STATUS OF THE SWINE INDUSTRY IN THE PHILIPPINES

by

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INTRODUCTION

The expansion and development of the swine industry in the Philippines is part of the government's current program to bridge the animal protein gap.

Basic food in the country was underproduced during the past few decades. Consumption was above production and to meet local demand, the administration had to import huge stockpiles of foodstuffs. In fact, yearly importation of meat and milk and their products alone amounted to ₱120 million[1](Novilla, 1973).

To narrow the gap between production and population, the Philippine administration channeled a sizeable portion of its resources to the production of all food items. Top priority was given to rice, the basic cereal of the people. A well-knit production program was prepared and implemented and today with the rice varieties, IRRI[2]-8 and IRRI-1561 and other high-yielding varieties in the lead role, other important programs are following.

With the success in the rice program, the government shifted emphasis from rice and other cereals to animal protein foods. This help balance the diet of more than 40 million

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[1]Equivalent to $3.03 million ($1.00 = ₱6.61)

[2]International Rice Research Institute situated in Los Banos, Laguna (Luzon Island).

Filipinos and could be a source of income for a good segment of the population.

BACKGROUND OF THE SWINE INDUSTRY IN THE PHILIPPINES

The first swine were brought to the Philippines by its first immigrants, the Malays and Indonesians. Chinese traders who eventually came to live in the islands brought unknown breeds of small-sized pigs. Most of these pigs are long snouted, fat and low-bellied, and very resistant to disease. During the Spanish regime, better-looking pigs were brought to the islands and thus started the improvement of the appearance of what we now call our native pig. The continuous inbreeding of these native pigs however, resulted in poor body size and performance.

America took over the Philippines from Spain and finally, the Philippines gained her Independence in 1946. Since then, massive importation of better breeds of swine paved the way for the improved breeds and crosses that we have today.

A. Methods of Raising Pigs

The Philippine pigs are either raised in small groups in backyards, or in confinement commercial systems. In "backyard" method, pigs may be confined in a small inclosure with slotted bamboo floors, or they may be tethered with abaca rope to a tree trunk or house post. In remote areas where neighbors know each other, pigs are allowed to roam free and scavenge any available garbage or feed

material.

Household slops and garbage mixed with rice bran or corn bran is a common diet of backyard-raised pigs. Additional feeds include root crops such as cassava, sweet potatoes, yams, and a variety of succulent grass and legumes.

The introduction of improved breeds of pigs gradually paved the way to better methods of confinement rearing. Modern commercial piggeries mushroomed as the result of expanded technical services from the government and the available financial assistance from leading banking institutions.

The "paiwi"[3] system of raising pigs is still common. An enterprising capitalist invests in several weanling pigs and distributes them to interested parties who rear them. Some of these pigs are fed to finishing weight, but some gilts are retained for breeding. This method gives a 40 percent share to the capitalist and 60 percent to the caretaker.

B. Sources of Feeds

The major crop grown in any locality, particularly the grains and their by-products, will make up the major portion of the feed for pigs in the area. Backyard-raised pigs depend little on formulated diets, but are raised according to the financial capacity of their owners. All

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[3]Paiwi is a local term for contractual method of rearing pigs.

available sources of swine feed in the farm are utilized. Banana stalks are chopped finely, cooked, and sprinkled with small amount of rice bran. Unripe papaya fruits are also cooked and fed the same say. Root crops with their vines and leaves also serve as a good source of feed.

In urban areas, household slops and garbage and restaurant refuse are the main base of swine feeds. Commercial feeds are diluted with rice bran or corn bran. Only large commercial piggeries can afford to feed the mixed feeds supplied by the feed millers. Some commercial piggeries mix their own formula feed.

C. Marketing

Backyard-raised pigs are either slaughtered in the local vicinity or bought by middlemen to be shipped to centers of population. Some piglets are reserved for neighbors and friends long before they are weaned. Other producers bring the entire litter to a local livestock market.

Commercial piggeries sell their pigs either as breeders or finishers. A number sell to contract buyers such as meat packing plants, ham, bacon and sausage factories, or supermarkets. The rest sell to large city markets.

PRESENT PORK PRODUCTION PROGRAM

The program on the production of animal protein foods (Expanded Animal Production Program, 1968) vividly describes our swine industry, and offers solutions to some of its problems.

A. The Pork Situation

In 1968 the total swine population of the country was estimated at 8.82 million head, with a total pork production of 335.53 thousand metric tons, which supplied about 59% of the effective demand for all kinds of meat (562.8 thousand metric tons). During that same year, 1,032 thousand metric tons of pork were imported.

Likewise, in the same year, 141 breeder pigs (102 boars and 39 gilts) worth over ₱185,700 ($28,136) were imported from abroad to shore up the country's breeder stock.

The greatest supply of pigs going to the abattoir comes from the backyard raisers.

Prices of hogs per kilo liveweight vary from province to province, with price differentials (with Manila as base) as high as ₱0.93 ($0.14). Likewise, prices of pork vary from one place to another.

B. Problems of the Industry

1. Production

Among the production problems are scarcity and high cost of hog feed and feed ingredients, poor management practices, and high mortality rate due to disease.

Feed ingredients, including fish meal, soybean oil meal, bone and meat meal, and sorghum must be imported. With the institution of the "floating" exchange rate for the Philippine peso, prices of these ingredients, including locally produced corn and rice bran have gone up.

In spite of the advances in swine management and technology, the average Philippine hog producer still knows very little about hog raising. The Bureau of Animal Industry disease control personnel claimed that 50% of hogs born are still lost to hog cholera, swine plague, etc. before reaching maturity. In addition, weight loss due to morbidity, parasitism and crippling afflictions are enormous.

2. Financing

Lack of low-interest loans, high collateral requirements and red tape are among the serious financial problems faced by swine raisers. Few credit institutions grant low-interest, long-term loans or development loans. High collateral is

required, and except for a few moneyed capitalists, most of the country's swine producers are backyard raisers who cannot put up such collateral.

3. Marketing

Among the problems in marketing are deficiencies in transportation, auction markets, slaughtering and cold storage facilities, farmers' marketing cooperatives and marketing information. Inhibition of trade by municipal regulations is also a problem.

C. Swine Production Program of the Government

Filipino pork consumption is roughly 60% of all meats (beef, carabeef (carabao's meat), poultry, etc.) combined. Pork is comparatively cheaper than other meats and can be prepared in many ways. Thus, pork production (in relation to the over-all meat production) deserves great importance.

1. Objectives

The objectives of the program are to 1) supply the effective demand for pork and 2) produce pork for export.

2. Production targets

Original targets were to produce 8.68 million head of pigs for slaughter (391,360 metric tons of pork) in 1970; and every year thereafter, step up production by 8%. Another target was to increase the swine population by 12% annually (table 1).

Table 1

PORK PRODUCTION TARGETS AND PROGRAMMED PORK PRODUCTION FOR THE YEARS 1970 TO 1974

Item	1968	YEARS 1970-71	1971-72	1972-73	1973-74	Average Growth Rate
Swine population (Million)	8.82	11.09	12.44	13.96	15.60	12
Pork production (Thousand M.T.)[1]	335.53	391.36	422.67	456.48	493.00	8
Effective demand (Thousand M.T.)	562.8	635.3	675.00	717.2	762.00	-
Programmed prod. (Thousand M.T.)	335.53	391.36	422.67	456.48	493.00	-
Percent of effective demand	59.61	61.60	62.61	63.64	64.69	-

[1] Metric Ton

3. Activities to achieve the targets

The main activities to achieve the targets are: 1) intensification of extension services, breeding services and veterinary services; 2) providing marketing services; 3) extension of liberal credit; 4) augmentation of feedgrain and fishmeal production and 5) research.

(a) Extension service

The targets in pork production could be attained more easily by setting up a strong supportive extension service. Farm management technicians of the Agricultural Productivity Commission, including the field personnel of the Bureau of Animal Industry, Presidential Assistance for Community Development, Philippine Rural Reconstruction Movement and agricultural schools constitute pools of available extension workers.

Under this program, 200 farm management technicians from the Agricultural Productivity Commission and 118 artificial breeding technicians and 82 livestock and poultry technologists from the Bureau of Animal Industry has already undergone training during the years, 1970 to 1972. Four training centers were established, namely, Dagupan City for Northern Luzon, University of the Philippines College of Agirculture for Central and Southern Luzon, Cebu City for the Visayas, and Xavier University in Cagayan de Oro for Mindanao. Expenses incurred by the trainees was provided by the National Food and Agriculture

Council.

(b) Breeding Service (Artificial and Natural)

During the first year (1970-71) of the program, 9.5% of the estimated total number of breeding sows were serviced by artificial insemination, versus 12% in the second year. It is expected that on the third year and fourth years, 14% and 16%, respectively, of the number of breeding sows will be serviced artificially.

(c) Veterinary Services

Veterinary services on swine have been intensified to complement the extension and breeding services. Strong emphasis has been given to disease prevention and control, which required strict quarantine measures, intensive and extensive vaccination, and accurate and early diagnosis and treatment of afflicted animals. This program was designed to stamp out hog cholera (No. 1 hog killer), swine plague and other diseases which take a heavy toll on swine population.

