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**The CGPRT Feed Crops Supply/Demand and
Potential/Constraints for their Expansion
in South Asia**

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The Demand for Animal Products, Animal Feeds and the Scope to Expand Feed Crops in the South Asian Region

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Introduction

The last few decades have seen a rapid and massive increase in the consumption of animal products throughout the world (Table 1). This phenomenon has been more evident in developing countries and as a result, the focus of animal production in the world is moving from temperate to tropical areas. At the same time, the production base in these countries is also changing from the traditional local, mixed-farms to intensive, market-oriented, vertically integrated agri-businesses. Finally, the dominant type of meat produced and consumed in developing countries is also changing from ruminants to poultry and swine.

Table 1. Per capita consumption of animal products (kg per annum)

	Developed countries		Developing countries	
	1973	1993	1973	1993
Beef	26	25	4	5
Mutton/Goat	3	3	1	1
Pork	26	29	4	9
Poultry	11	20	2	5
Eggs	13	13	2	5
Dairy	188	195	29	40

Source: Authors' calculation.

A team of researchers from the International Food Policy Research Institute, the Food and Agriculture Organization of the United Nations and the International Livestock Research Institute (*see Delgado et al.*, 1999) have used these trends to make projections of consumption and production of animal products in developing countries up to the year 2020. They have estimated from their model that during the next two decades, meat and milk consumption will grow at 2.8 and 3.3 per cent per annum in less developed Countries (LDCs) (Table 2) and that meat consumption in LDCs will more than double compared to increases of less than 20 per cent in developed countries. At the same time, the demand for milk will increase by 223 million mt in developing countries compared to an increase of only 18 million mt in the developed world.

They have predicted that, in value terms, products from livestock will equal or exceed those from crops by the year 2020 and have termed it the "livestock revolution"

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Table 2. Past, current and projected consumption of meat and milk

	(million mt)					
	Meat			Milk		
	1983	1993	2020	1983	1993	2020
World	139	184	303	355	412	654
Developed	88	97	115	233	245	263
Developing	50	88	188	122	168	391

Source: Authors' calculation.

These projected increases in production of milk from ruminants and, in particular, meat from swine & poultry will, in turn, create a huge demand for compound feeds high in energy and protein. Ruminant concentrate rations which are used to supplement forages, are generally more flexible and can be formulated with a variety of alternate energy feeds and oil cakes. On the other hand, rations for high producing poultry and swine are more demanding and the two preferred feed ingredients used are maize and soybean meal, both CGPRT crops. Due to a number of technical reasons, both these ingredients are difficult to replace in modern pig and poultry diets and a particular demand is being created for these two ingredients. Other coarse cereals and CGPRT crops such as pulses, roots and tubers can contribute towards monogastric feeds by substituting at least partly for these two main ingredients, they are, however, likely to be more significant in dairy feeds.

At present, only a few countries in the world produce surpluses of maize and soybean meal for export (Table 3). Most other countries in the world are net importers of one or both these ingredients.

Table 3. Chief exporters of maize and soybean meal (85 per cent of world exports)

	Maize 1,000 mt		Soybean meal 1,000 mt
US	41,491	US	6,441
Argentina	6,424	Argentina	8,123
France	7,124	Brazil	10,013
		India	2,915

Source: FAO, 1997.

The actual global situation in the year 1993 and projections to 2020 for meat and feed cereals in the world are shown in Table 4 (Delgado *et al.*, 1999). From the discussion above and particularly from Table 4, it can be seen that the expected increase in poultry and swine meat production in the developing world will lead to large deficits of feed ingredients, particularly cereals, in developing countries and that they will have to be imported from the developed world. There is a need, therefore, to investigate the real conditions, opportunities and constraints for feed crop farming in the South Asian region and to identify policy options to meet any shortfalls in production.

Table 4. Net balances in the trade of meat and cereals in 1993 and 2020 (projected)

Country/region	Million mt			
	Meat		Cereal	
	1993	2020	1993	2020
China	+0.9	+0.7	-0.9	-46.2
Other SEA	+0.1	+0.5	-3.2	-5.4
India	+0.1	0.0	1.3	-7.1
Other S.Asia	+0.0	-0.6	-4.5	-21.9
Developing	-0.2	-4.3	-93.3	-226.1
Developed	+0.2	+4.3	+93.3	+226.1

Source: Delgado *et al.*, 1999.

Characteristics of the South Asian Countries

Physical and economic

Agriculture is the main preoccupation of people in the region with 57 per cent being dependant upon it (Devendra *et al.*, 2000). Without taking into account the value of manure and draught power, agriculture contributes between 25 and 43 per cent to the GDP of these countries. The relative importance of agriculture and livestock to the economy of these countries is shown in Table 5 below.

