FAO Regional Office for Asia and the Pacific
Animal Production and Health Commission for Asia and the Pacific

# The Feed-Milling Industries of Selected Countries in the Asia-Pacific Region

Country reports presented at the 23rd Session of APHCA, Kochi, September 1999

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# Introduction

## Preamble

Although the contents of this publication date back to 1999, it is being reproduced because it is unique in the literature. Things may have moved on since then but the subject matter remains topical. Readers are requested to bear in mind this historical context as the reports have not been abridged with regard to political, socio-economic or sectoral developments within the Asia-Pacific region in the last decade.

Livestock play highly significant roles in most national economies of the Asia and Pacific region providing draught power, meat, milk, eggs and other by-products. Commercial animal feed enterprises vary in size and composition within the region and production is governed by state regulations that can determine their operations with regard to location, foreign investment, prices and trade, among other factors.

The country reports come from nine diverse Asia-Pacific economies – Australia, Bangladesh, Bhutan, Cambodia, Indonesia, Malaysia, Pakistan, the Philippines and Thailand as well as one in the Near East – the Islamic Republic of Iran. They were presented at the 23rd session of the Animal Production and Health Commission for Asia and the Pacific held in Kochi, India in September 1999.

The reports are structured to address the following issues where relevant:

## The feed-milling industry

The size and structure of the national feed-milling industry are examined. Questions are posited and answered about (1) the capacity of the sector and reasons for any excess output; (2) ownership – if large companies dominate the industry and whether this is caused by their vertical integration in animal industries or is attributable to government policies attempting to maintain economies of scale in feed milling; (3) future plans for capacity expansion and the sector's main clients; (4) focus on the poultry sector; (5) what is being done to address environmental issues; and (5) domestic sourcing of input requirements.

## Government regulations

The reports provide an interesting comparison of regulations in different countries that govern foreign investment and whether local partnerships are mandatory; export laws; the provision of incentives (if any) for animal production facilities; and land zoning or land taxes that influence industry location.

Given that the reports were produced in 1999, food for thought is provided about concerns at that juncture on whether the General Agreement on Tariffs and Trade

(GATT) reached as a result of the Uruguay Round would have major implications for the industry in the context of developments since then.

## Ingredients

The sources and quantities of feed components used in the livestock feed-milling industry are described and changes that have taken place in the sources, quantity and quality of feed components are noted. What determines the ingredient mix used in animal feed industries and whether the availability of ingredients is a constraint to the development of the industry are discussed (including ingredients such as minerals and supplements). Pricing issues and fluctuations as well as farmers' expenses are considered.

## Future prospects and problems for the feed-milling industry

Ample scope for reflection is available for today's stakeholders on the reports' perceptions about optimism in the industry and future plans at that time. It can be ascertained whether speculations about domination by fewer numbers of large firms have transpired or if the industry has retained its structure since then.

# The Australian feed-milling industry

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## Size/structure of the feed-milling industry

The stockfeed-using industry in Australia is diverse, varying from intensive livestock producers to those providing on-farm supplementary feeding of livestock. The section of the industry involved in intensive livestock production includes:

- Commercial manufacturers of stockfeed;
- Large-scale integrated operators who manufacture their own feeds;
- Smaller producers who home mix; and
- Smaller producers who purchase manufactured or preformulated feed.

The on-farm supplementary feeding sector includes dairy, sheep and extensive beef production. The intensive livestock sector comprises pigs, chickens, eggs, beef feedlots and dairy. Other speciality or small industries using stockfeed include aquaculture and those that raise horses, deer and ratites.

Stockfeed for intensive industries include:

- Complete feeds, that is fully formulated rations designed to provide all of the animal's nutritional requirements;
- Concentrates (a partial ration which is used as a supplement to pasture or to which is added cereal grain, roughage and, sometimes, a high protein ingredient to produce a complete feed); and
- Premixes (minerals, vitamins and, sometimes, medications to be added to other feed ingredients to produce a complete feed).

Stockfeed for extensive industries include:

- Loose mixes, that is mixtures of feed ingredients designed to provide nutrients unavailable in poor quality pasture, also used in the dairy industry; and
- Blocks, which are feed mixes as described above that have been compressed or poured into a solid mould for convenience.

The proportion of feed supplied by commercial feed manufacturers as opposed to that produced by home mixes varies between livestock industry and region, as does

the proportion of feed that is formulated and manufactured (as pellets, complete mixes, mashes and concentrates) versus simple grain supplements and mixes. A brief outline of feed distribution by sector is given below:

- *Chicken meat:* Birds are all fed complete, compounded rations, probably all pelleted. This industry is dominated by two major companies who both manufacture their own feed and purchase feed from commercial manufacturers. A second group of medium-sized companies do the same while many smaller producers, representing 30 percent of the industry, mostly purchase prepared stockfeed. Approximately 70 percent of necessary feed is manufactured by the end-user companies, the remainder being manufactured and supplied by commercial feed manufacturers.
- *Eggs:* This industry is less concentrated with approximately 60 percent of layer feed being purchased from commercial millers; 40 percent is home mixed by operators that vary in size.
- *Pigs:* Virtually all feed is a complete, compounded, mostly pelleted ration, mostly produced by the home mix sector (which includes large, vertically integrated operators), with about 40 percent being supplied by commercial feed manufacturers.
- *Beef feedlots:* They mostly buy whole grain and mix on farm, although concentrates may be supplied by the commercial feed manufacturing sector. This profile is changing as opportunity feedlots expand and custom feeding increases.
- *Dairy:* Approximately 60 to 70 percent purchase whole grain and feed, with minimal processing, loose mixes of grains, with or without concentrates, or single grain supplements. The remainder buy pre-formulated feed from commercial stockfeed manufacturers.
- *Sheep:* Animals exported live are mostly fed a pelleted ration supplied by commercial feed manufacturers. Straight grain may be fed in the paddock when pasture is scarce.
- *Equines:* The amount of feed supplied by commercial feed manufacturers is unknown, as is the proportion that could be considered a compounded ration.

The stockfeed manufacturing industry tends to be based on the location of the major centres of the end user livestock industries on a state/regional basis, and is highly concentrated, with the top four companies accounting for 50 percent of turnover. Most are close to major metropolitan areas, but environmental issues are generally not a problem. There are also many smaller operations that service regional markets due to the high cost of transport of raw materials. The average utilization of Australian feed mills is approximately 80 percent, based on a 120-hour week (two shifts a day, five days a week). This equates to 57 percent capacity in a 168-hour week. Labour costs discourage the milling industry working at full capacity. The large, vertically integrated companies have the highest levels of utilization. The dairy milling industry has the most underutilization; there is some oversupply of milling companies in Victoria, the main dairy state, and also, when grains are cheap, some farmers who normally mix their own feed buy milled feed.

**Table 1. Feed capacity and output in Australia, 1999**

| | |
|---|---|
| Total estimated feed capacity | 11 000 million tonnes |
| Total feed output | 8 892 million tonnes (~80% capacity) |
| Cattle feed | 37% |
| Poultry feed | 29% |
| Pig feed | 24% |
| Equines and others | 10% |
| Aquaculture | <1% |

Except for cattle feedlots that mix their own feed, the remainder of the feed-milling industry is dominated by large companies (including vertically integrated companies and large commercial millers). This has nothing to do with government policy, but is attributable to economies of scale and degree and level of expertise. These companies are largely Australian-owned and none control shipping. Some have involvement in a major ingredient supply chain, such as rice.

Apart from a possible dramatic increase in the beef feedlot industry, other parts of the feed-milling industry do not have plans for major expansion.

**Table 2. Summary of complete feed/feedgrain usage by individual industries**

| | 1994/1995 | 1997/1998 (forecast) |
|---|---|---|
| **Kilotonnes of complete feed** | | |
| Chickens | 1 684 | 1 957 |
| Eggs | 611 | 598 |
| Pigs | 1 877 | 2 080 |
| Sheep | 112 | 115 |
| Others (excluding pet food) | 212 | 250 |
| **Kilotonnes of feedgrain** | | |
| Dairy | 1 199 | 1 685 |
| Beef feedlots | 1 967 | 2 266 |
| Equines | 550 | 570 |

Practically all input requirements are domestically sourced. Exceptions are American soybean meal when Australian sources of high plant protein input are scarce, some fish meal and micro-ingredients like amino acids, vitamins, medications and some minerals.

## Government regulations

Foreign investment is not an issue. Stockfeed may be exported, depending on the existence of suitable protocols. However, except for some aquaculture meal, not a great amount is exported.

Operators do not receive any form of preferential treatment.

Land-zoning laws have encouraged some livestock industries to move away from metropolitan areas, taking feed mills with them.

GATT will have impacts on some sections of the milling industry via effects on the end user industries. Chicken and pig imports will compete with local industries while there should be an increase in beef exported.

## Ingredients/raw materials

Although quality is more of an animal health and an end product issue, the industry is now in a better position to use ingredients of lower nutritional quality. Rations are getting much tighter in terms of specifications; better scientific knowledge about ingredients, diets and their effects allows better balanced rations, the use of an expanded range of raw materials and the ability to rectify deficiencies in some ingredients. Enzymes may be added to overcome ingredient shortcomings or deficiencies in livestock physiology.

Currently meat and bone meal cannot be fed to ruminants in Australia. Canola meal has increasingly displaced other vegetable protein meals, and meat and bone meals to non-ruminants. Lupins were popular but less grain legumes are now grown because of the popularity of canola.

The mix is based on a least cost formula basis and the industry is now aware of the extent to which the proportion of grains in the ration can be raised. Feedgrain security is a major issue and the red (or feed) wheat industry is being developed. The last major drought early this decade necessitated the need to import grain and although there was opposition from cereal growers, the stockfeed industry would like to see an expansion of grain importation opportunities. Maize is very competitive as a grain for poultry and this industry would like to use much more (imported) maize. The supply of minerals and supplements is not a constraint and most can be readily sourced internationally.

The major components affecting the price of stockfeed in Australia are cereal grain and the protein source. Most major companies buy and store much of their feedgrain after harvesting to even out the cost over the whole year. Prices may vary by 25 to 30 percent throughout the year.

## Future prospects and problems

Generally, the Australian feed-milling industry does not have a feeling of great optimism. The dairy stockfeed sector has problems with oversupply, most end user industries are growing only slowly and improving nutritional science and ration formulation are constantly reducing feed conversion ratios.

The Australian stockfeed industry has gone through a considerable period of rationalization, and should now remain fairly stable. There is no obvious direction for the industry to take. Quality assurance (QA) issues are becoming increasingly important and the industry is meshing the QA requirements of its suppliers and end users. The Asian economic crisis has only had a marginal impact on the Australian feed-milling industry via effects on end user industries.

**Table 3. Estimated feedgrain usage, in kilotonnes by livestock type and grain component in Australia**

| | Pigs | Poultry | | Beef cattle | | | Dairy cattle | Sheep | | Other livestock | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Egg | Broilers | Comm. feedlot | Opportun. feedlot | Grass fed | | Paddock | Live export | | |
| **Wheat** | 511 | 197 | 532 | 218 | 10 | 5 | 135 | 39 | 6 | 56 | 1 707 |
| **Barley** | 505 | 37 | 139 | 570 | 72 | 31 | 275 | 39 | 11 | 88 | 1 766 |
| **Sorghum** | 79 | 67 | 116 | 266 | 77 | 37 | 83 | 4 | 6 | 0 | 734 |
| **Bran and pollard** | 155 | 31 | 51 | 19 | 4 | 0 | 68 | 0 | 28 | 71 | 426 |
| **Other coarse grains** | 56 | 67 | 153 | 184 | 58 | 10 | 192 | 257 | 11 | 523 | 1 511 |
| **Lupins** | 111 | 12 | 33 | 58 | 20 | 5 | 117 | 30 | 17 | 31 | 434 |
| **Field peas** | 37 | 18 | 90 | 0 | 0 | 0 | 17 | 4 | 0 | 6 | 172 |
| **Soybean meal** | 53 | 37 | 99 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 203 |
| **Canola meal** | 63 | 6 | 32 | 19 | 4 | 0 | 0 | 0 | 0 | 0 | 124 |
| **Other grain meals** | 0 | 46 | 142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 189 |
| **Cotton seed** | 0 | 0 | 0 | 77 | 16 | 0 | 0 | 0 | 0 | 0 | 93 |
| **Total feedgrains** | **1 570** | **520** | **1 386** | **1 412** | **260** | **89** | **887** | **373** | **77** | **788** | **7 360** |
| **Percentage (%)** | **21** | **7** | **19** | **19** | **4** | **1** | **12** | **5** | **1** | **11** | |
| **Other protein meals** | 192 | 65 | 192 | 0 | 0 | 0 | 0 | 0 | 0 | 84 | 533 |
| **Roughage and additives** | 93 | 26 | 64 | 522 | 138 | 956 | 5 977 | 484 | 33 | 608 | 8 900 |
| **Total feed** | **1 855** | **611** | **1 641** | **1 934** | **398** | **1 045** | **6 864** | **857** | **110** | **1 480** | **16 793** |
| **Percentage (%)** | **11** | **4** | **10** | **12** | **2** | **6** | **41** | **5** | **1** | **9** | |

# The feed-milling industry in Bangladesh

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## Introduction

Livestock play a very significant role in the national economy not only as a source of valuable human food but also in poverty alleviation, income and employment generation. Livestock also provide more than 95 percent of the draught power. Most farmstead animals (cattle, buffalo, goats, sheep, chickens and ducks) in Bangladesh are indigenous and their production potentials are very poor. They are generally reared in rural areas via the traditional system of foraging and semi-foraging. Exotic and crossbred livestock reared in urban, semi-urban and milk pocket areas are relatively healthier because of better feeding.

In the past not enough attention was paid to the development of livestock and the livestock industry. From the late 1980s onwards the government Initiated provision of various incentives for the establishment of livestock farms. As a result there has been a remarkable increase in the number of commercial farms of various sizes and the demand for balanced feed has increased considerably.

Monogastric animals, mainly poultry, obtain essential nutrients (amino acids, vitamins and minerals) from oilseed meal (amino acid sources) complemented by minerals and premixes. Energy comes from grains. The major production cost in the livestock industry is the feed, representing almost 70 to 80 percent of the total. The quality of feed components and mixed components is crucial for the success of the industry.

**Table 1. Livestock population in Bangladesh, 1998**

| Livestock | Numbers |
|---|---|
| Cattle | 23 400 000 |
| Buffalo | 820 000 |
| Goats | 33 500 000 |
| Sheep | 1 110 000 |
| Chickens | 138 2000 |
| Ducks | 13 000 000 |

**Table 2. Livestock farms in the public sector, 1998**

| Types of farm | Numbers |
|---|---|
| Dairy and cattle improvement | 7 |
| Goat breeding | 5 |
| Buffalo breeding | 1 |
| Piggeries | 1 |
| Poultry breeding and multiplication | 33 |
| Duck breeding | 2 |

**Table 3. Livestock farms in the private sector, 1998**

| Types of farm | Numbers |
|---|---|
| Dairy | 29 649 |
| Beef fattening farm (household level) | 53 200 |
| Goat | 20 833 |
| Sheep | 10 289 |
| Poultry | 60 670 |
| Ducks | 30 776 |

**Table 4. Present annual requirement of concentrate feed ingredients**

| Types of ingredients | Quantity (million tonnes annually) |
|---|---|
| Rice polish & wheat bran | 63.31 |
| Maize | 54.40 |
| Soybean oilcake | 7.06 |
| Molasses | 24.62 |
| Other ingredients | 19.45 |

## Size and structure

There are five animal feed mills In the public sector, one for cattle feed and four for poultry feed with annual capacity of 12 and 20 000 tonnes respectively. These mills, after meeting demand from government farms, supply feed to small farmers at cost price. In the private sector 14 commercial feeds mills have been established so far. Otherwise, 18 feed mills run by parent stock poultry farm owners meet their own demand.

The feed mills in the private sector have production capacity of about 230 000 tonnes of concentrate feed for poultry per year. This is sold directly to commercial farms or through agents and sale centres located in different parts of the country.

Most animals are reared in smallholder farms that mainly use hand-mixed feed either from the local market or prepared on farm after procuring raw materials.

**Table 5. List of feed mills and production capacity in 1999**

| Firm | Capacity/year in tonnes | Ingredients | Products |
|---|---|---|---|
| 1. Aftab Feed Mill Bajitpur, Kishorgonj | 60 000 | Maize, wheat, rice polish, fish meal (Denmark); soybean meal, full fat soybean, rice polish, meat and bone meal (India) | Mash, pellets, crumbles. Starters, growers, finishers, breeders; (broilers, layers) |
| 2. M.M. Agha Limited Chittagong | 2 400 | Soybean meal & rice bran (India); protein conc. and vit. premix (Belgium); maize (Myanmar); fish meal rice polish, sesame cake | Mash only. Starters, growers, finishers, breeders |
| 3. Denom Poultry Complex (Pvt.) Ltd. Hat-Hazari, Chittagong | 7 200 | Maize, rice polish, conc. soybean meal, sesame cake, full fat soybean, wheat bran, soybean oil | Broilers, starters, growers, breeders |
| 4. Paragon Poultry Ltd. Baniarchala, Bhabanipur, Gazipur | 12 000 | Maize, soybean meal, rice polish, full fat soybeans, sesame cake, bone meal, oyster shell, molasses soybean oil | Mash and pellets. Starters, growers, finishers, breeders (broilers and layers) |
| 5. Phenix Poultry Feed Ltd. Baniarchala, Gazipur | 4 800 | Maize and soybean meal imported from the USA etc. | Mash only. Starters, growers, breeders |
| 6. Krishipannya Feeds Ltd. Shafipur, Gazipur | 5 400 | Maize, soybean meal rice polish etc. | Mash. Broilers and layers |
| 7. Agro Industrial Trust (AIT) Shafipur, Gazipur | 7 200 | Maize, sesame meal wheat, rice polish soybean meal, oyster shell etc. | Mash. Broilers and layers |
| 8. Usha Poultry Ltd. Feed Mill. Nabinagor, Savar | 5 400 | Maize (local), soybean meal de-oiled rice bran (import) etc. | Layers, starters (mash). Broilers, finishers (pellets) shrimp, fish feed (pellets) |
| 9. Biman Poultry Complex Ganak Bari, Savar. | 1 200 | Maize, soybean meal, full fat, soybean, sesame cake, protein conc. bone meal | Mash only. Breeders, commercial layers and broilers |

| Firm | Capacity/year in tonnes | Ingredients | Products |
|---|---|---|---|
| 10. United Food Complex Ltd. Kashimpur. Gazipur | 1 200 Poultry & shrimp feed | Maize, soybean meal etc. | Mash only. Poultry parent stock |
| 11. Quality Feeds Ltd. Shirirchala, Gazipur | 75 600 Poultry & shrimp feed | Maize, soybean meal, dry fish, wheat, sesame oil-cake, full fat soybean, wheat bran, vitamins | 22 types of feed. Layers, broilers, ducks, parent stock, fish, shrimp |
| 12. BRAC Feed Mill Gazipur | 36 000 | Mostly local ingredients | Broilers, starters, finishers, layers, growers |
| 13. Saudi Bangla Feed Ltd. Bhaluka, Mymensingh | 7 200 | Mostly local ingredients | Mash and pellets, poultry, fish and shrimp feed |
| 14. Sundarbon Feeds Nimtoli, Dhaka | 4 200 | Maize, wheat, soybean meal etc. | Mash |
| **Total** | **230 000 (approx.)** | | |

Source: Private feed mills.

