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PROTEIN MEAL SUPPLY AND DEMAND FOR ANIMAL FEEDING

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Abstract

Improved animal production requires sufficient quantity and quality animal feed. One of the essential nutrients to support optimum production is protein and should be provided from feed ingredient rich in protein. World protein meal supply is derived from oilseed and animal by products. Major protein meals are soybean meal, rapeseed meal, cottonseed meal, Sunflower seed meal, Fishmeal, peanut meal, palm kernel meal and copra meal. There is an increasing in world production of soybean meal, rapeseed meal and palm kernel meal while the other meals remained stagnant. Soybean meal is the major supply of protein meal and it is mainly produced in USA, Argentina, Brazil and exported to many countries around the world and the demand continues to grow especially in Asia because of an increase in poultry and pig production. Indonesia animal production increased steadily in the last 5 years and poultry production become leading species to provide meat and egg for domestic consumption. Indonesia requires protein meal for feed production and it is mainly fulfilled by soybean meal imported from USA, Latin America and India. Local protein meals are mainly from palm kernel meal and copra meal that suitable for ruminant feed. The local price of protein meal is affected by world market price and tends to decrease except for fishmeal.

Introduction

Animal feeding requires protein for their life and production. Protein supply for animal feed especially poultry and swine can be derived from animal and plant protein. Animal protein is obtained from by product of animal industries such as meat bone meal, feather meal, blood meal, poultry by product meal, plasma protein and from fish industry such as fishmeal, fish soluble, shrimp meal etc. Plant protein is obtained from agriculture and by product of oil industries. There are many pulses or leguminous available as protein sources, these include lupin, peas, soybean, wing bean, *Cajanus cajan* (gude in local name), mung bean, velvet bean etc. In the case of by products from oilseed are soybean meal, rapeseed (canola) meal, peanut meal, cottonseed meal, sunflower meal, copra meal, palm kernel meal, kapok seed meal, rubber seed meal, castor bean meal, etc. The availabilities of the protein meal in the world are varying depending upon the type of protein meal and the countries in which the protein meal is produced. For example kapok seed meal may be available in Indonesia, Thailand and India and rubber seed meal is only in rubber producing

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countries such as Malaysia and Indonesia and the amount is very limited. The total major protein meal is only 8 and the world production in year 2000-2001 is around 174 MMT. In Asia and also many part of the world, major protein supply is obtained from soybean meal which derived from soybean that undergo oil extraction to produce cooking oil and the by-product is soybean meal. However many soybean meal available in market are not similar, it can be affected by genetic, agronomic background and also processing. This paper describes the supply and the demand of protein meal in the world and special reference is made for Indonesia.

World Supply and Demand of Protein Meal

Type of protein meal

Protein meal for animal feed is naturally derived from oil seed or by product of animal industries. Major oil seeds are soybean, cottonseed, peanut, sunflower seed, rapeseed copra and palm kernel. Other minor oilseed such as safflower and linseed are available in certain countries especially in temperate areas, while in tropical areas such as Indonesia, kapok seed can be found in Central or East Java. Major oilseed production in the world is presented at Figure 1. The figure indicated that soybean account for more than 55% of oilseed production in the world followed by rapeseed.

Initially the oilseed cultivated for oil production and oil seed meal is considered as by product of oil crushing industries. Oil seed is crushed either by expeller or solvent extraction or combination to produce oil for cooking. The by-product of oil extraction in rich in protein and used as animal feed. In many cases the higher value of meal may determine the profitability of crushing plant, especially when the price of oil is down.

World production and export of oilseed meal for year 2000-2001 is presented in Table1. Soybean meal is still the major supply of protein meal and followed by rape seed meal, sunflower and cottonseed meal. In general, protein meal is an oilseed meal that can be used as source of protein for feed. However meal can vary in protein. From the total production of protein meal 174 MMT, around 66% derived from soybean meal. World fishmeal production is around 6 MMT but fishmeal production tends to decrease in future because of over fishing. It is interesting to note that for the last ten years only soybean meal, rapeseed meal and palm kernel meal increased in production while other protein meal is remained stagnant. Most of protein meal is consumed locally in the countries in which protein meal is produced. Only 32% (55 MMT) of protein meal is exported and among the total export, soybean meal contributed around 72%.

