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THE A, B, C OF FEEDING PIGS
WITH LOCAL PRODUCTS AND BY-PRODUCTS
IN GUYANA



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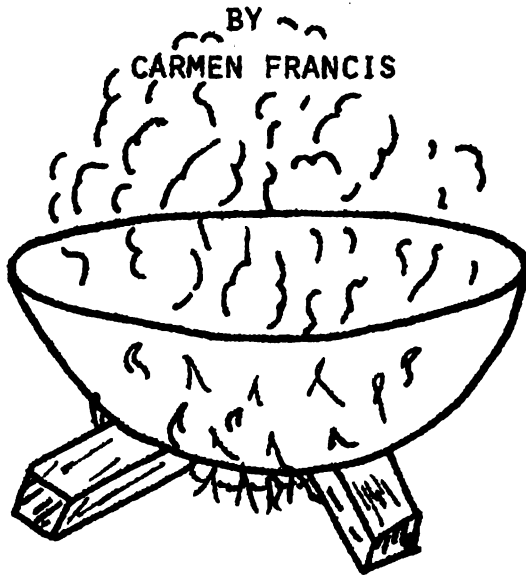
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THE A, B, C OF FEEDING PIGS
WITH LOCAL PRODUCTS AND BY-PRODUCTS
IN GUYANA

INTRODUCTION

BY
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IICA



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ACKNOWLEDGEMENTS

This booklet was prepared with the aim of advising pig producers how to replace expensive, imported feed ingredients with local by-products which are more readily available and economical. It is a composite of general information on feeds and feeding, research reports from the Ministry of Agriculture and the writer's personal thoughts and observations.

The writer wishes to express grateful appreciation to Dr. P.L. McKenzie, Deputy Chief Agricultural Officer, Ministry of Agriculture, for his most helpful and critical review of the booklet. Special thanks are also expressed to Dr. Francis Hackman Asiedu of the Faculty of Agriculture, University of Guyana for calculating the feed combinations; also to Jenny A. Fowler, formerly of the Ministry of Agriculture, Veterinary and Livestock Science Division. Due acknowledgement is given to personnel of Guyana Mining Enterprise Limited, Surapana Farm, Linden; Alliance Pig and Poultry Farms, Coverden, East Bank Demerara; Essequibo and Demerara Pig Rearers' Federations and the Hopetown/Bel Air Swine Multiplying Co-operative Society for their useful ideas on the use of local by-products to feed swine. Special appreciation is also expressed to the staff of the Inter-American Institute for Cooperation on Agriculture for their assistance in reviewing, editing and publishing this booklet and to all individuals who have contributed to its preparation.

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INTRODUCTION

In commercial swine production, feed represents 55 to 85% of the total cost, depending mainly on the relative cost of feed, labour and housing in a particular situation. For this and other reasons, it is important that economical but nutritionally balanced diets are used.

The pig has a simple digestive system with limited ability to utilize large quantities of forage and by-products with a high fibre content. Because of this the pig, like the chicken, is in direct competition with man for available food supplies.

The pig needs a nutritionally balanced diet in order to perform its body functions and to ensure a high level of production and productivity. The feed should contain adequate quantities of carbohydrates, proteins, vitamins and minerals.

Traditionally, swine production in Guyana has been dependent on the importation of the main ingredients of feed. But because of the present economic situation, it is essential that maximum use be made of local by-products in feeding swine.

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A. PIG'S NUTRIENT REQUIREMENTS

FOR: MAINTENANCE

GROWTH

FATTENING

REPRODUCTION

NUTRIENT REQUIREMENTS

The daily nutrient requirements for the different stages of the pig's production cycle are given in Table 1. Carbohydrates, referred to as digestible energy (DE), and crude protein (CP) are the main ingredients, with minerals and vitamins being required in smaller amounts.

Carbohydrates are required for energy, proteins for growth, maintenance and reproduction, minerals for building strong bones and teeth and for the general functioning of the body, and vitamins for efficient utilization of other nutrients in the metabolic activities that occur in the animal's body.

Carbohydrates can be obtained from the by-products of the rice, sugar, coconut and cassava industries. Proteins, the second largest component of the pig's diet, can be supplied from both plant and animal sources. But because proteins from plant materials do not contain all the kinds of amino acids that the animal requires, some protein of animal origin must be included. This can be obtained from the by-products of the livestock, shrimp and fish industries..

