AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: ECONOMICS

B. SECONDARY: AGRICULTURAL ECONOMICS

2. TITLE AND SUBTITLE

ANALYSIS OF MAIZ PRODUCTION IN NICARAGUA A DETAILED STUDY OF COSTS AND RETURNS

3. AUTHOR(S)

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4. DOCUMENT DATE: DECEMBER 1972

5. NUMBER OF PAGES: 32 PAGES

6. ARC NUMBER: ARC NU-338.17315-F513

7. REFERENCE ORGANIZATION NAME AND ADDRESS

UNIVERSITY OF MISSOURI
DEPT. OF AGRICULTURAL ECONOMICS
COLUMBIA, MISSOURI 65201

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

This study has considered 293 maiz farms. Initial emphasis was to give an overall view of the costs and returns (see Table 2). Comparisons of costs and returns were then made by:

Size (9 groupings)
Region (6 groupings)
Ecology (3 groupings)
Technology (3 groupings)

Special consideration was finally given to physical labor requirements (Table 7). Again these data were viewed in the context of size, region, ecology, and technology.

Statistical tests of Analysis of Variance were made and are summarized in the Appendix. With respect to size, region, ecology level, the following parameters were tested to ascertain if significant differences existed:

1. Gross Income
2. Yield
3. Total Labor
4. Total Cost

Coefficients of variation, F values and levels of statistical significance are presented. With respect to the various groupings, all parameters were statistically significant. In other words, the differences in, say, size groupings were genuinely different.

10. CONTROL NUMBER: PN-AAB-005

11. PRICE OF DOCUMENT:

12. DESCRIPTORS

SIZE, REGION, ECOLOGY, TECHNOLOGY, GROSS INCOME, YIELD, TOTAL LABOR, TOTAL COST

13. PROJECT NUMBER: 524-11-110-073

14. CONTRACT NUMBER: AID/CM/LA-C-73-21

15. TYPE OF DOCUMENT: SECTOR ANALYSIS

AID 590-1 (4-74)

ANALYSIS OF MAIZ PRODUCTION IN NICARAGUA: A DETAILED STUDY OF COSTS AND RETURNS

Presented to

Vice-Minister Mayo Vega

and

United States Agency for International Development/Nicaragua

by

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A.I.D.
Reference Center
Room 1656 NS

December 1973

CONTENTS

	Page
Introduction	1
Production Costs: Maiz--An Overall View	3
Maiz--Production Costs by Size	6
Maiz--Production Costs by Region	10
Maiz--Production Costs by Ecology Levels	14
Maiz--Production Costs by Technology Levels	18
Labor Requirements	22
Summary	26
Appendix	30

TABLES

Table		Page
1.	Maiz--Sample Description	2
2.	Maiz--Average Production Costs	4
3.	Maiz--Production Costs by Size Groups	7
4.	Maiz--Production Costs by Region	11
5.	Maiz--Production Costs by Ecology Level	15
6.	Maiz--Production Costs by Technology Level . . .	19
7.	Labor Requirements for Maiz by Region, Size, Ecology and Technological Levels	23
8.	Highest and Lowest Costs and Returns by Region, Size, Ecology and Technological Levels	28

Appendix Table 1. Analyses of Variance for Gross Income, Crop Yield, Total Labor and Total Cost--Coefficients of Variation, F Values and Levels of Significance 30

INTRODUCTION

The following discussion supplements the previous report, "Input-Output Analysis for Crops and Livestock in Nicaragua". Corn was the largest sample in the survey with 293 farms represented. Every size level, region, ecology level, and technological level were represented. In Table 1 it is noted that the vast majority of the sample fell into the size classification from 1 to 9.9 mz. There were only 7 farms less than 1 mz and only 6 farms in excess of 15 mz. (In fact, those farms above 15 mz perhaps should be considered case studies rather than sample farms.)

Distribution of corn farms by region was fairly evenly dispersed with the PC having the most farms (75--or over 25% of the sample) while the IC region had the fewest--27 farms and slightly over 9% of the sample.

All ecology levels were represented; however, 237 or almost 81% of the farms were in ecology level B. A few farms (36) were in ecology level M and still fewer (20) in ecology level P.

Less than 10% of the farms (29) were in technological level 3. The remaining farms were fairly evenly distributed between levels 1 and 2 with 129 and 135 farms in each technological level respectively.

TABLE 1. MAIZ--SAMPLE DESCRIPTION

Maiz-Size

Size	Number of Farms	Percent of Sample
1 (<1 mz)	7	2.4
2 (1-2.9 mz)	122	41.6
3 (3-4.9 mz)	60	20.5
4 (5-9.9 mz)	78	26.6
5 (10-15 mz)	20	6.8
6 (20 mz)	3	1.0
7 (25 mz)	1	.3
8 (33 mz)	1	.3
9 (75 mz)	1	.3

Maiz-Region

Region	Number of Farms	Percent of Sample
IC	27	9.2
IN	41	14.0
IS	58	19.8
PC	75	25.6
PN	53	18.1
PS	39	13.3

Maiz-Ecology

Ecology Level	Number of Farms	Percent of Sample
M	36	12.3
B	237	80.9
P	20	6.8

Maiz-Technology

Technological Level	Number of Farms	Percent of Sample
1	129	44.0
2	135	46.1
3	29	9.9