The extend of protein meal use in animal feed is vary depending upon the animal species and physiological state of the animals. Protein content of the meal will also influence the level of inclusion in the diets. Protein level of the meal is vary depending upon the type of the meal, ranging from 15% in palm kernel meal up to

more than 60% in the case of fish meal. Several protein meals also higher in fiber render it becomes unsuitable for monogatric animals such as poultry and pig. Cottonseed meal and sunflower seed meal is mainly used for ruminant feeding together with palm kernel meal and copra meal. The higher in fiber content send to have lower metabolizable energy value for monogatric animal and may limit the use in poultry and pig therefore the major supply for poultry and pig will come from soybean meal, peanut meal and limited quantity of rape seed meal. Consideration to use protein meal for poultry feeding will be discussed in separate paper by Swick (2002).

Major protein meal supplier

Major oilseed production countries are depending upon the type of oilseed. Soybean is mainly grown in USA, Brazil, China, Argentine, Europe Union, Paraguay and others. Rapeseed is mainly produced in China, Europe Union, Canada, India and Eastern Europe, while peanut is grown in India and China. Major fishmeal producing countries are Peru, Chili, Japan, Norway, etc.

Since soybean meal is the biggest and major protein meal in the world market, the discussion will be focused on soybean meal. The world soybean meal production and consumption is presented on Table 2. Total soybean meal production is similar to consumption around 112 MMT and major soybean meal production is USA, Brazil, Argentine, China and Europe Union. These countries, except Argentina, consume their soybean meal produced and the balance is exported. Table 3 shows the major exporter and importer of soybean meal and America both North and South are the biggest soybean meal exporting countries and will continue as the biggest exporter in future as production is increasing. Continued expansion in planting and infrastructure development in Argentina and Brazil will increase their capabilities as important world supplier of soybean meal. Since there is an excess supply of soybean meal after domestic usage, soybean meal is exported to many countries around the world. Europe and Asia are the major importer, Europe Union account almost half of the soybean meal export and followed by Asia.

Asian countries such as Japan, Korea, Taiwan, China, Southeast Asia (Philippine, Malaysia, Indonesia, Thailand and Vietnam) will continue to import soybean meal to fulfill the domestic demand of feed industries. A rapid increase in meat consumption especially poultry and swine will require large quantities of feed and its protein source in this region. It is expected that soybean meal will continue to be imported in Asia for feeding the animals. A rapid increase of income in developing countries, such as China, Indonesia and Vietnam will also increase the demand in animal protein food, which majority derived from poultry and swine and finally will increase the soybean meal import.

Most countries with feed industries have soybean-crushing facilities but the size and sophistication of operations differ widely making the final product variable between sources. An understanding of quality control and product specifications of this important ingredient is economically prudent especially when one considers that

up to 75% of the amino acid requirements of a typical broiler or swine grower feed may come from soybean meal. Soybean meal used in Asian countries exists in several forms with solvent extracted material containing hulls being the most common. Many locations use imported dehulled soybean meal obtained mostly from the USA and to a lesser extent Brazil and Argentina. In less developed areas, meal derived from expeller cake is used. Full fat soybean meal is also available, produced by extrusion or dry roasting in small-scale plants.

Rapeseed meal ranks second to soybean meal in terms of total world production of protein meals. According to Oilseed Blue Book (2002) estimates, total world production of rapeseed meal in 2000 was 22.3 million metric tonnes. The major producers are China, India, Germany, Canada and Japan.

Projection

Protein meal demand will depend upon the increase in animal production and increase in animal production will be affected by income of the people and the increase in human population. As general pattern of food component, the increase in the income of people will increase animal protein consumption in their diet. Aho (1998) reported that when income of people reaches $1000, the animal protein consumption would increase dramatically. A rapid increase of income in many Asian Countries such as China, Korea, Southeast Asia will increase the demand of animal protein. It is expected that Asia will become a major drive in protein meal demand due to the rapid growth in economic and large population. Other developed countries such as Europe Union, US and Japan will consume the major protein meal for animal feed but the rate of growth will not be significant compare to Asia (including Japan).

