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Costs and use of inputs in cassava production in Colombia : A brief description

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The collaboration of these and other persons who assisted in carrying out this study is acknowledged.

INTRODUCTION

Until recently, agricultural scientists and public policy makers paid little attention to cassava. With a growing awareness of the importance of the crop as a stable food in tropical countries and its potential as a livestock feed, the situation is changing. Within five years, two international agricultural research institutes have created multidisciplinary cassava research teams[1/] some national research programs are receiving increased support, and new national programs are being created.[2/] Private industry and bankers indicate an increasing interest in cassava production, processing and export as profitable investment opportunities and some governments are becoming aware of the crop's potential in promoting agricultural development and contributing to foreign exchange.[3/]

Future demands for dried cassava as a livestock feed appear to be strong both within and outside producing countries.[4/] This results partly from increased feed grain prices and partly from cassava's efficiency in producing carbohydrates.

To realize the demand potential, however, cassava yields must be increased, and most cassava production research seeks this goal. Such research must be focused on the problems at the farm level. However, because of lack of emphasis on the crop in the past, relatively little is known about the cassava production process and the relative importance of factors limiting production and productivity.

1/ Centro Internacional de Agricultura Tropical (CIAT), Colombia and International Institute for Tropical Agriculture (IITA), Nigeria.

2/ In addition to public funds from the producing countries, national and international research on cassava is supported by a number of agencies such as the International Development Research Centre (IDRC), Canada, and the Overseas Development Administration (ODA), England.

3/ Schemes to expand cassava production for export and domestic livestock feed are being developed in a number of countries such as Indonesia and Malaysia.

4/ A recent study by Truman Phillips indicates strong future demand for dried cassava in Europe ("Cassava Utilization and Potential Markets". International Development Research Centre, Ottawa, Canada, 1974). Other potentially good markets include Japan. Furthermore, the demand for livestock feed is rapidly increasing in most cassava producing countries.

Therefore, the economists within the CIAT Cassava Program decided to emphasize research to obtain data on the production process. The analysis reported here briefly describes the cropping systems, resource use and costs among Colombian cassava producers. This report should be considered preliminary. A more comprehensive study of the production process and the relative importance of factors limiting production and productivity is in progress.

After a brief discussion of the methodology, the sample is described. Then a presentation of the results follows and the report terminates with a brief summary and a discussion of the implications for future research and public policy.

A set of tables summarizing the data obtained from the survey may be obtained from CIAT.

METHODOLOGY AND SAMPLE DESCRIPTION

Data Collection

On the basis of available secondary data, information was collected from farmers in 18 departments of Colombia (Figure 1). While secondary data on cassava production and area are weak, the selected departments appear to account for approximately 92 percent of the national production and 80 percent of the total area (1969).

As no information is available to permit identification of all cassava producers, either nationally or in the selected departments, random sampling was not possible. A partial list of cassava producing regions and producers within these regions was developed from information provided by local extension and credit representatives, cassava wholesalers and retailers. A sample of 300 cassava producers was selected from this list. Information was obtained by interviewing each farmer once.

Data Analysis

Because of the preliminary nature of the data, analysis was limited to calculation of simple and weighted averages, totals and percentage distributions.

For data analysis, the sample farms were divided into three groups according to topography, as follows:

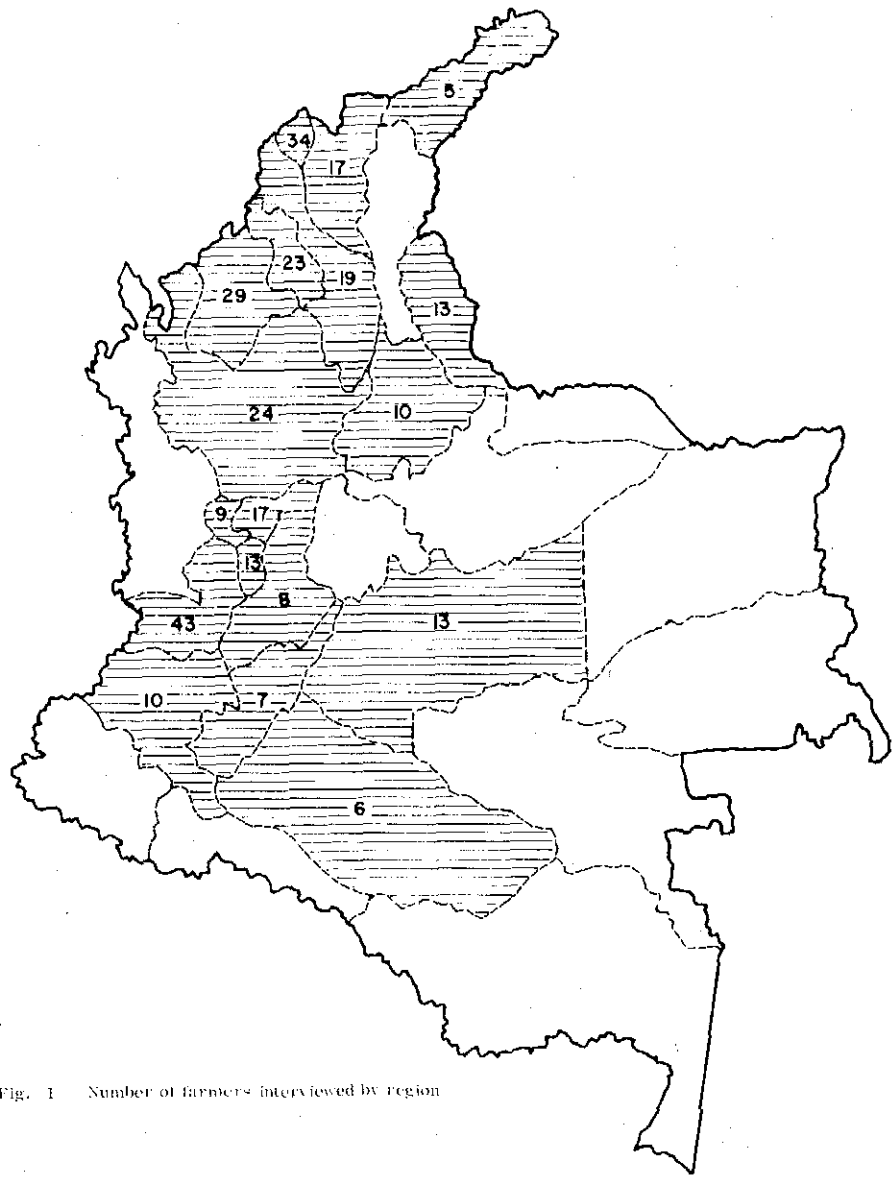


Fig. 1 Number of farmers interviewed by region

Zone I: Cassava growers on flat land outside the North Coast Region.

Zone II: Cassava growers on mountainous slops.

Zone III: Cassava growers in the North Coast Region.

Within each zone the sample farms were stratified according to size of cassava area as follows:

Strata 1: Less than 2 ha.

Strata 2: 2.0 - 3.99 ha.

Strata 3: 4.0 - 9.99 ha.

Strata 4: 10.0 ha. and more.

Finally, for certain parts of the analysis, the sample farms were divided into two groups, i.e. whether land was prepared manually or mechanically.

Sample description

Forty-two percent of the sample farms were located in the North Coast Region, 30 percent in mountainous areas and 28 percent on flat land. About 40 percent of the sample farms had less than two hectares of cassava and 15 percent had 10 hectares or more. For obvious reasons, almost all the farmers growing cassava on mountainous slopes prepared land manually. It is less obvious why only one-third of the farmers on flat lands and less than half of the farmers in the North Coast Region used machinery for land preparation. Mechanical land preparation is most common on large farms.