(d) Feedgrains and Fish Meal Production

The production of feedgrains (yellow corn, sorghum, soybeans, and other grains) is based on the implementation of the feedgrain production program by the National Food and Agriculture Council, the Agricultural Credit Administration and the Bureau of Animal Industry. This program has been financed at ₱21 million ($3.18 million) for the

periods, 1970 to 1974. A number of production projects and areas have been established and cooperator-farmers have been enticed into the venture since its implementation in 1970 (further discussed in a later chapter).

A program on expanded fish production will hopefully make available fish meal, a very important feed ingredient whose price has gone up considerably following the institution of the floating rate on the Peso.

(e) Marketing Strategy

To resolve marketing problems, the following measures as recommended by the program are now being undertaken:

1. Formation of farmers' production and marketing cooperatives, being worked out by the Agricultural Credit and Cooperative Investments, Agricultural Credit Administration and Agricultural Productivity Commission as coordinated by the National Food and Agricultural Council.
2. Production and/or purchase of feeds or feed ingredients by cooperatives.
3. Sale of hogs and pork by weight and grades through cooperatives.
4. Long range contracts for sale of hogs and pork to wholesalers and/or processing plants with prices and quantities to be fixed between producers and buyers.
5. Provision of marketing loans by the Greater Manila

Terminal Food Market, Agricultural Credit Administration, and rural banks.

6. Exploration of export markets by the Greater Manila Terminal Food Market.
7. Establishment of auction markets, modern slaughtering, processing and storage facilities and provision of transport facilities where necessary to be worked by the Greater Manila Terminal Food Market.
8. Supervision of marketing system implementation by the Greater Manila Terminal Food Market and the Bureau of Animal Industry.
9. Elimination of inhibitory trade regulation.
10. Improvement of public markets and establishment of more retail supermarkets.

(f) Credit Facilities

To compliment the other activities aimed at achieving the production targets, credit facilities (commodity and marketing loans) are now being made available to small hog raisers by the Agricultural Credit Administration, Greater Manila Terminal Food Market and rural banks.

The Central Bank of the Philippines and the rural banks are now financing small producers in the barrios (villages) up to ₱4,500 ($681.81) per individual at very liberal terms. Hence, small producers are being encouraged to stay in business. Being a supervised credit, the project is being visited from time to time by a bank

representative as well as the technical men and veterinarians from the Bureau of Animal Industry (Silverio, personal communication, 1973).

The financing of large-scale commercial piggeries has been discussed in a subsequent chapter, with special emphasis on the Development Bank of the Philippines which lends the largest sum of financial assistance to large-scale piggeries throughout the country today.

(g) Research on production, processing, economics and marketing

Corollary research on production, processing, economics and marketing are important aspects in the overall spectrum of pork production. The following research projects are now given top priority:

1. Breeding, genetics and physiology
   - (a) Studies comparing the performance of different breeds of swine for upgrading native swine.
   - (b) Determination of the most productive breed combinations for the production of crossbreed market pigs.
   - (c) Determination of the important economic traits for emphasis in selection programs.
   - (d) Heat synchronization in sows and gilts to facilitate artificial breeding.

2. Nutrition and management

   (a) Nutrient requirements of the different classes of swine raised under tropical conditions.

   (b) Utilization of locally available but untested feedstuffs for swine.

3. Animal Health

   (a) Studies to improve quality of locally produced vaccines.

   (b) Studies on prevention and control of tropical swine diseases.

   (c) Efficacy testing of newly-introduced drugs before they are released to the public.

4. Processing, marketing and economics

   (a) Formulation of standards for live hogs, hog carcasses, and various pork products by the Bureau of Standards.

   (b) Standardization of formulae generally used in pork processing.

   (c) Improvement of pork processing techniques and packaging materials.

The agencies that are now doing swine research include: Bureau of Animal Industry; University of the Philippines College of Agriculture; US Swine Research and Development (Phil.) Corp., feed manufacturing companies; vocational-agricultural schools and colleges and various projects under the National Science Development Board.

BREEDS, POPULATION AND REGIONAL CONCENTRATION OF SWINE

A. Breeds

Breeds of swine in the Philippines fall under the following categories;

Foreign:	Berkshire	Landrace
	Poland China	Chester White
	Duroc Jersey	Tamworth
	Hampshire	Minnesota No. 1
	Large White	
Native:	Philippine pigs	
	Batangas pigs	
	Koronadal pigs	
	Berkjala	

The most popular foreign breeds are the Berkshire, Duroc, and Large White (Yorkshire). Crossbreed favorites are: Duroc x Large White, Duroc x Landrace, Berkshire x Landrace, Berkshire x Large White and a number of triple crosses using any of these breed combinations.

Mensalvas (1968) reported the live weight of native Philippine pigs to be 34.5 kg at one year of age and 66.4 kg at two years of age. A heavier weight was recorded for the Batangas pig which ranged from 65 to 75 kg at 9 months of age and the Berkjala (a cross between the Berkshire and Jala-jala, developed at the University of the Philippines College of Agriculture) with a mature weight of 180 kg.

Catanaoan (1973) discussed the "Miracle Pig" recently developed at the University of the Philippines College of Agriculture, the result of a 7-year breeding program. The

crossbred foundation stock was 50% Large White, 25% Landrace and 25% Philippine native pig. Called the UPCA pig, after the abbreviation of the university, it has high feed conversion efficiency, fast growth rate, good carcass quality and other desirable economic traits. Like the native pig, it can thrive on kitchen refuse and slops.

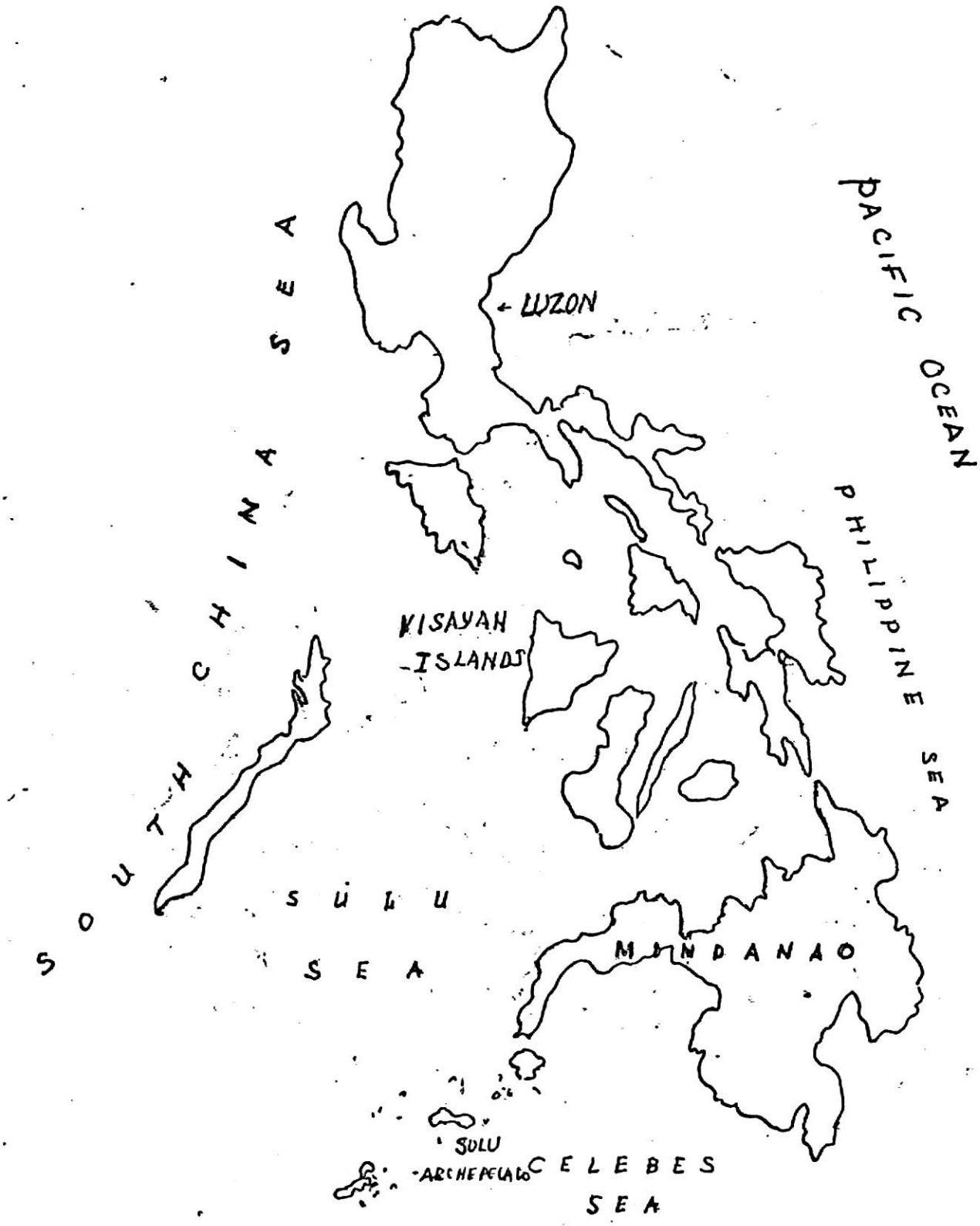
B. Population and Regional Concentration of Swine

The Bureau of Agricultural Economics reports the following concentration of pigs in the different regions of the country as of January 1, 1971:

REGION	NO. OF PIGS
Ilocos	52,200
Cagayan Valley	639,000
Central Luzon	798,100
Southern Tagalog	1,124,300
Bicol	692,000
Eastern Visayas	1,315,100
Western Visayas	922,400
Northern and Eastern Mindanao	867,200
Southern and Western Mindanao	540,000
Total	7,050,300

The greatest concentration of pigs, the majority of which are backyard or small farm-raised, is on the island of Luzon, which includes the Ilocos, Cagayan Valley, Central region, Southern Tagalog and the Bicol region. On January 1, 1971, Luzon had 3,305,600 pigs. Ranking next is the Visayas region (Eastern and Western) with 2,237,500, followed by Mindanao (Northern and Eastern, Southern and Western) with 1,407,200 pigs.