Table 5. Agricultural and livestock indicators in South Asian countries (1993)

	India	Nepal	Pakistan	Sri Lanka	Bangladesh
Agriculture as a percentage GDP	31	43	25	20	30
Livestock as a percent agriculture	23	15	45	10	14
Livestock as a percent of GDP	7.1	6.5	11.3	2.0	4.2

Source: Devendra *et al.*, 2000.

Much of the South Asian region is classified as arid or semi-arid with some sub-humid and, unlike in South East Asia, only a relatively small area is considered as humid. Most farming in the region depends on rainfall for cropping and productivity and is therefore affected by seasonal factors (Table 6). Although found in the arid or semi-arid regions and constituting a relatively smaller proportion, irrigated lands are much more productive, some areas of the Punjab in India and Pakistan, for example, compare favourably with some of the most agriculturally productive areas in the world. It can also be seen from Table 6, however, that although the productivity of rainfed areas may be lower, it supports a much higher proportion of farmers.

Table 6. Rainfed agriculture in the region

	Rainfed (RF) agriculture in South Asia			
	RF Area million ha	RF Area % total arable land	% Contribution to Agric GDP	% Population Dependant on RF
India	100	70	26	42
Nepal	2.6	84	41	75
Pakistan	5.4	27	5	12
Sri Lanka	0.5	50	20	29
Bangladesh	7.7	82	41	41

Source: Devendra *et al.*, 2000.

Most cropping systems in the region are rice or wheat based with annual and perennial secondary crops (Devendra *et al.*, 2000) and may be irrigated or rainfed. Meat from ruminants (cattle, sheep and goats) is produced mainly from animals raised on natural grasslands under extensive conditions. Milk, on the other hand is produced primarily on mixed crop-livestock farms using buffalo which, as a species, are able to use the crop residues produced on the farms more effectively.

Animal production in the South Asian region

Current Livestock production

The region has a large and diverse ruminant population with 69 per cent of the world's buffalo and 30 per cent of the goats. Overall a fifth of the world's ruminants are found in the region. Of the world's buffalo, Asia has 97 per cent and South Asia alone, 76 per cent. Asia produces 40 per cent of the meat in the world, but mostly in countries of South East Asia. In contrast, two thirds of the milk production in Asia is produced in South Asia which incidentally produces more than 90 per cent of the world's buffalo milk. Although more than half the eggs in the world are produced in Asia, this is again mostly in South East Asia, particularly China.

It can be seen, therefore, that there are clear differences between South and South East Asia with regard to milk and meat production, with milk dominating in the former and meat in the latter. The difference is most obvious for pigmeat production, whereas Asia produces more than half the pigmeat in the world, South Asia produces only 0.5 per cent. Indeed, 45 per cent of the pigmeat is produced in a single country, China. Aquaculture, although encouraged, has not developed to any significant extent as yet in South Asia with the possible exception of Bangladesh. On the other hand, the poultry meat sector has shown rapid increases in all South Asian countries and is expected to meet much of the increased demand for meat in the region. The current production of meat, milk and eggs in South Asia compared to other parts of the world is shown in Table 8 below (FAO, 2002).

Table 8. Livestock production in the year 2000 (million mt)

Region/Country	Meat	Milk	Eggs
World	232.0	575.0	51.0
Asia	92.0	169.0	29.0
South Asia	7.3	110.0	2.3
India	4.8	80.0	1.8
China	63.0	12.0	19.2

Source: FAO, 2002.

Trends in Livestock production, consumption in the South Asian region

The per capita consumption of animal products from 1961 to 1996 and projections to the year 2015 are shown in Tables 9 and 10.

Table 9. Per capita consumption of meat, milk and eggs and selected food items from 1961 to 1996 and projections to 2015 in South Asian countries (kg/annum)

		Bangladesh	India	Nepal	Pakistan	Sri Lanka	World
Beef + mutton	1961	2.8	3.1	6	6.8	3.4	9.1
	1996	2.3	3.4	8.7	11.6	1.9	11.4
	2015	2.8	3.9	9	14.4	1.8	12.5
Pigmeat	1961	0	0.3	0.4	0	0.1	4.7
	1996	0	0.5	0.5	0	0.1	13.7
	2015	0	0.7	0.6	0	0.2	14.8
Poultry meat	1961	0.4	0.1	0.4	0.2	0.8	2.4
	1996	1	0.5	0.5	2.5	3.1	9.5
	2015	3	1.8	1.1	5	5.7	12.9
Eggs	1961	0.4	0.3	0.9	0.1	1	3.3
	1996	0.8	1.4	0.9	1.7	2.3	7.7
	2015	2.1	3	1.3	3.1	3.7	9
Milk	1961	12.2	37	48	94	18	49
	1996	14.7	57	37	114	33	76
	2015	20	83	40	128	37	82

Source: Authors' calculation.