### *Location and environmental issues*

Most of the feed mills are located in and around urban areas where many commercial farms are located. Currently, livestock farming leads to direct competition for grain consumption between human and livestock.

Some of the industries are established within the compounds of the parent stock and hatchery farms. Dust and industry waste sometimes generate health hazards.

There is a lack of uniform decision-making and analytical skills regarding livestock resource use. Policies are often inconsistent and socio-economic objectives conflict with environmental objectives.

Institutions need to be developed to provide a regulatory framework. Technological change is also the key to solving environmental problems and needs to be facilitated by government support for technology adoption and transfer.

In the absence of quality standards, adulterated ingredients are also used; in some cases toxic feed ingredients are used by unscrupulous traders that may be injurious to both animal and human health. There are no rules and regulations to prevent adulteration.

The use of antibiotics, hormones, feed additives and so forth is inherent in intensive production systems. They potentially increase the risk of chemical residues in

livestock products. Extensive use of antibiotics in poultry leads to the emergence of resistant strains of salmonella, *E. coli* and other pathogens. Copper and zinc, which are essential minerals, are deliberately used in concentrated feed whereas other heavy metals, in particular cadmium, are introduced inadvertently via feed phosphates.

### *Domestic sources of inputs*

One of the major constraints for livestock development in Bangladesh is the acute shortage of feed and feed ingredients. An organized large-scale feed industry to cater to this need has yet to materialize. For steady production and supply of balanced feed, the availability of quality feed ingredients is essential. Maize is widely used worldwide as livestock feed but is not cultivated intensely in Bangladesh, although a programme is underway to address this issue; rice polish is not sufficient to meet demand and is also adulterated with husks. Domestic animal protein is of low quality. Maize and wheat are the main grains used in the preparation of feed.

The cost of prepared feed constitutes a different story due to inadequate formulation, quality and reliability of the produce which cannot match the benefits of formulated feed.

Recently, an attempt has been made to produce soybean in the country to meet the demand of oil for human consumption and meal for the feed industry. Introduction of maize in the cropping system is expected to partly solve the problem of grain availability.

## Government regulations related to the industry

### *Foreign investment*

The government has quite a liberal policy about investing in agro-based industry including the setting up of feed mills with modern facilities and equipment; however to date, entrepreneurs have failed to evince much interest. The government encourages and supports joint ventures with foreign investors.

There are currently very few fully-equipped industrial feed mills with the capacity to produce balanced and standardized quality livestock feed and there is no national grading certification system. The Department of Livestock Services provides some analytical services but not enough to maintain adequate standards. An Act is being drawn up by legislators to establish feed grade standards for quality control.

### *Feed export*

No feed is exported abroad. But ingredients like molasses and wheat bran are exported occasionally in limited quantity. A programme for establishing an organized

large-scale commercial feed industry with foreign joint ventures to cater to needs has yet to be developed.

### *Implications of the GATT agreement*

The GATT agreement intends to create free world trade by gradual lowering or removal of tariff barriers and the harmonization of non-tariff barriers. In almost every country agro-based industries are subsidized in some way or another to protect the producers, but in Bangladesh no such subsidies exist and as a result the country is facing unhealthy competition. The trade liberalization of livestock products would affect feed industries in terms of production and consumption patterns. Livestock farms in Bangladesh are facing difficulties in competing with less expensive imported products through formal and informal trade ventures that enjoy high subsidy in the country of origin. This issue needs to be examined nationally and regionally to protect the interests of the farmers/producers.

## Sources of ingredients and raw materials

Most livestock in Bangladesh are found on smallholders' farms in rural areas where there is complementarity between crops and livestock (farmers utilize the crop residues and other by-products for feed). The feed industries are mostly dependent on feed ingredients/raw materials from India, the United States, the Netherlands, Peru, Germany and Australia imported by the private sector. However they have very little knowledge about the origin of the raw materials, how they are produced and the sources as well as the stability of the supply channel.

**Table-6. Import of feed ingredients, 1997**

| Feed ingredients | Percentage of imports |
|---|---|
| Maize | 40% (Myanmar, India, USA) |
| Soybean | 100% (India, USA) |
| Protein concentrate/fish and bone meal etc. | 90% (Denmark, Peru, Germany, Australia, Belgium, Netherlands, USA & India) |
| Rice bran | 30% (India) |
| Sesame cake | 25% (India) |
| Premix, vitamins & minerals | 60% (Belgium, Denmark) |
| Amino acids | 100% (India, Belgium, USA, Germany, Netherlands) |

Source: Private feed mills.

## Price information

The percentage use of raw materials is determined by market prices that fluctuate continuously.

**Table-7. Approximate average price of raw materials, 1999**

| Feed ingredients | Price range (Tk/kg) | Source |
|---|---|---|
| Maize | 6.5-7.5 | Local (April to Sept.). |
| | 6.5-9.0 | Imported (rest of the year) |
| Soybean oil meal | 10-14 | Imported |
| Rice polish | 3.5-8.0 | Local & Imported |
| Soybean (full fat) | 14.0-17.50 | Local |
| Wheat grain | 8.0-10.0 | Local & imported |
| Wheat bran | 6.0-8.0 | Local |
| Sesame cake | 6.0-7.5 | Local & imported |
| Oyster shell/clam shell | 2.5-4.0 | Local |
| Bone meal | 6.0-7.0 | Local |
| Fish meal | 15.0-30.0 | Local & imported |
| Dry fish | 12.0-24.0 | Local |
| Protein concentrate | 28.0-40.0 | Imported |
| Vitamins/.... | 120.0-130.0 | Local distributor, imported |

Source: Private feed mills.

**Table 8. Approximate average price of finished products (Tk/kg), 1999**

| Products | From | Retail price | Contract farm price |
|---|---|---|---|
| Broiler starter | Mash | 13.5-14.0 | 11.75-12.60 |
| Broiler starter | Crumble | 13.80 | 13.10 |
| Broiler grower | Mash | 12.50-13.0 | 11.50 |
| Broiler finisher | Pellet | 13.7-14.50 | 12.90 |
| Layer starter | Mash | 12.0-12.25 | 10.0-11.0 |
| Layer grower | Mash | 11.0-11.50 | 10.50 |
| Layer laying | Mash | 11.50-12.0 | 9.75-10.90 |
| Duck | Pellet | 12.50 | - |
| Shrimp feed | Pellet | 16.50-18.50 | - |
| Fish feed | Pellet | 16.50-18.50 | - |

US$1.00 = Bangladesh taka 49.50 (1999, approximate).

Source: Private feed mills.

## Future prospects and problems for the feed industry

The feed industry in Bangladesh is in a nascent state but has the potential to expand rapidly. There is scope to increase the domestic production of feedgrain such as maize and wheat and for protein supplements such as soybean and other ingredients. Concomitantly, facilities for processing, handling and storage of domestic and imported feed ingredients have to be developed. There is plenty of scope to broaden the market base for prepared feeds as the number of commercial farms is increasing and farmers are interested in quality feed.

## *Problems*

At present feed industries are facing the following problems:

- High prices of feed ingredients;
- Seasonal variation in ingredient prices;
- Inadequate expertise and facilities for storage;
- No quality control facilities;
- No feed grade standards;
- No Feed Act or Ordinance to prevent adulteration;
- No proper marketing system.

The Asian economic downturn has affected the industry. As the economies in Asian countries as well as in other developing countries adapt, demand for livestock products will increase and consequently the demand for feed ingredients shall also increase.

Despite stabilization of the price of feedgrain and some secondary raw materials in the world market, the feed industries in Bangladesh may continue to face difficulties due to increase in exchange rates or the devaluation of local currency and trade liberalization fluxes. Adequate and appropriate measures, both locally and regionally, need to be taken to address these issues.

# The feed-milling industry in Bhutan

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## Introduction

Bhutan is a mountainous country in the Himalayan range with an area of 46 500 km$^2$. It is characterized by high terrain heavily dissected by steep valleys running mostly north to south. The climate varies from subtropical in the south, through temperate to alpine in the north. Forests are extensive covering 72.5 percent of the surface area; 7.7 percent of the total area is cultivated and mixed livestock/cropping systems are common.

## Livestock population

Table 1 gives details of the livestock population in Bhutan as reported by the 1996 Livestock Census.

**Table 1. Livestock populations in Bhutan, 1996**

| Species | Breed | Livestock numbers |
|---|---|---|
| Cattle | Local<br>Improved<br>Mithun (*B. Frontalis*) crosses | 223 847<br>38 123<br>53 914 |
| Yaks | | 37 871 |
| Buffalo | | 2 889 |
| Sheep | Local<br>Improved | 28 841<br>5 624 |
| Goats | | 66 320 |
| Pigs | Local<br>Improved | 50 355<br>10 655 |
| Poultry | Local<br>Improved | 146 672<br>22 536 |
| Equines | | 22 585 |

## Livestock management and feeding systems

Livestock production systems in Bhutan can broadly be categorized into three systems − mixed and sedentary smallholders, migratory cattle herds and migratory yak herds. The local cattle, sheep and goats are usually raised in subsistence farming systems with very low inputs − natural pasture/fodder, a modicum of concentrates

and occasional salt supplements. Approximately 1 553 $km^2$ are given over to natural pasture or about 3.9 percent of the total area. Crossbred cattle (crosses of Jersey/Brown Swiss and local animals) are mostly fed on improved pasture. They are provided with either home-made or commercial concentrates. Vital ingredients that are not available locally are purchased and fed along with kitchen waste as concentrates either in wet or dry form. Poultry are managed mostly in small backyard free range systems. Residues from maize, wheat and rice are fed at low elevations.

The improved dairy cattle (mainly Jersey/Brown Swiss and local animals) are mostly fed with mixed leguminous/non-leguminous pasture species. Local feed such as maize crush, rice/wheat bran, oil-cakes and kitchen waste are fed in the traditional manner in rural areas. In some semi-urban and dairy areas compound commercial feeds are employed.

The migratory herds spend most of the time away from cultivated land and graze on natural pastures, which are either community owned or within government forest territory. They are hardly given any concentrates apart from access to salt licks occasionally.

The allocation of compound feeds is gaining momentum especially in poultry and piggery production. In rural areas farmers mix their feeds with locally available ingredients. Commercially available feeds are also used but currently only form about 10 percent of the total production.

## Animal health services and veterinary infrastructure

There are 31 veterinarians working in the country. They are based at the Ministry of Agriculture and its divisions, the Royal Veterinary Epidemiology Centre (RVEC), regional veterinary laboratories, government farms, renewable natural resource research centres, training institutes and a veterinary hospital. In addition there are 356 para-veterinary staff including laboratory technicians who are posted in various hospitals, extension centres and laboratories to implement animal health services.

## Livestock diseases

The major livestock diseases in Bhutan are foot-and-mouth disease (mostly in cattle), Newcastle disease in poultry and swine fever in pigs. Other diseases of significance are various parasitic diseases, rabies, black quarter, infectious bovine rhinotracheitis, infectious bursal disease in chickens and also a few sporadic cases of anthrax. Vaccinations and deworming are conducted in routine programmes for the control of livestock and poultry diseases. Pasture-/feed-related health problems are often encountered; chronic obstructive pulmonary disease in horses and aflatoxicosis in poultry are two of the problems.

## Feed-milling industry

A pilot feed-mixing plant was established in 1986 with assistance from the United Nations Development Programme and the Food and Agriculture Organization of the United Nations. The main objectives of the project were:

- To produce high quality compound feeds for pigs, poultry and cattle.
- To conduct experiments on the use of conventional and non-conventional feed resources in the country.
- To disseminate knowledge on balanced feed manufacture and use to farmers.

Project activities thus addressed feed manufacturing, quality control, technical backstopping, experiments and research. The Feed Analytical Laboratory of the RVEC Serbithang provided technical support.

When the project was completed the feed mixing plant was privatized in line with the government policy of supporting the private sector. Monitoring of quality, price control and other related functions remained with the government. The plant has capacity of 12 tonnes per day. Only about 4 tonnes of feed are being produced currently. Government-run farms are the sole users of the feed and only about 10 percent of production is used by private farms. The feed mill is owned by M/s Karma Feeds, a subunit of the Karma Group of Organisations (KGO). KGO is one of the largest industrial organizations dealing in veterinary supplies and it has a very good reputation in Bhutan. Before the feed mill was established, KGO was the government agent for supplying feed to consumers in Bhutan.

Future plans for capacity expansion include reaching the 12 tonne capacity ceiling. In order to expand the market, efforts are underway to disseminate extension packages and delivery facilities to private farmers. The plant's management team is also planning to manufacture pellet feed and open retail outlets.

The feed mill is located within the border town of Phuentsholing about half a kilometre from the main town centre. Being located within the industrial area it does not pose any environmental problems to residents and the locality. Any waste generated from manufacturing feed is disposed safely. It has all the necessary provisions for quality production and safety measure in line with the Livestock Act and by-laws of the kingdom and conforms to industrial requirements. Inspectors from the Ministry of Agriculture and Ministry of Trade and Industries regularly monitor its operations.

Government regulations related to the industry stipulate that the industry should produce feed based on formulations provided by the government and sell the products according to prices fixed by the government. Foreign investment in the industry and the export of feed are permitted. The industry also receives preferential

treatment such as tax exemption on machinery and imported ingredients. Electricity is subsidized and the interest on loans is 13 percent which is 3 percent lower than the usual interest rate. The GATT agreement has no major implications for the industry.

The plant obtains most ingredients/raw materials from India. Availability is not a constraint. In one year on average about 600 tonnes of maize are obtained: 400 tonnes from India and 200 tonnes internally. Wheat bran (30 tonnes) and limestone (calcium) powder (30 tonnes) are also obtained in-country. All other raw materials are obtained from India, including rice bran (300 tonnes), mustard oil-cake (100 tonnes), *til* cake (100 tonnes), groundnut cake (50 tonnes), soybean meal (75 tonnes), fish meal (60 tonnes), oyster shell (30 tonnes) and molasses (75 tonnes); salt, minerals and vitamins are purchased periodically. Within Bhutan major ingredients are available but are widely dispersed. Because of the difficult terrain and poor communication infrastructure procurement of ingredients is difficult and costly so sourcing them from India is comparatively easier and cheaper. One of the extension messages to farmers, therefore, is to purchase high protein ingredients including fish meal and mix them at home with locally available energy sources. The plant in the near future may produce high crude protein content feed with required supplements as a premix which may then be used by farmers in rural areas to mix with high energy and fibre content ingredients to produce compound feeds at the farm level.

Current government prices for livestock feed are given in Table 2.

**Table 2. Feed prices for livestock in Bhutan, 1999 (per tonne)**

| Livestock | Price (Nu) |
|---|---|
| Chickens (starters) | 8 583 |
| Chickens (growers) | 6 745 |
| Chickens (layers) | 7 383 |
| Broilers (starters) | 8 383 |
| Broilers (finishers) | 7 809 |
| Pigs (starters) | 8 743 |
| Pigs (growers) | 6 414 |
| Pigs (finishers) | 5 792 |
| Cattle (calf starter) | 5 500 |
| Cattle (concentrate) | 5 418 |
| Dairy cows (concentrate) | 5 552 |

US$1.00 = Nu.43.5.

The prices do not vary throughout the year and the same price is charged to the farmers. However, if the cost of ingredients increases the government agency revises the cost of feed accordingly.

The future prospects for the feed industry are good and the plant is quite optimistic about the future. The industry is trying to promote consumer awareness in rural areas and also to produce feed in pellet form. With the government policy to de-

monopolize industries and open up market competition, more suppliers are expected to join the feed market. Bhutan and the plant are fortunate that the present Asian economic crisis has not affected the industry.

# The feed-milling industry in the Kingdom of Cambodia

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## General situation in the livestock sector

The main economic infrastructure of Cambodia is agriculture and promotion of public investment in this context is a government goal. Agriculture provides 44.90 percent of the gross domestic product (GDP) and livestock comprise about 13.2 percent.

Most cattle, buffalo, pigs and poultry in Cambodia are raised on small farms. There is little large-scale production of any of these livestock except for a few commercial pig- and poultry-breeding farms that have been developed in the last few years.

Cattle and buffalo are used for draught power transportation. About 85 to 90 percent of cultivated land is ploughed by animals. Cattle and buffalo are threatened by parasitic and infectious diseases (haemorrhagic septicemia, foot-and-mouth disease, anthrax and blackleg); pigs are confronted with pasteurellosis, salmonellosis and swine fever.

Cattle and buffalo feeding is characterized by supervised grazing supplemented with rice straw. Their lack of nutrition is generally reported as a serious constraint. Dry season feeding involves free grazing usually under the supervision of children, supplemented with rice straw which is fed in stalls beneath the house when the animals return each night. A similar feeding regime is practised during the wet season with limited controlled grazing on roadways and untilled areas, supplemented with straw, collected grass and leaves. Grass is never cut and stored as hay for later feeding. During cultivation periods animals are fed rice straw but grass may be collected as supplementary fodder for animals kept away from the rice paddies.

Normally a few pigs are kept under the house, either tethered or penned while small, and for much of the day they are allowed to roam free range. They are always tethered during the cropping season to prevent crop damage. Foraged feed contributes significantly to the diet of pigs raised by poor families. Banana pseudostems may be fed as a staple when they can be purchased, supplemented with food scraps, rice bran and broken rice which are available each day after the household rice requirements are dehusked. The mainly rice bran mixture is mixed with water before feeding but is not cooked.

Penned pigs, involving three to 12 finishing pigs, can be found in the lowland rice-producing areas; they are increasing in number especially where money is available to purchase some feed, or where there is access to broken rice and bran. A few pig-breeding farms have been established in the main provinces.

Extensive village chicken systems often produce four to five clutches of chickens (10 to 12 chicks per clutch). This system provides a good opportunity for poorer farmers with little land to generate cash income. Some intensive broiler production units have been established under a contract rearing system. In more highly populated areas there are also some intensive egg production units. These are generally for small-scale production with 1 000 to 5 000 birds kept in cages. A few larger scale units also exist.

**Table 1. Livestock statistics in Cambodia, 1988-1998**

| Livestock | 1988 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| Cattle & buffalo | 2 630 000 | 3 480 000 | 3 482 465 | 3 503 820 | 3 573 591 |
| Pigs | 1 500 000 | 2 200 000 | 2 228 781 | 2 422 510 | 2 339 168 |
| Poultry | 9 259 000 | 10 067 000 | 11 412 000 | 12 498 000 | 13 117 000 |

## The feed-milling industry

Piglets and one-day-old chicks for breeding have been imported from neighbouring countries. The import of piglets and breed chicks has decreased in the last few years because commercial pig- and chicken-breeding farms have been developed in-country. With the introduction of intensive pig- and chicken-raising techniques, some families have tried to set up their own farms, some of them producing animal feed by themselves and others relying on concentrated feed sold at markets.

### *CP Group*

Since 1998, Charoen Polepand (CP) has been the only company involved in the animal feed-milling industry in Cambodia. The company is located in Ang Snoul District of Kandal Province 25 kilometres from Phnom Penh. It is located in an isolated area along the national road and there have been no environmental issues to date.

The company produces chicken (broilers, layers and breeders), pig and duck feed (Table 2). The products are widely distributed in the main provinces throughout the country.

