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 fishmeal, 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 soyabees 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 1 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,
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).

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>1972</th>
<th>1973</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>59.45</td>
<td>114.69</td>
<td>93</td>
</tr>
<tr>
<td>Soya</td>
<td>144.32</td>
<td>268.14</td>
<td>86</td>
</tr>
</tbody>
</table>


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 converting 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 body weight. 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 should be fed to animals when their world market prices are lower than that of maize, or whether scarce foreign 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, 4,456 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.

Acknowledgement

I am grateful to Dr. Keith A.E. Archibald for very useful discussions and comments during the preparation of this paper.
References


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

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Cost of Land and Buildings</td>
<td>6.99</td>
</tr>
<tr>
<td>Cost of Chicks at day old</td>
<td>12.26</td>
</tr>
<tr>
<td>Light, Heat and Ventilation</td>
<td>1.13</td>
</tr>
<tr>
<td>Manure disposal</td>
<td>1.07</td>
</tr>
<tr>
<td>Litter</td>
<td>0.27</td>
</tr>
<tr>
<td>Fumigation</td>
<td>0.06</td>
</tr>
<tr>
<td>Labour</td>
<td>5.29</td>
</tr>
<tr>
<td>Food</td>
<td>78.20</td>
</tr>
<tr>
<td>Less Value of Birds at End of Lay</td>
<td>-5.27</td>
</tr>
<tr>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>


Table 2. Livestock Populations in the Commonwealth Caribbean

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

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.

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Pasture Acreage ('000 acres)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>10</td>
<td>0.15</td>
</tr>
<tr>
<td>Belize</td>
<td>43</td>
<td>0.63</td>
</tr>
<tr>
<td>Guyana</td>
<td>6,070*</td>
<td>89.10</td>
</tr>
<tr>
<td>Jamaica</td>
<td>643</td>
<td>9.43</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>15**</td>
<td>0.22</td>
</tr>
<tr>
<td>Leeward Is. &amp; Montserrat</td>
<td>20</td>
<td>0.29</td>
</tr>
<tr>
<td>Windward Is.</td>
<td>15</td>
<td>0.22</td>
</tr>
<tr>
<td>** Total</td>
<td>6,816</td>
<td>100.00</td>
</tr>
</tbody>
</table>

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. lm. ha.) in the Intermediate Savannas.
(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

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

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

<table>
<thead>
<tr>
<th>Crop</th>
<th>Kcal/ha/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>250</td>
</tr>
<tr>
<td>Maize</td>
<td>200</td>
</tr>
<tr>
<td>Rice</td>
<td>176</td>
</tr>
<tr>
<td>Sorghum</td>
<td>114</td>
</tr>
<tr>
<td>Wheat</td>
<td>110</td>
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</tbody>
</table>


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

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


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

<table>
<thead>
<tr>
<th>Country</th>
<th>Production 1972 ('000 metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>1</td>
</tr>
<tr>
<td>Guyana</td>
<td>14</td>
</tr>
<tr>
<td>Jamaica</td>
<td>10</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
</tr>
</tbody>
</table>

Source: F.A.O. *Production Yearbook.* 208.
Table 8. Composition of Animal Feed in Germany

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


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)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jamaica</td>
</tr>
<tr>
<td>Pioneer X 304</td>
<td>89.6</td>
</tr>
<tr>
<td>Local</td>
<td>39.7</td>
</tr>
<tr>
<td>Cost of Production</td>
<td>J$60/ac.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Country</th>
<th>('000 Metric Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belize</td>
<td>14</td>
</tr>
<tr>
<td>Barbados</td>
<td>1</td>
</tr>
<tr>
<td>Guyana</td>
<td>2</td>
</tr>
<tr>
<td>Jamaica</td>
<td>4</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>3</td>
</tr>
<tr>
<td>Lesser Developed Countries</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38</strong></td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th>Country</th>
<th>Meat and Meat Preparations (ECS'000)</th>
<th>Dairy Products (ECS'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>17,880</td>
<td>8,406</td>
</tr>
<tr>
<td>Guyana</td>
<td>2,165</td>
<td>10,869</td>
</tr>
<tr>
<td>Jamaica</td>
<td>39,191</td>
<td>36,710</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>18,137</td>
<td>26,053</td>
</tr>
<tr>
<td>Associated States (minus Antigua)</td>
<td>12,365</td>
<td>7,683</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Molasses Production (Metric tons)</th>
<th>ME* Value (°000 Mcals.)</th>
<th>Production (Metric tons)</th>
<th>(Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>46,600</td>
<td>141</td>
<td>42.2</td>
<td>22</td>
</tr>
<tr>
<td>Belize</td>
<td>18,306</td>
<td>55</td>
<td>16.5</td>
<td>9</td>
</tr>
<tr>
<td>Guyana</td>
<td>134,135</td>
<td>405</td>
<td>121.3</td>
<td>63</td>
</tr>
<tr>
<td>Jamaica</td>
<td>131,346</td>
<td>397</td>
<td>118.9</td>
<td>61</td>
</tr>
<tr>
<td>St. Kitts</td>
<td>10,821</td>
<td>33</td>
<td>9.9</td>
<td>5</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>95,159</td>
<td>287</td>
<td>85.9</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>436,367</strong></td>
<td><strong>1,218</strong></td>
<td><strong>394.7</strong></td>
<td><strong>204</strong></td>
</tr>
</tbody>
</table>

