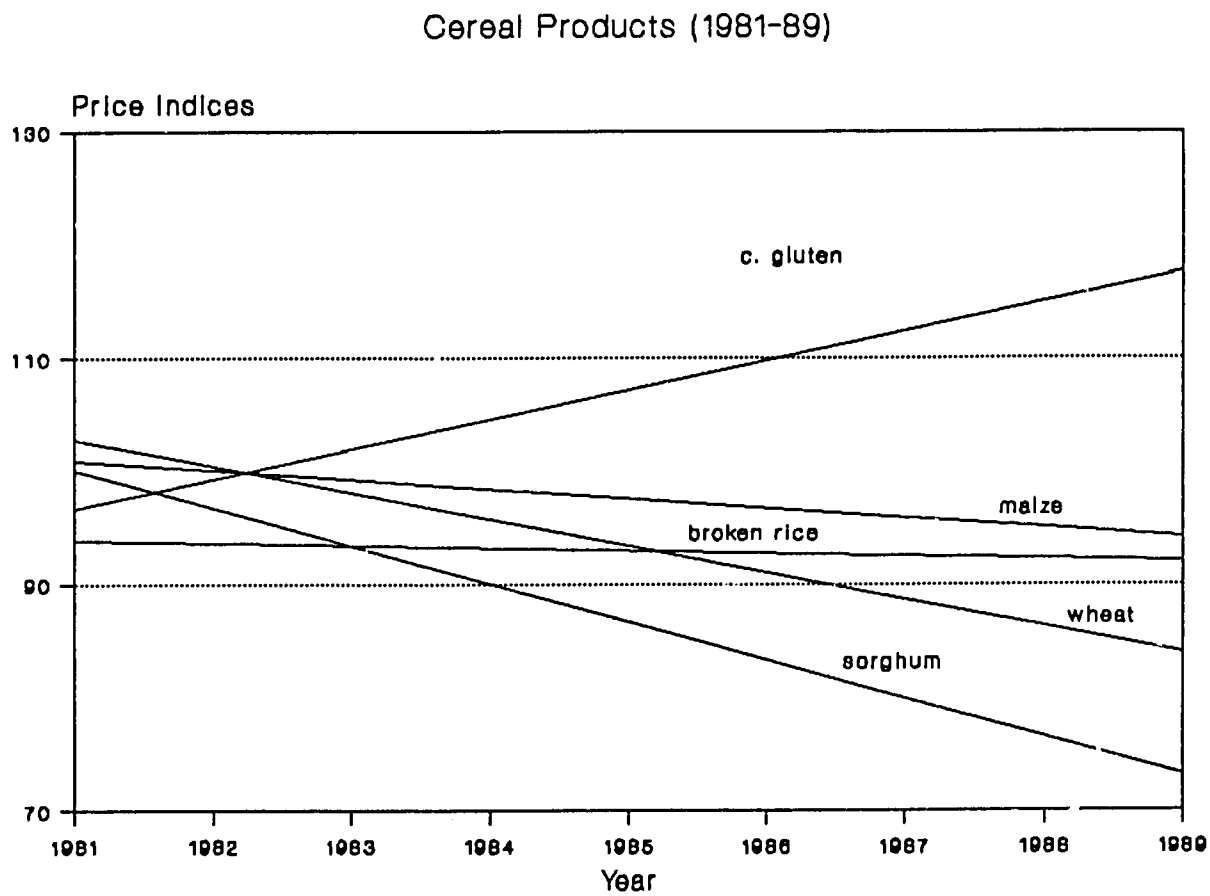
Ingredient	Rs./Kg.	Amount Kgs.	Cost Rs.	% Total Cost
Cottonseed Meal	4.28	100.00	428.30	13.3
Liq. Molasses 8%	0.75	20.00	15.00	0.5
Fish Meal	12.03	30.00	360.84	11.2
Corn Gluten	8.46	100.00	846.00	26.3
Salt	6.73	2.50	16.83	0.5
Wheat Bran	1.84	71.24	130.94	4.1
Rice Polishing	1.40	200.00	280.00	8.7
Limestone	0.26	50.00	13.00	0.4
Wheat Grain	2.63	462.26	1121.06	34.9
Total	**n.a.**	**1000.00**	**3211.97**	**100.0**

Source: RONCO. Livestock Feed Industry Case Study 1991 Analysis of Corporate Constraints in Agriculture Project, Agribusiness Cell, Ministry of Food, Agriculture and Cooperatives.

Apart from very small volumes of sorghum, barley and maize, rice is the only other whole grain used (although only rice polishings are incorporated in the present example of layers' mash). It is purchased by feed manufacturers in the form of broken rice, and constitutes less than 4 percent of poultry feed by volume. Cereal by-products such as rice polishings, wheat bran and especially corn gluten, are also major ingredients. Corn gluten is particularly important as it accounts for around one quarter of feed costs. The main oilseed derivative in poultry rations is cottonseed meal which constitutes around 10 percent of the ingredients in the ration by volume, and somewhat over 13 percent of total ingredient costs.

Despite the high rate of growth in the consumption of poultry products, their prices adjusted for inflation have trended downwards over the past two decades. Serious problems persist in the industry, because disease incidence and the poor and variable quality of poultry feed leads to sub-optimal conversion rates. Nevertheless, the cost of most feed ingredients has fallen in real terms. Since feed costs constitute 55 to 60 percent of total broiler production costs and 65 to 75 percent of the cost of egg production, this has facilitated the rapid expansion of the industry while enabling poultry prices to continue their decline relative to the price of most other livestock products.

FIGURE 11: Pakistan: Trends in Real Prices of Feed Ingredients: Cereal Products (1981-89)

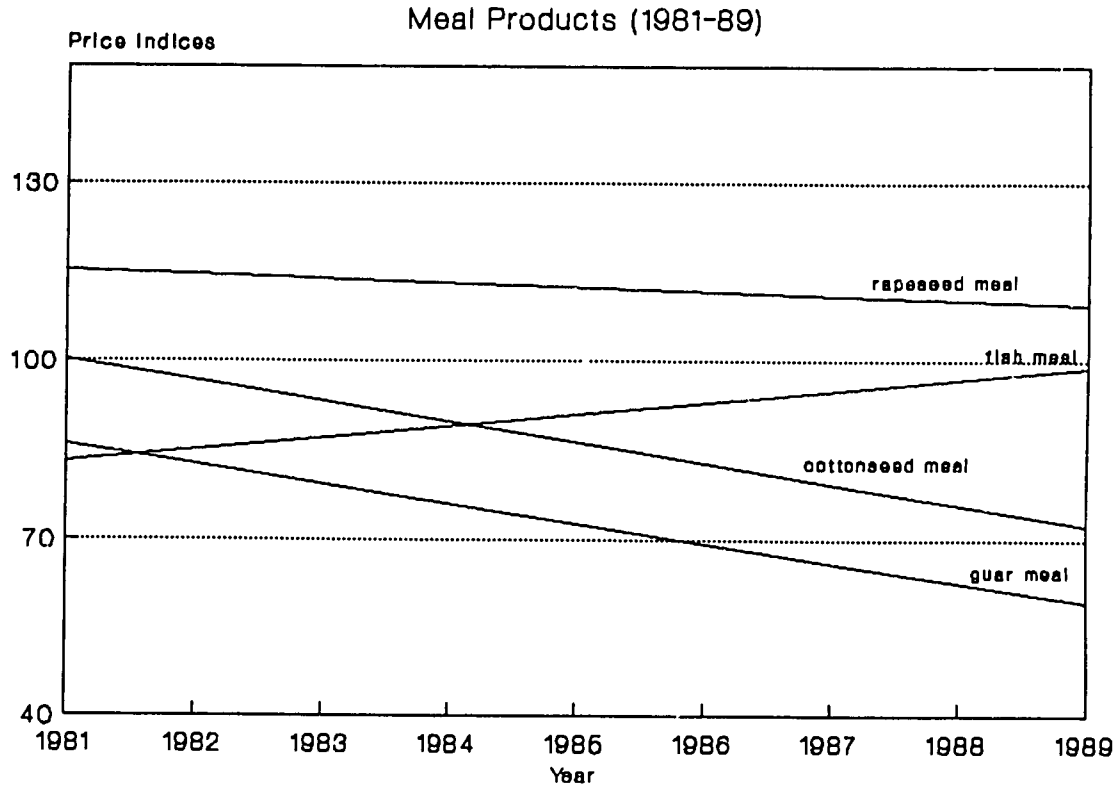


Source: Economic Survey of Pakistan, 1990-91

Figure 11 illustrates the trends in the deflated prices of the main cereal and cereal-based ingredients of poultry feed during the period 1981/82 to 1989/90. The price of wheat is the most important of these, and this has fallen more than any other except sorghum (-2.56% as opposed to -3.87% per annum).

Broken rice and maize are the other cereal-based ingredients whose real prices have been falling. The rates of decline have been very gradual (-0.86% and -0.23% per annum respectively) as, unlike sorghum, they have strong markets elsewhere (starch and corn oil manufacture for maize and manufactured foodstuffs plus direct human consumption for broken rice). Among cereals and cereal by-products, only the price of corn gluten has shown a tendency to rise (2.32% annually). This rise is rather serious, as corn gluten constitutes the second most important element of the cost of poultry feed after wheat.

FIGURE 12: Pakistan: Trends in Real Prices of Feed Ingredients: Meal Products (1981-89)



Source: Economic Survey of Pakistan, 1990-91

Figure 12 shows that the price of cottonseed meal, the most important ingredient derived from oilseeds, has fallen at the annual rate of 3.79 percent since 1981/82. During the same period cotton production has more than doubled.

The steep decline in cottonseed meal prices has affected all close substitutes, such as guar and rapeseed meals. Their prices fell by an average rate of 4.27 percent and 1.25 percent respectively, each year between 1981 and 1989. Apart from corn gluten, the only major source of protein to rise in real terms has been fish meal. Price rises in real terms have not been particularly steep—around 1.6% annually. However, this is of serious concern to poultry producers. The rate of increase has become more steep in recent years and a minimum amount of fish meal is vital to poultry rations, unless it can be replaced by another source of animal protein.

Unfortunately, domestic supplies of meat and blood meals are extremely limited and of such low quality that feed manufacturers hesitate to use them. Part of the explanation for the poor feed conversion rates obtained in Pakistan revolves around this issue.[16] The rising price of corn gluten and fish meals threatens to affect the future technical efficiency standards of the poultry industry, and this will undoubtedly accelerate the recent slight rise in the real price of

poultry meat. Import restrictions on these commodities are, therefore, discussed in later sections of the report.

Deflated prices of poultry feeds rose fairly rapidly between 1980 and 1984, at which point they subsided. Toward the end of the decade, 1984 levels were again equalled or exceeded except in the case of layers' mash. Price trends are shown in Table 5 for four types of poultry ration. Rises were modest when taken over the whole period, 1980 to 1989. They ranged from 1.05% per annum for broiler starter to only 0.55% annually for broiler finisher. As in the case of broiler rations, the price of higher-protein layers' rations rose more steeply: at an annual rate of 0.74% in the case of chick starter as opposed to 0.63% for layers' mash (although not shown, the price of the relatively low-protein growers' mash rose at the rate of only 0.32% annually). It seems that competition from the rapid growth of home mixing has prevented manufacturers raising prices, despite falling levels of capacity utilization. At the same time, price rises for corn gluten and fish meal have been offset by falls in the prices of other ingredients.

TABLE 5: Pakistan: Real Prices of Poultry Feeds (Karachi) - Rs per 50 kg bag

(1980 prices)

Year	Broiler Starter	Broiler Finisher	Chick Starter	Layers Mash
1980	120	118	112	103
1981	123	123	115	108
1982	130	126	121	113
1983	127	122	119	108
1984	134	128	126	119
1985	126	122	117	107
1986	123	119	114	110
1987	139	129	125	114
1988	133	128	124	115
1989	135	127	122	111

Source: Pakistan Poultry Association

6. INDUSTRY AND MARKET STRUCTURE

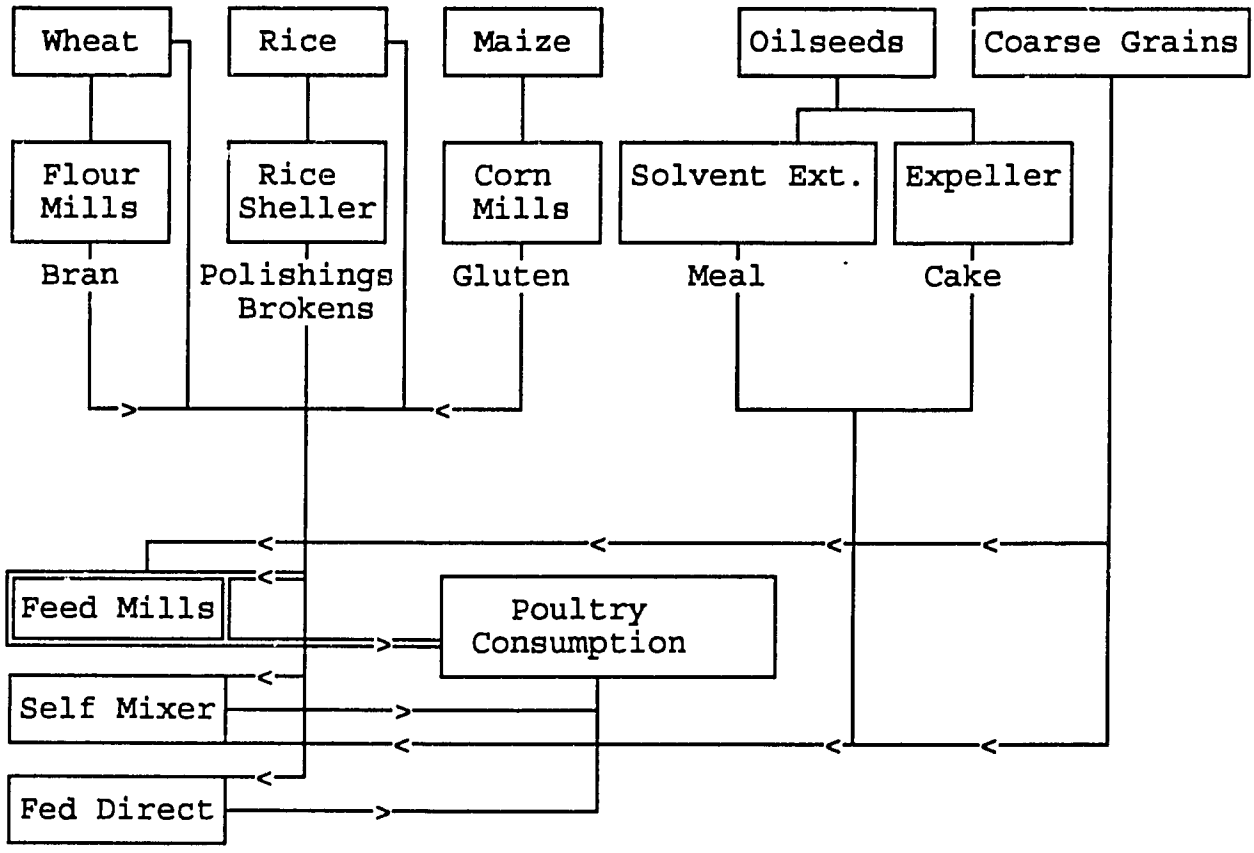
The market structure for livestock feeds is virtually restricted to that of poultry feed, as only very small quantities of ruminant feedstuffs are manufactured. Despite the virtual absence of ruminant feeds manufacturing, farmers feed large quantities (around one million tons per annum) of cottonseed cake to cattle and buffaloes.[17] The cake is bought from expelling plants and is usually fed without any further treatment. Although both dry and green fodders are marketed, they do not undergo any form of transformation before being fed.

