Table G-11 (6/12) ECONOMIC PRODUCTION COST PER HA
(PADDY FOR SMALL FARMER UNDER WITH PROJECT CONDITION)

(Unit:J$)

Item of Cost	Unit	Require-ment	Price	Total
WITH PROJECT CONDITION				
1. LABOUR OPERATION				
-Ploughing	0.5hr	2	173	350
-Harrowing & leveling	0.4hr	3	148	440
-Irrigation & drainage	man-day	4	15.0	60
-Seeding	man-day	1	15.0	20
-Herbicide application	man-day	2.0	15.0	30
-Fertilizer application	man-day	1.8	15.0	30
-Pest control	man-day	2.0	15.0	30
-Supplemental planting	man-day	0.4	15.0	10
-Harvesting	machine hr	1	370	370
-Transportation to Farmgate	per 45 kg	112	2	220
Subtotal				1,560
2. MATERIAL				
-Rice seeds	kg	112	1.51	170
-Chemicals	lit	13	120.91	1,570
-Fertilizer	kg	365	0.87	320
Subtotal				2,060
3. MISCELLANEOUS	10%			360
4. GRAND TOTAL				3,980

Table G-11 (7/12) ECONOMIC PRODUCTION COST PER HA
(SORGHUM UNDER WITHOUT PROJECT CONDITION)

(Unit:J$)

Item of Cost	Unit	Require-ment	Price	Total
1. LABOUR OPERATION				
-Ploughing	time	2	210	420
-Harrowing	time	2	160	320
-Planting/fertilizing/furrowing	time	1	100	100
-Apply pesticide/herbicide	time	4	50	200
-Harvesting	time	1	250	250
-Transportation to dryer	time	1	50	50
-Drying	time	1	370	370
-Transportation to feed mill	time	1	60	60
-Moulding & tining by tractor	time	1	150	150
Subtotal				1,920
2. IRRIGATION				
-Pumping	per ha	1	74	70
-Labour	man-day	2	15.0	30
Subtotal				100
3. MATERIAL				
-Seed	kg	10	12.58	130
-Fertilizer NPK(7:21:21)	kg	610	0.87	530
-Chemical	lit	2	120.91	240
Subtotal				900
4. MISCELLANEOUS	10%			290
5. GRAND TOTAL				3,210

Table G-11 (8/12) ECONOMIC PRODUCTION COST PER HA
(SOYBEAN UNDER WITH PROJECT CONDITION)

(Unit:J$)

Item of cost	Unit	Require-ment	Price	Total
1. LABOUR OPERATION				
-Harrowing	machine hr	0.4	85	30
-Rotavating	machine hr	0.6	85	50
-Land levelling	machine hr	2.5	85	210
-Ridging	machine hr	1.2	85	100
-Planting/fertilizing	machine hr	0.6	65	40
-Moulding	machine hr	1.2	65	80
-Herbicide application	man-day	2.5	15.0	40
-Pesticide application	machine hr	2.4	65	160
-Harvesting	machine hr	2.5	65	160
-Transportation	machine hr	1	80	80
-Irrigation	man-day	6	15.0	90
Subtotal				1,040
2. MATERIAL				
-Seed	kg	56	2.53	140
-Fertilizer	kg	365	0.87	320
-Insecticide	lit	17	120.91	2,060
Subtotal				2,520
3.OTHER COST	5%			180
4.TOTAL COST				3,740

Table G-11 (9/12) ECONOMIC PRODUCTION COST PER HA
(MANGO UNDER WITH AND WITHOUT PROJECT CONDITIONS)

(Unit: J$)

Item of cost	Unit	Require-ment	Price	Total
1. LABOUR OPERATION				
-Fertilizing & manuring	man-day	5	15.0	80
-Spraying	man-day	7	15.0	110
-Weeding	man-day	12	15.0	180
-Pruning	man-day	12	15.0	180
-Reaping, grading and packing	per 40 pcs	387	1.0	390
-Grading and packing	per 50 pcs	484	1.0	480
Subtotal				1,420
2. MATERIAL				
-Fertilizer	kg	897	0.87	780
-Chemicals	kg	140	120.91	16,930
-Boxes	per doz	1,613	1.00	1,610
Subtotal				19,320
3. MICSELLANEOUS	10%			2,100
4. GRAND TOTAL				22,840

Table G-11 (10/12) ECONOMIC PRODUCTION COST PER HA
(SUGARCANE)

(Unit: J$)

Item of Cost	Unit	Price	Replant		Ratoon	
			Require-ment	Total (per ha)	Require-ment	Total (per ha)
WITHOUT PROJECT CONDITION						
1. LABOUR OPERATION						
-Ploughing	machine hr	102	2	200	0	0
-Harrowing	machine hr	180	1	180	0	0
-Ridging	machine hr	127	1	130	0	0
-Planting	man-day	15.0	14	210	0	0
-Moulding/covering	machine hr	127	1	130	1	130
-Fertilizing	man-day	15.0	3	50	3	50
-Herbicide application	man-day	15.0	3	50	3	50
-Herbicide application	machine hr	21	1	20	1	20
-Weeding	man-day	15.0	6	90	6	90
-Moulding	machine hr	108	1	110	1	110
-Harvesting	man-day	15.0	31	470	22	330
-Loading	machine hr	217	1	220	0.75	160
-Transportation	per ha	217	1	220	2.77	600
-Water Management	man-day	15.0	4	60	4	60
Subtotal				2,140		1,600
2. MATERIAL						
-Fertilizer	kg	0.87	3,318	2,890	3318	2,890
-Chemicals	lit	120.91	4	480	4	480
-Cane Seed	ton	58.2	8.8	510	0	0
Subtotal				3,880		3,370
3. MISCELLANEOUS		5%		300		250
4. GRAND TOTAL				6,320		5,220
WITH PROJECT CONDITION						
1. LABOUR OPERATION						
-Furrowing	machine hr	50	2	100	0	0
-Ploughing	machine hr	25	6	150	0	0
-Harrowing	machine hr	37	4	150	0	0
-Levelling	machine hr	74	2.5	190	0	0
-Ridging	machine hr	49	2	100	0	0
-Subsoiling	machine hr	80	2	160	0	0
-Planting	man-day	15.0	2.8	40	0	0
-Covering	machine hr	49	2	100	0	0
-Moulding	machine hr	49	2	100	1	50
-Fertilizing	machine hr	30	0.5	10	1	30
	man-day	15.0	1.5	20	1.5	20
-Cultivating	machine hr	90	1	90	1	90
-Herbicide application	man-day	15.0	1.7	30	1.7	30
-Harvesting	man-day	15.0	32	480	27.3	410
-Loading	machine hr	484	1	480	0.853	410
-Transportation	per ha	1,144	1	1,140	0.853	980
-Water Management	man-day	15.0	8	120	8	120
Subtotal				3,460		2,140
2. MATERIAL						
-Fertilizer	kg	0.87	1,071	930	1,071	930
-Chemicals	lit	120.91	5.6	680	5.6	680
-Cane Seed	ton	68.5	10	690	10	690
Subtotal				2,300		2,300
3. MISCELLANEOUS		5%		290		220
4. GRAND TOTAL				6,050		4,660

Table G-11 (11/12) ECONOMIC PRUDUCTION COST PER HA (VEGETABLES FOR LARGE FARM)

(Unit: JS)

Items	Unit	Cucumber			Sweet pepper			Pumpkin			Zucchini		
		Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost
WITHOUT PROJECT CONDITION													
1. LABOUR AND OPERATIONS													
-Tractor operation	machine hr.	180	14.7	2,650	180	21.7	3,910	180	13.2	2,380	500	13.2	6,600
-Weeding/thining	man-day	15.0	31	470	15.0	44	660	15.0	22	330	15.0	22	330
-Irrigation	man-day	15.0	11	170	15.0	11	170	15.0	11	170	15.0	11	170
-Harvesting, grading	man-day	15.0	42	630	15.0	55	830	15.0	33	500	15.0	33	500
Sub-total				3,920			5,570			3,380			7,600
2. MATERIALS													
-Seed	kg	48.13	2.2	110	186.30	2.2	410	23.27	2.2	50	23.27	2.2	50
-Fertilizer	kg	0.87	753	660	0.87	963	840	0.87	1,120	970	0.87	1,120	970
-Chemicals	lit	120.91	67.8	8,200	120.91	79	9,550	120.91	81	9,780	120.91	81	9,780
Sub-total				8,970			10,300			10,800			10,800
3.MISCELLANEOUS	10%			1,290			1,640			1,420			1,840
4.GROUND TOTAL				14,180			18,010			15,600			20,240
WITH PROJECT CONDITION													
1. LABOUR AND OPERATIONS													
-Tractor operation	machine hr.	180	14.7	2,650	180	21.7	3,910	180	13.2	2,380	180	13.2	2,380
-Weeding/thining	man-day	15.0	31	470	15.0	44	660	15.0	22	330	15.0	22	330
-Irrigation	man-day	15.0	11	170	15.0	11	170	15.0	11	170	15.0	11	170
-Harvesting, grading	man-day	15.0	42	630	15.0	55	830	15.0	33	500	15.0	33	500
Sub-total				3,920			5,570			3,380			3,380
2. MATERIALS													
-Seed	kg	48.31	2.2	110	186.30	2.2	410	23.27	2.2	50	23.27	2.2	50
-Fertilizer	kg	0.87	753	660	0.87	963	840	0.87	1,120	970	0.87	1,120	970
-Chemicals	lit	120.91	67.8	8,200	120.91	79	9,550	120.91	81	9,780	120.91	81	9,780
Sub-total				8,970			10,800			10,800			10,800
3.MISCELLANEOUS	10%			1,290			1,640			1,420			1,420
4.GROUND TOTAL				14,180			18,010			15,600			15,600

Table G-11 (12/12) ECONOMIC PRUDUCTION COST PER HA (VEGETABLES FOR SMALL FARMER)

(Unit: J$)

Items	Unit	Calaloo			Cucumber			Onion			Pumpkin			Sweet pepper			Red pea		
		Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost
WITHOUT PROJECT CONDITION																			
1. LABOUR AND OPERATIONS																			
-Land clearing	tractor hr.	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250
-Plough,harrow and furrow	tractor hr.	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500
-Nursery bed	man-day	15.0	12	180	15.0	12	180	15.0	0	0	15.0	0	0	15.0	12	180	15.0	0	0
-Transplanting	man-day	15.0	15	230	15.0	10	150	15.0	0	0	15.0	0	0	15.0	10	150	15.0	0	0
-Planting	man-day	15.0	0	0	15.0	0	0	15.0	5	80	15.0	5	80	15.0	0	0	15.0	12	180
-Weeding/thining	man-day	15.0	62	930	15.0	37	560	15.0	200	3,000	15.0	12.5	190	15.0	37	560	15.0	18	270
-Fertilizer application	man-day	15.0	10	150	15.0	2.5	40	15.0	10	150	15.0	2.5	40	15.0	2.5	40	15.0	5	80
-Pesticide application	man-day	15.0	31	470	15.0	25	380	15.0	25	380	15.0	15	230	15.0	20	300	15.0	7.5	110
-Harvesting, grading	man-day	15.0	79	1,190	15.0	70	1,050	15.0	37	560	15.0	30	450	15.0	66	990	15.0	27.5	410
Sub-total				6,900			6,110			7,920			4,740			5,970			4,800
2. MATERIALS																			
-Seed	kg	16.92	0.07	0	48.13	0.7	30	85.86	8.5	730	23.27	4.5	100	186.30	0.7	130	5.50	72	400
-Fertilizer	kg	0.87	753	660	0.87	753	660	0.87	753	660	0.87	494	430	0.87	753	660	0.87	376	330
-Chemical	lit	120.91	28	3,390	120.91	27	3,260	120.91	28	3,390	120.91	33	3,990	120.91	27	3,260	120.91	12	1,450
Sub-total				4,050			3,950			4,780			4,520			4,050			2,180
3.MISCELLANEOUS	10%			1,100			1,010			1,270			930			1,000			700
4.GROUND TOTAL				12,050			11,070			13,970			10,190			11,020			7,680
WITH PROJECT CONDITION																			
1. LABOUR AND OPERATIONS																			
-Land clearing	tractor hr.	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250
-Plough,harrow and furrow	tractor hr.	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500
-Nursery bed	man-day	15.0	12	180	15.0	12	180	15.0	0	0	15.0	0	0	15.0	12	180	15.0	0	0
-Transplanting	man-day	15.0	15	230	15.0	10	150	15.0	0	0	15.0	0	0	15.0	10	150	15.0	0	0
-Planting	man-day	15.0	0	0	15.0	0	0	15.0	5	80	15.0	5	80	15.0	0	0	15.0	12	180
-Weeding/thining	man-day	15.0	62	930	15.0	37	560	15.0	120	1,800	15.0	12	180	15.0	37	560	15.0	18	270
-Fertilizer application	man-day	15.0	10	150	15.0	2.5	40	15.0	10	150	15.0	5	80	15.0	2.5	40	15.0	5	80
-Pesticide application	man-day	15.0	31	470	15.0	20	300	15.0	25	380	15.0	15	230	15.0	20	300	15.0	7.5	110
-Herbicide application	man-day	15.0	4	60	15.0	70	1,050	15.0	4	60	15.0	2.5	40	15.0		0	15.0	2.5	40
-Harvesting, grading	man-day	15.0	79	1,190	15.0	70	1,050	15.0	37	560	15.0	30	450	15.0	66	990	15.0	27.5	410
Sub-total				6,960			7,080			6,780			4,810			5,970			4,840
2. MATERIALS																			
-Seed	kg	16.93	0.14	0	48.13	2	100	85.86	4.5	390	23.27	4	90	186.30	0.7	130	5.50	72	400
-Fertilizer	kg	0.87	753	660	0.87	1,121	980	0.87	745	650	0.87	745	650	0.87	753	660	0.87	376	330
-Chemical	lit	120.91	30.8	3,720	120.91	20	2,420	120.91	20.8	2,510	120.91	34.4	4,160	120.91	27	3,260	120.91	13.4	1,620
Sub-total				4,380			3,500			3,550			4,900			4,050			2,350
3.MISCELLANEOUS	10%			1,130			1,060			1,030			970			0			0
4.GROUND TOTAL				12,470			11,640			11,360			10,680			10,020			7,190

Table G-12 ECONOMIC NET PRODUCTION VALUE PER HA FOR EACH CROPS

Crop	Production Cost (J$/ha)	Yield (ton/ha)	Marketable Rate (%)	Farmgate Price (J$/kg)	Gross Production Value (J$/ha)	Net Production Value (J$/ha)
WITHOUT PROJECT CONDITION						
A. DOMESTIC CROPS						
Calaloo	12,050	17.9	90%	1.40	22,600	10,550
Cucumber	11,070	13.4	90%	1.25	15,100	4,030
Pumpkin	10,190	9.8	90%	1.61	14,200	4,010
Sweet pepper	11,020	7.2	90%	2.70	17,500	6,480
Red pea	7,680	0.8	100%	11.74	9,300	1,620
B. EXPORT CROPS						
Cucumber						
large farm	14,180	7.2	90%	3.87	25,100	10,920
Pumpkin						
large farm	15,600	9.8	90%	2.26	19,900	4,300
Sweet pepper						
large farm	18,010	7.2	90%	5.26	34,100	16,090
Mango	22,840	9.4	70%	5.03	33,100	10,260
Sugarcane	5,440	59.0	100%	108.00	6,400	960
C. IMPORT FOOD						
Rice						
large farm	3,810	3.9	100%	1.28	5,000	1,190
Sorghum						
large farm	3,210	3.9	100%	0.94	3,700	490
Beef	2,700	1.3	100%	10.76	13,500	10,800
Milk	7,300	13.8	100%	0.75	10,400	3,100
Fish	53,600	7.0	100%	8.71	61,000	7,400
WITH PROJECT CONDITION						
A. DOMESTIC CROPS						
Calaloo	12,470	33.6	90%	1.40	42,300	29,830
Cucumber	11,640	13.5	90%	1.25	15,200	3,560
Onion	11,360	16.8	90%	7.00	105,800	94,440
Pumpkin	10,680	15.7	90%	1.61	22,700	12,020
Sweet pepper	11,020	13.4	90%	2.70	32,600	21,580
Red pea	7,910	1.1	100%	11.74	12,900	4,990
B. EXPORT CROPS						
Cucumber						
large farm	14,180	13.4	85%	3.87	44,100	29,920
small farm	11,640	13.4	85%	3.87	44,100	32,460
Pumpkin						
large farm	15,600	15.7	85%	2.26	30,200	14,600
small farm	10,680	15.7	85%	2.26	30,200	19,520
Sweet pepper						
large farm	18,010	13.4	85%	5.26	59,900	41,890
small farm	11,020	13.4	85%	5.26	59,900	48,880
Mango	22,840	9.4	70%	5.03	33,200	10,360
Sugarcane	4,940	78.6	100%	108.00	8,500	3,560
C. IMPORT FOOD						
Rice						
large farm	4,600	5.0	100%	1.28	6,400	1,800
small farm	3,980	5.0	100%	1.28	6,400	2,420
Maize						
large farm	5,740	6.0	100%	0.99	5,900	160
small farm	5,430	6.0	100%	0.99	5,900	470
Soybean						
large farm	3,740	2.6	100%	1.54	4,000	260
Beef	5,430	3.8	100%	10.76	40,700	35,270
Milk	6,300	16.1	100%	0.75	12,100	5,800
Fish	53,600	7.0	100%	8.71	61,000	7,400

Table G-13 ECONOMIC NET PRODUCTION VALUE PER HA FOR EACH CROPPING PATTERN UNDER WITHOUT PROJECT CONDITION

Cropping Pattern		Rainy Season	Dry Season	Annual Total
(1) Sugarcane				960
(2) Vegetable/Crops				
(2)-1 Vege. /Grain (Agro21)				
	Cucumber	10,920	-	
	Pumpkin	4,300	-	
	Sweet Pepper	16,090	-	
	Sorghum	-	490	
	Average	10,400	490	10,890
(2)-2 Vege./Crops (Small Farmer)				
	Calaloo	10,550	10,550	
	Cucumber	4,030	4,030	
	Onion	-	-	
	Pumpkin	4,010	4,010	
	Sweet Pepper	6,480	6,480	
	Red Pea	1,520	1,520	
	Average	5,300	5,300	
	Cropping Intensity	30%	20%	
		1,600	1,100	2,700
(3) Grains (Agro21)				
	Sorghum	490	490	
	Average	490	490	980
(4) Rice (Amity Hall)				
	Rice	1,190	1,190	2,380
(5) Orchard (Mango)				10,260
(6) Ornamental				282,300
(7) Pasture				
	Beef			10,800
	Dairy			3,100
	Average			5,100
(8) Aquaculture				7,400

