AGRONOMIC LIMITATIONS TO INCREASING COWPEA AND CASSAVA PRODUCTION IN GUYANA

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Introduction

In Guyana, agriculture is the leading sector in the national economy, contributing 25 per cent of the Gross Domestic Product (based on 1980 figures). Rice and sugarcane which have traditionally been dominant, remain the most important sub-sectors in terms of value added, employment generation, and contribution to foreign exchange earnings.

Over the past decade, however, the thrust has been to diversify the sector and to achieve self-sufficiency - if not exportable surpluses - in a number of other *non-traditional* commodities. Specifically, the *Directional Framework for Agricultural Development: 1983-1990* (Ministry of Agriculture 1983) has identified 15 commodities for national emphasis. These include crops, pasture and livestock (Appendix 1).

For many of the commodities, self-sufficiency requires a manifold increase in the current levels of production.

This paper examines some of the agronomic problems associated with the production of cassava and cowpea, both of which form part of the national emphasis, and are important for import substitution and replacement.

Production Considerations

At the moment, the Intermediate Savannahs and the Coastal Plains represent the main production locations for the crops under consideration.

1. Soils

Intermediate Savannahs -

The Intermediate Savannahs are located in North-east Guyana immediately south of the coastal plains. The *brown* sands which have relatively high potential for agricultural development represent 103,000 acres of the total expanse of 145,000 acres, the remainder being *white* sands which are thought to be unsuitable for agricultural purposes. These soils have been adequately described (Bullen *et al*, 1981a,b; 1983; Downer, 1972; TAMS, 1976). Essentially, the *brown* sands are characterized by:

- relatively low base status and moisture retention capacity
- low inherent nutrient status
- relatively low capacity to retain nutrients
- free draining
- low organic matter content.

Coastal Plains -

The soils of this ecozone include the sandy *reef* soils, clays, silty and clay riverain soils. These soils, with some exceptions, are generally fine textured, varying from grey to brown.

In addition, they are characterized by the following factors:

- high levels of native nutrients
- poor drainage and aeration
- easy compaction
- susceptibility to slaking and surface crusting.

2. Climate

Generally, temperatures are relatively constant. The daily mean for coastal areas is 30°C and for the Savannahs 26°C (diurnal fluctuations are less than 10°C).

Precipitation (annual mean 2000 mm - 2250 mm) is bimodally distributed with 40 - 60 per cent fallling in the long, wet season (May/July) and 20 per cent coming in the short, year end season (November/December). In both seasons, rainfall can be quite intense with as much as 60-65 mm descending in one hour.

Cowpea

Cowpea (*vigna unquiculata* (L.) Walp) is a very high demand as a high protein food crop. Previously, the emphasis had been on small farm production, but those efforts achieved little or no sustained success. More recently, the production of cowpea has become the responsibility of two agencies in the main - the Guyana Sugar Corporation (GuySuCo) and the Guyana National Service (GNS) - which operate respectively on the coastal clays (Blairmont) and in the Intermediate Savannahs (Kimbia). In both cases, production is fully mechanized.

National Demand/Production

It is estimated that the national demand for all grain legumes is 12.5m lb. annually, of which cowpea represents the largest component. Estimates of domestic production are variable, but generally indicate that production has been declining since 1978. The current annual production (1982 estimate) is 2.0 m lb. (Appendix 2).

Imports of legumes declined from 9.2m lb. in 1981 to 6.7m lb. in 1982 (Appendix 3). Since then, imports have been further restricted, if not prohibited. This means that domestic production must be increased five to six-fold to satisfy the shortfall of 10.5m lb. The expectation is that the demand can be satisfied through the commercial cultivation (mainly of cowpea) either by state agencies, parastatals or cooperative societies.

Limitations to Production

The first efforts at commercial producton at Kibilibiri (Intermediate Savannahs) established that cowpea was adaptable to the environment and yielded well. However, Fletcher and Gordon (1977) identified a number of problems associated mainly with its mechanical harvesting.

The large scale operations of the GNS at Kimbia and the Caricom Corn-Soya Company at Eberoabo have identified other problems which limit production.