PRODUCTION COSTS: MAIZ--AN OVERALL VIEW*

To obtain a broad perspective of all corn farms in general without reference to region, size, technology or ecology the following table (Table 2) is derived. Note that for the average corn farm Total Costs amounted to about C$490 per mz. (All data are presented on a per mz basis unless otherwise specified.) Of the C$490 total costs, about C$113 were Fixed Costs amounting to 23% of the total. Variable Costs, of course, by definition accounted for the remainder or 77% of the Total Costs. Of Fixed Costs, land was the most dominant entity accounting for most of the Fixed Cost and over 18% of the total expenditure. Labor was the most important cost item included in Variable Cost. The variable labor amounted to over 44% of the Total Cost. Chemicals were the next most important Variable Cost--over 10% of Total Cost. Animal and mechanical power were important items and were 9.3 and 5.4 percent of Total Cost respectively.

Gross Income, of course, was functionally related to the yield and the price received. The average yield for corn in the sample was about 22 qq/mz and the attendant price was slightly over C$27 per qq. Gross Income was approximately C$603 per mz. Net Cash Income, Net Farm Income and Net

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*The reader is urged to carefully review the previous report and the attendant tables to which that report was keyed. Furthermore, it is necessary to become familiar with the methods of calculation, e.g. how the functions were derived. This information too is contained in the previous report. In case of any questions concerning data or its source, the reader is referred to the previous report.

TABLE 2. MAIZ--AVERAGE PRODUCTION COSTS*

Total Cost C$	490.87	
Fixed Cost C$	112.94	(23.0%)
Depreciation	9.41	(1.9%)
Land	88.92	(18.1%)
Labor	14.60	(3.0%)
Variable Costs C$	377.93	(77.0%)
Labor	216.56	(44.1%)
Animal Units	45.76	(9.3%)
Mechanical Units	26.41	(5.4%)
Seed	15.31	(3.1%)
Chemicals	49.56	(10.1%)
Ener-Rep.	1.28	(.3%)
Interest	15.19	(3.1%)
Other	7.82	(1.6%)
Gross Income C$	602.89	
Net Cash Income	283.76	
Net Farm Income	224.96	
Net Benefit	112.02	
Total Cost/Gross Income	81.4%	
Return on Investment	22.82	
Return on Working Capital	29.64	
Yield/mz (qq)	22.01	
Price/(qq)	27.4	
Cost/(qq) C$	22.30	

*Data in parentheses refer to percentage of Total Cost.

Benefit are given with Net Benefit amounting to about C$112 per mz. When costs are compared to Gross Income, Total Costs were slightly over 81% of Gross Income. Rate of Investment, Rate on Working Capital were about 23 and 30 respectively.

With this background basis for the average farm we can now turn to the various classifications.

MAIZ--PRODUCTION COSTS BY SIZE

The following table (Table 3) gives the basic information for all corn farms according to size groupings.* Total Costs ranged from a high of almost C$1341 for Size 8 to a low of C$449 in the Size 3 (3-4.9 mz).

It is noted that Fixed Costs were relatively stable regardless of the size and really do not show much trend. The lowest percentage of Fixed Costs to Total Costs were associated with the smallest farms (less than 17%) and the high was the farm with 33 mz (Size 8) where almost 37% of the costs were fixed. Percentage Fixed Costs for most farms, however, were in the 20 to 30% range.

For all the farms (except the larger farms) the range in Variable Costs was not great. Excluding the three largest farms, the range was from a high of C$502 for Size 1 to a low of C$334 for Size 3. The larger farms had Variable Costs in the C$800 to C$900 range. Of the Variable Costs, labor was generally the largest input and these costs varied from a high of C$396 for Size 7 to a low of C$71 for Size 9. But considering only the farm Sizes 1 to 6 (< 1 to 20 mz) the range was a high of C$431 in Size 1 to C$198 in Size 3 with all other sizes being in the C$200 ranges. In percentage, the range was from 71.5 of the Total Costs for labor in Size 1

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*Size groupings were:

1 ... less than 1 mz
2 ... 1 to 2.9 mz
3 ... 3 to 4.9 mz
4 ... 5 to 10 mz
5 ... 10 to 15 mz
6 ... 20 mz
7 ... 25 mz
8 ... 33 mz
9 ... 75 mz