Most energy and protein sources provide some vitamins and minerals, but often it is necessary to supplement these with additional amounts to ensure a balanced diet. Mineral sources include sodium chloride (common salt), limestone, crab and shrimp shells, gypsum, dolomite limestone, wood ashes and meat and bone meal.

Many feedstuffs commonly used as energy and protein sources for swine contain some vitamins but in quantities inadequate to meet the animal's requirement. Green forages, e.g. water weeds, zeb grass, coastal bermuda grass, etc., are the main sources of vitamins and along with mud, supply other important trace minerals such as zinc, iron and selenium.

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TABLE 1: Daily Nutrient Requirements for the Pig (a)

Nutrients	Starter (Piglets) (10-30 lb)	Grower (Weaners) (30-100 lb)	Finisher (Sows & Boars) (100 lb+)
Digestible Energy (kcal/kg)	3 500.0	3 300.0-3 500.0	3 300.0
Crude Protein (%)	22.0	16.0	13.0-14.0
Minerals:			
Calcium (%)	0.80	0.65	0.50
Phosphorus (%)	0.60	0.50	0.40
Sodium (%)	-	0.10	-
Chlorine (%)	-	0.13	-
Iron (PPM)	80.0	-	-
Vitamins:			
A (IU)	2 200.0	1 300.0	1 300.0
B6 (mg/kg)	1.5	1.1	1.1
B12 (mg/kg)	0.022	0.011	0.011
D (IU)	200.0	200.0	125.0
E (IU)	50.0	50.0	-
Riblofavin (mg/kg)	3.0	2.6	2.2
Pantothenic acid (mg/kg)	13.0	11.0	11.0
Niacin (mg/kg)	22.0	14.0	10.0
Choline (mg/kg)	1 100.0	-	-
Thiamine (mg/kg)	1.3	1.1	1.1

CP/DE ratio (b)	62.9	48.5	39.3
Ca/P ratio (c)	1.33	1.30	1.25

(a) Source: Pond, W.G. & Maner, J.H. Swine Production in Temperate and Tropical Environments. San Francisco, W.H. Freeman & Co., 1968, 180-181 pp.

(b) Crude Protein/Digestible Energy

(c) Calcium/Phosphorus

4.

But the increase in confinement rearing of swine (indoor environment on concrete or wood) has decreased the use of pastures, forages and sunlight - an important source of Vitamin D. Confinement rearing has its merits especially with fattening stock, but it is recommended that a grazing area be provided for breeding animals.

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B. LOCAL PRODUCTS AND BY-PRODUCTS

FROM: CROPS

PLANTS

ANIMALS

LOCAL BY-PRODUCTS

Some of the most useful local by-products available in Guyana and their nutritive values are listed in Tables 2 and 3, respectively.

Rice bran is good swine feed. When fed fresh it is very palatable, but it turns rancid on storage. Because of rancidity the pig consumes less, resulting in wastage and decreased growth rate. Rice bran can replace corn in quantities as much as 30% (30 lb in 100 lb) of the diet. Larger amounts tend to depress weight gain but have no effect on feed conversion. Some results have shown that rice bran has approximately the same feeding value as corn if the level of substitution does not exceed 30% of the total diet.

Molasses is rich in carbohydrates and contains essential minerals such as calcium and iron. It is also a good source of vitamins. Molasses is very palatable and is often used to increase the palatability of roughage, thereby inducing the animal to eat materials that it would normally refuse. Because of its moist nature, it reduces dustiness in feeds and facilitates feed pelleting. Molasses should provide no more than 20 to 25% of the carbohydrate requirements of the pig because of its laxative properties.

Copra meal is relatively high in proteins but it should be supplemented with other by-products and animal proteins because excess of 20% copra meal in the diet of pigs may cause soft fat. It may also contain a high level of fat depending on the process of extraction. Copra meal is a good absorbent for molasses.

Brewer's grains are a by-product of the beer industry. It is a bulky, low-energy feed commonly fed to classes of livestock other than swine. Up to 50% of the protein of the ration can be supplied by brewer's grains. It is better when fed dry because the wet material is too bulky and the animal cannot eat enough to get an adequate amount of nutrients.

