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FEED USE ESTIMATION: DATA, METHODOLOGIES AND GAPS - THE CASE OF THE PHILIPPINES

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List of Acronyms

ADB	Asian Development Bank
AFMA	Agriculture and Fisheries Modernization Act
AFSD	Animal Feeds Standard Division
AFSIS	ASEAN Food Security Information System
AgSTAT	Agricultural Statistical System
APAFMI	Association of Philippine Aqua Feed Millers, Inc.
ASDP	Agricultural Statistical Development Program
ASA	American Soybean Association
ASEAN	Association of South East Asian Nations
BAEcon	Bureau of Agricultural Economics
BAI	Bureau of Animal Industry
BAR	Bureau of Agricultural Research
BFAR	Bureau of Fisheries and Aquatic Resources
BIR	Bureau of Internal Revenue
BLPS	Backyard Livestock and Poultry Survey
BOC	Bureau of Customs
CLPS	Commercial Livestock and Poultry Survey
CPS	Corn Production Survey
CrPS	Crops Production Survey
DA	Department of Agriculture
DTI	Department of Trade and Industry
ECC	Environmental Compliance Certificates
FAO	Food and Agriculture Organization
IAS AFS	Inter-Agency Committee on Agriculture and Fishery Statistics
IAS	Integrated Agricultural Survey
LGUs	Local Government Units
NAFC	National Agricultural and Fishery Council
NDA	National Dairy Authority
NFEPP	National Federation of Egg Producers of the Philippines/Egg Board
NFHFI	National Federation of Hog Farmers, Inc.
NFIS	National Fishery and Information Service
NIN	National Information Netwok
NMIS	National Meat Inspection Service
NSO	National Statistics Office
NSCB	National Statistical Coordination Board
PABI	Philippine Association of Broiler Integrators
PAFMI	Philippine Association of Feed Millers, Inc.
PAHRI	Philippine Association of Hog Raisers, Inc.

PASO	Provincial Agricultural Statistics Officer
PCA	Philippine Coconut Authority
PCC	Philippine Carabao Center
PDC	Philippine Dairy Corporation
PFDA	Philippine Fishery Development Authority
PHILSAN	Philippine Society of Animal Nutritionists
ProPork	Pork Producers Federation of the Philippines, Inc.
PSAS	Philippine Society of Animal Science
PSA	Philippine Statistical Association
PSA-BAS	Philippines Statistics Authority-Bureau of Agricultural Statistics
PSPA	Philippine Swine Producers Association (PSPA)
PVMA	Philippine Veterinary Medical Association
PVDA	Philippine Veterinary Drug Association
RCPS	Rice and Corn Production Survey
TWG	Technical Working Group
UBRA	United Broiler Raisers Association
UPLB	University of the Philippines at Los Baños
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USFGC	United States Feed Grains Council

Executive summary

It is a fact that the increasing demand for food to feed the world's burgeoning human population (7 billion people) is relentless and the improved affluence being enjoyed by an increasing number of people results in higher demand for animal products: meat, eggs and milk.
By 2050, most of the world's population 10 billion or so inhabitants will be living in towns and cities. Feeding these people will require a 70-100 percent increase in the amount of food produced today (Burney *et al*, 2010). It will also require an estimated additional 1,305 million tonnes of grain, of which 40 percent would be used for feeding livestock. A major contributory factor to this extra demand is expected to be substantial increases in poultry and pig meat production (FAO, 2013).

Accurate assessments of current and future supplies and demands for livestock feed are needed as input into national food security policies, as well as national livestock strategies which balance national food requirements with investments into environmentally sustainable livestock and feed systems. The general objective of this study is to: 1) assess current patterns of feed consumption in the Philippines, especially grain-use in livestock feed; and, 2) review the methodologies for their calculation.

Demand for feed crops like yellow corn, rice, wheat, and soybean will undoubtedly expand in the coming decade in the Philippines. As elsewhere, growth in the demand for those feed crops hinges on the rise in demand for meat, poultry, milk, eggs, etc, a trend which is catalyzed by rapid urbanization, rising incomes and changes in consumer tastes and preferences.

The Philippines Statistics Authority and the Bureau of Agricultural Statistics (PSA-BAS) maintains a very comprehensive database of agricultural statistics. Similar to many developing countries in the Asia-Pacific region, the statistical system in the Philippines and data related to the livestock, poultry and aquaculture sectors focus on production. Data on production originating from backyard farms is available since 1994 and complete commodity balance sheets are available since 1990, at least for maize and corn. So unlike other countries, the Philippines produces official statistics on feed use. The Technical Working Group composed of representatives from the PSA-BAS, DA, and feed associations, are able to use the balance sheet approach to calculate feed use of maize and rice since they produce regular surveys (monthly and annual) of stock and production of these cereals.

The official launch of CountrySTAT Philippines creates an opportunity for the policy-makers, government officials, development partners and other participants to get acquainted with the value-added of the system and to learn how it can be used to improved data quality and to support the policy making process. Though highly valuable and easily accessible,

CountrySTAT Philippines is still far from being ideal in providing the much-needed data in feed usage and estimation as shown by the author.

It is therefore imperative for the government and concerned stakeholders in the livestock and aquaculture sectors to encourage more data transparency and accuracy for compiling commodity specific data, especially consumption data which is often considered inconsistent and unreliable. It is also indispensable to improve access to timely data and forecasts on crop, livestock and aquaculture production.

1. Introduction

It is a fact that the increasing demand for food to feed the world's burgeoning human population (7.2 billion people) is relentless and the improved affluence being enjoyed by an increasing number of people results in higher demand for animal products: meat, eggs and milk. By 2050, most of the world's population 10 billion or so inhabitants will be living in towns and cities. Feeding these people will require a 70-100 percent increase in the amount of food produced today (Burney *et al*, 2010). It will also require an estimated additional 1,305 million tonnes of grain, of which 40 percent would be used for feeding livestock. A major contributory factor to this extra demand is expected to be substantial increases in poultry and pig meat production (FAO, 2013). "The limits of existing livestock production systems," observes Dr. Berhe G. Tekola, FAO Director for Animal Production and Health Division, are being approached, if not exceeded, because of increased demands for livestock feeds vis-á-vis availability."

The precarious and somewhat gloomy situation, as described by a high-ranking FAO expert, holds true in many countries in the Asia-Pacific region, including the Philippines. In this archipelagic country of 98.7 million people (as of March 14, 2014), demand for feed crops like maize, rice, wheat and soybean will indubitably expand in the coming decade. As elsewhere, growth in the demand for those feed crops hinges on the rise in demand for meat, poultry, milk, eggs, etc, a trend which is catalyzed by rapid urbanization, rising incomes and changes in consumer tastes and preferences.

Accurate assessments of current and future supplies and demands for livestock feed are needed as input into national food security policies, as well as national livestock strategies which balance national food requirements with investments into environmentally sustainable livestock and feed systems. National feed resources, according to Dr.Tekola, must be assessed and monitored to provide information that is useful for the development and implementation of appropriate policies that will contribute to the sustainable growth of national livestock sectors.

The general objective of this study is to: 1) assess current patterns of feed consumption in the Philippines, especially grain-use in livestock feed; and, 2) review the methodologies for their calculation. As part of proces, the national consultant has endeavored to identify key drivers and trends of feed utilization at national level. In general, this report aims to review existing data sources which contribute to the calculation of national feed use; describe the process for generating feed estimates; and identify weaknesses in national data systems and general knowledge that impede a better understanding of national feed systems.

Data gathering in this report was conducted basically through archival research and selected interviews with key informants from the livestock and feed industries (see Annex A). In

particular, representatives of the United Broiler Raisers Association, National Federation of Hog Farmers, Inc., Philippine Association of Feed Millers, Inc., Philippine Society of Animal Nutritionists, Philippine College of Swine Practitioners, Philippine College of Poultry Practitioners, Philippine Statistics Authority, and the Bureau of Animal Industry were interviewed. Relevant statistics and information were obtained from the PSA-BAS, BAI, Sikap Foundation and various other institutions.

2. Agricultural statistical system

2.1 The official statistical system

The Philippine Statistics Authority-Bureau of Agricultural Statistics (PSA-BAS) is the principal government agency created by law (Executive Order No. 116 of 30 January 1987 and recently amended by Republic Act No. 10625[1]) with the mandate for the efficient collection, processing, analysis and dissemination of official statistics on agriculture and fisheries. The PSA-BAS is recognized as a credible agricultural statistical agency with a competent workforce delivering high quality products and services through the use of appropriate technologies to support the information needs of stakeholders. As a major player in the Philippine Statistical System (PSS), its data systems and procedures adhere to standards, rules and norms set by the PSS.

The PSA-BAS serves as the focal point for the dissemination of agricultural statistics as shown in Table 1, generating basic data on production, prices and marketing, costs and returns of production and other socio-economic data related to agriculture and fisheries. It also compiles and generates production accounts, supply and utilization accounts (SUAs) and agricultural development indicators. These statistics are recognized as valuable inputs into policy formulation and decision-making to support a sustainable agricultural development in the Philippines.

The PSA-BAS also maintains a very comprehensive database of agricultural statistics. Data on production originating from backyard farms has been available since 1994 and complete balance sheets are available since 1990, at least for maize and rice. So unlike other countries, the Philippines produces official statistics on feed use. The Technical Working Group[2] composed of representatives from the PSA-BAS, the Department of Agriculture (DA), and feed associations, use the balance sheet approach to calculate feed use of maize and rice, building on regular government surveys (monthly and annual) of production and stocks of these cereals.