TABLE 3. MAIZ--PRODUCTION COSTS BY SIZE GROUPS*

	1	2	3	4	5	6	7	8	9
	<1 (7)	1-2.9 (122)	3-4.9 (60)	5-9.9 (78)	10-15 (21)	20 (3)	25 (1)	33 (1)	75 (1)
Total Cost C$	602.28	454.38	449.44	504.15	639.23	514.81	1217.44	1340.97	997.00
Fixed Cost C$	100.00(16.6%)	95.15(20.9%)	115.74(25.8%)	120.48(23.9%)	149.97(23.5%)	151.00(29.3%)	304.00(24.9%)	495.00(36.9%)	190.00(19.0%)
Depreciation	--	4.74 (1.0%)	8.23 (1.8%)	13.19 (2.6%)	27.32 (4.3%)	26.00 (5.1%)	31.00 (2.5%)	2.00 (.1%)	--
Land	100.00(16.6%)	86.53(19.0%)	95.16(21.2%)	83.69(16.6%)	100.50(15.7%)	83.33(16.1%)	100.00 (8.2%)	100.00 (7.5%)	100.00(10.0%)
Labor	--	3.87 (.9%)	12.35 (2.8%)	23.60 (4.7%)	22.15 (3.5%)	41.66 (8.1%)	173.00(14.2%)	393.00(29.3%)	90.00 (9.0%)
Variable Costs C$	502.28(83.4%)	359.23(79.1%)	333.70(74.3%)	383.67(76.1%)	489.25(76.5%)	363.81(70.7%)	913.44(75.1%)	845.97(63.1%)	807.00(81.0%)
Labor	430.57(71.5%)	213.37(47.0%)	198.00(44.1%)	207.80(41.2%)	250.11(39.1%)	200.20(32.5%)	395.92(32.5%)	247.00(18.4%)	70.96 (7.1%)
Animal Units	36.07 (6.0%)	50.61(11.1%)	50.50(11.2%)	39.25 (7.8%)	37.91 (5.9%)	31.66 (6.1%)	38.00 (3.1%)	-- --	-- --
Mechanical Units	-- --	11.78 (2.6%)	17.82 (4.0%)	40.44 (8.0%)	55.14 (8.6%)	53.33(10.4%)	166.00(13.6%)	317.30(23.7%)	330.00(33.1%)
Seed	18.57 (3.1%)	14.68 (3.2%)	10.73 (2.4%)	17.20 (3.4%)	20.24 (3.2%)	10.33 (2.0%)	49.00 (4.0%)	36.00 (2.7%)	60.00 (6.0%)
Chemicals	-- --	45.53(10.0%)	36.15 (8.0%)	53.46(10.6%)	95.23(14.9%)	47.16 (9.2%)	174.00(14.3%)	162.50(12.1%)	245.00(24.6%)
Ener-Rep.	-- --	.32 --	.14 --	1.78 (.4%)	3.56 (.6%)	--	16.50 (1.4%)	40.00 (3.0%)	60.00 (6.0%)
Interest	17.06 (2.8%)	14.02 (3.1%)	13.10 (2.9%)	16.19 (3.2%)	19.96 (3.1%)	17.36 (3.4%)	42.02 (3.6%)	43.17 (3.2%)	27.04 (2.8%)
Other	--	8.88 (2.0%)	7.22 (1.6%)	7.41 (1.5%)	7.08 (1.1%)	3.75 (.7%)	32.00 (2.6%)	--	13.50 (1.4%)
Gross Income C$	596.35	590.33	505.05	643.17	659.29	672.66	1960.00	1378.00	1440.00
Net Cash Income	237.93	295.73	229.79	300.87	239.91	307.95	1077.56	471.33	872.00
Net Farm Income	94.07	231.10	171.37	259.50	170.03	308.85	1046.56	532.03	633.00
Net Benefit	-5.92	135.94	55.62	139.01	20.06	157.85	742.56	37.03	443.00
Tot. Cost/Gross Income	101%	76.9%	89.0%	78.4%	97.0%	76.5%	62.1%	97.3%	69.2%
Return on Investment	-0.98	29.91	12.37	27.57	3.13	30.66	60.99	2.76	44.43
Return on Working Capital	-1.17	37.84	16.66	36.23	4.10	43.38	81.29	4.37	54.89
Yield/mz (qq)	19.58	20.42	19.68	23.86	26.31	27.33	70.00	53.00	48.00
Price/(qq)	30.5	28.9	25.7	27.0	25.1	24.6	28.00	26.00	30.00
Cost per (qq) C$	30.8	22.25	22.84	21.13	24.30	18.83	17.39	25.30	20.77

*Data in parentheses refer to percentage of Total Cost.

to 7.1 for the largest farm (Size 9). For most of the farms, however, labor was around 40% of the Total Cost. Animal units were important for the smaller groups--over C$50 per mz for classes 2 and 3 and finally in the two largest sizes, no animal power was employed. Machine units followed a pattern of increasing importance as farm size increased. Size 1 used no machine units and in the next size, less than 3% of the Total Cost was for machine units. Machine power increased with farm size until finally over 33 percent of the Total Costs were machine unit costs in Size 9.

Considerable variance was exhibited in the expenditure for seeds and chemicals on the lower size levels. These two inputs averaged 13.2% of the Total Cost, ranging from 3% in Size 1 to the largest size where over 30% of the Total Costs were for these expenditures.

Another input of some importance is that of interest. This input showed much stability with a very narrow range when viewed as a percentage of Total Cost. The range was from a low of 2.8 percent (interestingly for the highest and the lowest sizes 1 and 9) to a high of 3.6 in Size 7.

The Gross Income range was great--C$505 in Size 3 to C$1960 in Size 7. The Net Cash Returns, Net Farm Returns and Net Benefit showed similar variance. The highest Net Benefit was associated with Size 7--C$742. The lowest was associated with the small farms where returns were a negative C$6 per mz. Considerable variation was shown in the various sizes and it must be noted that a high Gross Income does

not necessarily give a high Net Benefit. For example, Size 8 had Gross Income of C$1378 per mz but only a C$37 Net Benefit because of the very high expenditures incurred.

