THE UTILIZATION OF AGRICULTURAL PRODUCTS FOR THE LIVESTOCK INDUSTRY IN THE CARIBBEAN

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Introduction

Feed constitutes 50 to 80 per cent of the total costs in livestock production (Table 1 shows the breakdown of costs for poultry production). Therefore for profitable livestock operation we should aim at reducing feed costs either from improved animal performance per unit of feed input or through the use of cheap sources of feed. In feeding animals we aim at supplying energy, protein, minerals, vitamins and water in the amounts and proportions needed by the type and age group of the animals we are rearing for the purposes of producing cheap animal products viz. meat, milk and eggs. Energy and protein are needed in fairly large amounts while minerals and vitamins are needed in small amounts and since water is relatively cheap, the high cost of feeds in livestock operations is due mainly to energy and protein probably in that order.

In conventional livestock enterprises e.g. in finishing cattle in feedlot, feed represents about 70 per cent of total cost. Protein and other supplements (minerals, vitamins etc.) account for only 15 per cent of this while 55 per cent is the approximate cost of providing energy. Therefore energy is by far the greatest single cost item in feedlot cattle operations, and how well cattle feeders control and utilise the energy component of the ration determines to a very large extent potential profits.

Most livestock enterprises in the Caribbean have relied heavily on imported energy and protein feeds. Maize, soyabean, groundnuts and fish-meal, the conventional feed ingredients, are not produced to any great extent in the region. This situation might change in the next few years if the plans by Guyana, Trinidad and Tobago, Belize and Jamaica to go into large scale production of maize and soyabeans are successful. Until enough of these feed ingredients become readily and cheaply available in the region, attempts should be aimed at using the crops and by-products of crops that are successfully produced in the region at the moment, e.g. citrus, bananas and root crops wastes, etc.

In Table 11 the value of imports of meat and meat preparations and dairy products into the region are shown to emphasize the need for the Caricom region to produce more feed in order to reduce the heavy import bills for meat and dairy products. In this regard this paper attempts to identify some of the sources and potential sources of the various nutrients obtainable in the Caricom region.

Systems of Ruminant Livestock Production

When considering the problems of providing enough feeds for farm livestock it is necessary to distinguish between ruminants (sheep, goats, cattle) and non-ruminants (pigs and poultry). Ruminants, because of their specialized digestive system, can utilize high proportions of poor quality, high fibre, low energy materials sometimes called roughages, and relatively higher proportions of non-protein nitrogen (NPN). On the other hand pigs and poultry have a limited capacity to utilize both fibre and non-protein nitrogen. It is therefore clear that the problem of providing feed for these two types of animals is basically different both in cost, quantity and quality.

For ruminant livestock two main systems of production are available:

(1) extensive systems - where the animals are kept out-doors and reared on grass and/or legume pastures; and

(2) intensive systems - where the animals are kept in-doors (housed) and the feed (usually high energy feeds) are given to them. A beef cattle feedlot is an example of an intensive system.

Various combinations of these two basic systems are also practised. These are the semi-intensive and semi-extensive systems. In these the animals are raised for varying periods on pasture before being fed intensively indoors, or the animals may be first fed intensively indoors and then finished at pasture. The selection of any particular system depends on the relative availabilities and costs of the feeds and also the comparative efficiencies of utilization of these feeds for the production of animal products.

What therefore is the potential in the Commonwealth Caribbean of producing enough feed for ruminant livestock to satisfy the requirements for efficient animal production (meat and milk)?

Table 2 summarizes the livestock populations in the Commonwealth Caribbean, and Table 3 shows the available permanent meadows and pasture lands. An attempt is made here, (1) to estimate the number of ruminant animal units that the present pasture acreages can sustain, and (2) to estimate the improved pasture acreages required to satisfy the present requirements for meat and dairy products if production is to come principally from pasture alone.