[1] R.A. No. 10625, otherwise known as the "Philippine Statistical Act of 2013", mandates that the Philippine Statistical Research and Training Institute (PSRTI) and PSA-BSA shall be attached to the National Economic and Development Authority (NEDA) for purposes of policy coordination.

Other major statistical associations include the National Statistics Office (NSO) which is responsible for conducting the Census of Agriculture and Fisheries (CAF) and other censuses and surveys as well as the compilation of trade statistics from which agriculture-based data are accessed by PSA-BAS and the National Statistical Coordination Board (NSCB). The latter institution serves as the coordinating and policy-making body of the PSS.

As part of its technical outreach program, the PSA-BSA, in collaboration with the Food and Agriculture Organization of the United Nations (FAO), has formally launched **CountrySTAT Philippines,** a web-based information system that allows gathering and monitoring of national and sub-national food and agricultural data in compliance with international standards. Easily accessible and maintained, it provides a solid framework for an improved accessibility of reliable and timely data, which is essential for implementing better policies and investments in agriculture. The implementation of this system will also help to strengthen the collaboration between statistical institutions, agricultural agencies and other relevant institutions in the country.

CountrySTAT Philippines creates an opportunity for the policy-makers, government officials, development partners and other participants to get acquainted with the value-added of the system and to learn how it can be used to improved data quality and to support the policy making process. Though highly valuable and easily accessible, **CountrySTAT Philippines** is still far from being ideal in providing the much-needed estimates on feed use, with the most outstanding challenges including the following:

- Quantity, source and price of raw materials ingredients and feed additives, both domestic and imported, used in feed compounding;
- Volume of mixed feeds produced by type and species – national and regional;
- Feed conversion ratios (FCRs) of commercial and backyard farm animals and aquatic species (only available from livestock, poultry and aquaculture industries); and,
- Farm efficiencies of commercial and backyard livestock and poultry farms (gathered during surveys/censuses).

Farm or production efficiency refers to the total amount of the different feed ingredients delivered to the farm or the total amount of mixed feed fed to the animals in the herd including wastage in proportion to the weight of live animals sold for the same period of time. This is usually computed at the end of every month.

By knowing the farm efficiency, the apparent profitability of the enterprise can be determined by converting the kilograms of feeds and live animals into pesos.

[2]The PSA-BAS has created a Technical Working Group (TWG) on Cereals Statistics to address statistics-related issues and concerns of this commodity group. Presided over by the PSA-BAS Director, the Inter-agency Committee (IAC) is composed of representatives from the PSA-BAS and the Department of Agriculture's National Agricultural and Fishery Council and the Bureau of Animal Industry. Concerned feed, livestock and aquaculture association representatives are invited during their monthly/quarterly meetings.

Table 1: PSA-BAS regular statistical reports and publications

Title of Publication	Domains / Contents	Medium	Format	Periodicity / Frequency	Release Calendar
Selected Statistics on Agriculture	Production, Trade, Prices, Farm Economics and Other Agriculture-related data	English	PDF, Handbook, CD	Annual	May
Performance of Philippine Agriculture					
January to December	Gross Output, Volume and Value, Growth Rates	English	PDF, Bulletin	Annual / Quarterly	21 days after the reference year
January to March January to June January to September					45 days after the reference quarter
Rice and Corn Situation Report	Production, Area, Yield	English	Memo, Bulletin	Quarterly	May/ Aug/Nov/Feb
Monthly Palay and Corn Situation Report	Updated Production Forecasts	English	Memo, Bulletin	Monthly	10 days after the reference month
Rice and Corn Stock Inventory	Stocks	English	Memo, Bulletin	Monthly	10 days after the reference month
Seasonally Adjusted Rice Production and Prices	Production, Prices	English	PDF, Bulletin	Quarterly	May/Aug/Nov/Feb
Crops Statistics of the Philippines (National and Regional)	Production, Area, Yield	English	PDF, Book	Annual	August
Major Crops Statistics of the Philippines (Regional and Provincial)	Production, Area	English	Book	Annual	September
Industry Performance Reports for Carabao, Cattle, Chicken, Duck, Dairy, Goat and Swine	Inventory, Production, Trade, Prices	English	PDF, Bulletin	Annual/ Semi-annual	May/ September
Fisheries Statistics of the Philippines	Volume and Value of Production	English	PDF, Book	Annual	October
Fisheries Situation Report	Fisheries Production, Prices	English	PDF, Bulletin	Quarterly/ Annual	May/Aug/Nov/Jan
Prices and Trade					
Producers Price Index for Agriculture	Price Index	English	PDF, Handbook	Semi-annual	September

Updates on Palay, Rice and Corn Prices	Prices	English	PDF, Memo	Weekly/ Monthly	Every Monday
Updates on Fertilizer Prices	Prices	English	PDF, Memo	Monthly	1 week after
Price Situationer of Selected Agricultural Commodities	Prices	English	PDF, Memo	Weekly	Every Monday
Updates on Agricultural Foreign Trade Performance	Trade	English	PDF, Memo	Quarterly	Jan/Apr/Jun/Oct
Agricultural Foreign Trade Development	Trade	English	PDF, Handbook	Annual	September
BAS Media Service					
Price Bulletin	Prices	English	PDF, Bulletin	3x a week	Tues/Thurs/Sat
Market Situation	Prices and Indicators of market	English	PDF, Bulletin	Weekly	Mid-Week
Agricultural Indicators System – National, by Module					
Agricultural Structure and Resources	Land Use, Livestock and Poultry Inventory	English	Monograph	Annual	July
Agricultural Credit	Credit	English	Monograph	Annual	August
Output and Productivity	Production, Area, Yield	English	Monograph	Annual	August
Agricultural Exports and Imports	Trade	English	Monograph	Annual	October
Food Sufficiency and Security	Production, Trade	English	Monograph	Annual	October
Food Consumption and Nutrition	Food Consumption	English	Monograph	Annual	November
Population and Labor Force	Population, Labor Force, Employment Agriculture	English	Monograph	Annual	November
Gender- Based Indicators of Labor and Employment Agriculture	Population, Labor Force, Employment in Agriculture by Sex	English	Monograph	Annual	November
Redistribution of Land	Agrarian Reform	English	Monograph	Annual	December
Economic Growth	Macroeconomic Indicators	English	Monograph	Annual	December

Inputs	Fertilizer Supply and Disposition Wages	English	Monograph	Annual	December
Prices and Marketing of Agricultural Commodities	Price Indices, Marketable Volume of Rice and Corn	English	Monograph	Annual	December
Development Trends in Agriculture: International Comparisons	Production, Macroeconomic Indicators, Trade, Land Use	English	Monograph	Biennial	May
Regional Agricultural Production Accounts	Gross Output in Agriculture, Volume and Value of Production	English	Monograph	Annual	August
Supply Utilization Accounts of Selected Agricultural Commodities	Production, Trade, Utilization	English	Monograph	Annual	November
Commodity Fact Sheets	Production, Trade, Prices, Consumption	English	Monograph	Annual	November
Trends in Agricultural Wage Rates	Sex-disaggregated data on Labor Inputs in Agriculture and Wage Rates	English	Monograph	Annual	November
Production Costs and Returns					
Updated Production Costs and Returns of Selected Agricultural *Palay and Corn (Part I) Selected Commodities (Part II)*	Profitability Indicators	English	Monograph	Biennial	October

It is worth mentioning in this report that the newly promulgated law on Philippine statistical system (R.A. No. 10625) and its implementing rules and regulations (IRR) will result in a reorganization of the Philippine Statistical System (PSS) in order to provide the public with access to more timely and accurate data.

This reorganization will undoubtedly result in a centralization of primary data collection, negating unnecessary duplication of work by the different agencies concerned with statistics. The problem of conflicting statistics and data gaps will also be addressed by the new law.

Two provisions of the new law and its IRR stand out: the provision on 1) confidentiality (Rule 29) and on 2) sanctions and penalties (Rule 30). Penalties will now be imposed upon respondents who fail to give truthful and complete answers to statistical inquiries, as well as to any person who breaches the confidentiality of information whether by carelessness, improper or malicious behavior, and the use of confidential information for profit. This will ensure generate more truthful and reliable data during PSA/BAS surveys.

2.2 Non-official statistical work

Non-government organizations (NGOs) in the Philippines (such as industry organizations/associations, educational institutions, consulting firms and professional associations) also produce other statistics that feed into public policy debates. Similar to the official statistics produced by the PSS, the statistics of these NGOs can be misinterpreted when changes in data are miscontrued to be real changes (even if these changes are actually within margins of error). NGO statistics are typically based on sample surveys, and/or qualitative research.

Non-official statistics related to animal and feed production are gathered, analysed and released by the above-mentioned quasi-public institutions and private consulting firms. Such data providers have their specific mandates and use their own methodologies to collect and compile information. It is apparent that none of them has adequate financial and human resources to undertake nationwide statistical works similar and comparable to PSA-BAS or NSO. More importantly, they have no administrative authority to require commercial entities (i.e. livestock, poultry and aquaculture growers or commercial feed compounders) to regularly share data. To a large extent, to ensure the representativeness of sample coverage, the collection of statistics has to be undertaken through a manditory process or based on the willingness of concerned microentities (ensuring confidentiality of the data). Private associations typically have a short history and their statistical work is still in a process of evolution. It is understantable that the data from such sources are inconsistent, due to both their inability to adhere to statistical concepts and inadequacy in data collection methods.

The Animal Feed Standard Division (AFSD) of the BAI is the central repository of feed statistics and provides technical assistance to the Director. There is, however, inadequate support for systems development in terms of training and skills enhancement for such activities. Animal and feed statistical systems developed and maintained in the BAI Central Office are also fragmented and non-complimentary. Different offices/units within the DA-BAI generate their own digitized data, which often results in overlapping and conflicting statistics.