Average size of the sample farms was 5 hectares. The average farm size in Zone I was 9 ha and about 3.5 ha in Zones II and III.

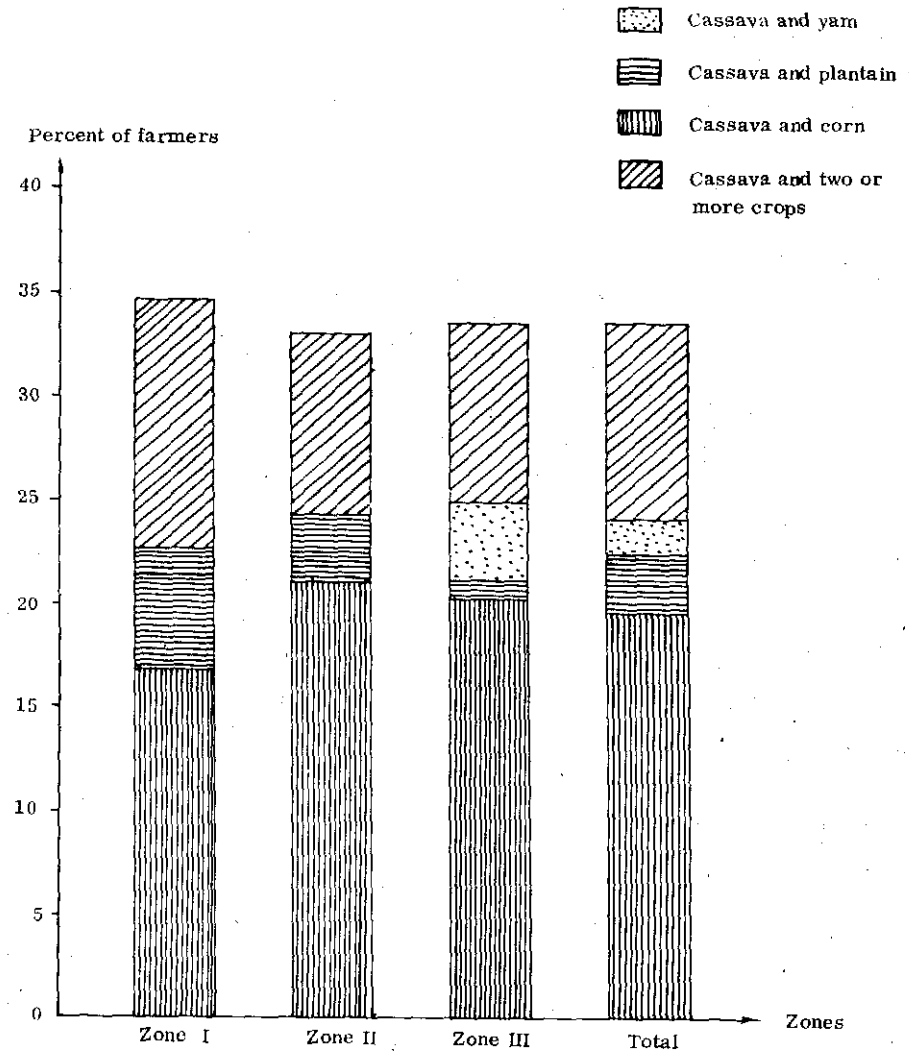
About 20 percent of the farmers interviewed owned the land on which they produced cassava. Almost two-thirds were sharecroppers, while the rest paid cash rent.

PRODUCTION PRACTICES

Cropping systems

About one-third of the farmers interviewed in each of the zones grew cassava mixed with other crops. Maize was most frequently found intercropped with cassava, followed by plantain, coffee, yams and beans (Figure 2).

Figure 2. Mixed Cropping Systems



Land preparation and planting

Manual land preparation is usually rudimentary and limited to land clearing and weeding. About 5 percent of the farmers in Zone I planted on ridges while this practice was almost non-existent in the other zones. About one-third of the farmers planted stakes horizontally, a practice most common outside the North Coast Region.

The average plant population was 8,800 plants/ha but the number varied greatly among the sample farms (Table 1).

The most commonly used planting distance was 1 x 1 meter, followed by 1.2 x 1.2 meters. Most farmers interviewed plant one stake per site (83%) while 17 percent plant two stakes together. The latter practice is most frequent in Zone I (35% of the farmers), less important in Zone II (25%) while none of the farmers interviewed in Zone III planted two stakes together. About 27 percent of the farmers in each zone re-planted. No farmer treated stakes against pathogens.

About one-third of the farmers grew two or more crops of cassava consecutively in the same field. The others either practiced crop rotation or planted cassava on virgin land.

Five percent of the farmers grew the variety Llanera. On the rest of the farms, the varieties grown were identified by 56 local names.

Weeding

No mechanical or chemical weed control was performed on the sample farms. About half of the farmers weeded three times during the growing season while 26 percent weeded four times (Fig. 3). The average number of weedings was 3.2.

Harvesting and length of growing season

All harvesting was manual. The length of the growing season depends on ecological conditions, variety, availability of labor for harvesting, cassava prices, and other factors. The majority of the farmers in Zones I and II harvested cassava at an age of 12-14 months while 13 percent harvested at 10-12 months and another 13 percent at 14-16 months. In the North Coast Region, one-third of the producers harvested at 6-8 months while the rest harvested between 8 and 14 months (Figure 4). The average crop age at harvest was 12.7, 12.5 and 9.1 months for zones I, II, and II, respectively.

Table 1. Average plant population and range of distribution (plant/ha)

	Range of distribution (plants/ha)								Average (plant/ha)
	2,000 to 6,000		6,000 to 10,000		10,000 to 14,000		14,000 to 16,000		
	No.	%	No.	%	No.	%	No.	%	
ZONE I	7	8.4	13	15.7	57	68.7	6	7.2	9,999
ZONE II	9	10.0	23	25.5	51	56.7	7	7.8	9,500
ZONE III	28	22.0	51	40.2	47	37.0	1	0.8	7,579
TOTAL	44	14.7	87	29.0	155	51.6	14	4.7	8,800

