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AGRICULTURAL SERVICE DEVELOPMENT PROJEC

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ANNEX 1: AGRICULTURE, RESEARCH, EXTENSION AND TRAINING

ANNEX 2: THE IMPORTANCE AND USE OF LIVESTOCK IN THE BAHAMAS

THE COMMONWEALTH OF THE BAHAM
MINISTRY OF AGRICULTURE, TRADE AND INDU

INTER-AMERICAN DEVELOPMENT BAN

INVESTMENT PROJECTS CENTER (C

THE BAHAMAS

AGRICULTURAL SERVICES DEVELOPMENT PROJECT

(BH-0011)

ANNEX 1

AGRICULTURE, RESEARCH, EXTENSION AND TRAINING

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San José, Costa Rica

November, 1989

ANNEX 1

AGRICULTURAL, RESEARCH, EXTENSION AND TRAINING

NOTE

The first four parts of the original report prepared by Dr. Herman Hamilton, namely:

I. Summary
II. Introduction
III. Background
IV. The Project Area

have been utilized in the writting of the initial chapters of the project's feasibility study. Since it would serve no purpose to repeat them, this Annex begins with section V of the consultant's original report, The Project. Those four sections mentioned above were, in turn, based on more detailed information about the agricultural sector of The Bahamas. This information is presented in the following Appendixes to this Annex:

Appendix 4 - Physiographic Regions of The Bahamas
Appendix 5 - The Farming Systems of The Bahamas
Appendix 6 - Land Tenure and Settlement Issues

ANNEX 1

AGRICULTURE, RESEARCH, EXTENSION AND TRAINING

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ABBREVIATIONS

BAIC	Bahamas Agricultural and Industrial Corporation
BARC	Bahamas Agricultural Research Centre
BARTAD	Bahamas Agricultural Research Training and Development
CIAREC	Coppice Islands Agricultural Research and Extension Centre
GRAC	Gladstone Road Agricultural Complex

Section V- THE PROJECT: CROP DEVELOPMENT AND RESEARCH, EXTENSION AND TRAINING SERVICES

A. CROP DEVELOPMENT SUBPROJECT

Overall objectives

The subproject is intended to increase farm family incomes, particularly in the Southeastern Islands, by addressing identifiable constraints to agricultural production and development, achieve a higher degree of self-sufficiency in agricultural production and earn foreign exchange through large-scale production of export-oriented crops.

These objetives will be pursued through the implementation of four activities or components. They are:

Component 1: Orchard Crops
Component 2: Selected Miscellaneous Crops
Component 3: Specialty Crops
Component 4: Export Crops

Selection of crops

Given the existing climatic conditions and soil types in the project area, there is an almost unlimited number of crops that could successfully be grown. Over 40 crops were identified as having been sold to the Produce Exchange.

A selected list of 29 crops (Table V-1) was developed by taking into account the following considerations:

a. Crop production priority of the different islands as evidenced by volume of purchases and volume of recepits at the local produce exchange.

b. The quantity and value of imported fruits which in recent years is typified by the imports of 1987 (Table V-3).

c. The major crops of interest to the tourist industry with islands having priority interest for production (Tables V-4A and V-4B).

d. The principal crops of subsistence farming namely corn, pigeon peas, cassava and sweet potato.

These crops would be given priority in terms of policy decisions relating to agricultural production and research and extension services.

TABLE V-1 29 SELECTED CROPS OF PRIORITY INTEREST FOR THE BAHAMAS

TREE CROPS	VEGETABLES	STORABLE GRAIN & TUBER CROPS	OTHER
TANGERINE PERSIAN LIME GRAPEFRUIT ORANGE AVOCADO GUAVA COCONUT BANANA PAPAYA MANGO	TOMATO CABBAGE SWEETPEPPER OKRA CUCUMBER PUMPKIN LETTUCE WATERMELON CANTELOUPE IRISH POTATO SWEET POTATO ONION	CORN PIGEON PEAS BEANS CASSAVA	PINEAPPLE HOT PEPPER THYME

TABLE V-2A

DOMINANT CROP PRODUCTION ACTIVITY ISLAND BY ISLAND.THE BAHAMAS 1989

CROP	ELEUTHERA	NORTH ANDROS	NORTH ABACO	GRAND BAHAMA	NEW PROVIDENCE
LIME	**	*	*	**	**
GRAPEFRUIT	*	**	**		
ORANGE		*			
TANGERINE	**	*			
MANGO	*		*		**
AVOCADO	**	*		**	*
GUAVA		*	*		
COCONUT		**			
BANANA	**	*	**	*	**
PAPAYA	**	**	**	**	*
PINEAPPLE	**				
PIGEON PEAS	*	*	*	*	*
BEANS	**			*	
CORN	**	**	*	**	*
TOMATO	**	**	**	*	*
CABBAGE	**	**	*		
SWEET PEPPER	**	**	**		
OKRA	*	**	**	**	
CUCUMBER	*	**			
PUMPKIN					
LETTUCE		**	**	**	
WATERMELON	**	**	*		
CANTELOUPE			**	*	
CASSAVA		*			
IRISH POTATO	*	**	**	**	**
SWEET POTATO		*	*		
HOT PEPPER	**	*	*	*	**
ONION	**	**	*	*	
THYME	**	*			

A double asterisk (**) indicates greater production potential compared to a single asterisk (*) when differing islands are compared.

SOUTH ON PAGE TO FOLLOW

TABLE V-2B DOMINANT CROP PRODUCTION ACTIVITY ISLAND BY ISLAND.THE BAHAMAS 1989

CROP	LONG ISLAND	CAT ISLAND	SOUTH		CROOKED ISLAND ISLAND	MAYAGUANA
			EXUMA	ACKLINS		
LIME	**			**	**	
GRAPEFRUIT			*	*	*	
ORANGE				*	*	
TANGERINE	*		*		*	
MANGO	**		*			
AVOCADO	**					
GUAVA						
COCONUT				*	**	*
BANANA	**		*			
PAPAYA						
PINEAPPLE	*		*			
PIGEON PEAS	*	*	*	*	**	**
BEANS					*	**
CORN	*	*	*	*	*	*
TOMATO		**	*	*	*	
CABBAGE		*	*			
SWEET PEPPER						
OKRA	*	*	*			
CUCUMBER						
PUMPKIN		*				*
LETTUCE						
WATERMELON		*	*			
CANTELOUPE			*			*
CASSAVA						*
IRISH POTATO	*		*			
SWEET POTATO				*		*
HOT PEPPER	*		**		**	
ONION	*		**			
THYME		*				

A double asterisk (**) indicates greater production potential compared to a single asterisk (*) when differing islands are compared.

TABLE V-3 IMPORTED FRUITS AND VEGETABLES INTO THE BAHAMAS 1987

CROP	UNIT	QUANTITY	VALUE $
LIME	HDS	88	1,290
OTHER CITRUS	HDS	232,657	28,766
ORANGE	HDS	78,431	811,119
AVOCADO	HDS	2,634	40,027
COCONUT	HDS	706	14,575
BANANA AND PLANTAIN	HDS	225,315	1,256,684
PINEAPPLE	HDS	68,535	38,301
BEANS	HDS	272,383	103,875
TOMATO	HDS	2,169,154	909,754
CABBAGE	HDS	1,405,917	292,825
OKRA	HDS	9,138	3,702
CUCUMBER	HDS	121,256	37,489
WATERMELON	HDS	33,544	8,410
ONION	HDS	2,456,333	594,571

SOURCE: DEPARTMENT OF STATISTICS, PLANNING & STATISTICAL UNIT
DEPARTMENT OF AGRICULTURE.

TABLE V-4A

CROPS OF INTEREST TO THE TOURIST INDUSTRY
WITH ISLANDS OF PRIORITY INTEREST FOR PRODUCTION
THE BAHAMAS 1989

CROP	NORTH				
LIMES/PERSIAN	ELEUTHERA	G.BAHAMA	N.PROVIDENCE	ABACO	ANDROS
GRAPEFRUIT	ANDROS	ABACO	ELEUTHERA		
ORANGE	ANDROS				
AVOCADO	G.BAHAMA	ELEUTHERA	N.PROVIDENCE	ANDROS	
BANANA	ELEUTHERA	ABACO	N.PROVIDENCE	ANDROS	G.BAHAMA
PAPAYA	ANDROS	ABACO	ELEUTHERA	G.BAHAMA	N.PROVIDENCE
PINEAPPLE	ELEUTHERA				
TOMATO	ANDROS	ABACO	ELEUTHERA	G.BAHAMA	N.PROVIDENCE
CABBAGE	ANDROS	ELEUTHERA	ABACO		
SWEET PEPPER	ELEUTHERA	ANDROS	ABACO		
CUCUMBER	ANDROS	ELEUTHERA			
LETTUCE	ABACO	ANDROS	G.BAHAMA		
WATERMELON	ELEUTHERA	ANDROS	ABACO		
IRISH POTATO	ANDROS	ABACO	G.BAHAMA	N.PROVIDENCE	ELEUTHERA
ONION	ELEUTHERA	ANDROS	ABACO	G.BAHAMA	
THYME	ELEUTHERA	ANDROS			

TABLE V-4B

CROPS OF INTEREST TO THE TOURIST INDUSTRY
WITH ISLANDS OF PRIORITY INTEREST FOR PRODUCTION
THE BAHAMAS 1989

CROP	SOUTH			
LIMES/PERSIAN	ACKLINS	CROOKED IS.		
GRAPEFRUIT	EXUMA	ACKLINS	CROOKED IS.	
ORANGE	ACKLINS	CROOKED IS.		
AVOCADO	LONG IS.			
BANANA	LONG IS.	EXUMA		
PAPAYA				
PINEAPPLE	LONG IS.	EXUMA		
TOMATO	CAT IS.	EXUMA	CROOKED IS.	ACKLINS
CABBAGE	CAT IS.	EXUMA		
SWEET PEPPER				
CUCUMBER				
LETTUCE				
WATERMELON	CAT IS.	EXUMA		
IRISH POTATO	EXUMA	LONG IS.		
ONION	EXUMA	LONG IS.		
THYME	CAT IS.			

SOURCE: DEVELOPED BY MISSION CONSULTANTS.

From among the twenty-nine crops, eleven (11) have been selected as the priority crops for inclusion in an orchard crops development programme directed to the Southeastern Islands. The programme involves the use of each of grapefruit, persian lime, orange or mango intercropped with a short-term crop chosen from tomato, cabbage, sweet pepper, cucumber, watermelon, Irish potato or onion.

The tree crops have a history of excellent growth under the rainfed conditions of the area as well as a good local and export market potential. The short-term crops have historically been widely cultivated and are in strong demand on the local market.

With a view to encouraging and supporting the vertical expansion of agricultural production in both sub-project areas, the selected list of sixteen (16) crops chosen in this case (Table V-5) consisted of:

a. those shown above for the orchard crops development programme in the Southeastern Islands,
b. banana, which has probably the best potential at import substitution, and
c. the principal subsistence crops of corn, pigeon peas, cassava and sweet potato.