The calculations in Table 4 indicate that with very intensive management and good animal husbandry, existing and/or projected pasture acreages in the region could probably sustain a cattle population of approximately 14 million. The projected annual total meat requirement of the Caricom region in 1975 has been put at 55,339 metric tons (Caribbean Economic Development Corporation, 1967). Assuming a daily rate of liveweight gain of 0.96 kg/day (0.68 kg/day is more realistic) and a 50 per cent killing-out percentage it would require no less than 12 times the present cattle population of 735,000 to approach 60 per cent of the 1975 meat requirements from beef. This presupposes the intensive utilization of over 6 million acres of land in Guyana or approximately 12 per cent of the total land area. Also, Guyana alone would have to produce almost 85 per cent of the total potential beef

output in the region. If Guyana, which has the land resources for expansion were to make this effort it could probably satisfy regional requirements and possibly get into outside markets. But this would require tremendous capital investment in addition to Guyana's existing animal health constraints in entering the regional meat market.

This analysis indicates that, given existing and/or projected acreages and present land use patterns, and present cattle numbers, it is most unlikely that the Caricom region could satisfy its meat requirements for 1975 by merely raising cattle on very intensively managed pastures.

Intensive Systems

This therefore emphasizes the need for the intensive feeding of cattle using very high energy feeds and utilizing less land. Such high energy feeds are discussed in the next section..

Sources of Energy

Root Crops

The comparative energy-producing values of selected crops are summarized in Table 5. This Table shows that cassava among the crops listed is the most efficient crop in producing energy and probably should be used for intensive beef production. In Table 6 projected human demand for cassava has been summarized. The present production of cassava in selected territories of the Caribbean is presented in Table 7. When these two Tables are compared we find that Guyana's production would all be used by humans while in Jamaica there is a surplus of about 2,000 metric tons which could be used in feeding livestock. However, the projected human need of 527,000 metric tons of cassava, by the Caribbean, in 1975, seems to be far higher than the present production. Indications are that increased production, of especially the varieties not preferred by humans, could help intensive animal production in the Caribbean.

In Europe, for example, it has been estimated that by 1980 the demand for cassava to be used in compound feeds will be from 246 to 634 per cent greater than the 1970 demand (Philips, 1974). In 1970 the EEC imported 1,410,000 metric tons of cassava mainly used in the feed industry. Table 8 summarizes the composition of animal feeds in Germany showing their high level use of cassava as a cereal substitute. Most of this cassava is imported from Asia (Thailand). Surplus or spoilt sweet potatoes and yams are also good sources of energy. About 4 pounds of potato or yam are equivalent to one pound of grain (e.g. maize).

Cereals

Other potential sources of high energy feeds for possible intensive animal production include cereals, like maize and sorghum. Maize is not produced in any great quantities at the moment except possibly in Belize. However, plans are being made for extensive production of maize and soyabean in Guyana in a joint project between Guyana and Trinidad and Tobago and also in Belize (Williams,

1974). Table 9 shows the yields of local and hybrid maize varieties in selected territories of the Caribbean. Table 10 summarizes the maize production for 5 of the Caricom countries. The total maize production of 38,000 metric tons if used solely for pig feeding would be capable of feeding 128,814 pigs from weaning to 200 pounds (90 kg.). This is equivalent to 8,115 metric tons of pork. Of course, this quantity of maize is not available for animal feeding. However, attempts being made, at Caymanas in Jamaica, Kibilibiri in Guyana and Chaguaramas in Trinidad, to grow maize on a large scale, might make it possible for some locally produced maize to be made available for livestock feeding.

In Jamaica, Barbados and Trinidad any significant increase in the acreage for maize production is likely to depend on the release of sugar cane lands. It has been estimated that more than 100 million pounds of maize is imported annually into Trinidad. With two crops per year the needs of Trinidad could be met from the farming of over 20,000 acres. A similar argument goes for Jamaica and Barbados. It is most probable that of all the Caricom countries Guyana and Belize have the greatest potential for increased maize production. Even so, it is most unlikely that the region will be self-sufficient in the production of cheap maize in the immediate future. However, the need for the region to reduce its import of grain for animal feeding by producing more is highlighted by the escalating costs of these imports as evidenced for Jamaica in the Table below.