Most, if not all, of the feed production data provided by feed compounders and feed ingredient manufacturers to BAI-AFSD and Bureau of Internal Revenue (BIR) are underestimated as shown by Table 2. The estimated mixed feed production (assumed at 20 percent soybean meal for all diets) is much higher than the total commercial feed production figures published by the BAI-AFSD.

Table 2: Estimated mixed-feed production vs. total commercial feed production ('000 MT)

Year	Soybean Meal Imports	Estimated Mixed Feed Production	Total Commercial Feed Production	Difference
2001	1555	7775	1945	5830
2002	1460	7300	2809	4491
2003	1171	5855	1675	4180
2004	1542	7710	3307	4403
2005	1646	8230	2259	5971
2006	1743	8715	1546	7169
2007	1627	8135	1766	6369
2008	1575	7875	1269	6606
2009	1719	8135	1140	6995
2010	1972	9827	1233	8594
2011	1833	9165	1422	7743
2012	1925	9624	1483	6995

Note: 1 – Soybean meal imports by year (USDA, 2013); 2 – Assumed at 20% SBM for all diets; 3 – Based on BAI mixed-feed production records (BAI, 2013)

The BAI-AFSD and DA regional offices are inadequately trained and staffed to be able to verify the actual production, feed ingredient usage, and capacity of registered feed compounders and feed ingredient manufacturers.

Deficiencies in official statistics offer private business an opportunity to provide data consulting services. With limited resources, consulting firms often use official production and trade statistics to generate balance sheets. Market analysis and databases of institutions such as FAO, U.S. Department of Agriculture (USDA), the US Feed Grains Council (USFGC) and the American Soybean Association (ASA) are used as data sources. However, most private sector analysis only focus on reviewing the current market situation with limited information on grain feed usages.

2.3 Available statistics and sources

The Philippines produces statistics related to the livestock and feed sectors, supplied by various governmental or quasi-governmental bodies. However, under the current institutional structure, each government body assumes responsibility for collecting statistical information within its own jurisdiction without considering the interaction between this data in the overall market system. When these data are compiled in a balance sheet, logical inconsistencies become apparent. Table 2 below shows the sources, nature of the data and related quality problems for statistics on livestock, the aquaculture sector and feed industry.

Table 3: Data sources related to livestock and aquaculture production and feed sectors

Indicator	Source	Nature of data	Availability	Major problems	Methods
Number of animals by types	PSA-BSA	Official	Annual and semi-annual	The number of animals is inventoried at a specific time of the year, not estimated by year.	Annual and semi-annual data collection via administrative statistical system
Outputs of animal products by type	PSA-BSA	Official	Annual and semi-annual		Annual and semi-annual data collection via administrative statistical system
Structure and scale of livestock production by animals	PSA-BSA and DA	Official	Every 11 years	Agro-census data are derived based on household survey	Census survey
Exports and imports of livestock products	BAI, NMIS and BOC	Official	Monthly and annually		Monthly and annually data collection via administrative statistical system
Structure and scale of aquaculture production by types	PSA-BSA and BFAR	Official	Irregular	Basic data and estimation methods are not transparent	Census survey
Exports and imports of aquaculture products	PSA-BSA and BFAR	Official			Annual data collection via administrative statistical system.
Production, cultivation area and yield of	PSA-BSA and NAFC	Official	Quarterly (May/Aug/Nov/Feb)		Quarterly data collection via administrative

cereals and soybean					statistical system.
Imports of cereals and soybeans	BAI-AFSD, PAFMI, USDA, USFC, ASA	Unofficial	Monthly and annual	Upon request.	
Food consumption of cereals and soybeans	PSA-BAS. NAFC	Official			
Feed consumption of cereals and soybeans	BAI-AFSD, PAFMI, USDA, USFC and ASA	Official and unofficial	Upon request.	Limited access	
Imports and exports of cereals and soybean	BAI-AFSD, USDA, USFC, ASA and BOC	Official	Monthly and annually		Monthly and annual data collection via administrative statistic system
Production of compound feeds and feed ingredients	BAI-AFSD and PAFMI	Unofficial estimation	Supplied annually to interested parties; however, limited access through public channels	Basic data and estimation methods are not transparent and thus data is not verifiable	Data collection via administrative statistic system of BAI-AFSD
Number of feed mills	BAI-AFSD	Official	Annually supplied to interested parties	Lacks sufficient work force. The BAI-AFSD is handled by one personnel	Data collection via administrative statistic system of BAI-AFSD
Feedstuffs used for processing compound feeds	BAI-AFSD and PAFMI	Unofficial estimation	Annually supplied to interested parties; limited release in public channels	Basic data and estimation methods are not transparent and thus data is not verifiable	Data collection via administrative statistic system of BAI-AFSD
Compound feed usage per head by type of	BAI-AFSD and PAFMI	Unofficial estimation	Depend on each research	Basic data and estimation methods are not	

animal and by operating scale				transparent and thus data is not verifiable.	

2.4 Methodological issues in estimating feed grains

In the United States and in Europe where statistics on the production of commercial feeds, meat, and feed conversion ratios (FCRs) are relatively accurate, consistent, and readily available, the estimation of cereal specific requirements for livestock is easier than in developing countries where there is more substitutability between feed products. It requires translating FCRs (when known) into commercial feed equivalents and then deriving the proportion of corn in the feed rations. For example, if the FCR of hogs is 3.0 then the commercial feed requirements to produce a kilogram of meat requires 3 kgs of feed. In the Philippines, however, accurate estimations of FCRs are difficult to derive. Secondly, the slaughterhouse meat output figures are not reliable because of the consistent underreporting of slaughtered animals. Finally, the mixed-feed production reports submitted by commercial and non-commercial mixed-feed manufacturers to the BAI are also inaccurate and unreliable since they are based on the inspection fees paid by companies; this implies underreporting. Therefore this method of estimation cannot be relied to derive corn requirements for livestock feed.

A more practical method for deriving feed requirements is based on live animals numbers. Since livestock and poultry inventories are monitored by the PSA-BAS very closely through quarterly surveys, this method appears more reliable and is, in fact, being used by Ad Hoc Technical Working Group from PSA-BAS, the BAI and the private sectors. The procedure involves the estimation of daily corn feed requirements of livestock populations, by type of animal and by degree of commercialization. These estimates are then translated into annual per capita requirements (Costales, 1996).

Costales (1996) estimated the 1990-1995 corn requirements for the livestock subsectors using technical parameters established by the Ad Hoc Technical Working Group. These parameters were used to generate livestock feed requirements per year by type of operation. They are summarized as follows: commercial hogs, 345.05 kg., backyard hogs, 91.25 kg.; commercial chicken 28.835, and for backyard chicken 15.33 kg. Costales then applied these feed requirements to the midyear livestock inventory (July 1) and thus generated corn requirements for livestock operations. Using the estimated 1994 distribution of corn utilization by the BAS, Philippine Statistical Association (PSA) and the Agribusiness Systems Assistance Program

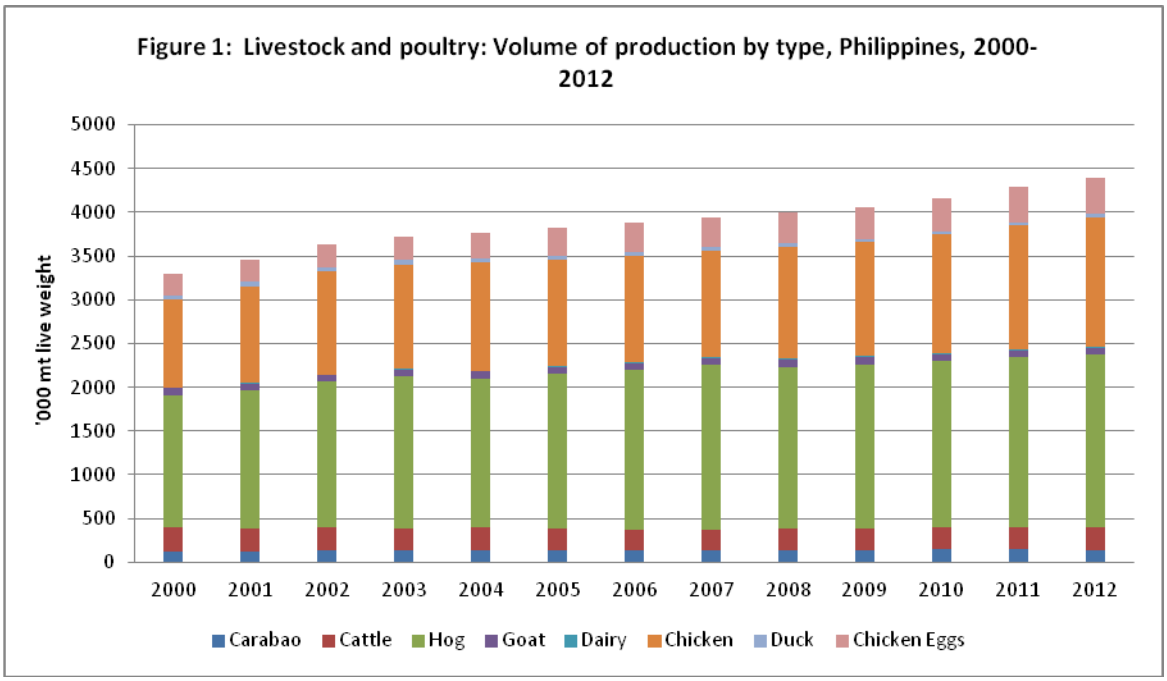
(ASAP), and assuming that the levels of non-feed utilization of corn remain constant, the author estimated the corn deficit to be around 695,000 metric tons in 1995.