Table G-14 ECONOMIC NET PRODUCTION VALUE PER HA FOR EACH CROPPING PATTERN UNDER WITHOUT PROJECT CONDITION

Cropping Pattern	Rainy Season	Dry Season	Annual Total
(1) Sugarcane			960
(2) Vegetable/Crops			
(2)-1 Vege. /Grain (Agro21)			
Cucumber	10,920	-	
Pumpkin	4,300	-	
Sweet Pepper	16,090	-	
Sorghum	-	490	
Average	10,400	490	10,890
(2)-2 Vege./Crops (Small Farmer)			
Calaloo	10,550	10,550	
Cucumber	4,030	4,030	
Onion	-	-	
Pumpkin	4,010	4,010	
Sweet Pepper	6,480	6,480	
Red Pea	1,520	1,520	
Average	5,300	5,300	
Cropping Intensity	30%	20%	
	1,600	1,100	2,700
(3) Grains (Agro21)			
Sorghum	490	490	
Average	490	490	980
(4) Rice (Amity Hall)			
Rice	1,190	1,190	2,380
(5) Orchard (Mango)			10,260
(6) Ornamental			282,300
(7) Pasture			
Beef			10,800
Dairy			3,100
Average			5,100
(8) Aquaculture			7,400

Table G-15 TOTAL NET PRODUCTION VALUE UNDER WITHOUT AND WITH PROJECT CONDITIONS

Pattern	Gross Area (ha)	Net Area (ha)	Unit Net Production Value (J$/ha)	Total Net Production Value (J$1,000)
Without Project Condition				
SUGARCANE	4,190	3,770	960	3,600
VEGETABLE	4,500	4,050		
Vege./crops	450	400	2,700	1,100
Vege./grain	4,050	3,650	10,890	39,700
GRAINS	770	690	980	700
RICE	710	640		
rice-rice	710	640	2,380	1,500
ORCHARD	80	70	10,260	700
ORNAMENTAL	170	150	282,300	42,300
PASTURE	1,180	1,070	5,100	5,500
AQUACULTURE	430	300	7,400	2,200
OTHERS		(1,290)		
TOTAL NET AREA		10,740		
TOTAL	12,030	12,030		97,300
With Project Condition				
SUGARCANE	3,260	2,930	3,560	10,400
VEGETABLE	4,200	3,800		
Vege./Vege.	750	680	50,600	34,400
Vege./grain	3,450	3,120	29,000	90,500
RICE	2,890	2,590		
rice/rice	710	640	3,600	2,300
rice/rice	1,010	910	4,840	4,400
rice/grain	2,180	1,950	2,820	5,500
ORCHARD	780	700	10,260	7,200
ORNAMENTAL	170	150	282,300	42,300
PASTURE	1,330	1,200	12,720	15,300
AQUACULTURE	590	410	7,400	3,000
OTHERS		(1,440)		
TOTAL NET AREA		11,780		
TOTAL	13,220	13,220		215,300
TOTAL INCREMENTAL BENEFIT				118,000

Table G-16 (1/10) FINANCIAL PRODUCTION COST PER HA
UNDER WITH PROJECT CONDITION (AQUACULTURE)

(Unit:J$)

	Unit	Require-ment	Unit price	Total
Cost per crop				
Pond maintenance	time	1	350	350
Fingeling	no.	11,600	0.97	11,250
Feed	kg	5,300	1.43	7,580
Fertilizer	kg	400	0.97	390
Fuel & utilities	L.S.	1	1,000	1,000
Labour	man-day	100	15	1,500
Miscellaneous		5%	22,100	1,110
Total cost per crop				23,200
Income per crop				
production per crop (ton/ha)			2.8	
farmgate price ($/kg)				11.01
production value per ha				30,800
income per crop(not include initial cost)				7,600
Net income per year				
number of crops per year				2.5
income per year				19,000
recovery of initial cost				11,800
net income per year				7,200

Initial capital cost (Unit:J$)

Item	Unit	Require-ment	Price	Total
Land clearing	time	1	1,500	1,500
Pond construction	time	1	18,500	18,500
Pond drain/piping	time	1	15,000	15,000
Pump (portable)		7%	98,900	6,600
Fencing	chain	31	120	3,700
Seines	ft.	500	30	15,000
Scales/balance	no.	2	1,000	2,000
Dipnets	no.	5	100	500
Cage	no.	7	100	700
Miscellaneous		5%		3,200
Total				66,700
Amortizing cost	10	years	12%	11,800

Table G-16 (2/10) FINANCIAL PRODUCTION COST PER HA
UNDER WITH PROJECT CONDITION (MAIZE)

(Unit:J$)

Item of Cost	Unit	Require-ment	Price	Total
LAGRGE FARM				
1. LABOUR OPERATION				900
-Harrowing	machine hr	0.8	85	70
-Rotavating	machine hr	0.6	85	50
-Land levelling	machine hr	2.5	85	210
-Furrowing & bedding	machine hr	1.2	65	80
-Planting	machine hr	0.6	65	40
-Spray	machine hr	0.6	49	30
-Weeding	man-day	2.5	15.0	40
-Fertilizing	man-day	1.2	15.0	20
-Spray	machine hr	3.6	65	230
-Harvesting	machine hr	2.5	65	160
-Transportation		1	370	370
-Irrigation	man-day	1	15.0	20
Subtotal				1,320
2. MATERIAL				
-Seed	kg	17	44.54	760
-Fertilizer	kg	1500	0.97	1,460
-Chemicals	lit	16	134.81	2,160
Subtotal				4,380
3. MISCELLANEOUS	10%			570
4. TOTAL COST				6,270
SMALL FARMER				
1. LABOUR OPERATION				
-Ploughing,Harrowing & Ridging	time	1	494	490
-Apply herbicide	time	2	49	100
-Plant (mannual)	man-day	7	15.0	110
-Apply fertilizer	man-day	2	15.0	30
-Weed & mould	man-day	12	15.0	180
-Apply pesticide	time	6	49	290
-HARVESTING	man-day	25	15.0	380
Subtotal				1,580
2. MATERIAL				
-Seed	kg	22.4	44.54	1,000
-Fertilizer	kg	627	0.97	610
-Chemicals	lit	16	134.81	2,160
Subtotal				3,770
3. MISCELLANEOUS	10%			540
4. TOTAL COST				5,890

Table G-16 (3/10) ECONOMIC PRODUCTION COST PER HA UNDER WITH PROJECT CONDITION
(INITIAL COST OF ORNAMENTAL HORTICULTURE)

(Unit:JS)

Cost of Item	Leather-leaf Fern	Dracanea Massan-geane (Canes)	Dracanea Massan-geane (Tops)	Croton Codiaeum Variegatum	Golden Pothos	Agiaonema (Silver Queen)	Yucca (Tips)	Dracaena Janet Craig (Tips)	Philoden-dron	Average
fencing	19,800	19,800	8,000	185,200	19,800	19,800	19,800	19,800	19,800	36,900
shade house	168,600	148,100			168,600	168,600		168,600	168,600	165,200
packing shade	61,700	61,700	61,700	61,700	61,700	61,700	61,700	61,700	61,700	61,700
pick-up track	404,900	155,600	155,600	155,600	155,600	155,600	155,600	155,600	155,600	183,300
cold room	259,300									259,300
office and storeroom	133,300		148,100	148,100	148,100	148,100	148,100	148,100		146,000
caretakers'quaters	29,600									29,600
construction cost	33,100									33,100
spray equipment	9,900									9,900
office equipment	8,600	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,800
irrigation pump	49,400	61,700	61,700	61,700	61,700	61,700	61,700	617,300	61,700	122,100
irrigation pipes & sprinkler	24,700	24,700	24,700	24,700	24,700	24,700	24,700	24,700	24,700	24,700
installation cost	8,600									8,600
agricultural tools				29,600						29,600
planting material	192,000	100,700	125,900	51,100	88,900	138,500	67,900	125,900	106,700	110,800
land preparation & planting	2,500	12,300	12,300	12,300	18,500	12,300	7,800	12,300	11,100	11,300
Total	1,406,000	594,500	607,900	739,900	757,500	800,900	557,200	1,343,900	619,800	1,241,900
			Average Annual Recovery Cost per ha				15%	20 years		181,200

Table G-16 (4/10) FINANCIAL PRODUCTION COST PER HA UNDER WITH PROJECT CONDITION (ORNAMENTAL HORTICULTURE)

(Unit:J$)

Cost of Item	1st Year	2nd Year	3rd Year	4th Year	5th Year
1. OPERATION AND LABOUR					
-weed control	1,200	1,200	1,200	1,200	1,200
-disease control	1,200	1,200	1,200	1,200	1,200
-fertilizing	700	700	700	700	700
-maintenance	800	800	800	800	800
-harvesting, grading and packing	700	3,200	4,900	5,100	5,100
-unskilled labour	4,000	4,000	4,000	4,000	4,000
-transportation	6,300	6,300	7,000	8,400	8,400
subtotal	14,900	17,400	19,800	21,400	21,400
2. MATERIAL					
-fertilizer	25,400	25,400	25,400	25,400	25,400
-agricultural					
-ag chemicals	7,100	7,100	7,100	7,100	7,100
-soil, saw dust and poultry manure	4,700	4,000	4,000	4,000	4,000
-fuel & oil	23,000	23,000	23,000	23,000	23,000
-electricity	2,900	2,900	2,900	2,900	2,900
-packing material	5,700	23,700	31,700	35,000	35,000
subtotal	68,800	86,100	94,100	97,400	97,400
3. OTHERS					
-Miscellaneous	8,400	10,400	11,400	11,900	11,900
-supervision	39,500	39,500	39,500	39,500	39,500
subtotal	47,900	49,900	50,900	51,400	51,400
4.INITIAL COST RECOVERY	181,200	181,200	181,200	181,200	181,200
5.GRAND TOTAL	312,800	334,600	346,000	351,400	351,400
6. INCOME					
(1) Leatherleaf	0	30,800	51,400	51,400	51,400
(2) Dracaena(cane)	0	0	0	30,300	30,300
(3) Dracaena(tips)	14,200	24,800	31,900	35,400	35,400
(4) Croton	34,600	37,700	69,300	69,300	69,300
(5) Golden Pothos	86,400	86,400	86,400	86,400	86,400
(6) Aglaonema	39,500	80,600	78,900	78,900	78,900
(7) Yucca	2,300	20,500	27,300	27,300	27,300
(8) Janet Craig	23,000	40,200	51,700	57,400	57,400
(9) Philodendron	172,800	172,800	172,800	172,800	172,800
Total Revenue	372,800	493,800	569,700	609,200	609,200
7. NET INCOME	60,000	159,200	223,700	257,800	257,800

Table G-16 (5/10) FINANCIAL PRODUCTION COST PER HA
UNDER WITH PROJECT CONDITION) (PADDY)

(Unut:J$)

Item of Cost	Unit	Require-ment	Price	Total (per ha)
FOR LARGE FARMER				
1. LABOUR OPERATION				
-Ploughing	machine hr	1	350	350
-Harrowing & leveling	machine hr	1.2	365	440
-Irrigation & drainage	man-day	18	15	270
-Pre-germinate & sow seed	time	1	141	140
-Herbicide application	time	2	62	120
-Fertilizer application	time	3	141	420
-Pest control	time	2	62	120
-Supplemental planting	man-day	2	15	30
-Harvesting (combine hrs)	machine hr	1	370	370
-Transportation to Farmgate	per 45 kg	112	2	220
Subtotal				2,480
2. MATERIAL				
-Rice seeds	kg	112	1.76	200
-Chemicals	lit	10	134.81	1,350
-Fertilizer	kg	365	0.97	350
Subtotal				1,900
3. MISCELLANEOUS	10%			440
4. GRAND TOTAL				4,820
FOR SMALL FARMER				
1. LABOUR OPERATION				
-Ploughing	0.5hr	2	173	350
-Harrowing & leveling	0.4hr	3	148	440
-Irrigation & drainage	man-day	4	15	60
-Seeding	man-day	1	15	20
-Herbicide application	man-day	2	15	30
-Fertilizer application	man-day	1.8	15	30
-Pest control	man-day	2	15	30
-Supplemental planting	man-day	0.4	15	10
-Harvesting	machine hr	1	370	370
-Transportation to Farmgate	per 45 kg	112	2	220
Subtotal				1,560
2. MATERIAL				
-Rice seeds	kg	112	1.76	200
-Chemicals	lit	13	134.81	1,750
-Fertilizer	kg	365	0.97	350
Subtotal				2,300
3. MISCELLANEOUS	10%			390
4. GRAND TOTAL				4,250

Table G-16 (6/10) FINANCIAL PRODUCTION COST PER HA
UNDER WITH PROJECT CONDITION (SOYBEAN)

(Unit:J$)

Item of cost	Unit	Require-ment	Price	Total
1. LABOUR OPERATION				
-Harrowing	machine hr	0.4	85	30
-Rotavating	machine hr	0.6	85	50
-Land levelling	machine hr	2.5	85	210
-Ridging	machine hr	1.2	85	100
-Planting/fertilizing	machine hr	0.6	65	40
-Moulding	machine hr	1.2	65	80
-Herbicide application	man-day	2.5	15	40
-Pesticide application	machine hr	2.4	65	160
-Harvesting	machine hr	2.5	65	160
-Transportation	machine hr	1	80	80
-Irrigation	man-day	6	15	90
Subtotal				1,040
2. MATERIAL				
-Seed	kg	56	3.00	170
-Fertilizer	kg	365	0.97	350
-Insecticide	lit	17	134.81	2,290
Subtotal				2,810
3.OTHER COST	5%			190
4.TOTAL COST				4,040

Table G-16 (7/10) FINANCIAL PRODUCTION COST PER HA
UNDER WITH PROJECT CONDITION (MANGO)

(Unit:J$)

Item of Cost	Unit	Require-ment	Price	Total
1. LABOUR OPERATION				
-Fertilizing/mannuring	man-day	5	15	80
-Spraying	man-day	7	15	110
-Weeding	man-day	12	15	180
-Pruning	man-day	12	15	180
-Reaping	per 40 pcs	387	1	390
-Grading/packing	per 50 pcs	484	1	480
Subtotal				1,420
2. MATERIAL				
-Fertilizer	kg	897	0.97	870
-Chemicals	kg	140	134.81	18,870
-Boxes	per doz	1,613	1.00	1,610
Subtotal				21,350
3. MICSELLANEOUS	10%			2,300
4. GRAND TOTAL				25,070

Table G-16 (8/10) FINANCIAL PRODUCTION COST PER HA
UNDER WITH PROJECT CONDITION (SUGARCANE)

(Unit:J$)

Item of Cost	Unit	Price	Replant		Ratoon	
			Require-ment	Total	Require-ment	Total
1. LABOUR OPERATION						
-Furrowing	per ha	50	2	100	0	0
-Ploughing	per ha	50	3	150	0	0
-Harrowing	per ha	50	3	150	0	0
-Levelling	per ha	50	3.8	190	0	0
-Ridging	per ha	50	2	100	0	0
-Subsoiling	per ha	80	2	160	0	0
-Planting	man-day	15	2.8	40	0	0
-Covering	per ha	50	2	100	0	0
-Moulding	per ha	50	2	100	1	50
-Fertilizing	per ha	30	0.5	20	1	30
	man-day	15	1.5	20	1.5	20
-Cultivating	per ha	90	1	90	1	90
-Herbicide application	man-day	15	1.7	30	1.7	30
-Harvesting	man-day	15	32	480	27.3	410
-Loading	per ha	484	1	480	0.853	410
-Trans-portation	per ha	1,144	1	1,140	0.853	980
-Water Management	man-day	15	8	120	8	120
Subtotal				3,470		2,140
2. MATERIAL						
-Fertilizer	kg	0.97	1,071	1,040	1,071	1,040
-Chemicals	lit	134.81	5.6	750	5.6	750
-Cane Seed	ton	68.80	10	690	10	690
Subtotal				2,480		2,480
3. MISCELLANEOUS		5%		300		230
4. GRAND TOTAL				6,250		4,850

Table G-16 (9/10) FINANCIAL PRUDUCTION COST PER HA WITH PROJECT CONDITION
(VEGETABLES FOR LARGE FARMS)

(Unit:JS)

Items	Unit	Cucumber			Sweet pepper			Pumpkin			Zucchini		
		Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost
1. LABOUR AND OPERATIONS													
-Tractor operation	tract.hr	180	14.7	2,650	180	21.7	3,910	180	13.2	2,380	180	13.2	2,380
-Weeding & thining	man-day	15	31	470	15	44	660	15	22	330	15	22	330
-Irrigation	man-day	15	11	170	15	11	170	15	11	170	15	11	170
-Harvesting & grading	man-day	15	42	630	15	55	830	15	33	500	15	33	500
Sub-total				3,920			5,570			3,380			3,380
2. MATERIALS													
-Seed	kg	52.61	2.2	120	220.26	2.2	480	27.50	2.2	60	27.50	2.2	60
-Fertilizer	kg	0.97	753	730	0.97	963	930	0.97	1,120	1,090	0.97	1,120	1,090
-Chemicals	lit	134.81	67.8	9,140	134.81	79	10,650	134.81	81	10,910	134.81	81	10,910
Sub-total				9,990			12,060			12,060			12,060
3.MISCELLANEOUS	10%			1,390			1,760			1,540			1,540
4.GROUND TOTAL				15,300			19,390			16,980			16,980

Table G-16 (10/10) FINANCIAL PRUDUCTION COST PER HA UNDER WITH PROJECT CONDITION
(VEGETABLES FOR SMALL FARMERS)

(Unit:JS)