Changes in Prices of Some Imported Feed Ingredients in Jamaica (c.i.f. $J/ton).

Ingredient	1972	1973	% Change
Corn	59.45	114.69	93
Soya	144.32	268.14	86

Source: *Economic and Social Survey, Jamaica, 1973.* National Planning Agency, p. 110.

Sorghum is not being produced to any appreciable extent at the moment, though attempts are being made in Antigua and Belize to grow sorghum.

Sugar cane and Its By-Products as Sources of Energy

Given existing levels of grain production and present heavy imports of grain for human needs it is likely that the Caricom countries may not produce enough grain for both human and livestock feeding. However, alternative sources of energy could be found in molasses which is produced in appreciable quantities in the region at the moment (Table 12).

Whole sugar cane has been successfully used in feeding ruminants when chopped (Preston, 1974) or when derinded (comfith) (Pigden, 1974). Sugar itself is a very good source of energy for both cattle and pigs.

When sugar prices are low enough it might be quite economical to utilize the sugar produced by coverting it into beef or even pork. Table 13 compares the prices of sugar for a number of years.

In 1969 the Commonwealth price for sugar was 10.2 cents (EC) per pound. In December, 1974, the c.i.f. price of maize in Trinidad was 18.22 cents (EC) per pound. At the 1969 price of sugar, it is clear that it would be more economical to feed Caribbean sugar to animals at 10.2 cents per pound than to import maize at 18.22 cents per pound. This is more so when there are clear indications that sugar when fed to pigs promote more liveweight gain at better or comparable efficiencies of feed conversion than conventional cereals (maize) (Table 14).

The feeding of high levels of molasses in intensive beef operations in Cuba (Preston, 1972) has demonstrated the energy value of molasses for beef production. Liveweight gains of up to 1 kg daily have been demonstrated. It has also been demonstrated that molasses could replace up to 20 per cent of gain in pig diets without sacrificing performance especially as the tolerance of pigs to molasses increases with age and bodyweight. The "loose faeces" sometimes observed when levels of up to 30 per cent have been fed to pigs *"has not presented a major problem of either animal health or sanitation"* (Pond and Maner, 1974).

Table 15 shows the availability of some feedingstuffs in Jamaica, and Table 16 presents c.i.f. (Trinidad) prices of some feed ingredients.

In Table 12 an attempt was made to compare the potential energy value of molasses produced in the Caricom region and to relate this to the quantity of corn or other energy feeds imported for livestock feeding. I think that the question to be answered is whether sugar and its by-products sould be fed to animals when their world market prices are lower than that of maize, or whether scarce foreigh exchange should be used to import maize at a higher unit cost for use in animal feeding.

Table 17 compares disposal of molasses in Jamaica as compared with the U.S.A. The need for some very serious thinking about this issue is highlighted by Table 18 which summarizes the imports and production of feedingstuffs for animals in the Caricom region in 1972.

Bananas as Energy Sources

It has been reported that appreciable quantities (10 per cent) of bananas produced in Jamaica and the Windwards are spoiled or rejected. The most serious losses occurred between cutting the bunch and wrapping it (Twyford, 1968). Table 19 shows the production of bananas in the two groups of territories. In 1973 the production was 205,232 metric tons. Spoilage and rejection would amount to 20,523 metric tons or about 4,064 metric tons of dry matter. Both green and ripe bananas have been successfully fed to livestock (Clavijo and Maner, 1974). With swine 4,064 metric tons of dry bananas would be equivalent to 7,273 Mcals of digestible energy. This would be enough to full feed 882, 35 kg grower pigs for one day assuming that protein and other nutrients are also supplied.

Protein Supply

In livestock feeding, protein is required in comparatively smaller amounts than energy. However, the cost of protein is considerably higher on a unit basis. The Caricom region does not produce appreciable quantities of conventional oil cakes and seeds and have therefore relied on heavy importation of these ingredients. Copra production (Table 20) is declining in the region though Jamaica is expanding coconut planting. With 65 per cent of the copra going as oil, only 14.4 metric tons of the 41 metric tons of copra is available for animal feeding. At 20 per cent crude protein this is equivalent to 6.4 metric tons of soyabean meal.