This feed estimation method of Costales can be used to extrapolate to 2000 (or beyond), assuming that the livestock subsector continues to grow at trend growth rates registered over the 1990-1996 period. The trend growth rates are extrapolated at: commercial hogs, 40 percent; backyard hogs, 1.79 percent; commercial chicken, 7.06 percent; and backyard chicken, 7.27 percent. By the year 2000, trend projections indicate total corn livestock requirements of 4,358 thousand metric tons or roughly the equivalent of the total corn production in 1995. If the other non feed uses of the corn are assumed to be constant at their 1995 levels of 1,164 thousand metric tons, conservatively the corn production levels of 1995 need to increase by 24 percent or 5 percent per year to meet livestock corn requirements by the year 2000. The estimated projection is somehow understated considering that the production cycle of broilers is 1.35 times higher than their inventory levels.

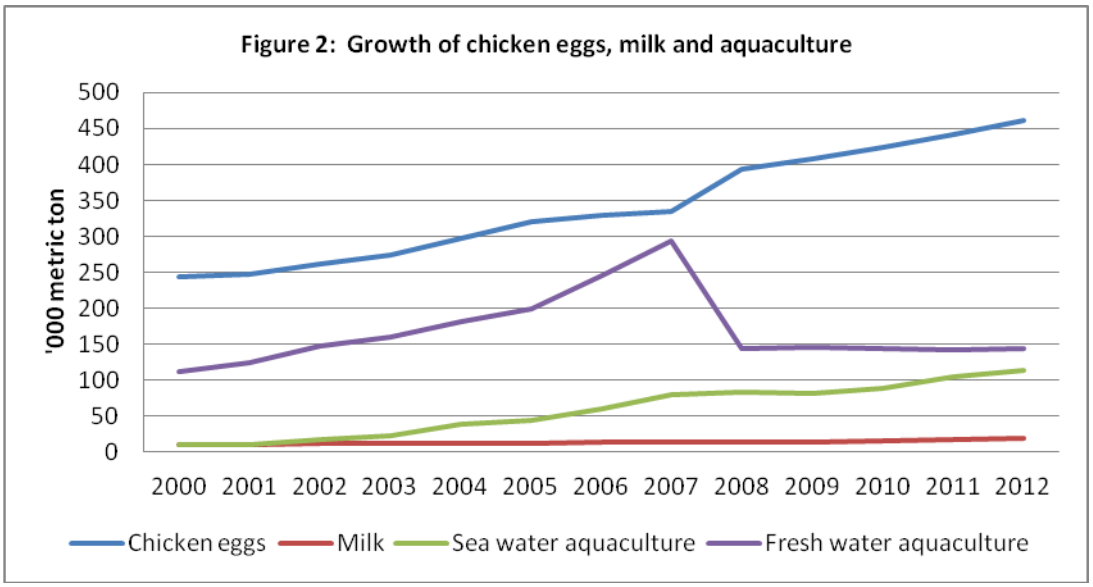
3 Growth and structural change in livestock and aquaculture production

3.1 Growth of livestock production

Induced by the increasing demand for quality and safe food products, the Philippines' livestock and fishery production expanded rapidly during the past decade (see Figures 1 and 2). While outputs of carabeef, beef, chevon, poultry meats and fishery products rose steadily, growth rate of pork production witnessed disease-induced fluctuations (PRRS, PCV2 and PED) in 2005.



Data source: PSA-BAS, 2013



Livestock production is a major component of the agricultural economy of the Philippines and its economic contribution goes well beyond direct food production. Sales of livestock and their products provide direct cash income to farmers. Livestock are donsidered a walking bank for many farmers and have a critical role in the agricultural intensification process through provision of draught power and manure for fertilizer and fuel. They are also closely linked to the social and

cultural lives of millions of resource-poor farmers for whom animal ownership ensures varying degrees of sustainable farming and economic stability.

In 2013 agriculture output in the Philippines grew 1.2 percent to P1.5 trillion (USD29 billion) and gains were registered in the livestock, poultry and fisheries subsectors. The Department of Agriculture-Bureau of Agricultural Statistics (DA-BAS), which released the data on November 15, 2013, said the value of agricultural output was 3.5 percent higher than in 2012, supported by .5 percent gains in farmgate prices. Livestock prices, however, were up by 8.6 percent, poultry by 1 percent, and fisheries by 2 percent. Farm output accounts for a fifth of the country's Gross Domestic Product (GDP).

The livestock subsector, which accounted for 16 percent of total output, grew by approximately 2 percent due to an expansion of cattle and hog production. Poultry, accounting for 15 percent of agriculture, also increased by 5 percent due to higher chicken output (up 5 percent), chicken eggs (up 2 percent), and duck eggs (up 10 percent).

The fisheries subsector posted a 3.4 percent increase, fueled by increased milkfish production, (up 5.5 percent to 288,320 metric tons, MT) and tilapia output rose by 2.4 percent to 240,820 MT due to the continuing dispersal by Bureau of Fisheries and Aquatic Resources (BFAR) of good-quality fingerlings, as well as an expansion of the Pangasinan mariculture areas. The value of the fisheries sector grossed P239.1 billion (USD5.3 billion), up by 2.8 percent from 2012.

Based on the January–March 2014 Philippine dairy production report of the PSA-BSA, dairy registered with a moderate increase both in volume and value of production, 6.24 percent and 8.15 percent, respectively. Carabao increased by only 0.10 percent but recorded a 1.96 percent in gross value of output. Gross earnings from cattle went up by 3.92 percent and from goat, by 6.94 percent as a result of better output and prices.

Total dairy production reached 4.94 thousand MT level and grossed more than P151 million-mark at current prices. More dairy animals on the milk line contributed to the increase in dairy production and gross value of output. On the weighted average, farm gate price of dairy reached to P30.59 per liter.

As of January 1, 2014, the total dairy animal population was 40,322 head. This was 3.21 percent higher than 2013's headcount. Dairy cattle stocks grew by 2.55 percent. Dairy carabao and dairy goat population went up by 2.84 percent and 15.26 percent, respectively.

3.2 Structural changes in the livestock sector

3.2.1 Pig sector

Pork remains a popular livestock commodity recognized as Filipinos' most referred animal meat product. Over the past decade, pork has consistently represented more than 55 percent of the total daily animal animal meat consumption of Filipinos. In 2002, per capita pork consumption was estimated at 16.9 kg, representing 57 percent of total meat consumed by Filipinos. Table 4 presents the evolution of per capita consumption of different animal meat products in the Philippines over the past ten years (1993 to 2002).

Pig farming is the second largest commercial agrifood industry in the Philippines, after the banana industry. According to the 2006 Census of Philippine Business and Industry (January 2009 Preliminary Data Release), it generated about 16% of agriculture and forestry sales in 2006.

Based on the estimated sow numbers, the key players in the hog industry in the Philippines are Monterey Farms (45,000 heads), Robina Agri-Partners (22,000 head), Foremost Farms (17,000 head), Cavite Pig City (8,000 heads), Holiday Hills (7,000 head), Hypig (6,500 heads), Pilmico (6,500), PIC Philippines (5,000 head), Maligaya (3,500 head) and Springside (3,000 head). Meanwhile, existing industry associations include the National Federation of Hog Farmers, Pork Board, Philippine Association of Hog Raisers, and the Philippine Swine Association whose members have average sow numbers of over 5,000.

Pig genetics companies provide hog breeds to commercial and backyard raisers. Integrators normally have their own contract breeding farms that supply the fattening pigs. Feeds, on the other hand, are supplied by commercial feed millers to backyard raisers and some commercial pig producers. Meanwhile, integrators purchase feed ingredients (e.g. soybean, wheat, corn, and fish meal) from local producers or from foreign sources. Among the locally sourced ingredients are corn, copra meal, and rice bran. Imported ingredients are soybean meal, wheat and corn.

Significant structural changes have occurred in the Philippine livestock industry sector, particularly in the pig industry, over the past 10 years. One important structural transformation is the growing intensification of pig production in urban and peri-urban areas in response to escalating demand for animal proteins in general and pork in particular. Over the past 10 years, national pig production is estimated to have grown at an annual rate of almost 4 percent from 9 million heads in 1996 to over 13 million heads in 2006 (BAS, 2006). The country's total swine inventory as of July 1, 2013, is estimated at 11.88 million head, among 1 percent lower than last year's inventory of 11.96 million heads. Inventories held by backyard farms went down by 1.18 percent while those held commercial farms grew by 0.4 percent against the 2012 level. It is estimated that approximately 64 percent of the national pig stocks were raised in backyard farms while 36 percent were in commercial farms. During the first half of 2013, hog production

reached 956.25 thousand metric tons liveweight or 2.4 percent higher than last year's level of 934.19 thousand metric tons livewight (PSA-BSA, 2013).

Backyard farms are defined as having less than 10 sows per household (PSA-BAS). These farms purchase commercial feeds, but have no business permits and generally lack farm records (Table 5).

Commercial farms, on the other hand, are classified into small, medium and large. **Small commercial farms** maintain less than 100 sows and purchase commercial feeds. Medium-scale farm maintain between 100 to 300 sows, register their businesses and have permits, and operate a specialized farm structure. Some mix their own feed. Meanwhile, **large-scale farms** typically breed more than 300 sows, maintain their own boars for breeding and often implement artificial insemination (AI). They also operate their own feed mills, keep computerized farm records, have business permits, and usually have a water treatment facility for the farm.