TABLE V-5 SELECTED MISCELLANEOUS CROPS FOR IMPROVED PRODUCTION IN THE BAHAMAS

TREE CROPS	VEGETABLES	OTHER
PERSIAN LIME GRAPEFRUIT ORANGE MANGO BANANA	TOMATO CABBAGE SWEETPEPPER CUCUMBER WATERMELON IRISH POTATO SWEET POTATO ONION	PIGEON PEA CORN CASSAVA

For a horizontal expansion of crop production in the North directed primarily to an export market and providing import substitution for products in high demand on the local market the following fourteen (14) crops were selected:

TREE CROPS	VEGETABLES
PERSIAN LIME	TOMATO
GRAPEFRUIT	CABBAGE
ORANGE	SWEET PEPPER
MANGO	CUCUMBER
AVOCADO	WATERMELON
BANANA	IRISH POTATO
PAPAYA	ONION

Banana, Irish potato and onion are the crops targeted for import substitution.

Finally, six specialty crops destined for an export market are to be introduced and established initially in the Southeastern islands and South Andros. They are: Passion Fruit, Annatto, Cashew, Neem, Tamarind and Pimento.

Identification of Components

A total of four components in the two project sub-areas have been designed. The projects are aimed at:

a. Development of orchard crop projects in the Southeastern Islands with an inter-cropping system of selected short-term crops. (Component 1)

b. Primarily a vertical expansion of agricultural production in the Southeastern Islands to enable within their capacities greater self-sufficiency for the country as a whole and provision of adequate supplies for the local market. (Component 2)

c. The introduction of specialty crops initially to the Southeastern islands and destined for export. (Component 3)

d. Horizontal expansion of crop production in the North directed primarily to the export market. (Component 4)

COMPONENT 1: ORCHARD CROPS

The technical and economic evidence points strongly towards the fact that Bahamian farming systems should be moving towards larger size farms with a mix of short-term crops and permanent tree crops. What constitutes a desirable mix in any one location has to take into consideration markets, environmental suitability and support systems in the form of research and extension services.

Tree crops do particularly well in all islands of the project area. They are more consistently productive under rainfed conditions than the short-term crops requiring planting schedules to coincide with the rainy seasons. Tree crops can accommodate erratic rainfall which is of usual occurrence in the Southeastern Islands.

Land preparation involving deep ripping allows rapid root growth of tree crops to sufficient depths for secure anchorage and the permanency of the crop once it is established has significant appeal in low labour requirements except for harvesting.

The tree crops selected for the project are:

- Persian Lime
- Grapefruit
- Orange
- Mango

Citrus fruits are remarkably easy to grow because of their tolerance to the highly alkaline conditions that predominate in Bahamian soils. The same applies to mangoes grown with the choice of proper root stock.

While citrus fruits and mangoes are highly responsive to supplemental irrigation, mangoes in particular do surprisingly well under low (<40 ins.) rainfall conditions as exist in the southeastern islands.

In the land clearing and preparation procedures for establishment of tree crops not only can the initially prepared lands be used for production of a short-term crop; but with proper selection, inter-cropping can be practised until the tree crops come into bearing and a cash flow is generated in the interim.

The crops selected for inter-cropping with tree crops are:

- Tomato
- Watermelon
- Sweet Pepper
- Onion
- Cabbage
- Cucumber
- Irish Potato

A detailed cost of production and estimated revenue for each of the selected tree crops and short-term crops is shown in Appendices 2A to 2K and Tables V-6A and V-6B.

1.1 Objectives and Justification

The objectives of the component are to facilitate primarily subsistence farmers in achieving a farm income which is in concert with the national per capita income and to provide permanency to the ownership of orchard developed farm lands.

The justification arises from the fact that an eroding drift of farming families to major populated centres would be stymied by the opportunity for resident inhabitants to engage in gainful and profitable employment.

1.2 Constraints

a. Land Clearing

Land clearing and preparation represents a critically important factor in the development of agriculture in the different islands of the Project Area. The distinct improvements that it will create are:

i. A more sustained production system.

ii. Higher yields and better returns per acre.

iii. A higher adoption rate and application of improved technology in the areas of machine use, irrigation, pest control and fertilization.

iv. Increased output per unit of input.

Based on detailed experiments involving 2000 acres of land at Andros, the BARTAD results suggested that a 1977-78 figure for such operations would be about $150 per acre for Class II and Class III lands. That figure has risen to approximately $1000 per acre in today's terms. In the Southeastern Islands the costs ($1500 per acre) are approximately 50% higher, given the fact of the higher costs for transportation of the heavy equipment being used and the extreme hardness of rock being pulverized. The investment required to embark on horizontal expansion of agricultural production in the North is substantial but virtually prohibitive in the Southeastern islands given the low farm income and economic base of the region. The land clearing and preparation methods developed during the BARTAD project are appropriate for today's needs.

A strategy to concentrate on fruit crop production of cleared

lands comes out of the fact that once cleared and prepared minimum tillage or no further tillage of the land is required for continuous crop production.

b. Research and Extension Services

Despite the expanded acreage of Orchard Crops in the project area, much of this has arisen outside of organized research. The focal areas of research speciafically related to Bahamian problems have therefore not been recognized. Questions relating to cropping associations, varieties, cultural practices, fertilizer formulation quantity and content as well as pesticide use at the level of commercial production need to be seen within the context of the specific environment. Improvement in the standard and quantity of orchard crop production is a classical role of the Extension Service - a service that currently does not exist in the Southeastern Islands. There is a need to interact with growers to address practical difficulties such as finding appropriate stock and scion material and obtaining fertilizers and pesticides, and to solve the more diffuse problems which will only come out of local research.

1.3 The Plan

An intercropping programme aimed at the ultimate production of an orchard crop under rainfed conditions is the basic design. A model involving onion as the intercrop and mango as the orchard crop was developed. The cost of production and expected revenues are detailed in Tables V-6 where there is an indication of all the assumptions inherent in the model. The total inflows and outflows of the programme developed over a 12-year period provide the net benefit which is an indication of the expected income of the farmer.

The assumptions of this model are spelled out in the notes which accoumpany it.

The orchard crops selected were Persian Lime, grapefruit, orange and mango, while the short-term intercrop could be any one of tomato, cabbage, sweet pepper, cucumber, watermelon, irish potato or onion. Several possible combinations may be selected for the different islands in the project area and this can be developed by use of Appendices 2A to 2K and Table V-2B. For example , the tree crops of the selected crops suitable for Long Island i.e. Persian Lime and mango, could either be intercropped with Irish potato or onion. Similarly, for Crooked Island, any citrus crop, but preferably Persian lime and tomato. The cost of production and revenue figures indicated in Appendices 2A to 2K can be used to develop the expected income of the farmer depending on the crop mix chosen . Crop mixes would be dictated by the extension personnel making use of information as to the most desirable crop for a particular island (See Table V-2B)

FARM MODEL 1
5-ACRE ORCHARD FARM (MANGO/ONION) 1/
(US $)

CONCEPT	WITH PROJECT												
	YEARS												
	1	2	3	4	5	6	7	8	9	10	11	12	13-20
ACRE 1	INFLOWS												
REVENUE													
ONION 2/		(1 ACRE)	(0.05 ACRE)	(0.60 ACRE)	(0.30 ACRE)								
YIELD (LB/ACRE)		1,200.00	1,020.00	720.00	360.00								
PRICE (POINT 1ST. SALE) 2.7$/LB.		2.70	2.70	2.70	2.70								
GROSS REVENUE		3,240.00	2,754.00	1,944.00	972.00								
MANGO 3/													
YIELD (BOXES/ACRE)						320.00	640.00	960.00	1,280.00	1,280.00	1,280.00	1,280.00	1,280.00
PRICE ($7/BOX)						7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
GROSS REVENUE						2,240.00	4,480.00	6,720.00	8,960.00	8,960.00	8,960.00	8,960.00	8,960.00
TOTAL REVENUE		3,240.00	2,754.00	1,944.00	972.00	2,240.00	4,480.00	6,720.00	8,960.00	8,960.00	8,960.00	8,960.00	8,960.00
INVESTMENT	OUTFLOWS												
LAND CLEARING ($300/ACRE x 5 ACRES) 4/	1,500.00												
LAND PREPARATION ($1200/ACRE x 5 ACRES) 4/	6,000.00												
SPRAYER WITH SMALL TOOLS 5/	350.00				350.00				350.00				
MANGO SEEDLINGS (1 ACRE) 6/		640.00											
TOTAL INVESTMENT	7,850.00	640.00			350.00				350.00				
OPERATING EXPENDITURES													
ONION	(1 ACRE)	(0.05 ACRE)	(0.60 ACRE)	(0.30 ACRE)									
INPUTS													
SEEDS (4 LB x $25)	100.00	85.00	60.00	30.00									
FERTILIZERS (1000 LB x $0.155)	155.00	132.60	93.00	46.00									
SPRAY MATERIALS													
HERBICIDE (1 GALLON x $40)	40.00	34.00	24.00	12.00									
FUNGICIDE (8 LB x $3)	24.00	20.00	14.00	7.00									
INSECTICIDE (2.5 QUARTS x $8.40)	21.00	18.00	13.00	6.00									
BAGS (300 x $0.40)	120.00	102.00	72.00	36.00									
TOTAL ONION INPUTS 7/	460.00	391.00	276.00	137.00									
LABOUR OPERATIONS (MAN/DAY)		(1 ACRE)	(0.05 ACRE)	(0.60 ACRE)	(0.30 ACRE)								
PLANTING (2 MD x $25)		50.00	42.50	30.00	15.00								
FERTILIZING (2 MD x $25)		50.00	42.50	30.00	15.00								
WEEDING/THINNING (10 MD x $25)		250.00	212.50	150.00	75.00								
SPRAYING (10 MD x $25)		250.00	212.50	150.00	75.00								
HARVESTING/CURING/GRADING (15 MD x $25)		375.00	319.00	225.00	113.00								
TRANSFER TO POINT OF SALE ($0.08/LB)		120.00	102.00	72.00	36.00								
TOTAL ONION OPERATIONS 8/		1,095.00	931.00	657.00	329.00								

FARM MODEL

6-ACRE ORCHARD FARM (RAMBUTAN) 1/

(US $)