Items	Unit	Calaloo			Cucumber			Onion			Pumpkin			Sweet pepper			Red pea		
		Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost	Price	Require-ment	Cost
1. LABOUR AND OPERATIONS																			
-Land clearning	tract.hr.	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250	500	2.5	1,250
-Plough,harrow and furrow	tract.hr.	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500	500	5	2,500
-Nursery bed	man-day	15	12	180	15	12	180	15	0	0	15	0	0	15	12	180	15	0	0
-Trans-planting	man-day	15	15	230	15	10	150	15	0	0	15	0	0	15	10	150	15	0	0
-Planting	man-day	15	0	0	15	0	0	15	5	80	15	5	80	15	0	0	15	12	180
-Weeding & thining	man-day	15	62	930	15	37	560	15	120	1,800	15	12	180	15	37	560	15	18	270
-Fertilizer application	man-day	15	10	150	15	2.5	40	15	10	150	15	5	80	15	2.5	40	15	5	80
-Pesticide application	man-day	15	31	470	15	20	300	15	25	380	15	15	230	15	20	300	15	7.5	110
-Herbicide application	man-day	15	4	60	15	70	1,050	15	4	60	15	2.5	40	15		0	15	2.5	40
-Harvesting & grading	man-day	15	79	1,190	15	70	1,050	15	37	560	15	30	450	15	66	990	15	27.5	410
Sub-total				6,960			7,080			6,780			4,810			5,970			4,840
2. MATERIALS																			
-Seed	kg	20.00	0.14	0	52.61	2	110	98.27	4.5	440	27.5	4	110	220.26	0.7	150	6.50	72	470
-Fertilizer	kg	0.97	753	730	0.97	1,121	1,090	0.97	745	720	0.97	745	720	0.97	753	730	0.97	376	360
-Chemical	lit	134.81	30.8	4,150	134.81	20	2,700	134.81	20.8	2,800	134.81	34.4	4,640	134.81	27	3,640	134.81	13.4	1,810
Sub-total				4,880			3,900			3,960			5,470			4,520			2,640
3.MISCELLANEOUS 10%				1,180			1,100			1,070			1,030			1,050			750
4.GROUND TOTAL				13,020			12,080			11,810			11,310			11,540			8,230

Table G-17 FINANCIAL NET PRODUCTION VALUE PER HA FOR EACH CROPS UNDER WITH PROJECT CONDITION

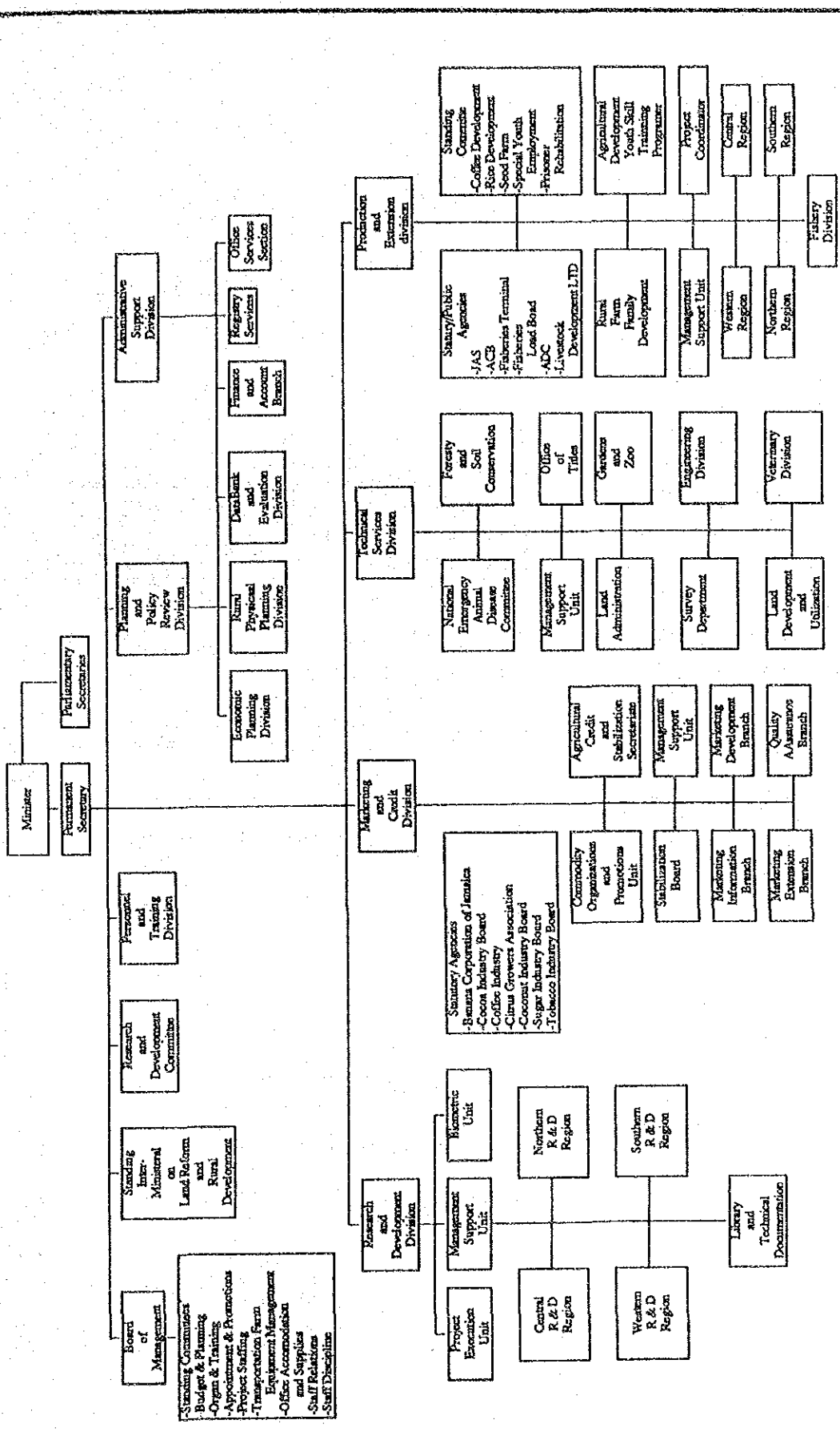
Crop	Production Cost (J$/ha)	Yield (ton/ha)	Marketable Rate (%)	Farmgate Price (J$/kg)	Gross Production Value (J$/ha)	Net Production Value (J$/ha)
A. DOMESTIC CROPS						
Calaloo	13,020	33.6	90%	1.19	36,000	22,980
Cucumber	12,080	13.5	90%	1.05	12,800	720
Onion	11,810	16.8	90%	5.33	80,600	68,790
Pumpkin	11,310	15.7	90%	1.30	18,400	7,090
Sweet pepper	11,540	13.4	90%	2.89	34,900	23,360
Red pea	8,230	1.1	100%	9.14	10,100	1,870
B. EXPORT CROPS						
Cucumber						
large farm	15,300	13.4	85%	3.81	43,400	28,100
small farm	12,080	13.4	85%	3.81	43,400	31,320
Pumpkin						
large farm	16,980	15.7	85%	2.86	38,200	21,220
small farm	11,310	15.7	85%	2.86	38,200	26,890
Sweet pepper						
large farm	19,390	12.1	85%	2.24	23,000	3,610
small farm	11,540	12.1	85%	2.24	23,000	11,460
Mango	25,070	9.4	70%	4.17	27,400	2,330
Sugarcane	5,130	78.6	100%	85.00	6,700	1,570
C. IMPORT FOOD						
Rice						
large farm	4,820	5.0	100%	1.43	7,200	2,380
small farm	4,250	5.0	100%	1.43	7,200	2,950
Maize						
large farm	6,270	6.0	100%	1.89	11,300	5,030
small farm	5,890	6.0	100%	1.89	11,300	5,410
Soybean						
large farm	4,040	2.5	100%	1.84	4,600	560
Beef	3,000	3.8	100%	6.96	26,400	23,400
Milk	6,300	16.1	100%	1.60	25,700	19,400
Fish	69,800	7.0	100%	11.01	77,100	7,300

Table G-18 FINANCIAL NET PRODUCTION VALUE PER HA FOR EACH CROPPING PATTERN UNDER WITH PROJECT CONDITION

Cropping Pattern		Rainy Season	Dry Season	Annual Total
(1) Sugarcane				1,570
(2) Vegetable/Crops				
(2)-1 Vege./Vege. (Small Farmer)				
	Calaloo	-	22,980	
	Cucumber	31,320	720	
	Onion	-	68,790	
	Pumpkin	26,890	7,090	
	Sweet Pepper	11,460	23,360	
	Red Pea	1,870	1,870	
	Average	17,900	17,800	35,700
(2)-2 Vege./Grains (Agro21)				
	Cucumber	28,100	-	
	Pumpkin	21,220	-	
	Sweet Pepper	3,610	-	
	Maize	-	5,030	
	Soybean	-	560	
	Average	17,600	2,800	20,400
(3) Paddy				
(3)-1 Rice-Rica (Amity Hall)				
	Rice	2,380	2,380	4,760
(3)-2 Rice-Rica (Small Farmer)				
	Rice	2,950	2,950	5,900
(3)-3 Rice-Grain				
	Rice	2,950		
	Maize		5,410	
	Soybean		560	
	Average	2,950	4,200	7,150
(5) Orchard (Mango)				2,330
(6) Ornamental				257,800
(7) Pasture				
	Beef			5,400
	Dairy			6,800
	Average			6,400
(8) Aquaculture				7,300

Table G-19 CALCULATION OF NET RESERVE OF EACH FARMING TYPE

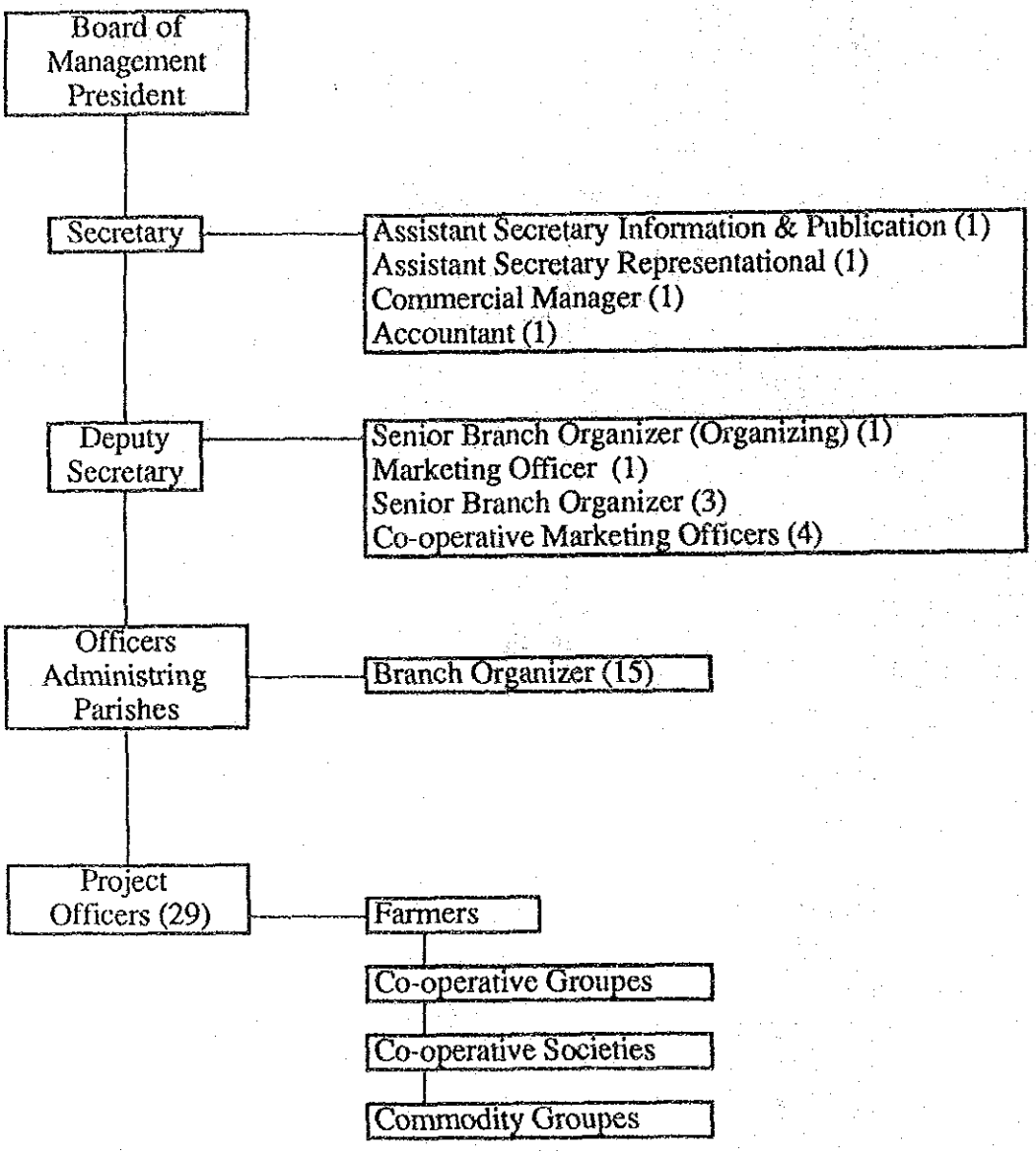
Farming Type	Average Size (ha)	Net Production Value for Farming Type	Average Living Expence	Net Reserve
1. Sugarcane	1690	2,653,000	0	2,653,000
2. Vegetables				
-Large	170	3,468,000		3,468,000
-Small	3.2	114,200	12,400	101,800
3. Paddy				
-Large	710	3,379,600		3,379,600
-Small	3.2	22,900	12,400	10,500
4. Orchard	180	419,000		419,000
5. Ornamental	2	516,000		516,000
6. Livestock				
-Dairy	70	476,000	12,400	463,600
-Beef	6.5	35,100	12,400	22,700
7. Aquaculture	6	43,800	12,400	31,400



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. G-1
ORGANIZATION CHART OF MINISTRY OF AGRICULTURE

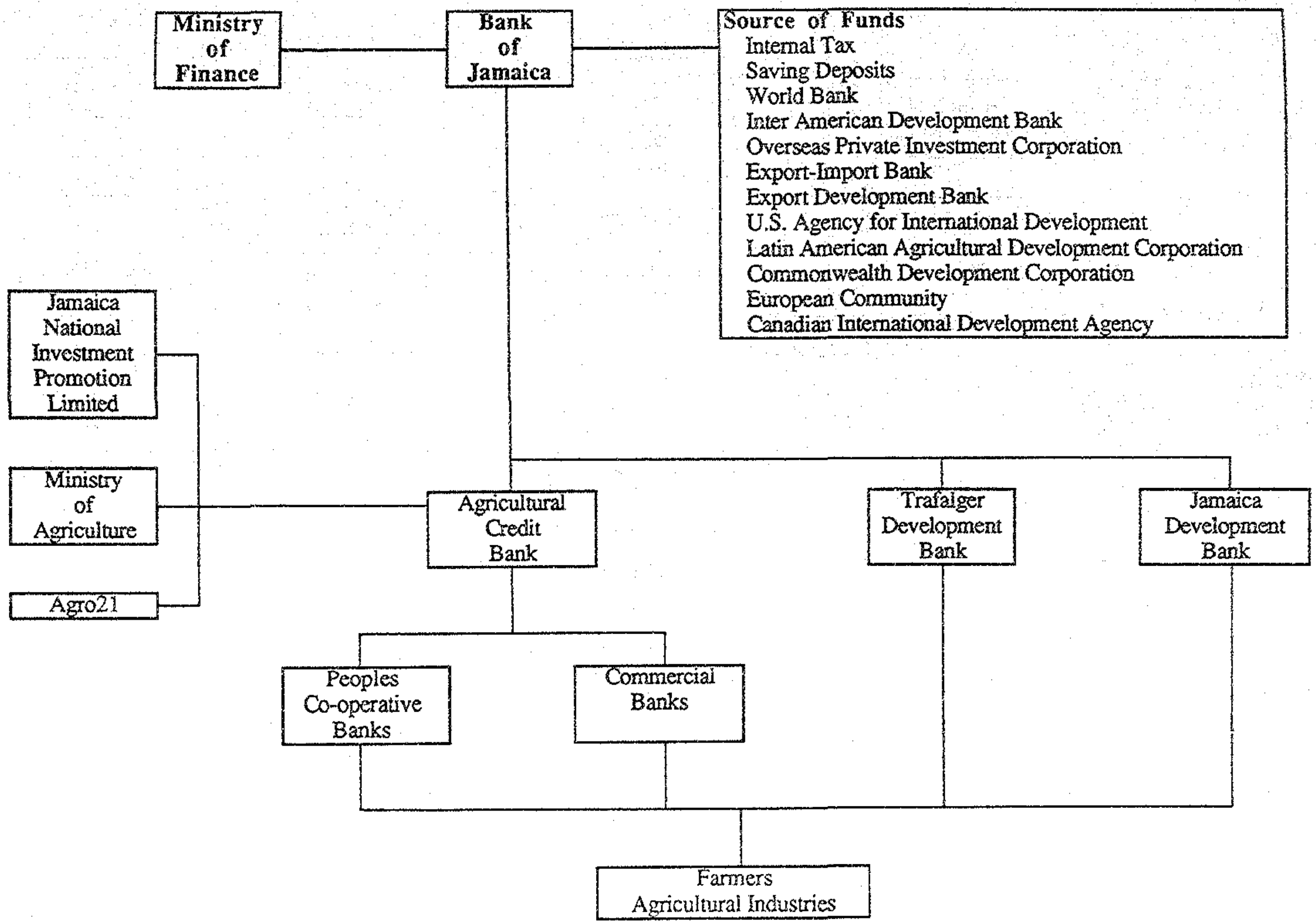
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. G-2
ORGANIZATION CHART OF JAMAICA AGRICULTURAL SOCIETY