Table 5: Hog farm description by type, Philippines

Type of Farm	Description
SMALL	<100 sows; no boars; buys feeds; no business permit; no permanent structures and generally no farm records.
MEDIUM	100 to 300 sows; mixes feeds; with business permit; has specialized structures and farm records.
LARGE	>300 sows; owns boars/breeders and implements artificial insemination; own feed mills; with business permit; has specialized structures, with farm records and water treatment facility

Source: *Sikap/Strive Foundation, December 2012*

While the share of commercial hog operations of total operations is growing quickly, the hog industry is still largely dominated by backyard operations. About 71 percent of the swine population is raised in backyard farms.

3.2.2 Poultry sector

From an industry that initially started as a backyard enterprise during the early '50s, the poultry sector is now coordinated by large integrated contract farming operations. The steady growth of

the poultry industry over the past years makes it one of the most vibrant animal industries in the Philippines, contributing greatly to agriculture production.

3.2.2.1 Broiler (chicken meat)

With the high demand for chicken meat, stemming from growing household consumption, a rapid expansion of institutional buyers like fast-food chain owners as well as its potential prospect as a export product, it is no surprise that the poultry sector has showed strong growth (in value and volume) over the last 14 years (2000-2013) as shown in Figures 1 and 2. Poultry has eroded shares of other meats with this trend evident also in the global meat market.

Poultry is mostly defined by chicken production, generating both meat and eggs. Chicken meat is the most utilized species of poultry, mainly for food production. In the Philippines, chicken ranks first in terms of economic importance as source of meat and eggs.

The poultry industry in the Philippines consists of "backyard" and "commercial" farms. **Backyard farms** are defined by the BAS as having less than 100 birds, with backyard chickens raised mainly by rural families to provide for their daily animal protein requirements. These are called native/improved chicken.

A poultry farm is classified as "commercial" if it has at least 1,000 broilers, or 100 broilers and 100 layers if raised in combination. Commercial broilers are chickens raised by integrators/growers for sale to processors, wet markets, supermarkets, hotels, restaurants, and similar institutions (see Table 6).

Commercial growers are classified as either integrators or non-integrators. **Integrators** are those with growers and company farms with at least 20,000 birds per harvests of five to six cycles per year. They have integrated operations, usually with their own GP breeder farms and feed mills. They are involved in the production and marketing of broilers, the importation of grandparent and parent stocks, and the manufacturing and sales of commercial mixed feeds, and breeder stocks to independent raisers. They mainly outsource breeding (PS) and dressing operations.

Non-integrators have the same number of birds with around five to six cycles. Their operations are not integrated, as they usually buy DOCs and feeds, although some own feed mills.

The share of the ouput of the commercial broiler industry to national aggregates grew from 46 percent in 2004 to 59 percent in 2011, even as the commercial sector declined by 8 percent in 2010, only to pick up and expand by 5 percent in 2012. It must be noted that the annual population was based on January 1 beginning inventory figures from the Philippine Statistics Authority-Bureau of Agricultural Statistics (PSA-BAS) and computed for six cycles. An industry source estimated total poultry numbers at close to 700 million birds in 2011.

Table 6: Broiler farm description by type, Philippines

Type of Farm	Description
SMALL	<100 birds per farm; baclyard owner operated; buys feeds; small house or free range; no farm records, business permits, ECC and labor standards compliance.
MEDIUM	20,000 birds/cycle; buys DOCs and feeds with some feed mixing; with farm records and business papers; modern technology (non-integrators).
LARGE	20,000 birds/cycle; imports GP/PS; with breeder farm, feed mill; with farm records and business papers; modern technology (non-integrator)

Source: *Sikap/Strive Foundation, December 2012*

The backyard poultry population in the Philippines decreased significantly from 54 percent of total in 2004 to 41 percent in 2012 and it has a low average annual growth of less than 1 percent. Backyard output exceeded commercial broiler only in 2004 and 2006.

3.2.2.2 Chicken layer

The laying industry in the Philippines is characterized by industry players as small, medium, and large as defined in Table 6. Layer farms by size are characterized by the following features – number of layers, type of management, source of feeds, type of hen houses, and certain farm practices.

Small-scale farms are those with less than 10,000 layers and basically use commercial feeds. Layer houses are open-sided and made of wood and bamboo. Generally, these farms do not have business permits, farm records, and Environmental Compliance Certificates (ECCs). They also are not required to comply with labor standards.

Medium-scale farms operate between 10,000 and 80,000 birds and use external and internal feeds (own feed formulation). Layer houses are either conventional open-sided like small-scale farms or semi-automated, that is, made of steel, elevated and open-sided. These farms have business permits and farm records. Some secure ECCs and comply with labor standards.

On the other hand, **large-scale farms** are normally managed by corporations and maintain more than 80, 000 layer birds. These companies have their own feed mills and house layers in tunnel

ventilated closed houses. These farms are administered with farm records, business permits, and ECC and compliant with labor standards.

Overall, large-scale farms invest more in their layer houses than small and medium-scale farms. These farms also focus more on bird bio-safety and health.

Table 7: Layer farm description by type, Philippines

Type of Farm	Description
SMALL	<10,000 layers; owner operated; buys feeds; conventional open-sided layer house; generally no farm records, business permits, ECC and labor standards compliance.
MEDIUM	10,000-20,000 layers; owner operated; buys feeds or into feed mixing; conventional open-sided or semi-automated layer house; with farm records and business papers and some without ECC and labor standards compliance.
LARGE	>80,000 layers; corporate; into feed mixing; tunnel ventilated closed layer house; and with farm records, business papers, ECC and labor standards compliance.

Source: *Sikap/Strive Foundation, December 2012*

Eggs are produced by commercial laying farms as well as by native chicken in backyard farms. Backyard farms are predominant in number but commercial farms account for 75 percent of total egg production. The commercial layer population increased by 8.7 percent per annum from about 17.8 million birds in 2004 to 31.4 million birds in 2011. This was fueled by the growth in parent stock (PS) layer importation over the period.

PS imports grew significantly in 2007, reaching 501,200 birds or almost 40 percent more than the normal import level of 360,000 birds. Thus, several layer farms had to close down as prices spiraled downwards as a result of a glut in egg supplies. According to an industry source, it only requires around 360,000 PS imports to maintain a population of 25 million layers; it is at this level that excess supplies of eggs are avoided.

3.2.2.3 Ducks

Duck is second to chicken in economic importance as a source of egg and meat in the Philippines. As of July 1, 2013, the country's total duck population totalled 10.06 million (M) birds which indicated a decrease of about one (1) percent from last year's inventory (10.16 M). Of the total duck population, about 73 percent (7.39 M) were raised in backyard farms while 23 percent (2.68 M) were grown in commercial farms.

The annual volume of duck production for 2013 was 34.46 metric tons. It increased by 1.80 percent over the 2012 level. From January-December 2013, duck egg production grew by 3.33 percent or from 39.7 metric tons in 2012 to 41.07 metric tons in 2013.

The predominant type of duck used for egg production is the Pateros type or the Philippine Mallard duck locally known as 'itik'. This is primarily raised for *balut* (16-18-day-old embryonated egg) production. The Philippine Mallard duck is very well adapted to local environmental conditions and management practices. These ducks are non-sitters and are good producers of eggs that are relatively large in size. Ducks eggs contributed 27,480 tons (t) to total egg production. Also, they accounted for 25 percent of the total egg consumption in Southeast Asia.

3.3 Growth and structural changes of aquaculture production

Fish and seafood represent an important source of protein for the average Filipino, accounting for around 41 percent of animal protein intake. But despite a high demand for fish products in the Philippines, and extensive aquatic resources, fish is becoming increasingly unaffordable for the country's poor due to dwindling stocks and increased costs of production. The fishing industry in the Philippines is also vulnerable to the effects of climate change – rising sea levels, increasing water temperatures and changing water patterns are all likely to have ongoing and negative impacts on the productivity of the industry.

With declining fish stocks (largely due to overfishing and habitat degradation) amidst increasing demand for fish and fish-based products, the Philippine Government provided significant support to develop the aquaculture industry that in recent years experienced significant increases in total production. In 2009, 49 percent of fish production originated from fish farms, compared to only 18 percent in 2003 (WorldFish, 2009).

Aquaculture production in 2013 grew by around 2 percent compared with the previous year's output with aquaculture comprising 42.5 percent of total fisheries output. Production of milkfish, tilapia and tiger prawn also increased during the year due to increased output from aquafarms.

These species accounted for 84.5 percent of the total aquaculture production. Other species like carp, catfish and oyster also contributed to higher aquaculture output for the year.

3.4 Feeding efficiency

In animal husbandry, **feed conversion ratio (FCR)**, **feed conversion rate**, or **feed conversion efficiency (FCE)**, is a measure of an animal's efficiency in converting feed mass into increases of the desired output. It is utilized to estimate the efficiency of feed use in livestock sector. However, in the Philippines, FCRs are only available for some sectors such as poultry, hog, and aquaculture (tilapia, milkfish and shrimp) because these sectors use industrial or commercial mixed feeds in production.

3.4.1 Poultry sector

The Philippines significantly improved its broiler production efficiency, characterized by a lower FCR, lower mortality, and shorter growing cycle for both integrators and non-integrators. Non-integrators were almost as efficient as integrators given their adoption of improved technology and farming practices. The average liveweight in the country, on the other hand, remained at almost the same level from previous years in response to preferred bird sizes by consumers. In Luzon, the live market size went from 1.65 kg to 1.70 kg while in the Visayas, it remained at 1.45 kg. Food service accounts prefers a bird size of 1.60 kg to 1.65 kg while wet markets and supermarkets prefer dressed chicken from live birds weighing 1.45 kg.