CONCEPT	WITH PROJECT												
	YEARS												
	1	2	3	4	5	6	7	8	9	10	11	12	13-20
HARDO													
INPUTS													
FERTILIZERS (80-320 LB x $0.15)		12.00	18.00	24.00	30.00	36.00	42.00	48.00	48.00	48.00	48.00	48.00	48.00
SPRAY MATERIALS													
FUNGICIDE (3-6 LB x $14)				42.00	42.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00
INSECTICIDE (2-4 QUARTS x $19)					38.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00
PACKING BOXES (320-1200 x $0.80)						192.00	384.00	576.00	768.00	768.00	768.00	768.00	768.00
FIELD BOXES (20-80 x $5.00)						100.00	200.00	300.00	400.00	400.00	400.00	400.00	400.00
TOTAL HARDO INPUTS 9/		12.00	18.00	66.00	110.00	488.00	786.00	1,084.00	1,376.00	1,376.00	1,376.00	1,376.00	1,376.00
LABOUR OPERATIONS													
LIKING AND PLANTING (9 MD x $25)		225.00											
FERTILIZING (1 MD x $25)		25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
CIRCLE WEEDING (6 MD x $25)			150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
SPRAYING (6-12 MD x $25)			150.00	150.00	150.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
HARVEST (8-16 MD x $25)						200.00	400.00	600.00	800.00	800.00	800.00	800.00	800.00
GRADE, HOT DIP AND PACKAGE (4-9 MD x $25)						100.00	200.00	300.00	450.00	450.00	450.00	450.00	450.00
TRANSFER TO POINT OF SALE ($0.80/BOX)						29.00	58.00	86.00	115.00	115.00	115.00	115.00	115.00
TOTAL HARDO LABOUR OPERATIONS 10/		250.00	325.00	325.00	325.00	804.00	1,133.00	1,461.00	1,940.00	1,940.00	1,940.00	1,940.00	1,940.00
TOTAL OPERATING EXPENDITURES ACRE 1	460.00	1,748.00	1,550.00	1,185.00	764.00	1,292.00	1,918.00	2,545.00	3,316.00	3,316.00	3,316.00	3,316.00	3,316.00
OTHER EXPENDITURE: LAND CHARGES ($20/ACRE)		20.00	20.00	20.00	20.00	20.00							
TOTAL OUTFLOW ACRE 1	8,310.00	2,488.00	1,870.00	1,205.00	1,134.00	1,312.00	1,918.00	2,545.00	3,666.00	3,316.00	3,316.00	3,316.00	3,316.00
NET BENEFIT ACRE 1	(8,310.00)	832.00	1,184.00	730.00	(162.00)	926.00	2,561.00	4,175.00	5,294.00	5,644.00	5,644.00	5,644.00	5,644.00
ACRE 2													
TOTAL REVENUE			3,240.00	2,754.00	1,944.00	972.00	2,240.00	4,488.00	6,720.00	8,960.00	8,960.00	8,960.00	8,960.00
TOTAL OPERATING EXPENDITURES		(460.00)	(1,748.00)	(1,550.00)	(1,100.00)	(784.00)	(1,292.00)	(1,918.00)	(2,545.00)	(3,316.00)	(3,316.00)	(3,316.00)	(3,316.00)
HARDO SEEDLINGS			(640.00)										
LAND CHARGES ($20/ACRE)			(20.00)	(20.00)	(20.00)	(20.00)							
NET BENEFIT ACRE 2		(460.00)	832.00	1,184.00	730.00	188.00	948.00	2,561.00	4,176.00	5,644.00	5,644.00	5,644.00	5,644.00
ACRE 3													
TOTAL REVENUE				3,240.00	2,754.00	1,944.00	972.00	2,240.00	4,488.00	6,720.00	8,960.00	8,960.00	8,960.00
TOTAL OPERATING EXPENDITURES			(460.00)	(1,740.00)	(1,550.00)	(1,185.00)	(784.00)	(1,292.00)	(1,919.00)	(2,545.00)	(3,316.00)	(3,316.00)	(3,316.00)
HARDO SEEDLINGS				(640.00)									
LAND CHARGES ($20/ACRE)				(20.00)	(20.00)	(20.00)							
NET BENEFIT ACRE 3			(460.00)	832.00	1,184.00	730.00	200.00	948.00	2,561.00	4,175.00	5,644.00	5,644.00	5,644.00

CONCEPT	WITH PROJECT												
	YEARS												
	1	2	3	4	5	6	7	8	9	10	11	12	13-20
ACRE 4													
TOTAL REVENUE					3,240.00	2,754.00	1,944.00	972.00	2,240.00	4,480.00	6,720.00	8,960.00	8,960.00
TOTAL OPERATING EXPENDITURES				(460.00)	(1,740.00)	(1,550.00)	(1,185.00)	(764.00)	(1,202.00)	(1,910.00)	(2,545.00)	(3,316.00)	(3,316.00)
MANGO SEEDLINGS					(640.00)								
LAND CHARGES ($20/ACRE)					(20.00)	(20.00)							
NET BENEFIT ACRE 4				(460.00)	832.00	1,184.00	759.00	208.00	948.00	2,581.00	4,175.00	5,644.00	5,644.00
ACRE 5													
TOTAL REVENUE						3,240.00	2,754.00	1,944.00	972.00	2,240.00	4,480.00	6,720.00	8,960.00
TOTAL OPERATING EXPENDITURES					(460.00)	(1,740.00)	(1,550.00)	(1,165.00)	(764.00)	(1,202.00)	(1,910.00)	(2,545.00)	(3,316.00)
MANGO SEEDLINGS						(640.00)							
LAND CHARGES ($20/ACRE)						(20.00)							
NET BENEFIT ACRE 5					(460.00)	832.00	1,204.00	759.00	208.00	948.00	2,561.00	4,175.00	5,644.00
NET BENEFIT BEFORE FINANCING													
A. TOTAL 5-ACRE FARM	(8,310.00)	372.00	1,556.00	2,295.00	2,133.00	3,871.00	5,680.00	8,651.00	13,186.00	18,872.00	23,668.00	26,751.00	28,220.00

FINANCING													
1. GRANTS (LAND CLEAR + PREPARATION)	7,500.00												
2. LOAN RECEIPTS	800.00	1,600.00	1,100.00	600.00									
3. INTEREST (12.5% ANNUALY)		100.00	287.00	425.00	500.00	500.00	400.00	300.00	200.00	100.00			
4. PRINCIPAL						800.00	800.00	800.00	800.00	800.00			
5. NET FINANCING (1 + 2 - 3 - 4)	8,300.00	1,400.00	813.00	175.00	(600.00)	(1,300.00)	(1,200.00)	(1,100.00)	(1,000.00)	(900.00)			
NET BENEFIT AFTER FINANCING													
TOTAL (A + 4)	(10.00)	1,772.00	2,369.00	2,470.00	1,833.00	2,571.00	4,480.00	7,551.00	12,186.00	18,872.00	23,668.00	26,751.00	28,220.00

NOTES ON TABLE V-6: FARM MODEL 1 - ORCHARD FARM

1. This farm model is supposed to be representative of all possible combinations of tree crops and short-term crops suggested in this Component, i.e.: Tree Crops: Persian Lime, Grapefruit, Orange and Mango; Short-Term Crops: Tomato, Watermelon, Sweet Pepper, Onion, Cabbage, Cucumber and Irish Potato.

2. Onions start by occupying a whole acre in Year 2 but, because mango seedlings are planted at the end of Year 2, the area allocated to onions is reduced in the following years, until onions are fased out in Year 6, the year in which mangoes start producing. The onion cropping season lasts for four months and the onions are graded in 50lb. bags. Onion prices are 15% than the present (without project) prices to cover for grading and packing on the farm.

3. Mango plant population is 80 trees/acre (spacing: 23'x23'). Mango yields are the following:

Year 6	: 4 doz.	or 48 lb/tree
Year 7	: 8 doz.	or 96 lb/tree
Year 8	: 12 doz.	or 144 lb/tree
Year 9-20	: 16 doz.	or 192 lb/tree

Fruits are graded and packed in boxes on the farm. Each box contains 9, 12 or 15 fruit (average 12 lb/box).

4. Land clearing and land preparation (ploughing and disking) will be performed on lands located on top of water lenses to allow for irrigation. In order to be cost-effective, both operations are carried out on a one-time basis for the whole 5-acre farm. The areas to be developed have been previously selected, and are shown, for each island, on the respective maps provided in Annex 6 of this report. Land clearing and land preparation are provided as a grant from the Government in order to encourage farmers to take up permanent farming in the Southestern Islands. Since such operations will be executed on good lands sitting on top of water lenses, the potential for a quick recovery of the investment is good. The initial investment of $7,500 can be recovered in just three years with the onion production of the first acre.

5. A sprayer and small tools will be provided to the farmer in the first year as part of a loan in kind.

6. Mango seedlings are provided in kind, as part of the initial loan, for the first three acres. Seedlings for the two remaining acres will be bought by the farmer.

7. Onion inputs will be provided in kind, as part of the initial loan, for the following operations:

Acre 1: first an second years ($460 and $390)
Acre 2: first year ($460)
Acre 3: first year ($460)

Onion inputs for the remaining years of the first three acres as well as for Acres 4 and 5 will be financed by the farmer.

8. Labour operations for both onion and mango crops will be entirely financed by the farmer. All labour is considered as hired labour. Payment for the owner's own labour and management skills are included in the farm's stream of net benefit.

9. All mango inputs are financed by the farmer.

10. The current land lease fee of Bh$20/acre for Crown lands will be charged to each acre, as it is put under production, until Year 6. In Year 7, after he has been cultivating the farm for five years, the farmer will be given a title of ownership to the land.

11. The stream of net benefit before financing for the whole farm represents the return to all resources engaged in production, without any consideration of financing. Since this is a new farm, established on previuosly unutilized land, all benefits are incremental, since there is no "without project" situation. The Financial Internal Rate of Return (FIRR) to this stream of benefits is 43%. Although such figure could be considered high in many agricultural development projects, it can become quite acceptable in this project, if the following factors are taken into account: (i) the figure is high because the initial investment is relatively small, there is just one negative chash flow and benefits after Year 10 become substantial; (ii) the farm will achieve full devolopment only in Year 13, with benefits from Year 2 to Year 7 being quite small; (iii) farmers will be attracted to the investment only if the long-term prospect is good and the overall rate of return is inviting. The Net Present Worth of this benefit stream, at 12% discount rate, is $73,000.

12. A loan for a total amount of $4,000 will be given in kind, to each farmer, in four different installments, from Year 1 to Year 4. Interest payments begin in Year 2 on the outstanding debt at a rate of __% a year. Repayment of the principal start in Year 6 and will be done with five payments of $800.

13. The stream of net benefit after financing represents the amount of money the farmer is going to receive by participating in the project. Discounted, it provides the financial rate of return to the farmer's own resources, if he has invested any of his own capital in the project. The special circumstance of this project, in which land clearing and preparation, at a total cost of $7,500, is provided to the farmer as a Government grant, makes the calculation of an internal rate of return after financing a ludicrous exercise, since the first and only negative cash flow is diminutive. If the farmer had to finance land clearing and preparation, the FIRR after financing would be 47.5%, slightly above the FIRR before financing. The Net Present Worth of the project, considering the grant, at 12% discount rate, is $80,600.

1.4 Support Services

The Ministry of Agriculture through its Extension and Research Branches will provide technical, managerial and marketing inputs as well as the loan, in kind, to initiate the project.

1.5 Markets

The expected markets for the short-term crops are:

a. The local market through the Produce Exchange.

b. The local market directed to and ultimately reaching the tourist trade.

The expected markets for the orchard crops are:

a. The local markets at the early bearing stage.

b. An export market as commercially greater production develops.

1.6 Environmental Impact

The observations here are equally valid for all areas receiving agro-chemicals and consequently spans the Orchard Crops Project as well as all instances in which agro-chemicals are used in either sub-project area.

Against the background of the fact that the preservation of freshwater lenses for potable water must have priority and a sensitivity to this fact must be in place, it is most important that the use of agro-chemicals be limited to absolute minimum quantities consistent with their effectiveness.

In the implementation of the project in the sub-project area of the south and that of the north, it should be expected that there will be a difference in the kind and quantities of fertilizers and pesticides that will be used.

Given the historically limited use of agro-chemicals in the south and the investment costs associated with their use, excessive use is not to be anticipated. While the project visualizes that in the initial years a variety of vegetable crops will be introduced in the area, the ultimate plan is to put in place orchard crops, where the pesticide requirements are likely to be less than those for vegetable crops. It is also expected that the

drier climatic conditions of the south will be less conducive to the development and persistence of most pests likely to be found in the project area.

With respect to the production activities of the North, a wider variety and larger quantities of agro-chemicals per unit area might be expected both from the standpoint of wetter and more humid conditions necessitating greater control of pests as well as the fact that highly commercial enterprises with a view to maximizing production often over-fertilize and make use of excessive pesticide applications as an insurance measure.