**Table 2. Animal feed categories of the CP company**

| Feed categories | Feed code | Protein content (%) |
|---|---|---|
| *Pigs* | | |
| - Piglets up to 15 kg | HI-GRO 351 | Not less than 18 |
| - Pigs from 15-30 kg | HI-GRO 352 | Not less than 16 |
| - Fattening pigs upper 15 kg | HI-GRO 151 | Not less than 36 |
| - Breeding pigs upper 90 kg | HI-GRO 155 | Not less than 28 |
| | HI-GRO 156 | Not less than 32 |
| *Ducks* | | |
| - Standard | HI-GRO 144 | Not less than 41 |
| *Chickens* | | |
| - Broilers 1-21 days | HI-GRO 310 | Not less than 20 |
| - Broilers 22-43 days | HI-GRO 311 | Not less than 18 |
| - Broilers 43 days | HI-GRO 313 | Not less than 16 |
| - Layers 8 weeks | HI-GRO 312 | Not less than 18 |
| - Layers 19 weeks | HI-GRO 324 | Not less than 16 |
| - Layers 19 weeks | HI-GRO 124 | Not less than 27 |

The industry can produce up to 72 000 tonnes per year of animal feed for chickens, pigs and ducks. In future, pig feed quantity will increase owing to local needs as well as the growth of piggeries in the country. Feed production by the company is for local consumption only.

The main ingredients and raw materials for animal feed production include maize, fish meal, soybean meal, wheat bran, rice bran, oyster shells, limestone, soybean seed, minerals and vitamins. Maize, fish meal, rice bran and oyster shells are supplied locally, while the others are imported.

The rapid growth of pig, chicken and duck farms at household and small industry levels will enable the company to expand its production capacity in the future. No problems are foreseen in the next few years.

# The feed-milling industry in India

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## Introduction

The livestock sector, next only to crop agriculture, plays a vital role in rural economy and contributes 5.9 percent to the total Gross Domestic Product (GDP) and employs 4.3 percent of the labour force. Livestock provide essential animal food products, draught animal power, manure, income and opportunities for export. Demand for animal food products is increasing with rising levels of income.

The livestock populations in India are the largest among the different countries of Asia and the Pacific, and were estimated at 204.5 million cattle, 83.5 million buffaloes, 50.8 million sheep, 115.3 million goats, 12.8 million pigs and 307 million poultry (1992 Livestock Census). These contributed 68.6 million tonnes milk, 28.2 billion eggs, 44.3 million kilograms wool and 4.14 million tonnes meat. Value of outputs from livestock at current prices was Rs. 897 billion (1996-97) excluding draught animal power which has been valued at between 45 and 95 billion rupees in terms of fuel equivalent.

## Production systems

Livestock production is primarily a small farm production system characterized mostly by low input - low output except poultry and to some extent dairying with crossbred cows and buffaloes, which not only are sustainable but provide good economic returns. Around 80 percent of livestock are in marginal, small and medium holdings having 53 percent of the operated area. Majority of livestock owners are below the poverty line. Average herd size per farm is 3.7 heads of cattle and buffalo. Small ruminants are mostly reared under nomadic (30 percent) and sedentary (70 percent) systems. Average herd size in nomadic system is 40 sheep and 20 goats while in the sedentary system, the average herd size is 1.5 sheep per household. Pig production is mostly under scavenging system practised by weaker sections of the society. Poultry production is reasonably organized; 60 percent of poultry meat and 56 percent of eggs are produced under intensive production system.

The milk production per animal unit is still very low. The non-descript cows and buffaloes produce around 1kg of milk, improved cows and buffaloes around 3kg and crossbred cows and Murrah buffaloes produce between 6 and 10kg of milk per day. Similarly, meat production also is very low and is estimated at around 100kg in buffaloes, 9kg each in sheep and goats and 40kg in pigs.

## Feed and feeding systems

The major feed resources in the country are grasses-cultivated fodder, edible weeds, leafy fodder from trees and grazing (57 percent), agriculture crop residues (40 percent), and grains/concentrates (3 percent). The quantity of fodder obtained through grazing varies from region to region and depends on the extent of the forest area. Large ruminants receive about 50 to 60 percent of their dry matter requirement from crop residues (straws, stovers). This is supplemented with small quantities of grass available through scanty grazing or cut-and-offered grass to the animals. Little or no concentrate mixture is given to growing, working, and dry animals. Only lactating animals are given better feeding through supplementation of by-product concentrates (oilcake, bran, chunnies, etc.). Sheep and goats are generally grazed/browsed and no concentrates are fed. Farmers neither have knowledge nor feed their livestock as per nutrient requirement.

Grains and concentrates are mostly used in intensive production system. The demands for grains are going up especially in poultry and dairy production. The present feed shortages are 31 percent in dry fodder, 23 percent in green fodder and 47 percent in concentrates. Technological breakthroughs are the only alternatives to meet shortages of energy and protein in livestock feed.

## Compound feed

Crop by-products like bran, husk, oilcake, solvent extracted meals, cottonseed, course grains and conventional feed materials totalling up to around 42 million tonnes form the raw materials for the livestock feed industry. These ingredients are used in different proportions as per the formula-mix and least cost analysis depending on their availability and price. Feed price directly depends on the price of raw materials as 70 to 80 percent of the production cost represents raw material cost. Of the total raw material available, around 25 percent are milled as compound feed and the rest fed as such to the animals by the farmers. Although grains are mostly used for manufacture of poultry feed, they are now increasingly being used in cattle feed also.

Feed milling industry in India can be divided into organized and unorganized sector. The total installed capacity of animal feed mills is approximately 17.7 million tonnes;- 10.7 million tonnes in organized sector and 7 million tonnes in unorganized sector. In the organized sector, members of the Compound Livestock Feed Manufacturers Association (CLFMA) and co-operative feed milling plants are manufacturing animal feed. Under unorganized sector, most of the cattle/poultry farms are mixing available concentrates on their farm production units. There are 108 feed manufacturers in the fold of CLFMA membership with about 184 feed mills having a total installed capacity of 5.1 million tonnes per annum. The actual annual production of compound animal feed by CLFMA members is around 3.2 million tonnes. There are about 60 associate members also consisting of manufacturers and suppliers of vitamin premixes, antibiotic preparations, coccidiostats, amino acids,

mineral mixture, growth promoters and other feed supplements. In addition, the feed mills under co-operative sector also produce around 4 to 5 million tonnes of balanced concentrate mixtures for dairy cattle. There are about 100 to 120 other unregistered feed plants which produce another 2.5 million tonnes of feed although they do not fulfil the conditions of becoming CLFMA members which require having a quality control laboratory and full-time nutritionist. Production of compound animal feed by CLFMA members has increased from 39 000 tonnes in 1964 to 3.2 million tonnes in 1998-99, over 80 time- rise giving a compound annual growth of more than 15 percent. This production, however, is insignificant looking to the total requirement of compound feed for the lactating cows and buffaloes and layers and broilers. With large growth potential especially in dairy and poultry sector, the future demand for compound animal feed is expected to grow at the rate of 12 percent.

Although the Indian compound feed industry is located in all parts of the country, the commercial segments of the organized sector of the feed industry are concentrated more in southern and western India. In north and eastern zones, the organized sector feed industry is manly comprising captive consumption segment. Feed mills of small, medium and large size exist. Seven plants have production capacity of over one lakh tonne, while 18 plants have capacity of less than 10 000 tonnes per year. Majority of the feed plants is of medium size with production capacity between 10 000 and 50 000 tonnes per year. Position is not likely to change significantly in near future. Animal feed industry does not produce any effluent or toxic substance and thus does not cause any environmental problem. Although foreign investment is not forbidden in the compound feed industry, there are hardly any major players from outside. The present Asian crisis has not affected the Indian feed industry because almost all major feed ingredients are sourced domestically and that there are negligible exports of complete animal feed/feed concentrates to Asian countries.

Feed mills are located in the proximity of both raw material sources as also feed consumption centres, so that the freight element could be reduced significantly. Almost all major raw materials are procured domestically. On rare occasions, maize in small quantities is imported. Some of the animal feed supplements such as amino acids and vitamin premixes are obtained from overseas. The animal feeds, including compound livestock feed, feed supplements and feed concentrates are fully exempted from central excise duties. This is done with a view to promote animal production on scientific lines so as to fully exploit the production potential of livestock.

The compound feed industry while helping in optimal utilization of course grains, agro-industrial by-products such as de-oiled meals and other non-conventional raw materials also provide nutritionally balanced and scientifically compounded animal feed with high conversion efficiency, and therefore, we can get increased animal products with less feed. These two are of great significance in view of shortage of feed in India.

## Constraints and suggestions

There has been steep rise in the prices of raw feed materials recently and this has greatly affected the economics of production. Both conventional and non-conventional feed resources (NCFR) therefore need to be optimally used to balance nutrients, energy and protein requirement and protein-energy ratios as well as palatability so that ultimate cost-effective productivity is achieved. Some of the NCFR have deleterious effects on animals. Not enough is known about the nature of active principles and ways of alleviating the effects. The NCFR have considerable potential as feed material and would greatly reduce the cost if these are effectively converted into usable products through appropriate technological interventions. The CLFMA should sponsor contract research to effectively utilize the NCFR.

Feed manufacturers in the unorganized sector do not have in-house quality control analytical laboratories for carrying out the proximate analysis of aflatoxins, urease activity and toxic residues. This leads to production of poorly balanced feed of questionable quality. The farmers using such rations are virtually cheated and do not get the expected products. The Government should encourage unorganized feed manufacturers to come under the fold of CLFMA and ensure their having the quality control laboratories. The unregistered feed companies should appoint animal nutritionists and engineers to control the quality of feed and maintain machines.

Adulteration in raw feed materials is a major problem. In fish meal, NPN urea and saw dust are added. Strict legislation and self-regulations by independent associations like CLFMA to ensure quality of feed materials should be enacted. The problems of aflatoxins in most feed materials like cereals and oilcakes are a continuing phenomenon. Education has to be imparted starting from the handling of the harvested crops, handling of materials and storage of seeds before, during and after processing. Improper storage of extracted cakes or harvested cereal results in fungal contamination and aflatoxin production.

The essential amino acids like lycine and methionine are imported and custom duty on them is high. The costs of amino acids need to be brought down by reducing this duty to encourage their higher utilization in feed formulations which would result in enhanced productivity of livestock and poultry. The joint-venture units for production of methionine need to be promoted.

It may be worthwhile to revise the standards now in vogue under Bureau of Indian Standards (BIS) for various raw materials, feed supplements, feed additives and animal feed in line with NRC standards. All feed manufacturing units should come under the purview of BIS so that only quality animal feed is made available. Besides statutory provisions, CLFMA can play a self-regulatory role which will enhance its prestige and earn farmers' trust in CLMFA certified products.

Import of maize has come under OGL for the actual users with the result that large feed manufacturers are able to import. It also needs to be eased for the traders so

that small poultry farmers producing their feed can also use cheaper source of feed ingredients.

There is a shortage of di-calcium phosphate in the country. The basic raw material for production of di-calcium phosphate namely bones are available in large quantities, both from slaughtered animals as well as from fallen animals. A few more plants for production of di-calcium phosphate need to be established in the country.

At present, the feed industry is not producing milk replacers for rearing of the calves and growth production rations for production of meat from sheep, goats and male buffaloes. Concerted efforts are, therefore, needed to promote and produce these balanced rations for intensive feeding of sheep, goats and male buffalo calves which is a feasible commercial venture for producing quality meat.

# Feed-milling industry in Indonesia

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## Introduction

Indonesian people obtain animal protein mainly from beef/buffalo, sheep/goats, pork and poultry. From 1990 to 1994, the commercial chicken population accounted for 64.2 of the total chicken population. The growth of the commercial production of both broilers and layers has achieved impressive results over the most recent five year planning period. This resulted in a significant contribution to meat and egg consumption from domestic production.

In line with the rapid growth of the poultry industry, the feed industry has also been growing very quickly. Feed generally is considered to be the major input for poultry production and may account for 65 to 85 of the total production cost. As poultry feed is composed of several raw materials, the cost and supply of raw material either produced locally or imported affects the feed industry.

With data being limited and difficult to collect, the information presented in this paper is the best available from either the feed-milling industry or from other sources.

## Size and structure of the feed-milling industry

Information on the level of production of commercial feed for 1995 to 1997 is presented in Table 1. The data for 1997 are subject to revision because of the drastic changes related to the economic crisis since the end of July 1997. Prior to then, feed production had been increasing at a rate of more than 10 percent since 1995. This increase is much the same as the increase in poultry production because most feed is used by the poultry industry.

**Table 1. Production of commercial feed in Indonesia**

| Feed producer | Capacity (tonnes) | | | | Share (%) |
|---|---|---|---|---|---|
| | 1995 | 1996 | 1997 | 1998 | 1998 |
| Charoen Pokphand | 1 496 878 | 1 608 674 | 1 553 000 | 2 670 000 | 28.10 |
| Japfa Comfeed | 1 016 117 | 1 019 346 | 1 029 000 | 1 622 000 | 17.07 |
| Anwar Sierad | 193 232 | 202 618 | 287 500 | 1 200 000 | 11.58 |
| Wonokoyo | 130 000 | 312 000 | 192 500 | 824 000 | 8.67 |
| Cheil Samsung | – | 65 728 | 150 000 | 750 000 | 7.89 |
| Cargill | 170 705 | 183 089 | 213 350 | 600 000 | 6.32 |
| Gold Coin | 118 025 | 154 695 | 232 600 | 311 040 | 3.27 |
| Subur Ripah | – | 79 463 | 72 850 | 302 400 | 3.18 |
| Sinta | 97 800 | 185 000 | 170 000 | 187 200 | 1.97 |
| Centra Profeed | 81 600 | 85 600 | 100 000 | 180 000 | 1.89 |
| Others | 263 571 | 680 646 | 1 051 370 | 854 000 | 9.86 |
| **Total** | **3 561 928** | **4 491 259** | **5 051 670** | **9 500 000** | **100.00** |

In 1988, Indonesia produced 1 401 176 tonnes of feed; in 1989 production was 1 511 203 tonnes and in 1990 it was 1 880 336 tonnes. From 1990 to 1995, production of feed increased almost 100 percent.

In the two years up until 1998, several new feed mill plants were established and this increased the capacity of the feed industry. Table 1 indicates that Indonesia had the capacity to produce 9.5 million tonnes of feed in 1997. This production was distributed to 25 feed mill companies. These companies operate more than 25 mills because many have three to six plants located in several sites in Indonesia. The feed industry utilizes approximately 50 percent of available capacity. The industry has high capacity because feed industries have exaggerated the growth of the poultry industry. Indonesia has relatively low consumption of poultry meat and eggs compared to other Association of Southeast Asian Nations (ASEAN) countries and demand is expected to grow as incomes rise. One other possible reason for the excess capacity is the tendency of companies to expand their feed mills to go for bigger capacity and possibly more efficient mills. Companies setting up new feed mills often establish them in a different province. For example, when a company has a feed mill in West Java, it is likely to expand into East Java, or vice versa.

On the basis of the feed mill capacity shown in Table 1, feed mills can be divided into three broad groups:

- Large feed millers with production of more than 1 million tonnes per year. Charoen Pokphand and Japfa Comfeed belong to this category.

- Medium-size feed mills with production of more than 100 000 tonnes per year. This group comprises eight companies, including Anwar Sierad, Cargill and Centra Profeed.

- Small feed mills with production of less than 100 000 tonnes per year.

All large feed mills are integrated with the poultry industry – each operates a grand parent stock farm, a parent stock farm, a commercial poultry operation and a poultry processing plant. Trading companies are also part of some companies. While some medium-size feed mills are not as fully integrated as the large companies, many have parent stock farms for broilers.

Although most protein feed sources for the feed mills are imported, the feed mills do not control the shipping. Many small vessels (these have a capacity of 5 000 to 15 000 tonnes) are able to carry oilseed meal from India, China or Argentina. Large feed mills have the advantage of being able to import raw materials themselves via large vessels such as Panama class ships. To reduce transport cost, for example, American soybean meal is imported by the two largest feed mills using sizable container ships. The large feed mills gain not only through lower transport cost but also through their strong bargaining power in buying materials, including premix and drugs.

Despite the many feed mills in Indonesia and quite intense market competition, investor interest in this industry still remains high. The Coordinating Board for Investment (BKPM) reported that in the first nine months of 1997, 15 new investments in the feed-milling business were reviewed and given permanent licences for expansion or for a new project. However, the Asian economic crisis, especially in January and February 1998, resulted in a dramatic drop in feed production and some feed mills even stopped production.

The percentage of feed consumed by livestock is shown in Table 2. Poultry feed production for both broilers and layers is the major focus of the industry, and represents 85 percent of production. The quantities produced for broilers and layers are about the same. It is expected that the industry will continue to focus mainly on poultry. Aquaculture uses more than 9 percent of the feed produced. Generally shrimp feed is not produced in the plants used to produce poultry feed. Very little feed is produced for ruminant animals. Feed for layers is partly manufactured as a concentrated ration. This is later mixed with maize and rice bran by farmers. In terms of type of feed product, almost all broiler feeds are produced in pellet form, while layer feeds come in mash form. Some starter feed is also provided in pellet form as this is considered beneficial for chickens.

**Table 2. Percentage of feed produced for different livestock, 1997**

| Livestock | Feed production (tonnes) | Share (%) |
|---|---|---|
| Broilers | 2 153 770 | 42.6 |
| Layers | 2 123 650 | 42.0 |
| Swine | 183 540 | 3.6 |
| Aquaculture | 466 950 | 9.3 |
| Cattle | 36 250 | 0.7 |
| Others | 87 510 | 1.8 |
| **Total** | **5 051 670** | **100.0** |

Feed-milling plants are concentrated in three major areas – the suburbs of Jakarta, Surabaya and Medan. Jakarta is the major area due to the number of consumers of poultry products and proximity to the port used to import the raw materials. Before the economic crisis, almost 1 million birds were consumed by Jakartans every day. The imported raw material arrives at the port of Tanjung Priok. Many new feed mills were established in Serang (to the west of Jakarta) because a new port for handling maize was built in this area (Cigading). Maize from Lampung also comes through Merak Port which is very close to Serang. Surabaya and Medan have also become major feed industry areas because of port facilities, the many consumers of poultry products and their closeness to local raw material supply, particularly maize and rice bran.

Raw material supply plays an important role in feed mill operations; the prices of raw materials are affected by season. However, very few contracts are drawn up for the purchase of maize or rice bran from local sources. Instead, the price follows the current market trend. The low price of maize during the harvest season (normally the wet season) has motivated some feed mills to set up maize drier facilities with silos to cope with the price increase during the off season. The other important ingredient, rice bran, is difficult to store, as it is not stable when stored for long periods.

Typical poultry feed formulas are presented in Table 3. As reported earlier, the major imported raw materials are protein sources. Almost 30 percent of feed raw materials is imported, namely soybean meal, groundnut meal, rapeseed meal, meat bone meal, maize gluten meal, fishmeal etc. They are purchased according to world market prices.