Figure 3. Number of weedings

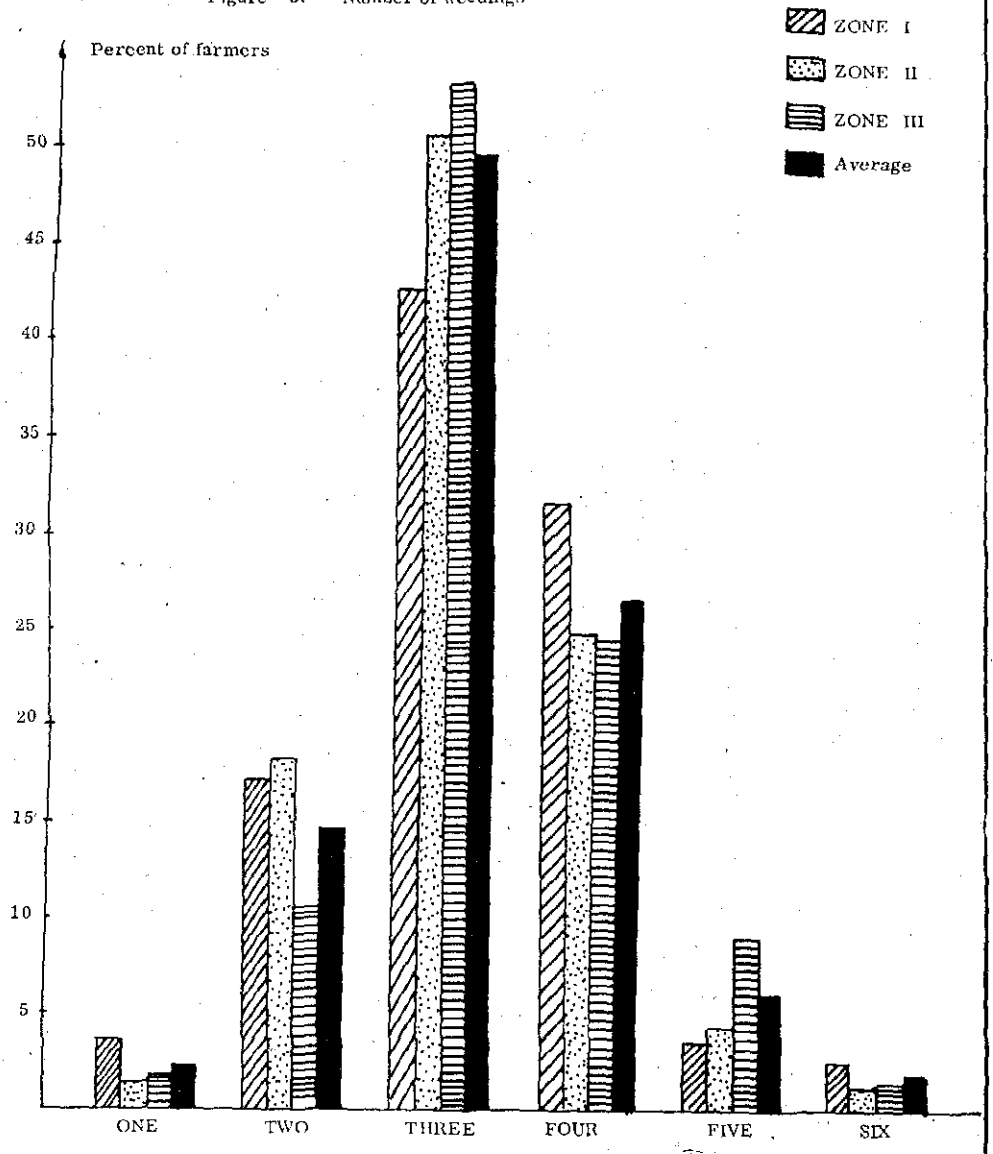
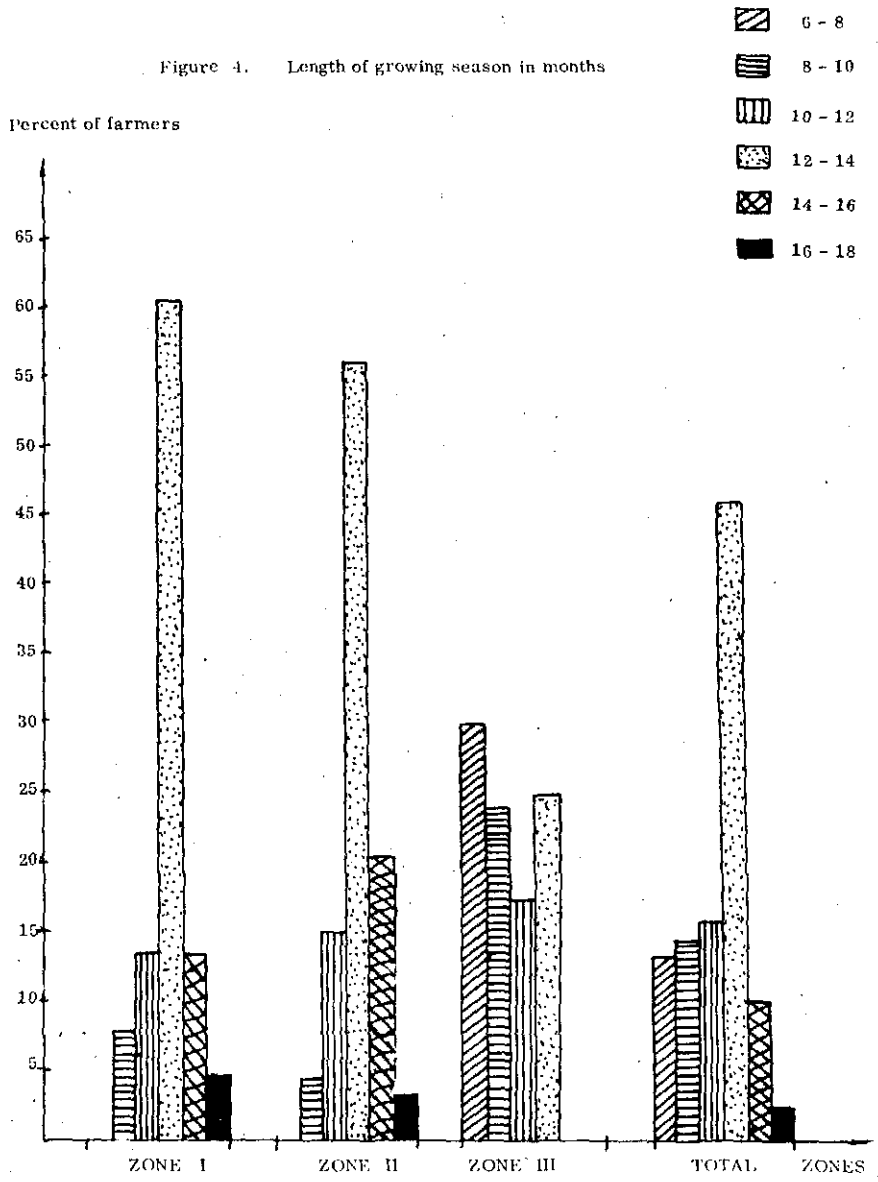


Figure 4. Length of growing season in months



INPUT USE

Labor

The level of mechanization in cassava production in Colombia is low and limited to land preparation on a small proportion of the cassava-producing farms. Furthermore, as will be indicated later in this report, the use of labor-saving chemical technology, such as herbicides, is almost non-existent. Hence, cassava production requires a considerable amount of labor. Tables 2 and 3 show the labor used in each production activity by zone, farm size and method of land preparation. The total labor use was estimated at 88 man-days/ha under mechanized land preparation and 110 man-days/ha if land was prepared manually. Weeding, accounting for about 40 percent of total labor requirements, is the most labor-consuming activity (Figure 5). Next follows harvesting and packing with a little less than 30 percent of the labor needs, land preparation (22) and planting (10).

Labor use per hectare increases with increasing size of cassava area. This primarily results from increased labor use in weeding as cassava area increases.

The largest labor requirements per hectare were found where cassava was produced on mountainous slopes (Zone II) and land was prepared manually (119 man-day/ha). The lowest labor requirements were noted in the North Coast Region where land was prepared mechanically (67 man-days/ha). The primary reason for this relatively large difference in labor requirements are expected to be: (1) Difference in method of land preparation, (2) a shorter growing season in the North Coast Region, (3) the more difficult working conditions on the slopes, and (4) the more favorable soil conditions in the North Coast Region. Labor requirements in the North Coast Region are lower than those on flat lands outside the region, regardless of land preparation method, primarily because of differences in harvesting costs.

A considerable variation of labor requirements was found among activities within each zone. About 38 percent of the farmers used from 10 to 20 man-days/ha for land preparation. Six percent used less, 30 percent used 20-30 man-days/ha and about 25 percent used more. All the farmers interviewed in the North Coast Region used 10-30 man-days/ha. About half of the farmers used 5-10 man-days/ha for planting, 16 percent used less and 34 percent used more. Only seven percent of the farmers used

less than 20 man-days/ha for weeding, 39 percent used 20-40 man-days and a little more than half of the farmers used more than 40 man-days/ha. Most of the farmers in Zones I and II use 20-40 man-days/ha for harvesting and packing, while the majority of the farmers in Zone III use less than 20 man-days/ha.