MAP OF THE PHILIPPINES



BANKING INSTITUTIONS THAT ASSIST THE INDUSTRY

Principal banks financing swine production are the Development Bank of the Philippines, Philippine National Bank, Private Development Corporation of the Philippines and those discussed in the Chapter covering credit facilities for small swine producers in the country.

The Development Bank of the Philippines lends the most money for swine production. In 1967 alone, it earmarked ₱18 million ($2.72 million) for a 10-year financial assistance to large piggeries. Loans granted per approved project averaged ₱120,000 ($18,181). Project goals include an increased swine population, a corresponding increase in pork production and an improvement in the quality of breeding stock. To implement this program, deserving swine raisers already in the business are granted adequate credit assistance and technical and management guidance to expand their operation (Development Bank of the Philippines, 1967). For the fiscal year ending June, 1973, it approved ₱13.1 million ($1.98 million) worth of piggery loans to 1,350 borrowers (Silverio, personal communication).

The present Development Bank of the Philippines Swine Financing Program, aimed toward the larger piggeries, is the result of a survey conducted to evaluate the results of earlier DBP-assisted projects. "Large" projects had greater chances for success than projects of smaller dimension.

Advantages of the larger units included better resource allocation, better quality of stock and herd management, better feed conversion and better returns.

FEED MANUFACTURERS AND FEED INGREDIENTS

A. Feed Manufacturers

The Bureau of Animal Industry, as cited by Quizon and Bandong (1969) reports 63 manufacturers of mixed feed and feedstuff in the Philippines. This number includes manufacturers of raw materials such as ipil-ipil[4] leaf meal, fish meal, yeast, and copra meal, who strictly speaking cannot be considered mixed feed manufacturers. Out of this number, 36 can be considered mixed feed producers of whom 28 are operational. Of the 28 operational feed mills, eleven control about 80 percent of the total mixed feed market.

The above authors made a thorough study of the Philippine feed milling industry covering the five-years, from 1961 to 1965. Their findings showed that of the total mixed feed produced over the five-year period, 84.5% was poultry feed, 14.5% swine feed, 0.5% pigeon feed, and 0.1% cattle feed. The growing importance of swine feed output in relation to total feed production was shown by the fact that swine feed output increased from a minimal 1.9% in 1961 to 24.2% in 1965.

Of all feed ingredients used by the feed manufacturers

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[4] Ipil-ipil (Leucaena glauca) = a leguminous tree or shrub growing abundantly in the Philippines.

included in their study, 78.8% of their ingredients and raw materials were locally procured and 21.2% was imported from foreign source. Ingredients consumed by these feed manufacturers for the 5-year operation (1961-1965) is shown on table 2.

Table 2

INGREDIENTS CONSUMED BY FEED MANUFACTURERS IN THE PHILIPPINES FOR 5-YEAR OPERATION (1961-1965)

Ingredients	Amount (M.T.[1])	% Used	% Imported
Corn	330,744	30.0	-
Rice bran	82,256	46.0	-
Wheat bran	118,038	13.8	-
Soybean Oil Meal	121,416	11.4	94.1
Fish Meal	53,516	5.1	95.0
Meat and Bone Meal	43,651	4.7	96.6

[1] Metric Ton

Ibarra (1970) reported that in 1969, the Philippine feed mill industry produced some 11 million bags (40 kg per bag) of feeds. This figure underscored at 134% increase over the 1961 output of only 4.7 million bags. It is currently estimated that about 30 million chickens and one million hogs raised by farmers throughout the country are served by the industry.

At present, the feed mill industry (all feed manufacturers included) provides direct employment to about 5,000 workers. Their aggregate investments in land, buildings, capital equipment, and other facilities sum up to more than ₱80 million ($12.1 million).

The growth of the feed mill industry is the single most important manifestation of the progress of our poultry and livestock industry. The economic significance and the cost-saving aspects of a thoroughly formulated and well-balanced livestock feed have slowly but widely pervaded the attitudes and practices of our farmers, despite the fact that even today, some still subscribe to the long-drawn practice of feeding fowl and livestock with haphazard feed mixes and left-overs.

B. Feed Ingredients

Procurement and availability of feed ingredients seem to be the major bottleneck for the Philippine feed mill industry. The low quality and high prices of mixed feed, which has adversely affected the profit margin of the poultry and swine raisers, have been directly attributed to the poor quality and high cost of feed ingredients. This holds true for both local and imported materials, the former due to under-supply and adulteration and the latter to poor quality control and adulteration with local poor-quality ingredients.

The major mixed feed ingredients are:

corn and corn by-products

rice bran

wheat bran or pollard

sorghum (only recently)

fish meal

soybean meal

meat and bone meal

Minor feed ingredients include copra meal, molasses (cane), ipil-ipil leaf meal, salt, limestone, dried whey, trace minerals, vitamins and antibiotics.

A search for promising local feedstuffs to substitute for commonly used high-priced ingredients is underway by a number of cooperating institutions and government agencies.

A description of the commonly used swine feed ingredients in the Philippines is shown on table 3.

The feed composition (Proximate Analysis) of some Philippine feedstuff used for swine feeding is shown on table 4.

Dry matter, digestible protein and total digestible nutrients of some Philippine feedstuffs is shown on table 5.

Table 3

SOME COMMONLY USED SWINE FEED INGREDIENTS[1]
AND THEIR DESCRIPTION

Local Name	Scientific Name	Description
I. Grains		
Corn	Zea mays	
1. Corn, yellow flint		Dried whole kernel of corn, ground; an excellent energy source with about 85% total digestible nutrient, 82.90% dry matter, 9.00% crude protein, 2.40% crude fat and 2.30% crude fiber.
2. Corn, white flint		The same nutritive value as yellow corn, but without carotene.
Rice	Oryza sativa	
1. Fine rice bran "Cono", 1st class		Fine bran and germs removed in milling rice. Free from coarse bran and hulls. 12% crude protein, 8% crude fiber.
2. Rice bran, "Cono", 2nd class		A mixture of bran, germs and some hulls. 9% crude protein, 20% crude fiber.
3. Rice bran, "Kiskis"		A mixture of bran, germs, and hulls, 30% crude fiber.
Wheat	Triticum aeativum	
1. Pollard		Outer coatings and aleurone layer of wheat kernel; 16% crude protein; 7% crude fiber.

[1]Source: University of the Philippines College of Agriculture Tech. Bull. 21 (1968).

Table 3 (continued)

	Local Name	Scientific Name	Description
II.	Seeds		
	Soybean	Glysine max	
	1. Soybean Oil Meal (Soya meal)		From soybean seed, after extracting oil; 44% crude protein.
III.	Tubers		
	1. Camote meal	Ipomoea batatas	Sweet potato tubers, chopped, dried, and ground.
	2. Cassave meal	Manihot utilisima	Tubers (including peelings), chopped, dried and ground.
	3. Gabi meal	Colocasia esculentum	Prepared as for cassava meal (above).
IV.	Feeds of Animal Origin:		
	1. Fishmeal		An animal protein source, from herrings; imported from Peru; 60% crude protein. Local fish meal made from goby, anchovy, grunts, etc. -45% crude protein.
	2. Bone Meal		From slaughter-house, bones dried, ground fine; source of calcium (21% calcium) and phosphorus (10% phosphorus).
	3. Skim milk powder		Dried skim milk, spray process; 33% crude protein (imported).
	4. Oyster shells		Ground oyster shells; excellent source of calcium (38% calcium), local.

Table 3 (continued)

	Local Name	Scientific Name	Description
V.	Leaf Meals		
	1. Ipil-ipil leaf meal	Leucaena blauca	Leaves and petioles; dried and ground; 18% crude protein, carotene source.
VI.	Coconut By-Products	Cocos nucifera	
	1. Copra meal or coconut oil meal		By-product of copra industry, after extraction of oil; 20% crude protein content.
	2. Paring meal		By-product of dessicated coconut industry; 18% crude protein content.
	3. Coconut oil		Crude coconut oil from copra
VII.	Others		
	1. Molasses		By-products of sugar mills. A "liquid concentrate", excellent binder of dusty feeds.
	2. Limestone		Source of calcium (38% calcium).
	3. Dicalcium phosphate		Source of calcium (26% calcium) and phosphorus (20% phosphorus).