Attempts at growing soyabean are being made both in Jamaica, Guyana and Trinidad. In Trinidad yields of 2,242 kg/ha have been reported in small plots, while commercial trials in Guyana have given yields of 1,906 kg/ha. In 1973 Trinidad and Tobago imported about 10,000 metric tons of oilseed cake meal. At yields of 2,242 kg/ha, 4,450 hectares of land would be required to satisfy the oil cake needs from local production.

Trinidad is also planning to produce microbial protein (SCP) from petroleum or molasses. This source of protein is likely to make its greatest impact in poultry, pig and pre-ruminant calf and lamb feeding operations (Osuji, 1974). Of course if microbial protein is produced from molasses and molasses is, as shown above, a potential source of energy, then the net change might be negligible as cereals would still have to be imported to supply energy in the livestock feeds. Even so, the future of SCP in Caribbean livestock industry will depend on its cost of production *vis-à-vis* cost of other protein feeds and on its nutritional value and capacity to promote the optimal utilization of other feeds. Table 21 compares the equal value prices of various ingredients for supplying energy and protein. The Table shows that subject to nutritional constraints, at EC$18.22 per 100 pounds for corn, molasses will be a better buy at any price less than EC$16.55 per 100 pounds. Similarly with soya costing EC$26.04 per 100 pounds, coconut meal will be a better buy at any price less than EC$11.57 per 100 pounds.

An Approach to Producing Livestock Products for the Caricom

This analysis has tried to show the need for intensive pasture management in order to try to satisfy part of the meat requirements of the Caribbean in 1975. It is suggested that the solution might lie in the intensive feeding of the animals. Since grain production now or in the immediate future, would not satisfy both human and livestock requirements, the use of sugar cane and its derivatives, root crops, and crop wastes for livestock production was suggested.

All in all, it is most likely that the future of livestock production in the region would have to depend on:

(i) optimum utilization of all available and potentially available pasture areas;

(ii) optimum utilization of sugar cane and its by-products -

- since the region successfully produces appreciable quantities of this crop; and

(iii) supplementation of the above with other agricultural crops and by-products which are in limited supply, e.g. citrus, cocoa, flour mill, rice by-products, abattoir by-products and other agricultural crop residues (Table 22).

It is however important to note that self-sufficiency in meat and dairy products can only be achieved if there is proper rationalization of the livestock sector. For example, the major effort in beef and probably dairy production could be made in Guyana, Belize, Jamaica and to a lesser extent Trinidad because they have the land. Other territories could be involved in pig and poultry production which do not need extensive acreages. Also, it may be found worthwhile, for example, Antigua and Nevis to go into specialized breeding operations to supply good genetic material (cattle, pigs, sheep etc.) for supporting the major efforts in Guyana, Belize and Jamaica. It is my belief that an approach along the lines outlined would pay great dividends for the livestock industry of this region.

Conclusion

In Table 23, I have attempted to estimate the annual maintenance feed requirements for the present livestock population in the Caricom region. To feed the present animal population 606,476 acres of maize and 393,777 acres of soyabean need to be planted. Production feed requirements would of course be over and above these.

Requirement figures used in these calculations have been drawn from the temperate regions. The need for the evolution of such requirement tables for the Caribbean is indicated. It should however be appreciated that livestock production in the Caribbean should aim for the optimum utilization of local resources even if this results in low levels of productivity when compared to values for Europe and America (Osuji, 1974b). There are appreciable quantities of agricultural crops and by-products in the region, what is needed is the rationalization of their collection, supply, handling, transportation, processing and utilization by the livestock industry.

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Table 1. Typical Percentage Costs of Production of Poultry, Egg, and Meat; 1969.

	(Per cent)
Annual Cost of Land and Buildings	6.99
Cost of Chicks at day old	12.26
Light, Heat and Ventilation	1.13
Manure disposal	1.07
Litter	0.27
Fumigation	0.06
Labour	5.29
Food	78.20
Less Value of Birds at End of Lay	-5.27
	100.00

Source: Bolton, W. (1972). *Proc. CENTO Conf.* 1971, Tropical Products Institute, London, p.187.