An analysis of the trends in Table 9 indicates that the per capita consumption of all foodstuffs has increased over this period. When compared to the modest increases in consumption of wheat and rice, however, the increase in consumption of meat, milk and eggs has been substantial. The intake of pulses has declined during this same period. The most marked increase has been for poultry meat and eggs with predicted increases of up to 15 times for chicken meat and 8 times for eggs in 2015 when compared to 1961. The per capita intake of milk will double and of ruminant meat increase by 50 per cent during this same period. When compared to per capita increases in the world, the region shows a much higher rate of increase for chicken meat, eggs and milk but a lower rate for pigmeat. Increases in the consumption of wheat, rice, vegetables and ruminant meat are similar in the region to world averages with both showing a noticeable decline in the intake of pulses.

These changes have not been similar, however, throughout the region. Whereas the increases in wheat and rice and the decline in pulses have been constant in all countries in South Asia, consumption of ruminant meat has only increased in India and Pakistan. Intake of milk has increased in all countries except Nepal but the increases have been mostly in India and Pakistan.

Table 10. Per capita consumption (kg/annum)

	% increase 1961-2015		per capita consumption by 2015	
	South Asia	World	South Asia	World
Wheat/rice	57	165	136	136
Pulses	-58	9	6	6
Beef/mutton	53	5	12.5	12.5
Chicken meat	1,469	2.4	12.9	12.9
Eggs	827	2.9	9	9
Milk	99	81	82	82
Pigmeat	115	0.5	14.8	14.8

Source: Authors' calculation.

The increase in Chicken meat and egg consumption has been seen in all countries of the region with meat being highest in Pakistan and Sri Lanka, and eggs least in Sri Lanka. It should be noted in this connection, however, that the per capita consumption of meat and eggs in countries of the region remains well below world averages. In contrast, the per capita consumption of milk in South Asia will reach world averages by 2015 but will remain below levels in developed countries.

The demand for meat, eggs and milk in the South Asian region

Ruminant meat

The demand for ruminant meat will increase and will have to be met by increased production and imports. Currently, ruminant meat arises from two sources, animals culled from the dairy industry as well as cattle, sheep and goats raised under extensive conditions on natural forages. Since the areas of natural grazing are limited, and by now perhaps saturated and even overgrazed in many areas, the supply of ruminant meat from this source may not increase to satisfy the demand. Although the supply from the dairy industry may increase with the growth of that sector, it is expected that there will be a net deficit of ruminant meat in the region by 2010. As ruminant meat production is under intensive and grain-fed systems are not economical, feed crops are not expected to play a role in ruminant meat production in the region unless such elite meats are being produced for export.

Swine meat

Swine meat production currently in the South Asian region is negligible when compared to countries of South East Asia. Moreover, growth is also likely to be small and, if at all, limited to a few countries. Demand will increase marginally in some countries, notably India, and can be met by a production increase. Although some compound feeds may be fed to breeding stocks, the majority of animals, the fatteners, are likely to be raised on by-products and swill. The demand for feed crops from this sector in the future will not be significant.

Chicken meat and eggs

The demand for chicken meat and eggs has increased dramatically in the region in the last two decades leading to the rapid development of the poultry industry in all countries of the region. This trend is expected to continue and even accelerate in some countries. It can be expected that the increased demand for meat in the region will be met primarily from chicken meat, a significant change from the earlier dependence on ruminant meat. The unit of production in the region has also changed from the traditional backyard and small-scale deep-litter systems to intensive, large-scale agribusinesses which demand sophisticated management. In the future, the great majority of meat and eggs will be produced using highly productive birds, in intensive commercial systems, comparable to those in developed countries, which will greatly increase the demand for high-quality compound feeds. This demand has led to a parallel growth in the large-scale animal feed industry in the region. Quite often, for reasons of economy, the feed milling, production of day-old chicks, commercial production of meat and eggs and even the supply of inputs such as drugs and services are vertically integrated into one or several companies in the private sector. These trends are expected to continue.

The development and expansion of a modern feed industry to service the expanding poultry industry will need a ready supply of high-quality feed ingredients. The nature of these

feeds - highly concentrated in energy and protein - demands the use of cereals for energy and high-protein oilcakes. The preferred ingredients for this purpose worldwide are maize and soybean meal, both of which are impossible to completely replace in modern poultry diets.

Milk

The South Asian region is well known for its well established milk drinking habit, similar to that in the West but unlike other countries of East Asia. The demand for milk will continue to increase in the region in the next decade and will have to be met primarily from cattle and buffalo and to lesser extent from goats and sheep. These animals are raised on smallholder mixed crop-livestock farms. Much of the milk is produced from buffalo. Under these conditions, the main feed resources for milk production are likely to be limited to crop residues and natural forages with some improved forages, supplemented with agro-industrial by-products.