The industry-defined technical parameters indicated that the laying rate across all layer farms in the country was **80 percent** or **292 eggs per bird per year**. Assuming that layers consume daily 100 grams of feed in small farms, 105 grams in medium farms, and 99 grams in large farms, the FCR of laying hens in large farms (**1.48**) was lowest followed by that in small farms (**1.50**) and then that in medium farms (**1.58**). This implies that large farms are the most efficient users of feeds. Recovery rates or the ratio of saleable eggs to total, across the farms, were generally the same at 90 percent to 92 percent. Meanwhile, the depletion rate or mortality rate of pullets was highest for small farms at 15 percent, while those in medium and large farms averaged only 10 percent.

3.4.2 Pig sector

The Philippines has significantly improved its hog production efficiency as revealed by a decline in feed conversion ratios (FCR) from about **3.3 kg** to **2.8 kg,** and an average daily gain (ADG) of around **550 grams** across farm sizes over the 2004 to 2009 period. Large farms were the most efficient users of feeds considering their capability of providing more cost-effective but nutritious rations to their hogs.

3.4.3 Aquaculture sector

In the Philippine aquaculture sector, the majority of formula feed is used in intensive farming, particularly in tilapia (*Tilapia sp*.), milkfish (*Chanos chanos*), carp, pangasius (catfish) and tiger shrimp production. In general, feed cost is critical in determining aquaculture productivity and farmer's profitability.

Estimating FCRs is a valuable and powerful tool for the fish farmer. It allows for an estimate of the feed that will be required in the growing cycle. Knowing how much feed will be needed allows the farmer to determine profitability of an aquaculture enterprise, allowing the farmer to make wiser choices in selecting and using feed to maximize profitability.

Based on the data shared by consultants, the FCRs of some aquatic species are as follows:

Tilapia:	About 1.2 to 1.8 kg in fishponds depending on stocking density, 1.5 to 2.1 in cages.
Milkfish:	Pond: 1.5-1.8; cage 2.0-2.3
Prawn:	1.3 to 1.5

4 Growth and structural changes in feed sector

4.1 Available feed resources

The most common feed ingredients used by the Philippine feed milling industry are yellow corn, soybean oil meal, rice bran, copra meal, fish meal, and wheat and wheat by-products. Cassava and sweet potato meals, brewer's yeast and ipil-ipil leaf meal are also used, to a lesser extent, as feed ingredients. Among these feed ingredients, yellow maize is considered the most critical, as it represents about 50 percent of formulated animal feed rations. In fact, over the past decade, access to maize was considered as a major bottleneck for the development of the feed milling sector and animal industries in general. However, with the implementation of an aggressive corn development program by the government, local production and supply of maize has somehow stabilized. Recently, the quality and prices of locally produced yellow maize have been competitive with imports.

The outlook for maize production and the increasing trend in local production and consumption of pork and poultry products paint a positive outlook for the local feed milling industry. However, ensuring the quality, efficiency and stability of national feed supplies is a challenge for local industries. To enhance the feed milling sector's global competitiveness, government should collaborate with the private sector to instituting policy reforms on importation, pricing and trade,

while supporting technological development, stronger information support systems; and, the establishment of critical infrastructure and facilities.

4.2 Growth and structural changes in domestic grain production

Grown primarily for human consumption, cereal grains are increasingly important as critical inputs for efficient animal production. Present-day high energy diets for monogastric farm animals often contain up to 80 percent cereal grains and their by-products. While cereal grains are considered mainly as a source of dietary energy, their by-products represent a fairly rich source of protein and polyunsaturated fatty acids (PUFA).

Cereal grains sometimes constitute a significant percentage of fish feed processed into pellets. Starch present in cereals act as good, natural binders when gelatinized under normal pelleting conditions, providing products that have high water stability. Grains are indispensable in the manufacture of floating-type pelleted feed in aquaculture production.

4.2.1. Rice

Rice (*Oryza sativa*) is seldom used for animal feeding because of its high cost, although damaged grain and portions considered unfit for human consumption, viz., sweepings from warehouses and mills, are available for that purpose. In the Philippines, where it is the principal grain crop, rice of low commercial value such as broken rice is also used as livestock feed. On the other hand, by-products from mills are more generally available and constitute the most important feed resource in all rice-producing countries like the Philippines. The by-products include: rice bran, rice polishings and rice mill feed.

Freshly produced rice bran has a high oil content (14-18 percent). The oil is sometimes recovered by solvent extraction because of its high commercial value, especially in countries where demand for cooking oil exceeds supply. The oil present in the bran is rich in polyunsaturated fatty acids which undergo rapid oxidation under normal storage conditions. Rice bran that has turned rancid has markedly reduced feed value. Rice bran has a higher protein content than the grain. It is also fairly high in fiber, thus limiting its use in fish feeds. Adulteration with hulls lowers its feeding value considerably.

4.2.2 Maize (corn)

Maize or corn (*Zea mays*) is the second most important crop in the Philippines after rice, with approximately one-third of Filipino farmers (~1.8 million), depending on maize as their major source of livelihood. White corn is the most important substitute staple in periods of rice shortage, especially for people in rural areas. Most of the yellow corn produced in the Philippines is sold to the livestock and feed milling industries, although some small farmers keep

some proportion of output to be consumed as food, especially in times of poor harvest (Gerpacio, Labios, Labios, and Diangkinay, 2004).

In the Philippines the two categories of maize consumption are food and feed. Maize demand for food is influenced by the prices of maize and rice, as well as per capita income. The elasticities of maize demand with respect to the prices of maize and rice, as well as per capita income were -0.31, -0.81 and -0.47, respectively. This implies that, as a food, maize is considered inferior, implied by the negative elasticity of maize demand with respect to per capita income. In other words, as per capita income rises, people in the Philippines purchase less maize and buy other sources of carbohydrates, such as rice.

Maize demand as feed in the Philippines is influenced by the wholesale price of maize, poultry production and pork production. The elasticities of maize demand are -0.08 (own price), 0.22 (poultry output) and 0.47 (pork output), respectively. This implies that a 1 per cent in poultry production ceteris paribus, raises maize demand as feed by 0.22 per cent.

4.2.3 Cassava, tapioca or yucca

For the most part, roots and tubers are grown as food for human consumption in the Philippines. However, because of their high starch content, some varieties are grown as industrial raw material. Notable among these is cassava or tapioca. Roots and tubers are also suitable for feeding fish, although their use for this purpose appears very limited due to their relatively high cost. Also, because the feed value of roots and tubers is in their carbohydrate content, they cannot be used at too high levels in feed for fish, which have a lower tolerance for carbohydrates than farm animals.

Cassava, scientifically known as *Manihot esculenta*, is one of the most important root crops in the Philippines. The versatility and multiple utility of this crop makes it economically promising, be it as human food, animal feed, medicine, alcohol, and for industrial uses like textile, binders, and as plain raw material in making biodegradable products.

Cassava production in the Philippines grew by 7.2 percent from 641.5 thousand metric tons (mt) in the same period of 2012 to this year's 687.8 thousand mt. This production growth was due to:

- continuous increase in the contract growing scheme implemented by San Miguel Corporation (SMC) in Bukidnon;
- reported increases in harvest areas in South Cotabato, Davao provinces, Isabela and Cagayan; and
- improved yield of cassava farms in the ARMM provinces due to favorable weather conditions.

4.2.4 Sweet potato

Sweet potato (*Ipomoea batatas*, L. Lam,) is mainly grown as food for human consumption in the Philippines. The tubers consist primarily of carbohydrates with a high content of sucrose. Protein content, although low, is almost twice that of cassava. The leaves of the sweet potato are highly digestible, free from toxins, and fairly rich in protein. The starch in the tuber provides good binding for dry and moist-type pellets if heat processing is employed.

The production of sweet potatoes increased to 123.04 thousand mt, or 6.5 percent higher than the 114.54 thousand mt output in the same period of 2012. Factors that bought about the increase were the following:

- wider harvest areas in Bukidnon, Lanao Norte, Davao Provinces, Cebu, Negros Oriental and Mindanao Occidental; and,
- better crop management that boosted yield of sweet potato farms in Zamboanga City.

4.2.5 Soybeans

Soybean oil meal is the most frequently used oil seed meal in livestock and poultry feeds. It is a by-product from the extraction of oil from soybean (*Glycine max*). Crude protein content of the soybean oil meal is dependent upon whether or not the soybean hull is added back to the oil-extracted bean. The soybean should be cooked or toasted to improve the quality of the meal. Because of its high quality protein, soybean oil meal can substitute for a great amount, or it can replace fish meal in the ration. Methionine is the only amino acid that is low in properly processed soybean meal.

To meet the domestic demand for soybean oil meal as feed, the Philippines is fully dependent on meal imports, since there is no significant production of soybeans the country. Soybean meal is primarily by-product of soybean oil production, which is not common in the Philippines.
Domestic production of soybean meal in the Philippines averages 8 percent of total domestic demand. About 92 percent of domestic consumption is imported from the global market. Imports increased from 1.55 million tons in 2001 to about 1.64 million tons in 2005 and then to 1.97 million tons in 2010 to 2.05 million tons in 2013 (Table 10). As the livestock industry develops in the Philippines, there is growing demand for feed and protein meals in particular as they increasingly are incorporated into compound feed rations.

4.2.6 Copra meal

Copra meal is what remains after the dried coconut meat has been subjected to a mechanical fat extraction process and ground. Copra meal is also available in cake and pellet form. The feedstuff is relatively high in protein (22 percent) although the quality is relatively low. It is also high in fiber. Copra meal is particularly prone to rancidity and aflatoxin contamination.