In the short-term, there is no great concern to possible contamination of the underground waters based on the following three considerations:

1. Movement of chemicals in solution to great depths within the soil profile is unlikely. The very important question of ensuring a lack of fresh water contamination can effectively and efficiently be handled by imposition of a monitoring system at sites with high agro-chemical activity.

2. In the highly calcareous environment that obtains in all soils of the area, the chemical interactions of fixation and immobilization will dominate in surface soil layers.

3. Microbial activity will slow down and in some cases eliminate the ultimate possible toxic chemicals reaching the underground water occupying lenses with depths of 40 feet or greater.

For the crops and cropping patterns anticipated in both sub-project areas, a list of expected pesticides that might be used is shown in Appendix 1A to 1K. It outlines in some detail important characteristics of the compounds. They are relatively safe chemicals which used according to the manufacturers specifications present no hazard.

1.7 Costs

An estimated cost of $1.4 million as indicated in Table V-7 would be required. This originates from an expected participation of 20 farmers from each of the 6 Southern islands plus South Andros each receiving $10,000 over the 5-year period of the project.

The disbursement scheduling is indicated in Table V-7.

TABLE V-7
PROJECT LOAN FACILITIES
REQUIREMENTS TO ESTABLISH 5-ACRE ORCHARD FARMS
(US$)

	YEARS				TOTAL
	1	2	3	4	
CREDIT REQUIREMENTS PER FARMER:					0
					0
SPRAYER + SMALL TOOLS	350				350
ONION INPUTS - ACRE 1	460	391			851
ACRE 2		460			460
ACRE 3			460		460
					0
MANGO SEEDLINGS - ACRE 1		640			640
ACRE 2			640		640
ACRE 3				640	640
TOTAL PER FARMER	810	1,491	1,100	640	4,041
FINANCING (LOANS IN KIND)	800	1,500	1,100	600	4,000
REQUERIMENTS PER ISLAND:	16,000	30,000	22,000	12,000	80,000
TOTAL SEVEN ISLANDS	112,000	210,000	154,000	84,000	560,000

1.8 Socio-Economic Benefits

In the model developed for a participating farmer growing mangoes intercropped to onion, a projected annual income of $1,585 in the first year rises to $4,094 in five years and reaches a maximum of $19.617 in the twelfth year (Table V-6D). It is expected that combinations of properly selected crop mixes involving a tree crop and a short-term crop will result in the same level of earned income.

The increased activity in crop production will provide increased employment and achieve a greater degree of food self-sufficiency for the Bahamas as a whole and a resulting saving of foreign exchange.

There is a great concern relating to the migration from Southeastern Island inhabitants to the highly populated centres of New Providence and Grand Bahama. Assured of a good standard of living and having acquired property - which is a feature of the project - one may look to the development of thriving communities within the sub-project area and a release of the pressure on the populated areas to accommodate an ever increasing number of migrants.

1.9 Beneficiaries

The primary and principal beneficiaries will be the currently classified subsistence farmers. In the Southeastern Islands of the project area there are 1105 farmers (Table V-8). Approximately 67% or 735 of these are subsistence farmers each farming cumulatively one acre of land normally in one quarter acre blocks. The rationale for one quarter acre blocks is that it spreads the risk of losing a crop and facilitates making use of selected sites that were easier to clear.

In addition to the number of subsistence farmers, there is a smaller number (370) of farmers who, in addition to supplying family needs, produce additional quantities of produce for sale locally or to the packing houses of the produce exchange.

While it might be anticipated that farmers in the commercial stream could more readily be accommodated in the project, an estimated 80% of the participants will be drawn from the subsistence stream and the remaining 20% from the commercial.

TABLE V-8 SUBSISTENCE AND COMMERCIAL FARMER DISTRIBUTION IN THE PROJECT AREA

ISLAND	NUMBER OF FARMERS		
	SUBSISTENCE	COMMERCIAL	TOTAL
ELEUTHERA	50	350	400
ANDROS	380	120	500
NEW PROVIDENCE	90	40	130
ABACO	105	25	130
GRAND BAHAMA	40	30	70
SUB-TOTAL	665	565	1230
LONG ISLAND	140	180	320
CAT ISLAND	185	65	250
EXUMA	200	70	270
ACKLINS	75	25	100
CROOKED ISLAND	65	20	85
MAYAGUANA	70	10	80
SUB-TOTAL	735	370	1105
TOTAL	1400	935	2335

COMPONENT 2: SELECTED MISCELLANEOUS CROPS

The development of agricultural productivity should be based on a two-pronged strategy of vertical expansion resulting in increased yields per acre and horizontal expansion on the more favored areas located over underground water reserves.

2.1 Objectives

The objectives of this component are to increase the level of crop production, as well as its profitability, and address by way of seasonality the need to attain greater self-sufficiency in the dominant crops marketed locally.

2.2 Crop Selection

The crops included in this component are comprised of:-

a) The crops included in the Orchard Crops Component.

The rationale is that these crops are in strong demand for the local market, and a history of familiarity with their husbandry, albeit insufficient, exists in Bahamian Agriculture. Secondly, the continued production of short-term crops without inclusion of a tree crop is a viable option as a farming system for beneficiaries in both sub-project areas.

b) The subsistence crops namely corn, pigeon peas, cassava and sweet potato.

These crops are the most amenable to considerable vertical expansion, given untested varieties and the lack of use of adequate agro-chemicals as well as farm machinery.

c) Banana.

Currently banana has the best potential for import substitution in the agricultural sector. Current import exceeds $1.25 million. The cost of production and expected revenue for the selected crops are outlined in Appendices 2A to 2K and Tables V-6A and V-6B.

2.3 Constraints

a) Seasonality of Crops

In the attainment of greater self-sufficiency, the seasonality of production for fruit and vegetables is probably of greater

importance than total quantity produced in that seasonal gluts result in waste.

The seasonality of differing fruit and vegetables in the sub-project areas as evidenced by supply to the Produce Exchange is shown in Table V-9. A most desirable situation would be to have demand and supply coinciding in the same periods. The difficulty is that in production scheduling for short-term crops, climatic factors and environment in general have a great impact on yields and indeed even on the survival of the crop. Consequently, planting schedules are dictated by climatic factors rather than demand which tends to be relatively evenly distributed throughout the year.

b) Irrigation

Under rain-fed conditions, it is necessary to program crop establishment to coincide with the period of higher rainfall. The net result is cycles of gluts and deficiencies of most crops at harvest depending on rainfall. The imposition of irrigation facilities permit a measure of control in maximizing crop yields but a major consideration is costs particularly for limited acreage.

c) Research and Extension

Research and Extension services are currently inadequate for the project area. Since they form a most important component in the totality of crop production, the present levels of production are reflected in that deficiency.

d) Farm Size

It was shown in Table IV-7 that 42.5% of farmers occupy less than 2 acres of land in the Bahamas. An additional 28% occupy 2-5 acres.For a viable operation providing returns that approach the national per capita income, a minimum of 5 acres would be required for most crops. Consequently, increased farm sizes are to be envisaged.

2.4 Production

(a) Seasonality

The seasonal availability of domestic produce is shown in Table V-9. The major componant of the seasonality problem from the standpoint of production is weather. Heavy rains, with an accompanying more humid atmosphere, greatly increases disease problems. In addition however is the natural seasonality of tree crops coming in to bearing.

Table V-10. which was developed from Table V-9. outlines

deficiency periods, solution of the problem via research and extension activities.

TABLE V-9 SEASONALITY OF SELECTED FRUITS AND VEGETABLES AS REFLECTED IN SALES TO THE PRODUCE EXCHANGE (1984 - 88)

CROP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
LIMES	*	*	*	*	*	*	**	**	**	**	*	*
GRAPEFRUIT	**	*	*							*	**	**
ORANGE	**	**	*						*	*	*	**
MANGO					**	**	**	**				
AVOCADO	*							**	**	**	*	*
COCONUT	*	*	*	*	*	*	*	*	*	*	*	*
BANANA	*	*	*	*	*	*	*	*	*	**	**	**
PINEAPPLE	*	*	*	*	**	**	*			*	*	*
PIGEON PEAS (DRY)	*	*	*	*	*	*	*	*	*	*	*	*
BEANS (DRY)	*	*	*	*	*	*	*	*	*	*	*	*
CORN	*	*	*	*	*	*	*	*	*	*	*	*
TOMATO	**	**	*	*	*	*	*				*	**
CABBAGE	**	**	*	*	*	*						
SWEET PEPPER	*	**	**	**	*	*	*					*
OKRA	**	**	*	*	*	*	*	**	**	**	**	**
CUCUMBER	*	*	*	*	**	**	*	*	*	**	**	**
PUMPKIN	*	*	*	*	*	*	**	**	*	*	*	*
WATERMELON							**	*	*	*	*	
CASSAVA	*	**	**	**								*
IRISH POTATO	*	*	**	**								*
SWEET POTATO	**	**	*	*	*	*	*	*	*	*	**	**
HOT PEPPER	*				*	*	*	*	*	**	**	**
ONION				**	**	*	*					

** REPRESENTS MAIN MONTHS OF RECEIVING PRODUCE
* REPRESENTS MONTHS DURING WHICH PRODUCE IS AVAILABLE
BLANK SPACES REPRESENT MONTHS OF LOW OR NON-AVAILABILITY OF PRODUCE

SOURCE: COMPILED FROM PRODUCE EXCHANGE RECORDS MINISTRY OF AGRICULTURE.

TABLE V-10 DEFICIENCY PERIODS OF SELECTED FRUITS AND VEGETABLES AS REFLECTED IN PRODUCE EXCHANGE PURCHASES AND PRODUCTION APPROACHES TO A SOLUTION.

CROP	PERIOD OF DEFICIENCY	LIKELY CONSTRAINT	APPROACH TO SOLUTION
GRAPEFRUIT	APRIL TO SEPTEMBER	SEASONALITY OF PRODUCTION	SELECTION OF VARIETIES, SHOCK TREATMENT
ORANGE	APRIL TO AUGUST	SEASONALITY OF PRODUCTION	SELECTION OF VARIETIES, SHOCK TREATMENT
MANGO	SEPTEMBER TO APRIL	SEASONALITY OF PRODUCTION	SELECTION OF VARIETIES, MANIPULATION OF FLOWERING
AVOCADO	FEB TO JULY	SEASONALITY OF PRODUCTION	SELECTION OF VARIETIES
PINEAPPLE	AUGUST TO SEPTEMBER	SEASONALITY OF PRODUCTION	CHEMICAL MANIPULATION OF FRUITING
TOMATO	AUGUST TO OCTOBER	HIGH RAINFALL AT PLANTING	ADAPTABLE VARIETIES TO ACCOMMODATE RAINFALL PATTERN
CABBAGE	JULY TO DECEMBER	HIGH RAINFALL AT PLANTING	ADAPTABLE VARIETIES AND MOUNDING
SWEET PEPPER	AUGUST TO NOVEMBER	HIGH RAINFALL AT PLANTING	ADAPTABLE VARIETIES AND PESTICIDE PROGRAMME
WATERMELON	JANUARY TO JUNE	LOW RAINFALL AND NUTRITION	IRRIGATION, VARIETY CHOICE AND PLANT NUTRITION
CASSAVA	MAY TO NOVEMBER	PLANTING SCHEDULING	ADAPTABLE VARIETIES, AND DELAYED HARVESTING
IRISH POTATO	MAY TO NOVEMBER	PLANTING SCHEDULING & TEMPERATURE	ADAPTABLE VARIETIES AND LOCATION
HOT PEPPER	FEBRUARY TO	INAPPROPRIATE PLANT SCHEDULING	PROPER PLANT SCHEDULING
ONION	AUGUST TO	INNAPPROPRIATE VARIETIES	SELECTION OF VARIETIES FOR PHOTO PERIOD SENSITIVITY

(b) Irrigation

Irrigation represents one of the major inputs significantly impacting on crop production. A constraint to its use arises firstly from the availability of water that is not in competition for potable needs and secondly, from the capital costs including installation costs as well as operational costs. The impact of irrigation on selected miscellaneous crops is shown in Table V-11. Against the background of identifying areas with sufficient availability of water for irrigation needs, models with costs were developed by the mission irrigation specialist for the following situations:

1. Commercial Supplementary, Unlimited irrigation system using a gun sprinkler for 35 acres of fruit, vegetable or forage in the North sub-project area.