Total Costs as a percentage of Gross Income ranged from a high of 101% in the case of the very small farms to a low of only 62% in Size 7. Two sizes--5 and 8--also indicated very high expenditures in relation to Gross Income. A close examination of these size groups reveals that Size 8 had a very high percentage of Total Cost in the fixed category but for Size 5 no real deviation from other classes is readily apparent.

Yields per mz varied from a high of 70 qq for Size 7 to a low of less than 20 qq for the smallest size. However, with only a small exception, yields increased with increases in farm size. Prices received showed considerable variance but no particular pattern with respect to size.

Another method of viewing efficiency is the cost of producing a hundredweight (qq) of corn. With the exception of Size 1 with a cost of C$30.80/qq and Sizes 6 and 7 with costs of C$18.83 and C$17.39/qq respectively, the range was narrow with most of the cost/qq in the low C$20's.

Note that high yield was not always associated with low cost/qq. For example, Size 8 had a high yield (53 qq/mz) but also high production costs. On the other hand, Size 3 had only a modest yield (less than 20 qq) but cost/qq was quite reasonable.

MAIZ--PRODUCTION COSTS BY REGION

As shown in Table 4, Total Costs by region ranged from a low of C$307 per mz in IS to a high of C$603 in PC. Fixed costs as a percentage of Total Costs varied from 32% in IN to only 17% in PC. The major Fixed Cost was land and ranged from a high of about C$131 in PN (24.5% of total cost) to a low of C$73.75 (14.6% of total cost) in IN.

Variable costs exhibited a range from almost C$500 in PC to C$236 in IS. Variable Costs as a percentage of Total Cost, of course, reflect the inverse pattern witnessed in Fixed Costs with the low being IN with 68% of the Total Cost as Variable to PC where almost 83% of the costs of a Variable nature.

In all regions labor was the major Variable Cost. The range was from IS where labor was over 60% of the Total Cost to PN where labor costs were 32.5% of the total. (Even in the PN region, labor represented the major cost.)

Animal unit power was most significant in regions IC, PC, PN and PS where these costs represented from 10 to 15% of the Total Cost. This input was least important in IN and IC where it accounted for only 4 to 5 percent of Total Costs. Mechanical unit costs were most important in regions IN and PN where almost 9% of the costs were associated with this input. The least expenditures for mechanical power were in regions IC and IS where only approximately C$3 per mz were expended (about 1% of the Total Cost).

TABLE 4. MAIZ--PRODUCTION COSTS BY REGION*

	IC (27)	IN (47)	IS (58)	PC (75)	PN (53)	PS (39)
TOTAL COST C$	391.06	505.12	306.60	603.17	532.69	546.35
Fixed Cost C$	95.14(24.3%)	163.07(32.3%)	70.75(23.1%)	103.41(17.1%)	146.30(27.5%)	108.30(19.8%)
Depreciation	12.11 (3.1%)	16.98 (3.4%)	5.70 (1.9%)	6.98 (1.1%)	8.72 (1.6%)	10.74 (2.0%)
Land	83.03(21.2%)	73.75(14.6%)	53.27(17.4%)	92.92(15.4%)	130.66(24.5%)	97.56(17.8%)
Labor	--	72.34(14.3%)	11.77 (3.8%)	3.50 (.6%)	6.92 (1.3%)	-- --
Variable Costs C$	295.91(75.7%)	342.02(67.6%)	235.84(76.9%)	499.76(82.9%)	386.38(72.5%)	437.94(80.2%)
Labor	169.15(43.3%)	203.86(40.4%)	185.70(60.1%)	279.82(46.4%)	173.31(32.5%)	245.71(45.0%)
Animal Units	58.69(15.0%)	18.59 (3.7%)	14.79 (4.8%)	59.72 (9.9%)	63.83(12.0%)	60.06(11.0%)
Mechanical Units	3.33 (1.0%)	44.53 (8.8%)	2.96 (1.0%)	25.41 (4.2%)	47.14 (8.8%)	31.94 (5.8%)
Seed	11.58 (3.0%)	9.19 (1.8%)	11.23 (3.7%)	22.58 (3.7%)	15.56 (2.9%)	16.10 (2.9%)
Chemicals	36.38 (9.3%)	37.98 (7.5%)	7.85 (2.6%)	79.58(13.2%)	62.46(11.7%)	57.63(10.6%)
Ener-Rep.	-- --	3.56 (.7%)	.67 (.2%)	1.13 (.2%)	1.30 (.2%)	.91 (.2%)
Interest	10.40 (2.7%)	16.80 (3.3%)	10.12 (3.3%)	19.43 (3.2%)	13.53 (2.5%)	18.44 (3.4%)
Other	6.35 (1.6%)	7.50 (1.5%)	2.49 (.8%)	12.05 (2.0%)	9.22 (1.7%)	7.10 (1.3%)
GROSS INCOME C$	523.20	547.05	531.18	707.18	561.90	678.79
Net Cash Income	304.65	194.04	318.56	298.83	277.55	291.31
Net Farm Income	227.28	205.00	295.33	207.31	175.51	240.84
NET BENEFIT	132.14	41.92	224.57	103.90	29.51	132.54
Total Cost/Gross Income	74.8%	92.3%	57.7%	85.3%	94.8%	80.5%
Return on Investment	33.79	8.29	73.57	17.22	5.48	24.26
Return on Working Capital	44.65	12.25	95.22	20.78	7.55	30.26
Yield/mz (qq)	17.67	23.72	16.71	25.80	21.11	25.04
Price/ (qq)	29.60	23.1	31.8	27.4	26.6	27.1
Cost per (qq) C$	22.13	21.20	18.35	23.37	23.23	21.82

*Data in parentheses refer to percentage of Total Cost.