Among the type of protein meal available, soybean meal still become the major supply of protein meal and followed rapeseed meal for feeding monogatric animals. Ruminant rather than non-ruminant animals better utilize high fiber protein meal, such as cottonseed meal, sunflower meal, copra meal and palm kernel meal. Peanut meal supply tends to be stagnant and export is expected to decrease as India continues to utilize the local protein meal to fulfill a rapid increase in poultry and dairy production.

As reported earlier, fishmeal supply tends to be saturated because of over fishing and the existing supply will be used for aquaculture production. There will be a limited supply of fishmeal for animal feed and most of fishmeal will be utilized in aquaculture feed, as the demand in aquaculture feed is high.

Since soybean meal becomes the most important protein meal for livestock, the future supply would depend upon the planting of soybean in major producing countries. Since the USA is the largest producing countries, although soybean is not native to USA, it is interesting to note how USA developed the soybean cultivation.

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History of Soybean in USA

Soybean has been considered as a "miracle crop" due to its ability to supply protein and oil in large quantity and cheaper price for human food. Compared to animal protein source, cost of soybean protein is approximately only 5 % of protein from beef and only 10 % of egg protein. The efficiency of soybean to produce protein due to its ability to fix nitrogen from the air. Besides it's efficiency and cheaper protein price, soybean has also been accepted by many people and has a good nutritional value not only for human but also for animals.

Soybean cultivation began in northern China and Inner Mongolia as early as 5,000 years ago. For many centuries it was an important staple food in China, Korea, Japan and other Asian countries. As Buddhism expanded throughout the region, its vegetarian philosophy may also have influenced the growing consumption of soy. In fact soy was considered of such value that the Chinese Emperor Shen-Nong declared it one of the five sacred crops.

It wasn't until the early 19th century that soybeans made their way to the western world. It is said that the first soybeans to reach the United States arrived as ballast in Yankee clipper ships. Sailors would load the empty vessels with the beans to steady the ships on their return voyage from China. Upon arrival in America they dumped the beans to make room for cargo. Farmers in the United States didn't start growing soybeans until the 1830s, and even then consumption was very limited. During the American Civil War, soldiers used soybeans as a substitute for coffee beans when real coffee was scarce. In the later part of the century more significant numbers of farmers grew soybeans as forage for cattle. In 1904 at Tuskegee Institute in Tuskegee, Alabama, George Washington Carver began studying the soybean. His breakthrough discoveries forever changed the way people view the soybean. No longer was it just a forage crop. It could be broken down as a rich source of oil and protein.

Farmers grew soybeans on over 72 million acres of land in the United States in 1999; making it the second largest crop in cash sales and the number 1 crop in export value. America's advantage to being the world's largest exporter of soybeans lies in its vast, rich farmland and it's efficient bulk commodity storage, handling and distribution infrastructure. During the past few years the soybean industry has experienced the introduction of a number of new technologies, which have, and will continue to have, significant impact on farming methods. One of these is biotechnology and the resulting development of new seed varieties. Initially these new seed crops have been mostly to the benefit of the farmer, allowing him to reduce his costs and increase his productivity. In the near future seed varieties will be developed with value-enhanced traits more specific to human food requirements and health benefits. As this trend develops, so too will the relationship between the farmer and the end-user move more directly in harmony, changing to a large degree today's commodity based infrastructure for bringing food to the dinner table.

Infrastructure and other facility from production to consumer may improve the efficiency may reduce the cost of soybean. The use of river transportation, crushing

plant at port has been well known in US and has been adopted in Argentine situation. The use of mechanization from planting to harvest has also shown to be important in many soybean-producing countries and improve productivity.

By 1929 soybean production in the United States had grown to 245 thousand metric tons. In 1999 production the U.S. rose to a staggering 73 million metric tons or almost a quarter of all crops grown in the country. Last year the world produced almost 165 million metric tons of soybeans. The United States accounted for almost half of the global production, followed by Brazil, Argentina and China. About half of the soybeans grown in the United States (or every other row of soy cropland) are exported in the form of whole beans, meal or oil. China, which up until 1995 was an exporter of soybean products, is now the world's leading importer of soybeans, with an estimated 5.8 million metric tons imported this year. Japan follows in second place, importing an estimated 4.8 million metric tons (Tangendjaja and Lindblom, 2001).