1. Varietal Selection

Early agronomic trials and easy availability of seed from reputable sources ubdoubtedly led to the choice of California #5 as the variety of preference (Stephenson, 1970). Ninety per cent of its pods matured over a short period which was an advantage for mechanical harvesting. Despite this and other desirable characteristics the variety was considered unsuitable for large scale cultivation (Rose, *et al*, 1979) because of the following factors:

- susceptibility to cowpea mosaic virus, powdery mildew and pod rot
- low grain yield potential.

Joint efforts by the Ministry of Agriculture and Inter-American Institute for Cooperation in Agriculture (IICA) led to the release of varieties Minica I and II which are in limited commercial use.

Some characteristics of these varieties are described in Appendix 4.

The average national yield is estimated at between 400 lb./acre and 500 lb./acre. In commercial fields, however, the GNS has obtained yields of between 300 lb./acre in 1979/80 and 850 lb./acre in 1983.

Experimental results at Ebini have verified that both Minica I and II are combine-harvestable, yield higher than California #5 and are less susceptible to pod rots. On the coastal clays, GuySuCo has achieved experimental yields of Minica of 900 - 1400 lb./acre which are consistent with its reported potential.

Although these results have not been verified in large scale cultivations either on the sands, or on the clays, they indicate that a marked increase in volume and productivity is possible, even with the present *state of the art*.

Soil Chemistry/Fertility

The inherently low native fertility and low nutrient retention capacities of the Savannah soils constitute major limitations to crop production.

Soil analyses show that the soils are extremely low in Ca^{++}, Mg^{++} and K^{+}. Soil pH ranges from 4.3 to 5.3 and per cent base saturation is generally below 50 (Bullen, 1981b).

Experiments have established that problems of exchangeable acidity, and base status at 0-15cm and 15-30cm, affect the ability of the root systems to exploit the lower soil horizons. Thus, the root systems of cowpea (among other crops) grown with recommended rates of fertilizer are poorly developed.

There is recent evidence (Bullen, 1983) to indicate that limestone is implicated in the phenomenon. Deep incorporation of limestone improved cotton root development on three soil types at Kimbia, and also resulted in higher yields of cowpea among other crops. The latter result is thought to be associated with better root penetration and proliferation which, in turn, permit exploitation of soil moisture and nutrients.

Prior to 1983, annual crops were grown with split applications of between 550 and 900 lb./acre of complete mineral fertilizers. Recently, however, these applications were reduced to approximately 400 lb./acre and coincided with an improvement in cowpea yield.

These reports establish the need for intensive examination of soil fertilizer - plant interactions, and for the determination of combinations of fertilizer nutrient elements, and systems for fertilizer and limestone application which would yield economic returns.

Soil Conservation/Management

Cultivation at Kimbia has established that, while tillage is necessary for adequate seed bed preparation and optimum plant densities, intensive land preparation has led to serious soil erosion particularly during periods of high rainfall. Reduced tillage must therefore be considered as an integral part of the soil management.

Strip cropping and contour ploughing have given some erosion control (Fletcher, 1980), but a conservation package involving an integrated system of crops, planting systems and soil management practices must be developed.

On the clays, maintenance of soil structure and field layout are important considerations. Simpson (1983) reported experiments aimed at developing a system of soil management practices for cowpea production on clay soils. These experiments involved:

- tillage method trials (deep, conventional, reduced)
- mulching trials
- bulk density trials

and led to the recommendation that a reduced tillage system, along with a grass mulch, would be suitable for cowpea production during the November/December (short) rainy season.

The clays tend to remain waterlogged particularly during the long rainy season. This feature has restricted cowpea cultivation in mid-year, so that, in effect, only one crop per year may be possible. However, Fraser (personal communication) has reported that the use of narrow beds (16 ft.) with literal Doudi drains would permit two crops of legumes between May/September.

Simpson and Gumbs (1983) have recommended that the use of clay soils should be de-emphasized in favour of the peat soils. This shift would permit year round cowpea production without tillage. These experimental results must be verified in larger trials.

Climate

Field operations are generally scheduled to coincide with prevailing weather conditions and available rainfall probability; and atmospheric water balance data have influenced the practice of planting in May/June and October/November. However, assumptions of weather events have at times been unrealiable and have resulted in crop loss.