Table 2. Livestock Populations in the Commonwealth Caribbean

('000)

Species	Country						Total
	Barbados	Belize	Guyana	Jamaica	Trinidad & Tobago	Others	
Cattle	20	40	254	270	67*	84	735
Sheep	45	3	90	7	6	59	210
Goats	21	1	36	360	38	37	493
Pigs	32	18	82	200	55	89	476
Poultry	324	280	8,000	3,500	5,550	663**	11,117

Notes: * Plus 7,000 Buffaloes. Both the Trinidad & Tobago Recent Land Capability Survey and a recent (1975) Department of Livestock Science Cattle Survey would suggest that a more realistic estimate is 26,000 to 31,000.

** Excludes St. Kitts/Nevis/Anguilla and St. Lucia.

Source: F.A.O. *Animal Health Yearbook, 1973*, F.A.O., Rome, and ECLA, 1974.

Table 3. Permanent Meadows and Pasture Lands in the Commonwealth Caribbean

Country	Pasture Acreage ('000 acres)	% of Total
Barbados	10	0.15
Belize	43	0.63
Guyana	6,070*	89.10
Jamaica	643	9.43
Trinidad & Tobago	15**	0.22
Leeward Is. & Montserrat	20	0.29
Windward Is.	15	0.22
Total	6,816	100.00

Notes: * Projected for the Coastal and Rupununi Ranches; Ebini Livestock Station occupies 50,000 acres of range land including 2,000 acres of improved pastures. Potential range lands 3,800 sq. miles (approx. 1m. ha.) in the Intermediate Savannahs.
(Source: Guyana Ministry of Agriculture, 1974.)

** *Annual Statistical Digest, 1971/72*, Central Statistical Office, Trinidad.

Source: *1967 Caribbean Statistical Yearbook*. Caribbean Econ. Dev. Corp. Doc. 230 3-1-67E, July 1967, San Juan, Puerto Rico, p.82.

Table 4. Potential Annual Metabolizable Energy (ME) and Digestible Protein (DP) Supplies from the Pasture Acreages Available in the Commonwealth Caribbean

Country	Mcals ME (Millions)	Kg Digestible Protein (M Kg)	Potential No. of Beef* Cattle fed/yr. ('000)	% of Beef Cattle fed/yr.
Barbados	113	5	19	0.14
Belize	484	22	829	5.97
Guyana	68,288	3,096	11,693	84.26
Jamaica	7,234	328	1,239	8.93
Trinidad & Tobago	169	8	29	0.21
Leewards & Montserrat	225	10	39	0.28
Windwards	169	8	29	0.21
Total	76,682	3,477	13,877	100.00

Assumptions: Pastures planted with Pangola grass (*D. decumbens*).
DM yield (DM actually consumed by stock) 11,000 lb/acre/yr. (12,320 kg/ha/yr).
Fertilizer: 400 lb. N/acre/yr. (448 Kg/ha/yr).
Composition: 10.2% CP, DE 2.74 Mcal/Kg (2.25 Mcal ME/Kg DM).
Mean daily ME requirement: 16 Mcal from 150 - 500 Kg bodyweight.
Mean daily DP requirement: 0.42 Kg.

Note: * Mean No. of beef cattle fed from 150 - 500 Kg (330 - 1,100 lb.) per year; using all the energy available. Liveweight produced = 350 Kg (770 lb.).

Table 5. Comparative Energy Producing Ability of Various Crops

Crop	Kcal/ha/day
Cassava	250
Maize	200
Rice	176
Sorghum	114
Wheat	110

Source: Coursey, D.G. & Haynes, P.H. (1970). "Root Crops and Their Potential as Food in the Tropics." *World Crops*. July/Aug. 261-265.