Apart from soybean meal, the only significant import that finds its way into manufactured feed is wheat.[18] Wheat imports in the three years to 1991 averaged 1.77 million tons. The amount of wheat used by millers and for home mixing probably averaged over 400,000 tons annually. This represented around 3 percent of average domestic wheat production over the same three year period. Most wheat used for poultry feed is bought in bulk at harvest time and stored by feed millers before use.[19]

Maize is not imported into Pakistan. Until recently it was subject to import duty and maize imports still face levies amounting to around 25% of their cif value. In addition, the subsidized domestic price of wheat has led to it being used for animal feed purposes that are usually fulfilled by maize.

Around 20,000 tons of soybean meal were imported in 1990 from India. Imports have been triggered by chronic quality problems with domestically produced oilseed meals. Despite these problems, about 80,000 tons of cottonseed meal is currently estimated to be consumed annually by the industry, which buys it directly from solvent extraction plants. By far the largest proportion of cottonseed cake (about 95 percent) is fed to cattle and buffaloes, and the remainder (4 - 5 percent) is assumed as a loss. The structure and flows described above are illustrated in Figure 13.

There were approximately 110 feed millers operating in 1989 (See Table 6), with an installed capacity of over 2.59 million tons. This includes large poultry farmers who, as groups or individually, mixed their own rations. These are estimated to account for between 40 to 50 percent of total feed manufactured. This type of production is estimated to have grown at an annual rate of 20 percent over the past decade. About 85 percent of the remaining volume of commercial feed output is supplied by fewer than 20 large feed mills.



As indicated in Table 6 below, manufacturing capacity almost doubled in 1989, compared to the previous year, despite a low rate of capacity utilization. Total manufactured production of livestock feeds rose at the annual rate of 18.1 percent during the 1985 - 89 period, but the vast majority of feed went only to the commercial poultry industry, which itself was growing at a similar rate.

TABLE 6: Manufactured Animal Feed Production in Pakistan
(Capacity = millions of tons)

Year	No. of Feed Mills	Installed Capacity	Feed Produced
1985	51	0.85	0.637
1986	76	1.20	0.140
1987	100	1.32	0.818
1988	100	1.32	0.952
1989	110	2.59	1.142

Source: Poultry Research Institute, Rawalpindi. Poultry and ruminant feed.

According to the RONCO study, feed millers market their products immediately and the only items that are stored in bulk are grains, cakes, meals and feed additives just prior to use. Millers plan their production on the basis of reports from commission agents who provide an important link with livestock producers. Only current orders enter into the schedule of production and feed is mixed, bagged and transported from the factory on the same day that an order is received. There are no facilities for the prolonged storage of finished produce as millers wish to avoid the risk of quality deterioration.

Livestock feed markets in Pakistan have only a rudimentary structure. Both backward and forward linkages are weak. Neither market research and development activities nor organized planning exist within the industry. Basic market demand data is unavailable as industry associations make no attempt to collect and collate it. Marketing budgets are rare and market testing and product demonstration activities completely absent.

7. PRICING POLICY—INSTRUMENTS AND MECHANICS

Since government policy towards the livestock sector is in general non-interventionist, pricing policy directed specifically at controlling prices of livestock products has only a limited impact on the livestock feed industry. In contrast, agricultural trade policy as a whole has a strong impact upon the industry.

7.1 Crop By-Products, Meals and Machinery Imports

The supply of several feed ingredients is seriously affected by taxes and other levies on imports. These interventions are summarized in Table 7. Although wheat is an imported commodity that is used for livestock feed, it is not included in the table. As it is not a traditional ingredient of manufactured feedstuffs, it has been considered along with other food crops in a later part of this section.

Besides import duties, government can also impose the following levies on imports:

- a 12.5% sales tax,
- an *Iqra* or education tax of 5%,
- an import surcharge of 10%.

TABLE 7: Duties and Fees Affecting Imported Manufactured Feed Ingredients
(Effective June 1991)

Commodity	Import Duty %	Import Surcharge %	Iqra Surcharge %	Sales Tax %
Soybean Meal	0	10	5	0
Other Oil. Meals	20	10	5	12.5
Fishmeal/Meat M.	20	10	5	12.5

Source: Agricultural Attache/FAS, 1991 Oilseeds and Products Annual Report. U.S. Embassy, Islamabad (June 1991)

It should be noted that Iqra and the import surcharge are levied on the pre-duty value of the commodity, whereas sales tax is levied after the duty is assessed. In addition, import license fees levied on the imported value of the product, are currently fixed at 6%, based on the value of the shipment at the time of establishing a letter of credit. Licenses can take up to two years to obtain. Octroi taxes (1 - 2%) and district council taxes (1 - 3%) are paid on goods in transit. The total impact of this array of policy instruments on the situation regarding feed ingredients

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has been to prevent any imports of traditional feedstuffs, except in the case of soybean meal for which both duty and sales tax were removed in May/June 1990.

Imports of machinery for the preparation of animal feedstuffs have also been severely impeded by government trade policies. Import duty is set at 80%, in addition to other levies. Duty on refrigeration equipment of all types varies between 100% to 125% and negatively influences the marketing efficiency of livestock products—especially dairy products. Imported tractors are not subject to import duty or sales tax, but Iqra and an import surcharge must be paid in addition to the import license fee. On top of these charges, imports of spare parts face an import duty of 60% and a 12.5% sales tax, thus constraining the rate of growth of crop mechanization and raising production costs of crops already mechanized.

Most tractors in Pakistan are in fact manufactured locally, and tractor loans are subsidized. Nonetheless, the prices of tractors relative to prices received for major crops such as wheat, have risen by more than 25 percent between 1986 and 1990.[20] This rise has largely been the result of 6 percent annual devaluation of the rupee against the american dollar—given that the great majority of new tractors are assembled locally from imported parts.[21] It should be noted, however, that the rupee has traditionally been overvalued and remains overvalued. This distortion of the exchange rate, discussed further in the latter part of this section, has the effect of making machinery imports cheaper in local currency terms than they would be if exchange rates were free to find their own level.

7.2 Pricing Policies for Crops

Government policies that manipulate the prices of domestically-produced crops also have an important effect on the livestock feed situation. These policies consist of a mix of direct and indirect restrictions on imports and exports. In addition, consumer and producer subsidies have strong effects on both supply and demand conditions. For example, the progressive removal of fertilizer subsidies during the 1980s has affected both the level and pattern of crop outputs.

Price policies related to wheat and cotton are the two most important in terms of the livestock feed situation. Wheat is both the main cereal used in poultry feed and the major source of the straw fed to ruminants. Cottonseed meal and cake constitute 87 percent by volume of domestic oilseed meal production. Cottonseed meal is the major oilseed meal in poultry feed, and cottonseed cake is the most important oilseed derivative fed to ruminants.

Wheat that is sold locally passes from farmers to village traders to the local flour mill and is then retailed as *atta*. The main Federal government institution involved in marketing the remaining wheat is the Pakistan Agricultural Storage and Services Corporation (PASSCO). Farmers sell wheat at an official procurement price either to PASSCO or the provincial food departments; or they deal with private traders at the market price.

Government dominates the wheat market and is able to stabilize and hold down prices by standing ready to sell any amount of wheat to anyone at a fixed release price. The margin

between the procurement and release prices is not enough to cover the full cost of storage and so this operation is not profitable to the private sector. In practice, most traders buy from farmers to sell to PASSCO. The arrangement also means that Government has to subsidize the cost of storage. The amounts involved are quite substantial, as the largest subsidy to date—in 1988/89—amounted to approximately one percent of total GDP and about 6 percent of total government revenue. The release price of wheat was raised for 1991/92 by 19 percent—the largest single rise ever announced. Nonetheless, wheat imports still have to be subsidized.

Maize imports were subject to import duty until June 1990 and they still face a range of other levies including a 12.5 percent sales tax. No maize is imported because the market price is less than import price. Since wheat imports are subsidized, it has become the dominant cereal used in the manufacture of poultry feed. In most countries maize is the main cereal used for this purpose.

A similar type of substitution has also occurred in the case of oilseed meals. In most countries soybean meal is the major oilseed-derived ingredient of commercial poultry rations, but in Pakistan the dominant ingredient is cottonseed meal. Until June 1990, all imports of oilseed meals were subject to a 20 percent import duty plus the usual range of other levies. As a consequence, domestically produced cottonseed meal, which is produced as the second by-product (after cottonseed oil) of cotton lint production, has been used instead of imported soybean meal in manufactured poultry feed. The falling real price of cottonseed, as a result of recent rapid gains in production, consolidated this situation despite persistent complaints by millers of poor quality standards. Since the abolition of the import duty plus the 12.5 percent sales tax, however, soybean meal imports have risen. The imported commodity seems to be preferred to domestic cottonseed meal, even at current price differentials. Although imports of soybean meal have not yet exceeded 20,000 tons in any one year, the oilseed industry is experiencing increasing difficulty in disposing of its total output of cottonseed meal to the producers of poultry feeds.

It is frequently argued that government policies are responsible for depressing retail prices of vegetable ghee (*vanaspati*) and vegetable oils, thus reducing incentives for domestic production of non-traditional oilseeds. A recent companion study concluded that these charges could not be substantiated.[22] This conclusion is valid, despite the existence of government subsidies to the Ghee Corporation of Pakistan (GCP) plants, financial transfers to the Trading Corporation of Pakistan (TCP) and the fact that market prices of vegetable ghee have fallen in real terms for several years. The study showed that, contrary to common assertions, the net effect of government policy—both in the pre-1986 era of administered pricing and the post-1986 era of market liberalization and large import taxes—was to protect the domestic market and promote a domestic price structure substantially above the world market equivalent. This being the case, domestic oilseed production is actually being stimulated by existing government interventions. The failure to increase supplies of non-conventional oilseeds must, therefore, be attributed to other factors, such as the high opportunity cost of the productive resources involved and institutional constraints related to supply of suitable seed and efficient marketing channels.

7.3 Policies Directly Affecting Livestock Product Prices

In addition to the above policies, affecting the import of livestock feeds and the price and supply of domestically produced crop by-products, certain government ordinances provide powerful indirect controls over the prices of livestock products. Section 144 of the Pakistan Penal Code can be invoked by Deputy Commissioners (DCs) to impose price controls on commodities or to prevent movement of commodities out of a district. It can be used without any appeal being allowed, either at provincial or federal level. It is not frequently resorted to, but if members of the public perceive that certain prices are too high they can petition for controls to be imposed. This measure is widely believed to combine with published maximum meat prices and the provision for two meatless days each week to depress the price of livestock products.

Maximum meat prices are rarely adhered to, however, especially in the case of higher-quality cuts.[23] The rapid rise in the real price of red meat in recent years would also seem to refute allegations that government is depressing meat prices. It is possible that the potential for punitive action has had a restraining effect on price rises. To the extent that it has, the derived demand for livestock feeds will have been influenced. There is not enough evidence available, however, to enable a firm conclusion to be drawn.

Export restrictions have also been quoted as depressing prices of livestock products.[24] Export bans are in effect for live sheep, beef and mutton (except for 50% of feedlot production), animal fat, milk (although 50% of milk treated at ultra high temperatures can be exported) and certain milk products, as well as certain categories of hides and skins. Quantitative restrictions in the form of quotas affect other livestock products. Live animals such as buffaloes, cattle, goats and camels are allowed to be exported only for breeding purposes, with specific limits being set on numbers exported.

Indirect restrictions include export duties and minimum export prices (MEPS). The most important duty concerns hides and skins, exports of which are taxed at 15 percent of the export price. MEPS are fixed for live animals—in 1990 the equivalent US dollar prices were US$ 1,000 for cows, US$ 1,500 for camels, and US$ 200 for goats. The stated rationale for MEPS is to protect against under-invoicing, but they also act to deter exports of some breeding stock.

The recent GOP/USAID study of restrictions on Pakistan's agricultural exports, concluded that the aggregate effect of the above export policy instruments was to prevent exports of certain livestock products that would otherwise be possible.[25] It cited UHT milk, mutton and beef as major examples of products whose domestic prices were either lower than or approximately equal to, the equivalent border price (-6% for milk and milk products; -14.6% for beef; +0.7% for mutton). However, the study included the caveat that the amount of UHT milk that could be exported was very limited and that beef exporters had reported that the market was confined to Pakistani workers in the Middle East. It can be safely concluded that the likely development of prices in Pakistan will be such that even these products will soon be priced out

of any export markets. The rise in domestic prices for meat is already tending to offset the positive effect of the continued devaluation of the rupee.

Another important policy intervention affecting animal products concerns the domestic price level of milk. Since the raw milk bought for processing is cooled by adding ice, it usually contains 20% to 25% water. This causes the solids-not-fat (SNF) content to oscillate between 6.75% and 7.2%, even though fat content is generally well above the statutory 3.5% required of standardized milk. The addition of skim milk is sometimes necessary in order to raise the SNF content of UHT Milk to the legal minimum for sale in urban areas. As indicated in Table 1 earlier in the report, imports of skim milk powder have fallen over the past decade, but those of whole milk powder, for retailing in tins, have been rising rapidly.

It is extremely difficult to calculate the effect that the taxes on imported milk powders have on raising the general price level of milk. Most calculations assume that the market for different forms of milk is fully integrated. This is clearly not the case, but processed milk does account for 10 percent of the fluid milk market and its price is considerably higher than that of raw milk. The most recent calculation of the overall effect of import taxes on dried milk[26] indicated that it raises domestic producer prices above import parity by less than 10 percent. Given the margin of error implicit in such a calculation, this is not a large amount. However, to the extent that the producer price is raised above import parity, government policy acts as a stimulus to milk production and therefore raises demand for feedstuffs consumed by cattle and buffaloes.