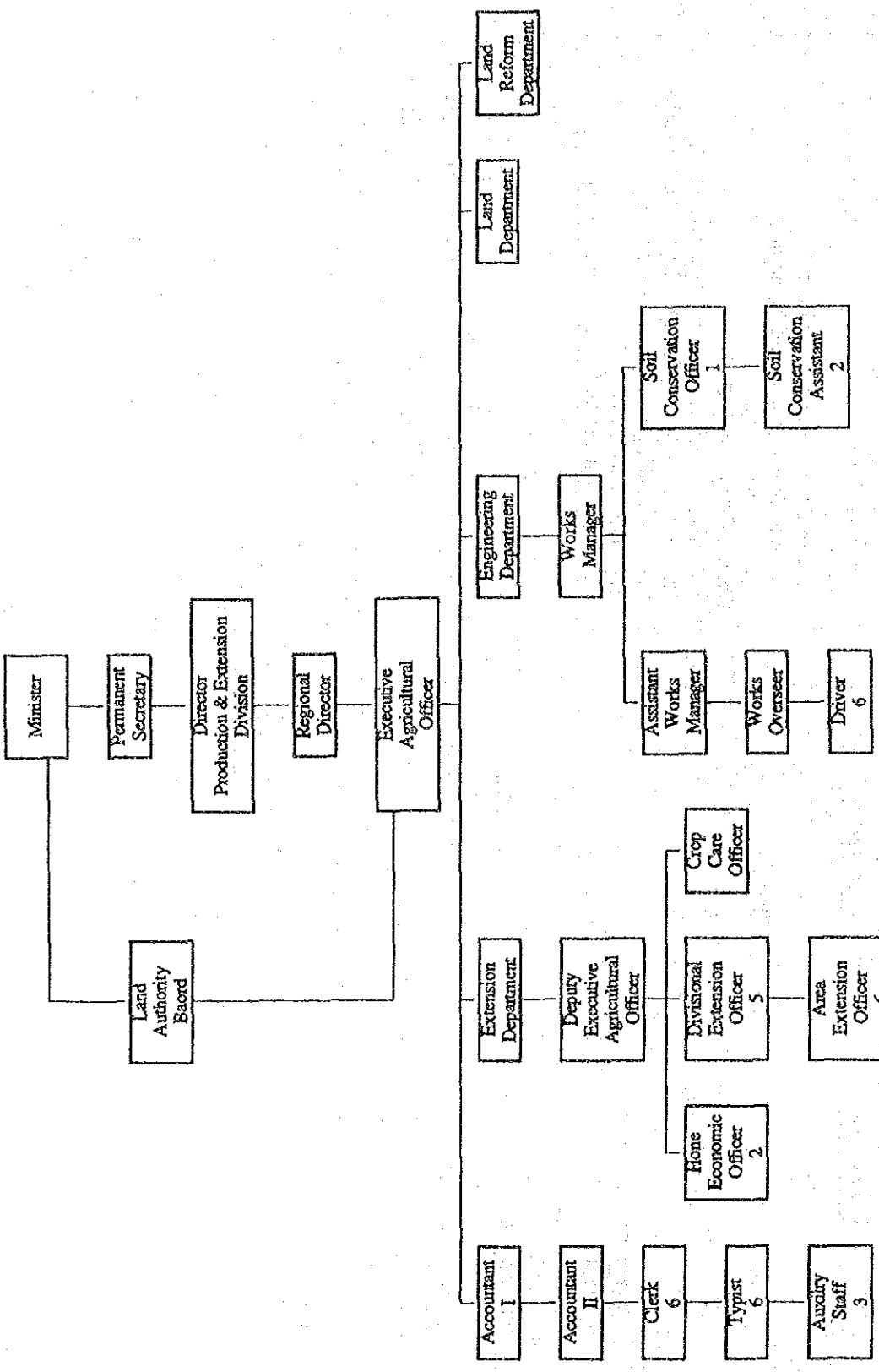
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. G-3
BANKING STRUCTURE IN JAMAICA

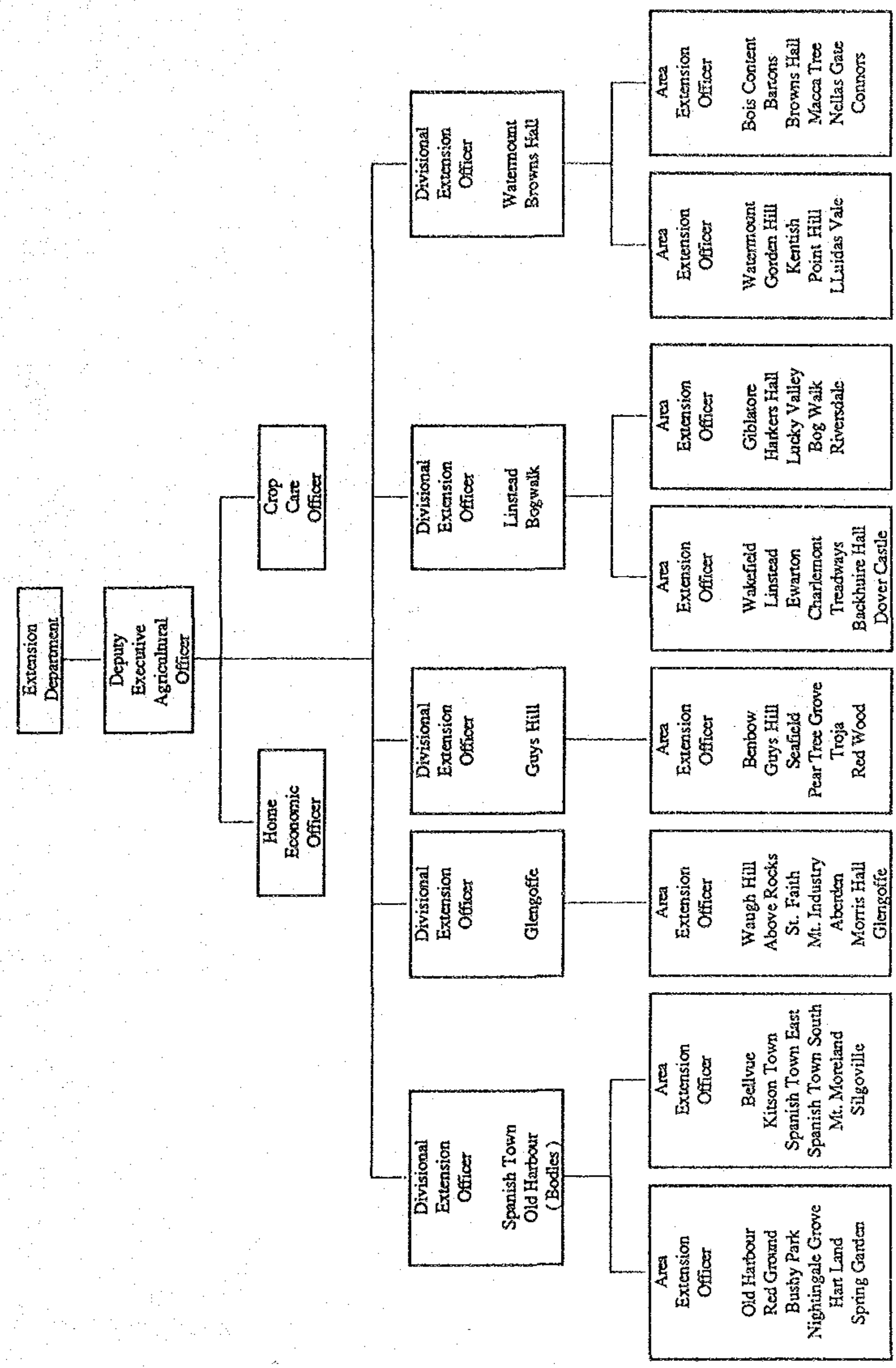
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. G-4
ORGANIZATION CHART OF LINSTEAD LAND AUTHORITY

JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. G-5
ORGANIZATION CHART OF EXTENSION DEPARTMENT IN LINSTEAD LAND AUTHORITY

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX - H

AGRICULTURE

ANNEX-H

AGRICULTURE

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1. EXISTING AGRICULTURAL CONDITION

1.1 Present Land Use

1.1.1 Category description and total land use

Based on the existing land use features of the study area, the following categories have been used for the present land use map as shown in Fig. H-1. Gross areas for each category are summarized in Table H-1.

(1) Arable and potentially arable land

- Sugarcane
- Vegetable/crop (crop includes field crops, tobacco and ornamental crops)
- Orchard
- Paddy
- Pasture (improved and unimproved pasture)
- Ruinate (grassland, bush/grass, bush)
- Woodland (forest with grass below)
- Aquaculture
- Swamp

(2) Non arable land

- Other land (Urban land, wet land (pond), limestone, salinas, mangrove, sand mining, gully, etc.)

Sugarcane category includes all cane fields and temporary fallow fields of four (4) large estates (Innswood, Bernard Lodge, Caymanas and Old Harbour) and some smaller farms located in Bushy Park and north of Spanish Town. This category accounts for 42% of the total arable and potentially arable land (hereinafter called arable land) in the study area.

Vegetable/crop category includes vegetables and several traditional field crops such as corn and red beans. These predominate in Spring Garden and Bushy Park. Tobacco is cultivated only at Colbeck in north St. Dorothy and ornamental crops at Caymanas. These crops account for 4.4% of the arable land.

Orchard category includes two (2) mango plantations one in south St. Dorothy and the other at Thetford. Many small orchards of banana, coconut, papaya, mango, etc. are scattered near the vegetable/crop area.

Paddy category describes the existing paddy fields located at Amity Hall. The present cultivated area of about 386 ha (1.8%) will be expanded to 600 ha or more within the next two (2) or three (3) years.

Pasture category includes improved and unimproved pasture and occupies about 13% of the arable land in the study area. Improved pasture includes those established with improved varieties of grass, and where irrigation and fertilizers are applied. Conversely, unimproved pasture is rainfed and usually not fertilized. Sometimes it has scattered bush owing to less frequent grazing. Area in bush may be kept at less than 20 to 30% of the pasture as long as rotational grazing is practiced. These areas are therefore included in the pasture category. However, when bush occupies more than 40 to 50% of the pasture owing to less frequent grazing, cattle can no longer graze and, instead, small livestock such as goats and sheep graze. This condition of pasture is included in bush/grass land. Bush land is the advanced stage of deterioration with more than 70 to 80% of bush where no livestock can penetrate.

Ruinate category is divided into three sub-categories, i.e. grassland, bush/grass land and bush land. Grassland is the early stage of abandoned field or long-term fallow in cropped field. As deterioration of the land progresses, the area in bush increases rapidly under no grazing, and the grassland changes to bush/grass land and then into bush land after two (2) or three (3) years of continuing deterioration. If grazing is practiced, these transition rates would be substantially decreased. The area in ruinate may be about 31% of arable land consisting of 12 to 13% in grassland or bush and 7% in bush/grass.

Woodland category represents forest with grass below, on the plains and along the river and accounts for 2.5% of total arable land. Woodland can be reclaimed as arable land but needs much more capital than in the case of bush land.

Aquaculture category includes fish ponds which are usually scattered in pasture areas, upland fields and bush. According to Ministry of Agriculture (MOA) data, the existing gross area of aquaculture is approximately 200 ha (500 acres). In this survey 250 ha is identified and accounts for 1.2% of total arable land.

Swamp category is restricted by the parameters of shallow peat layer, no sulphuric acidity and the possibility to be easily reclaimed for paddy field or aquaculture. Reservoir and swamp along the Ferry river at north Caymanas are also included in this category where the survey for aquaculture project in brackish water is going on with the assistance of United Nations Development Programme (UNDP). These account for 1.7% of total arable land.

Other lands collectively called non-arable land include urban land, wet land (pond), limestone, salinas, mangrove, sand mining, gully, etc.

1.1.2 Description of the division in the study area

The study area may be divided into the following eleven (11) divisions depending mainly on the geography and the present and future irrigation system as described under Irrigation Section.

(1) North St. Dorothy
(2) Bodles Research Station
(3) Spring Garden and Thetford

(4) North of Spanish Town
(5) Salt Island
(6) South St. Dorothy
(7) Bushy Park West
(8) Rio Cobre West
(9) Rio Cobre East
(10) Small farmers area
(11) Outside of Rio Cobre East

Table H-2 shows the area of arable land including potentially arable land by division and category.

North St. Dorothy is the area located north of St. Dorothy irrigation scheme pipeline (west of Old Harbour town) and includes Colbeck, Bodles Pen (except Bodles Research Station), and Lennansville. The arable area covers about 1,000 ha and most of the land is occupied by pasture (48%), tobacco (19%) and ruinate (18%). Irrigation water supplied by individual well is inadequate for all arable land.

The land belonging to Bodles Research Station extends north and south of the pipeline. The area in the station is about 450 ha and main land use is pasture accounting for 66% of the area. Irrigation water from their own well is sufficiently supplied.

Spring Garden and Thetford are the areas enclosed by Old Harbour town (west), the pipeline and railway (south) and Old Harbour branch canal (east). This area is approximately 1,390 ha and has three (3) dominant land use category, namely sugarcane, vegetable/crop and pasture each of which occupies nearly the same area (each about 19%). Most of bush land at Thetford is already planned for mango plantation. Sugarcane is grown on the leased land of Innswood estate. The source of irrigation water is by wells. Nightingale area however, is partly irrigated by pumping water from the Old Harbour branch canal.

North of Spanish Town is the area enclosed by Innswood estate (south-west), high way (south) and Rio Cobre river or boundary of the study area (north and east). Most of the area is urbanized (Spanish Town) and arable land is estimated at 1,750 ha, which is scattered in the urban land except the northern part of the area. Main features of the arable land in this area are grassland (34%) bush/grass (20%) and bush (22%), followed by pasture (9%) and sugarcane (9%). The grasslands are predominantly abandoned sugarcane lands and, bush/grass land abandoned pasture mainly due to lack of water.

Salt Island is located south of Hartlands (within Rio Cobre West area) bounded by Salt Island creek and Hellshire hills. This area is covered with bush and mangroves, and totals about 500 ha with strongly saline sub-soils (20 to 40 cm below) influenced by sea water. Large scale aquaculture (40 ha) is practiced by Urban Development Corporation

South of St. Dorothy is delineated by the pipeline to the north, the boundary of the study area to the west and Bushy Park or Old Harbour to Old Harbour Bay roads to the east. Irrigation water for this area supplied from St. Dorothy irrigation scheme is far from sufficient for supplying all arable lands. Supplemental water is supplied from private

wells, but is too expensive to allow irrigation of the remaining lands. The main land use is sugarcane (43%), pasture (36%) and ruinate (18%). Sugarcane is produced mainly by one (1) private estate and most of the pasture is managed by several large dairy farmers.

Bushy Park West area includes Brampton Farm and Lloyds Pen in St. Dorothy and part of Bushy Park west of the Coleburns Gulley. The main land uses in this area are pasture (30%), vegetable/crop (14%), sugarcane (12%) and orchard (10%). As water shortage is more severe than in South St. Dorothy, most of pasture and sugarcane are rainfed and ruinate occupies 33% of the area.

Rio Cobre West is enclosed by Bushy Park West on the west, Spring Garden on the north and Rio Cobre East on the east. The boundary of Rio Cobre West and East is the same as the one between Innswood and Bernard Lodge estates. Almost half of the arable land in Rio Cobre West is sugarcane (Innswood estate) and 26% ruinate. Paddy area at present is less than 400 ha (7%), but will be increased to 600 ha or more within the next two (2) to three (3) years. Some of the ruinate and swamp are included in the planned paddy area. South of this area suffers water shortage, especially at Bushy Park where it may be the most severe within the study area. In southern Bushy Park, water has not come into the terminal canal of the Old Harbour branch since 1983 where pasture and sugarcane are all rainfed.

Rio Cobre East area is delineated for the crop diversification project by Agro 21, which is being implemented with the assistance of United States Agency for International Development (USAID). Most of the area is covered with the sugarcane lands of Caymanas and Bernard Lodge estates, but present cultivated land of sugarcane is approximately 78% of the area and other areas are in fallow or ruinate owing to the lack of water or other reasons.

Small farmers area includes Hartlands (private-owned), the private land along the Town gully (including Hill Run) and Lawrencefield between the Rio Cobre river and railway. There is the Small Scale Farmer Linkage Project in this area with the assistance of USAID. In the former two (2) lands, grassland and other ruinate are the main land use. Hill Run with about 400 ha is largely covered with bush. Some area is used for aquaculture, sugarcane and upland crops, but suffers severely from water shortage. In Lawrencefield however, the Project Land Lease Programme is being practiced under the supervision of the Land Authority with irrigation water from the Cumberland branch canal. Seventy seven (77) farmers were allocated 0.4 to 0.8 ha (1 to 2 acre) each at 24.7 J$/ha/year (10 J$/acre/year), and mixed culture of orchard and vegetable/crop is practiced with some ruinate due to water shortage and other reasons.

Outside of Rio Cobre East includes the National Sugarcane lands (Caymanas and Bernard Lodge) and some privately-owned land outside of Agro 21 study area. The former is mainly located to the east of Agro 21 area, and the latter is mainly pasture for horses. The main land use categories of arable land in this division are, pasture (25.5%), sugarcane (23.3%) and ruinate (33%). As described above, swamp in this division (11%) includes reservoir and swamp along the Ferry river in Caymanas.

1.2 Agricultural Production

1.2.1 Agricultural production in the parish of St. Catherine

Table H-3 illustrates domestic crop production and area harvested in 1983 to 1984 in St. Catherine parish excluding sugarcane and tobacco which are primarily cultivated in the study area and described later. Depending on the table, vegetables, yam and legume are the main crops in the parish and to a lesser extent are cereal, potato and other tuber. Yam, potato and other tubers however, are not common on St. Catherine plain but are grown much more in the northern hilly sections of the parish. Other crops may be cultivated throughout the parish. Domestic crop production and area reaped increased by 9.7 and 7.9% respectively in 1984 in comparison with 1983. The increase in production was attributed to the availability of an export market for condiments, potato and other tubers. However, production of fruit and cereal decreased in 1984 because of disease (papaya), out of production (pineapple) and the unavailability of seeds (corn).

The parish of St. Catherine predominates in the production of livestock especially of cattle and goats. Table H-4 illustrates the number of main livestock slaughtered, and production of liveweight and dressed weight during 1981 to 1984 in the parish. In this table, the number of cattle and goats slaughtered in 1984 in St. Catherine were 14,502 and 10,817 and represented 21% and 19% of all island respectively, both of which are higher than for all other parishes. Liveweight production of cattle and goat in 1984 were 23% and 18% of all island respectively. The number of sheep slaughtered and liveweight production in 1984 were 190 (23%) and 3.4 tons (22%) respectively and were second only to amounts from Kingston. The number of cattle did not increase except in 1983, but liveweight has increased steadily since 1982. The number and liveweight of goat also increased since 1982, but the number of sheep declines annually.