Table 4

PROXIMATE COMPOSITION OF PHILIPPINE FEEDSTUFFS (%)[1]
(SELECTED FOR SWINE RATIONS)

NAME	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Ash	Nitrogen free extract
CONCENTRATES						
Batad, *Andropogon nodosus* grain	81.08	12.44	1.76	12.12	3.91	50.85
Blood meal	89.58	72.74	3.39	1.33	6.30	6.54
Bone meal (raw)	91.06	26.24	0.42	0.49	56.88	
Brewer's spent grain (Bagasse)	89.71	15.40	3.80	18.05	3.76	48.70
Brewer's yeast, dried	83.1	48.8	0.40	4.20	9.40	30.30
Coconut flour, *Cocos nucifera*	87.74	17.24	10.23	12.55	3.84	43.89
Coconut meat, *Cocos nucifera* fresh	51.20	5.0	33.0	2.20	1.20	9.80
Coconut oil meal ("sapal")	94.96	5.62	2.15		1.06	
Hand-expressed	91.53	6.08	4.95	32.89	1.54	46.10

[1] Nutrient Composition of Some Philippine Feedstuffs, Tech. Bull. 21 (1968) University of the Philippines College of Agriculture

Table 4 (continued)

NAME	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Ash	Nitrogen free extract
CONCENTRATES						
Coconut paring cake *Cocus nucifera*	90.90	16.99	6.05	13.49	6.56	49.44
Copera cake, *C. nucifera*	90.28	17.53	8.75	12.19	5.46	46.63
Copra meal, *C. nucifera* Solvent process	89.57	21.44	2.53	12.08	7.55	45.97
Expeller process	93.0	21.00	7.80	8.80	1.30	48.40
Corn bran "tahup" *Zea mays*						
Coarse	a	12.31	7.50	7.84	5.00	67.36
Fine	a	10.89	5.28	3.92	3.15	76.80
White corn	89.27	8.81	4.45	2.00	2.10	71.91
Corn germ meal	92.91	14.89	10.50	8.55	3.66	55.31
Corn gluten feed	91.00	24.66	2.17	5.06	1.80	57.31
Corn grain						
Yellow, flint	82.90	9.00	2.40	2.30	1.60	67.60
White	87.30	7.75	2.60	1.74	1.27	74.24

a Moisture-free basis

Table 4 (continued)

NAME	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Ash	Nitrogen free extract
CONCENTRATES						
Corn meal, white	91.90	8.70	1.10	1.40	0.30	80.40
Corn meal, yellow	95.40	8.80	4.30	0.10	1.40	80.90
Fish meal						
"Mermaid" brand	88.84	47.95	5.20	1.98	24.54	9.17
Imported, brand not specified	91.08	63.92	3.28	0.74	15.62	8.89
Bia (goby)	88.04	56.64	4.50	2.56	25.71	0
Dilis (anchovy)	78.84	42.21	4.58	7.41	16.74	10.98
Serum-serum	90.59	57.15	5.07	1.08	23.38	3.92
Ayungin (grunt)	93.15	58.72	20.00	2.67	23.10	0
Manure, chicken	72.73	14.00	8.08	9.98	11.35	46.44
Meat and bone meal	93.00	45.60	11.78	1.02	29.73	5.80
Meat meal	93.71	66.02	12.94	1.70	2.74	10.31
Molasses (cane)	76.32	1.71	0.60	0	7.17	66.84
Sugarcane bagasse	78.38	2.77	0.59	7.97	5.58	61.47
Sugarcane pith	82.41	6.75	0.58	16.81	10.66	47.61

Table 4 (continued)

NAME	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Ash	Nitrogen free nitrogen
CONCENTRATES						
Mungo (mung bean) *Phaseolus aureous*						
yellow, with hulls	88.85	28.79	3.70	4.21	3.17	48.98
green, with hulls	93.4	21.10	1.00	4.20	3.80	63.30
red	88.20	18.10	0.80	4.40	3.20	61.70
Rice bran, "darak" *Oryza sativa*						
Glutinous variety						
Coarse	89.01	9.56	3.51	20.74	19.89	35.29
Fine	87.37	15.55	16.12	7.20	9.96	35.83
Non-glutinous var.						
Coarse	a	10.03	8.61	16.35	15.90	49.17
Fine	88.00	11.4	10.50	12.30	12.00	43.10
Rice bran-hull mix.						
"Cono"	a	9.77	6.46	20.09	18.02	45.67
"Huller", fine	a	6.74	4.77	26.90	17.38	44.35
"Huller", coarse	a	4.05	3.32	35.03	17.46	39.68
Rice meal						
Grade A	90.24	14.37	15.90	11.00	7.66	41.31
Grade B	89.83	12.52	13.70	11.40	9.08	43.13
Rice middlings						
"binlid"	89.53	10.58	3.30	1.60	1.53	72.52

Table 4 (continued)

NAME	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Ash	Nitrogen free extract
CONCENTRATES						
Skimmilk						
Powder	90.28	32.20	1.27	0.37	7.48	50.02
Liquid	8.03	2.65	0	0	0.60	4.78
Snails, "susong-papang" *Paludina angularis*						
Meat and shell	29.30	3.50	0.20	0.30	2.90	22.40
Meat & shell, dried	98.08	11.30	5.44	0	71.17	10.17
Meat, dried	89.91	45.91	8.57	0	7.75	27.68
Sorghum, fines *Sorghum vulgare*	88.62	5.40	2.66	4.43	3.64	72.51
Sorghum, grain	88.32	9.30	2.58	2.47	1.56	72.47
Soya meal, *Glysine max*	86.14	42.12	--	5.12	5.58	--
Soybean, *Glysine max*	88.40	34.50	17.60	4.6	4.8	26.90
Soybean oil meal, *G. max* Solvent process	88.93	44.57	1.47	6.40	6.29	29.96
Wheat bran, *Triticum aestivum*						
Soft	88.65	9.77	2.12	7.53	3.90	65.33
Hard	89.04	15.16	4.62	9.47	4.71	55.08
Wheat germ meal	86.82	24.61	9.26	5.15	4.43	43.37

Table 4 (continued)

	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Ash	Nitrogen free extract
CONCENTRATES						
Wheat pollard						
Soft	88.56	11.60	5.29	6.63	5.02	60.02
Hard	88.09	17.58	3.20	8.67	6.01	52.96
Wheat shorts	91.17	15.44	4.89	7.25	4.23	59.36
Yeast (from coconut water)	95.31	30.64	27.22	10.72	8.05	18.68

Table 5

DRY MATTER, DIGESTIBLE PROTEIN AND TOTAL DIGESTIBLE NUTRIENTS OF SOME PHILIPPINE FEEDSTUFFS (%)[1]

Feedstuffs	DM[2]	DP	TDN
CONCENTRATES			
Binlid (rice middlings)	89.5	5.2	65.7
Cassava root, chopped, dried	95.9	0.0	94.9[3]
Coarse brewer's spent grains	88.6	11.57[3]	56.61[3]
Coconut meat, fresh	51.2	3.30	88.6
Copra meal	91.7	15.20[3]	69.9[3]
Corn gluten feed	90.1	17.5	74.9[3]
Corn grain, Laguna Yellow flt	88.8	7.7	84.2
Fish meal "lighthouse"	92.1	52.6	62.1
Fish meal "Mayon"	91.0	39.3	58.2
Molasses, cane	76.3	0.4	53.6
Mungo (mung bean)	89.0	16.8	73.7
Papaya, green, sliced, dried	93.0	9.3[3]	81.1[3]
Rice bran, coarse, "kiskis"	89.0	4.5	46.6
Rice bran, fine, "Cono"	88.0	8.3	69.1
Soybean	88.0	31.9	85.0
Soybean oil meal	88.9	41.0	75.3
Sweet potato tuber	22-37	0.2	15.9
Sweet potato tuber, sliced raw	22-37	0	88.8[3]

[1] Selected from "Nutrient Composition of Some Philippine Feedstuffs" Tech. Bull. 21 (1968) UPCA.

[2] Figures given are averages (as is) of representative samples not necessarily the same used in determining DP and TDN presented in this table.

[3] Moisture-free

Table 5 (continued)

Feedstuffs	DM	DP	TDN
Green Roughages[3]			
Banana stalk, tender part	5.3	0.1	1.6
Kangkong	9.0	1.9	7.6
Napier grass	27.5	1.6	12.6
Para grass, succulent leafy, 46 cm tall	33.7	2.9	31.5
Sweet potato vine	9.3	4.5	15.0
Tropical kudzu	21.1	1.4	14.8
Water hyacinth	7.8	0.3	2.1
Silages[3]			
Camote (sweet potato) vine-leaf ensiled fresh	20.5	2.2[4]	43.8[4]
Corn, Laguna yellow flint	26.0	1.2	20.1
Corn, few ears	26.0	0.3	16.1
Napier grass			
One-month old	18.6	1.7[4]	45.1
Two-month old	20.1	0.2[4]	46.7
Sugar cane tops	24.5	0.5	11.0
Water hyacinth	9.4	4.4[4]	44.1[4]

[3] Used for swine feeding (supplements or added to concentrate ration).

[4] Moisture-free basis

A review of some of the major feed ingredients used by feed manufacturers as well as small, semi-commercial and large-scale piggeries follows:

A. Corn

Corn is grown extensively for domestic use in the Philippines and is second in use only to rice.

According to Orticio (1971), the hectarage devoted to corn has doubled since the early 1950's. He further stated that in 1965-1966, the area planted to corn was 2,000,000 hectares (5,000,000 acres) with the average yield of 11.5 cavans (56 kilos per cavan) per hectare (10 bu/acre). Feed millers consumed an average of 15 percent of the total corn production; food consumption, 60 percent; feeds for farmer use, 15 percent; and other industrial uses, 6 percent. The rest was used as seed, waste, or other unspecified purposes.