The risk of cultivation without an adequate data-base is unacceptably high for commercial enterprises. Efforts must therefore be directed at collecting, analyzing, interpreting and disseminating climatic data which must permit interpretation for the prediction of planting/harvesting dates and the scheduling of other crop production activities.

Cassava

Although cassava has been a staple carbohydrate source for many Guyanese, its importance has only become significant as a consequence of recent import restrictions of wheat flour.

In addition to its consumption as a primary food, cassava has become prominent for its industrial uses, such as:

- flour (flocculent for bauxite industry
- chips (livestock feed)
- starch (seals and packaging industry, textile industry).

National Production/Demand

For 1980/82, the production of cassava (estimated at 65 per cent of ground provision production) was estimated at 26 - 30m lb./year, most of which is assumed to be *sweet*.

For food, cassava demand is in the order of 40m lb. Additionally 18 - 20m lb. of fresh root equivalent are required to satisfy industrial demand. The incremental production required to meet the joint food/industrial needs is therefore approximately 30m lb./year.

Limitations to Production

1. *Varieties*

At current national yields of 8,000 - 10,000 lb./acre, Guyana will require an additional 3,000 - 3,750 acres to meet present demand; and it is apparent that continued use of the traditional varieties poses a major limitation to production.

Wahab (1978), working on the peaty clays, reported that introduced varieties out-yielded local cultivars by 300 per cent. Similarly, GuySuCo (1981) reported experimental yields of up to 26,000 lb./acre from improved cultivars.

Using planting material of two of these varieties (Iracema, M Col 673) farmers in the Pomeroon River have obtained yields of 28,000 lb./acre on bagasse. These data indicate the possibility of immediate yield and producton increases by the adoption of improved cultivars.

The Guyana Sugar Corporation has maintained several of the exotic varieties in its germplasm collection, described by Forde (1979) Appendix 5, but these have not been incorporated into a national programme for distribution or cultivation even though the techniques for rapid propagation of planting material are well known (Wahab, 1977).

2. *Production Systems* -

Because of the gap between production and demand, it would be unrealistic to expect farmers to increase their acreage or output to the extent required.

The *Directional Framework* (Ministry of Agriculture, 1983) recommends commercial cultivation of high-yielding industrial types in the Intermediate Savannahs where the loose, sandy soils would allow better realisation of the yield potentials. Cassava would, in fact, be a new crop in this ecozone, but opportunities abound for large scale cultivation either by state or private enterprise.

In addition, production must be scheduled in areas promimate to the three existing cassava mills which have a total capacity of 21,000 tons/year (24 hr./day).

Because of the limited scientific attention paid to this crop, there is little information available on appropriate production systems for either soil type, research done in Guyana on this crop. There are therefore opportunities for an active agronomic programme of research to be done in Guyana focussing of the following:

- seedbed preparation
- fertilizer requirements
- soil management
- water management practices both on the peaty clays and the savannah sands.

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APPENDIX 1: Commodities for National Emphasis

a. Rice *(Oryza sativa)*	carbohydrate source, food, feed, edible oil
b. Sugar *(Saccharum officinarum)*	carbohydrate source, food, feed, alcohol, industrial uses
c. Cassava *(Manihot esculenta)*	food, feed, industrial uses
d. Coconuts *(Cocos nucifera)*	edible oil, feed, industrial uses
e. Cowpea *(Vigna unquiculata)*	food legume (protein)
f. Cotton *(Gossypium hirsutum)*	clothing, threads, etc.
g. Oil palm *(Elaeis guineansis)*	edible oil feed, industrial uses
h. Beef	food protein, hides, bone and blood meal for feed, industrial uses, handicraft
i. Dairy	milk, cheese, butter, protein, etc. (also contributes like h.).
j. Improved pastures	grass legume pasture for beef and dairy development
k. Soybean *(Glycine max)*	edible oil baby food, animal feed, protein source.
i. Peanuts *(Arachis hypogeae)*	food, edible oil, protein
m. Sorghum *(Sorghum* sp.)	carbohydrate source - flour food, feed
n. Poultry o. Swine	dependent on viability of production of feed materials

APPENDIX 2: Production of Black-eye Peas (Cowpea) in Guyana; 1973-82

Year	*Black-eye Peas (lb.)*
1973	*544,000*
1974	*1,800,000*
1975	*2,200,000*
1976	*1,600,000*
1977	*2,400,000*
1978	*3,200,000*
1979	*2,900,000*
1980	*2,900,000*
1981	*1,800,000*
1982	*2,000,000*

Source: Statistical Bureau, Ministry of Economic Planning & Finance, Guyana.