1.2.2 Present crop production in the study area

(1) General description

As described in section 1.1, within the study area, sugarcane, livestock with pasture and several upland crops such as vegetables and tobacco are dominant. Paddy and mango plantations have started only within the last two (2) years. Others are minor crops which include traditional fruit, condiments and ornamental crops.

A characteristic of crop production in the study area is this cultivation of high water requirement crops. This has been achieved by use of an irrigation system which was established more than 100 years ago. This productive structure however is now on the verge of collapse owing to lack of water due to the deterioration of the irrigation facility. Some farmers have their own water source from ground water, but are constrained by prohibitive electricity charges and salinity of ground water. Consequently, most farmers are forced to reduce their cropping areas, while others have succumbed and left in search of new job opportunities.

As a result, the cultivated area has decreased and uncultivated land (which then becomes ruinate) increases annually. Despite this, rainfed farming is practiced in parts of the study

area such as Bushy Park (within the Rio Cobre West area), where there is no water from the irrigation canal. This has brought about significant decrease in yield per area.

Sugarcane which is grown mostly by some large national and private estates occupies most of the fertile recent alluvial land in the study area and is the most important agro-industry for export and the domestic market. However, production of sugarcane has decreased owing to water shortage and low international sugar price.

Concerning vegetable production, many small farmers and some medium farmers are the chief producers mainly at Spring Garden and Bushy Park. There are many factors to their advantage in vegetable production not only access to markets in large areas of consumption such as Kingston and Spanish Town and the expanding overseas market, but also in benefits from a number of services from the St. Catherine Vegetable Producers Association (SCVPA). Nevertheless, production of vegetables in the study area has not been developed during the last five (5) years because of some constraints. These include lack of water for irrigation, low level of acceptance of cultural practices by the farmers especially for non-traditional crops including on-farm irrigation technology, shortage and high interest rate of credit for vegetable production and occasional unavailability of seeds, chemicals and equipment. SCVPA established in 1983 has received major assistance from "partnership for productivity" under the Small Farmer Production and Marketing Project of USAID in strengthening organization, production and marketing. Over the years, membership of SCVPA has increased from 7 to 250, and they benefited from a number of services. However, only 17% of members use SCVPA as their sole market outlet while others sell their products through both SCVPA and other buyers. Services of SCVPA in production are inadequate owing to lack of budget and staff.

Cigarette tobacco is cultivated by small farmers at Colbeck in North St. Dorothy under contract with Agricultural Products of Jamaica (APJ). APJ leases fields and barns, and supplies seedlings and other input materials to small farmers. Consumption of cigarette tobacco is declining because of its high price, therefore no expansion of the tobacco area is expected in future, even if sufficient irrigation water will be available. The following are descriptions of production, yield, cropping pattern and farming practices for each crop.

(2) Sugarcane

(a) Production and yield

There are no published statistics of sugarcane production in the study area, but from field surveys, the total cropped area of the four (4) main sugarcane estates was approximately 4,000 ha and production was 247,000 tons in 1985/86 as shown in Table H-5. The average yield differed considerably between each estate, from 55 ton/ha for Innswood to 81 ton/ha for Caymanas. These differences may primarily depend on soil properties. Soils in Caymanas and the eastern half of Bernard Lodge are sandy to clay loam (PRb1, PRb2) developed on the recent river alluvium and fertile, well drained, and easy to cultivate. By contrast, most of soils in Innswood and the western half of Bernard Lodge are heavy clay (POc2, POc5, POc6, Poc7) developed on old marine alluvium. These clay soils are not as

fertile as the Caymanas soils, are imperfectly drained and need much more power for mechanical land preparation. Moreover, some soils (POc5, POc6) in these areas have moderate to strong salinity. Therefore, cane yields on these lands are lower and sometimes cultivation of cane is abandoned. On the other hand, soils of Old Harbour estate are clay loam (PRb3) developed on recent river alluvium. They are like the Caymanas soils in physical properties, but are less fertile than Caymanas and more than Innswood. The soil conditions of Old Harbour estate are reflected in the yields.

(b) Cropping pattern

Sugarcane in the study area is replanted mainly in spring and to a lesser extent in fall, after which ratoon is practiced. Ratoon is reaped usually 4 to 5 times, depending on the rate of decline in the ratoon yield. The table below shows the cropping pattern of sugarcane in the study area. The time to harvesting of fall plants is longer than that for the spring plants owing to the lower temperature and shorter day length in the dry season which also coincides with the early stage of plant growth.

Type	Replanting Season	Harvesting Season	Months to Harvest
Spring plant	Jan.- Jul.	Jan.- Jun.	12 to 13
Fall plant	Aug.- Dec.	Jan.- Jun.	16 to 18
Ratoons	-	Jan.- Jun.	12

In the case of the 4th ratoon system, the area ratio of ratoons/replants should be logically four, but this ration differs by field, year and farm. The table below shows area of replants, ratoons and their ratio by year and farm. The ratio used in Innswood usually seems to be about three, but much more in some years as the area of replants decreases owing to lengthening of ratoon time and increase in temporary fallow etc. The ratio in Caymanas is higher than Innswood.

	Year	Replants	Ratoons	Ratoons per Replants
		(ha)	(ha)	
Innswood	1981	153	1,340	8.7
	1982	419	1,484	3.5
	1983	423	1,328	3.1
	1984	249	1,144	4.5
	1985	432	1,251	2.9
Bernard Lodge	1986	563	1,563	2.7
Caymanas	1986	46	306	6.7

The following table shows the area and difference in yield by plant type in Caymanas 1986. The yield of fall plants is higher than spring plants and the ratoon yield declines annually.

Plant type	Area	Production	Yield
	(ha)	(ton)	(ton/ha)
Replants	45	5,248	115
Fall plants	2	3,398	124
Spring plants	18	1,849	100
Ratoons	357	30,648	86
1st ratoons	224	21,360	95
2nd ratoons	21	1,813	88
3rd ratoons	40	2,987	75
4th ratoons	22	1,571	70
Others	50	2,915	58
Total or average	402	35,892	89

(c) Farming practices

Cultural practices of all the estates are mechanized except for planting, spraying and harvesting. Field operations, input materials and their costs are summarized in the Table H-6. After mechanical land preparation, manual planting is practiced including cutting and dropping cane seeds as in the case of replanting. Then the seeds are covered with soils using a ridger. These operations are not necessary in case of ratoon crops except moulding after emergence. Herbicides are applied once before emergence with a boom sprayer and 1 to 3 times by knapsack sprayer after emergence. In addition, one manual weeding is practiced, after which plants are moulded. Fertilizers are applied three times manually as shown in the Table H-6. No pesticide is used. Reaping is manual but loading reaped cane is with cane loader and transportation by truck to Monymusk Sugar Factory. For these three operations, contractors are used to handle half the volume of work as the estate is unable to manage the full amount.

(3) Vegetables and field crops

(a) Crop type and variety

The study area supports a range of vegetable and field crops during the spring and winter. These are of traditional and non-traditional types, an example of the latter is the Chinese winter vegetable group including dungua. Of greatest economic importance are calaloo, pumpkin, tomato, cucumber, okra, pak choi, onion, hot and sweet peppers. However, for this project the following crops will also be considered namely; watermelon, red peas and corn as they are frequently found on most farms contributing to farmers incomes.

Farmers have a range of improved variety seeds available to them through the centrally located SCVPA at Gutters and the Thetford Seed Farm. Some crops however, can only be grown using local strains e.g. calaloo and pumpkin.

(b) Production and yield

As shown in Tables H-7 and H-8, production and acreage cropped in 1985 was significantly lower than all other years with the exception of cucumber which increased by 77% and 13% respectively. As to be expected, there is a direct relationship between production and acreage reaped, however, in the case of okra, the percentage change in acreage from 1982 to 1983 was decrease of 0.7% while production increased by some 33%. There were similar cases for hot pepper in 1981 to 1982 and calaloo in 1983 to 1984 comparisons. These are explained by the fluctuations in yield per hectare. The average yield per hectare for okra in 1982 was 3.8 ton which increased by 33% to 5.0 ton in 1983. (see Table H-9)

Based on our survey, the parish and SCVPA data, Table H-10 indicates the average yield per hectare per crop. There is great disparity between sources and of particular interest, are those yields given specifically for the study area from SCVPA and the Data Bank of MOA (average in 1981 to 1985). Other yield data are estimations of national average yields. In most cases, except for tomato and cucumber, unit yields given by SCVPA were higher than those by the Data Bank being from 400% higher for calaloo to 6% for sweet pepper. The survey column in Table H-10 is based on present land use survey and interviews with farmers.

Areas in vegetables are concentrated in clusters mainly within the Rio Cobre West area and to a lesser extent in the St. Dorothy area. The total area for the 12 crops in 1985 was 293 ha, and mostly cropped twice in the year as winter and summer vegetables.

(c) Cropping pattern

With the expansion of overseas markets, farmers are encouraged to lengthen planting seasons of some vegetables to take advantage of a growing year round export trade. These vegetables include pumpkin, calaloo, hot pepper and okra. For this and other reasons, cropping seasons are not as distinct as when defined solely by the rainy seasons ; April, May and August to October (Fig. H-2).

Nevertheless, as there is a peak demand (see Fig. H-2 and H-3) for some crops e.g. cucumber and sweet pepper as winter vegetables, a pattern emerges based on peak volume of crops marketed through SCVPA and production data of the study area.

The primary planting season of these vegetables is September to January with a secondary season from April to July. The period of highest production is December to March ; the winter season, illustrated by Fig. H-3(1) and H-3(2). Fig. H-3(1) shows the amounts of these vegetables marketed through SCVPA peaking during the winter. This is supported by a similar curve in Fig. H-3(2)

based on data on these vegetables within the study area. However, Fig. H-3(1) shows a low peak in August to September which may correspond to the planting season during April to July. SCVPA markets only a small percentage of the vegetables produced in the study area but the production trend may be estimated by it.

Small farmers continue the growing of the same selected vegetable crops every year using a small land area usually 0.2 ha to 0.9 ha. Crop rotation is not practiced in its true sense, but farmers usually try to shift crops after two (2) or three (3) crop seasons due to decreased crop yields.

Generally, there is one main crop with a few (usually two or three) others grown in any one season. These include either onion, cucumber, pumpkin, pak choi, okra or red pea. Calaloo is by far the most popular crop grown by small farmers throughout the study area. For a number of reasons, it seems to play a pivotal role in the cropping pattern, either starting or ending the pattern (see table below). There are indications that there is high local demand (with increasing overseas demand); it is a relatively high income earner; and is easier to cultivate than other vegetables, so farmers prefer to grow it. On the other hand, calaloo is sensitive to continuous cropping showing a decline in yield after two (2) or three (3) crop seasons. It is then shifted to another parcel of land for the next crop season. On some farms typical of the Cherry Gardens area, only one vegetable is produced which is invariably calaloo. Occasionally, where calaloo is not grown, pak choi, cucumber or pumpkin may take its place as the main crop.

The table below shows some of the cropping patterns frequently practiced by small farmers. Crops are generally grown in pure stands but sometimes intercropping (+) of pumpkin, cucumber or red peas with corn can be seen.

(1) Calaloo - calaloo - calaloo - fallow
(2) Pumpkin + corn - calaloo - calaloo - fallow
(3) Cucumber + corn - okra
(4) Calaloo - calaloo - okra - calaloo

For large and medium sized farms, crop rotation is not always strictly adhered to. Usually there is slight variation in the crops grown during the summer and winter. For example, for one (1) season pumpkin, tomato, hot and/or sweet pepper and red peas; for next season, all crops with the addition of cucumber would be grown. This maybe so as it provides a satisfactory income level and/or reliable contracted markets are available for these crops.

(d) Cultural practices

After many years of cultivating a few selected vegetable crops, small farmers particularly in Rio Cobre west area have excelled in producing some of them. These small farmers are reputedly good growers of calaloo giving consistently good quality and yield. They practice preventive pest control, high fertilizer application rates and frequent harvests. In some cases e.g. weed control of

calaloo, they adhere to recommended cultivation practices. However, many deviations are adopted to produce a good quality crop. For example, the number of spray applications adopted for calaloo is usually twenty five (25) instead of eight (8) as generally recommended. The fertilizer application level is 125% higher and harvesting is done two and a half times more during the crop life than recommended.

Other crops grown with varying degrees of success are pak choi, okra, pumpkin, cucumber and sweet pepper which are attributed to (among other reasons) high plant population for pak choi and okra; frequent harvesting of okra, pumpkin and sweet pepper; favourable climate and the opportunity to market daily through SCVPA.

Notwithstanding their success in cultivating some crops, many small farmers consistently ignore recommended cultural practices for a number of crops. Without exception, small farmers do not use herbicides as a method of weed control. This maybe due to ignorance and/or availability of household helpers for manual weeding.

Low (if any) fertilizer application levels for corn and red pea is a common practice. Corn is usually used as shade e.g. pumpkin with corn, yet farmers continue to accept low yields without applying fertilizer as the market price is comparatively low. Usually, a low plant population density is attained for pumpkin, cucumber, red peas and corn. This is partially because they are usually intercropped and partially due to the relatively high price of planting material.

Farmers within the ambit of SCVPA benefit from a number of services. These include primarily the marketing of farm produce and technical advice, use of land preparation machinery and pest control equipment at reduced rates, supply of relevant input material and information on market trends among others. Farmers in Lawrencefield are serviced by the farm store in Spanish Town.

(e) *Labour input*

In most instances, farmers use a hired tractor for land preparation which involves ploughing, harrowing and ridging (to accommodate the flood irrigation method). In the Bushy Park area, farmers use a mule drawn ridger to cut costs. A high labour requirement is needed for calaloo, pumpkin, onion, sweet pepper and okra. Table H-11 indicates the amounts used by crop.

(4) Paddy

Paddy cultivation was practiced around Spanish Town some 10 to 20 years ago, but has disappeared within the last 8 to 10 years. However, recovery began last year (1985) in the form of the modernized farming system at Amity Hall. Phase 1 programme of the paddy development project was started by International Rice Corporation of Jamaica, which plans to develop a 607 ha (1,500 acres) paddy farm during 1985 to 1988.

The variety cultivated is CICA-8 which requires approximately 140 days to maturity. This variety is also cultivated at Jamculture (formerly BRUMDEC) and Meylersfield, the main paddy producers in Jamaica, because of its high resistance to blast disease and high yield. However, CICA-8 has little tolerance to lodging under high levels of nitrogenous fertilizer. Other varieties are being tested prior to introduction.

Seeding is staggered all year round and the cropping pattern is rice-rice-rice. Average number of crops per year is 2.5. Outline of farming practices are shown in Table H-12. Field operations are all mechanized using farm machinery and aircraft. Land is prepared under dry conditions and seeds are broadcast on a wet field at a rate of 110 kg/ha. Herbicides are applied twice at seedling stage (DCPA - Propanil) and maximum tillering stage (2,4-D), and pesticides also twice for the control of the plant hopper, leaf hopper and stink bug. Fertilizer applications are practiced four times; at basal (A), maximum tillering stage (B), panicle initiation stage (C) and 50% heading stage (D) as follows:

(Unit:kg/ha)

Fertilizer	Dosage	Active Ingredient		
		N	P_2O_5	K_2O
(A) 20-30-10	125.0	25	38	13
(B) 117-0-17	125.0	21	-	21
(C) Urea (45%)	62.5	28	-	-
(D) Urea (45%)	62.5	28	-	-
Total		102	38	34

Average yield of the first crop in 1986 was about 5.0 ton/ha (4,500 lb/acre). This is a very good yield for a first crop, and was confirmed by a yield sampling test survey as described later. (see section 2.3) However, there are some constraints to this system of paddy cultivation. First, the surface of the fields is uneven owing to lack of a leveller. This causes unequal growth of rice and high incidence of weeds, resulting in decreased yield. Secondly, the seed rate (110 kg/ha) gives a high plant population stand which causes much lodging during the ripening period coupled with the synergistic effects of heavy nitrogen fertilizer application. Thirdly, the first weed control by propanil often resulted in failure to control especially the barn-yard grass. Weeds increase gradually as continuous cropping goes on, and cultural control needs to be practiced as well as herbicide application. Fourthly, major insect and fungus pests of the paddy cultivation on the farm are plant hopper, leaf hopper and bacterial leaf blight. The former two are also serious constraints on double cropping of paddy in South East Asia. Staggering of the growing season supported with irrigation water results in continuous growing of rice or other host plants all year round, which encourage insect and fungus survival. Therefore, the spread of staggering causes increased incidence of the insect pests and diseases. As a result, paddy yields in irrigated staggering area may become lower year by year.

(5) Orchard

Orchards within the study area are mainly mango, others include papaya and coconut. There are two large farms, Brampton Farm (182 ha) and Thetford Farm (101 ha) and a number of small ones (usually less than 2 ha) which are usually located around farm houses throughout the study area. Estimated production of mango by MOA in the study area for 1985 was 35,700 dozen from 19 ha. Average yield per hectare was 2,606 dozen (Table H-13).

The main mango cultivars are Tommy Atkins, St. Julian and East Indian all of which are suitable for export. Tommy Atkins is an excellent cultivar as it is not only resistant to fruit flies and anthracnose (the two most serious pests) but produces a heavy summer crop and has good flavour, tenure and shelf-life. The other two varieties are very popular locally.

Brampton Farm anticipates an area of 73 ha in a first phase plan which goes to 1987 and hopes to export 80% of the yield and to attain maximum production by year 12. Currently, most mango trees on small farms are in production and are either sold on the the local fresh fruit market or via SCVPA to overseas markets. Anticipated yield for Brampton Farm is 29 ton/ha for St. Julian and 14 ton/ha for Tommy Atkins using drip irrigation.

Thetford Farm mango orchard has 97 ha of one year-old trees in Hayden, Keitt and Tommy Atkins cultivars. In addition to standard cultural practices, plant growth regulators are used and pruning is done as a full-time job to achieve a uniform shape and to remove growth of rootstock. Expected harvest is in 1988 with anticipated yield somewhat similar to that of Brampton Farm, also under drip irrigation. Future plans are to expand by 65 ha to 160 ha.

Small farm orchards are not fertilized, pruned or sprayed against insects and disease and are usually attacked by anthracnose and scale insects. There are only small holdings (less than 1 ha) of papaya for which records are not kept. These are found at Gutters, Bushy Park, Spring Village and at many other farms where they are sometimes used to delineate fields. The main variety is Solo which is used for the fresh fruit market. Fields are in production and are usually grown in pure stands (except in cases where a few trees are grown immediately around the farm house) with only mechanical pest control, that is, cutting down resulting in rejuvenation.