8. PRICING POLICY—TRADE PARITY PRICES AND OTHER ISSUES

A useful measure of the economic distortions arising from government pricing policies is obtained by comparing actual product prices with those that would occur in the absence of government interventions. For tradable commodities, such as most cereals, cotton and oilseeds, these prices are called "trade parity prices." The ratios of recent domestic producer prices to their trade parity equivalents are shown in Figure 14 on the next page. These ratios are called "nominal protection coefficients" (NPCs).

In order to avoid any bias due to transitory features, average prices for recent years have been chosen (1986/87 to 1988/89 except for wheat which is for 1983/84 to 1989/90). A coefficient of one indicates that domestic prices are equal to those that would prevail in the absence of policy interventions, i.e. under free trade conditions. An NPC greater than one, such as that for sugar cane, indicates that producer prices are being subsidized by policy interventions. Conversely, an NPC of less than one indicates a product that is being taxed, as government interventions have lowered the price to the producer below that which would have been reached under free market conditions.

In Figure 14, three commodities have an NPC greater than one and four have NPCs of less than one. Thus, sunflower, sugarcane and maize production is being subsidized by government policies and IRRI rice, basmati rice, wheat and cotton production is being taxed. Since growers respond rationally to economic stimuli, it can be assumed that this configuration of prices will cause a transfer of some resources out of the second group of crops into the production of crops within the first group. It is important to note, however, that in 1990/91, the area covered by the group of crops that are discriminated against by government price policies, was still around 7 times greater than that covered by the crops that benefitted.

Wheat is shown with two different NPCs. This cereal is imported at the margin in Pakistan, so one NPC is calculated with respect to the orthodox cif import price. It was thought, however, that this cif price would stimulate excess domestic wheat production causing prices to fall. A second NPC was, therefore, calculated using a price judged to be consistent with domestic supply/demand balance. Although Government significantly raised the procurement price of wheat in both 1989/90 and 1990/91, it is important to note that it still remains below its import parity equivalent.[27]

Although cotton lint and cotton textiles are major exports, the production of seed cotton is also discriminated against by national price policies.[28] The current policy is built around the benchmark price system that was introduced in 1988/89. This involves two policy prices: the benchmark price and the Minimum Export Price (MEP). The benchmark price is a ceiling price for cotton exporters, but government also determines a daily MEP that is always well above the benchmark price. The exporter receives the benchmark price, but the cotton is actually sold for at least the MEP. The difference accrues to government as a unit export duty on cotton. At the beginning of the ginning season, the benchmark price is set below the spot price, making it

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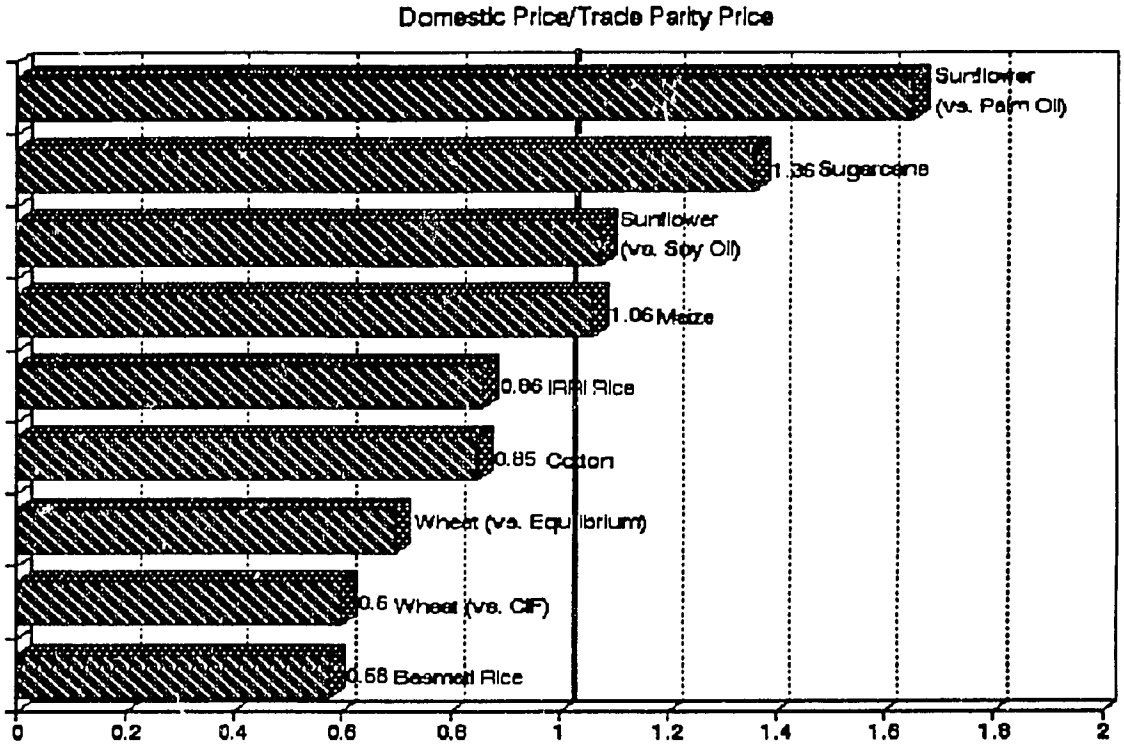
impossible for traders to purchase cotton and export it at a profit. This restriction of exports has the effect of lowering the cost of the raw material for the domestic textile industry at the expense of cotton producers.

FIGURE 14: Nominal Protection Coefficients



NOTES: These coefficients are based on representative average prices for recent years chosen to avoid year-specific bias. Wheat = 1983-90; Others = 86/87 - 88/89

Basmati rice is particularly heavily taxed by government price policies despite the fact that it is also an important export crop. Duty is levied as a fixed charge per metric ton and for IRRI varieties it is charged at 30 percent of export value. At current export prices the fixed basmati duty is equivalent to an export duty of approximately 41 percent. This represents a severe production disincentive that has serious implications for the livestock industry in terms of lower growth in the volume of milling by-products and rice straw.[29]

Conversely, if it is accepted that sunflower oil should be valued at the cif price of either palm oil or soybean oil, sunflower production is currently receiving a price stimulus (as was stated in the previous section). The reason for calculating an NPC for sunflower oil in this way is that small increases in production would be used for liquid cooking oil, where soybean oil is the natural substitute. Larger quantities would be processed into vegetable ghee, in which case

the lower palm oil price is a more appropriate frame of reference. Given the small amounts of sunflower seed currently being produced domestically, the most relevant NPC is that related to the price of soybean oil. However, even this NPC indicates a small subsidy being accorded to sunflower production.

The overall impact of the above direct price distortions, plus those arising from direct trade policies, upon the price and supply of major livestock feeds, is discussed in Annex D. In addition to these direct effects of government policies, important indirect effects have also taxed agriculture. The Report of the National Commission of Agriculture (1988) states that the taxation of the agricultural sector through the exchange rate mechanism varied between 21 and 33 percent during the period 1982 to 1987. Dorosh and Valdés reviewed the effect of the overvalued exchange rate on Pakistan's agriculture and concluded that these indirect effects had exerted an even greater negative influence on the sector than direct policy interventions.[30] On the other hand, an overvalued exchange rate has the effect of favoring fodder production by lowering the prices of competing traded crops.

Imports of feedstuffs and machinery have also benefitted from the overvalued exchange rate. For example, a recent study on the status of mechanized cotton picking in 1989 concluded that the estimated adjustment to the exchange rate (21%) to account for overvaluation reduced the effect of import surcharge and sales tax (35%).[31] When adjustments were also made to fuel and other costs, total hourly running costs were actually 16 percent higher in social cost terms than in financial terms. In other words, for mechanized agricultural operations, it appears that the effect of taxes and other duties are more than offset by the cost reduction bias of the overvalued exchange rate.

9. FUTURE SUPPLY AND DEMAND CONDITIONS FOR LIVESTOCK FEEDS

9.1 Methodology for Analyzing Supply and Demand for Feed

Since the bulk of feed consists of the by-products and residues of crops grown for other purposes, the output of feed is affected more by crop prices and the technological factors that shift crop supply curves than it is by actual feed price movements. Table 8 summarizes the main by-products and their percentage contribution to total value per hectare of crop.

In no case does the by-product contribute more than 22 percent of the gross value of the combined crop/by-product harvest. The highest percentage occurs in the case of wheat straw, where farmers can do very little to influence the grain-straw ratio. Only by increasing the percentage of nitrogen in fertilizer applications could any modification be achieved, but this latter practice would increase the chances of disease and fungal attacks. In *barani* areas, however, wheat is generally mixed with mustard/rape and the ratio can be varied according to relative prices.

TABLE 8: Major Crop By-Products and their Percentage Contribution to Crop Gross Outputs (1990/91 Crop Prices)

Crop & By-Products	% Harvest Weight		By-Products % Gross Value
	Main Product	*By-Product*	
Irrigated Wheat (Grain/Straw)	33	66	22
Barani Wheat (Grain/Straw)[32]	33	66	22
Basmati 385 Rice (Grain/Straw)	35	65	6
Grain Maize (Grain/Stover)	20	80	11
Sugar Cane (Cane/Tops/Leaves)	83	17	12

Source: Farm Management Handbook for Punjab. Bashir Ahmed et al, PARC/CIMMYT (in draft, December 1991)

Even where maize is grown primarily for grain, some flexibility is also available through the practice of thinning. However, higher livestock feed prices would also raise the price of maize grain and lower the incentive to increase thinning at the expense of grain.

It can be concluded that, with the exception of specialized fodders (berseem, fodder sorghum etc.) and grain grown primarily for human consumption and diverted to livestock feed, changes in the prices of livestock products do not affect the supply of livestock feed. Conversely, the changes in the supply of livestock feed do influence the prices of livestock products since they cause shifts in the supply curve for livestock products.

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Given the relationships outlined above, the most logical point to begin any investigation of demand and supply conditions for livestock feed is on the supply side. The following sequence is, therefore, followed in this section:

- Determination of future feed supply levels;
- Examination of projected supply and demand for livestock products;
- Initial estimation of future livestock population and yield levels;
- Calculation of future demand for feed;
- Analysis of the implications of the resulting balance of feed supply and demand for feed;

9.2 Future Supply of Feed Nutrients

Using the adjusted 1985/86 data on sources of feed supply given in Table 2, estimates for the year 2000 can be made by projecting production increases for the crops involved. It is assumed that the supply of nutrients from grazing and range sources will not expand during the period in question. Several rangeland and livestock specialists,[33] have stated that grazing resources are currently utilized to their maximum and that there is little prospect of improvements in pasture management during the period of discussion. This leaves the crop sector to bear almost all of the burden of producing the extra domestically-derived nutrients required to maintain Pakistan's ruminant and poultry population at the turn of the century.

The only other source of nutrients is from imported feedstuffs and non-traditional feeds. Changes to current policies could make more imported feed nutrients available and the use of non-traditional feeds could be greatly increased. These two possibilities are discussed in the final section of this report.

Within the crop subsector, grazing of stubbles can only increase with a total increase in cultivated land area. As stated below, this increase is likely to amount to no more than one percent yearly until the end of the present decade.[34] The situation regarding fallow grazing is even more unpromising, since continued growth of mechanized land cultivation and the further development of pump irrigation is gradually diminishing fallow area in favor of double cropping. With virtually no new land coming into production, any gain in crop area that increases total nutrients from crop residues and stubble can only be at the expense of the overall area of fallow grazing.

The report of the National Commission on Agriculture (March, 1988) assumed an overall growth in crop production of 4.5 percent per annum between 1987/88 and 1999/00. It was estimated that 3.1 percent of this increase would come from yield growth and 1.0 percent from area growth. Individual crop targets seem rather optimistic in most cases. Growth in production of wheat, the most important food and feed crop, is projected at 3.5 percent annually, despite the fact that during the 1980s it grew at only 2.6 percent. Total production of all types of rice is estimated to rise at an annual rate of 4.1 percent, while during the five years to 1989/90 it had only attained 0.09 percent. Similarly, annual growth of maize production is targeted at 5.0

percent, yet the record of the past decade (2.7%) has been little better than for wheat. Conversely, in the light of its performance during the past 7 years, the 3.9 percent annual target for seed cotton production seems rather modest. Details of National Commission's estimates broken down by area, yield and production growth are given on an individual crop basis in Table 9 below.

TABLE 9: Pakistan: Crop Targets and Productivity: 1987/88 - 1999/2000

CROP	1988 - 2000			1999/2000
	Area Growth %	*Yield Growth %*	*Production Growth %*	*Total Production '000 tons*
Wheat	0.5	3.0	3.5	20480
Basmati Rice	2.6	4.8	7.7	2050
Other Rice	-0.3	2.8	2.6	3320
Maize	2.0	3.0	5.0	1980
Mill/Sorg.	1.5	5.4	7.0	1100
Pulses	0.9	2.1	3.0	1050
Sugar Cane	1.1	2.4	3.5	49000
Cotton	0.4	2.8	3.2	1020
Oilseeds	5.5	1.8	7.3	1020
Fodder	2.6	3.0	5.4	104359
Tobacco	0.0	2.7	2.7	110
Horticulture	3.1	3.6	6.7	15800

Source: Report of the National Commission on Agriculture

An estimate of total feed nutrients from the above crop production scenario was made by re-calibrating the model used to calculate the situation in 1985/86 (See Annex B). If crop production targets for 1999/2000 are achieved, this would result in an increase in TDN of almost 45 percent over the 1985/86 figure, a rise of over 2.6% annually. In the case of DP, the projected increase is about 48 percent or 2.8% per annum.

Because, as argued above, The National Commission's crop production estimates are probably too optimistic, alternate projections of feed nutrient levels are made using different assumptions for the rate of production increase of the major crops. These assumptions were

arrived at by studying production trends during the 1980s and by reviewing likely future technical changes. They were also influenced by the performance of individual commodities in the 3 years that have elapsed since the original targets, used in the first scenario, were established. As in the initial crop production calculation, constant real crop prices were assumed. Table 10 contrasts both sets of assumptions in terms of production levels and growth rates.

This set of revised feed estimates, derived from a more realistic crop production scenario, results in a sharply lower output of feed nutrients. Compared to an expansion of 45 percent, there is a only a 32 percent increase in TDN over the 1985/86 base year, equivalent to a rise of almost 2.0% annually. As opposed to 48% in the first scenario, the increase in DP is just over 35 %, or nearly 2.5% at an annual rate.