Today's soybean crop makes an invaluable contribution to the feeding of our planet. It is grown by at least a million farmers, soybean are processed into meal, oil and a variety of food products in thousands of processing plants around the world. Each day, millions of people consume foods produced from bounty of more than 150 million metric tons of soybeans per year.

The interest on soybean planting is not only in the USA, it is also expanded to neighbouring countries such as Latin America or South America.South America's abundance of land, natural resources and favorable weather conditions makes it natural for large-scale crop production and expansion of their growing areas. Brazil has possibly the largest potential for soybean production. It was estimated that 80 million hectares of land could be used in grain production, including soybean (Portugal, 1999). In the case of Argentina, it is predicted that 8 million hectares of land will be planted for soybean in year 2010 (Larreche and Brenta, 1999). Besides Brazil and Argentina, potential areas for soybean production in South America will be Bolivia and Paraguay. India has also increased in soybean production that derived from 8 million hectares of land and projected to be 10 million hectares in year 2010. However low level in yield (1.2 MT/ha) and high local demand for cooking oil make India has less ability to export soybean (Paroda, 2000).

The expansion of soybean production is not only supported by intensification of the areas but increase use of fertilizers, pesticides, irrigation, equipment/ machineries, management of plantation include the new cultivars from conventional breeding and genetically modified contribute to the production.

Production and supply of soybean in future will depend on several factors:

1. Growth of income in major importing countries
2. Availability and price of other vegetable oil that can substitute soybean oil
3. International trade system such as trade barrier, tariff or tax or protection from the consumer
4. Research and development. Adoption of technology in agronomic such as double cropping of wheat-soybean and non-tillage system has accelerate Argentine soybean production. Introduction of new cultivars in China and Brazil that are

pest disease resistance may promote productivity. The new enhance genetic improvement will certainly benefit not only to increase production but lowering the cost.

Protein Meal in Indonesia

Protein meal supply and demand in Indonesia will be affected by world supply and demand as there is no restriction to import and export and Indonesia has signed up to join WTO (world trade organization). Since there is no tariff barrier and import duty, Indonesia is till freely import several type of protein meal from several countries.

Animal feed production

In year 2001 income per capita of Indonesia around $750 while economic can growth at rate more than 3.5%. It is expected that animal protein consumption will continue to increase accordingly. Current total meat consumption around 7 kg and poultry meat contributes 57% of the total meat supply (Ditjennak, 2001). Total egg consumption is around 5 kg and majority is derived from commercial chicken (Table 4.)

Most of commercial chicken production in Indonesia is fed the ration obtained from feedmill. Commercial feed production continues to growth after the economic crisis. Table 5. indicated that feed production increased more than double since 1998 to year 2001 and indicate that poultry industry was rebound after the crisis. Commercial poultry feed, both for broiler and layer, still play an important role in feed production, it accounts more than 82% of feed production and the rest is used for swine and aquaculture. Broiler feed production continued to increase in the last 5 years and this year it is expected to surpass layer feed production.

Protein meal requirement. Requirement of protein meal for feed production can be calculated from the amount of protein meal included in the formula of feed and multiplied by feed production. Typical formula of broiler, layer and swine grower feed is presented in Table 6. In present commercial situation, protein meal is derived from soybean meal, meal & bone meal, rapeseed meal and sometime corn gluten meal and feather meal. More than 10 years ago, Indonesia imported other type of protein meal such as sesame meal and peanut meal from India and China, but since the last few years there was no sesame meal and limited amount of peanut meal in the market as the local demand from both exporting countries continue to grow in their animal production. Currently soybean meal is still no. 1 source of protein for poultry and swine feed.