Source: Directional Framework for Agricultural Development 1983-1990, Ministry of Agriculture.

APPENDIX 3: Imports of Peas and Beans, 1973 - 1982

Peas and Beans	Unit	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Split Peas: (Q)	lb.	4,263,108	2,533,398	5,345,328	8,232,000	7,056,000	6,272,093	6,222,294	6,954,556	9,282,171	798,596
(V)	G$	946,266	1,645,320	2,824,148	4,067,045	3,472,687	4,031,912	3,499,774	3,866,911	7,594,547	728,087
Other Beans, dried	lb.	-	3,314	182,650	300,000	-	-	4	-	-	-
and shelled (V)	G$	-	2,259	111,032	257,873	-	-	4	-	-	-
Pigeon Peas, dried	lb.	-	216,077	22,000	110,880	-	-	7	-	-	-
and shelled (V)	G$	-	71,878	13,709	82,932	-	-	8	-	-	-
Other peas, Dried	lb.	-	3,873,692	1,402,530	-	905,030	3	4	7	57	-
and shelled (V)	G$	-	2,182,217	524,876	-	477,410	5	1	11	264	-
Pigeon Peas, Fresh	lb.	-	220,000	55,000	110,000	-	26	-	-	-	416
of chilled (V)	G$	-	115,368	25,481	68,862	-	30	-	-	-	1,325
Other Peas,	lb.	-	6,486	1,275	-	1,200	-	-	319	277	44
Frozen (V)	G$	-	9,196	2,901	-	927	-	-	1,625	969	201
Pigeon Peas,	lb.	-	39,100	-	-	-	-	5	-	-	-
Frozen (V)	G$	-	14,240	-	-	-	-	8	-	-	-
Other preserved (Q)	lb.	-	1,827	1,500	-	-	2	-	-	-	-
Pigeon Peas (V)	G$	-	1,935	1,729	-	-	1	-	-	-	-
Other preserved											
Red Kidney (Q)	lb.	-	7,796	9,450	23,475	-	-	-	-	-	-
beans (V)	G$	-	5,073	8,163	29,027	-	-	-	-	-	-

Source: Ministry of Economic Planning & Finance, Guyana.

APPENDIX 4: *Some Characteristics of Cowpea Varieties: Minica I and II*

Minica I:

This variety was introduced from IITA as entry (ER7) in the 1977 international cowpea uniform trials.

Characteristics -

- 50% flowering at 30-35 days after planting
- Maturity - 50-60 days (shorter than California #5)
- Determinate growth habit, self-defoliating
- High yield potential - av. 1400 kg/ha (dry seed)

Main advantages -

- High yield potential
- Short life cycle
- Determinate, self-defoliating

Minica II:

Minica II was first tested in Guyana 1977 as entry TVX 66-2H.

Characteristics -

- 50% flowering 46-48 days after planting
- Maturity - 70-80 days after planting (longer than Cal. #5)
- Interdeterminate growth habit, but tends to vine
- Some self-defoliation
- High yield potential - av. 1500 kg/ha

Source: Crop Science Division, Ministry of Agriculture.

APPENDIX 5: *Name and Source of Fifteen Cassava Cultivars*

Name of Cultivar	*Source of Material*
Brancha Butterstick	*Guyana*
Uncle Mack	*Guyana*
Bad Woman	*Guyana*
Four Month	*Guyana*
CMC 40	*Colombia*
Piracununga	*Brazil*
M Mexico 59	*Colombia*
M Mexico 23	*Colombia*
Del Pais	*Puerto Rico*
M Mexico 55	*Colombia*
M Col 673	*Colombia*
Tacana	*Brazil*
Iracema	*Brazil*
Llanera	*Colombia*
M Col 22	*Colombia*