About 8 man-days were used to produce a ton of cassava, if land were prepared mechanically, and 10 man-days, if prepared manually. Labor requirements per ton of cassava vary considerably among farm sizes (Table 4). This variation results partly from variation in labor use per hectare and partly from variations in yields. While the former was explained previously, this analysis does not provide sufficient information to explain yield variations (see section on yields).

Additional analysis of current labor use in cassava production in Colombia and expected impact of the introduction of mechanical, biological and chemical technology on labor requirements are presented in: "Present and Potential Labor Use in Cassava Production in Colombia" by Per Pinstrup-Andersen and Rafael O. Díaz. (Paper presented at the Third International Symposium on Tropical Root Crops, Ibadan, Nigeria, December 2 - 9, 1973. Copies available from CIAT).

Seed

About 70 percent of the farmers obtained stakes from their previous crop, 16 percent purchased stakes and 15 percent obtained them free from neighbors and friends. Virtually all the farmers in the North Coast Region obtained stakes from their own crop. It may be expected that the level of adoption of stakes from improved varieties will be higher among farmers who normally purchase stakes. If this expectation holds true, we may expect a greater ease of adoption outside the North Coast Region than within.

Fertilizers

Fifteen of the 300 farmers interviewed (5%) used fertilizers for cassava. Fertilizer use was most frequent among farmers on flat land outside the North Coast Region (Figure 6). Where fertilizer was used, the quantities per hectare were small.

Insecticides

Twenty-seven percent of the farmers used insecticides for cassava. This practice

TABLE 2

Estimated labor use in the production of cassava per hectare with mechanical land preparation.

ZONE I	0 - 2 has.		2 - 4 has.		4 - 10 has.		10 or more has.		Weighted average	
ACTIVITY	Man days per ha	%	Man days per ha	%	Man days per ha	%	Man days per ha	%	Man days per ha	%
Planting	4.0	5	12.6	13	8.5	9	7.7	6	8.6	8
Re-planting	0.5	1	0.7	1	0.4	1	0.4	1	0.5	1
Weeding	37.3	43	57.8	58	48.5	52	59.1	47	53.7	50
Apl. fertilizers	0.4	1	0.6	1	1.3	1	1.2	1	1.0	1
Apl. insecticides	0.3	1	0.3	1	0.5	1	0.4	1	0.4	1
Harvesting	32.7	38	20	20	23.2	24	47	38	33	31
Packing	9.5	11	6.6	6	11.1	12	8	6	8.7	8
TOTAL ZONE	84.7	100	98.60	100	93.50	100	123.8	100	105.9	100
ZONE II										
Planting	-	-	17.5	18	15.3	17	-	-	16.8	18
Re-planting	-	-	0.3	1	0	0	-	-	0.2	1
Weeding	-	-	43.6	45	49.3	55	-	-	45.5	48
Apl. fertilizers	-	-	0	0	0	0	-	-	0	0
Apl. insecticides	-	-	0.2	1	0.3	1	-	-	0.2	1
Harvesting	-	-	19.9	21	18.2	20	-	-	19.3	20
Packing	-	-	13.9	14	5.8	7	-	-	11.2	12
TOTAL ZONE	-	-	95.4	100	88.90	100	-	-	93.2	100
ZONE III										
Planting	7.7	12	9.3	13	-	-	6.8	8	8.0	12
Re-planting	0.3	1	0.3	1	-	-	0	0	0.3	1
Weeding	41.0	66	40.1	56	-	-	53.3	60	42.3	61
Apl. fertilizer	0	0	0.2	1	-	-	1.0	1	0.2	1
Apl. insecticides	0.3	1	0	0	-	-	0	0	0.2	1
Harvesting and packing	12.6	20	20.6	29	-	-	26.8	31	16.2	24
TOTAL ZONE	61.9	100	70.5	100	-	-	87.9	100	67.2	100
AVERAGE ALL ZONES										
Planting	5.9	8	13.1	15	11.9	13	7.3	6	9.1	10
Re-planting	0.4	1	0.4	1	0.2	1	0.2	1	0.3	1
Weeding	39.2	52	47.2	51	48.9	53	56.2	53	46.8	53
Apl. fertilizers	0.2	1	0.3	1	0.7	1	1.1	1	0.5	1
Apl. insecticides	0.3	1	0.2	1	0.4	1	0.2	1	0.3	1
Harvesting and packing	27.4	37	27.0	30	29.2	32	40.9	38	30.7	34
TOTAL ZONES	73.4	100	88.2	100	91.3	100	105.9	100	87.7	100

TABLE 3

Estimated labor use in the production of cassava per hectare with manual land preparation. Average by farm size.

ZONE I	0 - 2 has.		2 - 4 has.		4 - 10 has.		10 or more has.		Weighted average	
ACTIVITY	Man days per ha	%	Man days per ha	%	Man days per ha	%	Man days per ha	%	Man days per ha	%
Land preparation	20.0	19	20.8	22	18.2	16	20.8	19	20.0	19
Planting	7.9	7	10.5	11	9.2	8	12.3	11	10.3	9
Re-planting	1.2	1	0.8	1	0.6	1	0.2	1	0.7	1
Weeding	31.7	30	39.2	41	46.3	41	50.7	47	43.3	41
Apl. fertilizers	0	0	0	0	0	0	0.3	1	0.1	1
Apl. insecticides	0	0	1.2	1	0	0	0.1	1	0.4	1
Harvesting	40.6	39	14.5	15	22.8	20	16.5	15	21.5	20
Packing	4	4	8.8	9	16	14	6	5	9.0	8
TOTAL ZONE	105.40	100	95.8	100	113.1	100	106.9	100	105.3	100
ZONE II										
Land preparation	37.5	31	30.7	27	36.6	32	48.8	33	35.1	29
Planting	14.2	11	13.7	12	13.2	11	9.5	6	13.3	11
Re-planting	0.4	1	0.6	1	0.4	1	0.5	1	0.5	1
Weeding	40.4	34	37.8	33	46.7	41	68.0	46	42.8	36
Apl. fertilizers	1.2	1	0.4	1	0	0	0	0	0.5	1
Apl. insecticides	3.0	2	0.8	1	0.2	1	0.3	1	1.2	1
Harvesting	20.3	16	23.0	20	12.5	11	15.6	10	20	17
Packing	4.9	4	5.7	5	3.7	3	4.6	3	5.1	4
TOTAL ZONE	121.9	100	112.7	100	113.3	100	147.3	100	118.5	100
ZONE III										
Land preparation	22.3	24	17.5	19	0	0	-	-	19.6	21
Planting	9.3	10	8.5	9	10.7	10	-	-	9.2	9
Re-planting	0.5	1	1.1	1	0.3	1	-	-	0.6	1
Weeding	43.0	46	51.0	55	47.0	45	-	-	45.2	48
Apl. fertilizers	0	0	0	0	0	0	-	-	0	0
Apl. insecticides	0	0	0.5	1	0	0	-	-	0.1	1
Harvesting and packing	17.9	19	14.5	15	45.9	44	-	-	19.1	20
TOTAL ZONE	93.0	100	93.1	100	103.90	100	-	-	93.8	100
TOTAL ZONES										
Land preparation	26.6	25	23.0	20	18.3	16	34.8	27	25.0	24
Planting	10.5	9	10.9	10	11.0	10	10.9	8	10.8	10
Re-planting	0.7	1	0.8	1	0.4	1	0.4	1	0.6	1
Weeding	38.4	35	42.7	38	46.7	42	59.4	45	43.7	41
Apl. fertilizers	0.4	1	0.1	1	0	0	0.2	1	0.3	0
Apl. insecticides	1.0	1	0.8	1	0.1	1	0.2	1	0.6	1
Harvesting and packing	29.2	27	22.1	29	33.6	30	21.3	17	24.9	23
TOTAL ZONES	106.8	100	100.4	100	110.1	100	127.2	100	105.9	100