Swill, also known as garbage, kitchen waste or refuse, can be an important source of feed for swine. It consists mainly of food discarded from restaurants, hotels, supermarkets, institutions (hospitals and schools), military establishments and homes.

The major constraints to feeding swill to pigs are the difficulty in transporting swill, and problems associated with sanitation and diseases. Swill can be a vehicle for spreading highly infectious diseases such as Hog Cholera, African Swine Fever, Tuberculosis, Salmonellosis and Trichinosis. ALL SWILL AND LIVESTOCK WASTES (TABLE 2) MUST BE BOILED BEFORE FEEDING.

Water weeds (Aquatic plants) are rich in minerals such as iron and iodine, and Vitamins A, B, C and E. Some of these are water spinach, water-cress, floating rice and duckweed. The latter is widely used. It has a high protein content (37-45%) which is rich in amino acids that are normally lacking in plant protein.

Fish meal is the dried, ground carcass of fish. In order to make good fish meal, the following must be observed:

- Dry to a moisture content of about 15% to prevent growth of moulds. Avoid overheating and overdrying as this will damage both protein and oil;
- Reduce the fat content to 10% or less to prevent/reduce rancidity during storage;
- Cool fresh hot fish meal immediately after processing to maintain quality.

Fish meal contributes proteins, vitamins (B12, riboflavin, niacin and pantothenic acid) and minerals (calcium, phosphorus, sodium, magnesium, potassium, iron, copper, zinc and manganese).

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Fish meal, fish silage, etc. which contain too much fat may cause a strong, oily or fish off-flavour in fresh pork and pork products such as ham and bacon.

Fish silage is a grey viscous liquid, rich in vitamins, minerals and proteins. Fish silage is so called because the process of preparation resembles that of ensiling forage. A simple method of ensiling fish involves the following:

- Mince about 100 lb waste fish, low in oil, with 10 lb (6 pt) molasses;
- Add two gallons water, mix and cook for 20 minutes;
- Cool at room temperature;
- Place cooked fish-molasses mixture in drums coated inside with bitumen and add 5 ml or one (1) teaspoon culture of Lactobacillus plantarum^(a) to every 22 lb fish-molasses mixture;
- Stir the mixture, cover and allow to ferment at room temperature, taking care to stir occasionally;
- The product is ready in three (3) days.

Shrimp meal is the dried waste of the shrimp industry, consisting of heads and shells (hulls) and in some cases whole shrimps. Dried shrimp meal contains about 45% crude protein and a high mineral content (calcium, phosphorus, etc.).

(a) Obtainable from the Veterinary Diagnostic Laboratory, Mon Repos.

TABLE 2: Industries and their By-Products

INDUSTRIES	BY-PRODUCTS
Rice	Rice bran, broken rice, rice chips, rice husk and rice offal (bhussi)
Sugar	Molasses
Cassava	Cassava middlings
Coconut	Copra meal, coconut-oil meal, "cush-cush" and "sour water"
Fish	Fish meal and fish offal
Shrimp	Shrimp meal
Livestock	Abattoir waste, meat scraps, trimmings, blood, bones and chicken offal

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C. FORMULATING FEED RATIONS

BASED ON:

PIG'S REQUIREMENTS

NUTRITIVE VALUE OF LOCAL
PRODUCTS AND BY-PRODUCTS

TABLE 3: Nutrient Composition of some Local Products/By-Products

COMMODITY	DRY MAT- TER (D.M.) %	CRUDE PRO- TEIN (CP) %	DIGESTIBLE ENERGY (DE) %	CRUDE FI- BRE (CF) %	ETHER EX- TRACT (EE) %	CAL- CIUM (CA) %	PHOSPHO- RUS (P) %	SODIUM (Na) %	IRON (Fe) %	RIBO- FLAVIN mg/kg	PANTO- THENIC mg/kg	NIA- CIN mg/kg	CHO- LINE mg/kg
Molasses	71.0	4.7	2464	0.0	0.1	0.89	0.08	-	0.019	3.3	38.3	34.3	876.0
Rice bran	81.0	13.5	3256	10.1	15.1	0.06	1.82	-	0.019	2.6	23.5	303.2	1254.0
Broken rice	89.0	7.3	3784	0.4	0.4	0.03	0.12	-	0.002	0.6	3.3	14.1	907.0
Bhussí	90.0	12.0	3916	17.0	9.0	0.04	1.42	-	-	1.8	58.3	531.7	1307.0
Rice hull	90.0	3.3	1715	35.7	1.2	0.09	0.06	-	-	-	-	-	-
Cassava	88.6	1.8	2965	2.1	0.4	0.07	0.05	-	0.025	-	-	-	-
Corn	87.5	8.9	7098	2.0	3.9	0.03	0.29	-	0.003	1.2	4.9	24.6	537.0
Copra meal	88.8	22.4	3363	9.6	6.0	0.21	0.61	0.04	0.196	3.1	6.6	24.9	920.0
Brewer's grain (dried)	92.0	25.9	1892	15.0	6.2	0.27	0.50	0.26	0.025	1.5	8.6	43.4	1587.0
Swill	96.0	17.5	-	20.0	-	-	-	0.33	-	-	-	-	-
Meat meal	93.5	53.4	3010	2.4	9.9	7.94	4.03	1.68	0.044	5.3	4.8	56.9	1955.0
Fish meal	92.5	65.9	3190	1.0	5.8	4.46	2.66	-	0.043	6.6	9.8	68.9	2382.0
Shrimp meal	-	-	-	-	-	38.00	-	-	-	-	-	-	-
Wood ash	-	-	-	-	-	21.00	-	-	-	-	-	-	-
Limestone	-	-	-	-	-	38.00	-	-	-	-	-	-	-

FORMULATING FEED MIXTURES

When formulating feed mixtures, it is important to know the nutrient requirements of the pig and the nutrient composition of the ingredients that are to be used in preparing the feed.

There are different methods of formulating feed mixtures, but one of the most frequently used is the Square Method. This method places major emphasis on the protein requirement of the animal. For example, the farmer may want to prepare a feed mixture for piglets using rice bran, broken rice and fish meal. From Table 1, it is noted that the crude protein requirement of a piglet is 22% and from Table 3 we note the protein content of the by-products as follows: rice bran (13.5%), broken rice (7.3%) and fish meal (65.9%).

Use the "Square Method" to calculate the required quantities as follows:

- Draw a square on a piece of paper and place the protein requirement (22.0) in the middle (Fig. 1A).
- Work out the average crude protein content of rice bran and broken rice mixed in the proportion 1:2, i.e.

$$\{(1 \times 13.5) + (2 \times 7.3)\} \div 3 = 9.4\%$$
 This means that in every unit of rice bran/broken rice mixture the protein content will be 9.4%.
- Place the protein % for the rice bran/broken rice mixture (9.4%) in the upper left hand corner of the square and the protein % of the fish meal (65.9%) in the lower left hand corner.
- Subtract diagonally in order to find the proportion of each by-product required to prepare the feed containing 22.0% crude protein.