Table 6. Projected Human Demand for Cassava Based on Past Trends

	1970	1975	1980
	('000 metric tons)		
World Total	55,087	62,736	71,500
Caribbean Is.	464	527	598
Cuba	182	202	221
Jamaica	7	8	8
Puerto Rico	5	6	6
Guyana	10	12	14

Source: Philips, T.P. (1974). *Cassava Utilization and Potential Markets*. Int. Dev. Res. Centre (I.D.R.C.), Ottawa.

Table 7. Average Production of Cassava in Selected Territories in the Caribbean

Country	Production 1972 ('000 metric tons)
Barbados	1
Guyana	14
Jamaica	10
Trinidad & Tobago	4
Total	29

Source: F.A.O. *Production Yearbook*.

Table 8. Composition of Animal Feed in Germany

(per cent)

Type of Feed	Cow Standard	Beef and Calf	Layer Medium	Poultry Grower	Broiler	Broiler Finisher	Pig Starter	Pig 0-30 (kg)	Pig 30-100 (kg)	Sow
Cereals	-	-	26.4	45.7	-	-	-	10.0	10.0	-
Cereal by-products	13.4	17.3	8.0	8.0	3.0	6.1	20.0	10.0	10.0	10.0
Oil cake and seed	24.7	36.6	11.2	3.1	17.0	15.1	25.3	23.3	21.8	13.8
Animal meal	4.5	5.0	12.0	20.0	16.5	12.4	6.5	7.6	5.8	10.4
Cassava	43.2	24.1	31.6	20.0	56.2	60.1	47.3	40.8	44.5	49.6
Other	14.0	16.8	10.6	3.0	6.9	6.1	0.9	8.0	7.6	16.0

Source: Philips, T.P. (1974). *Cassava Utilization and Potential Markets.* Int. Dev. Res. Centre (IDRC), Ottawa.

Table 9. Yields of Local and Hybrid Maize Varieties in Selected Territories Bushels per Acre at 15.5 Per Cent Moisture (1 Bushel/acre = 62.8 kg/ha)

Variety	Country				
	Jamaica	Guyana	Trinidad	Barbados	Grenada
Pioneer X 304	89.6	76.0	86.4	64.4	56.1
Local	39.7	48.0	44.4	30.4	27.2
Cost of Production	J$60/ac.				

Source: Sehgal, S.M. (1969). "Can Maize be Grown Profitably in the Caribbean?" *Caribbean Farming.* Oct. 1969, p.15.

Table 10. Maize Production in Selected Caricom Countries in 1972.

Country	('000 Metric Tons)
Belize	14
Barbados	1
Guyana	2
Jamaica	4
Trinidad & Tobago	3
Lesser Developed Countries	14
Total	38

Source: ECLA (1974).

Table 11. Imports of Meat and Meat Preparations and Dairy Products in the Caricom Countries in 1972

Country	Meat and Meat Preparations	Dairy Products
	(EC$'000)	
Barbados	17,880	8,406
Guyana	2,165	10,869
Jamaica	39,191	36,710
Trinidad & Tobago	18,137	26,053
Associated States (minus Antigua)	12,365	7,683

Source: *Oil and Food*. Basic Discussion Paper, Government of Trinidad and Tobago Consultation on Oil and Food, Chaguaramas, Jan. 6th, 1975.

Table 12. Production and Energy Value of Final Molasses in the Caribbean

Country	Molasses		Maize Equivalent	
	Production (Metric tons)	ME* Value ('000 Mcals.)	(Metric tons)	(Acres)
Barbados	46,600	141	42.2	22
Belize	18,306	55	16.5	9
Guyana	134,135	405	121.3	63
Jamaica	131,346	397	118.9	61
St. Kitts	10,821	33	9.9	5
Trinidad & Tobago	95,159	287	85.9	44
Total	436,367	1,218	394.7	204

*ME (metabolizable energy) content of molasses 3.02 Mcal/kg. and maize 3.34 Mcal/kg (Latin American Tables of Feed Composition 1974). Maize yield - 1.94 metric tons/acre.

Source: Various sources.