Inclusion level of soybean meal in the formula may vary slightly depending upon price, quality and availability of other ingredients as well as the type of animals. Inclusion in broiler feed can be 20-25% in the diet while inclusion in layer can be 15-20%. Besides soybean meal, meat bone meal is also included in the feed at rate

between 3-7%. Sometimes, poultry by product meal is imported to replace meat and bone meal. When the price becomes feasible, feather meal and corn gluten meal is also imported and used in poultry feed. Fishmeal sometime available locally at a competitive price but it is affected by season and the supply tends to decrease as the demand for food is increasing. There is fishmeal available from tuna industries as the by-product of cold storage or canning industries. Some farmers may use fishmeal or purposely use fishmeal in the diet. However the increasing price of fishmeal may limit the use in poultry feed. Nutritionally it is not necessary to use fishmeal in poultry and swine feed.

Requirement of protein meal either derived from vegetable or animal is presented in Table 7. When feed production reach 6 MMT such as predicted in year 2002, it is calculated that protein meal requirement reached 2 MMT include 25% of this is derived from animal protein meal. A very limited supply of locally available protein meal will force Indonesia to rely upon world supply of protein meal.

Protein meal import. Import development of protein meal and corn from 1995 to 2001 is presented in Table 8. In year 2001 total protein meal import was1.7 MMT, not to include the import of rapeseed meal (Canola meal), corn gluten meal and feather meal. If these protein meals are accounted, the total import of protein meal may reach almost 2 MMT and it is comparable with the calculated figure from feed production. This figure also indicated that Indonesia do not have sufficient protein sources or almost negligible to fulfill the demand for feed production.

Majority of soybean meal is imported from US, Argentine, Brazil and India while meal and bone meal is imported from US, Australia and New Zealand and fishmeal is from Peru or Chili. Data of soybean meal import from 1998 to 2002 is presented in Table 9. Five years ago most of soybean meal was imported from India but last year (2001) majority of soybean meal was from US and none from Brazil and Argentine. No importation from those countries is related with outbreak of food and mouth diseases in those countries and this situation resulted on the ban of importation of any agricultural product by Indonesia government. It is expected that more soybean meal from Latin America may come to Indonesia in near future after the ban is lifted.

Local source of protein meal. As discussed previously, Indonesia do not have source of protein meal for commercial feed production. More than 10 years ago, Indonesia had a local company that process whole soybean to produce soybean meal. The whole soybean was imported and crushed in Jakarta to produce soybean oil and the by-product soybean meal was sold to most of feedmill in Indonesia. No local soybean is used in the processing since the local soybean is not sufficient to fulfill the demand for human consumption. However, the oil crushing plant has been closed down due to in competitiveness of the products.

Other local protein meal available in Indonesia is palm kernel meal. Aggressive expansion in oil palm plantation in Indonesia and Malaysia resulted in a steady increase of palm oil supply from both countries. Figure 2 indicated the increase of

world palm oil in the last 10 years. Malaysia is still the biggest supply of palm oil and followed by Indonesia. During the processing of palm kernel, oil is extracted by expeller and solvent to produce palm kernel oil and the resulted by product is palm kernel meal. It is calculated from palm oil production that Indonesia contributes around 31% of world palm oil production. According to USDA (2001), world palm kernel production in 2000-2001 is 3.64 MMT. It was calculated that Indonesia produced around 1.1 MMT palm kernel meal and majority is exported. Palm kernel meal, however, has a little value for poultry or other monogastric animal but it is suitable for ruminant feed either dairy cattle or beef cattle.

Indonesia also produces copra meal especially in Sulawesi or Nusa Tenggara. Indonesia currently is No. 2 in the copra meal production after the Philippines (Table 10). However the total production is only 475TMT and remained stagnant in the last 5 years. This may be related with the little expansion in planting and most of coconut is planted by small farmers, which is in contract with palm oil that is planted by corporation. Coconut oil is also more expensive than palm oil therefore the people has shifted to use palm oil in their daily cooking.

Most coconut oil is extracted using an expeller resulted in a higher oil content of the meal. Higher content of oil will contribute to the higher metabolizable energy for animals. It is not uncommon to have oil content up to 15% in copra meal. Copra meal has a higher protein and energy compare to palm kernel but the use for monogastric animal is also limited. Copra meal has been widely used for dairy cattle but there are many copra meal is exported to European countries.