Coconut fields are maintained by individual farmers with assistance from the Coconut Industry Board which on contract, supplies input material and cash for weed control, in exchange for at least 50% copra production. There are only a few commercial field in the study area, while unattended, scattered fields are more frequently seen.

There is a field trial of orchard crops at the Caymanas Development Company which totals about 3 ha consisting of papaya, passion fruit and pineapple.

(6) Tobacco

The production of tobacco in the island is managed by Agricultural Products of Jamaica (APJ)for cigarette and by Tobacco Industry Development Company Limited (TIDCO) for cigar. Tobacco for cigar is produced in Clarendon (243 ha) and St. Thomas (97 ha) and for cigarette in Clarendon (345 ha), St. Catherine (70 ha) and St. Thomas (131 ha). Production of tobacco for cigarette in St. Catherine is concentrated at Colbeck in the north St.Dorothy (hereinafter tobacco for cigarette is called as tobacco).

Tobacco is cultivated by small farmers who lease the land from APJ under the contracts. Tobacco land owned by APJ and some farmers at Colbeck is about 160 ha, but actually cultivated area has decreased to 70 ha because of decline in domestic demand, representing 44% for cropping intensity. The number of tobacco farmers is 50 and average cultivated area of each farmer is 1.2 ha. APJ supplies input materials for farming and also lease barns for drying. Tobacco seedlings are grown under black shade cloth in nurseries at Old Harbour which are leased from Old Harbour estate. Seedlings emerge from July to middle of January. The nursery period for seedling is 50 to 60 days. Planting season is September to March. Harvesting of tobacco leaves begins 17 to 18 weeks after planting and continues for 5 to 6 weeks. Tobacco fields are usually irrigated by sprinkler with an irrigation interval of 8 to 10 days, applying 254 ton/ha during a 2 to 2.5 hour cycle. Yield of dried leaves is 1,300 to 1,700 kg/ha.

(7) Other crops

Within the study area, small amounts of condiments, ornamental crops, tuber and root crops are found. Condiments are mainly onion (which is dealt with under the Vegetable/crop section), basil, thyme and pimento. Evidence of these crops was seen through the records of SCVPA which shows small sporadic supplies. They are grown in a few backyard gardens in Spring Village.

The largest area in ornamental crops is at Caymanas which has a gross area of 12 ha. This consists of 2 ha shade house for some export-oriented crop and for the establishment of orchard crop planting material; approximately 3 ha of orchard crops and 7 ha in ornamental crops. An Aglonemea (silver queen) farm is located in Spring Village (about 1 ha) which exports their produce. Only a few other farms are found with Heliconia and roses in Spring Village and Hill Run respectively which are operated by small farmers as one of several enterprises.

Incidence of tuber and root crops is low. However, cassava, dasheen, yam and sweet potato are found mainly in the Lawrencefield area. Cassava is usually used to delineate fields; dasheen grown along water channels, yam and sweet potato are planted scattered in fields or around houses. These crops are not grown as cash crops but for home use. They are more frequently found in the hilly region north of the study area.

Seed production of corn, (MD II hybrid), red peas and cow peas (Phaseolus and Vigna spps respectively) and peanut (Spanish types) is done at Thetford Seed Farm. Having adequate water supply, they are capable of producing seeds all year round. Even so, seeds are sometimes in short supply.

1.2.3 Livestock production within the study area

As described above, the parish of St. Catherine is the largest livestock producer in the island. Although there are no published statistics on livestock within the study area, most of the large and small livestock in the parish are produced within the study area except for dairy cattle which are raised on hilly land north of the study area.

Pasture is widespread in the study area, more so in the St. Dorothy area, and to a lesser extent at Bushy Park in Rio Cobre West area, where a number of cattle graze. These are dairy and beef cattle. Most dairy cattle are raised by large scale farmers in St. Dorothy where irrigation water is comparatively sufficient and much more improved pastures are maintained than in other areas. Beef cattle are concentrated on medium and small scale farms at Bushy Park where they suffer from water shortage. The reasons for these are as follows: (1) there are many large-pasture owners in St. Dorothy (2) they can supply the irrigation water from their own well or from a river and not necessarily from St. Dorothy irrigation scheme, (3) dairy cattle is more profitable on a large scale farm with milking machine (parlour) and milk cooler (used to determine grade A milk) than small and medium-sized farm which have no equipment for milk, and because of lower milk price in case of hand milking and no milk cooler, and (4) much more grass (pasture for grazing) is necessary for raising of dairy cattle than beef cattle.

Goats are generally raised alone or together with sheep by small farmers with small crop fields and/or by small and medium-sized beef cattle farms mainly at Bushy Park. These usually have no exclusive pasture and graze ruinate land of adjacent properties. They were therefore excluded from the scope of the survey.

(1) Dairy cattle

Most of the milk production in the study area is dependent on medium- and large- sized dairy farms and the contribution of small sized farms may be small. Table H-14 indicates the present condition of main milk producers which are chiefly concentrated in South St. Dorothy.

The gross area of these farms is 10 to 200 ha each and totals 787 ha accounting for 28% of pasture within the study area. The percentage area of improved pasture per gross area in each farm changes from 40 to 100% depending mainly on water supply. Herd size on each farm varies from 60 to 440 which does not necessarily corresponds to pasture area.

The percentage of milking cows per total herd ranges from 24% to 80%. There tend to be a higher percentage for smaller herd size farms and/or smaller pasture owners compared with herd sizes as in case 3 and 5 which have a smaller percentage of calves and heifers per milking cow. Total number of dairy cattle for all these farms is 1948, adding cattle from the other dairy farms within South St. Dorothy area it may be over 2100. Total number in the study area is however still not known.

Commercial feeds are used on all farms, but along with local feed on some farms (see Table H-14). Brewers grain and wheat middlings are common local feeds, others are sugarcane waste, molasses, poultry manure, soya bean etc. There is a direct relationship

between the amount of commercial feed given to each milking cow and daily milk production, but local feeds may not have marked influence on milk production. Cows in cases 2,3,5 and 6 farm produce more milk than the other two farms. Higher levels of both fertilizer application and adequate water supply to pasture have a marked effect on daily milk production. Case 4 farm is located furthest away from its water source and therefore suffers a more erratic supply. Conversely, Case 1 farm has sufficient water but applies only poultry manure. Difference in daily milk production between farm Cases 5 and 6 with the same amount of commercial feed may be attributed to the difference in the area of improved pasture per animal unit (see pasture) between the two farms (0.2 ha and 0.5 ha respectively).

Duration of lactation on each farm is 305 days except for 210 days on one farm, but the average number of lactations per cow changes from 4 to 8.

Total milk production within the study area for 1985 was 3,880 ton including 3,299 ton produced in Old Harbour which represents 85% of total production as shown in Table H-15. Total annual milk production of the six (6) farms in the table is approximately 1,818 ton, and adding the production of two (2) other farms and Bodles Research Station, it becomes 2,560 ton accounting for about 78% of Old Harbour Agricultural Extension area.

(2) Beef cattle

Beef production within the study area is essentially practiced on small to medium sized farms. Herd size ranges from 10 to 60 ha with usual gross farm area of 10 ha but ranging from 2 to 60 ha. Total pasture occupied by beef cattle in the study area is not known but it is estimated to account for a smaller percentage in the St. Dorothy area than in the Rio Cobre West area. These farms are mainly located in Bushy Park.

In most cases, farmers keep a small breeding herd to supply weaners for fattening, otherwise, they are purchased at 9 months old averaging 200 kg. The weaners are usually fattened on an intensive system (Zero-grazing: The practice where animals are confined so that it is necessary to cut and transport feed to them to avoid putting them on pasture.) but sometimes on semi-intensive system (Semi-intensive: Where weaners are first reared on pasture up to a certain weight, then later on zero-grazing until marketed) whereas the breeding herd are reared on mainly extensive system (Extensive: Where the animals are reared only on pasture.)

The weaners on zero-grazing take varying time period (6 months in case 1 to 2 years in case 4, see Table H-16) to achieve a market weight 400 to 450 kg. This is dependent on the types of feed used which are basically of three types namely, a blended mixture of local ingredients (e.g. wheat middlings, citrus pulp and brewers grain) and grass, concentrate and grass, and grass only. It seems more important to feed concentrates regularly as in cases 1 and 3 than for an all grass diet (case 2). However, a well-balanced feed consisting of improved pasture grass and concentrates gives the best yield expressed as daily liveweight gain in case 1 as 1 kg per day.

The daily liveweight gained (DLG) and stocking rate (number of animals per unit area of pasture) are incumbent on regular water supply. In case 3, amount of daily commercial feed is similar to case 1 (5.4 kg and 6.3 kg respectively), but due to rainfed pastures (which do not efficiently utilize fertilizer), DLG is only 0.6 kg. Farms represented by case 3 and 4 are located furthest away from their irrigation water source and are unable to support improved pasture. In case of available ground water, high electricity charges make irrigation prohibitive. Stocking rates under adequate water supply in case 1 is 21 per hectare but is reduced to 3 under rainfed condition (case 4). In case 1, pasture is overstocked and so, supplemental grass is sought from other farms.

(3) Pasture

Improved pastures are found mainly on large farm holdings which rear dairy cattle in South St. Dorothy. However, few beef cattle farms e.g. Villa Pen near Bernard Lodge and in Spring Village have improved pastures. Nevertheless, in Bushy Park where most beef cattle farms are located, only unimproved pastures are found owing to lack of water.

Improved pastures are those which receive regular irrigation, fertilization and stumping (manual removal of weeds). 0.4 ha (1.0 acre) regularly fertilized with not less than 51 kg (1 cwt) sulphate of ammonia in early spring, summer and in late fall together with one application per year of muriate of potash (51 kg) can normally be rated at a carrying capacity of 1 to 2 animals units (AU). Animal unit represents the pasturing requirement of one mature cattle. For example one cow or 2 yearlings or 4 calves (4 to 8 months) would require 1 AU. This depends on climatic factors, maintenance of controlled rotational grazing and availability of irrigation. To be rated at capacity of 5 AU/ha (2 AU/acre), more intensive application of fertilizers would normally be required.

Usually the grass type is African Stargrass which is vigorous, recovers quickly after grazing or harvesting and has a high stocking rate (number of animals/unit area). Other grass types of less importance (with specific reference to private farmers) are Pangola and Guinea Grass. At Bodles Research Station, these grasses are important and experimental yields of 15 to 17.5 ton/ha/year (dry matter) are obtained. Typical fertilizer levels used are given in the table below:

Application Fertilizer	No. of Rate (kg/ha)	Application
Sulphate of Ammonia	753	1
Muriate of Potash	251	2
Di-ammonium Phosphate	251	2

These levels are much higher than currently used by farmers even with improved pastures. In the study area, the highest fertilizer levels used on improved pastures are 376 kg/ha of sulphate of ammonia with 627 kg/ha of 7-14-14 per year which are considerably less than at Bodles Research Station. Yield estimations are not available for private farms.

As fertilizer cost is high, some farmers try to cut costs by using poultry litter entirely or, as a supplement which is applied without restraint. All dairy farmers use commercial and/or organic fertilizers applied two, three or four times per year under irrigated condition and, once or twice under rainfed condition.

Sprinkler irrigation is mainly used especially for large dairy farms. However, a few dairy farms still use flood irrigation to cut pumping costs whereas, indications are that small farmers previously only used this method (Bushy Park). Some small farmers in Villa Pen still use flood irrigation as water is available via Cumberland branch canal. In some areas of Rio Cobre West, surface water is pumped from the Rio Cobre irrigation canal while deep-well pumping is done in St. Dorothy except for the one large dairy farm which uses the Bowers river. On large farms, two 8-hr irrigation shifts per day are used on a 14 to 35 day cycle. Owing to rainfed conditions of beef cattle farms in Bushy Park, and also the negligence in fertilizing before rainy seasons, only unimproved pastures are found. Stumping is necessary to maintain high quality pastures. This is normally practiced once per year. Fence repairs are done throughout the year on large farms.

1.2.4 Post harvest facilities

Post harvest facilities have developed around the various products from the study area. They include milk processors, seed (planting material), rice, sugar, meat and vegetable producers (Table H-17). Each plays a significant role in maintaining living standards of the many farmers who supply them.

The Century Farm Milk Processors situated in the 'milk belt' in South St. Dorothy will have (after expansion) capacity to process 4,500 lit/hr. However, present operating capacity is about 20%. One third of their milk is supplied by farmers within the study area including a company-owned dairy which should double to accommodate a 500-milking herd. They produce 100% fresh milk.

Cremo Limited processes milk from five dairies within the study area. Present plant capacity allows packaging of about 6,250 lit/hr (Note: amount given is volume of fresh milk used, final product is 60% : 40% fresh to powdered milk). Present operating efficiency is 65%.

The rice mill situated in Spanish Town was reopened under private ownership in February 1986. Its present capacity is 2.72 ton/hr of finished rice and currently processes 43.5 ton/day. When fully operational, the mill will be able to produce about 14,149 ton of finished rice annually or approximately one-third of local needs.

SCVPA is now essentially a marketing organization operating as a cooperative business. A new packaging house (400 m^2 floor space) is currently used for storage rather packaging as produce is in short supply. Instead, office space at Gutters is used to select trim and package condiments and vegetables from between 35 to 50 members per week. They averaged, up to April 1986, 45,500 to 72,700 kg (100,000 to 160,000 lb) of produce per month, operating well below capacity.

Seed production at Thetford Seed Farm has been reduced considerably but nevertheless, corn, peas, beans and peanuts are available to farmers though in limited supply. The processing plant houses 3 dryers; threshing and grading equipment including elevators; holding bin to facilitate chemical treatment of seeds; ton scale; bag stitcher and other small items. The laboratory has digital moisture testers and germinating bins to monitor seed quality.

Operations of the Bernard Lodge sugar factory have been taken over by Petroleum Corporation of Jamaica but is not yet in operation. There is certainty as to whether ethanol and/or sugar will be produced. Currently, maintenance repairs are underway but installation of new ethanol-distillers are not in place. The capacity of the sugar factory is 51,000 ton/year but in 1985 processed only 16,300 ton (32% of capacity) down from 25,500 ton (50%) in 1984. This was attributed to low sugar production and decreased efficiency (by 40%) of the sugarcane grinder. Sugarcane was received from farmers of the St. Catherine plains (about 65% of total raw material) and from north St. Catherine.

There are a number of slaughter houses in the study area which usually operate for two or three days per week slaughtering up to six (6) head of cattle. Storage facilities are limited and so such fresh meat is sold.

In each case, the single major problem is insufficiency of raw materials resulting in low operating efficiencies. Increased area and/or intensification of production is needed.

1.2.5 Aquaculture

(1) Production

Aquaculture within the study area is found in South St. Dorothy and Rio Cobre West area. Fish ponds are usually scattered in pasture, upland fields and ruinate, but the main areas of concentration are south of Old Harbour, south of Little Hartland, Hill Run and Salt Island. Net fish pond areas by location estimated by MOA (Inland Fishery Division) in the study area are shown in the table below.

Location	Area	Land Use	Land Ownership
	(ha)		
Old Harbour	24.7	in Pasture	Medium and large scale livestock farmers (0.5 to 12 ha)
Little Hartland	34.8	in Ruinate	Small and medium special farmers (1 to 8 ha)
Salt Island	40.5	in Ruinate	Urban Development Corporation
Hill Run	51.4	in Ruinate/ cropfield	Small and large special farmers (0.5 to 15 ha)

Total net pond area in the study area is approximately 150 ha and mostly concentrated in the center of the St. Catherine plain where soils are mostly heavy clay and saline and are

unsuitable for crops other than paddy or salt tolerant crops and aquaculture. Depending on the field survey, ponds under-construction were found south of Old Harbour, along the Bushy Park to Old Harbour Bay road and at Little Hartland.

In large scale fish ponds, both breeding and production of fish are practiced but in most small scale fish ponds rearing only for production is common, where fingerlings are purchased from another place. As a consequence in the study area fingerlings are have to be purchased from Portland and Spring Plain in Clarendon as price of fingerlings becomes higher in the study area due to lack of production.

(2) Cultural practices

Cultural practices of fish farming are still in the pioneering stage. Farmers within the study area have been quite innovative and as such cultural practices vary with varied degrees of success notwithstanding severe lack of water especially during the months of January to July.

There are usually three ratios used in relation to pond types existing in the study area. They are 1:3:10, 1:5:10 (the ratios of brood ponds to nursery and production ponds) and, 1:2 (nursery to production ponds). The former two are used only on large farm which produce their own fingerlings (young fish). Usually, the silver perch (Tilapia nilotica) is grown, but silver hybrids (Tilapia aurea) and red Tilapia hybrids have been introduced. Brood fish of the latter two species are said to produce 90% males, however, farmers have indicated 65% as being a more accurate percentage as breeding in production ponds can be profuse.

Usually each brood and nursery pond is about 1.2 ha while production ponds are 2.5 ha or in some cases 5 ha. One large farm has production ponds up to 9 ha.

Fry (newly hatched fish of mixed sex) from the brood ponds are harvested each week (sometimes every 10 days) to stock nursery ponds at about 150,000 fry/ha. After about 8 weeks, the fingerlings are hand-sexed (silver perch only) prior to transfer to production ponds at 14,820 to 17,290 males/ha (6,000 to 7,000 males/acre). Mortality is usually quite high at this stage ranging from 30% to 50% due to stressing of the fish as they are kept out of water for about 10 minutes under hot climatic conditions.

Most farmers feed fish twice per day. One feeds only in the evening, while another feeds three times daily (red perch farmer only). In the former two instances, fish are fed based on 20% and 15% bodyweight respectively, in the other case, feeding continues as long as fish eat aggressively. It is expected that feed conversion ratios vary significantly but unfortunately, total amounts of feed/ha/crop used are not available for comparison.

Most farmers aim for a 0.23 kg (0.5 lb) sized silver perch for market in 14 weeks, some have achieved this in 12 weeks. However, a few farmers aim at 0.34 to 0.45 kg (0.75 to 1.0 lb) sized silver perch in which case, it takes 6 months to achieve. In case of the red hybrids, only 0.23 kg sized fish have been produced taking up to 4 weeks longer to reach 0.23 kg than silver perch. Farmer acceptance has been low so far, but consumer acceptance for red hybrids is higher than that for silver perch.