Figure 5. Labor use by activity (farmers preparing land manually)

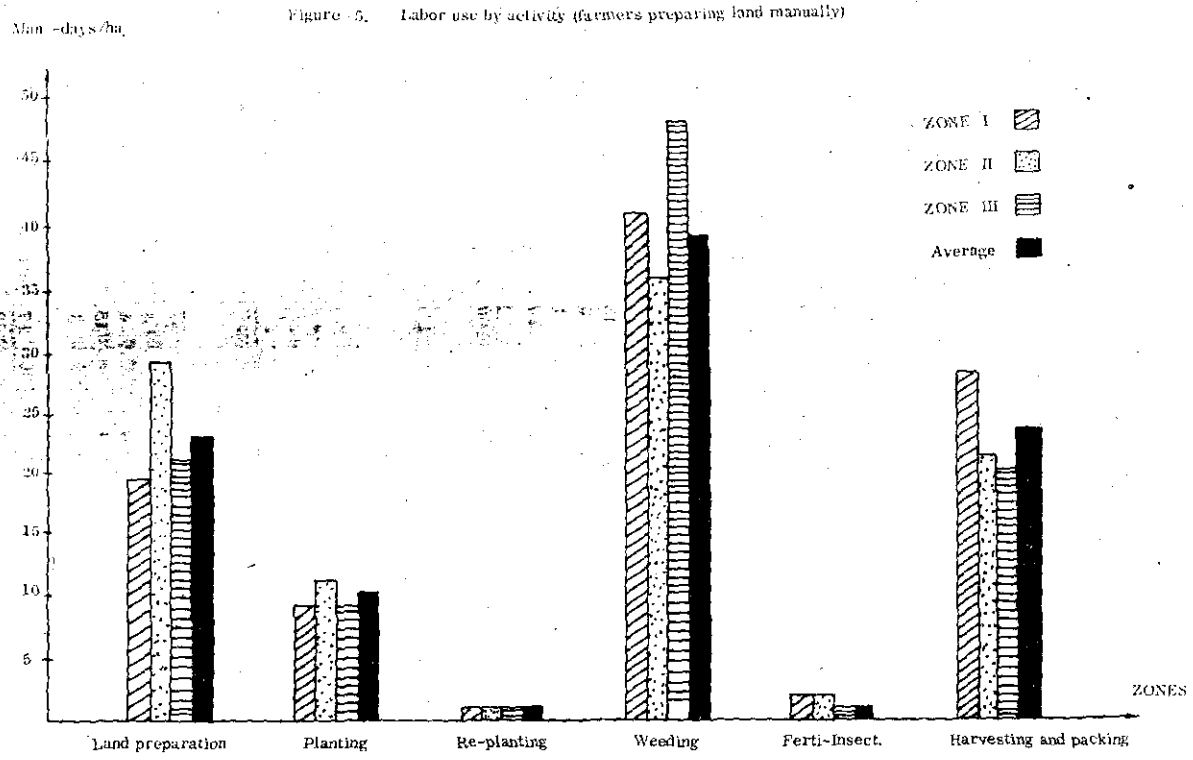
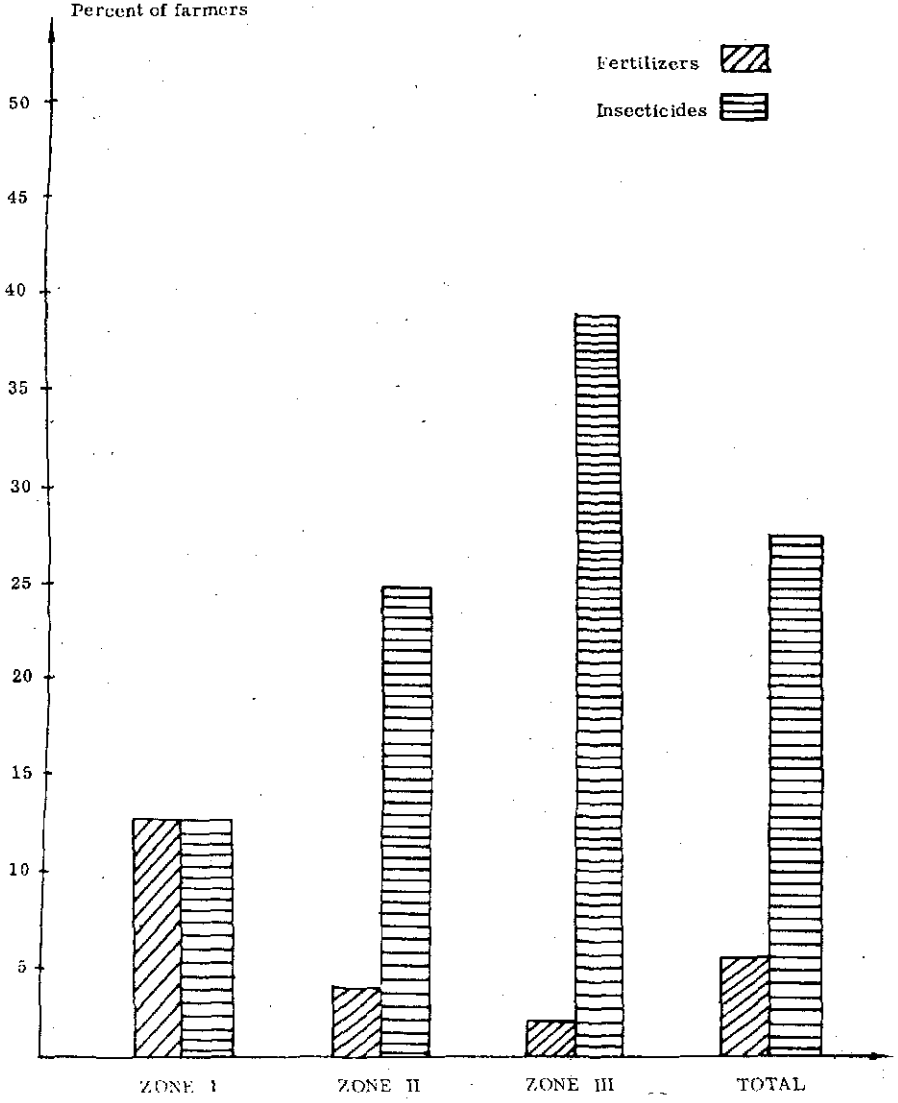


Table 4. Labor use in the production of cassava (man-days/ton). Average by farm size

Mechanical land preparation	0 - 2 has	2 - 4 has	4 - 10 has	10 or more	Weighted average
ZONE I	5.1	9.2	5.6	7.1	6.8
ZONE II	-	12.8	7.4	-	10.4
ZONE III	7.1	10.9	-	6.3	7.6
TOTAL MECH. LAND PREPARATION	5.8	10.7	6.4	6.7	7.9
Manual land preparation					
ZONE I	5.6	11.4	9.9	11.6	9.4
ZONE II	16.6	6.0	17.5	18.2	9.1
ZONE III	11.1	11.8	8.9	-	10.9
TOTAL MANUAL LAND PREPARATION	9.3	8.6	11.2	14.7	9.7

(-) Data not available

Figure 6. Fertilizer and insecticide use



appears to be most common in the North Coast Region and least common on flat lands outside that region (Figure 6).