Table 13. Sugar Prices on the International Market; 1960 to 1970

Year	World	Commonwealth
	(US cents/pound)	
1960	3.14	5.44
1961	2.70	5.52
1962	2.78	5.61
1963	8.29	5.64
1964	5.72	5.64
1965	2.03	5.82
1966	1.76	5.94
1967	1.87	5.94
1968	1.85	5.10
1969	3.20	5.10
1970	3.35	-

Source: Hunter, L.J. (1973). "Sugar - An Appraisal of Market Prospects and Investment Requirements in the Caribbean." *Proc. 8th West Indies Agric. Econ. Conference*, U.W.I., Trinidad, p.131.

Table 14. The Effect of Different Levels of Refined and Crude Sugar on the Performance of Growing and Finishing Pigs (20-90 kg).

Level of Ingredients					
Sugar (%)	0	15	30	45	60
Maize (%)	81	62	43	24	5
Soyabean meal (%)	14	18	22	26	30
Performance (refined):					
Av. daily gain (kg)	0.82	0.87	0.89	0.95	0.93
Feed/gain ratio	3.27	3.20	3.16	3.00	2.95
Performance (crude):					
Av. daily gain (kg)	0.73	0.85	0.76	0.82	0.75
Feed/gain ratio	3.72	3.54	3.56	3.30	3.55

Source: Pond and Maner (1974).

Table 15. Feeding Ingredients Available in Jamaica

	Available tons/yr.	Used Tons per year	% Used
Wheat middlings	12,000	12,000	100
Brewers grain	1,500	1,500	100
Citrus pulp	4,500	4,500	100
Coconut meal	5,000	5,000	100
Molasses	160,000	5,000	3
Bagasse	660,000	0	0

Note: 70 per cent of the locally produced feed is imported in the form of feed ingredients.

Source: "Cattle Feed from Sugar By-products." *Caribbean Farming*. Vol. 3, No.4, pp.9-11.

Table 16. C.i.f. Prices of Selected Ingredients Used in Feed Production in Trinidad and Tobago; December, 1974.

Ingredients	EC$ per 100 Pounds
Soyabean meal	26.04
Meat and bone meal	29.82
Fish meal	80.43
Feather meal	33.12
Coconut meal	10.04
Corn (maize)	18.22
Wheat	21.67
Milo	18.96
Oats	27.12
Citrus meal	7.04
Molasses	6.20
Wheat middlings	4.75
Spent grain	7.13
Rice bran	4.75
Alfalfa	20.24
Limestone	2.21

Table 17. Disposal of Molasses in Jamaica Compared with U.S.A.

Jamaica		U.S.A.	
Rum	25%	Livestock feeds	74%
Feeds	3%	Yeast, vinegar, citric acid	14%
Export	72%	Pharmaceuticals and edible molasses	8%
		Distilled spirits	4%

Source: *Caribbean Farming*. Vol.3, No.4, p.10.

Table 18. Imports and Production of Feedingstuffs for Animals in the Caricom Countries, 1972.

Countries	Imports (EC$'000)	Production* ('000 kg)
Barbados	6,551	21,053
Guyana	281	27,566
Jamaica	9,074	160,651
Trinidad & Tobago	11,837	90,720
Associated States minus Antigua	819**	-

* Leslie Liverpool, Dept. of Ag. Econ. & Farm Management, U.W.I., St. Augustine, Trinidad.

** St. Kitts/Nevis/Anguilla, St. Lucia and Montserrat only.

Table 19. Production of Bananas in the Windward Islands and Jamaica

Year	Windwards (metric tons)*	Jamaica**	F.O.B. Price ('000 $J)
1969	203,200	153,416	12,469
1970	-	136,436	11,830
1971	128,016	128,016	11,705
1972	-	129,032	11,854
1973	95,504	109,728	16,363

* *Trinidad Guardian*. January 15, 1975, p.7.

** *Economic & Social Survey, Jamaica*. 1973, p.136.

Table 20. Copra Production in Selected Caribbean Territories.

Country	('000 metric tons)
Jamaica	15.6
St. Lucia	4.6
St. Vincent	2.6
Trinidad & Tobago	11.2
Guyana	6.0
Dominica	1.0
Total	41.0

Source: Various.