2. Commercial Supplementary Unlimited irrigation system using drip for 32 acres of vegetables in the North sub-project area.

3. Commercial Supplementary Limited irrigation system using a gun sprinkler for one (1) acre of mixed crops in the Southeastern islands.

In the case of the system designed for one-acre mixed crops, farms in the Southeastern islands, if the capital costs including installation costs were amortized over a 10-year period ($107) and the operational cost of 54.75 per acre taken into account, the additional expenditure of approximately $162 per acre for irrigation would see sweet pepper providing an estimated revenue of $12,000 per acre (See Table V-11) compared to $6,000 per acre under rainfed conditions (Appendix 2G). Similarly, for banana revenues of $5,400 per acre (Appendix 3E) would increase to $10,800 per acre (See Table V-11).

(c) Research and Extension

The proposed establishment of a Research and Extension Centre in the Southeastern islands and the strengthening of the institutions at BARC and GRAC will provide substantial support in the thrust for increasing crop yields. Specific areas to be attended to would be the choice of varieties, irrigation and agro-chemical inputs that optimize the effect of fertilizers or control pests reacting to a change in environment. A detailed presentation relating to Research Projects is outlined in section D of this Annex.

TABLE V-11 THE BAHAMAS: SUPPLY OF AGRICULTURAL PRODUCE
"WHITOUT PROJECT" AND "WITH PROJECT" SITUATIONS
CROP DEVELOPMENT MODEL 2

	WHITHOUT PROJECT	Y E A R S																TOTAL INCREMENTAL	
		YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		YEAR 8-20			
		%	Q	%	Q	%	Q	%	Q	%	Q	%	Q	%	Q	%	Q	%	Q
A. MODEL 2: MISCELLANEOUS CROPS																			
1. ACRES UNDER CULTIVATION 1/	9,000		9,000	10	9,900	10	10,900	8	11,800	6	12,500	4	13,125	8	13,500		13,500		
INCREMENTAL					900		1,000		900		700		625		375			50	4,500
2. YIELDS (TONS/ACRE) 2/	1.33		1.33		1.36		1.38		1.40		1.42		1.44		1.46		1.46	10	
3. TOTAL PRODUCTION (TON)	12,000		12,000	12	13,440	12	15,000	10	16,500	8	17,800	6	18,900	4	19,700		19,700		
INCREMENTAL					1,440		1,560		1,500		1,300		1,100		800			64	7,700
4. RETURNS PER ACRE ($) 3/	700		700	10	770	5	808	5	850	2	870	2	890	1	900		900		
INCREMENTAL					70		38		42		20		20		10			29	200
5. VALUE OF PRODUCTION ($'000) 4/	6,300		6,300		7,623		8,807		10,030		10,875		11,681		12,150		12,150		
INCREMENTAL					1,323		2,507		3,730		4,575		5,381		5,850		5,850	93	5,850

NOTES ON TABLE V-11

1. Of the 170,000 acres of cultivable land in The Bahamas, it is estimated that only 17,000 acres, or 10%, are presently being cultivated, due to the dramatic decrease in farming activities over the last five to eight years. Of those, about 7,000 acres are allocated (although not fully utilized yet) to two large, export-oriented citrus enterprises on Abaco Island. That would leave 10,000 acres for "domestic production", mostly farmed by subsistence and commercial farmers on Andros and on the Southeastern Islands. The figure of 9,000 acres is a lower estimate of total area under cultivation.The increases in area under cultivation from Year 2 to Year 7, an increment of 50% over "without project" acreage, are conservative estimates of "old" areas being brought back into production because of the incentives offered by the project, and do not therefore represent "new" agricultural areas.

2. Some substantial improvements in agricultural yields are expected to take place under the project, due to a combination of better land preparation, provision of technical assistance by the Extension Service and, in some cases, irrigation. Nevertheless, a very conservative approach was adopted here, in which yields increase only 10% over a 6-year period.

3. Returns per acre will improve due to the production of better quality produce and to improved farming and marketing practices. Figures try to reflect the fact that a larger supply of better quality produce, coupled with sound marketing procedures, will eventually lower prices to the consumer and, therefore, to the farmer.

4. Due to the whole spetrum of improvements expected to take place under the project - adaptive research, extension services, market information service, improved marketing infrastructure and systems -, the total value of production is expected to pratically double in six years, causing, in turn, a substantial improvement in farmers' incomes throughout the country. The incremental figures for value of production are shown in its usual accumulated pattern while the others are shown on a year-by-year basis so that the annual increments may be noted.

(d) Farm Size

An increase in farm size to a minimum of five acres is anticipated for most crops to ensure a desirable farm income.

While the larger farm sizes will increasingly demand the use of farm machinery and equipment, at the level of 5 acres most farmers would need to look to some cooperative arrangement for equipment use.

In this regard the need to develop co-operatives might be attractive and would need the support of the extension service. A history of interest in co-operatives exists in the Bahamas and currently there are seven (7) active co-operatives of agricultural orientation in two sub-project areas, namely:

North Andros Agricultural Co-operative Society
Abaco Agricultural Co-operative Society
Exuma Agricultural CO-operative Society
North Cat Island Co-operative Society
South Cat Island Co-operative Society
Long Island Co-operative Society
Mayaguana Co-operative Society

2.5 Markets

In anticipation of increased crop production, the possible marketing outlets to be recognized are firstly the local market operating through the Produce Exchange and secondly, the local market directed to the tourist trade. Since the tourist trade requires fairly large volumes of fruits and vegetables at peak season, the matter of producing in a manner to address seasonality is of utmost importance.

TABLE V-12 ESTIMATED CROP YIELDS UNDER RAINFED AND IRRIGATED CONDITIONS

CROPS	RAINFED CONDITIONS		IRRIGATED CONDITIONS & IMPROVED HUSBANDRY (Lb/AC.)
	CURRENT (Lb/AC.)	IMPROVED HUSBANDRY (Lb/AC.)	
IRIS POTATO	8,300	15,000	20,000
SWEET PEPPER	7,300	20,000	40,000
CABBAGE	12,000	25,000	36,000
WATERMELON	15,500	20,000	40,000
ONION	8,000	12,000	16,000
SWEET POTATO	6,000	10,000	15,000
CORN	1,000	4,000	6,000
PIGEON PEA	1,100	2,000	2,500
CASSAVA	11,800	18,000	23,600
BANANA	15,300	20,000	40,000
PERSIAN FRUIT	10,800	17,000	22,800
GRAPEFRUIT	21,400	33,000	45,000
ORANGE	6,550	20,000	27,000
CUCUMBER	15,600	25,000	40,000
TOMATO	12,400	25,000	35,000

With hotels located in differing islands a strategy could be developed to have each island producing more competitively the needs of its tourist trade. From the selected fruit and vegetables involved in the project, crops have been matched with island potential for production (Tables V-4A and V-4B).

2.6 Costs

The major costs involved in pursuing the selected miscellaneous crops project are part of the $2.522 million needed as a facility for the Research, Extension and Training sub-project. In addition would be part of costs involved in putting in place a market information system as outlined by the mission marketing specialist.

2.7 Benefits

The focal interest of the project is the vertical expansion of crop production arising from better instituted cultural practices, increased use of fertilizers and pesticides, and the utilization of research information and the extension services.

Increased employment will develop from a more commercial approach to agricultural production and a farm income approaching and in many cases exceeding the national per capita income could be realized.

Import substitution for crops such as banana, onion and irish potato will result in substantial foreign exchange savings, and the supply of produce to the local market will contribute to greater food self-sufficiency.

2.8 Beneficiaries

In the first instance, the principal beneficiaries will be drawn from the commercial farmers of which there are 565 in the North sub-project area and 370 from the southern islands (Table V-8). This is to be expected in that the investment costs required could not be met by the larger number of subsistence farmers.

In the long term it is expected that by virtue of a generally better economic situation, previous subsistence farmers would benefit from embarking on commercial enterprises.

COMPONENT 3: SPECIALTY CROPS

Despite the wide variety of crops observed to be growing in The Bahamas, there are a number of crops with special characteristics at the production and marketing levels which could readily be accommodated and production concentrated in the Southern region, and South Andros. Indeed, a precedent exists in the current production of cascarilla at Crooked Island, and to a more limited extent in the other islands.

Such an approach allows for the participation of the southeastern islands in a programme geared to access international markets despite the constraints of soils and climate.

3.1 Objectives

By selecting crops of special characteristics that can accommodate the existing constraints of soils and climate of the southeastern islands, access special international market niches.

3.2 Justification

Arises from the considerations outlined in the selection of crops.

3.3 Crop Selection

The conditions taken into consideration in arriving at the selection of the crops were:

- Calcareous soils and rugged terrain dominate the southern islands.
- Rainfall is low, i.e. 30 to 40 ins. annually.
- A low level of crop care can be tolerated given crops known to be relatively free from attack by pests and diseases.
- The crops chosen lend themselves to on-farm storage prior to sale.
- High market value crops make small scale production acceptable and manageable from an employment standpoint.
- High international market demands prevail.

Detailed information concerning each crop is shown below. Of the crops indicated below, only tamarind is grown to any extent in the Bahamas, but a concentration of a greater number of trees per unit area would be required to ensure minimum volumes adequate for harvesting and shipping.

The crops chosen are: **ANNATTO (Bixa orellana)**
NEEM (Azadirachta indica)
CASHEW (anacardium occidentale)
PIMENTO (Pimenta dioica)
TAMARIND (Tamarindus indica)
PASSION FRUIT (Passiflora edulis flavicarpa).

Detailed information concerning each crop is shown below.

Name of Crop:	ANNATTO
Botanical Name:	Bixa orellana
Known Habitat:	Found in West Africa and South America, it is of wide occurrence in Jamaica.
Source of Planting Naterial	Jamaica
Propagation	Grown from mature seeds
Description	A fast growing shrub that reaches heights of up to 15 feet, it produces seeds in a pod. The outer coating of the seeds have a red to yellow pigment. Commercial quantities of seeds are produced within three years.
Potential for Production	The shrub thrives well on impoverished calcareous soils. While highly responsive to conditions of good rainfall, an excellent crop is obtained under continuously dry conditions.
Uses:	Of exceptionally high demand in the food industry as a colouring agent it is used with butter, margarine, cheese and chocolate.