Of the ingredients used in commercial feeds, corn is dominant. Quizon and Bandong (1969) indicate that corn constitutes 52% of poultry and 32% of swine feed manufactured by feed millers. The feed industry, according to the report, could easily utilize 77,000 metric tons of corn per operating year (300 eight-hour days). Their five-year study showed however, that the prices of corn to feed millers increased by 73.9% or an average of 14.8% yearly.

B. Rice bran

Rice bran, which constitutes 46% of mixed swine feed is similar in importance to corn (Quizon and Bandong, 1969). The feed industry consumed 82,256 metric tons of rice bran from 1961 to 1965.

Corn bran is used by a majority of the small swine raisers in the Visayas and Mindanao areas, but rice bran is used by the backyard-producers in Luzon regions. It is mixed with household slops, garbage or refuse and supplemented with legume vines, native succulent weeds or root crops.

In spite of the huge rice bran inventory in the country, supply problems exist. Rice bran shortages can be attributed to:

- Uneven distribution due to the wide dispersal of rice mills.
- Many rice mills "custom mill", so rice bran is taken back by the customers as feed for their own livestock.
- Rice bran derived from hand pounding is usually not available to traders; it is utilized for backyard poultry and swine raising.
- More swine, cattle and horses are being fed near rice bran sources.

C. Wheat bran

Wheat bran, a by-product of flour production, has practically the same nutritive value as rice bran, although it is bulkier. Because of its ready availability, feed millers have found it a convenient raw material.

Many flour millers have put up their own feed mills to use wheat bran as a base for mixed feed. The Republic Flour Mills, Inc. pioneered in this venture.

Wheat bran is produced by local flour millers, who import wheat. However, most flour millers do not sell wheat bran locally because export prices are higher.

D. Sorghum

Sorghum promises to gain importance. Successful tests have already taken place showing economic feasibility both as a farm cash crop and as a principal animal feed. As a farm crop, it is comparable to corn and the traditional rice culture in economic return. As a feed grain, it is as good as corn.

The Feed Millers Association of the Philippines, consisting of some nine ready mixed feed factories, and supplying about 85% of the total mixed feed production in the country can absorb sizeable quantities of sorghum (Tetangco, 1971). Some of these plants are prepared to use sorghum in place of 70% of their corn. The Janopol Farmers' Agricultural Cooperative at Tanauan, Batangas (Luzon) produces animal feed that is completely based on sorghum. It has a monthly sorghum consumption of 210 metric tons, acquired through the National Economic-United States Agency for International Development. The farmers' cooperatives that use their feed are finding it as efficient as corn-based

feed in swine and poultry projects.

The current sorghum program should not compete with the corn production. Corn is a versatile commodity with wide scope of industrial utility. Moreover, both corn and sorghum have bright export potentials. Should the demand for sorghum expand at the expense of that for corn, corn farmers could easily grow sorghum. With the same investment requirement per hectare, sorghum can be made to grow ratoon (regrowth) crops in 150 to 180 days after the principal crop, which matures in 90-110 days after planting. A ratoon produces about as much as the principal crop. Moreover, sorghum thrives on relatively drier conditions and less fertile soils.

The demand of feed millers for sorghum forms a sound basis for the current sorghum production and marketing program. For target areas, single-cropped (non-irrigated) lowland rice fields are given top priority. These areas are usually idle after the rice harvest, so their crop use will increase the rice farmer's income from the same piece of land.

E. Soybean meal

Soybean meal has become an indispensable protein supplement for Philippine swine rations. Due to this demand, its price has gone up every year despite the effort to reduce import tariffs. Domestic soybean production is still in its infancy. Present production

is only a fraction of the amount needed by feed manufacturers and other allied industries. The area planted to soybeans in 1971 was only 3,146 hectares, which gave a total yield of 4,720 metric tons, against a national requirement of 88,000 metric tons (Focus Philippines, 1972).

The production areas for soybeans are in Ilagan, Economic Garden, Novaliches, La Granja, Oroman, and Tupi (Bureau of Plant Industry, 1972). Mindanao has promising production areas. Ilagan in Isabela, Economic Garden in Laguna, and Novaliches in Rizal (in Luzon) are increasing their production areas and yield.

In 1965, the domestic production of soybean meal and cake was about 13,978 metric tons while imports amounted to 6,254 metric tons for a total of 20,232 metric tons. Domestic production of soybean meal and cake increased to 16,600 metric tons in 1966 (Program Implementation Agency, 1966).

Prior to 1967, soybeans were imported under the National Marketing Corporation Trade Assistance Program at US $120 per metric ton plus a 15% service charge for the corporation. The effective dock price for soybeans became subject to a tariff of ₱250.00 ($37.80) per metric ton, which boosted the price by 43% to ₱750.00 ($113.64) per metric ton. At this price, the only two oil extraction plants in the country, A-One Feeds, Inc. and Universal Corn Products were unable to operate profitably and closed down for one-and-a-half years.

Feed mill consumption of soybean meal from 1961 to 1965 was 121,416 metric tons or 11.4% of the total mixed feed. Of this, 94.1% was imported (Quizon and Bandong, 1969).

F. Fishmeal

The country still depends on imported fishmeal because it is of better quality than the local product.

Efforts are being made by a number of enterprising capitalists to invest in high-quality fishmeal production. A fish discovered in the Bicol region (Southern Luzon) called "Serum-serum" produces a meal comparable in quality with the Peruvian fishmeal (Silverio, personal communication, 1973).

Castillo (1973) outlines the available feed for swine in the Philippines as follows:

A. Energy Feeds

1. Corn and its milling by-products.
2. Rice and its milling by-products.
3. Wheat and its milling by-products.
4. Sorghum
5. Tubers--sweet potato, cassava, yams.
6. Molasses, sugar milling and fermentation products.
7. Coconut oil, beef and carabeef tallows.

B. Protein Feeds

1. Fism meal--imported, local.

2. Soybean meal.
3. Corn gluten and corn gluten feed.
4. Meat and bone meal.
5. Wheat and corn germ meal.
6. Copra meal or paring meal.
7. Coconut yeasts and yeats from molasses fermentation.
8. Sunflower seed meal.
9. Hydrolyzed feather meal.
10. Blood meal.
11. Cottonseed meal and rapeseed meal.
12. Snails.

C. Possible Feed Substitutes

1. Bakery discards including flour unfit for baking.
2. Institutional kitchen and table refuse.
3. By-products of food factories.
4. Corn silage and grass-legume silage or soilage.
5. Sweet potato tops, vines, cassava tops and leaves.
6. Ipil-ipil leaves and other legumes as soilage.
7. Ramie soilage (a fiber plant).
8. Water lily and seaweeds.
9. Banana trunks, excess suckers and banana fruit discards.
10. Industrial by-products as cassave meal refuse from starch.
11. Vegetable and fruit wastes in public markets or supermarkets.
12. Chichen manure.
13. Surplus or out-of-condition foodstuffs from relief agencies.

SWINE RESEARCH IN THE PHILIPPINES

Philippine swine research work is a joint endeavor between the government and private sectors. In the government, it is spearheaded by the Bureau of Animal Industry, that supports research in breed improvement and propagation (both natural and artificial insemination), feeds and feeding and disease control and prevention. It has swine research and breeding facilities in strategic areas. Government educational institutions like the University of the Philippines College of Agriculture in Los Banos, Laguna, Central Luzon Agriculture College in Munoz, Nueva Ecija, and allied colleges in the Visayas and Mindanao region conduct extensive research in swine production and nutrition. In the private sector, the Araneta Foundations, United States Swine Development and Research (Philippines) Corporation, and numerous medium and large-scale commercial piggeries test the performance of their own swine.

Research findings from the Bureau of Animal Industry are limited since its primary concern is the propagation of improved swine breeds and the extension of technical help to producers and would-be producers. Some recent research findings (Modern Agriculture and Industry, 1973) are:

1. Swine raisers can cut 50 percent of their feed expenses by feeding their stock unlimited forage (grasses and legumes) and get good results. One group of pigs

was fed a full concentrate (not ad lib) ration plus unlimited forage and the other fed 50 percent full concentrate ration plus unlimited forage. The latter had a better feed conversion, breeding performance, and carcass quality.

2. Up to 50% of the concentrate can be fed as sorghum in panicle.
3. Water hyacinth (water lily) minus the roots can substitute for other forages and can be used up to 25 percent of the full concentrate ration for pigs. Fresh water lily must be washed very well, or be cooked to preclude infection.
4. Chicken manure can substitute for up to 25 percent of the full concentrate ration without harmful effect. Beyond 25 percent, the broth of pork will have a "boary" odor.

The above findings are initial attempts to reduce the cost of feeding hogs by making use of locally available feed substitutes. Further studies, however, are still needed to determine restrictions or economic feasibility in larger groups of swine.