Besides those meals, Indonesia also produces kapok seed meal. Kapok (Ceiba sp.) seed has been collected as by product of kapok industry for mattress or pillow. Kapok seed has high oil content and has been extracted to produce kapok oil mainly for industry (drying oil). Kapok seed meal is not suitable for feeding poultry. The higher fiber content together with toxic component (cyclopropenoic acid) can be dangerous for layer. However, kapok seed meal can be used for ruminant feeding in limited quantity due to palatability problem.

Price. As discussed earlier that price of protein meal is affected by world supply and demand. Market price is mainly determined by Chicago Board of Trade (CBOT), as a center for world marketing for US. Market price was also based in different region in which the product is mainly produced. For soybean meal, the price is determined in different location such as Decatur for US, Rio Grande for Brazil, Buenos Aires for Argentine and Rotterdam for Europe. Peanut meal is determined at US and Rotterdam, rapeseed meal and fishmeal at Hamburg, Germany.

In general the price of protein meal tend to decrease in the last 20 years except for fish meal tend to increase due to limited supply and higher demand for aquaculture. Figure 3 indicated that price of soybean meal in US tend to decrease slightly in the last few years. The higher demand of soybean meal by animal industry did not increase the price because it is compensated by higher productivity and expansion in Latin America. Current market price is soybean meal is around

$200/mt FOB US (New Orleand), when the freight cost is around $28/mt the landed cost of soybean meal is around $230/mt. The current local market price is around $240-245/MT at feedmill.

The price of copra meal is also decrease to below $100/mt at Hamburg. The current local price is around $90 at feedmill. Copra meal has been used by some feedmill for their production but to the limited extend. Palm kernel meal is also used very little by monogastric animals, on the basis on nutritive value; the price of palm kernel meal should be less than that copra meal. The current market price is around $50-60/MT and available in Medan or Surabaya.

Conclusion

Indonesia will continue to import protein meal to support an increase in feed production. Soybean meal, rapeseed meal and animal protein meal are the main ingredients for poultry feed which contribute to 85 % of feed production. Local protein meal is very limited to the palm kernel and copra meal which more suitable for ruminant. Major supplier of soybean meal remained USA, Argentina, Brazil and India and the price will follow the world market price.

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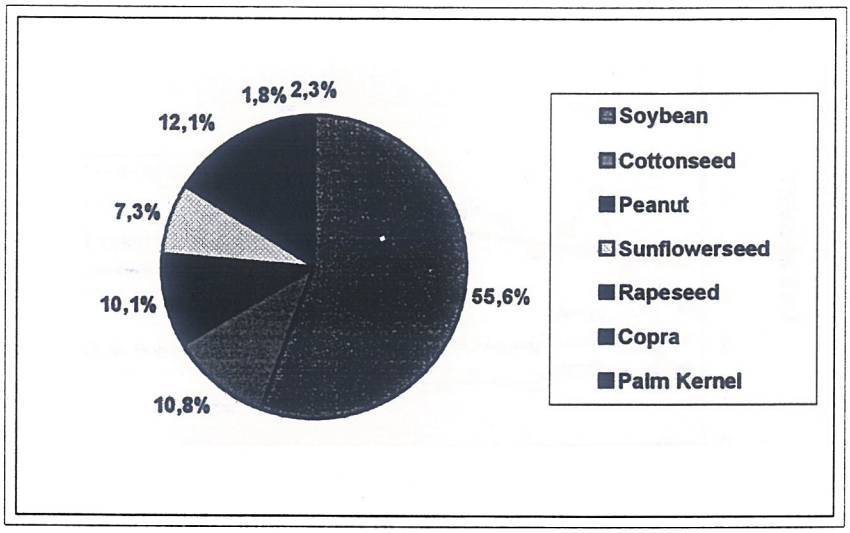

Figure 1. Major oilseed production in the world 2000-2001(adapted from Soya and Oilseed Bluebook, 2002)