TABLE 10: Alternative Crop Projections 1985/86 - 1999/2000

	Adjusted Assumptions		Commission Assumptions	
CROP	***Production Growth (%)***	***Total Production ('000 tons)***	***Production Growth (%)***	***Total Production ('000 tons)***
Wheat	2.0	18,564	3.5	20,480
Basmati Rice	3.2	1,397	7.7	2,050
Other Rice	0.0	2,122	2.6	3,320
Maize	2.0	1,231	5.0	1,980
Millet/Sorg.	3.0	722	7.0	1,100
Pulses	3.0	1,206[35]	3.0	1,050
Sugar Cane	1.0	32,007	3.5	49,000
Cotton	7.0	3,141	3.9	2,040
Oilseeds	4.0	2,714	7.8	2,075
Fodder	5.0	104,359	5.4	104,359
Horticulture	7.0	15,018	6.7	15,800

Source: Report of the National Commission on Agriculture plus assumptions

The two sets of feed estimates are contrasted in Table 11, in which it will be noted tha no increases have been assumed for feed nutrients derived from either rangelands of othe sources of grazing.

TABLE 11: Sources of Feed Supply - 1999/2000: Two Possible Scenarios
(million tons)

CROP TYPE	Adjusted Assumption		Commission Assumption	
	TDN	*DP*	*TDN*	*DP*
Crop Straws	21.31	0.67	25.81	0.91
Fodder Crops	16.86	2.53	17.15	2.55
Weeds/Stubble	5.96	0.36	6.76	0.40
Oilseed/Cotton	1.97	0.86	1.38	0.60
Grains/Brans	5.59	0.86	6.98	1.06
Other Crops	3.29	0.14	4.63	0.14
Total Crops	**54.99**	**5.41**	**62.71**	**5.65**
Rangelands	7.65	0.69	7.65	0.69
Other Graze	11.70	1.20	11.70	1.20
Other Feeds	1.36	0.43	1.46	0.46
TOTAL	**75.69**	**7.55**	**83.52**	**7.99**

Source: Annex B

9.3 Future Feed Demand

Demand for livestock feed in 1999/2000 has also been estimated by developing two distinct scenarios. The first is based upon projections of the livestock population made in the report of the National Commission on Agriculture. It could be called the "intensive technology option" since the number of animals does not rise at anywhere near past rates and yield improvements are relied upon for the major portion of the production increase. The second option was developed on the grounds that the high rates of assumed yield increase are not justified and that most of the anticipated increase in meat and milk will derive from higher livestock populations. In many ways it represents a continuation of past trends with the population growth rate slightly reduced.

The first scenario is more efficient from the viewpoint of feed utilization, since the overhead incurred in simply maintaining the livestock population is spread over a higher output. The higher the yield obtained in livestock production, the lower is the percentage of total feed used for maintenance. Table 12 contrasts the two sets of future output assumptions and also gives the estimates of the number of adult buffaloes and cattle at the end of the century.

TABLE 12: Two Scenarios for the Annual Expansion of Livestock Production to the Year 1999/2000

POPULATION ASSUMPTIONS				
	Adult Buffaloes		**Adult Cattle**	
	Female (%)	*Male (%)*	*Cows (%)*	*Bulls (%)*
Commission Plan	1.0	1.0	1.5	-0.5*
Adjusted Plan	3.0	3.0	3.0	-0.5
PRODUCTION ASSUMPTIONS				
	Milk (%)	*Beef (%)*	*Mutton (%)*	*Poultry (%)*
Commission Plan	4.6	4.8	4.7	9.5
Adjusted Plan	4.0	4.0	3.0	9.5

* originally 1.5% in Commission Report

The adjusted estimates allow for a continued increase in the population of buffaloes of 3 percent annually—somewhat lower than the inter-censal (1976 - 86) annual growth rate of 3.6 percent. Cattle population is also expected to increase at a reduced rate. Three percent for adult females and -0.5% for adult males, compared with 3.9% and -0.9% inter-censal growth.

This adjusted estimate embodies the continued effect of the process of tractorization of farm operations and the consequent reduced importance of work oxen within the cattle herd. Only a one percent annual increase in milk yield is anticipated, at constant real prices for milk and milk products, compared with 3.6 percent in the estimates of the Commission.

Production is higher in the "intensive technology" scenario. Although both scenarios forecast a 9.5 percent annual increase in poultry meat production, there are significant discrepancies in the growth rate projections of milk, beef and mutton production. The greatest

difference is for mutton (1.7 percentage points of growth), while beef (0.8 percentage points) and milk (0.6 percentage points) also exhibit important differences.

It is felt that price incentives and possible technological breakthroughs are unlikely to produce improvements in milk yield of the magnitude assumed by the Commission. The assumption of 4.2% annual yield growth for buffaloes and 3.5% for cattle contrasts with the adjusted assumption of 1% for both cattle and buffaloes. Similar large discrepancies exist for assumed increases in carcass weight—beef production (1.0% per annum versus 3.8%) and mutton production (3.2% per annum versus 0%). Again, these assumptions are made on the basis of constant real product prices. The nutrient needs implied by the two sets of assumptions are contrasted in Table 13.

TABLE 13: Nutrient Needs Implied By the Two Production Scenarios for the Year 1999/2000

(million tons)

	Adjusted Assumptions		Commission Assumptions	
Animal Type	***TDN***	***DP***	***TDN***	***DP***
Cattle	28.27	2.42	30.55	2.94
Buffaloes	36.41	3.18	31.96	3.32
Sheep/Goats	11.24	1.19	13.05	1.31
Equine/Camels	4.61	0.40	4.61	0.40
Poultry	2.99	0.65	2.99	0.65
TOTAL	**83.53**	**7.85**	**83.17**	**8.62**

Source: Annex C

Each scenario forecasts similar levels of nutrient need, from the viewpoint of energy, so the Commission scenario produces higher production growth rates more efficiently. The difference in efficiency has been enhanced, compared to the original Commission assumptions, because the continuation of change in gender structure within the cattle herd has been built into the model as in the case of the adjusted scenario. While continued change in the gender structure of the cattle herd will undoubtedly take place, it is highly dubious whether any of the Commission's yield targets will occur without very strong incentives in the form of steep price rises in real terms. This possibility will be examined later in the report.

The balance between the nutrition needs indicated by the two production scenarios and the output of TDN and DP estimated by the two alternative sets of feed production assumptions embodied in Table 10, is summarized in Table 14 below.

TABLE 14: Pakistan: Summary of Nutrient Needs and Nutrient Output, Year 1999/2000

(million tons)

	Adjusted Assumptions		Commission Assumptions	
Feed	*TDN*	*DP*	*TDN*	*DP*
Supply	75.69	7.55	83.52	7.99
Demand	83.53	7.85	83.17	8.62

Both sets of assumptions result in a nutrient gap. The gap is not great in view of the margin of error inherent in this type of calculation, but it does indicate a continuation of the precarious balance noted with respect to the situation in 1986. As a pair, the original Commission assumptions show only a moderate feed deficit. There is a slight surplus in terms of TDN, but protein (DP) is 7 percent below calculated needs in this "high technology" production scenario. The adjusted assumptions, that are thought to be more realistic in terms of nutrient supply and demand, result in a gap of more than 9 percent for TDN, but less than 4 percent DP. A "worst case" combination of adjusted feed supply estimates and Commission estimates of feed utilization needs would produce an energy gap of 7.48 million tons of TDN (a shortfall of 9%). In terms of protein, the gap would be in the region of 1.07 million tons of DP (a shortfall of 12.5%).

9.4 Future Demand for Livestock Products

The Commission on Agriculture estimated two sets of demand growth rates related to demand for agricultural commodities. Both appear to be based upon reasonable assumptions, but the authors of this report selected the moderate growth rate set as being the more appropriate. This alternative predicted an annual growth in demand for milk at constant prices of 4.9 percent, and for an aggregate of all meats a growth of 6.2 percent. In order to compare these demand estimates with the supply increases assumed in the two production scenarios above, the production growth rates of beef, mutton and poultry meat have been averaged (weighing according to per capita consumption by all groups in the latest HIES). This produces an estimate of annual increases in meat production of 5.3 percent for the Commission assumptions and 4.5 percent for the adjusted assumptions. The assumed rates of production increase for milk are also lower than the estimated growth in demand (4.6% for the Commission production assumptions and 4.0% adjusted assumptions, versus 4.9% demand increase).

9.5 Closing the Feed and Ruminant Products Gaps

As previously stated, the figures for feed output and feed demand produced by the adjusted scenarios are a priori the more realistic combination, since they accord more closely with recent trends and assumptions concerning future developments. However, this combination produces the greater shortfall of feed nutrients and would result in the greater rise in feed prices. The price rises would be accentuated by the inelasticity of supply of almost all animal feedstuffs. This, in turn, would have the effect of raising the cost of livestock production (causing an inward movement of the supply curve) and hence, causing a rise in product prices. In the absence of government interventions to stabilize food costs (e.g. subsidized imports of meat and milk powder), meat and milk prices would rise even without a shortage of animal feedstuffs, since the adjusted production scenario does not meet estimated demand levels. The feed gap will simply increase the severity of price rises.

Steep price rises for livestock products will, however, provide an incentive to move the equilibrium position towards the second livestock production scenario—the higher yield and lower animal population option. This change will take place more quickly if the price of straw—the fundamental maintenance ration for cattle and buffaloes—becomes more costly relative to other feeds. The adjusted production growth rates for wheat (2%) and rice (0%) would lead to the conclusion that this is exactly the situation that will emerge.

Wheat prices are subsidized and total demand satisfied by resorting to imports, while rice prices are determined on the international market. This means that prices of these grains would be less affected by slow growth in domestic grain production than would the price of their straw, which is a by-product. Supplies diverted to animal feed (wheat grain and broken rice) would increase in response to higher prices of livestock products, as farmers intensify feed regimes in an attempt to raise yields. Similarly, green fodder production (not a concentrate but a high-quality source of protein) would be stimulated by higher feed prices and more would be fed if livestock product prices rise faster than green fodder prices. This is likely to happen as the supply of green fodder is likely to be price-elastic—there is a gap between actual farm and research station yields that is greater than that for almost any other type of crop.

The combination of intensified animal feeding and lower ruminant populations, together with expanded use of green fodders and cereal grains (mainly wheat) will close the feed gap. The food gap—the difference in demand and supply of livestock products—will be closed by a combination of more efficient technology producing outward shifts of the supply curve (better husbandry) and a move up the supply curve in response to higher product prices (more intensive feeding and higher yields) together with lower levels of demand increase caused by the same price rises.

9.6 The Poultry Feed Situation in the Year 2000

Despite the relatively small proportion of total animal feedstuffs utilized by the commercial poultry industry, it is important to examine the feed situation for poultry very

carefully. The cost of broiler and egg production is highly sensitive to feed costs and the efficiency of feed conversion is equally sensitive to feed quality. In 1985/86, commercial and semi-commercial poultry feed production was estimated at around 1.15 million tons, equivalent to 830,000 tons of TDN and 180,000 tons of DP. At that time, poultry was a minor constituent of total feed consumption, accounting for somewhat less than 2 percent of total TDN and under 4 percent of DP. With the high rate of growth assumed for poultry to the end of the decade, however, the situation will change and the demand by poultry on total animal feed supplies will become a more significant factor in the livestock subsector. By that time, it is estimated that commercial and semi-commercial poultry will consume 3.6 percent of total TDN and 8.3 percent of total DP.

Even more importantly the percentage of available concentrated feedstuff ingredients needed by the poultry industry would constitute a much higher proportion. For example, assuming the same proportions of ingredients as a currently typical ration, 820,000 tons of broken rice and rice polishings, 410,000 tons of cottonseed meal and 290,000 tons of wheat bran and 410,000 tons of maize gluten would be needed each year. In addition, 1.88 million tons of wheat grain would be used annually by the industry, an amount greater than the annual average level of wheat imports over the past 3 years.

Although it is generally asserted that there is a physiological limit on how much wheat can be used in poultry rations before feed conversion suffers, the writer was not able to locate published evidence to this effect. If feed manufacturers attempt to restrain the proportion of wheat in their product, however, prices for broken rice and rice polishings and maize gluten could rise rapidly unless large imports of maize develop. Since no maize has yet been imported, despite the lifting of import duty, it can be concluded that sufficient incentives on the part of poultry feed manufacturers have yet to develop. However, the remaining levies on imports still amount to a tax of 27.5 percent and this will be passed on to the consumers of poultry products if imports do begin.

Projections of the number of commercial poultry in the year 2000 also indicate an annual demand for around 120,000 tons of fishmeal. Since domestic supplies are unlikely to increase much above their present level of 30,000 tons, a large deficit is in the process of developing rapidly. Fishmeal imports would currently face total import charges in the region of 50 percent of landed value. The situation for imports of meat meal and blood meals is similar. Animal proteins should ideally constitute at least 10 percent of total protein in poultry rations. Therefore, in the absence of a radical overhaul of the Pakistan meat industry to provide most of the increased demand for animal protein, poultry feed costs are certain to rise as feed manufacturers are forced to pay for imports made costly by current government trade policies. Even worse, feed manufacturers will probably attempt to dilute rations even further from the viewpoint of animal proteins. This will give rise to an industry of "semi-vegetarian" chickens with very inefficient feed conversion ratios leading to rapid rises in the price of poultry products.

10. POSSIBLE ADJUSTMENTS AND POLICY ISSUES

10.1 Technological Change

The technological changes with the greatest potential impact on the ruminant feed situation are 1) straw treatments to enhance digestibility, 2) methods of incorporating urea into the ration as a means of boosting protein intake, and 3) use of poultry manure as a ruminant feed. All have been well-researched but have not yet been applied on a significant scale.[36] The rise in the price of dry fodder, noted in Section 5.2, will accelerate under both feed production scenarios developed in the previous section and will eventually furnish a sufficiently powerful incentive to change feed husbandry techniques.

Since wheat straw treated with ammonia has a crude protein content that is 46 percent higher than untreated straw, this technology has the potential for halving the protein deficit. Further substantial gains in protein can be made through widespread use of molasses/urea blocks. Increased focus on these technologies is obviously of the highest priority when formulating livestock extension policies.

Concerning poultry production, no radical new technology of the sort mentioned above is readily available. However, the lifting of import duty on soybean meal may have precipitated an important process of change in terms of the major source of protein concentrates of vegetable origin. Unless current efforts to expand soybean production in Pakistan are more successful than they have been to date, it is logical to anticipate growing imports of soybean meal. These imports will be used to substitute for much of the cottonseed meal now being used. The degree of substitution will depend on the effort made by the manufacturers of cottonseed meal to raise the quality of their product. A likely response will be a diversion of the product to the manufacture of dairy rations, where the problem of quality is not so acute.