Copra meal or copra cake is the dried meat or kernel of a coconut. It is the by-product of extracting oil from coconuts. Copra meal is used as fodder for horses and cattle while its high oil levels and protein make it a good protein source for fattening livestock. The protein in copra meal has been heat treated and provides an excellent source of high quality protein for cattle, sheep, pigs and other livestock.

4.3 Development of feed industry

The beginning of the local feed milling industry can be traced back to the early fifties when foreign breeds of poultry and livestock were imported into the country. The entry of these breeds necessitated the importation of mixed feeds. Feed importation continued for several years until some Filipino entrepreneurs invested in the establishment of feed mills (Sison, 1996).

Small feed mills first were set up in the vicinity of Metro Manila. The practice at that time was to import feed concentrates (feeds containing high density of nutrients, usually low in crude fiber content and high in total digestible nutrients) and mix them with local feedgrains. As the raising of hogs and chickens advanced from backyard to commercial scale, the local feed millers increased their production capacities to meet the growing demand for mixed feed. Moreover, feed millers found ways to improve their technology at the same time limiting their importation only to some feed ingredients that were not locally available, such as protein meals.

From a fledgling enterprise in the 1950's, feed milling has evolved into a dynamic industry employing over 5,000 workers and contributing significantly to the development of the animal industry in particular and to the growth of agriculture in general.

As of December 31, 2012, 561 feed mills were registered with the Bureau of Animal Industry (BAI), the government agency mandated by law (Republic Act No. 1556, as amended by Presidential Decree No. 7, otherwise known as the Livestock and Poultry Feeds Act) to regulate the manufacture, sale and distribution of animal feeds. Of the 561 registered mills, 493 were mixed-feed manufacturers and the rest were feed ingredient manufacturers (Table 7). Of the mixed-feed manufacturers, 447 operated on a commercial scale, while the other 46 produced for their own consumption (home-mixers).

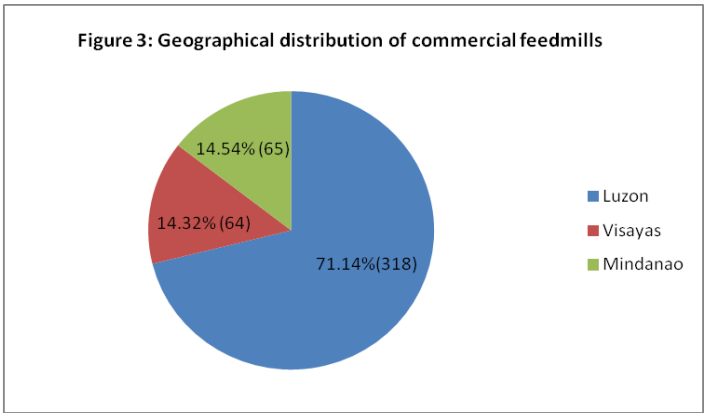
Table 8: Registered feed establishments in the Philippines, 2012

Establishments	Total No. Registered
Feed Manufacturers	447
Feed Ingredient Manufacturers	68
Commercial Feed Traders	19

Toll Manufacturers	45
Non-Commercial Feed Manufacturers	46
Importers	681
Indentors	161
Exporters	47
Suppliers	763
Distributors	376
Repackers	18
Retailers	3158

Source: Animal Feeds Standard Division, BAI

In terms of geographical distribution, 318 of the 447, or 71.14 percent of the registered commercial feed mills, are located in Luzon while the rest are thinly scattered in Visayas and Mindanao (Figure 3). The heavy concentration of feed manufacturers in Luzon, specifically in Metro Manila and its vicinity, i.e. Regions III (Central Luzon) and IV (Southern Tagalog), is due to the fact that majority of commercial livestock operators as well as feed ingredient suppliers are located in the area.



The total production of the registered feed millers in 2012 was estimated at 1,482,801 metric tons (Table 9). However, industry sources estimate the present combined rated capacity of all feed mills in the country at 26,674.58 metric tons per year.

The big discrepancy between total production and rated capacity of 26,674.58 metric tons can be attributed to low production efficiencies of small and medium-sized feed mills. Power outages, equipment breakdowns, and erratic supply of raw materials contribute to the low production efficiencies in most feed mills.

As previously stated, 561 feed mills were registered with the BAI as of December 31, 2012. Of this total, around 447 were commercial mixed-feed manufacturers, while the rest produced for their own consumption. The total capacity of all registered feed mills on an eight-hour shift was is estimated at around 17,000 tonnes, but only 36 mills account for 55 percent of the aggregate capacity.

Some 132 small-scale feed mills produce fewer than 20 tons of feed per eight-hour shift, representing 6.52 percent of total production capacity. Only 79 feed establishments produce more than 50 tons of feed per eight-hour shift, and these represent 77.8 percent of total rated feed capacity. The balance of 15.7 percent capacity is accounted for by feed mills with more than 20 tons but fewer than 50 tons of capacities.

Table 9: Size of commercial feedmills in the Philippines, 2012

RATED CAPACITY PER 8HOUR SHIFT (METRIC TON)	NO. OF MILLS	% DISTRIBUTION (Based on the No. of Feedills)	TOTAL RATED CAPACITY	% DISTRIBUTION (Based on Rated Capacity)
LESS THAN 25 (Small Scale)	273	61.07	3,113.08	11.67
25.1 - 50 (Medium Scale)	58	12.95	2,467.50	9.25
50.1 - 100 (Large Scale)	54	12.05	4,188.00	15.7
MORE THAN 100	62	13.94	16,906.00	63.38
TOTAL FEEDMILLS	**447**	**100**	**26,674.58**	**100**

Source: Animal Feeds Standard Division, BAI

The bulk of mixed-feed production is composed of poultry and swine feeds, with poultry feeds representing 52 percent and swine feeds 28 percent of total output, for a combine share of 80 percent.

Feed millers in Luzon account for more than 84 percent of the total mixed-feed production with over 94 percent being produced in the National Capital Region (NCR) and the nearby provinces of Bulacan, Cavite, Laguna, Batangas and Quezon.

At the forefront of the industry in terms of production output and market share is the Philippine Feed Millers Association, Inc. (PAFMI), which is presently composed of 32 large feed millers. In 2012, the combined production of PAFMI members reached 5,774,400 metric tons, representing 60 percent of the total mixed-feed production. The next biggest producer is the group of independent feed millers which accounted for 3,849,600 metric tons or 40 percent of the total mixed-feed output.

At present, the industry produces feeds not only for hogs and poultry but also for cattle, pigeons, rabbits, dogs, fish and prawns (Table 9). The large feed millers are highly mechanized and are utilizing computers in the feed formulation, thereby increasing production efficiencies. Moreover, some of the large feed millers have succeeded in integrating mixed-feed production with the contract growing of poultry and hogs, thereby assuring a market for their products.

Table 10: Commercial mixed feed production by type (in metric tons), Philippines, 2006-2012

Type	2006	2007	2008	2009	2010	2011	2012
Poultry	790,134.33	678,911.02	657,887.53	496,507.00	522,360.42	578,085.30	515,357.10
Hog	676,211.44	876,208.12	551,250.60	587,039.00	615,539.00	747,008.90	778,383.00
Aquafeed	78,126.10	195,111.30	54,526.20	52,182.43	89,747.30	90,560.00	61,846.00
Specialty feed*	1,530.13	3,662.40	2,106.20	1,637.00	3,222.00	2,462.20	121,671.00
Others	501.00	11,972.14	3,457.50	2,563.60	1,886.20	3,885.50	5,544.10
Total	**1,546,502.90**	**1,765,864.98**	**1,269,228.03**	**1,139,929.03**	**1,232,754.92**	**1,422,001.90**	**1,482,800.20**

**Specialty feeds include those of cattle, horses, dogs and rabbits.*

Source: Animal Feeds Standard Division, BAI (2012)

4.3.2 The role of imports as an input for feed manufacturing

The livestock and feed industries heavily depend on imported feed ingredients, i.e. soybean meal, maize, feed wheat, and fish meal (Table 11). Imports of soybean meal increased to 2.0 million tons in 2013 from about 1.9 million tons in previous year. Based on soybean meal import data, total feed production in 2013 was around 10.2 million tons (Sison, 2013). Soybean accounted for 20-25 percent of the feed formula while yellow maize or its substitute, feed wheat, accounted for 50-60 percent (Vasquez, 2010).

Table 11: Feedstuff imports by year('000 MT), 2001-2013

Year	Soybean Meal	Corn	Feed Wheat	Fish Meal
2001	1,555	246	2,922	72
2002	1,460	243	3,230	45
2003	1,171	102	2,975	46
2004	1,542	52	2,593	44
2005	1,646	157	2.963	33
2006	1,743	321	2,758	24

2007	1.627	58	2,269	24
2008	1,575	432	3,206	24
2009	1,719	118	3,197	16
2010	1,972	61	3,224	9
2011	1,833	202	4,075	11
2012	1,925	92	3,645	12
2013	2,050	50	3,600	12

Source: USDA, 2013

Feed millers choose to import energy feed sources when local corn prices are relatively higher. Total wheat imports reached 4.0 million tons in 2011 compared to 3.2 million tons in 2010 when local corn prices were relatively high.

4.3.3 Gap between demand and supply of feedstuffs

The Philippine feed milling industry has grown rapidly in the past six decades, now producing about 12.38 million tons of feed per year (2014 Alltech Global Feed Survey[2]). The figure provided by Alltech, although unofficial, is considered credible by the industry users. Where possible, information was gathered in partnership with local feed associations, and when that was not possible, it was done utilizing information collected by Alltech's global sales force who visit 447 than feed mills annually.