**Table 3. Typical poultry feed formulas used by feed mills**

| Ingredient | Broiler share | Layer share | Average share |
|---|---|---|---|
| | (%) | (%) | (%) |
| Maize | 50-60 | 40-50 | 50 |
| Soybean meal | 15-25 | 10-20 | 18 |
| Rice bran | 0-10 | 10-30 | 15 |
| Wheat pollard | – | 0-10 | 5 |
| Animal by-product meal | 0-5 | 0-5 | 3 |
| Rapeseed meal | 0-5 | 0-3 | 3 |
| Fat/oil | 0-3 | – | 1 |
| Others/oilseed meal | 5 | 5 | 5 |

## Government regulations

In the five year period up to mid-1998, the Indonesian feed industry grew by around 12 percent annually. As noted earlier, this was mostly because of the increase in poultry production. Therefore, any change in government policy for the poultry industry will also affect the feed industry. With regard to investment policy, Presidential Decree No. 23/1991 put a restriction on investment in the feed industry. The industry is still open to new investments by both local (PMDN, 'domestic') and foreign investors (PMA, 'foreign'). However, there are some requirements for foreign investors set out by the Coordinating Board for Investment (BKPM). One such requirement is that foreign investors must be in a joint venture with Indonesians. The Indonesian share has to be at least 20 percent at the initiation of the project, rising to 51 percent after 15 years. Foreign investment located in a border zone (such as in Batam Island) and exporting 100 percent of its production is only required to share 5 percent with the Indonesian partner. However, a foreign investment that exports at least 65 percent of its production and which is not in the border zone is required to set aside 20 percent of its share for Indonesian partners within ten years and 51 percent after 15 years of commercial operation. It is also required that foreign investment must exceed US$1 000 000 except for ventures that can meet the following conditions:

- Labour-intensive with at least 50 workers.

- At least 65 percent of production is for export and the project is located in the eastern islands of Indonesia. These include West Nusa Tenggara, East Nusa Tenggara, East Timor (now Timor-Leste), South Sulawesi, Southeast Sulawesi, Central Sulawesi, North Kalimantan, Central Kalimantan, Bengkulu and Jambi. PMAs of this type may start with an investment of at least US$250 000. Cooperatives or small enterprises are given priority to become Indonesian partners.

The local feed mills are not required to sell or export the products from the feed mill. They can sell the output locally if they follow the quality and safety regulations. Unlike dairy farmers who obtain feed from cooperatives, feed mills are not required to sell

their products to cooperatives. The feed mills are permitted to appoint a number of distributors or retailer agents in an area so long as the following rules are satisfied:

- The appointment must be in writing with a copy sent to the Directorate General for Livestock Services.
- The distributor/agent must have a trading licence from the Minister of Industries and Trade.
- Feed mills remain responsible for feed quality and distributors or agents are prohibited to replace the original packing of feed.
- Animal feed cannot be sold in the same area as chicken or eggs.
- Distributors/agents must comply with, and commit themselves to, the regulation for the control of animal feed.

Earlier it was stated the cost of feed is very much affected by the cost of raw material. The National Logistic Organisation (BULOG) at one time did procure feed ingredients. However, in 1989, BULOG waived its monopoly right in the procurement of maize, fish meal and soybean meal. In May 1995, the government issued a new deregulation policy to improve business efficiency, to strengthen economic resilience and to increase competitiveness. The import duty and surcharge on animal feed were reduced and for some feeds abolished. Import duties on feed ingredients were reduced to a range of zero to 5 percent. The major ingredients for poultry feed such as maize, soybean meal, fishmeal, groundnut meal and bone meal have zero import duty.

Most poultry feeds are processed with modern equipment that is imported. Equipment suppliers may come from Europe, the United States or Taiwan, Province of China. Several of the newly set up feed mills were built as turnkey projects, while other feed mills are only partly supplied for machinery. No preferential treatment is given to this industry. Investors can apply to the Coordinating Board for Investment (BKPM) with the master list of the equipment to be imported. They are exempt from import duties as long as they comply with the conditions set out by the government. As already stated, major feed mills are located close to the production farm and the breeding farm. Although incentives are provided to build feed mills in certain areas, such as those given to foreign investment, very few feed mills have been built recently in eastern Indonesia. All new projects of feed mills owned by foreign companies are located in Java except for one in West Kalimantan.

Deregulation has been enforced in Indonesia and there is great interest among industries in accepting it. It is expected that better efficiency for improving the business climate may accelerate the growth of the feed industry. As most of the industry is directed to meet local demand, there is very little opportunity to export poultry feed. Thus, although Indonesia has accepted the GATT agreement, it is generally thought that it will not have major implications for the feed industry. The only possible impacts are decrease in poultry farm numbers and replacement of local poultry production by imports of poultry products. When the cost of production of poultry meat in the United States or Brazil is much less than that in Indonesia, it is possible that imports of poultry meat will become competitive and feed production will be affected. However, considering the local production of maize, the relatively low price of rice bran and

consumer preference for hot chicken carcasses, the effect of GATT on Indonesia is likely to be minor.

## Ingredients

As almost 90 percent of feed produced by the feed-milling industry in Indonesia is for poultry, the typical feed ingredients used will be similar to those required by poultry farms. There are two distinct formulas for broilers and layers. As shown in Table 3, on average maize and soybean meal constitute almost 70 percent of the total ration. Although the Directorate General for Livestock Services provided a typical formula for poultry feed, it has never been followed by feed mills due to the rapid development of nutritional supplements and feed availability.

Unconventional feedstuffs are sometimes used by feed mills. These include cassava chips, palm kernel meal or coconut meal. However, these ingredients are not commonly fed to chickens due to their price and low nutritive value. A large proportion is exported or used locally as ruminant feed.

While maize is one of the main ingredients for poultry feed, its use is not restricted to feed. Maize is put to the following uses: 61.5 percent for human food, 29.5 percent for feed, 5 percent for seed, 3.5 percent for export and 0.5 percent is 'lost'. Maize is used in poultry rations as a source of energy. Although maize is not the only grain used for this purpose, the availability of other grains such as sorghum is very limited and available only in certain parts of Java during the dry season. With regard to maize production (Table 4) before 1990, Indonesia was self-sufficient. However, as already noted, in the last ten years the demand for maize for feeding poultry has increased significantly as the poultry industry grew. This resulted in the importing of maize to meet local demand. In 1990, the volume of maize required by feed industries reached 1.3 million tonnes and in 1996 it was estimated to reach 3.5 million tonnes. In 1998, it was estimated that 4.1 million tonnes of maize were needed for the feed industry. At the beginning of 1990, maize was imported from China and Thailand. However, in recent years maize imports have come predominantly from the United States because of insufficient supply from China. The rate of increase up to 1994 was more than 12 percent and at that time the trend in imports was expected to continue into the future. Before 1988, BULOG was the only agency authorized to procure maize or other basic ingredients such as soybean meal and fishmeal. At present the private sector is allowed to import maize. The maize used for poultry is the yellow variety and only small quantities of the white variety are available. Although nutritionally the two varieties are not different, the white variety is sold at a slightly lower price.

**Table 4. Production and imports of maize and rice bran, 1990-1997**

| Year | Maize | | | | Rice bran | |
|---|---|---|---|---|---|---|
| | Production (Kt) | Growth ( % ) | Import (Kt) | Growth ( % ) | Production (Kt) | Growth ( % ) |
| 1990 | 6 734.0 | – | 9.0 | – | 3 162.5 | – |
| 1991 | 6 256.0 | –7.1 | 323.3 | 3 472 | 3 128.2 | –1.09 |
| 1992 | 7 995.5 | 27.8 | 55.9 | –83 | 3 376.8 | 7.9 |
| 1993 | 6 459.7 | –19.2 | 494.5 | 785 | 3 372.7 | –0.1 |
| 1994 | 6 868.9 | 6.3 | 1 118.3 | 126 | 3 264.9 | –3.2 |
| 1995 | 8 223.0 | 19.7 | 969.1 | –13.4 | – | – |
| 1996 | 7 953.6 | –3.3 | 616.9 | –36.4 | – | – |
| 1997 | 9 261.0 | 16.4 | 478.0 | –22.5 | – | – |

Most of the imported maize is US Grade No. 2 and this is normally used for animal feed. With regard to quality, considerations in the purchase of maize are moisture content and the proportion of broken or damaged kernels and contamination by foreign material. The presence of mycotoxins has been put forward as an additional criterion. Although the moisture content of maize has been limited to a maximum of 16 to 17 percent, many feed mills are still willing to receive maize with a high moisture content if there is a price adjustment. Many feed mills are equipped with either an on-site maize drier or a special buyer that dries maize in the production area. Maize drier facilities may be essential as much of the maize is harvested in the rainy season. Poor handling methods can result in increased incidence of mycotoxin contamination. Results of a survey by a research institute showed that almost all maize produced locally was contaminated by aflatoxin to varying degrees.

The Indonesian Government has stated that the country will have to reach self-sufficiency in maize and it also has to try to reduce maize imports. There are several options to increase maize production. The first two are to increase the maize area or to switch to hybrid maize. Increasing the area planted is perhaps more difficult due to competition with rice production. Alternatively, planting hybrid maize is more realistic but the adoption rate has been slow. In the last three years, the government launched a hybrid maize programme with a target of 500 000 hectares. The programme covers Java, Lampung, South Sulawesi and North Sumatra. Currently, there are three hybrid maize producers in Indonesia – the Charoen Phokphand group, Cargill and Pioneer.

**Table 5. Imports of soybean meal and soybean, 1990-1997**

| Year | Soybean meal | | Soybean | |
|---|---|---|---|---|
| | (Kt) | (% change) | (Kt) | (% change) |
| 1990-1991 | 5.2 | – | 526.3 | – |
| 1991-1992 | 193.3 | 3 581 | 631.0 | 19.9 |
| 1992-1993 | 170.6 | -11.7 | 687.6 | 8.9 |
| 1993-1994 | 361.1 | 111.6 | 700.2 | 1.8 |
| 1994-1995 | 498.6 | 38.1 | 628.2 | -10.3 |
| 1995-1996 | 894.0 | 79.3 | – | – |
| 1996-1997 | 1 085.0 | 21.4 | – | – |

The second major ingredient for poultry feed is soybean meal, all Imports coming from India, Argentina, Brazil, China and the United States. Although Indonesia grows more than 1.5 million tonnes of soybean per year, this production is not sufficient to meet the demand for processed products such as tempeh, tofu and soy sauce. In 1990, Indonesia established a soybean crushing plant located in Jakarta but it was closed down in 1996.

Imports of soybean meal increased steadily in the first part of the 1990s, resulting in more than 1 million tonnes of soybean meal being imported in 1996-1997. Between 1990 and 1994, imports increased at a rate of 9.4 percent per year, almost a similar rate of increase as recorded for the poultry industry. A dramatic increase of more than 100 percent happened from 1994 to 1997. The main supplier was India, followed by South America. The United States supplied 56 000 tonnes in 1996-1997 but none in 1997-1998. In contrast with whole soybeans, imports of American soybean meal are limited due to its higher price and because it cannot be shipped in small quantities. Only large feed mills can import soybean meal from the United States using Panama class vessels. Before 1996, with the local crusher still operating, the government applied a tariff on imported soybean meal and set a local content requirement. The tariff was lifted but the government then added a 10 percent tax. Now the tax has been lifted and feed mills can import directly for their own use without paying a tax.

Soybean meal is regarded as the best protein source for poultry. If properly processed, its digestibility for chickens is relatively higher compared to other plant protein sources. Most feed mills have used soybean meal in their formulas, although other alternative oilseed meal sources such as groundnut meal from India are available. Rapeseed meal imported from India or China is also used in small quantities – the maximum is 3 percent – due to possible toxicity and low digestibility.

The quality of soybean meal coming to Indonesia also varies not only in its protein content but also in other quality parameters such as potassium hydroxide (KOH) solubility and urease activity which indicates the adequacy of processing. Indian soybean meal contains hulls that increase the fibre content in the feed.

Besides maize and soybean meal, rice bran is also a major ingredient of poultry rations. The use of rice bran in broiler feed may account for up to 10 percent of the ingredients

while for layer feed this percentage can be up to 30 percent. Rice bran is produced by many small rice mills throughout Indonesia especially in the rice-producing areas. It is estimated that more than 3.5 million tonnes of rice bran are produced per year. Rice bran is viewed as a relatively cheap feed ingredient for poultry within ASEAN countries. Rice bran, however, cannot be stored for long periods due to its instability during storage. Hydrolytic rancidity of the oil in rice bran and insect contamination are the main problems. The quality of rice bran varies depending on the contamination of rice hulls. Observation in the field indicated that hull inclusion may vary from close to zero to up to 50 percent in rice bran. As rice hulls have no nutritive value as poultry feed, feed mills need to check the amount of hulls before accepting them for poultry feed. Other contaminants that have also been detected in the field include cassava waste, soil, limestone and sawdust. The price of rice bran fluctuates more than any other local ingredient, and it can vary by more than 100 percent depending on the season.

Indonesia also produces wheat pollard/bran as a by-product of wheat milling. Estimates are that 30 percent of imported wheat (2.5 million tonnes) is produced as a by-product. The quality of wheat pollard/bran is more consistent than rice bran because it is produced by a few large wheat mills. The use of wheat pollard in poultry feed is limited, and most wheat pollard is sent to dairy cooperatives for dairy cows.

Cassava chips or pellets are available in certain parts of Indonesia. Once cassava pellets were exported to Europe under a quota system. Recently, the quota system has been closed and cassava chips have become available for use as poultry feed. If used in broiler rations, the addition of oil is sometimes needed. The type of oil available in Indonesia is crude palm oil and fish oil, the latter being seasonal and produced from sardine-type fish.

To provide a balanced diet for poultry, several minor ingredients and feed additives are needed. Di-calcium phosphate is mostly used as a phosphate source. This material is imported from Belgium, the United States or China. The local phosphate source is limited, with bone meal sometimes being used. Most calcium comes from locally available limestone or oyster shells. The situation is similar for salt. All other feed additives including vitamins, trace elements, coccidiostat, growth promotants, choline chloride, antioxidants, preservative or nutritional supplements such as enzymes, are imported.

The choice of the ingredients used in formulating the feed ratio is influenced by price, availability and services provided by the supplier. Most feed mills use computer programs to formulate the diet, with linear programming being used for single mix or multimix mixtures. In linear programming, the nutritive value and price are the constraints that need to be considered. The prices of imported ingredients depend upon developments in the world market, while local ingredient prices are affected by the season. Traders, both international and local, are well informed regarding world market prices and the information is available to the feed mills. Some feed mills may import certain ingredient directly without using outside traders. They open a letter of credit, at sight or later, depending upon the relationship between purchaser and supplier. Some feed mills, particularly the smaller ones, obtain ingredients through local

traders using local currency. The price is normally the landed cost of ingredients plus value added tax, income tax or import duty, as well as a margin for the trader.

On average about 82 to 85 percent of the selling price is the cost of raw materials and to this is added the cost of processing, any losses, the cost of packaging and so forth. During the economic crisis of 1997, the feed mill association increased the selling price of feed several times to take account of the fluctuation in the exchange rate between the Indonesian rupiah and the US dollar. Most of the feed mills lost money during this period.

The change in the price of feed both for layers and broilers over time is shown in Table 6, which shows that prices rose steadily over the last few years due to the increase in price of local ingredients and the depreciation of the rupiah against the dollar.

**Table 6. Average price of feed in Indonesia (Rp/kg)**

| Year | Layers | | Broilers |
|---|---|---|---|
| | Starters | Layers | |
| 1990 | 573 | 492 | 589 |
| 1991 | 602 | 541 | 623 |
| 1992 | 606 | 520 | 660 |
| 1993 | 600 | 540 | 707 |
| 1994 | 694 | 624 | 688 |
| 1995 | 716 | 641 | 794 |
| 1996 | 798 | 760 | 913 |

## Future prospects and problems for the feed-milling industry

Between 1990 and 1994, broiler consumption rose 15.5 percent and this accounted for 56 percent of chicken meat consumption. Besides broilers, people also consume village chickens (local chickens) which are normally raised in backyard systems. The local chicken is multi-purpose, being used for meat or for egg production. Although its contribution to protein has become less in percentage terms and although it has poor efficiency in converting feed to protein, the village chicken is raised extensively due to low input costs.

Based on income and population, Capricorn Indonesia Consult, Inc. (1996) predicted that chicken meat and egg consumption would increase steadily over the next few years (Table 7). Based on this prediction, it is possible to forecast feed requirements. This is because 85 to 90 percent of the feed is produced for broiler and commercial egg production. With almost equal production of feed for broilers and layers, feed requirements will increase at a rate of 8.3 percent per year. The prospects of the feed industry remain good and the opportunity for investment will continue to expand. Many firms in the feed industry continue to expand their scale of production and also the extent to which their operations are vertically integrated. New feed mills in West Java have already been built by local investors such as PT Wonokoyo or PT Kerta Mulya, and by foreign companies such as PT Cheil Jedang from Republic of Korea and PT Cargill

from the United States. Expansion has occurred in the Jakarta area, in Surabaya (PT Anwar Sierad and PT Arta Citra Terpadu) and in Lampung (PT Anwar Sierad and PT Centra Profeed).

**Table 7. Estimate of total consumption (tonnes) of chicken meat and eggs in Indonesia, 1995-2000**

| Year | Broilers | Village chickens | Commercial eggs | Village chicken eggs |
|---|---|---|---|---|
| 1995 | 548 746 | 261 679 | 376 896 | 97 642 |
| 1996 | 606 929 | 275 697 | 398 669 | 99 171 |
| 1997 | 672 644 | 287 988 | 420 906 | 102 709 |
| 1998 | 744 101 | 298 458 | 447 687 | 104 256 |
| 1999 | 823 537 | 311 160 | 475 038 | 107 869 |
| 2000 | 909 095 | 321 971 | 505 053 | 111 532 |
| **Average growth (%)** | **10.62** | **4.29** | **6.01** | **2.69** |

Vertical integration has been started by firms with their own broiler farms and processing plants. At least two slaughterhouses for broilers have been completed recently. They are owned by PT Charoen Pokphand and PT Wonokoyo. It seems that a few large feed mills and their integrated companies are likely to dominate the industry. The small feed mills with production of less than 50 000 tonnes per year will disappear unless they utilize feed from their own farms.

The economic crisis in Indonesia has resulted in a severe setback to the poultry industry and the feed-milling industry. The US dollar exchange rate rose from Rp2 400 in July 1997 to Rp9 000 in February 1998. This caused an increase in the prices of imported products such as soybean meal, meat bone meal, rapeseed meal, synthetic amino acids (lysine, methionine), vitamins, minerals and drugs. However, the final price of feed is not three times higher and did not follow the US dollar exchange rate due to relatively low prices for maize and rice bran. The increase in feed price forced farmers to increase the price of eggs and broilers. The egg price rose from Rp2 000/kg to Rp4 500/kg at the end of February 1998. With the economic crisis, the population of poultry, both broilers and layers, has drastically fallen. Many have claimed that the total broiler population decreased from 15 million birds per week to only five million birds while the layer population decreased to less than 40 percent of its pre-crisis level. As most feed is produced for poultry, the feed-producing industry has been badly affected. It is difficult to get accurate data but the 1998 production was at most only 40 percent of production in 1997 (5 000 000 tonnes). Several feed mills have closed down while the surviving feed mills have reduced their production. Concomitantly, several feed mills in West Jakarta that have recently been built, have not started operation yet. Also, new contracts to build feed mills have been cancelled.

It is not possible to predict when the situation will recover because poultry farms are operating at 40 percent capacity, and broiler and egg supplies have declined due to the

lower purchasing power of the average household. Production from feed mills will not recover in one or two years because of the situation in the poultry industry.

## Concluding comments

The following points can be made on the basis of the information in this paper.