Although concentrates are fed to these animals, they are generally less demanding in the levels of energy, protein and fiber than for poultry. Feeds for these animals are, therefore, made with brans and oil cakes, the latter with levels of protein lower than soybean meal. Moreover, the ingredients may be fed straight or mixed simply so that elaborate feed mills are not needed. As milk production develops further, however, and high-producing animals are available through breeding programs, there may be some elite animals on large-scale commercial farms that will need feeds high in energy and protein. In India and Pakistan, limited amounts of grains are already being used in dairy rations. Although such systems are likely to be few and limited only to some economic environments such as peri-urban areas at present, they can be expected to expand in the future to meet the demand. Even though the proportion of feed grains in dairy rations is small, the volume is high when compared to poultry feed and the dairy industry and therefore, may place a significant demand on feed grains, even in South Asian countries.

Feed crops in the region

From the discussion above, it can be concluded that demand for feed crops will arise from both the poultry and dairy industries but that there are qualitative differences between the two.

Modern poultry feeds usually include the following ingredients:

- Energy
 - Maize.
 - Brans and other milling by-products of rice and wheat.
 - Other coarse cereals such as sorghum and millets.
 - Roots and tubers, primarily cassava.
- Protein
 - Soybean meal.
 - Other high protein oilcakes such as groundnut or sesame.
 - Animal proteins, usually from fish meal, meat and bone meal.
- Micronutrients: In the form of premixes.

The ingredients used in dairy rations are usually limited to the following:

- Energy
 - Milling by-products of rice and wheat, including brans and broken rice.
 - Coarse cereals such as maize, sorghum and millets.
 - Roots and tubers.
- Protein
 - Oil cakes, usually with moderate protein levels such as coconut or cotton seed.

It can be seen that the CGPRT crops that can provide ingredients for animal feeding are primarily maize and soybean together with sorghum, pearl and other types of millets and perhaps, cassava. The discussion, therefore, will be focused on these feed crops.

Manufacturing of animal feed in South Asian countries

The Animal Feed Industry in South Asian countries consists of the following components.

- Large-scale integrated operators who make the feed for their own operations.
- Registered commercial manufacturers of animal feeds.
- Smaller producers and “home-mixers”.

The commercial feed mills in South Asian countries are mostly private sector establishments and there appears to be no shortage of investors for this purpose. The scale of operations and the level of sophistication, however, vary widely unlike in developed countries in which the size of the mills and the products themselves are more uniform. Most feed mills have been formed to manufacture feeds for poultry and these have expanded with this industry. In the case of ruminants, concentrates are usually fed only to lactating animals and even in these cases, animals are fed with agro by-products available in the area or with simple home mixes of a few ingredients or what are often called “loose mixes”. Other sectors such as pigmeat (a major consumer of animal feeds in other countries), beef and intensive dairy production are not significant in the region. As a result, only around 10 to 20 per cent of the output of the commercial feed manufactured is for the dairy industry, even though, quantitatively, the amounts of concentrate fed to ruminants is very much higher than that fed to poultry. In India and Pakistan, there are manufacturers who cater specifically to the dairy industry, particularly those operated by the dairy co-operatives.

In general, the concentrate feeding systems in the region may be classified as follows:

- Chicken meat Complete, balanced compound rations.
- Eggs Around two thirds complete rations and a third home-mixed.
- Dairy Majority are loose-mixes or straight feeds with perhaps 20 per cent compound feeds (mostly in India).
- Pigmeat Breeders – complete compound rations.
 Fatteners – usually by-products and swill.

Feed manufacturers and their capacities

At present, none of the countries are importing compound feed but have all established manufacturing facilities. Since many of the feed mills are not registered, it is difficult to accurately estimate the capacity for feed milling in the region. Table 11 shows the estimated capacity from the registered millers.

Table 11. Estimated capacity from registered millers

	Mills	Capacity
Bangladesh	37	260,000
India	228	17,700,000
Nepal	149	500,000
Pakistan	150	650,000
Sri Lanka	17	450,000

Source: Authors' calculation.

In most cases, the installed capacity exceeds the actual quantity manufactured. While many of these mills may operate to international standards and even obtain international standards certification, others are still primitive. It can be said, however, that the industry is capable of expanding to meet the rapidly growing demand for poultry feed.

Ingredients used and their sources

The ingredients used for the manufacture of complete feeds for poultry are similar throughout the region.

Grains	Maize, broken rice, sorghum, wheat, pearl millet and other minor millets.
Brans	Rice and wheat.
Oilcakes	Soybean meal, sesame cake, mustard cake, groundnut meal, sunflower meal and rapeseed meal.
Animal protein	Fish meal, meat and bone meal.
Additives	Micronutrient premixes, antioxidants and antibiotics.