The Animal Husbandry Department of the University of the Philippines College of Agriculture in Los Banos, Laguna, is perhaps doing the best research on swine production. Some of its swine research findings are as follows:

In a study on the economic feasibility of

large-scale production, Eusebio and Oñate (1967) reported the following 5-year average percentage production costs:

Operating Expenses	Percent
Feed cost	74.0
Salaries and wages	5.2
Medicines and chemicals	5.0
Depreciation on fixed assets	7.4
Transportation expenses	1.4
Capital interest	0.4
Land rent	0.4
Miscellaneous	4.9
Total	100.0

Eusebio and Oñate found that a 12.5 percent improvement in feed efficiency would require an improved diet which would cost 12 percent more. They also reported the cost of major feed nutrients in a typical pig growing ration (14-16% crude protein) as shown below:

	Percent
1. Energy (corn, rice bran)	47.0
2. Protein (fish meal, soybean meal, meat and bone meal)	42.5
3. Minerals	3.2
4. Vitamins (additive)	6.6
Total	100.0

Research studies at the University of the Philippines College of Agriculture have been directed toward substantial cost savings and improvements in production efficiency through increased litter size, economical weight gains and improved carcass quality. Based on the data of Eusebio and Oñate (1967), the energy and protein portions of the diet offer maximum potential for increased profit.

Studies on energy and protein feed utilization as

well as a least-cost ration experiment at the UP College of Agriculture as analyzed and compiled by Eusebio and Oñate (1967) indicate the following results:

A. Energy studies

1. Corn and rice bran as energy feeds constitute 60 to 70 percent of the balanced ration for growing-finishing hogs.
2. Normal, healthy litters can be produced when sows are fed daily 4 kg corn silage plus 1.2 kg of concentrate balancer (supplying the protein, vitamins and mineral requirements).
3. Results of corn silage feeding on growing-finishing hogs weighing from 50 to 90 kg have shown that 20 percent corn silage mixed with 80 percent growing ration (containing 16 percent protein) was 92 percent as efficient as those fed 100 percent growing ration. Cost of feed was cut 7 percent.

B. Protein feed studies

Since protein feeds such as soybean oil meal, fish meal and dried skimmilk are imported and expensive, research at the UPCA have explored the use of locally grown beans, namely, paayap, tapilan, mungo, and kadyos.

Their initial findings (Eusebio and Oñate, 1967) showed that toasted paayap (56 percent of the diets) and toasted tapilan (69 percent of the diet) were 69 and

82 percent as efficient, respectively, in promoting weight gains as dried skimmilk when used in starter diets. Protein efficiencies gain/protein intake were 3.95 and 2.60 for toasted tapilan and paaya, respectively.

Perhaps, the most valuable research product from the UP College of Agriculture has been the "Miracle Pig" (Catanaoan, 1973). This new breed, now called the UPCA pig, was the product of a 7-year breeding program started in 1962. It came from one of the research projects funded by the National Science Development Board (NSDB) in cooperation with the UP College of Agriculture. The research was conducted by Dr. Ernesto M. Rigor and Mr. Melanio Supnet, both of the UPCA.

The UPCA is a triple cross, 50% Large White (Yorkshire in the United States), 25% Landrace, and 25% Philippine native pig. It utilized the Landrace for its leanness in carcass, good-sized litter and efficient feed utilization; the Large White for its fast growth and efficient feed utilization; and the Philippine pig for its adaptability and hardiness.

Mensalvas (1968) described the Philippine native pig as black-and-white in color, weighs only 0.6 kg at birth, 9.9 kg at 6 months, 34.5 kg in one year, 55.9 kg in one-year-and-a-half, and 64.4 kg in 2 years of age.

The UPCA pig is highly efficient (3.3 kg of feed

per kg gain versus 3.6 to 4 kg for other breeds), thrives on table scraps and kitchen refuse and greens, and grows rapidly (90 kg or more in 180 days with a daily gain of 0.6 kg).

As early as Feb., 1970, there were about 300 UPCA weanlings on sale at ₱70 ($10) each at the UP College of Agriculture. In 1971, more of the offsprings were dispersed to Ilocos Norte, Cebu, Mindoro, and Iloilo through the 12 regional branches of the NSDB.

In 1966, the US Swine Development and Research (Philippines) Corporation initiated a pork grading and standardization project similar to that used by the United States Department of Agriculture or the National Pork Producer's Council of the United States. Their work showed that it is feasible to produce "meat type" hogs on a nation-wide scale.

De La Rama (1970) cited the following reasons for the grading system:

> "The tremendous progress made in the marketing of foodstuff today, especially in the meat and poultry products was triggered by the improvement of refrigeration and cold storage facilities. Frozen meat and poultry products can be stored for as long as 4 months without any deterioration in taste and flavor. The development too, of the supermarket had spawned a big demand for poultry and livestock products. Tourist promotions have brought about hotel and restaurant trade, which also demand high quality poultry and livestock products acceptable to the taste of their foreign guests. Added to these, are the processing and canning plants which as much as possible choose the best quality in meat and poultry products to sustain the demands of the supermarkets and supplant the imported meat and poultry products which were curtailed due to the dollar restriction. The recent operation

> of the Greater Manila Terminal Food Market is also to be considered. This wholesale marketing complex was patterned after the ones in Europe and America, where the farm produce is graded according to the accepted standards."

As stipulated in their recommendations to hog producers, a good herd should have the right breeds to produce the type of hogs that will be demanded by the new grading system. Some mode of identification, such as earnotching must be adopted, so that accurate production records can be maintained. Gilts selected for breeding must be fast growing, meaty, have adequate bones, twelve well spaced nipples, and be sound on their feet. Gilts should be bred at 7-8 months. Experience at the project showed that breeding gilts early shortens their reproductive life. Extreme care must be observed before and after breeding. Many farrowing troubles can be attributed to overfeeding. Selection of boars was also emphasized.

PROBLEMS AND THEIR REMEDIES FOR SWINE PRODUCERS

The swine industry in the Philippines today is not very stable. The floods of July, 1972 has caused heavy losses. Prices of feed ingredients have gone up and rice bran is in short supply because of a crop failure in Central Luzon as a consequence of the flood. In the same year, there was drought in the Visayas region and the harvest of corn was poor. There was very little corn imported from the United States and other countries. The shortage of fish meal is worldwide. While there is local fish meal available, the quality is not very reliable since the government has no quality control over it. Most of the local fish meals are very salty and adulterated. Local fish meal is usually sundried, and consequently, exposed to flies, becoming a potential source of salmonella infection.

Most of the swine in the Philippines are raised by the back-system where, at most, a swine project has 5-8 sows or finishers. Some producers are leaving the business because the high feed costs and poor quality ingredients have reduced profit margins. Although the government is generous with financial and technical aid, the swine producers are reluctant to expand their projects due to uncertainty. The demand for pork is very high but so are production costs. Since the imposition of the Martial Law in late 1972, prices of commodities have gone up tremendously. Construction materials, labor costs,

taxes, and fuel have gone up. Commercial feeds have increased in price from 30 to 40%.

Swine markets are poorly developed in the Philippines. Swine raisers from as far as Mindanao market their pigs in Manila both by land and water transportation. Consequently, loss of weight during shipment is large. Cost of freight, handling, taxes, stockyard fees, etc., all add up to the cost of pork, which is usually passed on to the consumers. Large producers do not deal with marketing middlemen. He markets the pigs, butchers them and sells direct to consumers, supermarkets, hotels, restaurants, hospitals, or to meat packing plants like the Delta Packing Corporation and the Pure Foods, Incorporated. The Robina Livestock Farm has its own canning facilities too. Antonio Floreindo of Tagum, Davao (Mindanao), whose famous Nenita Farm has 18,000 swine (the biggest in the Philippines and the Far East) should be in a good profit situation, since he produces a large part of the feed for his hogs. Rice bran, corn, copra meal and fish meal are also cheap in his area. He slaughters his pigs in Davao and ships the carcass to Cebu and Manila by plane at a very low cost.

The Monterey Farms, Inc., with swine projects located on various areas in Batangas and in Laguna (Luzon) has 10,000 head of hogs. They plant large quantities of corn on their 1,200 hectare farms in Cauayan, Isabela (also in Luzon) and feed it to their hogs. Hormel buys and produces its hogs direct, cutting out the middlemen.

The government is encouraging farmers to produce more grain crops such as rice, corn and sorghum. Sorghum and soybeans are well-adapted in the Philippines and many farmers are now engaged in the production.

The Central Bank of the Philippines and the rural banks are now financing small producers in the barrios (villages) up to ₱4,500 ($690) per individual, at very liberal terms. Hence, small producers are encouraged to produce more and stay in the business. The producer is visited from time to time by a bank representative as well as the technicians and veterinarians of the Bureau of Animal Industry. Similarly, artificial insemination is extended to these small producers by the Bureau of Animal Industry.

LINEAR PROGRAMMING

For the past few years, there has been a tremendous increase in the number of medium and large commercial piggeries in the country, as well as expansion of the existing ones. The keen competition for feedgrains between the human and livestock population, national calamities such as floods, typhoons and drought, and the high cost of importation aggravated already high feed costs. To remedy the situation locally grown "substitute feeds" are finding their place in good swine rations.

Ration formulation is not a problem to small or backyard producers whose feeds consist of household slops, garbage or residues mixed with rice bran, grated coconut meat, corn bran and excess fruits or vegetables from the farm. Medium-sized producers buy ready-mixed feeds from feed millers or dealers and often dilute these feeds with rice bran, wheat bran or corn bran to economize without regard to the reduced nutritive value of the final ration. Some rely on the "Pearson Square" method of formulating rations or follow the Bureau of Animal Industry feed formulae as shown on table 6.