Harvesting is done by seine and the usual yield and number of crops per year are 2,240 to 2,576 kg/ha and 2.5 respectively in case of fish of 0.23 kg each. The average turn around time between fish crops is 7.5 weeks. Farmers are not able to accurately estimate yields due to loss by predial larceny, predatory birds, dogs and even crocodiles. Also silver perch tend to live towards the bottom of ponds and are difficult to see through the green plankton in the water.

The plankton or bloom is achieved by fertilizing the water prior to and during fish growth with 12-24-12 fertilizer and/or poultry manure. In the latter case, an off-flavour of the fish may develop if the plankton becomes very dense prior to harvesting. Flushing, that is placing live harvested fish into tanks or ponds with unfertilized water for about 4 to 12 hours is used to alleviate this problem.

Most farmers supply middlemen who collect at the pond side but others carry out their own marketing directly to the consumer.

2. AGRICULTURAL DEVELOPMENT PLAN

2.1 Proposed Land Use within the Project Area

As described above, the project area includes South St. Dorothy, Bushy Park West, Rio Cobre West, Small Farmers and Rio Cobre East area, which are selected depending mainly on availability of surface water source and irrigability by gravity. Bodles Research Station area however, is excluded from the project area for the reason that its objective of the land use is for agricultural research rather than production, and irrigation water from their own wells fully meets their requirements.

In the project area, South St. Dorothy area is referred to only as St. Dorothy and Bushy Park West area is included in Rio Cobre West area. The reason is that under the projected irrigation system South St. Dorothy will be irrigated from the St. Dorothy Irrigation System, and Bushy Park West area within the jurisdiction of the St. Dorothy Irrigation System will be irrigated from the new Rio Cobre Irrigation System. Proposed land use within the project area under the new irrigation system is formulated and based on government policy, present land use and agricultural conditions, soil condition and crop suitability, agro-economic and social conditions including intentions of farmers. Table H-18 shows the area of proposed land use by each area and by category. Fig. H-4 illustrates the proposed land use in the project area by category.

2.1.1 St. Dorothy area

Most of the lands in this area are privately-owned and occupied by large-scale farms (more than 20 ha) of which dairy cattle with pasture and sugarcane are the main land use. Medium-scale farms (2 to 20 ha) with beef cattle and pasture and small-scale farms (less than 2 ha) have proportionately far less of land area. Fertile clayey loam soils (PRb3) extend along the Bowers River (lower stream of Plantain Gully), and other lands have clay soils with no salinity except on the coastal plains. St. Dorothy Irrigation Scheme supplies water for only 20% of some pastures and 40% for sugarcane fields. Water supply to remaining lands depends on farm-owned wells or the river. Concerning arable land including ruinate, present land use is sugarcane (43%), pasture (36%), ruinate (18%) and vegetable/crop (1.4%). When sufficient irrigation water is available in the future, the intentions of livestock farmers are to increase their herds with the increase in grass yield and expansion in pasture area. The intentions of sugarcane and other crop farmers are to increase yields and the cultivated area. They do not want to change their present enterprises even if sufficient water is available. In case of privately-owned land, greater priority should be given to the intentions of farmers for their land use. Production of sugarcane in this area is beneficial for its considerably high yield and may be necessary to maintain the sugar industry of the island. Production of milk and beef adhere to national policy as substitutes for imported foods and have sufficient volume for domestic demand.

According to these conditions and intentions of the farmers, land use is formulated as: present pasture and part of ruinate owned by livestock farmers should be converted to improved pasture, and production of sugarcane should be increased by improvement of

cultural practices and expansion of the areas under increased irrigation water. As sugarcane fields and pasture occupy most of the fertile land of recent alluvial soils in this area, there is little land available to change to vegetable crops.

2.1.2 Rio Cobre West area

Most of this area is the Government lands of Innswood Estate (sugarcane), Amity Hall (paddy) and Hartlands (sugarcane and ruinate) representing 62% of the area. Other parts are privately-owned including Bushy Park West, East Bushy Park (east of the Coleburns Gully) and Little Hartlands. In Bushy Park West and East, there are several large scale farms including three dairies, one each of beef cattle with sugarcane, orchard and vegetables. Medium-sized farms manage beef cattle and/or sugarcane and a number of small scale enterprises including vegetables or beef cattle. Little Hartlands is mostly covered with bush except for some fish ponds.

Most soils in the area are old alluvial heavy clay except the recent alluvial clay loam (PRb3) along the Coleburns Gully which is suitable for vegetables. Moderately and strongly saline soils are frequently found on old alluvial soils on Government lands and Little Hartlands. Severe salinity of soil (Class 4) has been judged to be unsuitable for upland crops.

Government policy for Government land use in this area, is that Innswood Estate should continue production of sugarcane for sugar and Amity Hall should expand paddy fields and increase rice production. Sugarcane in Hartlands should be diversified to grains for import substitution. As there is no suitable land use other than for paddy or aquaculture in these saline clay areas, and paddy is an important crop in the self sufficiency programme, paddy should be the main land use of national and private (Little Hartlands) lands except for Innswood. In Little Hartlands, as aquaculture is being practised at present mainly in the south, the available lands in the north have been earmarked for paddy cultivation. It is not desirable that fish ponds should be interspersed in paddy fields due to environmental/agricultural requirements and water use management for improved paddy cultivation.

In the Bushy Park area, present land-owning farmers usually want to continue and/or expand their present sugarcane or vegetable/crop fields, orchards and pastures under the conditions of sufficient water supply. There are however some lands suitable for vegetables mentioned above, and for paddy in the south part of east Bushy Park (saline clay soils), and the Bushy Park area is one of the Small Farmers Linkage Projects of Agro 21. The proposed land use plan will be, therefore, that a new vegetable/crop belt should be developed along the Coleburns Gully and paddy in south part of east Bushy Park. On the other lands of the area, present land use should be continued and expanded.

2.1.3 Rio Cobre East area

The Crop Diversification Programme is underway in this area by which most of the national sugarcane lands at Caymanas and Bernard Lodge Estates are being divided into nine (9) areas and diversified to winter vegetables with grains, ornamental crops, orchard and aquaculture as shown in Table H-19. However, sugarcane remains in one area and,

orchard and aquaculture are still tentative due to water supply and other reasons. A land use plan is proposed, based on this programme, which is almost the same except for a few changes related to estimation of water supply and soil conditions. Changed areas will be as follows:

In area D, as the soils are moderately saline, paddy is a suitable crop to reduce or to prevent increase in the soil salinity and will be more beneficial than grains such as field corn as long as the water requirement can be supplied. Therefore, it is planned to introduce paddy in the rainy season with grains as a subsequent crop to match conditions of water supply and the need for production of grains.

Concerning area H, the soils are fertile and have good drainage and some orchard trees have done well in trial cultivation at Caymanas. On the other hand, in the orchard area in Agro 21 Programme tentatively located at the southern end of area E, orchard trees seem to be unsuitable where soils are moderately or strongly saline, imperfectly drained and surface water from upper lands is prone to accumulate on lower flat land in rainy season. Therefore, orchard crops suitable for export market such as mango and papaya are proposed as land use plan for area H. Other areas are not changed.

2.1.4 Small farmers area

Small farmers predominate on the private lands including Hartlands, the land along the Town Gully (including Hill Run) and Lawrencefield. Ruinate covers more than 70% in the former two (2) areas, but in the latter, Project Land Lease Programme is in progress and Small Farmers Linkage Project will be started soon. Mixed cultures of orchards and vegetable/crops is already practised by small farmers in Lawrencefield who are leased 0.4 to 0.8 ha (1 to 2 acres) each from the Land Authority. Soils are recent alluvial clay loam and suitable for vegetables and orchards. Conversely, in the other two areas, soils are old alluvial clay with moderately to strongly saline subsoil. On these soils, only upland crops tolerant to salinity and paddy or aquaculture are suitable. Therefore, proposed land use is formulated as vegetable/crops with some orchards in Lawrencefield and paddy with grains and aquaculture in Hartlands and Town Gully area.

2.2 Proposed Cropping Pattern and Farming Practices

Depending on proposed land use described above, main land use categories concerning crops are vegetable/crops (29% of total project area), sugarcane (23%), paddy (26%) and pasture (9%). Others are orchards (5%), aquaculture (4%) and ornamentals (1%). In vegetable/crops category, the cropping pattern will be divided into vegetables-grains in Agro 21 area and vegetables-vegetables in other areas of privately-owned lands. Cropping patterns in the paddy category include paddy-paddy and paddy-grain due to water supply and soil conditions. Other categories include perennial crops. The following are description of each proposed cropping pattern with proposed farming practices for each one.

2.2.1 Sugarcane

Cropping pattern of sugarcane in the project area is usually 4 to 5 ratoons after reaping one year old replants, but differ by field and year. Four (4) ratoons after spring replants is assumed in this plan. The main verities cultivated are BJ70/15, BJ70/13 and UCW 54/65. Cultivation of BJ70/15 is spreading gradually but UCW 54/65 (bred by a USA company) is contracting.

Cultural practices are usually mechanized except for planting, spraying of herbicide after emergency and harvesting. In this plan, most field operations proposed are similar to those at present, but land preparation and fertilizer applications are increased for increased yield as shown in Table H-19 and H-20.

Active ingredients of fertilizer applied per year on national and private estates are shown in the table below:

(Unit: kg/ha)

	N	P_2O_5	K_2O
National estate	300	95	190
Private estate	215	90	110
Plan	262	112	134

Application of nitrogen and potassium is much higher on national estates that on private estates. This may be attributed mainly to soil fertility and salinity. Soils in the former are lower in fertility than the latter and higher in soil salinity, therefore, much more fertilizer may be required by the former. Based on these data, the fertilization plan for the project area is set up as shown in the above table.

Usually no pesticide is applied for cane in this area therefore, application of chemicals is only herbicide. Herbicides are applied usually twice at pre- and post- emergence. Mechanical application can be practised for pre-emergence herbicide, but manual application is usual for post-emergence. The leading types of herbicide currently used by sugarcane growers are Gesapax Combi 500 (ametrine), 2-4D and paraquat. Some growers use Gesapax with Asulox 40 and 2-4D with Actril D for far more effectiveness, but this may be more expensive. Gesapax Combi 500 can be used for pre- and post-emergence applications and has contact and long residual action. In this plan, Gesapax Combi 500 will be used for pre-emergence application and early stages after emergence because of its long residual action, and 2-4 D with Actril D will be used for broad leaf weeds mainly at middle or late stages of sugarcane growth.

To achieve higher yields of sugarcane especially of ratoons, the followings are recommended.

(1) Improvement of chemical and physical properties of soil by proper management of soils such as:
   - leaching and/or application of soil conditioners for saline soils,
   - increasing soil permeability by subsoiling and,
   - application of organic materials.

(2) Improvement of the fertilization programme depending on chemical analysis of soils.

(3) Improvement of farming practices namely:
   - water management,
   - effective application of herbicides and,
   - introduction of rotation crops such as paddy.

2.2.2 Paddy - paddy

Year around cultivation of paddy in the project area has been practised by staggering seeding about every two weeks. In the longer term this may cause an increase in insect and fungus pests and, serious crop damage. Experience in Malaysia (Dr. Yamada, Journal of Irrigation Engineering and Rural Planning, No. 8, 1985) showed that the first damage due to plant and leaf hoppers occurred in 1973 (3 years after starting double-cropping) in an irrigated and staggered double-cropping area of paddy. Rice tungro virus disease was found in 1981, of which the vector is green leaf hopper, and it spreads rapidly throughout the whole area by 1982, resulting in 20 to 30% lower paddy yields than 1981. It has been observed in other countries of South East Asia that the spread of irrigated paddy double-cropping causes increased incidence of diseases and insect pests. The year around cultivation of paddy with irrigation makes available host plants, and may create favourable conditions for establishment of populations of both pathogen and insect.

To overcome these constraints, the proposed cropping pattern of paddy is planned on the new system of double cropping reported by Nozaki et al. (JARQ 180-1, 1984). Under this system there should be one month of perfect fallow without irrigation during the dry season practised simultaneously over the entire paddy area with the aim of killing leaf and plant hoppers completely under the condition of no host plants.

The table below and Fig. H-6 show the duration of each crop and the number of staggering and fallow days.

	Planting	Harvesting	Days to Maturity	Land Preparation	Staggering	Fallow
				(days)	(days)	(days)
Spring Crop	Mar. 1 to 30	Jul. 19 to Aug. 17	140	-	-	30
Fall Crop	Aug. 18 to Sep. 6	Dec. 31 to Jan. 29	135	30(20)	30(40)	-

In the table above, seeding of the Spring crop starts after one month perfect fallow (February) including, time for land preparation. The growing season of Spring and Fall

plantings for variety CICA-8 are somewhat different owing to difference in daylength. When duration of land preparation is set up for 20 days, staggering duration is 40 days. A short time for land preparation and staggering need much machinery, labour and irrigation water simultaneously. Therefore, earlier maturing varieties are necessary to extend the duration of staggering. BRUMDEC (St. Elizabeth) reported that USA varieties of Newbonnet, Lamont and Bond are early varieties with yields of around 5 ton/ha, but results of varietal tests are not available for this area.

Cultural practices for paddy are summarized in Table H-22. In land preparation, specific attention should be given to the levelling of the field surface. As long as uneven parts of land are small in area and gently undulating, operation with rotary harrow may be effective after ploughing and harrowing, but when it is large, a land leveller is necessary. To avoid overgrowth (resulting in lodging) and late tillering, the usual seed rate (110 kg/ha) should be decreased to 90 kg and the following fertilization programme is recommended. Fertilizer should be applied three times; at basal (A), tillering stage (B) and panicle initiation stage (C) with increase in phosphate and potassium to compensate for the low levels in the soils.

Fertilizer	cwt	kg/ha	N	P_2O_5	K_2O
(A) 12-24-12	1.5	188	23	45	23
(B) Urea (45%)	0.6	82	37	-	-
(C) (17-0-17)	1.5	188	32	-	32
Total			92	45	55

For the control of insect pests especially of leaf or plant hopper, two applications of Fenitrothion (Sumithion) are recommended usually at panicle initiation and early ripening stages. In case of direct sowing, weed control at early stages of growth is the problem. Propanil (DCPA) is known as a contact type herbicide for paddy fields in early stages. As it is ineffective for pre-emerged weeds, it is necessary to delay the application until barnyard grass grows to 3.0 to 5.0 leaf stage for sufficient herbicide efficacy by one application. A high dosage level is required for the control of progressed growth stage of weeds which tend to be unfavourable for the growth of rice plants. Moreover, its herbicidal efficacy varies according to soil moisture, rainfall and temperature. On the other hand, Bentiocarb is a growth inhibitor-type herbicide which is effective against annual graminaceous and cyperaceous weeds from pre-emergence through 1.0 to 2.0 leaf stage and has long persistence. Therefore, a combination of these two herbicides has excellent synergistic effect with contact and persistent activity as well as inhibitory activity. One application of the combination at 2.0 to 4.0 leaf stages of barnyard grass may kill seedlings and inhibit emergence for a long time.

2.2.3 Paddy - grain

Proposed cropping pattern of paddy-grains is introduced at Hartlands, Small Farmers area (except Lawrencefield) and area D for the reason of soil salinity and water supply as

mentioned above. Grains include field corn for feed and soybean, and paddy is cultivated around the rainy season (Sept. to Dec.) Fig. H-5.

To decreased soil salinity, paddy should first be cultivated and if necessary, followed by sorghum because of its tolerance to saline soil. After then, paddy-grains are repeated every year.

Farming practices for paddy are as given above for paddy-paddy. Proposed farming practises of soybean and corn are projected for large-scale farms as shown in Tables H-23, H-24. In soybean fields where Rhizobium (the nitrogen fixing bacteria) exists, it is not necessary to apply nitrogen fertilizer. However, basal application of it should be practised in fields where the Rhizobium is not in existence or active. Soybean requires relatively large amounts of phosphate and potash both of which have low levels in the soils of paddy area. Therefore, considerable amounts of phosphate and potash should be applied (P_2O_5 116, K_2O 75 kg/ha). As soybean is not a strong competitor in the early stage of growth, weed control should be concentrated during that time. Diphenamid and Bentazon (Basagran) are applied at pre-emergence and the early stage of growth.The most serious insect pest of soybean is the stink bug which attacks it late in the growing season and damages the seeds. Spraying of monocrotophos (Navacron) every one or two weeks during the young pod stage is effective.

Corn needs much nitrogen and potassium fertilizer. As a crop of 1,000 kg grain per hectare removes 30 kg of N, 12.5 kg of P_2O_5 and 35 kg of K_2O, nitrogen and potassium application should be increased. Plant protection of corn should be practised that is, spraying with Zineb (Dithane) to control leaf spot and with Diazinon (Basudin) or Trichlorophon (Dipterex) to control army worm, stem borer and corn ear worm.

2.2.4 Vegetable - grain

This proposed cropping pattern and the farming practices given are based on those which have been planned by Agro 21 and practised by International Agri-management Workyard (IAW), now changed to Intergrow Ltd. at Bernard Lodge. According to the arrangements between Agro 21 Secretariat and managers of large-scale Government winter vegetable projects, Intergrow Ltd. (in this case), they cultivate vegetables geared for an export market (usually USA) and, practise large scale cultivation of grains such as corn and soybean which are important in the self-sufficiency import substitution programme during the summer. Large scale cultivation of summer vegetables is prohibited in consideration of the pressure it could generate on domestic production and prices.

Mild weather throughout the growing season and dry, sunny conditions at harvesting favour the production of good quality and yields of vegetables during the winter. An integrated cropping pattern of vegetable-grain is illustrated in Fig. H-5.

The four vegetables grown for these projects are cucumbers, sweet pepper, zucchini squash and cantaloupe for which cultural practices are somewhat similar. Cantaloupe and zucchini squash are hand planted on raised beds using 2.24 kg/ha of seeds. (see Table H-25) The cantaloupes are later thinned to a distance of 30 to 36 cm on bed 1.5 m wide

while squash are planted 1 m apart. However, cucumber and sweet peppers are mechanically planted on beds 1.5 and 1 m apart respectively then later thinned.

For all crops, fertilizer is applied at bed formation and side dressings are periodically applied during the growing season. In case of cucumbers, potash and nitrogen are side dressed 3 to 4 times.