Seed costs per mz ranged from a low of about C$9 in IN to a high of over C$22 in PC. Expenses for chemicals ranged from a high of almost C$80 in PC (13.2% of Total Cost) to about C$8 in IS (less than 3% of Total Cost). Interest costs, while showing some variance in absolute amounts, showed relatively little range when converted to percentage of Total Cost--a low of 2.5% in IN to a high of 3.4% in PS.

Gross Income ranged from a high of C$707 in PC to a low of C$523 in IC. Net Benefit varied from a low of about C$30 per mz in PN to a high of about C$225 in IS.

Total Costs as a percentage of Gross Income showed a wide range and this factor is reflected in part in Net Benefit. In PN, Total Costs amounted to almost 95% of Gross Income while in IS Total Cost amounted to only about 58% of the Gross Income. Returns on Investment and Working Capital show similar patterns.

The major key of region IS's high Net Benefit lies in keeping costs low in general and with keeping Fixed Costs low in particular. Land costs in IS were the lowest of any region and labor costs while moderately high, were only about average (see Table 2). Apparently farmers in this region did considerable work for themselves and did not rely on great amounts of animal or mechanical input for power. The yields were not high in IS, however the selling price was high but this factor alone does not account for the profitability of this region.

Costs per qq varied from a low of C$18.35 in region IS to a high of C$25.23 in PN. Region PN had the highest

percentage of Fixed Costs (27.5) accounted for mainly by a very high land cost (C$131 in PN vs. C$89 for average of all regions). Other factors contributing to the high cost of production in PN were below average yields and prices received.

MAIZ--PRODUCTION COSTS BY ECOLOGY LEVELS

Table 5 (Maiz--Crop Ecology) gives basic cost information for maiz, broken into three categories, M, B and P, structured from lesser to optimal conditions respectively. Total costs in this breakdown showed direct correlation with ecological level. Farms in the M category had costs totaling C$348.58, those in the B category had total costs of C$504.51, and those in the optimum level, P, totaled C$585.35. This factor again should not preclude lower returns for the farms in higher ecological levels. In fact quite the opposite was the case. Those farms in the highest level yielded almost a 44% return to their total investment and over a 60% return to their working capital. Those farms in the B category returned almost 20%, and those in the M, a 36% return.

A smaller variation in fixed charges was evidenced in the ecological breakdowns as opposed to the technological categories (see Table 6). Fixed land and labor amounted to 25% of total charges in the P category while the large portion of fixed costs accrued to land and labor in the others as well. Fixed labor was not significant except in the P category where it amounted to C$55.50 or 10% of Total Costs. Land opportunity charges were relatively constant for all three levels with the highest <u>percent</u> charge accruing to the lowest ecological level (category M, the level with the lowest total cost for each mz). This land charge was over 20% of the total charges accrued

Table 5

Maiz--Production Costs by Ecology Level*

	M	B	P
Total Cost C$	348.58	504.51	585.35
Fixed Cost C$	86.52(24.8)	112.89(22.4)	161.11(27.5)
Depreciation	5.97 (1.7)	9.19 (1.8)	18.21 (3.1)
Land	72.08(20.7)	91.61(18.2)	87.40(14.9)
Labor	8.47 (2.4)	12.08 (2.4)	55.50 (9.5)
Variable Cost C$	262.05(75.2)	391.62(77.6)	424.23(72.5)
Labor	175.36(50.3)	225.19(44.6)	188.41(32.2)
Animal Units	40.24(11.5)	47.77 (9.5)	31.95 (5.5)
Mechanical Units	3.19 (.9)	25.11 (5.0)	83.56(14.3)
Seed	9.09 (2.6)	16.53 (3.3)	12.07 (2.1)
Chemicals	18.76 (5.4)	51.84(10.3)	78.02(13.3)
Ener-Rep.	0.00 --	.96 (1.2)	7.30 (1.2)
Interest	9.58 (2.8)	15.72 (3.1)	19.05 (3.3)
Other	5.81 (1.7)	8.47 (1.6)	3.85 (.6)
Gross Income C$	474.95	602.11	842.53
Net Cash Income	273.65	271.91	442.39
Net Farm Income	212.89	210.48	418.30
Net Benefits C$	126.37	97.59	257.18
Total Costs/Gross Income	73%	84%	69%
Returns to Investment	36.25	19.34	43.93
Returns to Working Capital	48.22	24.91	60.62
Yield/mz (qq)	16.26	21.98	32.79
Price/qq	29.21	27.39	25.69
Cost/qq C$	21.43	22.95	17.85

*Data in parentheses refer to percentage of Total Cost.

in this category.