- The feed industry grew at a rate of more than 12 percent in the first half of 1990. Production was dominated by commercial chicken feed for broilers and layers. This accounted for 85 percent of the total feed production. The industry remains dominated by large- and medium-size feed mills. Large mills have a capacity of more than 1 million tonnes per year while medium mills have a capacity of more than 200 000 tonnes per year.

- About 30 percent of the raw material for poultry feed is imported and most imports are either plant protein or animal protein. If the promotion of hybrid maize leads to it being accepted by farmers, Indonesia could become self-sufficient in maize. However, Indonesia is still importing maize to meet the demand of the feed industry. The price of feed will increase in years to come due to the depreciation of the rupiah, and this will inflate the price of imported raw material.

- The government provides an environment conducive for investment in the feed industry and new investors, local and foreign, are still interested. Although a cooperative system is encouraged, there is no obligation to sell products to the cooperatives.

- While the future of the feed-milling industry is uncertain and new plants have recently been established, the economic crisis has resulted in a dramatic downturn in the industry. If production drops to between 30 and 40 percent of the pre-crisis level, the future of the feed-milling industry is becoming questionable.

# The feed-milling industry in the Islamic Republic of Iran

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There are 210 poultry and livestock feed-milling plants in the country of which 160 units − with 6.7 million tonnes potential capacity − are currently operational. The remaining 50 are not functioning owing to:

- Direct supply of raw materials to livestock owners;
- Non-acceptance of outputs by livestock owners;
- The presence of small mixers in farms;
- Lack of suitable quality control systems in plants;
- Plant difficulties in requisitioning and supplying raw materials.

The functioning plants have annual feed capacity of 1.8 million tonnes, which is only 29 percent of their potential capacity.

The 30 plants that produce mineral and vitamin supplements are working at full capacity (40 000 tonnes annually). This also applies to fish meal plants (56) and Dicalcium Phosphate plants (14) which deliver 75 000 and 27 000 tonnes per year respectively.

Sector-wise, ownership of livestock feed-milling industries is disaggregated into the government sector (10 percent); the cooperative sector (20 percent); and the private sector (70 percent).

The third five year plan (2000-2004) for economic, social and cultural development has the following objectives for the feed-milling industry:

- To increase production of poultry and livestock feed up to potential capacity.
- To increase fish meal output from 75 000 to 200 000 tonnes.
- To increase di-calcium phosphate production from 27 000 to 50 000 tonnes.

There are no plans to increase the output and develop the capacity of mineral and vitamin supplement plants. At present most livestock feed-milling industries are working for the poultry sector.

Livestock feed-milling industries are strategically located away from urban centres so there is no threat from pollution.

Owing to water shortage and limited agricultural land, which is needed to supply

food needs (such as wheat and rice), only 43 percent of the raw materials for poultry feed is supplied domestically; the remaining 57 percent is imported.

Foreign investment in poultry and livestock feed-milling industries is permitted, but no foreign firm has done so yet. Due to limited production and domestic needs, poultry and livestock feed cannot be exported to other countries yet.

Permission to establish facilities such as livestock feed-milling plants on non-agricultural lands can be sought from the relevant authority. However there are stipulated distances between these facilities and road, rail and port infrastructure which increase transportation costs.

Poultry and livestock industries are considered to be part of the agriculture sector so they are exempted from tax payments. As I.R. Iran is not a party to GATT these industries are not directly affected by GATT agreements.

Required volumes of poultry and livestock feed in the country amount to 60 million tonnes annually or 30 million tonnes of total digestible nutrients. The most important sources are given in Table 1.

**Table 1. The most important sources of feedstuffs in I.R. Iran**

| Feedstuff | Quantity (dried), tonnes |
|---|---|
| Edible plants | 7 |
| Concentrates and plant by-products | 11 |
| Straw and crop residues | 32 |
| Pasture forage | 10 |
| **Total** | **60** |

In 1997, more than 2.5 million tonnes of poultry and livestock feed including barley, maize, soybean meal and fish meal worth approximately US$900 million were imported; 500 000 tonnes were used for livestock feed (beef and dairy production) and 2 million tonnes were used by the poultry sector (Table 2).

**Table 2. Import of main items of poultry and livestock feed during the second national development plan ('000 tonnes)**

| Ingredient | 1999 | 1997 | 1996 | 1995 |
|---|---|---|---|---|
| Barley | 694 | 605 | 314 | 122 |
| Maize | 768 | 1 510 | 1 445 | 1 097 |
| Soybean meal | 434 | 390 | 680 | 510 |
| Fish meal | 41 | 55 | 61 | 61 |
| **Total** | **1 937** | **2 560** | **2 500** | **1 790** |

Source: I.R. Iran customs.

In 1997, 3.5 million tonnes of poultry feed were consumed of which more than 2

million tonnes were imported and 1.5 million tonnes were supplied domestically (Table 3).

**Table 3. Poultry feed consumption in I.R. Iran in 1997**

| Feedstuff | Volume ('000 tonnes) |
|---|---|
| Maize | 1 900 |
| Soybean meal | 665 |
| Non-standard wheat | 470 |
| Barley | 105 |
| Fish meal | 185 |
| Supplements | 25 |
| Others | 150 |

Forty percent of the feed in Table 3 was allocated to poultry and livestock feed-milling plants and 60 percent to poultry farms.

The price of raw materials for poultry and livestock feed has been increasing in recent months; this also affects the final price of animal products such as beef, milk, chicken and eggs.

# The feed-milling industry in Korea (Rep. of)

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## The size and structure of the feed milling industry

The size of feed industry in Korea (Rep. of) has increased simultaneously with the growth of Korean economy and livestock industry from 1960s. The growth of Korean feed industry can be classified chronologically into 3 developing stages; which comprise; 1) introductory stage (1960s-1970s), 2) quantitatively expanding stage (1970s-1980s), and 3) steadily growing stage (1990s). The first feed company in Korea, Joongang Feed Manufacturing Company, was established in 1946. At that time the company used shovel and manual assorting machine. Korean government initiated to prepare a plan for feed supply in 1961 and initiated feed supply plan and permitted the establishment of Korean Feed Industry Co-operation. The feed management law and regulations were established in 1962. In 1960s, modernized feed companies such as Purina Korea (1967), Korean Cargil (1968) and Woosung Feed (1968) emerged. In 1963, there were only 7 compound feed companies with annual compound feed production of 10 000 MT. Annual feed production and the number of feed company have continuously increased year by year; i.e., 47 000 MT by 48 companies in 1965; 507 518 MT by 68 companies in 1970; 901 000 MT by 73 companies in 1975; 3 462 000 MT by 78 companies in 1980; 6 451 000 MT by 79 companies in 1985; 10.4 million MT by 81 companies in 1990; and 15.9 million MT by 95 companies in 1997.

Most feed industries are close by Seoul such as Incheon city and Kyunggi province (29 out of 95 factories, 30.5 percent; capacity of feed supply 36.7 percent of the whole country's capacity). The reasons for centralized feed milling industry in the area of Incheon city and Kyunggi province are that:-1) major livestock industry has been established around Seoul to target mass consumer's need, and 2) feed industry takes geolographical advantage of the biggest harbour in Incheon for cereal import.

By daily production capacity, 24 factories fall on 300 MT, 20 factories on 200 MT, 14 factories on 400 MT, 15 factories on over 500 MT. Top 10 companies are occupying 45 percent of the total feed market. Swine industry is the major target feed market for the feed milling industry to date. In 1997, 5.06 million MT of compound feed was produced for swine (31.9 percent of total feed production 15.9 million MT), 4.4 million MT for beef cattle (27.6 percent), 3.8 million MT for poultry (23.7 percent), and 2.1 million MT for dairy cattle (13.2 percent). Feed industry may expand its capacity for swine due to the continuous growth of swine industry.

In 1997, domestic source feed components comprised 3.9 million tonnes (24.5 percent) within the total of 15.9 million tonnes. However, this may have been overestimated because domestic components included by-products of imported cereal. Currently, it is estimated that over 90 percent of feed components are imported.

## Livestock policies and their implications for the feed milling industry

Livestock industry is the second largest source of farm income, following rice. The ratio of production value from livestock industry to the gross national product decreased from 4.5 percent in 1970 to 1.9 percent in 1993, however, the proportion of the production value of the livestock industry to agricultural value of production increased from 16.5 percent in 1970 to 27 percent in 1993. In terms of production value, beef cattle ("Hanwoo"), dairy cattle, pig, and chicken are major sources livestock products. Since the Uruguay Round negotiation was concluded on December 15, 1993, Korean livestock farmers strongly complain about the results of this Uruguay Round negotiation. Farmers felt that Korean livestock industry would completely collapse when beef market is opened as agreed in the negotiation due to a small-scale production structure and low competitiveness. Cattle and dairy industries are particularly less competitive compared to pig and chicken industries. Korea has limited land to produce livestock feeds such as feed grains and fodder crops, and the development of Korean livestock industry should be highly dependent upon imported feed grains. Korea has imported a substantial amount of livestock products (largely, beef and milk products) in order to stabilize domestic supply and demand. Consumption of livestock products increased substantially due to consumers' need for more protein-rich diet. Per capita consumption of beef, pork, chicken, and milk between 1970 and 1993 increased to 4.5, 5.2, 3.8, and 28.5 times, respectively. The trend is expected to continue in the future.

Stabilization of prices of livestock products and livestock farmers' income, and preservation of a certain level of domestic production for food security have long been traditional policy goals of the Korean government. The objectives of government policy in the future should not be so much different from those in the past. However, the means and strategies to achieve the policy goals should be subjected to many changes. As the results of the Uruguay Round, market opening is an inevitable process. Major actors in world trade and domestic market are not governments or their agencies, but private entities. Fundamentals in foreign trade and in domestic markets are determined by interactions of the private entities and their shares are directly affected by their competitiveness. In this context, the government is encouraging the private entities to improve their competitiveness so that they can compete with foreign producers and exporters without a resource to the government. Thereby government regulations on private economic activities are being mitigated or removed. Main government policy objectives can be summarized as follows: - 1) to make weak production structure more competitive, 2) to gradually stabilize livestock prices downwards, 3) to improve marketing structure including the

enhancement of product quality and safety, 4) to improve implementation system of livestock policies, and 5) to protect and preserve the natural environment.

Foreign investment has been permitted in the feed industry in Korea since the introductory stage. The best example is "Purina Korea" which was founded in 1967. Purina Korea is one of the biggest companies, owns three main factories, exports its products to other countries, and targets 10 percent market share in Korea by 2002.

## Sources of ingredients and raw materials

In 1997, feed components comprise 57.7 percent grain, 21.1 percent vegetable protein, 10.6 percent bran, 9.6 percent inorganic substance and others, and 0.9 percent animal protein. The proportion of grain in compound feed has continuously increased during 1980s, but the government restricted the proportion of grain in 1984 and maintained the upper limit around 60 to 63 percent until recent years. At present, the proportion of grain in feed is determined by the industry's own hand-based on the comparison of the price and nutritional value between grain and alternative raw materials. It is expected that the proportion of grain may not increase due to an increase in the proportion of vegetable protein and bran.

## Future prospects and problems for the feed milling industry

The future of feed milling industry in Korea is mainly depending on domestic livestock industry and consumers' need. It may not be optimistic. Korea will maintain import quota system on beef until December 2000. However, it has an obligation to completely liberalize the beef market by January 2001. Therefore, whether beef cattle (Hanwoo) industry (2.2 million heads, March 1999) can survive after the import liberalization largely depends on how Korean farmers can produce higher quality beef and how they can reduce production cost within a couple of years. The fate of beef cattle industry may directly impact on bovine feed industry in the near future. Dairy cattle industry (0.53 million heads, March 1999) is relatively less sensitive to the impacts of the Uruguay Round negotiation because tariff rates of major dairy products increase to relatively high levels. In pork industry, Korean government has stimulated domestic private enterprises to increase export of pork to Japan. In 1993, Korea exported 11 329 MT of pork to Japan. The export volume increased to 51 451 MT in 1997. To hit the target, 40 pork export complexes were established in 1994. It is likely that the present swine industry (7.4 million heads, March 1999) and feed company for swine steadily expand their capacity if environmental problems are permitted. The management of sewage and waste water resulted from operating livestock industry is a hot issue for Korean people. Due to this issue, some livestock farmers had been forced to move into isolated mountainous areas. Farmers have obligation to equip disposal plants of wastewater and sewage. The environmental contamination by centralized, large-scale livestock industry must be a limiting factor for Korean livestock industry to keep growing. Another problem the feed industry faces up is consumerism, for instance, "dioxin" sensation all over the world. The feed industry must give consumers safe and

healthy food at an affordable price. Consumers wish to know what goes into the feed utilized to produce animal products such as meat, eggs, milk, and seafood.

Because of the economic crisis, total amount of compound feed reduced down to 17.4 percent for beef cattle in 1998 compared to 1997 (dairy cattle 15.7 percent, swine 2.8 percent, and poultry 11.4 percent reductions). In livestock production today, a major issue is vertical integration. Feed companies use forward vertical integration as an important strategy and are investing in primary animal production in order to safeguard sales. Some feed manufacturers such as National Livestock Co-operatives Federation (NLCF) actively participate in the processing and marketing of animal products. The recent Korean economic crisis drives NLCF to integrate into the National Agricultural Co-operatives Federation.

# The feed-milling industry in Lao PDR

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## Introduction

In lower-income developing countries like Lao PDR where agriculture and now agro-industries are primary income earners, the introduction of the latest technology in feed production is mandatory. The best utilization of raw materials and producing the highest quality feeds are necessary to raise high quality livestock and fish to support human being with richness of protein food.

Over the period of close to two decades, Lao government has continually improved feed production and become approximately self-sufficiency in the area of animal feed. The government as well as private owners have devoted tremendous effort in conducting the research and development of products to ensure the best quality, providing nutritional feed for each age and animal species. Today in Lao PDR, there are two animal feed mills, one is located in Vientiane City and was built in 1979. The other one is set up this year in Bokeo province. Our two feed factories are able to manufacture a good quality feeds for swine, broilers, layers, and dairy cattle.

## Background of animal feed mills

The first public animal feed factory was built in 1979. It had been in operation from 1982 to 1992 with the production capacity of 10 tonnes per hour. However, the productivity at that time was still low and the average production was only about 2 000 tonnes a year. From 1993 to 1996 the factory was leased to private company, thence the production increased from 1 690 tonnes to 5 000 tonnes. It was able to supply about 36 percent of the demand for animal feed in that year. Though the productivity was increased, it could not meet the local demand. To improve its production capacity the government has encouraged a reform of ownership of that mill. In 1997, a foreign partner was founded and it was formed as a joint venture between Lao and Singaporean investors and upgrading the production capacity up to 70 000 to 80 000 tonnes a year by full-time running. Since then, the production sharply increased from 8 200 tonnes in 1998 to 18 000 tonnes in 1999. It can supply about 75 percent of the demand of which 80 percent went to poultry operations, 19 percent to swine and 1 percent to dairy cattle. The average prices of the animal feed are 1 300 to 2 300 kip (about US$0.23- 0.24) per kilogram.

The second factory started its operation three months ago by international company. It is 100 percent foreign owned. The capacity of this factory is about 3 to 5 tonnes per day. It produces complete and concentrate feeds for pig and poultry.

In general, the current production reaches the top in comparing with the past performance, but the factories still have faced some problems such as:

1. Financial constraint.
2. The first factory is operated with the out-of-dated technology, i.e., old machinery and it is difficult to find spare parts when needed.
3. Not enough drying capacity during the peak harvest season and storage to store raw materials.
4. There is a keen market competition with imported animal feed.
5. There is a scarcity of foreign exchange to cover the raw materials from abroad.

## Raw materials for the feed milling industry

The factories use the local raw materials about 70 percent of total ingredients namely corn, rice bran, soybean, broken rice, phosphorus, calcium, and salt. The rest 30 percent are imported namely soya cake, fish meal, leucaena, methionine, vitamins/pre-mix, formaline, and plastic bag. A project is underway to increase the production of locally-produced ingredient. There are some problems with storing raw materials because the dried silo for storing corn, rice bran and soybean is not enough. In harvest season, the factory could buy only limited quantity of maize because it can dry a maximum of only 50 tonnes of maize a day. The rest is dried by the farmers, therefore in rainy season the quality of maize is low and it has an impact on the quality of the feed as well as a length of the stocking.

## Regulations related to the Industry

According to the fact that Laos' economy is based on agriculture. The promotion of agriculture is one of the priorities on which the government has focused including the feed milling industry. Due to limitation of local capital, foreign investment is encouraged. Foreign investors can hundred percent invest in this sector or form a joint-venture with local investor.

There is no restriction on this industry. All the firms involved in feed milling will be promoted to produce feed for local consumption and also for export.

The other measures to facilitate the operation of animal feed production taken by the government are:

- Impose a low rate of import tariff, free of tax on machinery and equipment for feed mill.

- Access for foreign exchange: Since there is scarcity of foreign exchange, the government assists the operators of animal feed production facilities to easily access to foreign exchange to cover the necessary import cost.

Concerning the related regulations such as land tax law which influences the location of the industry, there is no specific regulation. However, there are some laws such as Land Law, Agricultural Law and Foreign Investment Law that could be considered as a means to promote the feed milling industry.

Regarding the GATT agreement reached as a result of the Uruguay Round, we do not think it will have any major implication for the industry in a short run; because of the status of Lao PDR being a less developing country, Lao PDR could have a longer transitional period to comply with those agreements if joining WTO. So far, Laos is not a member of WTO.

## Future prospect for feed milling industry

Due to the promotional policy of the government, increase of the livestock industry leads to a growth of demand for animal feed, thus implies that feed should also be increased. In so doing, the government plans to expand small-scale feed milling factories in 4 provinces namely Luangprabang, Khammuane, Savannakhet and Champasack. The government also encourages the existing feed mill at Thagone to produce concentrate feed and supply to the 4 new feed mills. The concentrate feed will be mixed and becomes a complete feed. Apart from 4 provinces, the others are also encouraged to establish their small-scale feed milling to meet the demand of local livestock.

In summary, for the rural area, we promote the use of locally available feed resources such as rice straw conservation and treatment, i.e., “urea treated rice straw”, multi-nutritional blocks, backyard cut-and-carry forage, the use of fodder leaves and residues of crops and industry by-products. The promotion of animal feed mill whether from small to medium size mix millings or concentrate feed factories should be developed along the livestock industry development programme in order to meet the increasing needs of meat, milk, eggs and fish of the growing urban population. The strategies and comprehensive industry programmes targeted up to the year 2020 need to be developed in our country and these will be guidelines for sustainable intensification of smallholder food and feed production systems.

# The feed-milling industry in Malaysia

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## Introduction

The feed-milling industry in Malaysia has a history dating back 28 years. The estimated annual turnover is in the region of RM3 billion [1US$=3.8RM]. The annual growth rate of the industry is estimated to have averaged between 3.5 and 4.0 percent from 1990 to 1996 and is expected to slow down to between 2.0 and 2.7 percent from 1997 to 2000.

There are currently 42 commercial feed mills, including nine in East Malaysia. Otherwise, there are also about 200 self-mixers or home mixers who mix feeds mainly for the pig industry. The distribution of commercial feed mills in Malaysia is shown in Table 1.

**Table 1. Distribution of commercial feed mills in Malaysia**

| State | Number of mills |
|---|---|
| Penang | 9 |
| Perak | 2 |
| Selangor | 8 |
| N. Sembilan | 2 |
| Malacca | 5 |
| Pahang | 2 |
| Johore | 5 |
| Sarawak | 6 |
| Sabah | 3 |
| **Total 9** | **42** |

Annual production in 1998 was estimated at 3.6 million tonnes, which includes the self-mixers. Distribution of these feed mills according to capacity of production is presented in Table 2.