*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

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

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

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


Table 15. Feeding Ingredients Available in Jamaica

<table>
<thead>
<tr>
<th>Available tons/yr.</th>
<th>Used Tons per year</th>
<th>% Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat middlings</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Brewers grain</td>
<td>1,500</td>
<td>1,500</td>
</tr>
<tr>
<td>Citrus pulp</td>
<td>4,500</td>
<td>4,500</td>
</tr>
<tr>
<td>Coconut meal</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Molasses</td>
<td>160,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Bagasse</td>
<td>660,000</td>
<td>0</td>
</tr>
</tbody>
</table>

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

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

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

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

<table>
<thead>
<tr>
<th>Jamaica</th>
<th>U.S.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rum 25%</td>
<td>Livestock feeds 74%</td>
</tr>
<tr>
<td>Feeds 3%</td>
<td>Yeast, vinegar, citric acid 14%</td>
</tr>
<tr>
<td>Export 72%</td>
<td>Pharmaceuticals and edible molasses 8%</td>
</tr>
<tr>
<td></td>
<td>Distilled spirits 4%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Countries</th>
<th>Imports (EC$'000)</th>
<th>Production* ('000 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>6,551</td>
<td>21,053</td>
</tr>
<tr>
<td>Guyana</td>
<td>281</td>
<td>27,566</td>
</tr>
<tr>
<td>Jamaica</td>
<td>9,074</td>
<td>160,651</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>11,837</td>
<td>90,720</td>
</tr>
<tr>
<td>Associated States minus Antigua</td>
<td>819**</td>
<td>-</td>
</tr>
</tbody>
</table>

* 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

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


Table 20. Copra Production in Selected Caribbean Territories.

<table>
<thead>
<tr>
<th>Country</th>
<th>('000 metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jamaica</td>
<td>15.6</td>
</tr>
<tr>
<td>St. Lucia</td>
<td>4.6</td>
</tr>
<tr>
<td>St. Vincent</td>
<td>2.6</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>11.2</td>
</tr>
<tr>
<td>Guyana</td>
<td>6.0</td>
</tr>
<tr>
<td>Dominica</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41.0</strong></td>
</tr>
</tbody>
</table>

Source: Various.

Table 21. Equal Value Prices of Various Feedstuffs

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

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.

215.
Table 22. Some Major or Potential By-products Available for Animal Feeding in Some Caricom Countries.

<table>
<thead>
<tr>
<th>Energy Sources</th>
<th>Barbados</th>
<th>Belize</th>
<th>Guyana</th>
<th>Jamaica</th>
<th>Trinidad &amp; Tobago</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(’000 lb.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>-</td>
<td>-</td>
<td>25,441</td>
<td>18,200</td>
<td>36,165</td>
</tr>
<tr>
<td>Citrus pulp</td>
<td>-</td>
<td>10,404</td>
<td>2,200</td>
<td>8,800</td>
<td>6,300</td>
</tr>
<tr>
<td>Rice bran</td>
<td>-</td>
<td>7,800</td>
<td>47,000</td>
<td>134</td>
<td>6,142</td>
</tr>
<tr>
<td>Fats and oils from plants and animals</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Garbage (swill)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cocoa shells and fines</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>510</td>
<td>11,000</td>
</tr>
<tr>
<td>Coffee by-products</td>
<td>-</td>
<td>-</td>
<td>981</td>
<td>1,962</td>
<td>3,924</td>
</tr>
<tr>
<td>Distillery and brewery by-products</td>
<td>474</td>
<td>-</td>
<td>620</td>
<td>5,560</td>
<td>1,845</td>
</tr>
<tr>
<td>(spent grain only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried bakery products</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Species</th>
<th>Population</th>
<th>Conversion factor</th>
<th>Total Units</th>
<th>Energy, Daily Requirements</th>
<th>Protein, Daily Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Mcal ME) x 10^6</td>
<td>Crude Protein (m tons)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maize (tons)</td>
<td>Soya (m. tons)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maize (acres)</td>
<td>Soya bean</td>
</tr>
<tr>
<td>Cattle</td>
<td>735,000</td>
<td>0.70</td>
<td>514,500</td>
<td>6.40</td>
<td>1,840</td>
</tr>
<tr>
<td>Sheep</td>
<td>210,000</td>
<td>0.13</td>
<td>27,825</td>
<td>0.35</td>
<td>100</td>
</tr>
<tr>
<td>Goats</td>
<td>493,000</td>
<td>0.13</td>
<td>64,090</td>
<td>0.80</td>
<td>229</td>
</tr>
<tr>
<td>Pigs</td>
<td>476,000</td>
<td>0.37</td>
<td>176,120</td>
<td>2.20</td>
<td>630</td>
</tr>
<tr>
<td>Poultry</td>
<td>11,117,000</td>
<td>0.009</td>
<td>100,053</td>
<td>1.25</td>
<td>358</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Requirements</td>
<td>4,015</td>
<td>1,152,305</td>
<td>606,630</td>
<td>160,965</td>
<td>358,065</td>
</tr>
</tbody>
</table>

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.