Name of Crop:	NEEM TREE
Botanical Name:	Azadirachta indica
Source of Planting Material:	Haiti or Suriname
Known Habitat:	A native of the Indo-Pakistan sub-continent, it is now cultivated in the drier areas of Sri Lanka and the drier Indonesian islands east of Java. Found in East and West Africa. In the New World, it is cultivated in Haiti, Suriname and Nicaragua.
Propagation:	Grown from ripe seed, seedling or sapling.
Description:	A hardy fast growing evergreen, mature trees go 20-60 feet high. Fruits of small size are produced in four to five years. Mature trees will produce 60-100 pounds fruit annually.
Potential for Production:	Once planted it requires very little attention. It would be expected to thrive well under the semi-arid conditions of South Bahamas. It can be established without irrigation in warm areas with rainfall less than 25 ins.
Uses:	The leaf, fruit, bark or seed can be processed for compounds effective against a wide variety of insects, mites and nematodes.

Name of Crop:	CASHEW
Botanical Name:	Anacardium occidentale
Source of Planting Material:	Trinidad or Guyana
Known Habitat:	A native to tropical America from Mexico to Peru to Brazil and the West Indies. Introduced to the Eastern Hemisphere, its commercial exploitation there now exceeds that of the West Indies.
Propagation:	Grown from seeds, that germinate it can be propagated vegetatively by air-layering, grafting or in arching.
Description:	Cashew trees are medium-sized evergreens, with a bushy irregular canopy. In full bloom, the trees are covered with numerous flowers which are a good source of honey. It bears an odd-looking fruit to which is attached a kidney-shaped nut. While the fruit is edible, it is the nut that is of commercial importance as cashew nut. Economic bearing of trees come into production within three to four years and yields up to 50 pounds per tree can be expected of mature bearing trees.
Potential for Production	Grown on a wide variety of sub-marginal lands, much of the production in the West Indies is by voluntary growth. Organized orchards however are widespread in Thailand on the very sandy coastal soils. Cashew growing in Jamaica is concentrated on droughty infertile soils receiving minimum care. Many areas in the southern islands of The Bahamas, particularly the sandy strips adjoining beaches could readily be exploited.
Uses:	As an extremely high priced nut, it lends itself to small scale type operations. The demands on the international markets are no way near being adequately met.

Name of Crop:	PIMENTO (All spice)
Botanical Name:	Pimenta dioica
Source of Planting Material:	Jamaica
Known Habitat:	Indigenous to Jamaica, it is now grown in Guatemala, Honduras and Mexico on a commercial scale.
Propagation:	Grown from seeds, germination is greatly reduced quickly. A dependable method of bud propagation has been developed in Jamaica and now permits the planting of cloral female trees. Male trees will not produce berries.
Description:	Trees may be male or female bearing. They will grow to heights of 30 feet and bear berries which are harvested and allowed to sun dry. The leaves of the trees can be extracted for pimento oil.
Potential for Production	Adapted to a wide variety of soils, pimento trees are found Production: to thrive vigorously on the calcareous soils in Jamaica. Low rainfall is tolerated but vigorous growth occurs with rainfall at 40 ins or more annually.
Use:	Of international acceptance, the dried berries are ground and used in pickles, ketchups, sauces and sausages. It is extensively used in curing meats and the leaf oil is in great demand for perfumes. The favourable international markets are the United States of America, Russia, the United Kingdom and West Germany.

Name of Crop:	TAMARIND
Botanical Name:	Tamarindus indica
Source of Planting Material:	The Bahamas and Jamaica
Known Habitat:	Of tropical African origin, it is widely grown in India and the Caribbean region.
Propagation:	Grown from seeds, trees will begin to bear in 6-8 years. However tamarind can be propagated asexually by budding and fruit within 4-5 years.
Description:	Tamarind trees which are leguminous will attain heights in excess of 50 feet. With dense foliage, it makes an attractive shade tree. Brown pods borne are curved and flattened. They become brittle when ripe. Seeds are embedded in a sticky brown granular edible pulp within the pods. Mature trees will produce as much as 200 lb of fruit annually.
Potential for Production:	Trees are of wide occurrence but limited in numbers in The Bahamas. Adapted to conditions of low rainfall and poor soils, they are found mainly at low elevations. They will withstand long periods of drought, salt spray and require dry weather during the period of fruit development. In order to accommodate an export market, a greater concentration of trees at any one site is desirable.
Uses:	Used primarily as a food in the Caribbean, its potential as an export product rests in its use for seasoning other foods, and in curries preserves, chutnies and sauces. It has an exceptionally high demand in the ethnic markets of Europe and North America.

Name of Crop:	PASSION FRUIT
Botanical Name:	Passiglora edulis flavicorpa
Source of Planting Material:	DOMINICA OR PUERTO RICO
Known Habitat:	A native of Brazil but extensively grown in Hawaii, Puerto Rico, New Zealand and Australia.
Propagation:	Propagation from seeds is the more usual method but cuttings with 305 buds will readily root.
Description:	While there is a purple passion fruit, it is the yellow passion fruit grown at lower elevations which is of great commercial interest. A vitorous woody perennial climbing vine, it bears fruit used for making juice. Vines will bear within 12 months and produce yields up to 12000 lbs per acre.
Potential for Production:	The crop does well in regions of 30-50 inches of rainfall. It is not exacting in its soil requirements and will readily tolerate calcareous soils. Great soil depth for anchoring roots is not a necessity and preparation of holes without ploughing, harrowing or refining operations is possible Pollination is done mainly by the Carpenter Bees (Xylocopa spp), but also by honey bees and wasps.
Uses:	Used as a fresh fruit but in great demand as a juice in fruit cocktail mixes.

3.4 The Plan

A profile of activities and requirements follow:

CROP: A total of 6 crops are involved and a minimum of 4 crops will be introduced to any one island in the southern sub-project area as well as South Andros.

LOCATION: Selected islands chosen with a primary concern for rainfed conditions and soil type.

PLANTING MATERIAL: The approach to ensure that the effort has very positive results with wide farmer participation should come out of the government taking the initiative of securing, propagating and then distributing the planting material. This programme could readily be carried out in tandem with that designed for the ultimate development of crops in the southeastern islands.

Planting material would be released through the Extension Department of the Ministry of Agriculture and controlled in a manner to ensure annual planting by participants.

STRATEGY FOR DEVELOPMENT: The participating farmers and beneficiaries would be selected and chosen on the basis of their willingness to provide all inputs of production exoept the planting material. As a condition for continued participation, they would have to abide by the instructions and advice of extension personnel.

EXTENSION SERVICES: Extension agents will be active in the supervision, planting material release, and interacting with local farmers. Fertilizer application and other desirable inputs are to be encouraged. Crop management and periods of establishment will be outlined.

3.5 Markets

In the first year of the programme only passion fruit would be expected to come into bearing, followed by annatto within two years, and most other crops within five years.

The principal activity to promote and provide market information would be extended through The Bahamas Agricultural and Industrial Corporation (BAIC).

The Produce Exchange would be the channel to ensure marketing of products initially.

3.6 Costs

A projected development of trees equivalent to 280 acres over seven (7) islands (Table V-12A) would take place over a two year period at a cost of $78,000 as shown in Table V-12B.

The costs of the extension services and those incurred by the participants are not included.

TABLE V-12A ACREAGE, LOCATION AND COST OF NEWLY INTRODUCED PLANTS TO THE SOUTH BAHAMAS. 1989.

ISLAND	NEEM AC	ANNATTO AC	CASHEW AC	PASSION FRUIT AC	PIMENTO AC	TAMARIND AC	TOTAL ACRES
ANDROS (SOUTH)		5	10	10	5	10	40
LONG ISLAND		10	10	10	10		40
CAT ISLAND	10	10		10	10		40
EXUMA		10		10	10	10	40
ACLINS	10	5	10		10	5	40
CROOKED ISLAND	10	5	10	5	5	5	40
MAYAGUANA	10	5	10	5		10	40
TOTAL ACRES	40	50	50	50	50	40	280
PLANTING MATERIAL (ea.)	2,800 seedl.	10,000 seeds.	3,500 seeds.	14,500 seeds.	3,500 seedl.	2,800 seedl.	37,100
IMPORTATION COSTS $	14,000	500	500	250	17,500	14,000	46,750
PROPAGATION COSTS		10,000	3,500	14,500			28,000
DISTRIBUTION COSTS	450	750	600	1,200	600	450	4,050
TOTAL COSTS $	14,450	11,250	4,600	15,950	18,100	14,450	78,800
COST/ACRE	361.25	225.00	92.00	319.00	362.00	361.25	281.43

TABLE V-12B ACREAGE AND CAPITAL DISBURSEMENT FOR ESTABLISHMENT OF SPECIALTY CROPS.

CROP		ANDROS (SOUTH)		LONG ISLAND		CAT ISLAND		EXUMA		ACKLINS		CROOKED ISLAND		MAYAGUANA	
		AC.	DISBURSEMENT	AC.	DISBURSEMENT	AC.	DISBURSEMENT	AC.	DISBURSEMENT	AC.	DISBURSEMENT	AC.	DISBURSEMENT	AC.	DISBURSEMENT
NEEM	YR I	-	-	-	-	5	1806.25	-	-	5	1806.25	-	-	10	3612.50
	YR II	-	-	-	-	5	1806.25	-	-	5	1806.25	10	3612.50	-	-
ANNATTO	YR I	5	1125	5	1125	5	1125	5	1125	5	1125	5	1125	5	1125
	YR II	-	-	5	1125	5	1125	5	1125	-	-	-	-	-	-
CASHEW	YR I	5	460	5	460	-	-	-	-	5	460	-	-	-	-
	YR II	5	460	5	460	-	-	-	-	5	460	10	920	10	920
PASSION FRUIT	YR I	10	3190	10	3190	10	3190	10	3190	-	-	5	1595	5	1595
	YR II	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PIMENTO	YR I	-	-	-	-	-	-	5	1810	5	1810	5	1810	-	-
	YR II	5	1810	10	3620	10	3620	5	1810	5	1810	-	-	-	-
TAMARIND	YR I	-	-	-	-	-	-	-	-	5	1806.25	5	1806.25	-	-
	YR II	10	3612.50	-	-	-	-	10	3612.50	-	-	-	-	10	3612.50
TOTAL		40	10657.50	40	9980	40	12672.50	40	12672.50	40	11083.75	40	10868.75	40	10865

3.7 Socio-Economic Benefits

(a) Sowing the seeds for the continuing development of an agricultural crop with export potential and consequently foreign exchange earnings.

(b) As anticipated widespread participation by farmers in the South could fuel the expansion potential to the North by private investors.

(c) Definitive participation of newly introduced extension agents will have great credibility to farmers when dealing with crops previously unknown to local farmers.

(d) Development of a viable economic sector.

3.8 Targeted Beneficiaries

Principally Farmers. A total of twenty (20) participants from each of seven islands and an average of two (2) acres would accommodate 140 beneficiaries.

COMPONENT 4: EXPORT CROPS

In the North, large tracts of land, suitable soils and sufficient water resources to ensure adequate irrigation, set the stage for agricultural production to access and re-enter world markets with fruits and vegetables.

One of the early difficulties relating to land preparation has successfully been overcome as evidenced by large citrus and papaya groves in the North sub-project area. In this respect, vegetable production is not as impressive though substantial information illustrating constraints and desirable areas for continuing research were established at Andros.

4.1 Objectives

To facilitate an attractive milieu that would assist in the large scale production of selected fruits and vegetables destined for an export market and thereby increasing the foreign exchange earnings/savings contribution of the agricultural sector.

Large-scale mechanized agriculture of the high investment nature is not new to the Bahamas. There has been a number of successes and failures which should point to the more desirable directions to follow. Most projects have taken place in Eleuthera, Andros, Abaco and Grand Bahama.