A further process of change in feed technology would be precipitated by the abolition of the wheat subsidy and the facilitation of maize imports by removing some of the remaining levies. This would cause wheat to be replaced by maize as the main cereal ingredient of poultry rations. At this point the ingredients of poultry feed produced in Pakistan would be similar to those in most of the rest of the world, i.e., mainly maize and soybean meal. Further progress in raising poultry feed efficiency would be achieved by liberalizing imports of animal proteins.

10.2 Parity Price and Trade Policy Issues

Whatever point is reached between the two extremes represented by the different livestock production scenarios presented in Section 9.3, a feed shortage would theoretically develop. In the absence of specific incentives to raise crop production above those assumed by the Agricultural Commission, and thus above the adjusted targets, the implied deficit will result in the rise of feed prices. As already discussed, a wide range of livestock feeds have inelastic supply schedules, so the feed gap will be filled mainly by using more wheat and by producing

more green forage. The use of more wheat would greatly expand wheat imports and burden the government budget with increased subsidy payments. Despite these adjustments, prices of livestock products would still rise, in reaction to the higher price of some feedstuffs and because neither production scenario would deliver the quantities demanded at constant real prices.

This outcome is partly due to the slow adoption of more intensive animal husbandry technology and is not only caused by a shortfall in feed supply. Nonetheless, livestock product prices will not increase to the same extent if crop production levels can be raised. One policy change that could offer the sort of incentive to raise the total production of most crops would be the adoption of trade parity pricing for traded agricultural products. Essentially, one would expect all those crops shown in Section 8 with an NPC of less than unity to achieve higher production levels under such a regime.

The crops with the lowest NPCs would receive the greatest incentive, so the production of cotton and basmati rice would be catalyzed more than wheat and IRRI rice. The new price incentives would result in intensified production and expanded area. Area would be expanded at the cost of much of the remaining fallow grazing as well as that of the currently subsidized crops. Intensification would take the form of increased fertilizer use, heavier applications of animal manure where available, and also more careful weeding and better timing of crop operations.

This last development could have an important moderating effect on potential wheat expansion, because of the fact that both rice and cotton normally follow wheat in the main irrigated rotations. Even at present price levels, there are conflicts between the need to complete rice and cotton harvesting and the need to finish sowing wheat before the end of November. After this date, wheat yields are reduced progressively.[37] Even at current price ratios it has been demonstrated that it pays to delay wheat sowing and complete a fourth picking of cotton. Parity pricing would further reinforce this conclusion, thus constraining sought-after yield increases for wheat. In the case of the wheat-rice sequence, the recent adoption of Basmati-385 has ameliorated the problem of late wheat sowing but has not removed it.[38]

Despite the negative effect of poorer timing, it is probable that wheat production would increase because of area expansion, more intensive husbandry and higher levels of fertilizer. Parity pricing would, therefore, probably enable the Commission targets for wheat and rice production to be attained. As a result more straw and rice bran, but not more wheat grain or wheat bran would be produced for use in animal feed rations.[39] It would increase the growth in cotton production by an much higher rate than current official estimates. This would result in a boost to supplies of protein concentrates, such as cottonseed cake and meal, with important consequences for the dairy industry.

Any effect on the availability of maize and maize by-products and residues for feed purposes would not result from a direct price stimulus, since maize is currently priced very close to import parity. However, the rise in wheat prices implicit in the move to parity pricing would cause some substitution of maize for wheat for feed purposes. If maize imports continue to be

deterred by the remaining import levies (around 25% of cif price), this substitution could not be very great before domestic maize prices would be driven up to the level of the new wheat price. If these levies were to be removed, however, maize could be imported at around three-quarters of the cost of wheat and the process of substitution would cause a total replacement of wheat in the poultry industry, as well as in the manufacture of ruminant feedstuffs.

Apart from this effect, the poultry industry would benefit from relatively cheaper cottonseed meal after a move to parity pricing. This price decline might be enough to ensure a place in the poultry feed market for cottonseed meal in face of increased competition from imported soybean meal. This is doubtful, however, since demand for both cottonseed meal and cottonseed cake will grow very rapidly due to the anticipated expansion of the dairy industry. Further major benefits for the poultry industry could, as already discussed, be derived from a more liberal import policy with respect to animal proteins, vitamins and amino-acids.

10.3 Specific Recommendations

Apart from a general recommendation to move towards a trade parity pricing regime, several more specific policy recommendations are listed below:

Policy Adjustments: As discussed above, a move towards parity pricing would improve the livestock feed situation in Pakistan, especially if it was combined with measures to facilitate the import of maize (on the same basis as current arrangements for soybean meal). Removal of import restrictions on fishmeal, meat meal and blood meal would greatly improve the poultry feed situation, especially if combined with similar measures to facilitate imports of vitamins, minerals and other feed supplements. Incentives for the expansion of the solvent extraction industry would improve supplies of high quality oilseed meals and measures to expand the use of manufactured ruminant feeds would have a positive impact on the production of milk and red meat.

Better Data on Feed Availability: Better information on feed availability is needed in order to improve relevant policies and investment programs. Despite their importance as a source of protein feed, data on the main production parameters (area, yield and output) for green fodders is not included in official statistical series in the same way as for other crops. Their inclusion would facilitate the calculation of national feed availability. A further improvement would be gained if the USAID-assisted, crop-cutting exercises would incorporate routine weighing of straw and chaff when measuring grain yields. Price series for different types of fodders should be initiated on a national basis.

Technology Generation and Dissemination: Increase productivity of green manures is of the utmost importance and calls for improved research and extension efforts. Breeding programs for cereals, pulses and oilseeds should systematically evaluate new genetic materials for improved by-product production that contributes to livestock feed. In this respect, improving the feeding value and yield of cereal straws should receive the greatest priority. The situation regarding the use of combined harvesters for cereal harvesting should be carefully monitored

from the viewpoint of its effect on the availability of straw as fodder. Combines that can chop straw as finely as static threshers, and then deliver it effectively in bags, should be developed. Research to modify existing combines and develop new ones with the above specifications should be supported. Extension campaigns to popularize straw treatments (urea and ammonia) should receive more emphasis, together with measures to increase the use of urea/molasses blocks and the feeding of poultry manure to ruminants. Finally, improvements to slaughter facilities and slaughtering technology would enhance national production of blood and meat meals, so programs aimed at this goal deserve support.

ANNEX A

TABLE A.1: Production of Major Livestock Products 1971/72 to 1990/91
('000 Tonnes)

Year	Milk	Beef	Mutton	Poultry Meat	Eggs (Million)
1971/72	7,800	346	208	14	583
1972/73	7,899	349	224	19	695
1973/74	8,044	354	245	24	811
1974/75	8,173	357	265	27	907
1975/76	8,348	362	288	34	1,159
1976/77	8,524	375	303	37	1,443
1977/78	8,704	389	319	41	1,557
1978/79	8,888	404	335	44	1,805
1979/80	9,075	418	352	49	2,094
1980/81	9,267	434	370	52	2,319
1981/82	9,462	448	389	57	2,664
1982/83	9,662	464	408	75	3,200
1983/84	10,242	488	436	86	3,619
1984/85	10,856	513	467	99	4,093
1985/86	11,500	539	500	114	3,460
1986/87	12,198	567	534	122	3,800
1987/88	12,900	595	570	154	4,140
1988/89	13,708	626	610	172	4,300
1989/90	14,528	658	653	195	4,680
1990/91	15,400	692	678	222	5,000

Source: Livestock Division, Ministry of Agriculture 1990/91 figures are provisional.

TABLE A.2: Consumption per capita in Calories and as a Percentage of Household Expenditures on Foodstuffs, All Income Groups

SOURCE	Quantity (kgs.)	Calories	Expenditure %
Wheat and Flour	10.62	1277	16.56
Rice and Flour	1.22	144	3.98
Pulses	0.53	63	3.31
Dairy Products(liters)	7.22	203	23.89
Edible Oils	0.65	189	6.52
Meat and Poultry	-	58	8.65
Fruit and Veg	9.24	100	12.06
Sugar Products	1.17	147	7.76
Other	0.43	0	17.27

Source: National Household Income and Expenditure Survey, 1987/88
Federal Bureau of Statistics

TABLE A.3: Monthly Per Capita Consumption of Major Foodstuffs in Pakistan—All Income Groups

Date of HIES	Milk (liters)	Beef (kgs)	Mutton (kgs)	Chicken (kgs)	Eggs (#)	Wheat/Wheat Flour (kgs)
1970/71	4.38	0.32	0.10	na	1.38	10.63
1971/72	4.66	0.34	0.10	na	1.47	11.30
1979	5.18	0.41	0.16	0.05	1.35	11.20
1984/85	6.34	0.42	0.14	0.05	1.62	10.74
1985/86	6.67	0.42	0.12	0.06	1.54	10.96
1986/87	6.61	0.44	0.12	0.07	1.65	10.67
1987/88	6.72	0.41	0.11	0.07	1.33	10.62

INDICES 1979=100

Date of HIES	Milk (liters)	Beef (kgs)	Mutton (kgs)	Chicken (kgs)	Eggs (#)	Wheat/Wheat Flour (kgs)
1970/71	84.62	77.75	60.88	-	102.32	94.95
1971/72	89.92	82.62	64.69	-	108.74	100.91
1979	100.00	100.00	100.00	100.00	100.00	100.00
1984/85	122.39	102.44	87.50	100.00	120.00	95.89
1985/86	128.76	102.44	75.00	120.00	114.07	97.86
1986/87	127.61	107.32	75.00	140.00	122.22	95.27
1987/88	129.73	100.00	68.75	140.00	98.52	94.82

Source: National Household Income and Expenditure Surveys
Federal Bureau of Statistics

TABLE A.4: Real Retail Food Prices Major Food Products, 1960 - 1989, Rs/Kg

Year	Wheat	Rice	Veg Ghee	Pulses	Beef	Mutton	Poultry *	Milk	Eggs	Desi Ghee
1960	1.34	2.23	9.77	2.73	3.98	8.[illegible]	n.a.	2.11	n.a.	18.27
1961	1.36	2.04	9.90	3.78	4.32	8.87	n.a.	2.10	n.a.	17.79
1962	1.25	2.11	8.59	3.98	4.46	9.43	n.a.	2.14	n.a.	17.86
1963	1.34	2.03	7.99	3.85	4.42	10.13	n.a.	2.03	n.a.	17.20
1964	1.31	2.02	11.57	3.76	4.47	10.89	n.a.	2.18	n.a.	17.84
1965	1.25	1.86	11.10	3.75	4.36	11.08	n.a.	2.31	n.a.	17.61
1966	1.42	2.23	12.13	3.57	3.99	10.30	n.a.	2.23	n.a.	17.28
1967	1.35	2.93	10.65	3.42	4.23	11.10	n.a.	2.34	n.a.	17.01
1968	1.23	2.70	9.49	3.74	4.60	11.32	n.a.	2.42	n.a.	17.18
1969	1.23	1.99	10.[illegible]	4.27	4.64	11.30	n.a.	2.52	6.05	17.77
1970	1.23	1.80	11.05	4.14	5.39	12.53	n.a.	2.56	5.96	18.25
1971	1.33	2.00	10.29	3.51	5.18	12.33	n.a.	2.54	6.25	20.90
1972	1.27	2.52	9.56	4.38	5.13	11.72	n.a.	2.56	5.89	19.18
1973	1.22	2.58	9.34	4.64	6.25	12.03	n.a.	2.55	6.13	25.47
1974	1.44	2.05	9.42	3.75	6.57	12.72	n.a.	2.68	5.77	22.95
1975	1.30	2.04	9.64	3.36	6.45	12.43	n.a.	2.71	5.50	21.36
1976	1.21	2.17	8.66	4.00	5.99	12.27	13.10	2.71	5.35	20.61
1977	1.22	2.34	8.02	4.58	5.65	12.48	12.30	2.58	5.22	21.94
1978	1.26	2.33	7.58	4.48	5.77	12.95	11.68	2.51	4.72	25.13
1979	1.20	2.05	7.57	3.86	5.66	12.75	12.71	2.45	4.63	25.48
1980	1.11	2.06	6.79	4.07	6.04	13.82	11.78	2.36	4.74	22.53
1981	1.17	2.42	6.14	5.37	6.10	13.57	11.97	2.37	4.42	20.28
1982	1.17	2.45	5.88	4.67	6.17	13.38	12.46	2.50	4.58	20.44
1983	1.16	2.28	6.30	4.87	6.17	13.54	11.91	2.48	4.61	24.01
1984	1.20	2.23	6.52	4.50	6.21	13.78	11.79	2.62	4.12	25.44
1985	1.23	2.21	6.19	4.24	6.38	13.80	12.45	2.58	4.21	23.83
1986	1.19	2.16	5.83	4.11	6.88	14.75	12.95	2.57	4.46	23.03
1987	1.09	2.10	6.12	4.37	7.18	15.67		2.51	4.49	
1988	1.10	2.03	6.67	5.50	7.84	16.18		2.42	4.90	
1989	1.15	2.01	6.56	4.39	8.20	16.85		2.52	3.99	

Source: Pakistan Statistical Yearbook, 1990-91

TABLE A.5: Real Retail Food Price Indices: 1960 - 1989

	Indices (1975=100)									
Year	Wheat	Rice	Veg Ghee	Pulses	Beef	Mutton	Poultry *	Milk	Eggs	Desi Ghee
1960	102.81	109.19	101.36	81.32	66.49	67.31	n/a	77.79	n/a	88.63
1961	104.60	99.98	102.72	112.61	72.10	72.29	n/a	77.42	n/a	86.31
1962	96.07	103.49	89.14	118.59	74.52	76.85	n/a	78.97	n/a	86.63
1963	103.18	99.33	82.89	114.66	73.90	82.59	n/a	74.74	n/a	83.43
1964	100.55	98.79	120.06	111.85	74.62	88.81	n/a	80.37	n/a	86.57
1965	96.03	91.14	115.17	111.46	72.77	90.29	n/a	85.24	n/a	85.42
1966	109.14	109.12	125.86	106.29	66.62	83.96	n/a	82.11	n/a	83.84
1967	103.56	143.56	110.50	101.92	70.63	90.50	n/a	86.25	n/a	82.52
1968	94.79	132.21	98.40	111.41	76.91	92.31	n/a	89.20	n/a	83.35
1969	94.48	97.43	110.73	126.94	77.60	92.12	n/a	93.08	113.11	86.18
1970	94.24	88.02	114.60	123.22	89.99	102.12	n/a	94.28	111.34	88.53
1971	102.42	97.90	106.73	104.47	86.62	100.49	n/a	93.76	116.89	101.39
1972	97.62	123.52	99.21	130.28	85.73	95.51	n/a	94.31	110.01	93.06
1973	93.61	126.24	96.88	138.13	104.49	98.06	n/a	93.96	114.52	123.56
1974	110.81	100.72	97.77	111.67	109.70	103.69	n/a	98.86	107.91	111.32
1975	100.00	100.00	100.00	100.00	107.76	101.33	n/a	99.97	102.80	103.62
1976	92.91	106.57	89.84	119.03	100.00	100.00	100.00	100.00	100.00	100.00
1977	93.86	114.74	83.17	136.36	94.43	101.70	93.91	95.22	97.58	106.42
1978	97.00	114.09	78.65	133.44	96.36	105.59	89.14	92.46	88.16	121.93
1979	92.48	100.29	78.48	114.88	94.56	103.92	97.05	90.25	86.60	123.61
1980	85.20	100.92	70.43	121.05	100.99	112.69	89.96	87.02	88.65	109.28
1981	90.12	118.72	63.68	159.92	101.91	110.66	91.37	87.26	82.53	98.36
1982	89.82	120.28	61.01	139.01	103.11	109.05	95.14	92.10	85.69	99.17
1983	89.51	111.87	65.35	144.94	103.07	110.36	90.94	91.58	86.15	116.47
1984	92.01	109.36	67.65	133.78	103.81	112.37	89.98	96.83	76.92	123.42
1985	94.82	108.14	64.17	126.30	106.54	112.47	95.05	95.30	78.72	115.60
1986	91.53	105.67	60.44	122.31	115.02	120.27	98.88	94.75	83.29	111.74
1987	84.20	03.06	63.46	130.19	119.94	127.73	0.00	92.64	83.84	0.00
1988	84.33	99.41	69.17	63.82	31.03	131.93	0.00	89.30	91.62	0.00
1989	88.22	98.77	68.01	130.65	137.01	137.36	0.00	92.94	74.53	0.00