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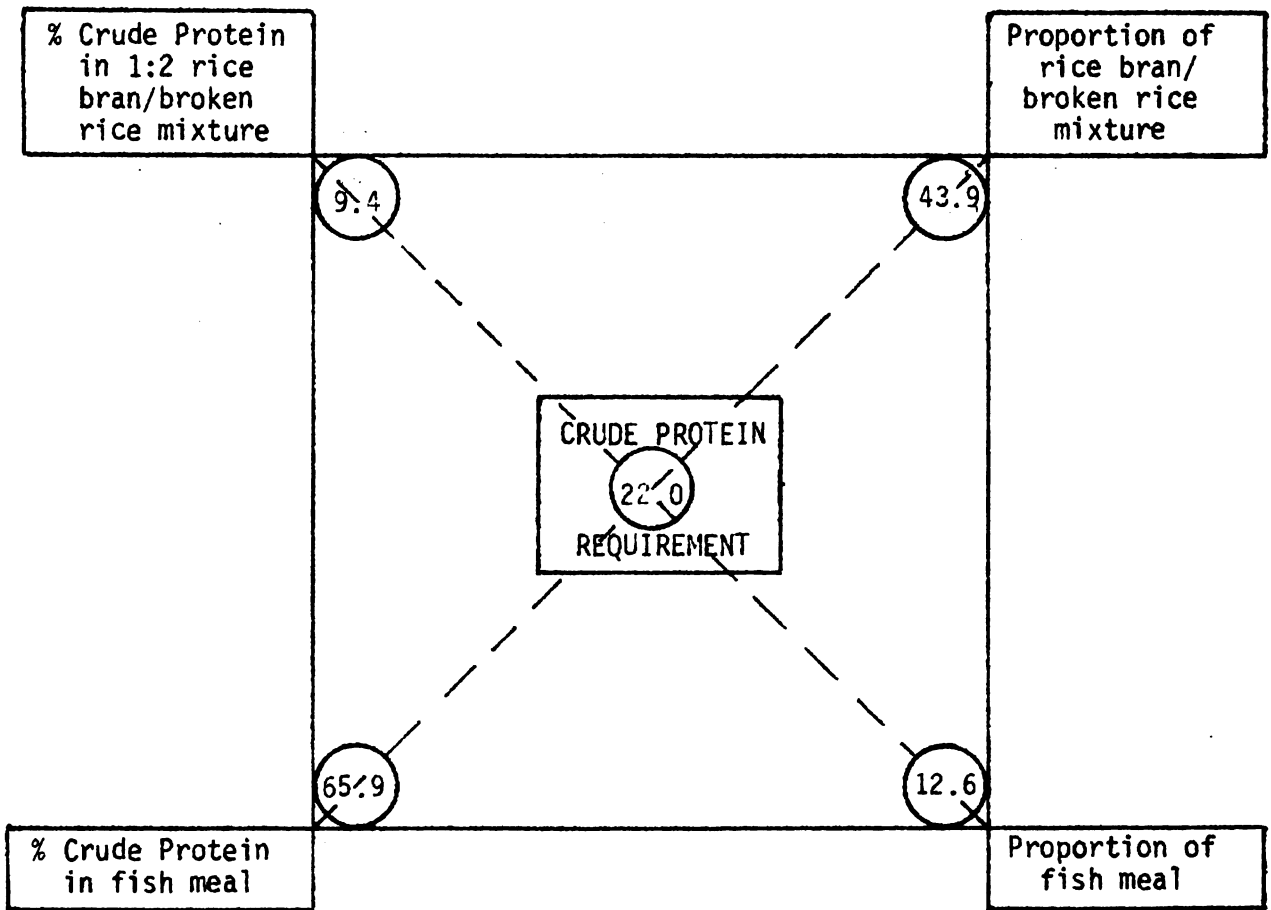


Figure 1A: The "Square Method" of feed formulation

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- Convert the parts of protein to percentages (%) as follows:

$$- 43.9 \div 56.5 \times 100 = 77.7\%$$

$$- 12.6 \div 56.5 \times 100 = 22.3\%$$

This indicates that for every 100 lb of feed, there should be 77.7 lb rice bran: broken rice mixture and 22.3 lb fish meal. The final formula should contain:

Rice bran	25.9 lb
Broken rice	51.8 lb
Fish meal	22.3 lb
Total	<u>100.0 lb</u>

In another case, a pig farmer wishes to mix a ration containing 16.0% crude protein for fattening pigs, using rice bran, broken rice, fish meal and some mineral/vitamin supplement. He proposes to use 15.0 lb rice bran and 2.0 lb mineral/vitamin supplement per 100 lb feed and needs to know what combination of broken rice and fish meal can be used to make up the other 83.0 lb of the mixture and result in an overall ration containing exactly 16.0% crude protein.

We note that 15 lb rice bran per 100 lb ration will supply 2.02 lb crude protein (13.5% of 15 lb) and that the mineral/vitamin supplement has no proteins. The remaining 13.98 lb of protein therefore must be obtained from 83 lb broken rice: fish meal mixture, the combination of which is calculated as follows:

- If 83 lb mixture contains 13.98 lb crude protein, therefore 100 lb will contain $(13.98 \times 100 \div 83) = 16.8$ lb.
- Place this figure in the centre of the square and the % protein in broken rice and rice bran at the left top and bottom corner, respectively (Fig. 1B).