Advanced feed formulation techniques find their greatest application with feed millers and large-scale commercial piggeries who mix their own feeds. They purchase ingredients in large batches making least-cost formulation feasible. Feed manufacturers will be able to supply to their customers

Table 6

BUREAU OF ANIMAL INDUSTRY FEED FORMULAE FOR SWINE[1]

Ingredients	Pre-Starter %	Creep %	Growing %	Breeding %	Fattening %
RICE BRAN	25.0	32.0	48.0	60.0	65.0
CORN (YELLOW GROUND)	44.0	42.0	31.0	20.0	24.0
COPRA MEAL	--	3.0	3.0	8.0	2.0
SOYBEAN MEAL, 44%	15.0	12.0	8.0	3.0	3.0
FISH MEAL, 60%	12.0	7.0	6.0	5.0	2.0
MOLASSES	2.0	2.0	2.0	2.0	2.0
OYSTER SHELL POWDER	1.5	1.5	1.5	1.5	1.5
SALT	0.5	0.5	0.5	0.5	0.5
Protein (NLT[2])	20	17	16	15	12
Fiber (NMT[3])	5	6	8	10	10
Fat (NLT)	2	2	2	2	2
Fat (NMT)	10	10	10	10	10
Moisture (NMT)	13	13	13	13	13

[1] Bureau of Animal Industry 1968 file

[2] Not less than

[3] Not more than

through the use of least-cost formulation, better quality feeds at a reduced cost.

Linear programming offers the best method for meeting all specified nutrient requirements at the lowest cost. However, the computer can make no inclusions regarding palatability, possible toxicity, or adequacy of nutrients not specified. Ration requirements and specifications for growing-finishing swine as specified by the National Research Council are shown on table 7.

Computers capable of linear programming are now available in the Philippines. There is one at the University of the Philippines College of Agriculture and several are owned by leading feed manufacturers. Currently, many are poorly utilized since few operators are trained in linear programming techniques.

Linear programming has become an important tool to modern managers, especially in allocating business resources to achieve maximum profit or minimum cost. In the United States, the commercial significance of linear programming was first discovered in the early fifties and since then it has served in many important industries. The petroleum industry has led in the use of linear programming for gasoline blending and refinery scheduling. Linear programming is also used in meat packing, milk processing, steel fabricating, and airline scheduling. Agricultural economists determine cropping patterns and acreages for optimum land utilization through its use.

Table 7

RATION REQUIREMENTS AND SPECIFICATIONS FOR SWINE[1]

Crude protein, %	16	14	13	12	Min.
Fiber, %	5	5	5	5	Max.
Calcium, %	.6	.5	.5	.5	Min.
Calcium, %	.7	.6	.6	.6	Max.
Phosphorus, %	.5	.4	.4	.4	Max.
Salt, %	.5	.5	.5	.5	Const.
Cottonseed meal, %	5	5	5	5	Max.
Feathermeal, %	2	2	2	2	Max.
Rye, %	15	15	15	15	Max.
Fat, %	7	7	7	7	Max.
Lysine, %	.54	.54	.54	.50	Min.
Tryptophan, %	.13	.10	.09	.09	Min.
Cystine and Methionine, %	.55	.43	.40	.37	Min.
Metabolizable Energy, kcal/lb.	1250	1250	1250	1250	Min.
Vitamin premix, %	.2	.2	.2	.2	Const.

[1] National Research Council ration requirements as specified for growing-finishing swine, 1968.

When linear programming is applied to swine rations, the least-cost combination of ingredients is put together to meet the animal's specified nutrient requirements. All feed ingredients are considered in terms of their chemical make-up and are described in terms of energy, fiber, proteins, minerals and vitamins.

A. Theory Behind Linear Programming

Perry (1966) stated that, according to linear programming, there is no "one best formula," because of possible interchangeability among various feed ingredients on a nutritional basis. However, when cost is considered, there is one and only one combination that will meet the nutrient specifications at lowest cost. One must assume that any single amino acid from one source is as valuable to an animal as the same amino acid from another. In other words, there must be a complete interchangeability of nutrients among sources, otherwise, linear programming will be of no value. Naturally, there are cases in which this assumption is not met. It is the task of the animal nutritionist to know and account for these exceptions.

B. Information Needed

Perry (1966) and Dent and Casey (1967) agreed on the following considerations for successful linear programming of rations:

1. Tolerances must be known. The machine does not know and perhaps even the technician operating the machine does not know that cottonseed meal which has not been degossypolized is toxic to swine. The typical tolerance limit of 5% must be specified. If no minimum is specified and if the price is high enough, no cottonseed meal will be found in the final least-cost ration. If the price is favorable, up to, but no more than, specified maximum tolerance level will be used in the final formula.

Minimum levels may also be specified. For example, a ration for pregnant brood sows in drylot should contain at least 15 percent dehydrated alfalfa meal. If its price is low enough, more than 15 percent might be found in the final formula, but no less than the specified minimum will be used.

Finally, both a minimum and a maximum (a range) may be established for certain nutrients or ingredients. In the case of calcium in swine rations, a minimum is obviously necessary but high levels may result in parakeratosis due to increased zinc needs.

2. Feedstuff composition. Accurate formulation of the least-cost rations depends on accurate knowledge of the nutrient composition of the feedstuffs. If the formulator plans to use "averages" from typical published feed tables, liberal safety margins should be included in the specifications for the final formula.

Knowledge of the nutrient composition is critical for major nutrients as well as those apt to be limiting but may be less important where minor nutrients will be supplied at the recommended nutritional level in premixes. An example is the use of trace-mineralized salt.

3. Cost of ingredients. Ingredient prices are the most variable item in least-cost formulation. The prices specified should be those at the point where the feed is mixed and not at some distant point where transportation costs will alter price relationships. Any unusual processing requirements should be included in the price.

4. Constant ingredients. Certain ingredients (for example, salt) need not be included in the program if they are to be held at constant levels. If salt were to be included at 0.5% of the ration, computations might be based on 99.5 lbs. instead of 100 lbs., thus reducing computer operating time.

5. Animal nutritionist essential. There are characteristics of some feedstuffs not revealed by typical analyses. Palatability is difficult to describe, and no known chemical or physical analysis will give an indication of this phenomenon. Therefore the animal nutritionist may not accept the least-cost ration. The nutritionist must make the final acceptance, at least until better methods are known for identifying and

characterizing feedstuffs.

6. Protein versus amino acid requirement. Probably both total protein and essential amino acid requirements should be considered for simple-stomached animals. Lysine and methionine are the two essential amino acids most likely to be limiting. However, tryptophan or threonine may be deficient under certain conditions. The other essential amino acids are ordinarily adequate when total protein requirements are met. Excesses of some amino acids may be detrimental but such excesses are not common.

C. Preparation of Information for Computer Analysis

The preparation of data for linear programming will vary, depending upon the program and the computer. However, the following basic information will be required in all cases:

1. Setting up a program (see data matrix, appendix table 8).
   a. Across the top of the table can be listed all the ingredients to be considered. The number of ingredients must not exceed the capacity of the computer, but some can handle as many as 75 ingredients.
   b. Along the left hand side of the table, list the different items to be considered in the ration which includes weight, protein, energy, fiber, calcium, phosphorus, and individual amino acids. Fat and vitamin contents are sometimes included

if necessary.

c. Under each ingredient, list the analysis for each of the items listed.

d. Along the right hand side (RHS) of the table list the desired characteristics and the tolerances, (fixing weight at 100 or equality (=), protein is greater than or equal to ($\geq$), energy is greater than or equal to, fiber is less than or equal to ($\leq$), calcium is more than or equal to, phosphorus is less than or equal to, lysine and methionine is greater than or equal to, etc.).

e. At the bottom of the table, list current prices.

When this table has been completed, a computer operator should be consulted for conversion to input information for the computer. (FORTRAN Coding forms are prepared with the information from matrix table. Restrictions, ranges, and bounds of some of the ingredients will appear in this form, then cards are punched for the computer input.) After execution, the proposed least-cost ration is inspected, and accepted or rejected by the nutritionist. The nutritionist may actually accept the second or third least-cost ration because of unprogrammed or unprogrammable characteristics of the least-cost ration.

Formulas may be rerun as often as desired. Usually, only ingredient cost changes, unless a new ingredient is added to the matrix. Thus the feed formulator is able to change

the ration to take advantage of these price changes and availability. Obviously, large price fluctuations will be reflected in formula changes. However, the nutritionist must consider these changes based on their expected effect on animal performance.

The pertinent parts of the least-cost formulation, based on the data matrix in appendix table 8, is shown in appendix table 9 and 10.