Source: Pakistan Statistical Yearbook, 1990-91

TABLE A.6: Pakistan Production: 1970/71-1989/90

Production Indices (1970=100)					
Year	Wheat	Maize	Sugar Cane	Cotton	Rice
1970	100	100	100	100	100
1971	106	98	86	130	103
1972	115	98	86	130	106
1973	118	107	103	122	112
1974	118	104	92	117	105
1975	134	112	110	95	119
1976	141	106	127	80	124
1977	129	114	130	106	134
1978	154	111	118	87	149
1979	163	122	119	134	146
1980	177	135	140	132	142
1981	175	130	158	138	156
1982	192	140	140	152	157
1983	168	141	148	91	152
1984	181	143	139	186	151
1985	215	141	120	223	133
1986	186	155	129	242	158
1987	196	157	143	271	147
1988	223	168	159	263	145
1989	223	164	153	269	146

Source: Agricultural Statistics of Pakistan 1989-90, Economic Wing, Ministry of Food, Agriculture and Cooperatives

TABLE A.7- Punjab: Real Fodder Prices in January for Six Major Cities

	(Rs per 100 kgs)									
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
INDEX	177.5	185.8	199.4	210.7	219.9	227.8	242.1	267.3	283.4	315.1
GREEN FODDER										
Lahore	11.3	13.5	17.6	21.4	10.2	10.3	7.4	10.3	10.9	13.3
Faisalabad	14.1	9.7	16.9	20.5	11.7	10.8	12.5	12.0	9.5	9.8
Sargodha	12.7	11.8	16.3	15.4	9.3	12.1	13.7	9.4	8.8	12.7
Multan	9.3	11.8	18.2	21.4	9.8	9.6	16.0	9.4	10.2	8.9
Bahawalpur	9.9	10.8	18.8	20.5	11.2	13.2	9.3	9.7	16.2	9.8
Gujranwala					9.2	9.1	14.0	10.5	15.2	11.1
DRY FODDER										
Lahore	15.5	19.5	11.3	14.5	17.1	24.8	17.0	25.4	25.8	23.8
Faisalabad	22.5	20.9	10.8	17.5	17.1	18.2	16.1	18.0	25.8	17.1
Sargodha	15.2	16.1	11.9	17.5	17.1	22.8	17.7	24.3	26.5	17.5
Multan	15.5	23.4	11.6	18.7	17.6	20.9	22.2	17.6	30.7	25.1
Bahawalpur	19.7	21.5	11.3	13.1	18.0	18.7	16.4	15.7	30.3	23.2
Gujranwala					19.3	18.7	18.3	15.9	24.0	18.4

Source: Directorate of Agriculture (Economics and Marketing) Government of Punjab

TABLE A.8: Punjab: Real June Fodder Prices in Six Major Cities: 1981 - 1990

(Rs./100 Kgs.)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
C.P.INDEX	177.5	185.8	199.4	210.7	219.9	227.8	242.1	267.3	283.4	315.1
GREEN FODDER										
Lahore	10.6	14.1	11.3	10.9	10.2	10.8	11.4	12.3	10.2	11.4
Faisalabad	14.1	9.1	10.5	10.7	11.8	14.8	12.0	15.7	8.5	14.0
Sargodha	10.7	10.4	13.8	12.3	11.6	10.4	11.8	12.7	9.5	11.7
Multan	8.7	10.4	11.3	11.9	7.4	12.6	8.3	9.7	8.1	8.9
Bahawalpur	9.3	12.1	13.8	11.0	12.5	12.1	11.6	16.8	14.5	8.6
Gujranwala					10.7	6.7	9.3	11.2	8.5	11.1
DRY FODDER										
Lahore	14.1	15.9	15.8	16.6	14.8	13.0	17.2	26.6	14.8	21.9
Faisalabad	14.6	16.1	18.8	13.7	13.5	15.2	13.4	15.3	15.5	13.6
Sargodha	15.5	14.8	17.6	13.9	19.3	17.1	14.7	26.9	15.2	14.9
Multan	15.5	19.5	14.3	17.7	14.2	19.8	18.4	17.6	18.7	13.3
Bahawalpur	20.6	18.8	21.3	13.0	17.1	16.5	16.7	20.6	24.0	18.4
Gujranwala										

Source: Directorate of Agriculture (Economics and Marketing) Government of Punjab

ANNEX B: SUPPLY OF LIVESTOCK FEED

1. Adjustments to the Livestock Sector Study

Major adjustments were necessary to the calculations made in the 1987 Livestock Sector Study, concerning nutrients derived from crop production. Although the calculations were based upon official production figures, certain discrepancies were discovered and remedied.

Among the most important of these discrepancies was the ratio of grain to straw, which was found to be too low for both wheat and rice. These ratios were increased from 1:1.25 to 1:1.8 for wheat and from 1:1.1 to 1:1.8 for rice.[1] The percentage of DP in straw was raised from 0.3% to 3.5% for wheat and from 0.4% to 4.0% for rice. Cottonseed meal was adjusted for the fact that lint to seed ratio is 1 : 2 and that only 85% of cottonseed is crushed; while crushed seed yields 46% of cottonseed meal/cake. Figures for other oilseeds were adjusted to reflect the fact that rapeseed oil dominates this category. Forage yields were increased from 26 tons/ha. for rabi fodder to 52 tons; and for kharif fodder from 14 tons/ha to 25 tons. Sugarcane molasses were added as being potentially available although mainly exported. Animal proteins and concentrates were deducted from "Other Crops" transforming the table to one that considers the feed supplies to ruminants rather than ruminants plus poultry.

Before these adjustments to crop sector nutrient supplies, it appeared that a serious shortfall of both energy and protein supplies was being faced in the light of the higher livestock numbers revealed by the 1986 Census. This supposed shortfall seemed to contradict the fact that prices of most ruminant feeds were actually falling in real terms during the inter-censal period (1976-1986).

The shortfall in the level of nutrient availability calculated in the Study, was initially attributed to a major underestimate of the nutrient value of grazing resources. Since these had been treated as a residual due to the absence of accurate production data, it was felt that this was a reasonable assumption. In the event, the adjustments made to crop sector and sources yielded a sufficient net increase in total nutrients to cover most of the extra feed needs of the larger 1986 livestock population. The original nutrient supply calculations related to grazing and rangelands were, therefore, accepted. Table B.1 summarizes the adjusted 1986 situation with regard to sources of livestock feed supplies.

The table shows the effect of the adjustments upon the amounts of TDN and DP derived from the main categories of feed supplies. The crop sector is considered to be supplying 46 percent more TDN and 52 percent more DP than in the original estimates. There has also been a slight increase in the relative importance of the crop sector, especially as a source of protein. As a source of energy (TDN), the crop sector is providing 66 percent of the total, compared to an unadjusted figure of 63 percent. In terms of protein (DP), the sector is seen to emerge as the major source—accounting for 64 percent of the total, as opposed to the previous estimate of 53 percent.

[1] Estimates grain to straw ratios vary widely. The estimates were made as a result of a discussion with CIMMYT personnel. The ratio normally adopted for wheat is 1:2, but it was decided to use a more conservative ratio.

TABLE B.1: Sources of Feed Supply: 1987 Survey Estimates and Adjusted Estimates

(million tons)

Source of Nutrients	Sector Study		Adjusted Data	
	TDN	*DP*	*TDN*	*DP*
Crop Sector	29.66	2.27	42.06	3.45
Rangelands	4.64	0.48	4.64	0.48
Other Grazing	11.70	1.20	11.70	1.20
Other Feeds	1.35	0.37	0.84	0.23
TOTAL	**47.35**	**4.32**	**57.34**	**5.05**

Table B.2 gives details of the calculation for the adjusted 1986 situation. Table B.3 illustrates the calculation of the feed supply situation in the year 2,000 adopting the assumptions embodied in the report of the 1986 Commission on Agriculture. Table B.4 gives details of the estimates made for the year 2000 using an adjusted set of assumptions concerning future crop production levels.

TABLE B.2: Calculation of Available Nutrients from All Sources Using Adjusted Assumptions: 1985/86

Source of Feed	Portion fresh basecorn	Dry matter %	Dry matter TDN %	Dry matter DP %	Fresh TDN %	Fresh DP %	1985/86 production	Nutrients TDN (000 tonnes)	Nutrients DP (000 tonnes)
GRAIN									
Wheat	0.100	88	90	14	79	12	13,923	1,103	165
Rice (broken)	0.080	89	75	7	67	6	2,919	156	14
Barley	0.300	88	82	11	72	10	131	28	4
Sorghum/Millet	0.400	90	89	9	80	8	477	153	15
Maize	0.750	88	93	8	82	7	1,009	619	53
BRAN/MILLED PRODUCTS									
Wheat bran	0.250	89	71	13	63	12	12,531	1,980	368
Rice bran	0.103	91	74	10	67	9	2,685	186	24
Maize gluten	0.150	90	83	23	75	21	200	22	6
STRAW									
Wheat	1.800	90	42	1	38	1	13,923	9,473	203
Rice	1.800	91	44	2	40	2	2,919	2,104	81
Barley	2.500	91	48	1	44	1	131	143	2
Sorghum/Millet	4.000	85	56	1	48	1	477	908	13
Maize	4.000	85	60	3	51	2	1,009	2,058	96
Oilseeds	1.250	91	63	5	46	2	1,567	901	39
Pulses	1.000	90	54	11	49	8	797	387	64
STUBBLE									
Wheat	0.150	90	42	0	38	0	13,923	789	6
Rice	0.150	91	44	1	40	1	2,919	175	4
Barley	0.150	91	48	1	44	1	131	9	0
Sorghum/Millet	0.100	85	56	1	48	1	477	23	0
Maize	0.100	85	60	3	51	2	1,009	51	2
Oilseeds	0.100	91	63	11	57	10	1,567	90	16
Pulses	0.100	90	54	5	49	5	797	39	4
Fodder-Kharif	0.150	42	55	8	23	3	18,415	638	96
Fodder-Rabi	0.150	16	62	20	10	3	31,470	468	41
SUGARCANE									
Tops	0.330	33	49	2	16	1	27,856	1,486	67
Dry leaves	0.010	85	50	3	43	3	27,856	118	7
Molasses	0.036	75	73	2	55	1	27,856	549	11
SUGARBEET									
Pulp	0.750	15	69	9	10	1	135	10	1
Tops	0.150	84	60	8	16	8	135	3	2
Molasses	0.042	78	76	4	59	3	135	3	0
FODDER									
Kharif	1.000	42	55	5	23	2	18,415	4,254	387
Rabi	1.000	16	64	15	10	2	31,470	3,223	755

Source of Feed	Portion fresh basecom	Dry matter %	Dry matter TDN %	Dry matter DP %	Fresh TDN %	Fresh DP %	1985/86 production	Nutrients TDN (000 tonnes)	Nutrients DP (000 tonnes)
WEEDS									
Field Crops	4.000	15	30	1	5	0	16,309	2,936	49
Orchards	6.000	15	30	1	5	0	430	116	2
OILSEED CAKE									
Cotton	0.736	93	83	37	77	34	1,218	692	304
Others	0.600	94	80	33	75	31	273	123	51
OTHER CROPS									
Mustard/Rape Thins	1.000	15	70	10	11	2	4,000	420	60
Maize thinnings	5.000	15	69	6	10	1	1,009	522	45
Maize cobs	0.300	90	66	0	59	0	1,009	178	0
Cottonseed hulls	0.235	91	52	0	47	0	1,218	136	0
Spoiled Fruit	0.200	10	85	8	9	1	3,609	61	6
Spoiled Veg.	0.100	10	84	18	8	2	2,214	19	4
OTHER FEED									
Milk to Youngstock							3,679	391	110
Non-conventional feeds							680	356	88
Fishmeal							31	24	13
Animal Origin Meal							187	82	62
Total Crop								37,355	3,068
Total other feed								853	273
Total range								7,650	689
Total other grazing								11,700	1,200
GRAND TOTAL								57,558	5,230
DEDUCTION FOR POULTRY FEED								830	181
NET OF POULTRY								56,728	5,049

Notes: Wheat straw:grain ratio is 1.7 and TDN 49 DP=0.35 Rice straw:grain ratio is 1.8 TDN=38 and DP=0.4. Cottonseed:lint ratio is 2.0 and assumed that 85% seed crushed yields 46% meal Rangeland feed resources taken from Noor Mohammad, Rangeland Management in Pakistan ICIMOD, 1989.