In analysis of Variable Costs, a direct correlation of absolute charges with ecological level was found (with minor exception in the subcategories of labor and seed). Of these charges labor was the most significant. In the M category C$175.36 (50.3% of total), in the B C$225.19 (44.6% of total), and in the P C$188.41 (32.2% of total) was charged to labor. The reason that variable labor was a smaller charge for the optimum level was due to a larger use of full time (fixed) labor.

Animal unit power was a significant charge in the M and B categories having a relatively large influence of about 12% and 10% of total costs respectively. Mechanical units were a small charge at the M level but did amount to C$25.11 (5% of total) for farms categorized B, and a much larger figure of C$83.56 (14% of total) for those farms in the optimum level. Seed was a small charge in all three categories amounting to 3% or less for all farms.

Chemical use in the form of fertilizers, pesticides, and insecticides showed wider variation in charges among the categories. Only C$18.76 (5.4% of total) was expended for M farms. Those farms in the B category paid an average of C$51.84 (10.4% of total) for chemicals and those in the P, C$78.02 (13.3% of total). The interest charge showed almost the same percent variation as the charges for chemicals indicating the increased use of capital inputs as the ecological levels increased.

Net Cash Income and Net Farm Income were both higher in the M category than the B, but considerably less in both cases as opposed to those farms at the P level. (P farms had nearly twice the income over the other two categories.) It should be noticed that the cost/qq was nearly the same for the M and B levels and the difference in returns was largely due to the difference in prices received by the farmers in these categories.

Before optimum input levels are decided for these categorical breakdowns a consideration of land values and a choice of intensive or extensive types of farming should be noted. Those farms in the M category are returning to investment at larger rates than those farms in the B category but at the M level, little is apparently being done to replenish the soils. Projections of long range productivity should be considered in terms of need and desirability.

MAIZ--PRODUCTION COSTS BY TECHNOLOGY LEVELS

In Table 6 (Maiz--Crop Technology) the basic cost information is set forth for all maiz farms according to technological level. Total Costs ranged from C$326 for the 01 level to C$841 for the 03 level. The latter figure is almost 2½ times the former but in further analysis the yield/mz for the 03 category was almost 3 times that for farms in the 01 level and cost/qq was significantly lower for the 03 maiz farms. This indicates increasing returns to technology at more than nominal rates.

Fixed Costs followed similar proportionate breakdowns for costs among the three levels. The 01 level incurred C$86.60 (26.5% of Total Costs), the 02 level C$125.70 (21.4% of Total Costs), and the 03 level C$170.73 (20.3% of Total Costs). Depreciation in the Fixed Cost category was five times larger for 03 level farms than those in 01 but these still amounted to only 3% of total costs. Fixed labor was a relatively small charge for all farms but did amount to C$36.65 or 4% of total costs in the 03 category. Land charges increased from the 01 through the 03 levels but decreased in relative significance as higher levels of technology were approached. While absolute figures increased from about C$71 for the 01 level to C$106 for the 03 category, the percent charge declined from 22% to 13% of total charges respectively.

Variable Costs contained the highest charges. Of these items labor was the most significant, amounting to C$182.61

Table 6

Maiz--Production Costs by Technology Level*

	01	02	03
Total Cost C$	326.63	572.71	840.51
Fixed Cost C$	86.60(26.5)	125.70(21.9)	170.73(20.3)
Depreciation	5.41 (1.7)	9.22 (1.6)	28.11 (3.3)
Land	70.54(21.6)	102.82(18.0)	105.96(12.6)
Labor	10.64 (3.2)	13.65 (2.3)	36.65 (4.4)
Variable Cost C$	240.03(73.5)	447.00(78.1)	669.77(79.7)
Labor	182.61(55.9)	237.81(41.5)	268.61(32.0)
Animal Units	29.04 (8.9)	62.66(10.9)	41.53 (4.9)
Mechanical Units	3.18 (1.0)	27.44 (4.8)	124.94(14.9)
Seed	9.26 (3.0)	16.08 (2.8)	38.66 (4.6)
Chemicals	1.06 --	75.23(13.1)	145.81(17.3)
Ener-Rep.	0.00 --	0.89 (.2)	8.76 (1.0)
Interest	9.25 (3.0)	17.98 (3.2)	28.66 (3.4)
Other	5.61 (1.7)	8.88 (1.6)	12.76 (1.6)
Gross Income C$	411.91	678.33	1101.28
Net Cash Income	217.62	300.68	499.28
Net Farm Income	171.87	231.33	431.50
Net Benefits C$	85.27	105.62	260.77
Total Costs/Gross Income	79%	84%	76%
Returns to Investment	26.10	18.44	31.02
Returns to Working Capital	35.52	23.62	38.93
Yield/mz (qq)	15.12	24.17	42.64
Price/qq	27.24	28.06	25.83
Cost/qq C$	21.60	23.69	19.71

*Data in parentheses refer to percentage of Total Cost.

(56% of all charges) for the 01 farms, C$237.81 (41.5% of all charges) for the 02 farms, and C$268.61 (32% of total charges) for the 03 farms. Again notice that even as these costs increased moving from lower to higher technological levels, the percent amount of total costs for each category is decreasing. This is the case for all items under the Variable Cost heading.