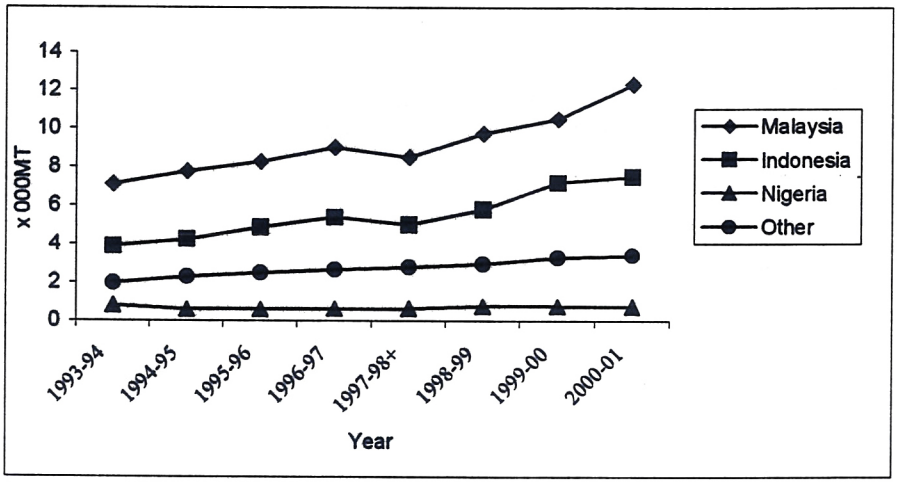

Figure 2. Palm oil production in Malaysia, Indonesia, Nigeria and other (adapted from Soya and Oilseed Bluebook, 2002).

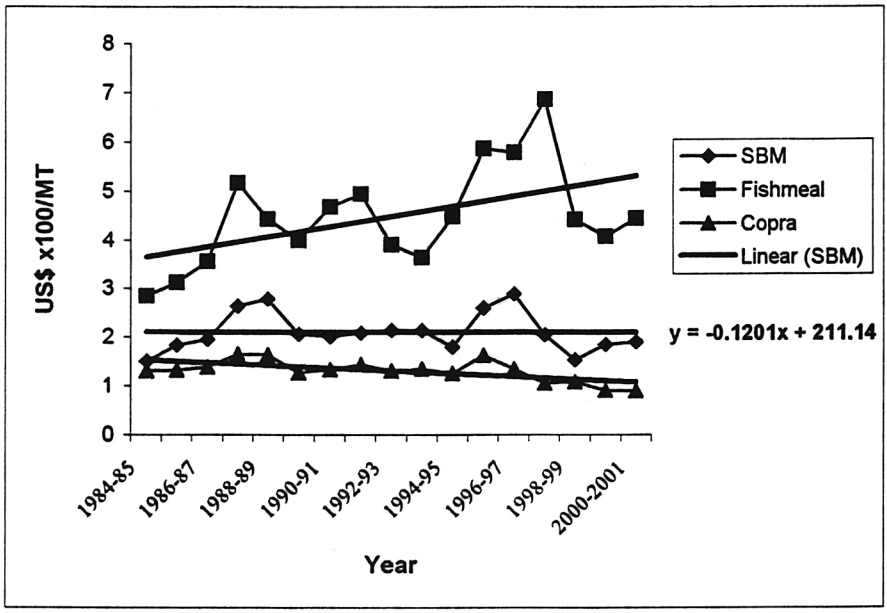

Figure 3. Price change in soybean meal, fish meal and copra meal (adapted from Soya and Oilseed Bluebook, 2002)

Table 1. World Major Protein Meal Production and Export in 2000-2001 (MMT) (adapted from Soya and Oilseed Bluebook, 2002)

Meal type	Production	Export
Soybean	114.9	39.7
Cottonseed	11.2	0.6
Rapeseed	21.3	4.1
Sunflower seed	9.5	2.6
Fish	6.0	3.8
Peanut	5.5	0.3
Copra	1.8	1.1
Palm Kernel	3.6	3.3
Total	174.0	55.4

Table 2. World soybean meal production, consumption and ending stock (MMT) (adapted from Soya and Oilseed Bluebook, 2002)

	1993-1994	1994 - 1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001
PRODUCTION	81.28	87.5	89.08	90.82	98.80	107.48	107.94	114.94
CONSUMPTION	80.92	87.61	87.94	91.55	99.25	106.91	109.06	114.72
ENDING STOCK	3.97	4.38	4.31	3.69	3.67	4.82	3.85	3.99

Table 3. Major Soybean meal Exporter and Importer (2000-2001) (USDA, 2000)