Table 8

MATRIX FOR A SWINE CREEP RATION

LHS	Corn, yellow	Corn gluten meal	Copra meal	Fish meal	Rice bran	Sorghum
Weight, kg	1	1	1	1	1	1
Protein	.089	.429	.20	.613	.135	.111
Dig. Energy, Mcal	3.61	3.54	3.36	3.12	3.25	3.41
Fiber	.02	.04	.12	.01	.15	.03
Calcium	.0002	.001	.0021	.055	.0006	.0004
Phosphorus	.003	.0012	.0061	.028	.018	.0031
Lysine	.002	.006		.05	.005	.002
Methionine	.001	.09		.02	.002	.002
Cost (₱)[1]	.58	.50	.45	2.30	.43	.54

[1]Philippine peso (April 1973 values)

Soybean meal	Wheat bran	Limestone	Dical	Trace mineral Premix	Vitamin Premix	Lysine	Methionine	Salt		RHS
1	1	1	1	1	1	1	1	1		100
.44	.16								≥	22
3.34	2.93								≥	350
.07	.10								≤	4.5
.0025	.0014	.33	.26						≥	.80
.0024	.0025		.195						≤	.60
.03	.004					.78			≥	1.20
.006	.001							.98	≥	0.80
1.30	.42	.35	1.94	2.64	7.33	17.60	11.74	.50		N

Table 9

RESTRICTIONS, RANGES, AND BOUNDS FED INTO THE COMPUTER FOR A SWINE CREEP RATION[1]

Items	Restrictions	Ranges	Bounds
Weight, kg	100	--	--
Protein, %	25	3[2]	--
Digestible Energy, Mcal	350	--	--
Calcium, %	0.8	0.2[3]	--
Phosphorus, %	0.6	0.1[4]	
Fiber, %	4.5	--	--
Lysine, %	1.2	--	--
Methionine, %	0.8	--	--
Salt, %	--	--	0.5
Vitamin Premix, %	--	--	0.3
Trace Mineral Premix, %	--	--	0.2
Fat, %	--	--	5.0

[1]Swine creep ration used in table 8.

[2]Spread of 3% increase from minimum protein of 22% to 25%.

[3]Calcium percent can go as high as 1 or a spread of 0.2% from 0.8 to 1%.

[4]Phosphorus can go below 0.6% by 0.1% only.

SIGNS OR ABBREVIATIONS USED

WT	Weight
PROT	Protein
DE	Digestible Energy
CA	Calcium
PHOS	Phosphorus
FIB	Fiber
LYS	Lysine
MET	Methionine
CGM	Corn Gluten Meal
CM	Copra Meal
SBM	Soybean Meal
RB	Rice Bran
FM	Fish Meal
SG	Sorghum
WB	Wheat Bran
LM	Limestone
DC	Dicalcium Phosphate
VITP	Vitamin Premix
TMP	Trace Mineral Premix
REST	Restraints
SPRD	Spread (Bounds)
FX	Fixed
PROD	Product
UL	Upper Limit
LL	Lower Limit

Table 10

COMPUTER OUTPUT OF A SWINE CREEP RATION[1]
SECTION 1-Rows

No.	Row	At	Activity	Slack activity	Lower limit	Upper limit	Dual activity
1	COST[2]	BS	74.87	74.97	NONE	NONE	1.00
2	WT	EQ	100.00	.	100.00	100.00	.24
3	PROT	UL	25.00	3.00	22.00	25.00	.29
4	DE	LL	350.00	.	350.00	1.00	.22
5	CA	LL	.80	.	.80	1.00	1.77
6	PHOS	LL	.50	.10	.50	4.5	8.79
7	FIB.	UL	4.50	.	NONE	NONE	22.87
8	LYS	LL	1.20	.	1.20	NONE	.
9	MET	BS	4.35	3.55	.80		

[1] Computer output of the swine creep ration in table 8.

[2] Cost expressed in Philippine peso

Table 10 (continued)

SECTION 2-COLUMNS

No.	Column	At	Activity	Input cost	Lower limit	Upper limit	Reduced cost
10	CORN	BS	31.35	.58	.	NONE	.
11	CGM	BS	47.64	.50	.	NONE	.
12	CM	LL	.	.45	.	NONE	.06
13	SBM	LL	.	1.30	.	NONE	.35
14	RB	BS	13.11	.43	.	NONE	.
15	FM	LL	.	2.30	.	NONE	.55
16	SG	LL	.	.54	.	NONE	.03
17	WB	LL	.	.42	.	NONE	.13
18	LM	BS	1.79	.35	.	NONE	.
19	DC	BS	.56	1.94	.	NONE	.
20	SALT	EQ	.50	.50	.50	.50	.74
21	VITP	EQ	.30	7.33	.30	.30	7.56
22	TMP	EQ	.20	2.64	.20	.20	2.87
23	FAT	BS	3.52	1.39	.	5.00	.
24	LYS	BS	1.01	17.60	.	NONE	.
25	MET	LL	.	11.74	.	NONE	11.97

Table 10 (continued)

SECTION 1-ROWS AT LIMIT LEVEL

No.	Row	At	Activity	Slack Activity	Lower limit Upper limit	Lower activity Upper activity	Unit cost Unit cost	Limiting Process	At At
2	WT	EQ	99.99	.	99.99	98.57	.25	FAT	UL
					99.99	103.42	.24	FAT	LL
3	PROT	UL	24.99	3.00	21.99	16.18	.29	DC	LL
					24.99	37.35	.29	CORN	LL
4	DE	LL	349.99	.	349.99	337.43	.22	FAT	LL
					--	355.26	.22	FAT	UL
5	CA	LL	.80	.	.80	.20	1.77	LM	LL
					1.00	1.27	1.77	FAT	UL
6	PHOS	LL	.50	.10	.50	.39	8.79	DC	LL
					.60	.94	8.79	LM	LL
7	FIB	UL	4.50	.	--	2.84	1.98	RB	LL
					4.50	5.41	1.98	DC	LL
8	LYS	LL	1.20	.	1.20	.42	22.87	LYS	LL
					--	2.32	22.87	FAT	UL

Table 10 (continued)

SECTION 2-COLUMNS AT LIMIT LEVEL

No.	Col.	At	Activity	Input Cost	Lower limit Upper limit	Lower activity Upper activity	Unit cost Unit cost	Upper cost Lower cost	Limiting Process	At At
12	CM	LL	.	.45	. NONE	14.33 17.86	.06 .06	Infinity .39	DC RB	LL LL
13	SBM	LL	.	1.30	. NONE	48.71 33.69	.35 .35	Infinity .95	DC LYS	LL LL
15	FM	LL	.	2.30	. NONE	12.11 3.28	.55 .55	Infinity 1.75	FAT DC	UL LL
16	SG	LL	.	.54	. NONE	71.64 30.00	.03 .03	Infinity .51	FAT FAT	LL UL
17	WB	LL	.	.42	. NONE	11.46 10.84	.13 .13	Infinity .29	DC FAT	LL UL
20	SALT	EQ	.50	.50	.50 .50	2.92 1.93	.74 .74	Infinity .24	FAT FAT	LL UL
21	VITP	EQ	.30	7.33	.30 .30	3.12 1.73	7.57 7.57	Infinity .24	FAT FAT	LL UL
22	TMP	EQ	.20	2.64	.20 .20	3.22 1.63	2.88 2.88	Infinity .24	FAT FAT	LL UL
25	MET	LL	.	11.74	. NONE	3.42 1.43	11.98 11.98	Infinity .24	FAT FAT	LL UL

Table 10 (continued)

SECTION 4-COLUMNS AT INTERMEDIATE LEVEL

No.	Col.	At	Activity	Input Cost	Lower limit Upper limit	Lower activity Upper activity	Unit cost Unit cost	Upper cost Lower cost	Limiting Process	At At
10	CORN	BS	31.35	.58	. NONE	3.00 38.97	.03 .12	.61 .46	SG PROT	LL UL
11	CGM	BS	47.64	.50	. NONE	38.63 47.95	.09 1.17	.59 .67	PROT CA	UL LL
14	RB	BS	13.11	.43	. NONE	24.23 14.50	.08 .65	.51 .22	CM PROT	LL UL
18	LM	BS	1.79	.35	. NONE	1.16 2.39	1.67 .59	2.02 .24	CM CA	LL LL
19	DC	BS	.56	1.94	. NONE	2.58 1.26	3.21 1.49	5.15 .44	FM CM	LL LL
23	FAT	BS	3.52	1.39	. NONE	2.52 4.15	3.29 .57	4.69 .82	FIB CA	UL LL
24	LYS	BS	1.01	17.60	. NONE	.83 2.44	10.03 17.81	27.63 .20	FM LYS	LL LL

SUMMARY

The swine industry of the Philippines is at the threshold of rapid growth and development. The present hog population of almost 10 million head serves as a good foundation for needed expansion. The gradual transition from crude production of inferior pigs to modern systems with better breeds, and at the same time, the tremendous increase of medium and large-scale commercial piggeries, is essential, since almost 60 percent of the total meat supply for 40 million Filipinos comes from pork.

Problems which beset the swine industry are manifold. Foremost are poor feed supplies and high feed cost. The keen competition between the human and livestock populace for most of the feed grains and other ingredients, natural calamities, high cost of importation, unscrupulous middlemen, poor marketing and poor transportation facilities are all contributory factors.

The government and private enterprise are now cooperating to relieve some of the problems of the industry. Technical and financial assistance are extended on a nation-wide scale both large and small producers. Artificial insemination, use of better breeds of swine and use of improved swine rations are commonplace. Feedgrain production, especially corn, soybeans and sorghum is being accelerated. Local feeds are being studied as substitutes for higher priced grains to bring down cost of production.

Formulation of least-cost swine rations with computers can reduce feed costs. However, nutrient specifications, and special characteristics of locally produced feedstuffs must be carefully considered. Nutritionists must carefully accept or reject least-cost rations based on their knowledge of these local feeds.

Increased demand for pork, as well as technical advancements in the swine industry indicate a bright future for Philippine swine production.

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STATUS OF THE SWINE INDUSTRY IN THE PHILIPPINES

by

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