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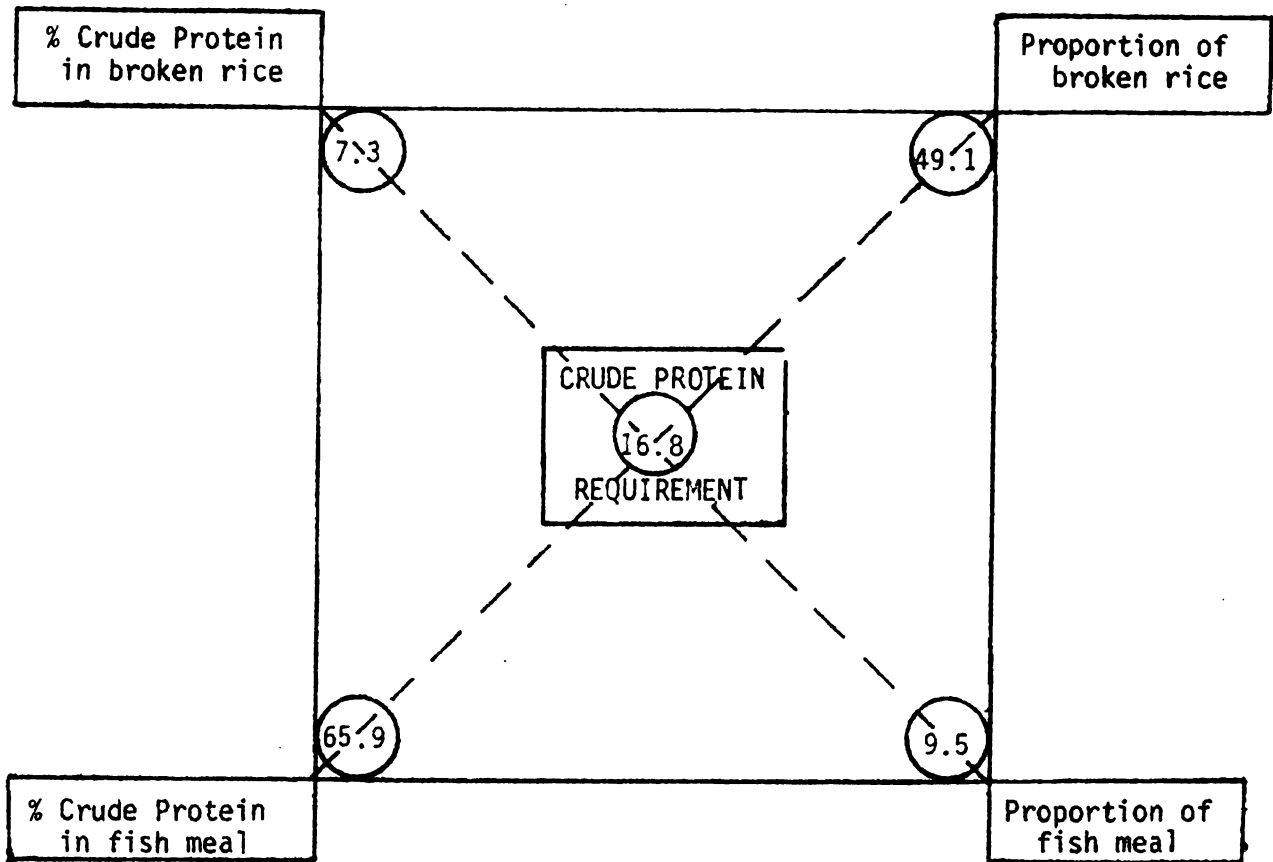


Figure 1B: The "Square Method" of feed formulation

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- Subtract diagonally (49.1 and 9.5) and add the two figures (58.6).

Amount of broken rice is $(49.1 \times 83 + 58.6) = 69.5$ lb

Amount of fish meal is $(9.5 \times 83 + 58.6) = 13.5$ lb

- The final ration should then contain

Rice bran	15.0 lb
Broken rice	69.5 lb
Fish meal	13.5 lb
Minerals/Vitamins	2.0 lb
Total	<u>100.0 lb</u>

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A N N E X

- ABBREVIATIONS USED
- EXAMPLES OF FORMULAE

ABBREVIATIONS USED

lb	pound
kg	kilogram
%	percent
ml	millilitre
°C	degrees Celsius
D.M.	Dry Matter
CP	Crude Protein
CF	Crude Fibre
CA	Calcium
P	Phosphorus
Fe	Iron
DE	Digestible Energy
kcal/kg	kilocalories per kilogram
mg/kg	milligrams per kilogram