Herbicides

None of the farmers interviewed used herbicide for cassava.

PRODUCTION COSTS

Estimated variable costs of production are shown in Tables 5, 6, 7, 8 and 9. A daily wage of Col. $20 was assumed for all zones. Hence, labor costs were estimated by multiplying labor use by 20. Input costs were obtained from the survey. Labor costs account for about 60 percent of total variable costs on farms, where machinery was used for land preparation and 90-95 percent when the land was prepared manually.

Investments in fertilizer and insecticides increase with increasing farm size. This reflects the somewhat higher level of technology on large farms and may explain in part the higher yields on larger farms as discussed later. Total variable costs are higher on farms where land was prepared with machinery than on farm with manual land preparation. This is related partly to higher costs of mechanized land preparation and partly to higher levels of input use. Variable costs in the North Coast Region are considerably below those for the other regions. Average variable costs for all the sample farms were estimated to be Col. $2,400.00/ha.

To estimate total production costs, an average value of land of Col. $15,000/ha and an annual land rent of 12 percent were assumed. Using an average land value rather than the actual value for each farm biases production costs upward in regions with low land values and downwards in regions with high land values. However, it was not possible to obtain reliable land value data for the sample farms. Hence, total costs are estimated as an average of all sample farms. Transportation costs were obtained from survey data and interest charges on operating capital were assumed to be 24 percent per year. Finally, an amount equal to 20 percent of total costs thus far estimated was added to cover costs not previously included such as administration, protection from robbery of the crop, etc.

TABLE 5
Estimated variable production costs per hectare of cassava for Zone I.

Mechanical land preparation	0 - 2 has		2 - 4 has		4 - 10 has		10 or more has		Weighted Average	
	$/ha	%	$/ha	%	$/ha	%	$/ha	%	$/ha	%
Land preparation	650.00	23	897.11	29	950.00	30	853.68	23	869.72	26
Planting	80.00	3	252.00	8	170.00	5	154.00	4	172.00	5
Re-planting	10.00	1	14.00	1	8.00	1	8.00	1	10.00	1
Weeding	746.00	26	1156.00	37	970.00	31	1182.00	33	1074.00	33
Apl. fertilizers	8.00	1	12.00	1	26.00	1	24.00	1	20.00	1
Apl. insecticides	6.00	1	6.00	1	10.00	1	8.00	1	8.00	1
Harvesting	654.00	23	400.00	13	464.00	15	940.00	26	660.00	20
Packing	190.00	7	132.00	4	222.00	7	160.00	4	174.00	5
TOTAL	2344.00	85	2869.77	94	2820.00	91	3329.68	93	2987.72	92
INPUTS										
Seed	366.25	13	100.89	3	106.32	3	172.00	5	157.38	5
Fertilizers	30.00	1	88.69	2	169.27	5	44.69	1	87.38	2
Insecticides	9.00	1	9.89	1	27.27	1	37.50	1	25.62	1
TOTAL INPUTS	405.25	15	199.47	6	302.86	9	254.19	7	270.38	8
TOTAL VARIABLE COST	2749.25	100	3069.24	100	3122.86	100	3583.87	100	3258.10	100
Manual land preparation										
Land preparation	400.00	18	416.00	19	364.00	15	416.00	17	400.00	17
planting	158.00	7	210.00	10	184.00	8	246.00	10	206.00	9
Re-planting	24.00	1	16.00	1	12.00	1	4.00	1	14.00	1
Weeding	634.00	28	784.00	37	926.00	38	1014.00	43	866.00	37
Apl. fertilizers	0	0	0	0	0	0	6.00	1	2.00	1
Apl. insecticides	0	0	24.00	1	0	0	2.00	1	8.00	1
Harvesting	812.00	36	290.00	14	456.00	19	330.00	14	430.00	18
Packing	80.00	3	176.00	8	320.00	13	120.00	5	180.00	7
TOTAL	2108.00	93	1916.00	90	2262.00	94	2138.00	92	2106.00	91
INPUTS										
Seed	168.00	7	183.17	8	153.55	6	153.92	6	164.28	7
Fertilizer	0	0	0	0	0	0	42.77	1	12.93	1
Insecticides	0	0	33.50	2	0	0	1.23	1	9.72	1
TOTAL INPUTS	168.00	7	216.67	10	153.55	6	197.92	8	186.93	9
TOTAL VARIABLE COST	2276.00	100	2132.67	100	2415.55	100	2335.92	100	2292.93	100

(-) Data not available
(*) Estimated man-day value $20.00

TABLE 6

Estimated variable production cost per hectare of cassava for Zone II

Mechanical land preparation	0 - 2 has		2 - 4 has		4 - 10 has		10 or more has		Weighted average	
	$/ha	%	$/ha	%	$/ha	%	$/ha	%	$/ha	%
Land preparation	-	-	955.33	31	803.33	30	-	-	904.66	31
Planting	-	-	350.00	11	306.00	11	-	-	336.00	11
Re-planting	-	-	6.00	1	0	0	-	-	4.00	1
Weeding	-	-	872.00	28	986.00	37	-	-	910.00	31
Apl. fertilizers	-	-	0	0	0	0	-	-	0	0
Apl. insecticides	-	-	4.00	1	6.00	1	-	-	4.00	1
Harvesting	-	-	398.00	13	364.00	14	-	-	386.00	13
Packing	-	-	278.00	9	116.00	4	-	-	224.00	7
TOTAL	-	-	2863.33	94	2581.33	97	-	-	2768.66	95
INPUTS										
Seed	-	-	146.00	5	67.06	2	-	-	119.69	4
Fertilizers	-	-	0.00	0	0	0	-	-	0	0
Insecticides	-	-	5.00	1	10.00	1	-	-	6.66	1
TOTAL INPUTS	-	-	151.00	6	77.06	3	-	-	126.35	5
TOTAL VARIABLE COST	-	-	3014.33	100	2658.39	100	-	-	2895.01	100
Manual land preparation										
Land preparation	750.00	29	614.00	26	732.00	29	976.00	32	702.00	28
Planting	284.00	11	274.00	11	264.00	10	190.00	6	266.00	10
Re-planting	8.00	1	12.00	1	8.00	1	10.00	1	10.00	1
Weeding	808.00	31	756.00	32	934.00	38	1360.00	45	856.00	34
Apl. fertilizers	24.00	1	8.00	1	0	0	0	0	10.00	1
Apl. insecticides	60.00	2	16.00	1	4.00	1	6.00	1	24.00	1
Harvesting	406.00	15	460.00	19	250.00	10	312.00	10	400.00	16
Packing	98.00	4	114.00	4	74.00	3	92.00	3	102.00	4
TOTAL	2438.00	94	2254.00	95	2266.00	92	2946.00	98	2370.00	95
INPUTS										
Seed	94.89	4	83.31	3	183.35	7	53.42	1	99.28	3
Fertilizers	19.50	1	4.40	1	0	0	0	0	6.98	1
Insecticides	25.15	1	7.85	1	1.54	1	11.88	1	11.51	1
TOTAL INPUTS	139.54	6	95.56	5	184.89	8	65.30	2	117.77	5
TOTAL VARIABLE COST	2577.54	100	2349.56	100	2450.89	100	3011.30	100	2487.77	100

TABLE 7

Estimated variable production cost per hectare for cassava for Zone III.