The two main ingredients used by the modern poultry industry are maize and soybean meal which can only be replaced partly in these rations with other coarse cereals and oilcakes respectively. Cattle mixtures are more flexible and other coarse grains and oilcakes with lower protein levels can be used for them. These feeds are, therefore, much more varied. Coarse grains are being used to some extent in dairy rations, particularly in India and Pakistan, where a variety of such grains are available and where there are animals with a high potential.

Many of them, however, import feed ingredients and it is expected that these imports will increase. At present, the only country that can source all its ingredients within itself is India. All other countries import maize and soybean meal (SBM) as well as their substitutes from a range of countries both within and outside the region. Some examples are shown below.

Imports of feed ingredients

Bangladesh	Maize, SBM, rice bran and sesame cake.
Nepal	Maize, mustard cake, finger millet, SBM, sesame cake and groundnut cake.
Pakistan	Maize, SBM and other oilcakes.
Sri Lanka	Maize and SBM.

In addition, all countries including India, import premixes with micronutrients and some fish meal.

Constraints to feed manufacturing in South Asian countries

Some of the difficulties faced by feed manufacturers in these countries have been identified as follows:

- Lack of a ready supply of ingredients at the desired quality.
- High prices and large seasonal variation in prices.
- Lack of infrastructure for minimal processing and storage.
- Lack of quality control standards.
- Lack of legislation for proper regulation in some countries.
- No proper marketing systems or networks for raw ingredients.

These constraints are not found in all countries since many of them are now developing good systems of feed regulation with the necessary legislative backing. In addition, the feed industry in the SA countries needs to be continuously upgraded by training technicians in modern methods of feed manufacture.

The timely availability of ingredients of a consistent quality at prices that do not vary considerably remains the primary need of the industry in order to meet the expanding demand for poultry and cattle feeds. Many manufacturers in the region faced with this problem prefer to import. What is needed is to ensure that both the manufacturer and the farmer benefit from the demand for animal feed. The main strategy, therefore, is to bridge the gap between the primary producer and the feed manufacturer with suitable structures and intermediaries who will attend to the following tasks:

- Purchase of raw material at farm gate at fair prices.
- Attend to immediate processing needs such as dehusking and drying.
- Ensure proper storage.
- Attend to any further processing required.
- Supply quality ingredients to feed manufacturers.

These different tasks may be carried out by one or several persons or organizations together with some infrastructure support. There should be forward contracts between the collector and the farmer on the one hand and the supplier of ingredients and the feed manufacturer on the other, to ensure a smooth flow of ingredients required by the feed industry.

Scope for expansion of feed crops

In a discussion of this nature, to identify the potential for and constraints against expansion of feed crops, it must be appreciated that these will be quite complex issues in a region so vast and varied as South Asia. It must also be remembered that the countries in the region are not equal either in their size or economies and that some countries will be dominant. This discussion will attempt, however, to identify some common issues. The discussion also needs to keep in mind the importance of using this opportunity to alleviate rural poverty in the region. This would mean the need to ensure the participation of smallholder farmers who cultivate marginal land under rainfed conditions and how they can participate in the supply of feed ingredients for the manufacture of animal feed.

Maize and soybean production in South Asia

Although there has been a 3 fold increase in maize production in the region since 1961, it remains a net importer of maize. Most of this increase has been in India and Pakistan where there has been a steady increase in production with a spurt in growth in the 1990s.

Table 12. Maize and soybean production in South Asian countries

	Production of maize (1,000 mt)					Increase %
	1961	1970	1980	1990	2000	
Bangladesh	7.0	3.0	1.5	3.5	4.0	57.1
India	4,300.0	7,500.0	9,300.0	9,400.0	16,000.0	372.1
Nepal	843.0	833.0	743.0	1,230.0	1,445.0	171.4
Pakistan	487.0	717.0	970.0	1,184.0	1,643.0	337.4
Sri Lanka	9.5	14.5	21.0	33.5	31.0	326.3
Total	5,646.5	9,067.5	1,1035.5	1,1851.0	19,123.0	338.67
India %	76.2	82.7	84.3	79.3	83.7	

	Production of soybean (1,000 mt)					Increase %
	1961	1970	1980	1990	2000	
Bangladesh	na	na	na	na	na	
India	5.0	14.0	442.0	2601.0	5085.0	101,700.0
Nepal	2.0	3.5	5.0	12.8	16.8	840.0
Pakistan	0.4	0.9	1.3	0.8	10.0	2,500.0
Sri Lanka	na	na	na	na	na	
Total	7.4	18.4	448.3	2614.6	5111.8	69,078.4
India %	67.6	76.1	98.6	99.5	99.5	

Source: FAO, 2002.

On the other hand, production has been stagnant in Sri Lanka and Bangladesh whilst Nepal has shown small increases. Overall production of maize remains low when compared to countries such as the USA, Brazil and China.