As a percent charge, animal unit costs were most significant in the 02 category and least significant in the 03 level. Mechanical units were most significant on the 03 level, being almost 40 times larger than the 01 level, and about 5 times larger than that at the 02 level. This relatively high use of machinery coupled with large expenditures for chemicals, (fertilizer, insecticide, and pesticides) and larger use of capital inputs decreased the per unit charge of fixed costs at the 03 level. This level yielded over 2½ times the output of those farms in the 01 level and almost twice that of those farms in the 02 level. Even as Total Costs increased rapidly moving to higher levels of technology, Returns on Investment were 5 percentage points higher at 03 level than at the 01 and almost 13 percentage points higher than those in the 02. Thus the implication is that highest returns are netted with low capital investment (low costs) and low returns, or with high capital investment and high returns. The largest variation occurs in the absolute differences in the category of Net Benefits. The 01 level returned C$85.27; the 02, C$105.62; and the 03, C$260.77. The intensive nature of farming at the 03 level and the higher return per manzana is thus reflected.

Net Farm Income and Net Cash Income increases moving from the 01 level to the 03 level even while returns to C$ invested decreases. High returns at low technological levels might be due to depletion of soil resources without replenishment (chemical use per mz was about C$1 for farms at the 01 level). Consideration of future agricultural intensification would not only increase productivity in the short run but could increase returns as land becomes more of a scarce resource.

LABOR REQUIREMENTS

(Table 7)

Size

Labor requirements per mz varied from a high of 76 days in the smallest size to about 14 days in the largest size. However, since there was only one farm in each of the largest sizes, discussion will center only on the sizes from <1 mz to 20 mz. As prior noted the small farms had high labor (76 days) but this coefficient decreased steadily to 45 days for the 1-2.9 mz class to 38 days for the 3-4.9 mz class. After this period no significant changes in labor amounts were apparent as land area increased to 20 mz. Only .4 day difference existed among these categories. Some difference occurred, however, in the amount of fixed labor requirements for the 20 mz farms where a much higher proportion of the labor was fixed.

Region

Regional differences were pronounced when labor days/mz were compared. The range was from a low of 26.2 days in region IS to a high of 52.8 in PC. Only in region IN were fixed labor days of any great importance--in that region 5 days were allocated as fixed.

Part of the differences in regional labor use is found in the degree of mechanization. For example in the high labor region, PC, only C$25/mz were spent on machine units while in the low labor area, IN, almost C$45/mz were spent for

Table 7

Labor Requirements per Mz for Maiz,
by Region, Size, Ecology,
Technological Level

	Days of Labor/Mz		
Size	Total	Fixed	Variable
<1 mz	76.1	--	76.1
1 - 2.9 mz	45.0	.4	44.6
3 - 4.9 mz	38.0	1.6	36.4
5 - 9.9 mz	32.4	1.2	31.2
10 - 15 mz	32.3	1.1	31.2
20 mz	32.8	6.3	26.5
25 mz	57.6	11.0	46.6
33 mz	44.7	20.0	24.7
75 mz	13.7	6.0	7.7
Region			
IC	32.9	--	32.9
IN	43.8	5.0	38.8
IS	26.2	1.2	25.0
PC	52.8	.2	52.6
PN	30.8	.4	30.3
PS	48.5	--	48.5
Ecology Level			
M	33.3	1.5	31.8
B	40.8	.8	40.0
P	41.1	3.9	37.2
Technological Level			
1	36.1	1.4	34.7
2	43.5	.5	43.0
3	40.1	2.4	37.7
Average for all farms	39.9	1.1	38.8

machine power (see Table 4). Hence, to some degree, a machine-labor substitution is apparent.

Ecology

As Ecology level changed from M to B to P labor days increased over 10 days per mz. Part of the reason for the increase from M to B levels is due to the more intensive agriculture in B (e.g., yields increased over 35% in B as compared to M).

The total days of labor increased by over 3 days in Ecology P as compared to B. Here also an intensification of agriculture contributed--yields increased 50% over level B and over 100% compared to level M.

Two other items should be noted. First, even though total labor days increased slightly from 40.8 in Ecology B to 41.1 in P, fixed labor days absorbed almost 11% of the labor in P is less than 2% in M.

Furthermore, even though variable labor days in P were less than B (37.2 vs. 40.0), payments to variable labor were greater in P compared to B (C$188 vs. C$175) indicating that a higher quality, hence, more productive labor may have been utilized in Ecology P (see Table 5).

Technology

Labor days increased from technological level 1 to 2 but decreased from level 2 to 3. Some differences in proportions of fixed to variable labor occurred with fixed being more significant in level 3. Also noteworthy is the attendant

increase in animal and machine power as technology increased--C$32 in 01 to C$166 in 03 (see Table 6).

Likewise note that the quality of labor was higher (as reflected in higher average wages) as technology increased. For example, the total amount for variable labor increased from C$182 in 01 to C$269 in 03.

Labor productivity of course increased when viewed in relation to average yield. As compared to 01, level 02's yield increased 60% and yield in 03 increased almost threefold.