4.2 The Experience

Eleuthera - Eleuthera is typified by the diversity of crops being produced.

A 1500-acre milk enterprise farm established by Austin Levy has been abandoned, presumably due to an insufficiency of irrigation water. A 1200-acre farm in South Eleuthera owned by Bahamas Star Company is actively producing Sunrise Solo papaya under drip irrigation for export to the U.S. market. Avocado is also being produced for the local internal market. An estimated 15 to 20 investors occupy farms with acreages up to 200 acres, principally in the North section and avocado, mango, Persian Lime, grapefruit and banana are the principal tree crops of interest. Pineapple, vegetables and pigeon peas are produced commercially and canning facilities are in place but not currently being used.

An estimated 8476 acres of minimum potential agricultural land has been identified at 6 locations in Eleuthera (Table V-13). A possible 1242 acres suitable for irrigation could be used in the first phase of the project.

Andros - As early as in the 1950s, the parker Brothers had been exploring the possibility of commercial agriculture in North Andros, and with great success established a giant market share for cucumbers in the U.S. and Canada. In 1978, over 450 acres in the Twin Lakes region were cultivated to cucumbers, strawberry, okra and sweet pepper for export. With the advent of the BARTAD project in Andros, a diversity of agricultural projects were carried out and the best recorded information as to crop capabilities came out of those investigations. Tree crops, vegetables, pastures and other crops were studied. In 13 differing areas within North and Central Andros, 62,819 acres of minimum potential agricultural land has been identified. Of this total, 26,271 acres have been designated as suitable for irrigation in the first phase of the project (Table V-13).

Abaco - The Bail lands of approximately 10,000 acres used for sugarcane production were abandoned in 1972. Currently 5,000 acres of this land is occupied by Harmon Limited, 2,080 acres of which have been established to citrus, principally grapefruit, and destined for the Japanese market. A seemingly well-run operation, the company has a total of 26 employees for their 2,080-acre operation, the organization uses Bahamian labour exclusively, pays an hourly working wage of $3.50 per hour which is in excess of the norm for the Bahamas. Ruby Reed and Rio are the dominant red varieties of grapefruit planted and drip irrigation is used throughout the orchards. Technology is imported from Florida and executed by trained Bahamians. The Bahamas Star company occupies 3,000 acres of prime land in Abaco. In early 1972, the interest was in the production of vegetables under irrigated conditions.

Some avocado varieties were established but abandoned presumably because they were of the wrong varieties in terms of market demands that favour the smaller Haas type varieties. They are now engaged exclusively in citrus production, principally grapefruit but also Persian lime. The red variety of grapefruit Star Ruby, as well as the white Marsh seedless was being produced under drip irrigation. The company currently was in an active mode of expanding acreages. Marketing is carried out directly by the Company and the established market is the U.S. Bulk transportation of produce by their own vessels is made to Florida, and packaging takes place in their Miami-based warehouses. A fair number of smaller farms, 5-25 acres exists with interest in Bananas, Canteloupe, Watermelon and vegetables destined to an internal local market. Proper infrastructure such as irrigation was not in place. 18,015 acres of land scattered over 10 locations in Abaco have been classified as minimum potential agricultural land with adequate water resources for irrigation (Table V-13) and 14,775 has been established as being suitable in the first phase of the project.

Grand Bahama - There is considerable activity in large-scale production of tree crops in Grand Bahama. Grand Bahama Growers Ltd., occupying 2,000 acres, is actively producing Sunrise Solo papaya, 200 acres of which are already established under drip irrigation, and an additional 200 acres of land actively being prepared for the further establishment of papaya. Papaya production was destined for the Florida market but the European market had also been accessed. A substantial acreage of avocado was being established. The Bahamas Star Company had 1,000 acres identified principally for Sunrise Solo papaya production. Two hundred (200) acres currently being established were at differing stages of maturity. Drip irrigation was being used. The projected market was Florida and the significant appeal for the investors was the proximity of the U.S. market. The company was involved in the establishment of a large-scale guava project involving a red-coloured variety.

Freeport Citrus Company currently has 360 acres of Persian Lime in full bearing and an additional 240 acres which have been cleared in preparation for expansion. Drip irrigation is being used. The principal market currently being acceseed was Europe.

On Grand Bahama Island was concentrated the largest number of medium-sized commercial farms varying from 25 to 100 acres. The principal interests were in citrus, papaya, banana, tomato, cabbage and sweet pepper. Irrigation was in place. High technology was not apparent on these smaller farms.

The minimum potential agricultural land (Table V-13) identified in Grand Bahama is 60,025 acres at 5 differing locations. 5,435 acres have been designated as being suitable for irrigation in the first phase of the project.

TABLE V-13 SELECTED AGRICULTURAL LAND OF 40ft MINIMUN LENS THICKNESS IN THE NORTH SUB-PROJECT AREA.

ISLAND	NUMBER OF LOCATION	MINIMUM POTENCIAL AGRICULTURAL LAND	AREA SUITABLE FOR IRRIGATION IN FIRST PHASE
		ACRES	ACRES
ELEUTHRA	6	8,476	1,242
ANDROS	13	62,819	26,271
ABACO	10	18,015	14,775
GRAND BAHAMA	5	60,025	5,435

Source: Developed with mission irrigation specialist and with the Land and Surveys Department.

4.3 Targeted Crops

The targeted crops for production in the North sub-project area were determined on the basis of export potential and the attractiveness relative to import substitution. They are:

Persian Lime	Tomato
Grapefruit	Cabbage
Orange	Sweetpepper
Mango	Cucumber
Avocado	Watermelon
Banana	Irish Potato
Papaya	Onion

Banana, Irish potato and onion are targeted for import substitution.

In the initial stages of the project a limited number of crops will be considered based primarily on current trends and opportunities in the Florida market (Table V-14A) and the recent export of fruit from the Bahamas (Table V-14B).

TABLE V-14A EXPORT OPPORTUNITIES FOR SELECTED FRUITS AND VEGETABLES AS REFLECTED IN FLORIDA IMPORTS (S/TONS) 1987 - 1988

CROP	SHORT TONS
LIME (PERSIAN)	52,500
GRAPEFRUIT	350
ORANGE	500
PAPAYA	150
PINEAPPLE	3,500
TOMATO	66,500
SWEET PEPPER	13,000
CUCUMBER	220,000
WATERMELON	153,500
CANTELOUPE	170,000

SOURCE: MARKETING CONSULTANT 1989.

TABLE V-14B TOTAL FRUIT EXPORT FROM THE BAHAMAS 1986 - 1988
UNIT:SHORT TONS

FRUIT	1986	1987	1988
PERSIAN LIMES	2519	880	912
GRAPEFRUITS	2705	4732	3346
ORANGES	158	49	73
PAPAYAS	325	124	2
AVOCADOES	318	62	30

SOURCE: PLANNING AND STATISTICS UNIT - DEPARTMENT OF AGRICULTURE

Citrus - In the current trend of production directed to an export market, citrus is the overwhelming choice with grapefruit and Persian lime being preferred to orange. The investment costs involved in a medium to large-scale citrus enterprise is relatively high. The FAO mission of 1988 estimated developing costs over a

three year period would be $6,350 per acre, with equipment requiring an additional $6,500 and working capital $350,000. A citrus budget developed in association with the Ministry of Agriculture for mixed orchards of 50 and 100 acres respectively is summarized in Table V-15. These are indicative costs. In embarking on the large-scale production of citrus a detailed feasibility study including a financial forecast would be mandatory.

Papaya - Several medium to large-scale papaya orchards are currently in production particularly in Grand Bahama. The variety being grown is exclusively Sunrise Solo. The highest possible technology was in operation for the large-scale enterprises. Papaya production is relatively new to the project area and some problems have been encountered relative to nutrition and disease. Present producers however are averaging 250-300 pounds per tree within a 24 month period after first harvest. Since the crop comes into bearing within 8 to 9 months it is particularly attractive as an orchard crop from an investment stand-point. The possibility of using papaya as an intercrop with permanent tree crops which would seem most desirable was not in evidence.

TABLE V-15 ESTIMATED LEVELS OF RETURN AND PROFITIABILITY FOR MIXED CITRUS ORCHARDS WITH HIGHEST PRODUCTION LEVELS AT MATURITY.

CITRUS MIX	PRODUCTION HARVESTING MARKETING COSTS	REVENUE	PROFIT
GRAPEFRUIT 30ac.	238,740	600,000	361,260
PERSIAN LIME 15ac.	68,025	126,000	57,975
ORANGE 5ac.	35,195	50,000	14,805
TOTAL 50ac.	341,960	776,000	434,040
GRAPEFRUIT 60ac.	453,606	1200,000	746,394
PERSIAN LIME 30ac.	136,050	252,000	115,950
ORANGE 10ac.	70,390	100,000	29,610
TOTAL 100ac.	660,046	1552,000	891,954

Other Crops - Among tree crops, a major export crop in the past was avocado. Currently there is no great interest in production though one large-scale project was being embarked on. Mando and guava represent two crops of excellent potential for export. There is some restriction currently for mango entering the U.S. market but a very strong market exists in Europe and Canada. With respect to vegetables, there has been a number of projects with successes and others with failures. Much of the problem in the unsuccessful ventures were more related to marketing considerations rather than production.

Import Substitution - Import of bananas to the Bahamas was in excess of $1.25 million in 1988 and represents the trend over the last few years. It is therefore a prime target for import substitution.Wind is the greatest problem for growers of bananas, and this accounts for the universal popularity of the dwarf types. Technical practices observed currently indicate that in as much as many farmers were engaged in production standards were low. Inadequate use of fertilizers and poor cultural practices was widespread. On many farms banana cultivation was of secondary interest. Pure stand commercial cultivations have a definite place in agricultural development. In addition to banana, the two most likely candidates for increased production as it relates to import substitution is onion and Irish potato. In both cases the major constraint is seasonality of production under rainfed conditions. The matter of appropriate varieties, irrigation and storage techniques will need to be a concern of the Research Services of the Ministry.

4.4 Infrastructural Requirements

For large-scale production of any of the selected crops targeted for export, irrigation is mandatory. This arises fromt he fact that in addition to the desirability of maximizing yields, price competitiveness is on an international scale.

TABLE V-16 WHOLESALE PRICES OF SELECTED FRUITS AND VEGETABLES - MIAMI SEPTEMBER 1989

ITEM	UNIT	PRICE RANGE
GRAPEFRUIT	4/5 BUSHEL COUNT (26-27)	 15.00 - 16.00
LIMES	38LB CARTOON COUNT (106-137)	 20.00 - 20.00
ORANGES	72-88 COUNT	14.00 - 16.00
AVOCADO (HAAS)	44-48 COUNT	28.00
MANGO (TOMMY ATKINS KEITT)	10-16 COUNT	5.50
BANANAS	40LB CARTON	8.00 - 9.50
PAPAYA	12-14 COUNT 9-12 COUNT	11.00 - 11.50 11.00 - 12.50
WATERMELON(JUBILEE)	18-24LB 25-30LB 30-36LB	2.00 - 3.00 3.00 - 3.50 4.00 - 4.50
IRISH POTATO	50LB COUNT (70-80) " (100)	 12.00 - 14.00 12.00 - 12.50
ONION	50LB JUMBO MEDIUM	 9.25 7.50 - 9.00
TOMATO	25LB 5 x 6 6 x 6	 10.50 - 11.00 9.00 - 9.50
SWEET PEPPER	25LB EXTRA LARGE MEDIUM SMALL	 13.00 - 14.00 9.50 - 10.50 8.50 - 9.00
CABBAGE	45LB	8.00 - 8.75
CUCUMBER	40LB	10.50 - 11.50

SOURCE: MIAMI WHOLESALE FRUIT AND VEGETABLE REPORT SEPTEMBER 1989

In the selection of primary fruits and vegetables for export production, the recent wholesale prices in Miami (Table V-16) were used as a reference for arriving at desirable levels of production per acre that would make Bahamian produce competitive. In most instances the price ranges in Miami are considerably less than those obtained for locally produced fruits and vegetables. The implications are that from the export standpoint economies of scale from higher production levels and or lower production costs will need to be in place. The substantial difference in yield with the provision of irrigation is indicated in Table V-11. Irrigation is therefore an overriding consideration in production.