**Table 2. Capacity of commercial feed mills**

| | Capacity per month (tonnes) | Number of mills |
|---|---|---|
| | 10 000 | 19 |
| | 5 000 | 13 |
| | 3 000 | 1 |
| | 2 500 | 3 |
| | 2 000 | 3 |
| | 1 000 | 3 |
| **Total** | **274 500** | **42** |

There is currently excess capacity in the feed-milling industry due to the rapid expansion and increase in the number of small feed mills. Capacity utilization varies very widely among the commercial feed millers as shown in Table 3.

**Table 3. Percentage utilization of commercial feed mills**

| Percentage utilization | No. of mills | Percent of mills |
|---|---|---|
| 85-90 | 4 | 9.5 |
| 60-65 | 6 | 14.5 |
| 35-55 | 16 | 38.0 |
| 20-30 | 16 | 38.0 |
| | **42** | **100.0** |

## Industry structure

Currently there are no feed millers with a commanding share of the market. The largest feed miller has only an 8-9 percent market share if all feeds consumed are taken into account (both commercial and home mixers).

With an installed capacity of around 4 million tonnes and serious underutilization, there is not likely to be much expansion in the immediate and medium term. Consolidation is more likely through closure of the smaller mills. The future of the industry will be closely tied to the direction in which the poultry and pig sectors move. Cattle will not make a significant impact on the feed-milling industry.

There are currently few major environmental concerns. Most commercial feed mills have the necessary managerial and technical expertise to handle these problems, if and when they arise.

## Raw materials

Sourcing of raw materials from domestic suppliers varies from mill to mill but the major components are imported. None of the feed mills reported more than 30 percent to be domestically sourced while the vast majority reported around 10 percent.

The sources and quantities of the major feed components used in the feed-milling industry are shown in Table 4.

The determining factors in all these sources are price and quality of the raw ingredients. There is currently no problem with availability. Prices of raw materials vary according to supply and demand and also the price which farmers pay depends on the type of feed, credit terms and volume used.

## Regulations

Foreign investments are permitted and depending on the Act under which they are licensed, they usually need local partners. Exports are permitted. No preferential treatment is granted to operators who must comply with land-zoning laws. In the long term, GATT will have implications in terms of availability and pricing of animal proteins which will impinge on the amount imported, thereby affecting the local industry.

## Future of the industry

The future is viewed optimistically by most stakeholders. However, some consolidation is expected. Diversification into other animal feeds is also anticipated. Stricter enforcement of good management practices and the need for 'B' licences will drive the home mixers out of business.

The Asian economic crisis has affected the industry adversely with animal protein demand sliced by 20 to 25 percent. Malaysia also experienced an outbreak of the Nipah virus in pigs which passed over into humans with serious consequences.

**Table 4. Sources, quantities and countries of origin of feed components**

| Component | Quantity (tonnes) | Country of origin |
|---|---|---|
| Maize | 2 645 683 | Argentina, Australia, China, India, Thailand, United States |
| Miaze grains | 167 248 | Argentina, China, Indonesia, Thailand, United States |
| Maize bran, sharps and other residues | 21 847 | Australia, Indonesia, Italy, Japan, Republic of Korea (ROK), Myanmar, United States |

| Component | Quantity (tonnes) | Country of origin |
|---|---|---|
| Other worked maize grains (e.g. hulled, pearled, sliced or kibbled) | 56 820 | China, France, Indonesia, Netherlands, Singapore, Thailand, United States |
| Wheat bran and pollard | 63 315 | Australia, China, India, Indonesia, Japan, Thailand, Ukraine, United States, Viet Nam |
| Other wheat residues | 27 885 | Australia, Germany, Hong Kong Special Administrative Region (SAR), Indonesia, Japan, Thailand, Ukraine, United States |
| Lucerne meal/pellets | 2 190 | Australia, China, Indonesia, New Zealand |
| Rice bran | 4 250 | Australia, India, Indonesia, Japan, Myanmar |
| Soybean oil-cake/ meal | 467 915 | Argentina, Brazil, Canada, Ecuador, India, Indonesia, ROK, Netherlands, Norway, Taiwan, Province of China (POC), Thailand, United States |
| Groundnut oil-cake | 8 270 | India |
| Rapeseed oil-cake/ meal | 9 494 | China, India |
| Other oil-cakes | 4 790 | Canada, China, India, Switzerland, Thailand, United States |
| Meat or meat offal, flour, meal and pellets | 30 092 | Australia, Brazil, Canada, Indonesia, Italy, Japan, ROK, New Zealand, Norway, Taiwan, POC, United Kingdom, United States |
| Fishmeal | 6 604 | Brazil, Chile, Denmark, Germany, Indonesia, Peru, Thailand, United States |
| Starch residue, manufactured/similar residue | 24 165 | Australia, Belgium, Germany, Netherlands, United States |
| Brewing and distilling dregs/waste | 1 132 | China, France |

| Component | Quantity (tonnes) | Country of origin |
|---|---|---|
| Other preparations used in animal feed (including feed supplements such as calf milk replacers, mineral preparations, skimmed milk, vitamins, amino acid preparations and other feed supplements and finished feeds) | 76 170 | Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Ecuador, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Indonesia, Ireland, Italy, Japan, ROK, Mexico, Netherlands, New Zealand, Norway, Philippines, Singapore, South Africa, Spain, Switzerland, Taiwan, POC, Thailand, United Kingdom, United States, Viet Nam |

Prices have increased for the following reasons:

- Higher energy cost (power, fuel);
- Higher transportation cost;
- Higher wages;
- Higher Forex Parity Rate;
- The inventory of raw materials in the market;
- Higher medicine, vaccine and service costs.

Currently, 68 large dams are in the course of construction which naturally will have a positive effect on irrigation and increase of agricultural products such as livestock forage; therefore, the future for the poultry and livestock feed-milling industries is optimistic.

Optimal use of the potential capacity of facilities and development of fish meal, meat meal and di-calcium phosphate in the future is expected.

The present structure of livestock feed-milling industries will change in favour of cooperatives and the private sector because government policy is based on decentralization.

# The feed-milling industry in Myanmar

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## Introduction

Myanmar's economy is based on agriculture. Livestock breeding is an integral part of the agriculture and the animal feed resources such as crops, leaves, fodder, pasture, agriculture by-products, industrial by-products, industrial waste, sun dried fish and oyster shell, are generally rich as particular feed in a specific region. However, lack of knowledge in proper utilization of animal feed and lack of transport facilities leads to uneven distribution of feed throughout the season and the country.

There are two principal ways of livestock breeding in Myanmar, traditional and semi-commercial or commercial breeding.

The population stock of poultry in 1998 is 37.5 million and 79 percent of which is rural chicken while the rest is crossbred or commercial stock. Indigenous pig in a portion of 60 percent of the total pig population is still survived in rural areas. Similarly draught cattle are detained in 92 percent of the total cattle population. Sheep and goats are utmost indigenous. The rural chicken and pigs are still surviving and proliferating by getting of feed mostly on scavenging by themselves. The kitchen wastes are the main feed for rural pigs and poultry. Stover, fodder, grass leaves of trees and bushes are basic needs of rural ruminants. In the semi-commercial and commercial type of breeding poultry, pigs and dairy cattle are managed with much care of the farmers and are provided with good rationed feed of mash form or pellet. There are many small-scale industries of feed mill and a few numbers of medium size feed milling industries which can produce required feed in the country.

## Feed milling industries

The report focuses on four feed milling industries that are located in lower Myanmar. Two feed milling industries are owned by Livestock Feedstuff and Milk Product Enterprise under the Government and other two industries belong to private sector; i.e., Myanmar CP Livestock Company Limited (origin is Thailand CP Group) and May Kha Livestock Industry Limited (origin in Indonesia, Jaffa Company).

**Table 1. Feed mill capacity**

| Name of Feed Mill | Full Capacity | Utilized Capacity |
|---|---|---|
| Daiku feed mill industry (State owned ) | 12 tonnes/hour for mash form<br>7 tonnes/hour for pellet form | 30-40 tonnes/day |
| Danyingone feed mill industry (State owned) | 4 tonnes/hour for mash form<br>2.5 tonnes/hour for pellet form | 20 tonnes/day |
| May Kha feed mill industry | 50 tonnes/hour for mash form | 35 tonnes/day |
| CP feed mill industry | 375 tonnes/hour | 3 000 tonnes/day (2 shift) |

## *Future plans for feed production capacity*

### *(1) Two feed mills of the government*

The daily production is still under full capacity. Ninety percent of feed produced by the feed mills is used for government poultry, pig and dairy cattle farms and the rest (10 percent) is used in private farms. The managers of these feed mills are seeking out more potential market to boost full capacity production.

### *(2) Feed milling industry of Myanmar CP Livestock Company Limited*

Myanmar CP Livestock Company Limited has been present in Myanmar since 1997. Broilers are introduced throughout the country initially and followed layer breeders. The functions of the company are selling of chicks and pullets to individual farmers, contract farmers and selling of feed (concentrate or completed) and procurement of raw feed materials. The CP feed covers not only its contract breeding farms but also other individual buyers.

### *(3) Feed milling industry of May Kha Industry Limited*

This industry has been also implemented in Myanmar in the same year as the CP Livestock Company. The function and target of business is selling of DOC (broilers and layers) to individual farmers, contract farmers, and selling of corn feed as a completed feed. Both CP and May Kha companies now construct the PS farms to produce CS for broilers and layers in Myanmar, instead of imports of DOC and hatching eggs.

## *Environmental problems*

All the industries are operated by electric motors. No problem in air pollution but dust spreads with air inside the building during the operation.

### *The sources of raw feed*

All ingredients raw feed are obtained within the country. Feed additives and supplements are imported.

The ingredients of raw feed available in the country are broken rice, rice bran, corn feed, groundnut or sesame cake, sun dried fish and oyster shell. Those feeds available are mainly on the season of different region. The industrial manager, who has well experienced in marketing of seasonal crops, can purchase raw feed ingredients cheaper. All these ingredients are relied on agri-farmers and available in free markets. The constraint is the unstable prices. The raw feeds of by-products are usually stored in feed mill for about two months and the sun dried fish are stored for six months to overcome the raining season.

### *The cost of raw feed*

The costs of raw feed ingredients (as of July 1999) are described as the follows:

**Table 2. Cost of feed ingredients in Myanmar**

| | |
|---|---|
| Broken rice | 32 kyats/kg |
| Rice bran | 17.5 kyats/kg |
| Corn | 31.5 kyats/kg |
| Groundnut cake | 37.5 kyats/kg |
| Sun-dried fish (salty ) | 31.25 kyats/kg |
| Fish meal | 125 kyats/kg |
| Vitamins, mineral supplement | 460 kyats/kg |

*Conversion rate 1 US$ = 320 kyats*

### *Sales price*

The price by government industry is usually added per kilogram of feed with a 5 to 6 percent of profit margin on the production costs.

### *Regulation of the industry*

In accordance with the Animal Health and Development Law which has been enacted since 1993, and Ministry of Livestock and Fisheries promulgated the regulations and orders very recently which prescribed “the animal feed is of standard quality and free from harmful pathogens or toxin”. To obey the law, rules and orders are constructed as follows:

(a) The animal feed mills are registered at Livestock Breeding and Veterinary Department.
(b) Regarding the construction for feed milling industry, to avoid environmental complaints, the location of building is sanctioned by supervisory committee.

(c) Origin of raw feed, finished feed and qualities are under inspection of Livestock Breeding and Veterinary Department.
(d) Inspection is made by visual, smell, texture, and consistency of feed with an assistance of laboratory test.

## Future of the industry

Myanmar has a high potential for animal breeding. The government encourages related agencies and private farmers to increase livestock breeding for increased production of meat. The objectives of increased production of meat are to fulfil need of domestic consumption and share the surplus to neighbouring countries. The investors within the country and abroad are invited to invest in the country with financial or technical basis. Nowadays, there are two private companies in the livestock sector, CP and May Kha, which invested in Myanmar with livestock farming and animal feed industries in large scale. These industries are not affecting the government's industries and they promote the increase of livestock breeding.

Myanmar is an agro-based country. Rice, pulps, beans and crops for oil and vegetables for human consumption are locally available. Fresh water fish, marine fish and livestock meat production increases year by year. Industrial crops have also increased during this year. So the Asian economic crisis has almost neither affected the industries nor the country.

# The feed-milling industry in Nepal

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## Animal production systems

In Nepal, a large altitude variation from 8 442 metres at northern border to 60 meters at southern border has immensely diversified agro-climatic condition to allow many agricultural production systems at subsistence level of production. Broadly there are five physiographic regions running more or less parallel bonds from north-west to south-east in the rectangular shaped country. Each of these regions has a distinct agriculture and forestry land utilization pattern. Subsistence level of production aims self-sufficiency and does not allow maximum output of particular crops, although it is a very efficient system in resource utilization. Hence, commercialization in all spheres of livestock production system has been aimed at the pace of demand driving force. However, more than 75 percent of ruminants are in remote areas raised as an integral part of agriculture system and their value are accounted in manure production, draught power, pack animals and cash resource besides the food production through milk and meat.

At present, livestock contribute 31 percent to the total Agricultural Gross Domestic Product (AGDP) of Rs. 32 887 million of the country, and 53 percent of this amount is derived from the hills, 38 percent from terai, and 9 percent from the mountains. In future, the contribution of livestock sector in total AGDP is expected to reach 45 percent and has been identified a very potential economical sector for faster growth. Growth of livestock population and products is presented in Table 1 and 2, respectively.

Transhumance, part-time grazing inside forest and supplement feeding, complete stall-feeding is the system adopted to raise ruminant animals. Poultry are mainly on deep litter system but battery system of rearing on cages is also becoming popular but large numbers of birds are still raised under scavenging system in the rural areas. Similar is the situation in pigs and more modern farms are being developed.

**Table 1: Livestock Population in 1997/98 and annual compound growth rates during the period 1985/86 to 1997/98.**

| Category | No. of animals (1997/98) | Annual Compound Growth Rate (%) (1985/86-1997/98) |
|---|---|---|
| Cattle | 7 048 336 | 1.19 |
| Buffaloes | 3 388 660 | 1.29 |
| Milking Cows | 826 320 | 1.87 |
| Milking Buffaloes | 882 140 | 1.61 |
| Sheep | 869 142 | 0.18 |
| Goats | 6 080 060 | 1.46 |
| Pigs | 758 616 | 3.77 |
| Poultry | 16 650 152 | 4.77 |
| Ducks | 416 943 | 2.96 |
| Laying Hens | 5 181 880 | 4.35 |
| Laying Ducks | 218 687 | 3.15 |

**Table 2: Livestock products in 1997/98 and annual compound growth rates during the period 1985/86 to 1997/98.**

| Livestock Products | Products in 1997/98 | Annual Compound Growth Rate (%) (1985/86-1997/98) |
|---|---|---|
| Milk (MT) | 1 048 040 | 2.43 |
| Cow milk | 318 680 | 3.18 |
| Buffalo milk | 729 360 | 2.11 |
| Meat (MT) | 180 675 | 2.51 |
| Buffalo | 117 350 | 2.08 |
| Mutton | 2 903 | 0.78 |
| Goat | 35 640 | 2.55 |
| Pig | 13 090 | 4.35 |
| Chicken | 11 400 | 5.97 |
| Duck | 292 | 3.53 |
| Egg ('000#) | 440 910 | 4.32 |
| Hen egg | 424 910 | 4.39 |
| Duck egg | 16 000 | 2.82 |
| Wool (MT) | 623 | -1.62 |

Despite the high density of livestock, Nepal still imports around 0.3 million goats and 0.2 million buffaloes from India and Tibet. Poultry and pig production has been established in commercial scale and feed industries are producing 80 percent of the total volume of complete feed mainly for poultry. Besides the commercial farms, in agrarian society of the country, most of the households tend to raise mixed species

of domestic animals for home requirement. Ethnicity also plays a great role in type of animals of choice, and pig and sheep are not raised commonly by all households. Different type of animals raised in different Eco-zones of Nepal has been given in Table 3.

**Table 3: Percentage of households keeping livestock and birds in different physiographic regions.**

| Species | Physiographic Regions | | | Average |
|---|---|---|---|---|
| | Mountain | Hills | Terai | |
| Cattle | 82.8 | 77.3 | 74.4 | 76.6 |
| Buffaloes | 44.8 | 60.0 | 35.8 | 48.5 |
| Goats | 55.5 | 54.2 | 46.8 | 51.3 |
| Sheep | 6.5 | 4.2 | 1.8 | 3.4 |
| Pigs | 10.3 | 12.2 | 7.1 | 9.9 |
| Yak | 2.9 | 0.1 | 0.0 | 0.3 |
| Horses | 1.3 | 0.4 | 0.4 | 0.5 |
| Poultry | 56.4 | 67.4 | 32.4 | 51.9 |
| Ducks | 6.0 | 9.2 | 15.7 | 11.6 |

*Source: National Agricultural Sample Census, 1991.*

Average number of livestock per household in different physiographic regions is presented in Table 4.

**Table 4: Average number of livestock per household in 1995/96.**

| Species | Physiographic Region | | | | Average |
|---|---|---|---|---|---|
| | Mountain | Hills | Siwalik | Terai | |
| Cattle | 2.78 | 1.98 | 2.21 | 1.43 | 2.100 |
| Buffaloes | 1.05 | 1.13 | 0.84 | 0.56 | 0.895 |
| Sheep | 1.13 | 0.24 | 0.16 | 0.05 | 0.395 |
| Goats | 2.81 | 1.86 | 1.63 | 0.88 | 1.795 |
| Pigs | 0.28 | 0.21 | 0.25 | 0.09 | 0.207 |
| Chicken | 4.22 | 4.86 | 5.58 | 2.18 | 4.210 |

*Source: - Animal Population, Central Bureau of Statistics (CBS), 1996*
*- Human Population Growth between 1981 to 1991, (CBS)*

## Feed industry

There are altogether 149 feed mills of different sizes in operation. Most of them are smaller units producing poultry feed to meet their own requirement. In absence of knowledge of feed formulation and nutrition, quality of feed from smaller units is very much variable. However, there are 20-25 medium and large units producing standard poultry and cattle feed sufficiently to meet the national demand. Also many of the smaller units located in remote areas are dependent on larger units for the supplement of protein and concentrated vitamins. Their location at different Eco-zones is given in Table 5.

**Table 5: Distribution of feed mills in different eco-zones of Nepal.**

| Eco-zones | Number of Feed Mills | Percent of the Total |
|---|---|---|
| Mountain | - | - |
| Hills | 92 | 61.75 |
| Siwalik | 33 | 22.15 |
| Terai | 24 | 16.10 |

*Source: Nepal Feed Industry Association.*

Majority of feed mills are in the hills and close to Siwalik regions coinciding both with the intensive poultry and dairy production area. About 43.62 percent of the feed mills are located around the capital alone.

## Feed requirements

Based on the national output of milk, poultry meat and eggs, many studies have projected demand for concentrate, and a requirement of 486 000 MT was calculated for the year 1999 (APROSC, 1995). However, present requirement is only 216 318 MT with a growth rate of 13 percent (NFIA, 1999). The above large difference mainly arises due to little use of concentrate feed for milk production where homemade feed is still in use.