Table 21. Equal Value Prices of Various Feedstuffs

Feedstuffs	ME/lb.	Protein (%)	Equal Value Price with Corn $18.22	Equal Value Price with Soya $26.04
Soya	1,150	45	13.43	26.04
Meat & bone meal	870	50	10.16	28.90
Fish meal	1,192	70	13.92	40.51
Coconut meal	1,502	20	17.54	11.57
Corn (maize)	1,560	9	18.22	5.21
Wheat	1,360	12	15.88	6.94
Milo	1,480	9	17.29	5.21
Oats	1,140	12	13.32	6.94
Citrus meal	945	7	11.04	4.05
Molasses	1,417	4	16.55	2.31
Wheat middlings	810	12	9.46	6.94
Spent grain	842	25	9.83	14.47
Rice bran	1,509	14	17.62	8.10
Alfalfa	1,022	18	11.94	10.42

Note: At $18.22 per 100 lb. for corn, molasses will be a better buy at any price less than $16.55 per 100 lb. Also, at $26.04 per 100 lb. for soya, coconut will be a better buy at any price less than $11.57 per 100 lb. Subject to nutritional constraints.

Table 22. Some Major or Potential By-products Available for Animal Feeding in Some Caricom Countries.

Energy Sources	Barbados	Belize	Guyana	Jamaica	Trinidad & Tobago
			('000 lb.)		
Wheat middlings	-	-	25,441	18,200	36,165
Citrus pulp	-	10,404	2,200	8,800	6,300
Rice bran	-	7,800	47,000	134	6,142
Fats and oils from plants and animals	-	-	-	-	-
Garbage (swill)	-	-	-	-	-
Cocoa shells and fines	-	-	-	510	11,000
Coffee by-products	-	-	981	1,962	3,924
Distillery and brewery by-products (spent grain only)	474	-	620	5,560	1,845
Dried bakery products	-	-	-	-	-
Protein Sources:					
Slaughter house by-products potential total Caricom	405,991				
- meat and bone meal - blood and digesta					
Fish and shrimp wastes	-				
Poultry (by-products):	-				
- hatchery wastes - feather meal - blood and offals					
Cottonseed meal	931				
Single cell protein (Trinidad potential (tons))	100,000				
Sea weed	-				
Non-protein nitrogen (urea in Trinidad) (Production - Consumption) (S. tons)	193,970				

Source: Liverpool, L. (1974). Personal communication and various other sources.

Table 23. Annual Maintenance Feed Requirements for the Present Livestock Population in the Caricom Area.

Species	Population	Conversion factor	Total Animal Units	Energy, Daily Requirements			Protein, Daily Requirements[2]		
				(Mcal ME) x 10^6	Maize (tons)	Maize (acres)	Crude Protein (m tons)	Tons Soya (m. tons)	Acres Soya bean
Cattle	735,000	0.70	514,500	6.40	1,840	969	257	572	629
Sheep	210,000	0.13	27,825	0.35	100	53	14	31	34
Goats	493,000	0.13	64,090	0.80	229	120	32	71	78
Pigs	476,000	0.37	176,120	2.20	630	332	88	196	215
Poultry	11,117,000	0.009	100,053	1.25	358	188	50	111	122
Total Annual Requirements[1]				4,015	1,152,305	606,630	160,965	358,065	393,470

Assumptions: One animal unit = a Holstein cow weighing 1,100 lb. and producing 800 gal. milk.
Daily requirements for maintenance: Energy 12.5 Mcal ME; Crude Protein 0.5 kg.
Maize - ME/lb = 1,560 Kcal; Yield/acre = 1.9 tons;
Soyabean - Crude Protein 45%; Yield/acre = 2,000 lb. (0.909 m. tons).

It has been assumed that maize does not contribute any protein. In fact it would contribute about 9% Crude Protein.

(1) 882,588 = Total Animal Units. To estimate annual requirements the total daily requirements have been multiplied by 365.
(2) m = metric.