SUMMARY

This study has considered 293 maiz farms. Initial emphasis was to give an overall view of the costs and returns (see Table 2). Comparisons of costs and returns were then made by:

Size (9 groupings)

Region (6 groupings)

Ecology (3 groupings)

Technology (3 groupings)

Special consideration was finally given to physical labor requirements (Table 7). Again these data were viewed in the context of size, region, ecology and technology.

Statistical tests of Analysis of Variance were made and are summarized in the Appendix. With respect to size, region, ecology level, technology level, the following parameters were tested to ascertain if significant differences existed:

1. Gross Income
2. Yield
3. Total Labor
4. Total Cost

Coefficients of variation, F values and levels of statistical significance are presented. With respect to the various groupings, all parameters were statistically significant. In other words, the differences in, say, size groupings were genuinely different.

* * *

To a large degree, the tables (2, 3, 4, 5, 6) form a summary which is not duplicated here. However, Table 8 provides a brief snyopsis of the findings. Few surprises exist here. In general, the larger farms had higher costs, yields, and incomes. Also Variable Costs as a percentage of Total Costs showed an inconsistent pattern as size increased. Labor as a percentage of Total Cost steadily declined as size increased while animal unit power first increased and then declined as a relative cost. Chemicals and seeds increased with size in both relative and absolute measures.

Regional differences were pronounced and significant. Total Cost as a percentage of Gross Income ranged from 57.7% in region IS to 94.8% in region PN. Region IS also had the highest Net Benefit. This was accomplished in spite of rather low yields (prices received, however, were over 16% above average). The key for region Is's success was in low costs--both in the fixed and variable categories.

Total Costs, Fixed Costs, and Variable Costs varied directly with ecological level. Increasing costs were incurred but increased yields raised the return to investment despite a lower price/qq received by farmers. The optimal or highest ecological level, P, also had the lowest production costs. These low costs accompanied by yields that were twice as high for P farms as opposed to M farms, made farming at the P level the most profitable one. Lesser returns were experienced for the middle (B) category. Economies of ecological level were less pronounced at this level than at

Table 8

Maiz--Highest and Lowest Costs and Returns by Size, Region, Ecology and Technological Levels

		Size	Region	Ecology	Technology
1.	Highest Total Cost	8	PC	P	3
2.	Highest Fixed Cost	8	IN	P	3
3.	Highest Variable Cost	7	PC	P	3
4.	Highest Gross Income	7	PC	P	3
5.	Highest Net Benefit	7	IS	P	3
6.	Highest Return on Investment	7	IS	P	3
7.	Highest Return on Working Capital	7	IS	P	3
8.	Highest Yield	7	PC	P	3
9.	Highest Prices	1	IS	M	2
10.	Highest Cost per qq	1	PC	B	2
1.	Lowest Total Cost	3	IS	M	1
2.	Lowest Fixed Cost	2	IS	M	1
3.	Lowest Variable Cost	3	IS	M	1
4.	Lowest Gross Income	3	IC	M	1
5.	Lowest Net Benefit	1	PN	B	1
6.	Lowest Return on Investment	1	PN	B	2
7.	Lowest Return on Working Capital	1	PN	B	2
8.	Lowest Yield	1	IC	M	1
9.	Lowest Prices	6	IN	P	3
10.	Lowest Cost per qq	7	IS	P	2

the P level. Returns were smaller and costs were higher for B farms than for M farms but as previously mentioned a plan of maintaining or supplementing soil productivity is carried out by B farmers and not by M farmers. As the opportunity cost of land rises, reductions in the profitability of investment at the M level is likely to result. But for the present, low capital input (M level production) nets very equitable returns.

Costs by technology level express similar relationships as costs by ecology level. Total Costs, Fixed Costs, and Variable Costs showed direct relationship with ecological level as did yields, income figures, and net benefit calculations.

Increased yields at the 03 level more than offset the increased costs incurred. Returns to investment were highest for the 03 level and the capital intensified nature of this category reduced costs/qq significantly.

Returns to Investment were lowest for the B category despite higher income figures and higher prices received than the other two levels. This low return reflected the highest cost/qq caused by high cost inputs (chemicals, machine units, and animal units). Evidently the input usage was not high enough to reduce costs to level P. Category B definitely does not reflect economies of technology despite the increased yields but the difference is small enough to encourage more capital use to improve long run productivity.

Appendix Table 1.

Analysis of Variance for Gross Income, Crop Yield Total Labor and Total Cost--Coefficients of Variation, F Values and Levels of Significance

		Coefficient of Variation	F Value	Prob.>F
Gross Income:	Size	64.83%	3.22	.0019
	Region	66.12%	2.17	.0567
	Ecology	65.77%	5.53	.0048
	Technology	57.34%	53.04	.0001
Crop Yield:	Size	61.50%	3.64	.0007
	Region	62.11%	4.00	.0019
	Ecology	69.91%	9.46	.0003
	Technology	52.20%	72.29	.0001
Total Labor:	Size	43.23%	8.07	.0001
	Region	39.41%	26.44	.0001
	Ecology	46.98%	2.52	.0802
	Technology	46.55%	5.25	.0061
Total Cost:	Size	52.39%	4.37	.0001
	Region	50.58%	11.04	.0001
	Ecology	53.70%	6.85	.0016
	Technology	43.42%	87.29	.0001