Like its flour milling counterpart, the feed industry is import-dependent in relation to most of its feed ingredients as shown in Table 9.

The most chronic problem the industry faces is the frequent shortage of cheap raw materials, which has perennially undermined production and caused a wide gap between the available supply and demand for feeds. This problem is aggravated by other complications, such as increasing high and volatile prices, inadequate storage and the ensuing quality deterioration.

Most Philippine feed mills are located in the main island of Luzon, while demand for mixed feeds is highly dispersed all over the country. Consequently, access to feed inputs is severely

[2] The feed statistics provided by Alltech, although unofficial, are considered credible by the industry users. Whenever possible, information is gathered in collaboration with local feed associations, and when that is not possible, it was done utilizing information collected by Alltech's global sales force who visit 447 than feed mills annually.

hampered on both ends for procurement of raw materials and distribution and marketing of finished mixed feeds and feed products, driving up costs.

Because procurements of affordable raw material is very important for feed milling and because raw material availability is seasonal, local feed millers find it economical to channel procurement of raw materials to dealers. The tight supply of feed grains in recent years has, however, forced big feed millers to stockpile to enable more efficient production programming. This trend is expected to continue.

Corn accounts for about 70 percent of local feed requirements. No matter how big in terms of size and regardless of their financial capability, feed millers use yellow corn in the production of feed. The availability and affordability of this input has great impact on feed millers' operations.

5 Conclusion and recommendations

Demands for foods of animal origin are increasing globally due to increasing population growth, urbanization and income growth. The limits of existing livestock production systems are being approached, if not exceeded, because of increased demands for livestock feeds vis-á-vis availability. Consequently, more accurate assessments of current and future supplies and demands for livestock feed are needed for national food security policy, as well as the strategically planning for the development of a vibrant yet sustainable livestock sector.

The animal and feed sectors are dynamic and responsive to the needs of a growing human population. With the advent of new technologies and feed alternatives, both animal and feed sectors have been able to cope with the rising cost of raw materials and feed additives worldwide while improving their production efficiencies.

A glaring weakness in the current animal and feed production statistics structure in the Philippines is that there is no single information system covering all official statistics collected by the DA and the BAI. The system is characterized by small, activity-focused applications and data compilation is slowed by the need to share information between Government offices. Furthermore, data generated by the different applications are often conflicting and difficult to reconcile.

Animal and feed statistical systems developed and maintained in the Central Office are also fragmented and non-complimentary. Different offices/units within the DA and BAI generate their own digitized data, which often results in overlapping and conflicting statistics.

Most, if not all, of the feed production submitted by feed compounders and feed ingredient manufacturers to BAI-AFSD and Bureau of Internal Revenue (BIR) are underestimated. The BAI-AFSD and DA regional offices are totally understaffed and unable to verify the actual production of registered feed compounders and feed ingredient manufacturers based on their feed ingredient usage and rated capacity.

The following recommendations are made to improve the availability of timely and reliable data on livestock, poultry, aquaculture and feed operations:

- Strengthen public institutions (BAI, NMIS, BFAR) under the DA. Empower the DA to tap expertise of universities and other academic institutions (UPLB Institute of Animal Science, College of Veterinary Medicine, SEAFDEC).
- Allocate adequate funds to improve basic services (production, research and regulatory affairs).
- Undertake institutional assessments of the DA agencies involved in livestock, poultry and fisheries with the objective of streamline data collection processes.
- Encourage stronger and more unified livestock, poultry, aquaculture and feed associations with open information systems (e.g. mixed feed production data from commercial and non-commercial manufacturers, parent stock importation, SPS importation of meat and by-products, open cost system).

It is strongly recommended that PSA-BSA, in collaboration with BAI, livestock and feed associations, undertake jointly a nationalwide annual feed production and utilization survey. Home mixers should be included in this survey to assure documentation of the actual production, utilization and consumption of mixed feeds and raw materials.

To further strengthen the statistical capacity across the entire Philippine Statistical System (PSS) and assist the PSS to carry out its mandate to produce meaningful official statistics, there is an urgent need for the PSA/BAS to:

- prepare, in coordination with BAI-AFSD, PAFMI, APAFMI and other concerned sectors, a work plan for undertaking a national mixed-feed production survey next year. The respondents should include commercial and non-commercial feed manufacturers.
- upgrade the feed usage and estimation data of CountrySTAT Philippines by incorporating the following:

    - Quantity, source and price of ingredients used in feed compounding;
    - Volume of mixed feeds produced by type and species – national and regional;

- Quantity, source and price of imported raw materials and feed additives used in feed compounding;
- Feed conversion ratios (FCRs) of commercial and backyard farm animals and aquatic species (to be supplied by the stakeholders from the livestock, poultry and aquaculture industries); and,
- Farm efficiencies of commercial and backyard livestock and poultry farms (to be gathered during surveys/censuses).

References

Albert, J.R.G., Reyes, R.S. 2013. Better Statistics for a Better Philippines. Philippine Statistics Authority – National Statistical Coordination Board 2013, Makati City, Philippines.

BAS (Bureau of Agricultural Statistics), 2013. Selected Statistics on Agriculture 2013. Department of Agriculture, Quezon City, Philippines.

Calud, A.T., Apo, L.T., Villar, E.C., Guico, A.B. 2013. The 2012 Swine Production Performance in the Philippines. Philippine Swine Industry Research and Development Foundation, Inc. (PSIRDFI) and Philippine Council for Agriculture, Aquatic and Natural Resources and Development- Department of Science and Technology (PCAARRD-DOST), Los Baños, Laguna, Philippines.

Calud, A.T., Apo, L.T., Villar, E.C., Guico, A.B. 2014. The 2013 Swine Production Performance in the Philippines. Philippine Swine Industry Research and Development Foundation, Inc. (PSIRDFI) and Philippine Council for Agriculture, Aquatic and Natural Resources and Development- Department of Science and Technology (PCAARRD-DOST), Los Baños, Laguna, Philippines.

Chang, C. Analysis of the Philippine Chicken Industry: Commercial versus Backyard Sectors. 2007. Asian Journal of Agriculture and Development, Vol. 4, No. 1.

FAO. 2012. Conducting National Feed Assessments by Michael B. Coughenour and Harinder P.S. Makkar. FAO Animal Production and Health Manual No. 15. Rome, Italy.

Gerpacio, R., Labios, J., Labios, R., and Diangkinay, E. (2004). Maize in the Philippines: Production systems, constraints and research priorities. International Maize and Wheat Improvement Centre (CIMMYT), Texcoco, Mexico.

Gonzales, L.A., Dy, R.T. 2012. Benchmarking the Livestock and Poultry Industries: A Cross Country Analysis of the Philippines and Four Other Southeast Asian Countries. SIKAP/STRIVE Foundation, Los Baños, Laguna.

National Statistical Coordination Board. 2012. The Philippine Statistical Development Program 2011-2017 Strategic Plan. Makati City 1200, Philippines.

PHILSAN (Philippine Society of Animal Nutritionists), 2010. Feed Reference Standards (4th Edition), 2010. College, Laguna, Philippines.

Sison, J.A., Baconawa, E.T. 1996. Feed Mill Project Feasibility Study. Farm Integrated Animal Health and Production Project (FIAHPP) under RP-FRG BAI-GTZ. Quezon City, Philippines.

Annex A: List of Associations/Organizations Interviewed

Industry Associations:

National Federation of Hog Farmers, Inc. (NFHFI)
Rm. 401 R & G G. Tirol Building, No. 831 EDSA cor. E. Lopez St., South Triangle, Quezon City
Philippines/Tel. No. (632) 924-2317
Daniel P. Javellana, Jr., President

Philippine Association of Feed Millers, Inc. (PAFMI)
Unit E 2703 D East Tower, Tektite Condominium, Philippine Stock Exchange Center, Exchange Road, Ortigas Center, Pasig City 1605/Tel. Nos. 687-2472 and 687-5269

Pork Producers Federation of the Philippines, Inc. (ProPork)
Unit 305, 3/F Reliance House, No. 205 EDSA cor. Rochester Street
Greenhills, Mandaluyong City, Metro Manila, Philippines
Edwin Chen, President

Philippine Veterinary Drugs Association (PVDA)
Unit 1629, 16th Floor, City & Land Megaplaza Condominium
ADB Avenue, Ortigas Center, Pasig City
Dr. Javier Mateo, President

United Broiler Raisers Association (UBRA)
Room 218 Philippine Social Science Building, Commonwealth Avenue, Diliman, Quezon City/Telefax: (632) 922-9622

Academe:

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University of the Philippines Los Baños, College, Laguna, Philippines, 4031
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Crop Science Cluster
College of Agriculture, UPLB, College, Laguna, Philippines 4031

Professional Associations:

Philippine Society of Animal Nutritionists
Institute of Animal Science, College, Laguna, Philippines

Philippine College of Poultry Practitioners
Mallinckrodt Veterinary, Inc.,
946 Km. 18 South Super Highway, Sucat,
Parañaque, Metro Manila

Philippine College of Swine Practitioners
42 Castello St., Casa Milan, North Fairview
Quezon City, Philippines
Dr. Zoilo Lapuz, President

Philippine College of Veterinary Feed Practitioners
c/o Animal Feeds Standard Division
Bureau of Animal Industry, Visayas Avenue
Diliman, Quezon City, Philippines

Philippine Veterinary Medical Association
Unit 233, Union Square Condominium
15th Avenue, Cubao, Quezon City, Philippines

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