## Feed mill capacity and utilization

Of the total 149 feed mills, only 10 have annual capacity above 10 000 MT and some others have between 300-500 MT only. Majority of them is registered with Cottage Industry Department and located in remote places with annual production capacity less than 300 MT.

Of the total feed mills, 70 percent do not have mixers in their plants. Usually, a grinder of different capacity is installed for grinding the feed ingredients and mixing is done manually. Only eight feed mills have both grinder and mixing facilities - grinders with 10.2 horsepower motor and mixers with 0.5 to 1 tonne capacity. These mills are operated for 6-8 hours a day. In a recent study, out of 40 feed industries sampled, capacity utilization found was:

| | |
|---|---|
| 3 feed mills: | < 20 percent |
| 11 feed mills: | 20 - 40 percent |
| 13 feed mills: | 40 - 60 percent |
| 8 feed mills: | 60 - 80 percent |
| 5 feed mills: | > 80 percent |

*Source: Central Bureau of Statistics, 1998.*

Under-utilization of the capacity resulted mainly from unavailability of feed ingredients, poor maintenance of machinery, inconsistent feed quality produced, irregular supply of electricity and variation in market demand.

## Legal status of feed mills

Most of the larger mills are registered by Department of Industry and rests are registered as small industry under Department of Cottage Industry. There is only one government supported feed plant, which mainly produces cattle feed, and the pelleted feed for poultry and rabbit.

Of the 40 feed mills sampled for the study, 18 of them were owned personally, 10 were on partnership, 11 were private company limited, and one government supported. This showed that most of the feed mills were developed privately without government support.

## Future plans

Feed mills of Nepal are mainly producing poultry feed and are vertically integrated with hatcheries, marketing and support services of veterinary supplies. A growth rate of 18.3 percent in broiler production and 10 percent in egg is envisaged for the periods of the 9$^{th}$ five-year plan, i.e., 1997-2001 (Nepal Feed Industry Association, 1999). To cope with this growth rate, annual increment in poultry feed is required to be 13.8 percent to reach an annual production of 976 216 MT.

At present, 80 percent of the total feed production is fed to poultry and 20 percent to dairy cattle. In another study based on national annual milk, egg and poultry meat production of 1992 and population growth of livestock and birds, feed requirement estimated is given in Table 6 (APROSC, 1995).

**Table 6: Projection of estimated demand for animal feed (x 1 000 MT).**

| Feed for production of | 1993 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|
| Milk | 292 | 359 | 372 | 385 | 398 | 411 | 428 | 439 |
| Meat | 50 | 61 | 63 | 65 | 67 | 69 | 71 | 73 |
| Egg | 46 | 63 | 66 | 70 | 74 | 78 | 82 | 86 |
| Total | 388 | 483 | 501 | 510 | 539 | 558 | 581 | 598 |

In the above estimates, cattle feed is not included due to the most beef production occurring in remote areas where milk market has not come under formal marketing system. Less than 15 percent of total milk production is marketed through formal marketing channel of Dairy Development Corporation and private dairies.

## Feed ingredients

Available ingredients (CBS, 1998) and quantity required according to present level of poultry feed production (NFIA, 1999) and the cattle feed requirement estimated by APROSC, 1995 are given in the Table 7.

**Table 7: Availability and requirement of feed ingredients (x 1 000 MT).**

| Feed ingredients | Availability | Requirement |
|---|---|---|
| Maize | 1 367 | 106.3 |
| Wheat | 1 000 | 5.7 |
| Rice polish | 109 | 19.1 |
| Wheat bran | 210 | 32.2 |
| Rice bran | 364 | 69.4 |
| Mustard cake | 59 | 127.1 |
| Molasses | 510 | 385.0 |

Recently, poultry feed formulae are developed on the use of synthetic amino acids to reduce the use of animal protein. This has reduced the need to import large quantities of fish and meat meal. Common feed ingredients include all types of animal protein, vegetable protein and aflatoxin, flavouring agents, synthetic amino acid, anti-oxidants, vitamins and minerals. Synthetic amino acids and vitamins are imported from overseas countries whereas other ingredients mainly come from India. Feed ingredients imported from India are given in Table 8.

**Table 8: Feed ingredients imported from India (MT).**

| Item | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|
| Complete feed | 4 969 | 1 534 | 7 159 |
| Maize | 6 109 | 2 045 | 2 105 |
| Wheat | 1 158 | 933 | 7 832 |
| Oilcakes | 4 002 | - | 5 310 |
| Finger millet | 448 | 296 | 871 |
| Fish meal | - | - | 1 769 |

*Source: Department of Commerce.*

Commonly used ingredients and their ratio in cattle feed are given in Table 9.

**Table 9: Feed formulations and amount of ingredients required.**

| Commodity | Percent in Poultry Feed | Percent in Cattle Feed | Available from |
|---|---|---|---|
| Maize | 42 | 5-10 | Nepal/India |
| Wheat | 3 | - | Nepal/India |
| Rice polish | 10 | - | Nepal |
| De-oiled rice polish | 4 | - | Nepal |
| Rice bran | - | 20 | Nepal |
| Wheat bran | 6 | 5-7 | Nepal |
| Molasses | 2 | 10 | Nepal |
| Fish meal | 3 | - | India |
| Groundnut cake | - | 10 | Nepal/India |
| Soybean meal | 11 | 1-2 | India |
| Sesame cake | 6 | - | India |
| Sunflower cake | 5 | - | India |
| Mustard cake | 3 | 35-40 | Nepal/India |
| Bone meal | 1 | - | Nepal |
| Oyster shell | 1 | - | India |
| Limestone | 2 | - | Nepal |
| Vitamins/Minerals/ Amino acids | 1 | 1 | India/Overseas |
| Common salt | 0.5 | 0.5 | India |

## Government policies and regulations

Establishment of livestock industry, feed industry and dairy industry requires license from the Department of Industry (DOI) or Department of Cottage Industry (DOCI) depending on the size of capital investment. According to Industrial Act 1992, industries are classified under broad 6 headings such as production, energy, agriculture and forestry, mineral, tourism, services and construction. These are further classified depending on capital investment and those less than Rs. 20 million are licensed by the Department of Cottage Industry and above Rs. 20 million to Rs. 500 million and larger, above Rs. 500 million are licensed by the Department of Industry. Small and cottage industries are licensed to Nepalese citizen only but, any types of industry that have technology transfer component may be licensed to foreigners too. Technical feasibilities are studied by the concerned technical department prior to license issued to the industrialist.

Both the Industrial Act 1992 and Foreign Investment and Technology Transfer Act 1992 encourage industrial development both at local and foreign investment level. Foreigners are allowed to establish industry either on their own or as a joint venture. Government policy remains to establish industry throughout the country to provide a regional economic balance and hence, more encouragement for establishment is made on remote and less developed areas by offering lower income tax, sales tax

and custom duties to the industries settled in less developed areas. However, out of 149 animal feed industries established, there appears no foreign investment.

Nepal Feed Act 1976 and Nepal Feed Regulation 1984 prohibit unwanted adulteration and does not allow reduction or removal of natural property and utility of any feed ingredients. The Act provides appointment of standardization committee to set standards of animal feed concentrate and to issue orders settling the standards of quality of ingredients used in concentrate mixture for animal feed. An inspector appointed under the Act enforces the law and quality as regulated through laboratory testing.

Investors in Nepal are encouraged with the benefits of:

- No income tax on 5 years' production.
- Further extension of above to 7 years in industries established in remote areas.
- Income tax rate is lowered by 5 points as compared to slab and corporate tax.
- No tax on the income received from the sale of produce in foreign countries.
- No tax on dividend received from industrial investment.
- Additional 2 years' tax exemption on industry employing more than 600 workers.

Such benefits are annually reviewed and added through Financial Act issued for every fiscal year. Of the 137 industries on foreign investment receiving letter of credit, 45 have been established and 19 are under construction. None of these include animal feed mills.

Once the GATT Agreement is adopted, Nepalese feed industry will come on direct competition with well-established Indian feed industries and may find a great difficulty unless they improve the efficiency of production. As transport of bulky ingredients such as cereals and bran may not be easy from production areas due to the poorly developed transport system, using protein and vitamin concentrate from successful large industries, smaller feed mixers may continue feed production in remote areas.

## Feed and ingredient prices

Slight increase in all types of animal feed is seen from 1994 onwards due to similar increase in price of ingredients required. More or less current price of animal feed is at par with the price of neighbouring states of India and is allowing export to either way at border areas, depending on the reliability in the quality feed. Prices of the feed and some ingredients are presented in Table 10. Besides complete relation, larger feed mills produce protein concentrates with vitamins and minerals enough to meet present demand of animal feed. Most of the smaller feed mills established in

the remote areas, are supplied such concentrate to produce hand-mixing animal feed.

**Table 10: Prices of some ingredients and complete feed in Nepal (Rs/Kg).**

| Item | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|---|---|---|---|---|
| Maize | 4.81 | 5.8 | 6.25 | 5.5 | 7.4 | 8.5 | 9.5 | 10.5 | 11.5 |
| Rice bran | 2.06 | 4.8 | 4.5 | 4.0 | 4.5 | 4.9 | 5.0 | 5.5 | 5.5 |
| Wheat bran | 2.75 | 2.8 | 3.15 | 3.75 | 4.15 | 5.5 | 5.75 | 6.0 | 7.0 |
| Mustard cake | 3.4 | 4.5 | 5.15 | 5.15 | 5.15 | 6.0 | 6.25 | 6.5 | 7.0 |
| Sesame cake | 4.91 | 6.5 | 4.5 | 7.7 | 6.77 | 8.0 | 8.5 | 9.0 | 11.0 |
| Groundnut cake | - | - | 11.6 | 8.5 | 11.0 | - | - | - | - |
| Soybean cake | 7.4 | 7.9 | 6.75 | 11.35 | 12.5 | 13.0 | 16.0 | 18.0 | 15.0 |
| Molasses | 1.4 | 1.4 | 8.0 | 3.0 | 6.5 | 3.0 | 5.0 | 3.0 | 8.0 |
| Fish meal | 13.9 | 12.9 | 13.0 | 12.0 | 12.4 | 15.0 | 16.0 | 18.0 | 19.0 |
| Bone meal | - | - | - | - | 5.5 | 8.5 | 8.5 | 9.5 | 10.0 |
| Meat meal | - | - | - | - | 16.0 | - | - | - | - |
| Limestone | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 1.00 | 1.00 | 1.00 | 1.50 |
| Mineral mix | 18.0 | 18.0 | 24.0 | 24.0 | 24.0 | 30.0 | 35.0 | 40.0 | 45.0 |
| Vitamin Supplement | 12.0 | 12.0 | 13.5 | 15.0 | 16.0 | 17.0 | 19.0 | 20.0 | 25.0 |
| Starter ration (No.1 poultry feed) | 6.75 | 7.1 | 8.4 | 5.15 | 10.1 | 10.1 | 11.1 | 13.4 | 14.0 |
| Grower ration (No.2 poultry feed) | 5.6 | 6.3 | 7.3 | 7.85 | 8.65 | 8.65 | 9.7 | 11.75 | 12.4 |
| Layer ration (No.3 poultry feed) | 5.7 | 6.35 | 7.4 | 8.0 | 8.85 | 8.8 | 9.8 | 11.9 | 13.65 |
| Broiler ration | 7.2 | 7.6 | 8.9 | 9.6 | 10.7 | 10.65 | 11.75 | 14.2 | 15.0 |
| Cattle feed | 4.43 | 5.1 | 6.1 | 6.54 | 7.5 | 7.4 | 8.3 | 9.8 | 10.7 |
| Pig ration | 6.0 | 7.5 | 8.8 | 9.6 | 10.6 | 8.7 | 9.7 | 11.7 | 11.7 |

*Source: APROSC, 1995 and Animal Feed Production Development Board, 1999.*

## Conclusion

Most of the feed mills are smaller unit producing mainly poultry feed to meet the local demand of small area where intensive poultry production is established. Of the total, 20-25 medium and large units producing standard concentrate feed for livestock, are capable to manufacture enough feed to meet the present demand. All these successful feed mills are creating market demand mainly through the vertical integration of marketing poultry products and supplying protein concentrate to the smaller units. This symbiosis between larger and smaller units may continue in the near future in a situation of poorly developed transport system and bulk nature of animal feed to be carried.

At present, only 20 percent of the total feed produced are used in milk production. As dairy sector will grow with marketing of milk through formal sector, demand for cattle feed may increase dramatically. This may aggravate the deficiency in feed ingredients particularly maize and oilcakes. Use of maize as animal feed, depends on rice production to meet feed requirement of human population. There is room to increase paddy production from the present level of 2.4 MT per hectare. However, paddy is mainly grown in Terai, whereas maize in the hills and, therefore, demands very efficient low cost transport system to supply maize from the hills.

Efficiency of feed mills needs improvement to utilize optimally their capacity. Most of the feed mills do not possess storing capacity for the bulk of ingredient procured at a time of lower price available, and even established go-downs are poorly constructed and aflatoxin content is seen very high in Nepalese animal feed. Therefore, the need of improvement in efficiency both in terms of production and quality of feed has become equally important.

Support services in developing quality of feed to feed manufacturers is not available at present. Government is trying to build up a quality control division with an efficient analytical unit so that continuous analytical report on feed and ingredients be made to manufacturers to improve the feed quality.

# The feed-milling industry in Pakistan

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## Introduction

The livestock feed industry can be defined as that organized agribusiness activity which purchases livestock feed inputs in the open market and subsequently mixes, grinds and compounds such inputs into specific finished feeds which are offered for sale to the open market.

The Pakistani livestock feed industry is composed of approximately 140 to 150 businesses, almost all family-owned. Of these, approximately 25 have the capacity to produce over than 20 tonnes a day. Currently the majority produces poultry feed; only a few produce cattle feed. Almost 40 percent are home mixers, businesses that produce feed for their own poultry flocks. The rest sell feed commercially. One company selling cattle feed is a wholly owned subsidiary of a dairy products firm. The animal feed industry is mostly located in the provinces of Punjab and Sindh.

The primary product of Pakistan's livestock feed industry is poultry feed. Poultry feed millers produce the following rations:

- Broiler starter;
- Broiler finisher;
- Chick starter;
- Grower mash;
- Layer mash;
- Breeder starter;
- Breeder grower;
- Breeder layer.

Cattle rations are an extremely small component of the livestock feed industry. Two dairy cattle ration millers currently producing cattle rations in Pakistan are located in Punjab. The third manufacturer is located outside Karachi.

The primary domestic inputs used to manufacture poultry feed in Pakistan are wheat, broken rice, wheat and rice brans, maize (corn) and maize gluten, cottonseed meal and molasses. Other inputs include sunflower meal, rapeseed meal, guar meal, sorghum, millet, fish and blood meals. Other inputs are utilized depending on availability and price; sunflower meal, for example, is available from June through August, but its use is restricted by very poor processing and storage methods.

Import duties on maize have recently been removed and increased imports can be expected. Imports of soybean meal and other oil-cake residues of soybeans total Rs.24.67 million. Imports of soybean meal and other oil-cake residues have shown large increases over the past few years. Micronutrients are also imported.

## Feed resources

Feed for the various livestock populations in Pakistan is derived from the crop sector, rangelands and other grazing areas, from agro-industrial by-products and from animal and fish meals and waste. The total feed available at present from all sources, is estimated at 47.3 million tonnes of Total Digestible Nutrients (TDN) and 4.32 million tonnes of Digestible Protein (DP) as detailed in Table I. Availability of ingredients is a constraint for the development of the industry.

**Table 1. Total feed availability in Pakistan (million tonnes)**

| | Dry matter | TDN | DP |
|---|---|---|---|
| Crop sector | 53.6 | 29.7 | 2.27 |
| Rangelands | 10.2 | 4.6 | 0.48 |
| Other grazing | 23.4 | 11.7 | 1.20 |
| Other feeds | 1.9 | 1.3 | 0.37 |
| **Total** | **89.1** | **47.3** | **4.32** |

Table 1 shows that the crop sector contributes about 60 percent of DM and TDN, but overall feed quality is low as it contributes only 50 percent of available TDN. This reflects the widespread use of low quality crop residues. Fodder crops provide about 13 percent of total DM but only the winter fodder, berseem, provides balanced nutrition. Rangelands, which include riverine areas, wastelands, fallow land and forested grasslands, provide about 11 percent of total DM and other grazing; they make an important contribution to feed resources (27 percent of total DM output).

## Feed consumption

Present consumption of feed by existing livestock populations has been estimated at 49 million tonnes of TDN and 4 million tonnes of DP. This is based on assumptions about the number of animals in different production systems and likely feeding levels. The estimated consumption by different types of animals is given in Table 2.

**Table 2. Feed consumption in Pakistan (million tonnes)**

| | TDN | DP |
|---|---|---|
| Buffalo | 20.57 | 1.83 |
| Cattle | 17.66 | 1.50 |
| Sheep and goats | 7.68 | 0.62 |
| Equines and camels | 3.12 | 0.24 |
| Poultry (commercial) | 0.50 | 0.07 |
| **Total** | **49.53** | **4.26** |

Table 2 shows that 40 percent of available feed is consumed by buffalo, 35 percent by cattle, 15 percent by sheep and goats and the remainder by equines, camels and poultry. Generally the feed prices do not vary with the season.

## Feed balance

Clearly, existing feed resources are in balance with livestock requirements, at present levels of performance, as there are no significant imports of livestock feed. The quantities of feed available and feed consumption are estimates, but they adequately reflect the balance on a national basis. It must be emphasized that assumed feeding rates for most rural animals are at least 20 to 25 percent below the amount required to enable them to produce at their full genetic potential. On a provincial basis, the estimates show a deficit in Punjab; this may be explained partly by trans-shipment of livestock into the Northwest Frontier Province and Azad Kashmir.

In general, commercial poultry producers and larger commercial milk producers usually provide adequate nutrition, with a proper balance between energy and protein. Traditional producers usually use whatever feed is available at low cost, so protein (and often energy) is deficient. This is in part remedied if good quality grazing is available but it is often seasonal.

Being small, the poultry industry of Pakistan is not generating any environmental threat. At the moment foreign investment is welcomed by the government. There is no need for local partners and the processed feed is freely exportable. There are no special regulations for location of the industry or any preferential treatment for stakeholders. As low amounts of feed/ingredients are imported/exported, the GATT agreement has not had a significant impact on the industry to date.

# The feed-milling industry in the Philippines

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## Introduction

For the past three decades, the feed-milling industry in the Philippines has evolved from a customary practice into a sound business enterprise due to advances and modern research findings in animal nutrition, genetics, physiology and agricultural business management. In the past, commercial feed milling was associated with only a few feedgrains and by-product traders who mixed and sold feeds based mainly on the traditional methods of raising and feeding livestock. Today, to be successful, feed millers must produce feeds based on consumer specifications as well as nutritional standards and sell them at prices consumers are willing to pay.

The feed-milling industry is one subsector of agriculture in the Philippines that has grown rapidly. It now produces about 7.5 million tonnes of feed per year but is highly dependent on imported raw materials. On average it imports yellow maize worth US$77 million per year, fish meal (US$26 million), meat and bone meal (US$5.6 million) and soybean oil meal (US$65 million). These figures do not include the millions of dollars spent on feed additives and supplements.

Aside from the heavy import dependence of the industry, it is also beset by chronic shortages of reasonably priced local feed ingredients. Low productivity and lack of storage facilities in production centres contribute significantly to this problem.