Exporter		Importers	
US	6.7	Europe union	19.7
Brazil	10.3	Asia	7.9
Argentine	13.3	Middle East	3.8
Europe Union	5.1	Latin America	3.9
India	2.5	Eastern Europe	2.5
	1.4	Others	1.6
Total	39.2	Total	39.4

Table 4. Animal protein consumption in Indonesia from 1997-2002 (ASA, 2002)

	1997	1998	1999	2000	2001	2002
Total Meat (kg)	7.95	5.45	6.34	7.10	7.40	7.50
Poultry Meat (kg)	4.39	2.94	3.24	4.09	4.79	5.27
Broiler Meat (kg)	2.26	1.42	1.60	2.45	3.15	3.62
Spent Layer, Duck, Native Chiken (kg)	1.77	1.52	4.03	1.64	1.64	1.65
Eggs, (kg), Incl. Native Chicken And Ducks	5.99	3.45	5.60	4.78	4.75	5.90
Milk (kg)	5.80	5.60	5.60	5.70	5.90	6.20

Tabel. 5. Commercial feed production in Indonesia from 1998-2002 (ASA, 2002)

Feed Type	1998	1999	2000	2001	2002*
Broiler	643	1369	2046	2340	2804
Layer	1146	1485	1876	2456	2452
Swine	500	500	500	529	555
Aquafeed	249	330	432	468	515
Total	2538	3684	4854	5793	6326

Table 6. Formulae of broiler, layer and swine grower feed and cost of ingredients (August, 2002)

	Broiler	Layer	Pig grower	Price (Rp/kg)
Corn	54.0	47.14	49.34	1075
Rice bran	10.0	25.00	30.00	900
Soybean meal (48)	20.71	13.51	17.91	2300
Limestone	0.33	7.07	1.18	120
Meat & bone meal	5.00	3.37	-	2.600
Feather meal	2.00	2.00	-	3.250
Bone meal		1.06	-	1.850
Crude palm oil	3.00	0.34	-	3.400
Salt	0.24	0.28	0.42	450
Methionine	0.24	0.11	-	27.000
Lysine	0.24	0.03	-	16.500
Rapeseed meal	3.00		-	1.350
DiCal.phosphate	0.94		1.06	3.500

Table 7. Total feed ingredients requirement at different level of feed production.

	Average (%) formulae chicken	Production (MMT)					
		3.5	4.0	4.5	5.0	5.5	6.0
Corn	52	1660	1900	2140	2380	2610	2850
Rice Bran	12	480	550	620	690	760	825
Protein meal							
- Vegetable	25	875	1000	1125	1250	1375	1500
- Animal	4	260	200	340	375	415	450
Oil	2	60	70	80	90	100	105
Phosphorus	1	4	5	6	6	7	8
Others	4	161	175	189	209	233	262
Total	100	3500	4000	4500	5000	5500	6000

Calculated based on chicken formulae at price in 1999

Table 8. Import of feed ingredients in Indonesia from 1995-2001 (Ditjennak, 2001)

Year	Corn	Fish Meal	SBM	MBM	PBM
1995	979.145	128.957	681.875	133.131	
1996	616.888	126.842	942.292	184.994	
1997	1.098.012	115.180	868.790	251.128	
1998	298.234	35.291	688.412	155.703	
1999	591.234	71.725	934.864	201.885	
2000	929.633	64.883	975.091	215.331	52.536
2001	1.072.538	68.313	1.339.301	311.575	41.052

Table 9. Soybean meal import in Indonesia from 1998 to 2002 (ASA, 2002)

Origin	1998	1999	2000	2001	2002*
Usa	63	0	295.3	882.4	650
Argentine	69	182	126.5	0	120
Brazil	93	190	94.7	0	180
India	342	356	452.2	460	450
Others	4	0	0	7.3	19.5
Total	571	728	968.7	1350	1,420

Table 10. World copra meal production from 1995 –2001. (USDA, 2001)

	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001
Philippines	631	767	788	425	735	780
Indonesia	475	642	418	438	433	475
India	230	244	255	262	270	270
Other	316	313	274	278	284	291
Total	1,652	1,966	1,735	1,403	1,722	1,816