TABLE B.3: Calculation of Livestock Feed Nutrients from All Sources: Year 2000 National Agricultural Commission Assumptions

SOURCE OF FEED	PORTION FRESH BASECOM	DRY MATTER %	DRY MATTER TDN %	DRY MATTER DP %	FRESH TDN %	FRESH DP %	YEAR 2000 PRODUCTION	NUTRIENTS TDN ('000 TONNES)	NUTRIENTS DP ('000 TONNES)
GRAIN									
Wheat	0.100	88	90	14	79	12	20,480	1,622	243
Rice (broken)	0.080	89	75	7	67	6	5,370	287	26
Barley	0.300	88	82	11	72	10	0	0	0
Sorghum/Millet	0.400	90	89	9	80	8	1,100	352	35
Maize	0.750	88	93	8	82	7	1,980	1,215	105
BRAN/milled products									
Wheat bran	0.250	89	71	13	63	12	18,432	2,912	541
Rice bran	0.103	91	74	10	67	9	5,370	372	48
Maize gluten	0.150	90	83	23	75	21	1,980	222	61
STRAW									
Wheat	1.800	90	42	1	38	1	20,480	13,935	299
Rice	1.800	91	44	2	40	2	5,370	3,870	150
Barley	2.500	91	48	1	44	1	0	0	0
Sorghum/Millet	4.000	85	56	1	48	1	1,100	2,094	30
Maize	4.000	85	60	3	51	2	1,980	4,039	188
Oilseeds	1.250	91	63	5	46	5	2,370	1,363	135
Pulses	1.000	90	54	11	49	10	1,050	510	104
STUBBLE									
Wheat	0.150	90	42	1	38	1	20,460	1,160	25
Rice	0.150	91	44	1	40	1	5,370	323	7
Barley	0.150	91	48	1	44	1	0	0	0
Sorghum/Millet	0.100	85	56	1	48	1	1,100	52	1
Maize	0.100	85	60	3	51	2	1,980	101	5
Oilseeds	0.100	91	63	11	57	10	4,261	244	0
Pulses	0.100	90	54	5	49	5	1,050	51	5
Fodder-Kharif	0.075	42	55	8	23	3	38,524	667	101
Fodder-Rabi	0.075	16	62	20	10	3	65,835	490	154
SUGARCANE									
Tops	0.330	33	49	2	16	1	49,000	2,615	117
Dry leaves	0.010	85	50	3	43	3	49,000	208	12
Molasses	0.036	75	73	2	55	1	49,000	966	20
SUGARBEET									
Pulp	0.750	15	69	9	10	1	300	23	3
Tops	0.150	84	60	8	16	6	300	7	3
Molasses	0.042	78	76	4	59	3	300	8	0
FODDER									
Kharif	1.000	42	55	5	23	2	38,524	8,899	809
Rabi	1.000	16	64	15	10	2	65,835	6,742	1,580

SOURCE OF FEED	PORTION FRESH BASECOM	DRY MATTER %	DRY MATTER TDN %	DRY MATTER DP %	FRESH TDN %	FRESH DP %	YEAR 2000 PRODUCTION	NUTRIENTS TDN ('000 TONNES)	NUTRIENTS DP ('000 TONNES)
WEEDS									
Field Crops	4.000	15	30	1	5	0	18,739	3,373	56
Orchards	6.000	15	30	1	5	0	1,162	314	5
OILSEED CAKE									
Cotton	0.736	93	83	37	77	34	2,075	1,179	518
Others	0.600	94	80	33	75	31	445	201	83
OTHER CROPS									
Mustard/Rape Thins	1.000	15	70	10	11	2	4,596	483	69
Maize thinnings	5.000	15	69	6	10	1	1,980	1,025	89
Maize cobs	0.300	90	66	0	59	0	1,980	350	0
Cottonseed hulls	0.235	91	52	0	47	0	2,075	231	0
Spoiled Fruit	0.200	10	85	8	9	1	9,308	158	15
Spoiled Veg.	0.100	10	84	18	8	2	5,710	48	10
OTHER FEED									
Milk to Youngstock							7,384	774	218
Non-conventional feeds							1,029	539	133
Fishmeal							31	24	13
Animal Origin Meal							283	124	94
Total crop								62,711	5,652
Total other feeds								1,461	458
Total range								7,650	689
Total other grazing								1,1700	1,200
GRAND TOTAL								*83,522*	*7,999*
			Deduction for Poultry Feed					2,988	652
			NET OF POULTRY					80,534	7,347

NOTES: Wheat straw:grain ratio is 1.7; TDN 49 DP=0.35. Rice straw:grain ratio is 1.8; TDN=38 and DP=0.4. Cottonseed:lint ratio is 2.0 and assumed that 85% seed crushed yields 46% meal. Rangeland feed resources taken from Noor Mohammad, Rangeland Management in Pakistan ICIMOD, 1989.

BLE B.4: Calculation of Livestock Feed Nutrients from all Sources: Year 2000 Adjusted Assumptions

	PORTION USED		DRY MATTER		FRESH		PRODUCTION		NUTRIENTS	
	FRESH BAECOM %	DRY MATTER %	TDN %	DP %	TDN %	DP %	YEAR 1985/86	YEAR 2000	TDN	DP
GRAIN									('000 Tonnes)	
Wheat	0.100	88	90	14	79	12	13,923	18,364	1,454	218
Rice (broken)	0.080	89	75	7	67	6	2,919	3,353	179	16
Barley	0.300	88	82	11	72	10	131	151	33	4
Sorghum/Millet	0.400	90	89	9	80	8	477	722	231	23
Maize	0.750	88	93	8	82	7	1,009	1,331	817	70
BRAN/milled products										
Wheat bran	0.250	89	71	13	63	12	12,531	16,528	2,611	485
Rice bran	0.103	91	74	10	67	9	2,685	3,353	233	30
Maize gluten	0.150	90	83	23	75	21	200	264	30	8
STRAW										
Wheat	1.800	90	42	1	38	1	13,923	18,364	12,495	268
Rice	1.800	91	44	2	40	2	2,919	3,353	2,417	93
Barley	2.500	91	48	1	44	1	131	151	165	2
Sorghum/Millet	4.000	85	56	1	48	1	477	722	1,375	20
Maize	4.000	85	60	3	51	2	1,009	1,331	2,715	127
Oilseeds	1.250	91	63	5	46	2	1,567	2,714	1,561	68
Pulses	1.000	90	54	11	49	8	797	1,206	586	96
STUBBLE										
Wheat	0.150	90	42	1	38	1	13,923	18,364	1,041	22
Rice	0.150	91	44	1	40	1	2,919	3,353	201	4
Barley	0.150	91	48	1	44	1	131	151	10	0
Sorghum/Millet	0.100	85	56	1	48	1	477	722	34	0
Maize	0.100	85	60	3	51	2	1,009	1,331	68	3
Oilseeds	0.100	91	63	11	57	10	1,567	2,714	156	27
Pulses	0.100	90	54	5	49	5	797	1,206	59	5
Fodder-Kharif	0.075	42	55	8	23	3	18,415	38,524	667	101
Fodder-Rabi	0.075	16	62	20	10	3	31,470	65,835	490	154
SUGARCANE										
Tops	0.330	33	49	2	16	1	27,856	32,007	1,708	77
Dry leaves	0.010	85	50	3	43	3	27,856	32,007	136	8
Molasses	0.036	75	73	2	55	1	27,856	32,007	631	13
SUGARBEET										
Pulp	0.750	15	69	9	10	1	135	178	14	2
Tops	0.150	84	60	8	16	8	135	178	4	2
Molasses	0.042	78	76	4	59	3	135	178	4	0
FODDER										
Kharif	1.000	42	55	5	23	2	18,415	38,524	8,899	809
Rabi	1.000	16	64	15	10	2	31,470	65,835	6,742	1,580

	PORTION USED		DRY MATTER		FRESH		PRODUCTION		NUTRIENTS	
	FRESH BASECOM %	DRY MATTER %	TDN %	DP %	TDN %	DP %	YEAR 1985/86	YEAR 2000	TDN	DP
WEEDS										
Field Crops	4.000	15	30	1	5	0	16,309	16,309	2,936	49
Orchards	6.000	15	30	1	5	0	430	1,109	299	5
OILSEED CAKE										
Cotton	0.736	93	83	37	77	34	1,218	3,141	1,784	785
Others	0.600	94	80	33	75	31	273	413	186	77
OTHER CROPS										
Mustard/Rape Thins	1.000	15	70	10	11	2	4,000	5,040	529	76
Maize thinnings	5.000	15	69	6	10	1	1,009	1,331	689	60
Maize cobs	0.300	90	66	0	59	0	1,009	1,331	235	0
Cottonseed hulls	0.235	91	52	0	47	0	1,218	3,141	350	0
Spoiled Fruit	0.200	10	85	8	9	1	3,609	9,308	158	15
Spoiled Veg.	0.100	10	84	18	8	2	2,214	5,710	48	10
OTHER FEED										
Milk to Youngstock							3,679	6,372	677	191
Non-conventional feeds							680	1,029	539	133
Fishmeal							31	31	24	13
Animal Origin Meal							187	283	124	94
Total crop									54,980	5,414
Total other feed									1,364	431
Total range									7,650	689
Total other grazing									11,700	1,200
GRAND TOTAL									**75,694**	**7,734**
		Deduction for poultry feed							830	181
		TOTAL FOR POULTRY							74,864	7,553

Notes: Wheat straw:grain ratio is 1.7; TDN= 9, DP=0.35. Rice straw:grain ratio is 1.8; TDN=38, DP=0.4. Cottonseed:lint ratio is 2.0 and assumed that 85% seed crushed yields 46% meal.
Rangeland feed resources taken from Noor Mohammad, Rangeland Management in Pakistan, ICIMOD, 1989.

ANNEX C: LIVESTOCK NUTRITION NEEDS

LIVESTOCK AND NUTRITION NEEDS

Total quantities of energy (TDN) and protein (DP) needed by the national ruminant herd and poultry flock were calculated for the time of the 1986 Livestock Census and for the projected situation in the year 2,000. The major source of basic coefficients were taken from Kearl, L.C. (1982), *Nutrient Requirements of Ruminants in Developing Countries*, International Feedstuffs Institute, Utah State University, Logan, USA. Where necessary, this source was supplemented by assumptions made in the 1987 Livestock Sector Study.

The basic calculations for 1986 are contained in Table C.1. The following table (Table C.2) is identical in structure, but livestock populations have been changed to those assumed by the National Commission for Agriculture for the year 2,000. In addition, a higher level of nutrient needs is assumed to reflect the higher intensity of production embodied in the Commission forecasts.

Table C.3 also has the same structure, but contains population and nutrient need coefficients that reflect the assumptions made in the adjusted scenario for the year 2,000. This essentially embodies a continuation of the status quo in 1986, since herd and flock growth continues at a relatively high rate, while yield levels improve only at a modest rate or not at all.

TABLE C.1: Pakistan: Livestock Feed Consumption Calculations: 1985/86

ANIMAL CATEGORY	NUTRIENT INTAKE PER HEAD		1986 Census Number	NUTRIENT INTAKE TOTAL (TONNES)	
	TDN	DP		1986 TDN	1986 DP
CATTLE					
Adult Females	1.45	0.125	6,802,503	9,863,629	850,313
Female 1-3 years	1.05	0.095	891,738	936,325	84,715
Female 0-1 years	0.40	0.040	1,611,926	644,770	64,477
Male 0-1 years	0.35	0.035	2,045,103	715,786	71,579
Male 1-3 years	1.05	0.095	819,205	860,165	77,824
Adult Males	1.80	0.145	5,370,125	9,666,225	778,668
Total				22,686,901	1,927,576
BUFFALOES					
Adult Females	2.05	0.180	8,979,714	18,408,414	1,616,349
Female 1-3 years	1.45	0.125	1,647,071	2,388,253	205,884
Female 0-1 years	0.55	0.045	2,509,943	1,380,469	112,947
Male 0-1 years	0.45	0.040	1,953,953	879,279	78,158
Male 1-3 years	1.45	0.130	417,302	605,088	54,249
Adult Males	2.05	0.180	197,460	404,793	35,543
Total				24,066,295	2,103,130
SHEEP & GOATS					
Adult Females	0.19	0.020	31,002,189	5,890,416	620,044
Male/Female 0-1 yr	0.08	0.010	16,164,594	1,293,168	161,646
Adult Males	0.22	0.020	6,064,999	1,334,300	121,300
Total				8,517,883	902,990
EQUINES/CAMELS					
Adults	1.05	0.090	3,461,378	3,634,447	311,524
<3 years	0.4	0.04	952,331	380,932	38,093
Total				4,015,[illegible]9	349,617
GRAND TOTAL				*59,286,459*	*5,283,313*

	NUTRITIONAL INTAKE PER HEAD									NUTRITIONAL INTAKE TOTAL			
	1986		2000		DATA: 1986 Census		Estimates: Year 2000			1986		2000	
ANIMAL TYPE	*TDN*	*DP*	*TDN*	*DP*	*Total Head*	*% of Herd*	*Growth Rate*	*Number of Head*	*% of Herd*	*TDN (Tonnes)*	*DP*	*TDN (Tonnes)*	*DP*
CATTLE													
Adult Females	1.45	0.125	1.80	0.20	6,802,503	38.8	1.50	8,380,684	41.1	9,863,629	850,313	15,085,231	1,676,137
Female 1-3 years	1.05	0.095	1.30	0.12	891,738	8.3	1.50	1,098,621	5.4	936,325	84,715	1,428,208	131,835
Female 0-1 year	0.40	0.040	0.80	0.07	1,611,926	16.4	1.50	1,985,893	9.7	644,770	64,477	1,588,714	139,012
Male 0-1 years	0.35	0.035	0.60	0.04	2,045,103	11.9	1.50	2,519,567	12.3	715,786	71,579	1,511,740	100,783
Male 1-3 years	1.05	0.095	1.20	0.11	819,205	4.9	1.50	1,009,261	4.9	860,165	77,824	1,211,113	111,019
Adult Males	1.80	0.145	1.80	0.15	5,370,125	29.0	-0.05	5,407,838	26.5	9,666,225	778,668	9,734,108	784,137
Total								**20,401,863**		**22,686,901**	**1,927,576**	**30,559,114**	**2,942,922**
BUFFALOES													
Adult Females	2.05	0.180	2.30	0.25	8,979,714	57.2	1.00	10,317,691	57.2	18,408,414	1,616,349	23,730,690	2,579,423
Female 1-3 years	1.45	0.125	1.80	0.16	1,647,071	24.5	1.00	1,892,485	7.3	2,388,253	205,884	3,406,472	302,798
Female 0-1 years	0.55	0.045	0.70	0.07	2,509,943	49.4	1.00	2,883,925	12.1	1,380,469	112,947	2,018,747	201,875
Male 0-1 years	0.45	0.040	0.70	0.05	1,953,953	5.8	1.00	2,245,092	3.6	379,279	78,158	1,571,564	112,255
Male 1-3 years	1.45	0.130	1.60	0.16	417,302	0.9	1.00	4,794,80	0.6	605,088	54,249	767,168	76,717
Adult Males	2.05	0.180	2.05	0.20	197,460	0.4	1.00	226,882	0.3	404,793	35,543	465,107	45,376
Total								**18,045,554**		**24,066,295**	**2,103,130**	**31,959,749**	**3,318,443**
SHEEP/GOATS													
Adult Females	0.19	0.020	0.22	0.02	31,002,189	54.7	2.00	40,891,887	28.3	5,890,416	620,044	8,996,215	858,730
Male/Female 0-1 yrs	0.08	0.010	0.10	0.01	16,164,594	60.7	2.00	21,321,099	20.4	1,293,168	161,646	2,132,110	255,853
Adult Males	0.22	0.020	0.24	0.02	6,054,999	57.9	2.00	7,999,734	9.1	1,334,300	121,300	1,919,936	191,994
Total								**70,212,720**		**8,517,883**	**902,990**	**13,048,261**	**1,306,576**
EQUINES/CAMELS													
Adults	1.05	0.090			3,461,378	78.4	1.00	3,977,123	39.2	3,634,447	311,524	4,175,979	357,941
<3 years	0.0	0.0			952,331	100.0	1.00	1,094,228	17.7	380,932	38,093	437,691	43,769
Total								**5,071,352**		**4,015,379**	**34,9617**	**4,613,671**	**401,710**
Ruminant Total										*59,286,459*	*5,283,313*	*80,180,795*	*7,969,651*
Poultry Total												*2,990,000*	*650,000*
GRAND TOTAL												**83,170,795**	**8,619,651**