## Status of commercial feed mills

There were 460 feed mills registered with the Bureau of Animal Industry as of 15 April 1998; 274 were commercial mixed-feed manufacturers and the rest produced for their own consumption. The total rated capacity of all registered feed mills is 15 408.23 tonnes per eight-hour shift. About 106 feed mills are classified as small-scale producers which manufacture less than 20 tonnes of feed per eight-hour shift. Only 7.51 percent of total production capacity can be attributed to small-scale production. Although there are only 69 feed establishments that produce more than 50 tonnes of feed per eight-hour shift, their production capacity constitutes 77.98 percent and the remaining 14.51 percent is attributed to feed mills with more than 20 and less than 50 tonne capacities. Table 1 shows the distribution of feed mills according to production capacity.

**Table 1. Size of commercial feed mills, 1998**

| Rated capacity per 8-hour shift (tonnes) | No. of mills | Total rated capacity | Distribution (%) |
|---|---|---|---|
| Less than 20 | 131 | 1 157.67 | 7.51 |
| 20.1-50 | 68 | 2 235.50 | 14.51 |
| > 50.1 | 69 | 12 015.06 | 77.98 |
| **Total feed mills** | **268** | **15 408.23** | **100.00** |

Source of basic data: Animal Feeds Standard Division, Bureau of Animal Industry.

Significantly, 274 firms are engaged in commercial feed milling but only 34 firms account for 61.46 percent of the aggregate capacity. The rated capacities of the top 13 firms registered with the Bureau of Animal Industry (BAI) are shown in Table 2.

For enhanced efficiency and to economize, feed millers have banded together in different associations. At the forefront of the industry is the Philippine Association of Feedmillers that has most of the top ten producers as members.

**Table 2. Capacities of top 13 feed mills, 1997**

| Firm | 1996 rated capacity in tonnes per 8-hour shift |
|---|---|
| Vitarich Corporation (Bulacan) | 1 122.66 |
| San Miguel Foods, Inc. (Manila) | 1 122.00 |
| Swift Foods, Inc. (Mandaluyong City) | 800.00 |
| General Milling Corp. (Lapu-lapu City) | 720.00 |
| Purina Phils. Inc. (Pangasinan) | 640.00 |
| Universal Robina Corporation | 450.00 |
| Nutrimix Feeds Corporation | 450.00 |
| Purina Phils., Inc. (Bulacan) | 420.00 |
| General Milling Corporation (Pasig) | 400.00 |
| Purefoods Corporation | 240.00 |
| Swift Foods, Inc. (Bulacan) | 220.00 |
| LIMCOMA Multi Purpose Cooperative | 200.00 |
| Pulilan Agri-Development Inc | 180.00 |

While demand for mixed feeds is highly dispersed all over the country, the capacity and concentration of firms in the Greater Manila area has had adverse effects on marketing and distribution costs, as well as procurement costs of maize, the basic raw material in feed production.

## Types of commercial feed

1. **Swine feed**: Different classes of swine of various stages of growth have different nutrient requirements and the process of determining a well-balanced ration to meet these requirements is not easy. The availability of commercially mixed feed in the local market, however, reduces this difficulty as local feed millers already have their own standard feed formulation to meet the nutrient requirements of both poultry and hogs. These various types of feed are named according to the different stages of growth. Hence, a pre-starter mash is made available for piglets of two to four weeks and weaning mash is fed to weanlings of five to eight weeks.

2. **Poultry feed:** Poultry feed does not vary significantly from swine feed in terms of the ingredients or raw materials used. Only the formulation is changed to meet the minimum nutrient requirements of the different types of birds.

## Problems affecting the feed industry

### *Shortage of vital raw materials*

The biggest problem of the feed-milling industry has been the shortage of vital raw materials which has perennially undermined production, causing a wide gap between available supply and demand for feed. This problem has led to a host of attendant complications, among them the high and rising prices of scarce inputs and inadequate storage facilities to absorb stockpiles which several companies have maintained to assure adequate supplies over a period of time. The inadequacy of storage facilities has been partially solved by feed millers who rent storage space outside of their plant premises although, of course, they incur more transport costs.

The shortage of raw materials has likewise affected the planning strategies of feed millers, particularly with regard to expansion programmes. Expansion projects have been quite impossible to pursue except for short-range targets, in view of uncertainty in raw material supply. On the whole, feed mills have been underutilized. Thus, the feed requirements of the livestock population are greater than ever and the high prices of commercial feeds have raised the prices of livestock and poultry products by the time they reach the consumers. Feed mills unable to cope with these problems have been shut down.

### *Procurement*

1. **Government purchases:** The procurement of raw materials has been more of a problem for small rather than large feed manufacturers. While the big firms in the industry largely benefit from the procurement system employed by the National Food Authority (NFA), the limited cooperation and involvement of the small-scale feed millers create problems for them to the detriment of operations.

At present, the NFA regularly monitors the price and supply of yellow maize in the country. If a shortage is expected, the NFA allows the feed millers to submit their import requisitions, which specify the quantity and time of delivery. The NFA then imports yellow maize from various sources on a FOB basis and charters government-authorized vessels for its transport to Philippine ports.

2. **Volatile prices:** Because almost all of the feed ingredients are agriculturally based, their supply becomes seasonal. Unsurprisingly, such commodities have volatile prices. Very few feed millers purchase and stock these ingredients for fear of spoilage.

3. **Tight credit:** During shortages, feed millers claim that most suppliers prefer cash on delivery, hence they are forced to spend more working capital. Some claim that the number of days extended to them for payments is insufficient elbow room for financial allocations.

4. **Late deliveries:** Many feed millers complain of late deliveries. Most of them bank on the suppliers' promise of early deliveries. If the suppliers cannot deliver on time. the usual excuse is unavailability of transport. In most cases, to avoid this problem, some feed millers pick up their orders using their own vehicles. This means additional expense for them.

5. **Adulteration**: Rice bran is usually adulterated by unscrupulous suppliers. Complaints reaching the BAI indicate that many raw materials are being adulterated nowadays. For example, low protein content fish meal is used to adulterate high protein content fish meal; starch is added to amino acids and vitamin-mineral premixes; and sand, oil and wire are added to raw materials to increase weight.

# The feed-milling industry in Sri Lanka

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## Introduction

Agriculture contributes around 20 percent of the Gross Domestic Product (GDP) in Sri Lanka and within this, livestock about 2.0 percent. This production is dominated by the poultry industry (44 percent chicken, 26 percent eggs) whilst that from swine is only 1 percent; ruminant meats contribute a further 18 percent (mutton 3 percent and beef 15 percent) and the (formal) dairy sector around 11 percent. Mutton and beef originate largely from animals raised by smallholders under grazing systems in which no concentrates are fed. Since fattening pigs are usually raised on swill, concentrate feeding is largely restricted to chicken, milking cows and breeding pigs.

An island-wide study by the Agrarian Research and Training Institute has shown, moreover, that most dairy farmers in Sri Lanka feed coconut poonac, rice bran or a homemade mixture of the two to their cows. The proportion of farmers feeding commercial compounded feed to cows is less than 10 percent of those giving supplementary feed. It is not surprising then that the feed milling industry, producing compound feed, is geared mainly to produce feed for the poultry industry.

## Historical developments

Commercial scale animal feed production is of relatively recent origin having begun in the early fifties. In the early years, nearly all the feed production was in the hands of two Provender Mills, both states controlled, namely, the Oils and Fats Corporation and the British Ceylon Corporation (BCC). Animal feed produced by them were marketed at a subsidized rate as an incentive to promote livestock development. Feed was issued on a quota basis both to direct users and to retailers. As a result, there was a heavy demand for the feed produced by them not only because of the subsidy but also due to consistent quality. During this period, other few private sector mills could not compete with these two state corporations and they played a secondary role; i.e., they usually supplied feed to the larger commercial farms and to those receiving an inadequate quota from the State.

Another feature of this period was that the feed industry was sustained almost entirely on local feed resources supported by rejected food items considered unfit for human consumption. Imports were restricted to a few animal protein sources such as fish meal and meat and bone meal and to vitamins, minerals and other feed additives.

In the late seventies, the Government policy changed to privatization of commercial ventures and as a result, the Oils and Fats Corporation was taken over by the private sector. Through the eighties, the open economy encouraged many private entrepreneurs to the industry to supply the feed required by the rapidly growing poultry sector. These changes were accompanied by the increased use of imported feed ingredients, primarily maize. At present, the animal feed industry is completely in the hands of the private sector and up to 80 percent of the ingredients is imported.

## Size and structure of the feed milling industry

The feed milling industry in Sri Lanka has a total installed capacity of 450 000 tonnes per year of which an average of around 80 percent is utilized; the production in 1998 was 375 000 tonnes. This excess capacity could be attributed to the establishment of several mills during the period 1990 to 1995 as a response to a rapid growth in the poultry sector encouraged by the state with duty concessions on animal feed ingredients and parent stock.

Ownership of the industry is completely in private hands apart from a few Co-operative Societies which carry out some feed mixing mostly for their own farmers. Large companies dominate the industry with 3 of them being responsible for 70 percent of the feed produced. The growth of these companies dues no doubt to the advantages and economies of large scale operation and not to any conscious policies of the government. Since the feed industry caters primarily to the poultry sector, vertical integration has become a feature of the industry since the feed millers have a distinct advantage over those who have to buy the feed. Accordingly, the larger provender plants also own their hatcheries, both layer and broiler, and have contract growing systems with processing facilities and in addition, often carry out their own marketing.

Most of the mills are located in and around the capital city of Colombo together with most of the breeder farms, poultry farmers and processing facilities. In 1998, 17 manufacturers registered a total of 129 feeds with the Registrar of Animal Feeds. These included 87 poultry, 14 dairy, 14 swine, 10 fish and one horse feed and these figures demonstrate that the feed milling present industry caters primarily to the poultry sector. At the same time, 18 importers registered 30 energy and protein feed ingredients and a number of feed additives. The only compound feed imported into Sri Lanka was pet and fish feed.

In the immediate future, this situation is expected to continue with no increase in the present milling capacity. The government is concerned that most of the ingredients used are imported into the country and that such a situation may not be sustainable in the future. Accordingly, the government plans to encourage the establishment of small-scale feed mills in rural areas in order to use the locally available materials.

## Regulation of the industry

With the prevailing open economy, foreign firms are allowed to invest freely and there is no requirement for local partners. Similarly, there is no restriction on exports, and in fact, the government actively encourages foreign investments through the Bureau of Investment and gives a range of incentives to such investors. These include priority in allocating land on industrial estates, duty free import of machinery and project related items, tax-free status for five years, and no taxes on exports. Since the feed industry has been opened-out already, the GATT agreement and the WTO rules are not expected to have significant effects.

An Animal Feed Law was enacted in 1986 by the government and is now in force and aims to protect the genuine producer and the farmer from unscrupulous competition. It provides for the appointment of a Registrar of Animal Feeds, annual licensing of manufactured feed and imports, and bans the sale of unlicensed feed in the open market. It also allows farmers to appeal against poor quality feed and for the sampling and analysis of such feed. The law is being implemented in a manner that does not stifle the industry or investment.

## Ingredients used and their origins

Poultry feed, which amounts to 90 percent of the total compound feed, is largely produced from imported ingredients. The local ingredients used include rice bran/rice polish, broken rice, coconut poonac, maize and minor ingredients such as gingelly poonac. Information on the ingredients imported is shown below:

| Ingredient | Origin | Imports as percent (%) of total used |
|---|---|---|
| *Maize* | China, India, Indonesia, USA, Thailand and Argentina | 80 |
| *Fishmeal* | New Zealand, Denmark, Chile, Maldives, Indonesia and Malaysia | 99 |
| *Soybean Meal* | 95 percent from India | 100 |
| *Meat and Bone Meal* | Germany, Australia and New Zealand | 100 |
| *Feed Additives** | Holland, Belgium, UK, USA, Singapore and South Africa | 100 |

* *other than minerals*

The availability of local ingredients and their quality is highly variable and for this reason, feed millers often prefer to import rather than source them locally. Current average prices of poultry and pig feed prepared by the 3 large manufacturers are shown below:

| Feed | Rs per tonne |
|---|---|
| Chick starter | 19 200 |
| Grower | 17 000 |
| Layer | 15 500 |
| Broiler starter | 23 750 |
| Broiler finisher | 22 500 |
| Pig starter | 13 750 |
| Pig fattener | 13 500 |

Rs70=1US$

The feed prepared by these manufacturers is up to international standards of quality. There are, however, many smaller mills which sell cheaper feed which is nutritionally less complete; the farmers who purchase this feed accept a lower production as it is cost effective. Since most farmers feed coconut poonac and rice bran to their dairy cattle, only a small amount of cattle compound feed is prepared by the industry; these are priced at Rs 17 000 for a calf starter and Rs 10 000 for dairy cow feed per tonne.

## Future prospects

It is clear from this paper that the fate of the feed industry at present, is closely tied to the fortunes of the poultry industry. The latter is facing some competition from cheaper imports but this amount to no more than 4 percent of the total production. The poultry sector has shown rapid growth during the last decade and has established itself firmly in the country as part of the economy and is a significant avenue of employment for Sri Lankans. For these reasons, the government feels obliged to support the sector and the feed industry with suitable incentives.

The growth of the industry will depend on the extent to which swine production increases and dairy farmers start feeding compound feed and not coconut poonac to their cows.

The extent to which the industry depends on imported ingredients, particularly maize, is a matter of concern for the government. This dependence makes the feed and poultry industries extremely vulnerable to fluctuations in availability and cost of maize in the world markets. Attempts to grow maize in Sri Lanka to meet the needs of the industry have, for a variety of reasons, not been successful.

For these reasons, the programmes of the Government are designed to encourage the industry to develop local raw materials and use them as substitutes for imports. Some examples of such potential feedstuffs, either unutilized or under-utilized are shown below:

- Rice bran - *Estimated that less than 50 percent is used*
- Rubber seed meal - *No significant use at present*
- Tea refuse - *Not used*

- Jak seeds - *Possible substitute for maize*
- Fruit seeds - *A wide variety of fruit seeds not used at present*
- Fish waste - *Not used at present*
- Abattoir waste - *Not processed or used*

One strategy that is being developed is to promote the establishment of small-scale feed mills at small town level. It is thought that such mills are more likely to use local materials and provide a market for those who collect local raw materials and process them into feed ingredients. One of the main constraints to such a programme has been identified as the lack of know-how among that eager to begin such enterprises; accordingly, a strong training programme has been planned and is being implemented.

# The feed-milling industry in Thailand

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## Introduction

Thailand is an agricultural economy that produces enough food to meet domestic needs and for export. Livestock and livestock products are the main sources of protein in the country and contribute significantly to farmers' livelihoods. Farmers now combine livestock raising with crop cultivation to supplement income as crop yields are becoming inconsistent each year. Promotion of livestock raising is part of the National Economic and Social Development Board's eighth plan (1997-2001). Provision of suitable animal feed is therefore an essential component of livestock production requiring good coordination and cooperation among stakeholders within the animal feed-milling industry.

As the provision of nutritious feed is a major investment in livestock farming − about 70 percent of the production cost − the quality of the feed is a major concern for farmers. Choice raw materials need to be selected to formulate good quality feed appropriate for different livestock species. Animal feed-milling capacity in Thailand can be divided into three categories:

1. Home mixing − small-scale capacity in which some large farms prefer to mix their own feed.
2. Independent − medium- to large-scale capacity involving animal feed production for retail purposes.
3. Integrated − large-scale capacity involving corporate stakes in all aspects of the livestock industry.

Integrated and independent feed mills produce about 60-70 percent of the entire animal feed output. There are about five large companies in this context but they do not dominate the industry − they may produce large quantities of animal feed but they use most of their products on their own integrated farms.

The 89 feed mills in Thailand produced about 6.63 million tonnes in 1998 of which 6.03 million tonnes were finished feed and 0.603 million tonnes were concentrates. Feed production in Thailand during 1994-1998 had a rising trend but after 1998 output declined sharply owing to the economic crisis within the country and region.

Most Thai feed mills are located around 300 kilometres from Bangkok. However, within the next five years most of them will move closer to the sources of raw materials, i.e. Northeast Thailand. When choosing the location of an animal feed mill,

environmental and social impact must be considered. It should be at a distance from community residential areas, especially schools and hospitals. In Thailand, the establishment of an animal feed-milling plant must be approved by the Ministry of Industry and environmental protection is one of the main criteria for approval.

Essential animal feed ingredients are maize, soybean meal, fish meal, broken rice or rice bran and tapioca as well as minerals and vitamins. Thai feed millers try to use ingredients that are available in-country as much as possible in order to lower the cost of production, but some, i.e. vitamins and minerals have to be wholly imported. Others are partially imported (maize, soybean meal and fish meal). The main sources of these raw materials for many countries are Brazil, Argentina, Chile and Peru but Thailand also imports them from China, India and Indonesia.

Health hazards to livestock and humans posed by contamination of feed via micro-organisms (e.g. salmonella and aflatoxin) or chemical residues are given serious attention. Feed production in Thailand meets international standards for quality control. The Department of Livestock Development (DLD) has shifted responsibility for the animal feed industry to the Division of Feed Quality Control. (DFQC). The DFQC supervises and monitors formulation, distribution, advertising and sale of animal feed, including premix and supplements, as prescribed in the Feed Quality Control Act B.E. 2535 (1982). Manufacture, import or distribution of animal feed for commercial purposes is prohibited without permits from and registration of the products at the DLD.

The government is trying to improve the standard of living in rural areas and reduce congestion in large cities, especially Bangkok. Government policy mandates the transfer of industry to special zones in rural areas. Any factory that is located in this Investment Promotion Zone is granted tax exemption on imported equipment and machinery for certain periods of time under the supervision of the Board of Investment in order to attract new investors. Foreign investment in the feed-industry is permitted as long as local partners are involved. Any feed-milling firm is permitted to export under supervision of the DLD for quality certification. As a consequence of the GATT agreement, the government has designated an import tax on raw materials for animal feed production such as maize, soybean and soybean meal at 20 percent with a limited quota of 53 253 tonnes for maize, 10 633 tonnes for soybean and 224 459 tonnes for soybean meal.

The government also has a policy to promote the use of local raw materials first such as maize, soybean and soybean meal at a guaranteed price (lowest ceiling) before importing them. For example soybean and soybean meal must not be sold lower than 11 baht/kg and 9.50 baht/kg respectively. The monthly average market prices of maize and soybean meal varied during 1997-1999 but to a lower extent than those of fish meal. Another policy controls the price of animal feed by setting a ceiling price that prevents farmers from spending too much. This policy is good for both crop farmers and livestock farmers but not for the animal feed miller and is a major problem for other stakeholders in the animal feed-milling industry in Thailand.

The Thai Feed Mill Association was established in 1978 with the objective of sharing experience and addressing problems encountered by members in order to develop the animal feed-milling industry to meet international standards. The association also helps to establish linkages among feed millers, the farmers who produce raw materials for the industry and livestock farmers; it generates better understanding of markets and sharing of benefits.

In conclusion, the animal feed-milling industry in Thailand is optimistic about the future. In 1998 the estimated demand for animal feed was about 8.56 million tonnes − 37.7 percent for broilers, 31.0 percent for swine, 17.1 percent for layers and the remainder for ducks, dairying and aquaculture. We expect the economic crisis to have abated by 2000; hence, the livestock population will increase, requiring greater amounts of feed. Improved feed quality will lead to enhanced animal products for domestic consumption and trade in global markets.