Production of soybean, which was negligible in India in 1960, has shown huge increases since then and India now produces considerable surpluses. Whilst modest increases in production have been shown by Nepal and Pakistan, there is no soybean grown in Sri Lanka or Bangladesh. India produces nearly all (99.5 per cent) of the soybean meal in the region and although overall production in the region is low when compared to the USA, China, Brazil and Argentina, the South Asian region as a whole, produces surpluses and is a net exporter.

Table 13. Trade in maize and soya

Trade in maize and soybean meal in South Asian countries					
Period: 1995 to 1997 cumulative					
(X 100 mt)					
	Maize			Soybean meal	
	Imports	Exports		Imports	Exports
India	0	862	India	0	62,375
Nepal	50	0	Nepal	15	0
Pakistan	136	0	Pakistan	290	0
Sri Lanka	2,588	0	Sri Lanka	1,210	0
Bangladesh	122	0	Bangladesh	120	0

Source: FAO, 1997.

Chief exporters of maize in the world are countries such as the USA, Argentina and France which produce surpluses. Most other countries are net importers. In South Asia, all

countries other than Sri Lanka and Bangladesh are self-sufficient in maize with India exporting modest quantities. The country that imports most maize in the region is Sri Lanka and during the years 1995 to 1997, the region as a whole imported around 200,000 mt.

Of the 46 million tons of oilcakes traded worldwide, the majority (70 per cent) consists of soybean meal for animal feeding. The major exporters are USA, Argentina and Brazil who accounting for 85 per cent of exports. In the SA region, India is the major producer of soybean meal and all other countries import from India with Sri Lanka, once again, being the highest. During the period 1995 to 1997, the region was a net exporter of 6 million mt of soybean meal.

Soybean (meal)

In India, the huge demand for edible oils results in extensive cultivation of oilseeds which has resulted in surpluses of oilcakes including soybean meal. The trade in the oilcakes has in turn given an economic impetus to the oilseed industry. The overall production of oilcake is greater than the requirement for the region. Pakistan has also increased their production of soybean in recent years.

Soybean, from a technical point of view, is considered a relatively easy crop for farmers to grow successfully. Growing soybean as a feed crop in other countries of the region, Nepal, Sri Lanka and Bangladesh, however, will be faced with several difficulties:

- Soya will only be viable as a feed crop if an oil-extracting industry is already in place as in India and Pakistan, and if there is a ready market for this oil.
- If there is no oil-extracting industry, farmers prefer to grow other pulses as cash crops instead.
- The preferential trading agreements between South Asian countries and the bilateral free trade agreements between some will make it difficult to prevent the entry of cheaper SBM from India.

In any event, there appears to be no urgency for other countries in the region to grow soybean as a feed crop for animal feeding if considerable amounts are available for purchase from India. Cultivation of soybean may be viable in these other countries as a food crop provided again that the necessary facilities to process soybean seed are in place.

Other oilcakes from CGPRT crops

Groundnut and sesame are the other two high-protein oilcakes that can be used for poultry feeding although they can only partly substitute SBM. Limited amounts of these oilcakes are already available in most countries of the region to meet this partial substitution. Again, these crops are driven by the demand for the oil rather than the by-product and it is not feasible to promote them as feed crops alone.

The dairy industry is able to use a variety of oilcakes with lower levels of protein and higher concentrations of fiber than poultry. These include cotton seed cake and coconut cake which are used widely in ruminant rations.

Maize and other coarse cereals

The increase in demand for feed grains in the region will have to be met by increasing the production of maize and other coarse cereals and by making them available to the feed industry in sufficient quantities with acceptable quality. If not, projections are that by 2010, all countries in the region including India, will need to resort to large-scale imports. This situation should be seen as a great opportunity, which if exploited, will also provide a steady long-term income for poor, rural farmers. There is also a renewed interest in these cereals among people

looking for high-fiber, unprocessed cereals for health reasons. Governments should, therefore, accord some priority to these crops as, in the past, they have not been given the same degree of support as rice and wheat.

In developed countries, coarse cereals are the main source of energy in animal feeds. In Australia, for example, more than two thirds of the cereals fed to animals consist of barley, sorghum and maize with wheat and milling products providing only a third. In this country, 4,000 out of a total of 6,000 kilotons of feed grain were fed to dairy and beef cattle. In South Asia, the practice of feeding grain to dairy cattle has only started recently and is fed in relatively small amounts. This proportion may need to increase, however, if the animals produced from the numerous breed improvement programs are to perform optimally. Whereas maize is the preferred grain for poultry feeding, other coarse grains such as sorghum and millets could be targeted to the dairy industry in South Asia.