Mechanical land preparation	0 - 2 has		2 - 4 has		4 - 10 has		10 or more has		Weighted average	
	$/ha	%	$/ha	%	$/ha	%	$/ha	%	$/ha	%
Land preparation	378.52	21	393.50	21	-	-	520.00	20	398.92	20
Planting	154.00	9	186.00	10	-	-	136.00	5	160.00	8
Re-planting	6.00	1	6.00	1	-	-	0	0	6.00	1
Weeding	820.00	47	802.00	42	-	-	1066.00	41	846.00	44
Apl. fertilizers	0	0	4.00	1	-	-	20.00	1	4.00	1
Apl. insecticides	6.00	1	0	0	-	-	0	0	4.00	1
Harvesting and packing	252.00	14	412.00	21	-	-	536.00	21	324.00	17
TOTAL	1616.52	93	1803.50	96	-	-	2278.00	88	1742.92	92
INPUTS					-	-	203.17	8	112.86	6
Seed	111.79	6	70.59	3	-	-	83.00	3	9.88	1
Fertilizers	0	0	0	0	-	-	4.00	1	5.93	1
Insecticides	7.04	1	3.9	1	-	-	290.17	12	128.67	8
TOTAL INPUTS	118.83	7	74.49	4	-	-	2568.17	100	1871.59	100
TOTAL VARIABLE COST	1735.35	100	1877.99	100						
Manual land preparation					0	0	-	-	392.00	19
Land preparation	446.00	23	350.00	18	214.00	8	-	-	184.00	9
Planting	186.00	9	170.00	8	6.00	1	-	-	12.00	1
Re-planting	10.00	1	22.00	1	940.00	43	-	-	904.00	45
Weeding	860.00	43	1020.00	51	0	0	-	-	0	0
Apl. fertilizers	0	0	0	0	0	0	-	-	2	1
Apl. insecticides	0	0	10.00	1	918.00	42	-	-	382.00	19
Harvesting and packing	358.00	18	290.00	14	2078.00	94	-	-	1876.00	94
TOTAL	1860.00	94	1862.00	93						
INPUTS					101.17	5	-	-	101.81	5
Seed	98.66	5	111.30	6	0	0	-	-	0	0
Fertilizers	0	0	0	0	21.58	1	-	-	14.71	1
Insecticides	13.93	1	14.95	1	122.75	6	-	-	116.52	6
TOTAL INPUTS	112.59	6	126.25	7						
TOTAL VARIABLE COST	1972.59	100	1988.25	100	2200.75	100	-	-	1992.52	100

(-) Data not available

TABLE 8

Estimated variable production cost per hectare of cassava average, all zones

Mechanical land preparation	0 - 2 has.		2 - 4 has.		4 - 10 has.		10 or more has.		Weighted average	
	$/ha.	%	$/ha.	%	$/ha.	%	$/ha.	%	$/ha.	%
Land preparation	514.26	22	748.87	27	876.67	30	686.84	22	674.29	25
Planting	118.00	5	262.00	10	238.00	8	146.00	4	182.00	7
Re-planting	8.00	1	8.00	1	4.00	1	4.00	1	6.00	1
Weeding	784.00	34	944.00	34	978.00	32	1124.00	36	936.00	34
Apl. fertilizers	4.00	1	6.00	1	14.00	1	22.00	1	10.00	1
Apl. insecticides	6.00	1	4.00	1	8.00	1	4.00	1	6.00	1
Harvesting and packing	548.00	24	540.00	20	584.00	20	818.00	26	614.00	23
TOTAL	1982.26	88	2512.87	94	2702.67	93	2804.84	91	2428.29	92
INPUTS										
Seed	239.02	10	105.82	4	86.69	3	187.58	6	167.12	6
Fertilizers	15.00	1	29.56	1	84.64	3	63.84	2	40.99	1
Insecticides	8.02	1	6.26	1	18.63	1	20.75	1	12.10	1
TOTAL INPUTS	262.04	12	141.64	6	189.96	7	272.17	9	220.21	8
TOTAL VARIABLE COST	2244.30	100	2654.51	100	2892.63	100	3077.01	100	2648.50	100
Manual land preparation										
Land preparation	532.00	23	460.00	19	366.00	15	696.00	25	500.00	21
Planting	210.00	9	218.00	9	220.00	9	218.00	8	216.00	9
Re-planting	14.00	1	16.00	1	8.00	1	8.00	1	12.00	1
Weeding	768.00	33	854.00	35	934.00	39	1188.00	43	864.00	35
Apl. fertilizers	8.00	1	2.00	1	0	0	4.00	1	6.00	1
Apl. insecticides	20.00	1	16.00	1	2.00	1	4.00	1	14.00	1
Harvesting and packing	580.00	25	442.00	27	672.00	28	426.00	16	530.17	25
TOTAL	2132.00	93	2008.00	93	2202.00	93	2544.00	95	2142.17	93
INPUTS										
Seed	120.51	5	125.92	5	146.02	6	103.67	3	124.34	5
Fertilizers	6.50	1	1.47	1	0	0	21.39	1	5.33	1
Insecticides	13.03	1	18.77	1	7.71	1	6.56	1	13.59	1
TOTAL INPUTS	140.04	7	146.16	7	153.73	7	131.62	5	143.26	7
TOTAL VARIABLE COST	2272.04	100	2154.16	100	2355.73	100	2675.62	100	2285.43	100

TABLE 9

Estimated variable production cost per hectare of cassava average for all farmers.

	0 - 2 has		2 - 4 has		4 - 10 has		10 or more has		Weighted average	
	$/ha	%	$/ha	%	$/ha	%	$/ha	%	$/ha	%
Land preparation	523.13	23	604.44	24	621.34	23	691.42	24	569.96	23
Planting	164.00	7	240.00	9	229.00	9	182.00	6	195.16	8
Re-planting	11.00	1	12.00	1	6.00	1	6.00	1	9.52	1
Weeding	776.00	34	899.00	35	956.00	35	1156.00	39	869.50	36
Apl. fertilizers	6.00	1	4.00	1	7.00	1	13.00	1	6.28	0
Apl. insecticides	13.00	1	10.00	1	5.00	1	4.00	1	9.16	0
Harvesting and packing	564.00	23	491.00	23	628.00	23	622.00	21	557.90	24
TOTAL	2057.13	90	2260.44	94	2452.34	93	2674.42	93	2217.48	92
INPUTS										
Seed	179.77	8	115.87	4	116.36	4	145.63	5	139.04	6
Fertilizers	10.75	1	15.52	1	42.32	2	42.62	1	21.03	1
Insecticides	10.53	1	12.52	1	13.17	1	13.66	1	11.65	1
TOTAL INPUTS	201.05	10	143.91	6	171.85	7	201.91	7	171.72	8
TOTAL VARIABLE COST	2258.18	100	2404.35	100	2624.19	100	2876.33	100	2389.20	100

Under these assumptions, average total costs were estimated as Col. $6,586/ha and Col. $598/ton as follows:

	Pesos/ha	Pesos/ton
Average variable costs	2,390	217
Land rent	1,800	164
Transportation costs	720	65
Interests on working capital	576	52
Other costs	1,100	100
Total cost	6,586	598

At the exchange rate of Col. peso $20 to one U.S. dollar the cost per ton is thus approximately US $30. This is considerably higher than the price paid to the cassava producer in the major cassava exporting country, Thailand. Hence Colombia does not presently appear to be competitive in the world market. The introduction of yield increasing technology could reduce rapidly per unit costs and bring Colombia into a competitive position in so far as the price of raw material for processed cassava products are concerned.

YIELD

Table 10 shows estimated yields by zone and farm size. Overall average yield was estimated to be 11 tons/ha. Yields were relatively low in the North Coast Regions while they were high on flat lands outside the region (Zone I). Although yields appeared to be higher on large than on small farms, no definite relationship between yield and farm size was established.