TABLE C.3: Pakistan: Livestock Feed Consumption Estimates: Adjusted Scenario - Year 2000

Animal Category	NUTRIENT INTAKE PER HEAD							TOTAL NUTRIENT INTAKE			
	TDN	DP	1986 Census #s	% Herd	Growth Rate	Pop. Estimates: Year 2000	% Herd	1986 TDN	1986 DP	2000 TDN	2000 DP
CATTLE											
Adult Females	1.45	0.125	6,802,503	38.8	3.00	10,292,107	45.5	9,863,629	850,313	14,923,671	1,286,523
Female 1-3 years	1.05	0.095	891,738	8.3	3.00	1,349,200	3.9	936,325	84,715	1,416,660	128,174
Female 0-1 years	0.40	0.040	1,611,926	16.4	3.00	2,438,844	7.3	644,770	64,477	975,538	97,554
Male 0-1 years	0.35	0.035	2,045,103	11.9	1.50	2,519,567	5.6	715,786	71,579	881,848	88,185
Male 1-3 years	1.05	0.095	819,205	4.9	1.50	1,009,261	2.3	860,165	77,824	1,059,724	95,880
Adult Males	1.80	0.145	5,370,125	29.0	-0.50	5,009,445	10.5	9,666,225	778,668	9,017,001	726,370
Total						22,618,503		22,686,901	1,927,57[illegible]	28,274,441	2,422,685
BUFFALOES											
Adult Females	2.05	0.180	8,979,714	57.2	3.00	13,586,307	57.2	18,408,414	1,616,349	27,851,930	2,445,535
Female 1-3 years	1.45	0.125	1,647,071	24.5	3.00	2,492,018	7.3	2,388,253	205,884	3,613,427	311,502
Female 0-1 years	0.55	0.045	2,509,943	49.4	3.00	3,797,544	12.1	1,380,469	112,947	2,088,649	170,889
Male 0-1 years	0.45	0.040	1,953,953	5.8	3.00	2,956,331	4.3	879,279	78,158	1,330,349	118,253
Male 1-3 years	1.45	0.130	417,302	0.9	3.00	631,378	0.7	605,088	54,249	915,498	82,079
Adult Males	2.05	0.180	197,460	0.4	3.00	298,757	0.3	404,793	35,543	612,452	53,776
Total						23,762,335		2,066,295	2,103,130	36,412,304	3,182,036
SHEEP AND GOATS											
Adult Females	0.19	0.020	31,002,189	54.7	2.00	40,891,887	28.3	5,890,416	620,044	7,769,459	817,838
Male/Female 0-1 yrs	0.08	0.010	16,164,59[illegible]	60.7	2.00	21,321,099	20.4	1,293,168	161,646	1,705,688	213,211
Adult Males	0.22	0.020	6,064,999	57.9	2.00	7,999,734	9.1	1,334,300	121,300	1,759,941	159,995
Total						70,212,720		8,517,883	902,990	11,235,088	1,191,043
EQUINES/CAMELS											
Adults	1.05	0.090	3,461,378	78.4	1.00	3,977,123	39.2	3,634,447	311,524	4,175,979	357,941
<3 years	0.4	0.04	952,331	100.0	1.00	1,094,228	17.7	380,932	38,093	437,691	43,769
Total						5,071,352		4,015,379	349,617	4,613,671	401,710
Ruminant Total								59,286,459	5,283,313	80,535,305	7,197,475
Poultry										2,990,000	650,000
GRAND TOTAL										*83,525,505*	*7,847,475*

ANNEX D: INCENTIVE AND DISINCENTIVE EFFECTS OF EXISTING POLICY MEASURES

TABLE D.1: Summary of Policy Effects

Feed Source	Feed Cost	Domestic Supply	Total Supply
Wheat Grain	L	L	H
Wheat Bran etc.	L	L	H
Broken Rice etc.	H	L	L
Wheat/Rice Straw	H	L	L
Maize Gluten	H	H	L
Cottonseed Meal	H	L	L
Sunflower Meal	H	H	L
Molasses	L	H	H
Green Forage	L	H	H
Fallow Grazing	L	H	H

L - Lower Cost/ Reduced Supply H - Higher Cost/ Greater Supply
Source: Author's estimates

The aggregate effect of existing policy measures upon current feed costs and domestic supply levels has been estimated in qualitative terms in this annex. Table 4.1 indicates whether these policies have causes costs to rise of fall, and supply to increase or decrease, compared to levels that would exist in the absence of government intervention. The table is not particularly easy to interpret, since some of the signs are counter-intuitive. In the case of wheat, however, the fact that household consumers of wheat are subsidized means that feed millers and poultry farmers are able to obtain wheat grain at lower prices than would rule in the absence of government interventions (L). On the other hand, growers receive lower prices as a result of such policies and can be assumed to produce less than they would have done at higher trade parity prices. This lower level of domestic supply (L) has not been allowed to lead to higher consumer prices, as wheat imports are subsidized. These subsidized imports push total supply higher than if Pakistan had been self-sufficient in wheat at higher producer prices, since they stimulate both domestic food and feed consumption (H).

The availability of wheat straw has, however, been reduced and as a consequence straw prices are higher than they would have been at higher levels of supply. Subsidized imports consist of whole wheat and are milled in Pakistan so, to the extent that the consumer subsidy increases total wheat consumption, it both increases the supply and lowers the price of wheat bran and other by-products of the wheat flour industry.

Broken rice has commonly been used in the manufacture of poultry feed and for feeding directly to ruminants. Increasing amounts are also used for the manufacture of cereal-based products such as baby food and broken basmati has grown in popularity as a substitute for whole rice for human consumption. Despite this diversified pattern of demand, the price of broken rice has fallen in real terms by an average of 0.86 percent annually throughout the 1980s. This is mainly because substitution of subsidized wheat by feed manufacturers has offset the increasing demand from the growing food processing industries. With NPCs well below unity, especially in the case of basmati rice, potential production has been depressed and production growth has been slow throughout the 1980s (only 0.31% annually). Whole rice is an export commodity and the export duties mean that it is available to domestic consumers at a lower cost than the trade parity equivalent. In the case of broken rice, however, only limited quantities are exported so price is determined by domestic supply and demand forces. Since all rice is processed before export, the depressed producer price and consequent lower production level has led to reduced availability of broken rice and milling by-products. The result is a higher price for these commodities than would occur at more favorable producer prices (and therefore higher production levels) for rice. Rice straw is similarly affected, as supply is depressed and prices consequently higher than they would be if a trade parity producer price was in effect.

Maize producers receive a price that is slightly higher than trade parity equivalent and therefore receive an incentive as a result of price and trade policies. However, as stated in Section 4.2, during the 1980s maize production only grew at about the same annual rate as wheat (2.66% and 2.63% respectively). Despite the fact that import duties on maize were abolished in 1990, the continued existence of sales tax and other levies, plus the availability of cheap wheat, has prevented any imports up to the present time. Maize gluten is an important ingredient of poultry feed whose rising real price indicates a supply shortage. The excess demand for maize gluten can not be met by imports, since it is still subject to a 20 percent import duty.

The NPC for cotton is about the same as for IRRI rice and represents a production disincentive. Since cottonseed meal and cake are by-products of cotton lint production, price policy depresses domestic supply, thus raising domestic prices. The continued existence of a 20 percent import duty on oilcakes and oilmeals (with the exception of soybean meal) currently obviates the possibility of imports. This duty theoretically also has a negative effect on the total supply of sunflower meal. However, even without this duty, it is unlikely to be able to compete with Indian soybean meal, because of higher freight costs. Since sunflower seed would have to be imported from Europe or Latin America, problems would arise regarding freight rates and other charges arising from the relatively small amounts likely to be purchased. The positive NPC for sunflower means that growers benefit from a price incentive relative to the position they would face if trade parity prices were allowed and other vegetable oils able to compete freely. The failure of sunflower to become a major crop despite modest production increases suggests that this incentive is not sufficient to cause farmers to switch crops.

Molasses, green fodder and fallow grazing all benefit from the current pricing policy. Sugar cane growers receive a price above import parity equivalent and this acts as a positive

production stimulus. Even this has not been enough to prevent production languishing in the present decade (annual growth is 0.25%). Molasses face an export duty of 25 percent, but this has not been enough to stimulate its use in the domestic feed industry and the bulk is still exported. The main reason for this failure is the fact that the manufacture of ruminant feed is minimal. The small amount that is retained for domestic purposes is used mainly by the tobacco industry.

The fact that many major crops are either near parity (maize) or substantially below it (rice, wheat and cotton) favors the existence of fallows and the cultivation of green forage (including green maize and sugarcane tops). Since hay and green forage are only traded domestically, they are not subject to import duties and their accompanying levies. The positive overall supply impact indicated in Table D.1 is therefore considered to be in the same direction as for domestic supply impact.

The aggregate effect of direct government price and trade policies is strongly to the detriment of the livestock feed situation. The major exceptions are wheat grain and its milling derivatives, plus the last three commodities discussed.

ENDNOTES

1. FAO/ADB Cooperative Program 1987 Vol. 1, Ch. 3 gives details of production systems by region and type of animal.

2. Sheep and goats often graze land that can not be cropped and are less integrated into the farming system. In Pakistan official statistics, mutton is defined as both sheep and goat meat. Peri urban production of milk from buffaloes is a further distinct production system, but probably accounts for less than 6% of the milking buffalo population.

3. Wherever more than two datapoints are involved, growth rates have been estimated from semi-log regressions. Estimates of production, livestock numbers, and consumption are from different sources and data bases. Attention is called in the text and notes to some of the more apparent inconsistencies.

4. For more details, see Economic Analysis Network 1987.

5. FAO/ADB 1987, *Pakistan Livestock Sector Study, Vol. 1-2.*

6. Government of Pakistan 1989.

7. For example, see Government of Punjab 1991, 59.

8. It might be argued that lactating cattle need a higher level of nutrition than draught bullocks, but at the levels of milk yield normally obtained in Pakistan this is incorrect.

9. It should be noted that vegetable ghee is an important source of calories—being more important than liquid milk alone. In terms of expenditure, however it is much less than dairy products. Compared to these, and to meat products, vegetable ghee is a cheap source of calories.

10. In view of its high income elasticity of demand, this result is anomalous. It also contradicts official data on the growth of mutton production (although it is consonant with inter-censal growth rates for sheep and goats). It is likely that data concerning flock numbers and total offtake are heavily distorted by movements and marketing of refugee livestock on the border with Afghanistan.

11. Goldman 1992.

12. Much of the information on wheat production presented in this part of the paper is taken from Byerlee and Siddiq 1989.

13. In Pakistan wheat is fed as a mixture of chopped straw and chaff (*bhusa*), which is the form in which the mechanical threshing process leaves it. Most rice straw, however is fed without being chopped, since it is threshed by hand. Despite a theoretically higher DP content, even Basmati 385 straw fetches only one third of the wheat straw price. Without doubt, farmers have

judged the chopped wheat straw and chaff to have a substantially higher feeding value than rice straw, despite the evidence of the animal nutrition tables.

14. See Byerlee an Siddiq 1989.

15. RONCO 1991.

16. FAO/ADB Cooperative Programme 1987 Vol. 2, Annex 4.

17. RONCO.

18. *IBID.*

19. *Ibid.*

20. Government of Punjab.

21. *Ibid.*

22. Goldman 1991, 13-17.

23. FAO/ADB, Vol. 1 Ch V, para 5.2.

24. For more details, see Scott.

25. *Ibid.*

26. Personal communication, Gary Ender, Senior Economist, Abt Associates/USAID Islamabad.

27. This statement applies both in relation to the wheat import parity price calculated in Goldman 1991 and to the more recent calculations of World Bank consultant Jim Longmyer (personal communication).

28. For more detail of cotton price and trade policy interventions, see Block 1991.

29. Although broken rice contributes 10-20 percent of the volume of commercial poultry rations at present, it is likely that most is derived from IRRI varieties. Human consumption of broken rice is estimated to be increasing (personal communication, Salman Elahi, Enterprise and Development Consulting (Pvt.) Ltd.—both for direct use and in manufactured forms such as baby food. It is assumed that most direct consumption is of broken basmati—the preferred rice.

30. For a discussion of macroeconomic effects on the price of major agricultural commodities in Pakistan, see Dorosh and Valdés 1990.

31. See Shafiq et al. 1991.

32. Most rainfed (*barani*) wheat is mixed with rape/mustard which is harvested green. The physical ratio for grain:straw:mustard is 1:2:4.5. Gross output percentages are as follows: grain 56%; straw 16%; mustard 27%.

33. This was also the consensus of opinion arrived at during the preparation of the *Pakistan Livestock Sector Study* (Annex 2, p. 4-3, para II).

34. The report of the National Commission on Agriculture (March 1988) assumed an overall growth in crop area of one percent per annum between 1987/88 and 1999/00.

35. The seeming discrepancy between production total for crops increasing at the same rate in both scenarios, is caused by different base years: 1987/88 for National Commission Estimates and 1985/86 for adjusted estimates.

36. See in particular, Muller 1986.

37. The work of PARC/CIMMYT researchers is extremely important on this topic. For example, see Smale 1987, Tetley 1988, and Aslam 1989.

38. See Sharif 1989 for more details.

39. Since new wheat production would reduce wheat import by an equivalent amount, its volume of wheat grain and bran available for animal production would be unchanged. However, wheat straw production and availability would increase since it is not imported.

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