In South Asian countries, unlike in developed ones, coarse cereals are used primarily as food for human consumption, usually by the poorer section of society. According to Indian Government targets, 90 per cent of the coarse cereal production should be used for human food, with 5 per cent as animal feed and 5 per cent for seed. The demand for cereals from the fast growing poultry industry has resulted in this limit already being exceeded, however, and it is estimated that up to 20 per cent of the maize produced is used for animal feed. Estimates for other coarse cereals are pearl millet 50 per cent, barley, sorghum and minor millets 10 per cent.

Maize is the preferred cereal for modern poultry feeds, particularly the broiler feeds, for a number of technical reasons. There are limits to the levels at which all other coarse cereals can be included in such feeds. The rapid growth of the poultry meat sector is therefore placing an immediate demand for maize which has to be accorded a special place in any plans for increasing feed grains.

In India, the coarse grains cultivated include maize (35 per cent), sorghum (29 per cent), pearl millet (bajra, 19 per cent), barley, finger millet (ragi) and several "minor" millets (little millet, kodo millet, foxtail millet, barnyard millet, proso millet and savan millet). The area under these crops has shown a steady decline over the past decade with the exception of maize, which has increased. In the case of maize, area and production are expected to increase from 6.5 million ha and 11.9 million tons to 7.5 million ha and 17.7 million tons respectively by the year 2010. All other coarse grains have shown a decline and although the productivity has increased due to improved germplasm and technology, the overall yield is expected to stagnate up to 2010 for millets and to decline in the case of sorghum and barley.

These coarse cereals are presently grown in the region by the poorer farmers under rainfed conditions on relatively infertile land and as a result, yields are low, they are rarely grown on good land under irrigation. For this reason, the yields are less than half when compared to those in other parts of the world. When new areas of land come under irrigation with new schemes, this new land is used for rice and wheat and other cash crops including oilseeds and the coarse cereals are then pushed out to even more infertile areas. Some of the general constraints to expansion of coarse cereals in India are listed below.

- Lack of high-yielding, improved varieties; low priority for development.
- Primitive farming practices; need to optimize cropping mixtures.
- Feed crops grown under rainfed conditions are subject to the vagaries of the weather and poor soil fertility; only maize is grown on productive lands.
- Poorly developed markets and support prices; there is a need for market intervention mechanisms to ensure firmness in market prices on par with rice, wheat, pulses, oilseeds and cotton.
- Prices of coarse cereals vary much more than wheat, rice and oilseeds.

- Apart from millets, Indian prices of coarse cereals were higher than International prices.

These observations appear valid for other countries in the region as well.

Sorghum

It is felt that particular attention should be paid to increase the production of sorghum which is considered the most important cereal crop for poor farmers and can be cultivated under poorer soil and rainfall conditions. It can also be used in dairy feeds, to partially substitute maize in poultry feeds and for industrial purposes. In India, 9 million tons were produced in 1960 on 18 million ha of land but this has declined at present to 8.3 million tons on 10 million ha. In addition, although the winter (Rabi) yields are lower, the proportion grown in this season has increased since farmers prefer to use the land for more profitable crops such as oil seeds, pulses and cotton in the summer.

Some of the proposals to increase the production of sorghum in India include the following:

- Introduce summer dual-purpose varieties.
- Introduce intercropping with high value crops.
- Cultivate in fallow rice fields.
- Use of hybrid seed technology to increase yields.
- Use of winter cropping under irrigation.
- Farmer education to optimize yields.

Maize

Maize is the preferred cereal in poultry rations throughout the world and is used at levels of around 40 per cent in modern poultry feeds. Global maize demand is increasing fast and may even exceed those for rice or wheat. Unless maize production is increased significantly, countries in the region will be importing large quantities by the end of the decade. At present, Sri Lanka, Nepal and Bangladesh import maize from a number of countries. Present requirements are sourced locally in India and Pakistan.

In India, 13.5 million tons of maize were produced on 6.5 million ha in 2001. The yields are low (1.8 tons per ha) when compared to yields obtained elsewhere (8 tons/ha in the US). Despite this, when compared to other coarse grains, maize accounts for 40 per cent of the coarse grains in India on 25 per cent of the land and is the most efficient.

The challenge then is to increase yields on the available land. Maize is ideally grown under irrigation, when greater yields can be expected. However, it is likely that in the case of irrigated land, priority will be given to food crops. The main focus, therefore, should be on problems relating to the production of maize under rainfed conditions and how to overcome them. Solutions to these problems will benefit resource-poor farmers and ensure their participation in maize production for animal feeding. Some of the proposals to increase maize production in India include the following:

- Maize to be given a “special” status for strategic development.
- Provide a support price together with a food subsidy similar to those for rice.
- Promote the development and use of hybrid maize and high protein maize.
- Fast track seed production to ensure quality seeds.
- The Indian Maize Development Association should encourage contracted farming for maize linked to exports and value-added products.
- Upgrade and renovate processing plants.