Because of the preliminary nature of the data, no attempt was made to explain yield differences among zones and farm sizes. However, to get some idea of the relative importance of yield-limiting factors beyond production practices and input utilization, the sample farmers were asked about their principal problems in cassava production. Farmers perceived excess water during the rainy season as the most important problem. Other problems mentioned included robbery from the field, diseases and insects.

Table 10. Estimated yield of cassava (tons/hectare)

	0-2 has	2 - 4 has	4 - 10 has	10 or more has	Weighted average
Mechanical land preparation					
ZONE I	16.47	10.71	16.56	17.44	15.59
ZONE II	-	7.48	11.96	-	8.97
ZONE III	8.75	6.49	-	14.05	8.84
TOTAL MECH. LAND PREP.	12.61	9.23	14.26	15.76	11.13
Manual land preparation					
ZONE I	18.82	8.41	11.41	9.22	11.18
ZONE II	7.34	18.85	6.48	8.10	13.00
ZONE III	8.37	7.88	11.70	-	8.58
TOTAL MANUAL LAND PREPARATION	11.51	11.71	9.86	8.63	10.92
TOTAL ALL FARMERS	12.06	9.97	12.06	12.21	11.03

CREDIT AND TECHNICAL ASSISTANCE

About one-third of the sample farmers obtained credit for the production of cassava. Two-thirds of the farmers that obtained credit had less than three hectares of cassava, and the amount of credit usually was less than $3,000/ha. Caja Agraria was the credit source most generally mentioned.

Ten farmers (3 percent) reported receiving technical assistance for cassava production. Six of these farmers were in Zone I.

MARKETING AND PRICES

Slightly more than half of the farmers sold the cassava on the farm while the rest brought it to the market place for sale. Seven farmers sold cassava for processing, the rest was sold for direct human consumption. Only three farmers (all in Zone I) sold their cassava while still in the ground, i.e. the buyer was responsible for harvesting.

Cassava is frequently produced far from consumption centers and roads are often poor or non-existent. Furthermore, cassava is a bulky product. Hence, transportation problems are frequent and costs high. Trucks are used most frequently. Although, many farmers use animals, primarily donkeys, to transport the cassava either to the market or to the road where it is transferred to a truck, bus or jeep.

The average of the prices paid to the sample farmers prior to the period of the survey was Col. $769/ton. A considerable difference was found between prices paid to small farmers and those paid to larger ones. Farmers with a cassava area of less than 2 hectares received 70 percent of the price paid to farmers with 10 hectares or more (Table 11). It is not clear from the survey data why this price differential exists. One explanation may be economies of size in transportation and other marketing activities. Furthermore, it is likely that small farms tend to be further removed from roads and consumption centers than larger ones, hence transportation costs are high and visits of cassava buyers more infrequent. However, additional research is needed to explain satisfactorily the existence of the price differential. The issue seems sufficiently important to warrant such research.

Table 11. Average price of cassava received in each size group (Col. $/ton)

	0 - 2 has	2 - 4 has	4 - 10 has	10 or more	Weighted average
ZONE I	681.87	736.69	1061.56	1117.40	948.82
ZONE II	917.52	800.93	820.45	900.77	868.21
ZONE III	518.31	687.41	907.41	684.70	587.52
TOTAL	656.21	741.68	954.00	955.07	769.36

FARM RETURNS

Given the preliminary nature of the data, the large variation in costs, prices and yields among farms and the lack of accurate estimates of land values, any estimation of net returns to the farmer is at best superficial. Furthermore, both prices and costs have increased considerably since the survey was completed. However, it appears cassava prices have increased more than production costs. Hence, the net returns estimated here are likely to be less than those prevailing at the time this report was written.

With the qualifications mentioned above, the average net returns were estimated to be Col. $1,896/ha and Col. $171/ton and estimated as follows:

	Pesos/ha	Pesos/ton
Value of production	8,482	769
Total costs	6,586	598
Net returns	1,896	171

SUMMARY AND CONCLUSIONS

This report describes the cassava production process in Colombia. The description is brief and the information is preliminary. Emphasis is placed on a description of production practices, input use and costs. The results from this study provided guidelines for a more comprehensive analysis of factors limiting cassava production and productivity now in progress.

Data for the analysis reported here were obtained from 300 farms in 17 departments of Colombia.

The cultural practices on most of the sample farms consisted of (1) land preparation, in most cases rudimentary, (2) planting, (3) weeding and (4) harvesting. In addition, re-planting and application of insecticides and fertilizers were carried out on some farms. Cassava was intercropped with maize, plantain, coffee, yams or beans on one-third of the sample farms.

The level of technology in cassava production was low. Mechanized land preparation was found on a small number of farms. No other use of machinery in cassava production was reported. Use of fertilizers and insecticides was limited, and no herbicides were applied. None of the sample farmers applied irrigation. The

use of credit and technical assistance for cassava production was limited.

It may be concluded that cassava production in Colombia is based on traditional production methods with land and labor accounting for a large majority of the resources used.

Labor use per hectare varied from 67 man-days in the North Coast Region where land was prepared mechanically to 119 man-days on mountainous slopes with manual land preparation. On the average, farmers using mechanical land preparation spent 88 man-days/ha while 110 man-days/ha were used where land was prepared manually. Weeding was the most labor-consuming activity followed by harvesting/packing, land preparation and planting. Labor use per ton of cassava was estimated at about 8 and 10 man-days for mechanical and manual land preparation, respectively.

Average yield of cassava was estimated at 11 ton/ha with considerable variation among farms. No definite relationship was found between yield level and farm size.

Total costs were estimated to be Col. $6,586/ha and Col. $598/ton. Net returns were estimated to be Col. $1,896/ha and Col. $171/ton. Given the preliminary nature of the analysis and the lack of reliable data on certain costs components, estimated total costs and revenues should be considered as approximate magnitudes rather than exact figures. The reliability of the estimates will be tested on the basis of results from a more comprehensive study presently underway.

Prices received by farmers vary considerably. Small farmers seem to receive considerably lower prices than larger ones. On the average, the price received by the farmer with less than two hectares of cassava is about 70 percent of the price received by the farmer with more than four hectares. The relationship between price level and farm size is particularly marked in the North Coast Region where farmers with less than two hectares received about 60 percent of the price received by farmers with 10 hectares or more. With respect to economies of scale in cassava production in Colombia it appear that price differentials are more important than cost and yield differentials. However, additional data are needed to verify this finding.

On the basis of this analysis, additional research is recommended on the following subjects:

1. Factors explaining yield differences among farms and regions. This research should focus on identifying yield limiting factors and estimating their relative importance for production and productivity. Such work is now in progress.
2. The role of intercropping. Emphasis should be placed on (a) estimating relative net return and risk from alternative cropping systems using present and improved technology, and (b) the farmer's expectation of net benefits from alternative systems.
3. The relationships between farm size and prices received by farmers. The findings of this study should be verified and if they are confirmed, efforts should be made to explain the price differential.

It is not the purpose of this study to suggest priorities in biological research related to cassava. However, results from the study suggest that research be carried out:

1. to estimate the relationship between level of weeds and cassava yields. Work on this subject is in progress.
2. to identify inexpensive means of weed control in cassava.
3. to estimate the impact of alternative degrees of land preparation on cassava yields. Land preparation accounts for a considerable portion of total production costs on some farms while it is of little importance on others. Controlled experiments are needed to determine the pay-off from improved land preparation.

It is expected that the more comprehensive study now in progress will provide information useful for establishing further priorities in biological research on cassava.