<u>Formula 1</u>	CATEGORY OF PIG		
	Ingredients (lb)	Piglets	Fatteners
Rice bran	24.0	15.0	24.5
Stockfeed rice (Broken rice)	50.0	69.0	64.0
Fish meal	23.0	14.0	9.0
Salt	0.5	0.5	0.5
Limestone or oyster shell or Wood ash	1.0	1.0	1.5
Premix or green forage	2.0	0.5	0.5
	100.0	100.0	100.0
Crude protein (%)	22.46	16.30	13.91

<u>Formula 2</u>	CATEGORY OF PIG		
	Ingredients (lb)	Piglets	Fatteners
Rice bran	50.0	63.5	54.0
Copra meal	20.0	15.0	12.0
Molasses	10.0	11.0	25.0
Fish meal	16.0	6.5	5.0
Salt	0.5	0.5	0.5
Limestone or oyster shell or wood ash	2.0	3.0	3.0
Premix or green forage	0.5	0.5	0.5
	100.0	100.0	100.0
Crude protein (%)	22.59	16.80	13.16

Formula 3	CATEGORY OF PIG		
	Ingredients (lb)	Piglets	Fatteners
Bhusi	58.0	66.0	70.0
Copra meal	16.0	18.0	20.0
Molasses	4.0	5.0	6.0
Fish meal	18.0	7.0	-
Salt	0.5	0.5	0.5
Limestone or oyster shell or wood ash	3.0	3.0	3.0
Premix or green forage	0.5	0.5	0.5
	100.0	100.0	100.0
Crude Protein (%)	22.59	16.80	13.16

Formula 4	CATEGORY OF PIG		
	Ingredients (lb)	Piglets	Fatteners
Stockfeed rice (Broken rice)	20.0	37.0	46.0
Rice bran	40.0	33.0	30.0
Copra meal	18.0	18.0	15.0
Fish meal	18.0	8.0	5.0
Salt	0.5	0.5	0.5
Limestone or oyster shell or wood ash	3.0	3.0	3.0
Premix or green forage	0.5	0.5	0.5
	100.0	100.0	100.0
Crude protein (%)	22.75	16.46	14.07

<u>Formula 5: Alternative A</u>	FOR FATTENING STOCK		
	Option 1	Option 2	Option 3
Ingredients (lb)			
Rice bran	60.0	80.0	85.0
Rice husk (hull)	15.0	5.0	4.5
Ground corn*	14.5	4.5	-
Copra meal	10.0	10.0	10.0
Minerals	0.5	0.5	0.5
	100.0	100.0	100.0
Crude protein (%)	12.13	13.61	13.87

* Using Corn

<u>Formula 5: Alternative B</u>	FOR FATTENING STOCK		
	Option 1	Option 2	Option 3
Ingredients (lb)			
Rice bran	60.0	80.0	85.0
Rice hull	15.0	5.0	4.5
Cassava meal*	14.5	4.5	-
Copra meal	10.0	10.0	10.0
Minerals	0.5	0.5	0.5
	100.0	100.0	100.0
Crude protein (%)	11.10	13.29	13.87

* Replacing corn with cassava meal

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<u>Formula 5: Alternative C</u>	FOR FATTENING STOCK		
	Option 1	Option 2	Option 3
Ingredients (lb)			
Rice bran	60.0	80.0	85.0
Rice hull	15.0	5.0	4.5
Broken rice*	14.5	4.5	-
Copra meal	10.0	10.0	10.0
Minerals	0.5	0.5	0.5
	100.0	100.0	100.0
Crude protein (%)	11.90	13.54	13.87

* Replacing corn with broken rice

<u>Formula 6</u>	CATEGORY OF PIG
	Piglets
Ingredients (lb)	lbs
Rice bran	34.3
Molasses	23.8
Fish meal	15.0
Poultry offal	22.0
Shrimp meal	4.9
	100.0
Protein content (%)	28.0

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97	98	99	100

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THE A, B, C OF FEEDING
PIGS WITH LOCAL PRODUCTS
AND BY-PRODUCTS IN GUYANA

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24 May 1985
18 Nov 1985

[Signature]
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