In Nepal, maize is included in around 40 per cent of poultry rations. Maize is grown mostly on hill farms as a subsistence crop under rainfed conditions. The area under maize was not related to prices since it is a subsistence crop. Yield is low and stagnant. Moreover, the feed mills are not located close to the maize growers. Since the poultry feed manufacturers are interested in quality, their maize requirement was largely imported from India. The overall maize requirement was estimated at 210,000 tons in 1999 increasing to 342,000 tons by 2010. The challenge in Nepal is to increase the yields of the small maize farmers and to link them to the feed mills. The latter can be affected, as in other countries, by promoting research and development of varieties, promoting forward contracting and improving infrastructure for storage, processing and transport. It may also be necessary to grow winter maize in the Tarai even at the expense of food crops that are presently being exported.

In Sri Lanka, a rapid expansion of the poultry industry has led to greatly increased demands for feed grains in the last two decades. This situation is set to further expand in the future. Locally grown maize is available for animal feeding but not any other coarse cereals. The quantity of local maize however, is woefully inadequate to meet the food and feed requirements and at present, Sri Lanka imports 80 per cent of its maize requirement for animal feeding. After considering factors such as international maize prices, the availability of (irrigable) land and planting material, it has been concluded that Sri Lanka will not be able to grow the maize required for both food and feed by the year 2010. Since there are no other suitable substitutes, she will have no option but to import. However, present levels of production can be increased to optimum levels by taking some measures such as those shown below:

- Implementation of enlightened policies that are consistent and will allow a suitable balance between imports for the feed manufacturers and the interests of local maize farmers.
- Provision of good-quality seeds of high-yielding varieties.
- Implementation of a technology package suitable for each season and pre-determined levels of production.
- Use of fallow, well-drained paddy fields for maize cultivation.
- Use of irrigated paddy fields in the dry season where there is sufficient moisture for maize but not paddy.
- Farmer education on production of quality grain and linking prices to it.
- Forward sales contracts with groups of farmers for growing maize.
- Maize cultivation by the private or NGO sector on a large scale.
- Improve infrastructure for minimum processing, drying and storage.

Some of the common issues that need to be addressed in order to increase yields of coarse cereals in India have been identified as follows:

- Provision of appropriate high-yielding varieties suitable for soil and moisture conditions; use of hybrid-seed technology.
- Proper cultural practices in planting, fertilizing, weed control and thinning.
- Irrigation at critical stages of water stress.
- Educate and make farmers aware of the need for quality grain.
- Appropriate arrangements to purchase produce at farm gate at fair prices, to carry out minimum processing, storing and supplying feed mills.

Overall, India feels that the potential to increase production of coarse cereals to meet the increasing demands for food and feed can be achieved. This can be done with maize and

sorghum alone provided the necessary recognition and patronage is given for these crops. The efforts have to be supported by research and development. It is also felt that access to export markets will greatly stimulate the coarse cereals sector. Such exports are feasible within the region as other SA countries will face deficits of feed grains.

Cassava

Cassava is grown throughout the region for human consumption and although India is one of the largest producers, it has not been developed to the extent found in South East Asian countries. Its great advantage over grains is that the production of energy (starch) per ha is almost double. Compared to grains, however, it has several disadvantages being low in protein and other nutrients, the content of anti-nutritional substances, notably HCN, and fiber. These do not preclude its use in ruminant or even monogastric feeding. However, although numerous experiments have shown its potential as an animal feed, including its use as a substitute for maize, it is not fed to animals in any of the South Asian countries.

Thailand presents an outstanding example of the use of cassava as an energy source in animal feeds. This development has been fuelled, however, by a demand for cassava chips in Europe which grew into a lucrative export market. To meet this need, Thailand developed an agro-industrial infrastructure consisting of chipping yards, pellet factories, dockside warehouses and established a market network throughout the country. The area under cultivation increased dramatically once pelleting was introduced. Nothing similar to these facilities are presently available in South Asia.

Sri Lanka, a tropical Island with humid conditions is similar to countries in South East Asia and probably has the best conditions for growing cassava in the region. The crop has always been grown on smallholdings and fetches a good price as a food item in rural areas. Recently, opportunities have opened up to export fresh tubers to expatriate Sri Lankan workers. Under these conditions there is little available for animal feeding. Other constraints to its use as animal feed include the following:

- Lack of suitable processing technologies and facilities.
- Preference for other energy sources.
- High demand (and prices) for fresh tubers as food.
- Demand from industry.
- Seasonality and length of the crop.

For these reasons, cassava is not used as an animal feed at present. However, with the demand for feed energy increasing, if the availability of other sources is for some reason compromised, cassava will have advantages in the humid and sub-humid zones of the region. Some of the inputs needed would be State patronage, development of suitable varieties, correct cultural practices among farmers and suitable incentives for investment in processing. Above all, to make cassava a viable crop, production and processing will have to be integrated into a strategy that is compatible with that of small-scale producers.

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