Regular weekly spraying programmes are followed to prevent disease problems and insecticides are applied as needed. Hand weeding is usually done but small tractors are sometimes used. Other manual labour includes pruning and fruit picking.

For weed control, plastic mulching will be used for the 1986-87 winter season for some crops. However, this method has some disadvantages in that, it is costly and also requires expensive specialized equipment to lay the plastic; the critical zone for weed growth immediately around the crop plant is also exposed thereby weeds can grow. It also produces high soil temperatures unfavourable to plant growth. This method is most efficient and effective for minimizing water loss when coupled with drip irrigation system. However, at Bernard Lodge, a relatively small area can be drip irrigated and flood and sprinkler systems are more frequently used. On the other hand a combination of hand and chemical weed control methods can be quite effective especially using systemic selective herbicides which give control for several weeks. Also, hand weeding is most effective during the dry season. After ground cover by crop plants is achieved, weeding may not be necessary. Despite the high costs of other inputs, Bernard Lodge's pre-harvest costs per ha in 1985-86 were competitive with those of Florida and Mexico. It is believed that the plastic mulch method including, material and equipment is more expensive and therefore, a combination of hand and chemical weeding is recommended.

As these vegetables are short-term crops, harvesting begins approximately two months after planting. The table below gives the harvesting schedule used and proposed for future use.

Crop	No. Days to First Harvest	Duration of Harvest Period	Frequency of Harvest
	(days)	(days)	
Cucumber	40 to 42	21	everyday
Sweet pepper	80	21	every other day
Zucchini squash	35	25	everyday
Cantaloupe	70	N/A	N/A

For each crop, hand picked fruits are first placed in stackable field boxes, onto trucks, and then transported to the packing house.

2.2.5 Vegetable - vegetable

As mentioned above, crops within the vegetable/crop category are high water requiring crops. It is proposed that the total vegetable/crop area be modestly increased. However, even with the proposed increase in water supply, year round production cannot be maintained as July and August are the driest months of the year, thereby requiring abundant water supply. It is for this main reason that the following general growing seasons are proposed in the table below and the cropping patterns in Fig. H-7:

	Primary Season (winter)	Secondary Season (summer)
Planting	September to November	February to April
Harvesting	December to March	May to August

The season is described as summer or winter depending on the time of year harvesting occurs.

The cropping pattern of vegetable/crops is based on water availability, farmers' intentions, export and local market demand and suitability of season for the optimum yield of the vegetables or field crops.

In the following table, five cropping patterns are given. They maybe adopted by small or medium-sized farms. Usually the winter season is longer than the summer season except in patterns where calaloo is grown in summer.

Winter	Summer
1) Cucumber/String bean (90 days)	Calaloo/Okra/String bean/Corn (90 days)
2) Tomato/Onion (120 days)	Red peas/Corn/Cucumber (90 days)
3) Sweet pepper/Pumpkin/Pumpkin & Corn (150 days)	Corn/Okra/Pak Choi (90 days)
4) String bean/Cucumber (90 days)	Pumpkin/Calaloo/Pkra (150 days)
5) Onion/Sweet pepper/Pumpkin (120 days)	Hot pepper/Calaloo/Okra (120 days)

The use of the herbicides Fusilade (trade name) and Gramoxone have been introduced into the farming practices especially for small farmers (see Table H-26, H-27). These two have been chosen because, Fusilade can be safely sprayed over the top of vegetable crops and broad leaf crops in general as it is selective to grass weeds (of which there are many) and, Gramoxone has only contact action (that is, it is not translocated but kills tissue only where sprayed). Herbicides should be applied when weeds are in the actively growing

stage. Recommended application rate for Fusilade and Gramoxone is 1.4 lit/ha. In all cases with the use of herbicides, the labour requirement for weeding has decreased. Most noticeable are for calaloo down by 42% and onion by 40%.

Most labour and material inputs have been increased for corn, red peas, tomato and pumpkin whereas less pesticides are recommended for onions as early curative not preventive control of thrips (the most serious pest) is sufficient. Amounts have been adjusted from 12 applications of 2 lb/ac (28 kg/ha) to 8 applications (18 kg/ha). (also see Table H-11)

Fertilizer use has been limited at present to sulphate of ammonia for both leaf and fruit crops, therefore complete fertilizers to be applied at planting and at onset of flowering are introduced. Side dressings of sulphate of ammonia at 251 kg/ha after first and subsequent harvest of pumpkin, calaloo and okra are advised to prolong the life of the crop and so ensure increased yields. However, no complete fertilizer is recommended for calaloo as it encourages seed setting at an early stage which is undesirable for leafy crops.

In case of general pesticide usage, Table H-26 gives recommended chemicals, rates of application and other relevant information. However, no systemic insecticides are recommended as small farmers tend to allow only 1 week before harvesting whereas systemics may require 3 weeks or more.

2.2.6 Orchard

Proposed cultural practices for orchard crops include new planting of some varieties of mango, and papaya; increased fertilizer and spraying applications and, pruning and record keeping (mainly for small farmers).

Cultivars recommended for new plantings are based on Table H-28, which indicates characteristics of some varieties. The Tommy Atkins and Keitt varieties are superior in size, fruit bearing regularity and colour, also the former is resistant to the fruit fly. St. Julian variety although it produces somewhat irregularly, is resistant to anthracnose and has good flavour. Therefore these three varieties are chosen. However, East Indian and Hayden varieties are not recommended owing to susceptibility to anthracnose and poor fruit bearing regularity (in case of Hayden).

In the case of papaya, Sunrise Solo cultivar is recommended due to market acceptance, availability of planting material, fruit quality and farmers willingness to grow.

The table below gives a recommended fertilizer programme for mango and papaya. A fertilizer relatively high in nitrogen and potash but low in phosphate (16-9-18) replaces the 10-10-10 fertilizer for non-bearing stage of mango trees to improve fruit quality.

	Age of Tree	Type of Fertilizer	Amount per Application	No. of Appli-cation	Maximum Total Amount	Amount per Year
	(year)		(kg/tree)	(per year)	(kg/tree)	(kg/ha)
Mango	1-2	10-10-10	0.1-0.35	4	1.4	773
	3-4	10-10-10	0.6-0.85	2	1.7	210
	5-6	16-9-18	1.0-1.25	2	2.5	309
	7-8	16-9-18	1.5-2.0	2	4	494
Papaya	Up to 6 months	12-6-6	0.12	12	1.4	753
	Over 6 months	12-6-6	0.35	4	1.4	753

The papaya plant grows vigorously and continuously, and therefore has a regular demand for fertilizer nutrients. Both crops respond favourably to organic manures which maybe applied regularly. However, if organic manure is added, it maybe necessary to decrease the recommended fertilizer applications given above subsequent to soil tests.

Chemicals recommended for mango against fruit flies are Rogor-40 and Lebayacid, 0.5 lit of active ingredient per 100 lit water at 14-day intervals has proven effective. Spraying should begin at the half-mature stage up to 2 weeks before harvesting. Against anthracnose, weekly spraying of Dithane M45 (at 2 kg/ha) or Benlate (at 1 kg/ha) from blossoming time is required. Monthly applications of a copper-based fungicide eg. Cupravit Blue are also necessary.

Regular pruning of mango trees and record keeping of yield and cultural practices should also be done.

Interplanting in the early stage of mango orchards with short-term economic crops such as legumes, vegetables and pineapples maybe done. Papaya may also be used especially if the mangoes were established using wide inter-row spaces and relatively shorter distances within rows.

2.2.7 Ornamentals

All ornamental crops proposed are based on the Agro 21 plan which are earmarked for Caymanas area only. They are Leatherleaf fern, Dracaena massangeane (canes and tips), Croton (Cordiaeum Variegatum), Golden Pathos, Aglonemea (silver queen), Yucca (tips), Dracaena Janet Craig (for tips) and Philodendron.

The table below gives the required number of plants/ha and location grown by crops for production.

Crop	Plants per ha	Location
Leatherleaf fern	107,500	indoor
Dracaena Janet Craig	66,700	indoor
Dracaena massangeana	13,800	outdoor
Golden Pothos	395,200	
Croton	39,500	indoor
Philodendron	395,200	indoor
Aglonemea	79,000	indoor
Yucca	14,000	outdoor

Indoor ha = 2,987 m^2 (actual area in crops)
Outdoor ha = 3,453 m^2

Very high population rates are used for Golden Pothos and Philodendron but yields compensate for the very high initial costs. (see Table H-31) Generally, fertilizer practice for most of these crops is applying 3.36 kg per plant per year of a 2-1-2 mixture spread over three or four applications. In case of Croton however, a 10-6-6 mixture is recommended.

Chemical weed control should be limited as use of non-selective or persistent herbicides can be washed or splashed into beds to damage plants over a long period. A contact herbicide for aisles plus hand weeding of beds is considered a good method of restraining weed population.

Insects can be a serious problem in production of Leatherleaf ferns, Yucca and Crotons if they are allowed to proliferate. Aglonemea is relatively free but suffers periodic infestations of lepidopterous pests such as caterpillars. Generally, for most of the ornamental crops, a regular fortnightly spraying programme using Basudin or other contact insecticides along with fungicides is helpful to prevent disease/insect damage. In case of Yucca, weekly applications are required.

Large volumes of coir or sawdust are used as growing medium only for Golden Pothos, Philodendron and Aglonemea.

2.2.8 Field operation and labour requirement

Proposed field operations for crops are semi-mechanized systems which are manual for planting, harvesting, fertilizing and weeding and, are mechanized for land preparation and spraying, except for all mechanized large-scale paddy and grains. Total daily labour requirements, based on these field operations in the project area, are 3,660 man-day on average and 7,130 man-day at peak in January (Table H-29). However, as agricultural labour force in the project area is estimated to be 7,380 and with 14,300 unemployed, the labour requirement will be fully met and the proposed field operations are therefore feasible.

2.3 Anticipated Yield and Production of Crops

2.3.1 Sugarcane

There are two cases of sugarcane yield in the project area. One (case A) is higher yield on fertile recent alluvial loam soils and the other (case B) is a lower yield on infertile old alluvial clay soils, as described above. The following table shows yield and production of both cases A and B.

		Area	Production	Yield
		(ha)	(MT)	(MT/ha)
(Case A)	Replants	85	7,480	88
	Ratoons	340	24,820	73
	Total or Average	425	32,300	76.0
(Case B)	Replants	324	26,892	83
	Ratoons	1,296	77,760	60
	Total or Average	1,620	104,652	64.5

Above table indicates that the difference in yield between A and B is larger for ratoons than for replants, moreover, area of ratoons is four (4) times larger than that of replants. Therefore, it is reasonable to say that the difference in average yields of sugarcane is influenced primarily by the yield of ratoons. The higher yield of ratoons on fertile land may significantly be attributed to the lower rate of annual decrease in ratoon yield as in Caymanas as described under present crop production. Yield of ratoons itself may be increased by decreasing the number of ratoons but, the resulting increase in area of replants will cause much increase in production costs which are brought about by increased operations for land preparation and planting.

Depending on the cultivation programme of sugarcane in Innswood Estate, increased percentage in yield is 20 to 30% and that of production is 40 to 60% including increased cultivated area as shown in the table below:

	1987	1989	1990
Harvest area (ha)	1,690	2,033	2,033
Total cane production (MT)	105,963	153,085	168,332
Average yield (MT/ha)	62.7	75.3	82.8

Based on this information, average yields and total production of sugarcane within the project area are anticipated under improved conditions of soils and cultural practices as follows:

	Area	Yield	Production
	(ha)	(ton/ha)	(ton)
Replants	567	93	52,731
Ratoons	2,268	75	170,100
Total or Average	2,835	78.6	222,831

Note: Gross area of sugarcane 3,261 ha
Net area of sugarcane 2,935 ha
For seed materials 100 ha
Harvested area 2,835 ha

2.3.2 Paddy, grains

As mentioned above, average paddy yield of the first crop was about 5 ton/ha (4,500 lb/acre) which has been confirmed by a yield sampling test survey. Three (3) plots of paddy plants seeded in late October 1985 were reaped on March 5, 1986 and yield was determined by the number of panicles and sample of paddy harvested. The results are shown in the table below:

Plot No.	Number of Panicles	Paddy Weight Per m^2	Paddy Weight per 1,000 Grains	Number of per m^2	Number of per m^2	Percentage of Ripening
		(g)	(g)			
1	265	586	25.8	26,197	22,678	86.5
2	434	534	22.8	37,036	23,389	63.2
3	514	702	25.8	34,628	27,361	79.0
Average	404	607	24.8	-	-	76.2

The average yield of the three plots is 607 g/m^2 (6 ton/ha). This shows a good yield. Even taking into account harvesting loss (mostly combine loss) and sampling error, an average yield 5 ton/ha may be recognizable. However the second crop was not as good as the first crop (estimated at 4.5 ton/ha) owing to weeds and lodging.

Although there will be considerable constraints for the cultivation of paddy, the target yield may be anticipated at 5 ton/ha (4,500 lb/acre) under the improvement of field conditions and cultural practices and introduction of better varieties.

Soybean yield is mainly dependent on the control of insect pests. However, even if varieties insensitive to day length are selected, when seeds are planted in October to December the number of days to maturity may become shorter and the yield decrease by 10 to 30% in comparison with the other months. The anticipated yield of soybean at full development would be 2.5 ton/ha under the conditions of suitable varieties chosen and improved cultural methods.

The main constraints of corn cultivation may be insect pests and disease. However, when these constraints are controlled by adequate applications of pesticide, with hybrid varieties, sufficient fertilizer and water supply, yield potential may approach the average yield of 5 to 7 ton/ha in USA. The target yield in this plan is anticipated at 6,000 kg/ha under the above improved conditions. The following are the targeted yields for the production of paddy, soybean and field corn.

	Yield	Harvesting Area	Total Production
	(ton/ha)	(ha)	(ton)
Paddy	5.0	5,040	25,200
Soybean	2.5	1,269	3,172
Field corn	6.0	3,807	22,842

Note: Paddy area (paddy-paddy 1,545 ha x 2) + (paddy-grains 1,951 ha)
Grains area (vegetable-grains 3,125 ha) + (paddy-grains 1,951 ha)
Corn:soybean = 3:1
Gross area: Paddy-paddy 1,716 ha,
Paddy-grains 2,168 ha,
Vegetable-grains 3,472 ha

2.3.3 Vegetables (Agro 21)

Anticipated, past and national average yields are given in the table below for comparison:

(Unit: ton/ha)

Crop	IAW Yield 1985-86	National Average Yield 1981-85	Anticipated Yield
Cucumber	19.3	12.58	13.4
Sweet pepper	6.89	8.7	13.4
Zucchini squash	11.25	N/A	13.1
Canteloupe	8.55	12.5	17.5
Pumpkin	-	13.0	15.7

Source: Agro 21 and Data Bank MOA

Yields of sweet pepper and cantaloupe of the 1985-86 winter by IAW at Bernard Lodge season were lower than national average yields. However, projected yields are higher than national average, anticipating a better performance with experience gained from the previous season and proposed cultural practices given under the previous section.

Assuming that cropping intensity is 100% for winter vegetables for export and an equal area for production of cucumber, sweet pepper and pumpkin are practiced, total production per annum would be 44,270 ton from a net area 3,125 ha (gross 3,472 ha) as given in the following table.

	Net Area	Anticipated Production
	(ha)	(ton)
Cucumber	1,042	13,963
Sweet pepper	1,042	13,963
Pumpkin	1,041	16,344
Total	3,125	44,270

2.3.4 Vegetable - vegetable

Production of vegetables should increase sharply owing to availability of sufficient irrigation water, improved cultural practices and increased cropping intensity.

Depending on yield data in Table H-10 and from other informations, yield of each crop is anticipated in the table below:

Crops	Yield	Crops	Yield
	(ton/ha)		(ton/ha)
Calaloo	33.6	Pak Choi	13.4
Sweet pepper	13.4	Tomato	11.2
Pumpkin	15.7	Okra	13.4
Cucumber	13.4	String bean	7.5
Onion	16.8	Hot pepper	11.2
Peas	1.1	Water melon	20.0
Corn	3.8		

Assuming that production of vegetables is represented for 6 typical crops as shown in the table below and cropping intensity of 100% for winter and summer with an equal area for each crop per season, then anticipated production of vegetables is approximately 25,000 ton from net area 674 ha (gross 749 ha).

	Net Area	Anticipated Production
	(ha)	(ton)
Calaloo	112	7,526
Sweet pepper	112	2,755
Pumpkin	112	3,517
Cucumber	112	3,002
Onion	112	3,763
Red pea	112	246
Total	674	25,044

2.3.5 Orchard

Under proposed land use, gross area in orchard crops will increase to 786 ha (net 707 ha), assuming net 700 ha to be primarily for mango and papaya. Highest ratio of papaya to mango produced (based on export volume 1982-85 Marketing and Credit Division of MOA market research data) was 11:89 in 1984 up from 6:94 in 1982. It is anticipated that the ratio might stabilize at 15:85 in favour of mango production. Based on this assumption, net area in mango is 595 ha and for papaya, is 105 ha. (see Table H-30)

Planting of mango orchard is extended over 2 years assuming 12 md/ha for land preparation, and planting. However, as papaya yields decline sharply after year 1, planting is in two marked phases beginning year 1 (also year 1 for mango in case of intercropping) and in year 3 (95 ha). Replanting is done after the second harvest hence from year 3, a 3-year cycle is repeated as replanting is done every three years as the table below:

Papaya	Phase 1				Phase 2				
	Year 1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Yield kg/tree (52.5 ha)	23	17	10	23	17	10	23	17	10
Yield kg/tree (52.5 ha)	-	-	23	17	10	23	17	10	23
Average	23	17	16.5	20	13.5	16.5	20	13.5	16.5

Production of mango at full bearing stage (year 8) is 5,600 ton at 9.4 ton/ha and, for papaya it is 2,600 ton at 25 ton/ha.

2.3.6 Ornamentals

Anticipated yields of the eight ornamental crops mentioned above are given in Table H-31. Specific area allocated by Agro 21 to each crop is yet tentative therefore, it is not discussed here. Nevertheless, most anticipated yields are encouraging as, Golden Pothos yield to planting materials ratio in year 1 is 12.5:1 and increases to 25:1 from year 2 onwards; while for Aglonemea it is 2:1 in the first year and 4:1 from year 2 onwards.