With respect to the North sub-project area irrigation installation and operational costs have been developed for:

a. 32-acre vegetable crop production under drip irrigation.

b. 40-acre citrus crop production under drip irrigation.

c. 35-acre fruit or vegetable production under gun (sprinkler) irrigation.

The indicative costs are a sound basis at the pre-feasibility stage for assessing a potential investment. Feasibility studies would naturally follow.

With the great concern for maximizing production, site selection assumes an importance equal to that of the imposition of irrigation facilities. in this respect, the most suitable areas from the standpoint of the availability of an irrigation water supply was developed (Table V-13) and should be of major service at the preliminary stages of investment promotion.

4.5 Markets

A prominent feature of current investments in fruit and vegetable production in the North sub-project area is the fact that most producers are producing for their own markets. This is exclusively so for the major producers farming in excess of 1,000 acres. A definitive marketing strategy will therefore be needed for the small to medium-scale producers looking to the export market. This has been dealt with in some detail by the Marketing Specialist.

In the very short-term, the export opportunities to Florida (Table V-14A) has been identified as a priority approach to production.

In view of the fact that most tree crops only come into production after three to four years from establishment, papaya is an attractive crop for production in that only 8 to 9 months are required for mature fruit.

4.6 Research and Extension

While the very large-scale producers, i.e. those occupying in excess of 1,000 acres can and do bring in their own technology with on-going retainer contracts, this is less likely for the medium to small-scale producers who will increasingly look to Government sources by way of Research and Extension for assistance. At the research end, the areas of work have previously been identified (See pages 78 to 84).

A possible role for the Extension Service relates to assistance that could be provided in the organization of co-operatives that would facilitate production and marketing of crops for the smaller scale producers. A list of presently active co-operatives is shown on page 39- .

4.7 Costs

The costs which may be attributed to the project are included in firstly, the costs proposed for marketing missions, marketing information systems and in general the promotion of investment opportunities as outlined by the marketing specialist. Secondly, they form part of the costs identified as being necessary for the establishment of an effective Research and Extension Department.

4.8 Socio-Economic Benefits

The socio-economic benefits to be earned from embarking on the large-scale production of fruit and vegetables relate principally to foreign exchange earnings and import substitution. The development of an agricultural sector should offer the kind of diversification that allows for greater stability of the country as a whole. It is to be expected that a demand for employment will be generated both at the production level and at the level of services required for export activities.

4.9 Beneficiaries

The targeted beneficiaries are not restricted to farmers currently involved in agricultural production but is open to the employment demands generated in large-scale agricultural projects.

B. RESEARCH, EXTENSION AND TRAINING SERVICES SUB-PROJECT

1. OBJECTIVES

Within the context of the overall objectives, the objective of the Research Extension and Training Sub-Project is to have provided sufficient capacity to enable the Department of Agriculture to facilitate the shift of farm families operating at the subsistence level to a commercial farming level.

2. JUSTIFICATION

The development of Agriculture in countries such as the Bahamas with limited availability of land and water supply must be based on the adoption of technologies that will maximize production. Scientific research is the source of such technologies whether it is original or whether it adapts technology to the country's specific conditions.

The ready transfer of research information and results to farmers for their adoption and use is facilitated by extension services. Of equal importance is the fact that a properly organized extension service is the major source of providing information that prioritizes the research effort.

In order to provide the essential link in the technology transfer process between agricultural research and farmers, extension personnel will not only require pre-service training, but also on-the-job training.

3. CONSTRAINTS TO THE PRESENT SITUATION

Research and Extension Services are an integral part of the mandate of the Ministry of Agriculture in the BAhamas. As such, it maintains research institutions at the Gladstone Road Agricultural Complex (GRAC) on New Providence Island, and the Bahamas Agricultural Research Center (BARC) on Andros Island.

RESEARCH

There are no research facilities nor any investigational work relating to agriculture in the Southeastern islands. This is so despite the fact that soil, climatic conditions and potential farming systems are quite different from what obtains in the Northern islands.

The research facility at GRAC had an early beginning in 1968 as the Central Agricultural Station. Its stated objectives were:-

(a) To test locally the results of research carried out

elsewhere in order to provide a sound basis for extension programmes in the Bahamas.

(b) To serve as a demonstration center for techniques in plant and animal husbandry.

(c) To provide a center for instruction and training courses for field staff, farmers, school teachers etcetera.

By 1980 a Food Technology Unit and an Animal Nutrition Unit was added and the Centre formally became known as Gladstone Road Agricultural Centre. The stated purpose of the centre was:-

To conduct research projects aimed at increasing crop and livestock production and promoting all aspects of the agricultural industry.

It would serve very little purpose to detail the deficiencies from the standpoint of research investigations in that there is no research and consequently no final reports available of research work carried out.

The following observations are pertinent and they form the basis of the detailed plan outlined for a Research and Extension Service.

o The institutional specialist has provided a review of the Ministry of Agriculture and its severe weaknesses in administrative capability and performance efficiency.

o Physical facilities of an office complex, maintenance buildings, laboratories, greenhouses, staff houses, farm machinery, laboratory equipment are in place and to the largest extent are in good condition.

o There are 57 positions in the Ministry of Agriculture of officers with at least training to the Bachelor's degree level. Most of those assigned to Research or Extension activities are shown to be at GRAC.

o Of the fifteen professional members of staff at GRAC, only one junior member has received training to the Master's degree level. All other staff members hold a Bachelor's degree.

o There are thirteen (13) vacant positions in the Ministry where the required training is at the Bachelor's degree level.

o Several officers assigned to a particular area of work

have not received formal academic training in the particular area of work.

o Recent graduates with Bachelor's degrees see themselves as occupying a research position.

o Against the background of no training in research nor association with researchers, there were no laboratory or field experiments of a research nature.

o Officers could not clearly define what they were expected to do.

o No job descriptions were presented to officers when occupying positions at the centre.

o Monthly reports of research activity by staff members are required but are rarely ever done. There was no one at the centre qualified to design field experiments.

o There are no research reports available from the institution.

o There was no soils laboratory.

o There was no library.

o There are no departments nor recognized disciplines of work.

o An existing plant propagation unit provided seedlings or plants for the public.

o Most officers expressed the desire to pursue further training at the Master's degree level.

o There are six veterinary officers in the Ministry of Agriculture, two of whom are stationed at GRAC.

The Bahamas Agricultural Research Center (BARC) is located in North Andros. It was established as a result of the Bahamas Agricultural Research Training and Development Project (BARTAD) sponsored jointly by the Commonwealth of the Bahamas and USAID.

The project, initiated in 1973, had as its objectives:-

o To establish a Research and Training Center.

o To develop 16 Pilot Test Farms.

o To conduct research on the best types of grasses and

legumes, and to conduct fruit and vegetable research.

o To study the economic and marketing aspects of livestock enterprises.

o To conduct sociological research.

o To determine the most economical means of bringing land into production.

o To find out the best pastures and feed crops for livestock production.

o To determine the best livestock breeds for the Bahamas.

o To provide and/or make arrangements for academic training for selected Bahamian candidates.

Over the 5-year period of the project, ending in 1978, all of the objectives were met.

Unfortunately the research activities were not continued after 1978. Yet BARC currently employs 8 degree-level agriculturists, one of whom is a Veterinary Surgeon and an additional 30 full-time employees.

The situation at BARC is much the same story as at GRAC from the standpoint of research activities and organization. Physical facilities are excellent with several staff houses and an apartment building with several single family units. A training centre dormitory complex is also in place. Maintenance buildings, farm machinery and passenger vehicles are in excess of $1 million in value. There are 386 acres of pasture, 11 acres of orchard and 7 acres reserved for agronomic studies. The interest in crops and animals is quite varied, largely as a hold-over from the BARTAD project. However, the lack of research training by staff members limits research activity. Field plots of diverse crops on an ad hoc basis were established. Tree crops established during the BARTAD project are not baing used experimentally.

EXTENSION

The Extension Service although it functionally exists in Bahamian Agriculture, is far from baing truly operational. The Extension Services Division has a mandate and parsonnel is assigned to the islands of Eleuthera, Abaco and Grand Bahama. Given the much more advanced agricultural activities in Abaco and Grand Bahama, it is difficult to understand why these two islands should have assigned

extension officers before any of the Southeastern Islands.

For development to take place in Bahamian agriculture, a whole spectrum of information covering from market knowledge to technical assistance is urgently needed for farmers, so they may cope and compete with one of the most advanced agricultural economies in the world. The most critical factor in the development of a modern agriculture sector will be the help and support extended to farmers particularly in the southeastern islands. Since the Department of Agriculture has an Extension Service which is charged with this specific responsibility, a resolution of the problem requires merely making it fully operational. In this respect, it will be mandatory to ensure proper training of personnel and deployment of this personnel to the farming communities.

4. THE FOOD TECHNOLOGY UNIT

The food technology unit came into existence in 1980 and was intended to play a role in research and the processing of Bahamian agricultural products as well as provide technical advice tot he private sector and administer the regulations of the Food Act of the Bahamas. A service as well as a research function was therefore envisaged.

In terms of physical plant it has microbiology, chemistry and product development laboratories as well as a pilot plant. The product development laboratory and pilot plant have limited space.

Equipment is adequate for current activities, but in many respects under-utilized.

There are twelve (12) professional positions requiring training to at least the bachelor's degree level and of these there were six vacancies. No one is adequately trained to carry out research in the food technology field. With the present professional staff seeming to be less than fully occupied, it is obvious that in terms of present activities the number of professionals apportioned to the unit is excessive.

In most instances officers had received general training in the sciences but not specific to the disciplines in which they had been assigned to.

It will be necessary to have officers receive further training. This should be done in concert with the imposition of technical assistance that is being recommended for institutional strengthening.

5. PROJECT IMPLEMENTATION

The format for implementation of the Research Extension and Training sub-project covering both sub-project areas would be built around a project management council consisting of:

a. Project Leader

b. Director of Agriculture

c. Deputy Director - Research

d. Deputy Director - Extension

e. Deputy Director - Production and Marketing

f. Consultant in Research Management

g. Consultant in Extension Design and Management

The qualifications of the Project leader are outlined below:

A senior executive with several years management experience at the highest organizational level and familiarity with the agricultural sector of the Bahamas within the context of its technical and administrative responsibilities.

Training to at least the Master's degree level in the agricultural field and preferably Economics, Agribusiness or Project Management.

A training officer would be part of the support staff assisting the project leader during the period of project implementation.

5.1 General Considerations

1. There should not be an institutional seperation of research and extension, i.e. we have a Director of Agriculture with overall responsibilities for both.

2. A strong central organization and backed up by sufficient funds such as 0.8 to 1.0% of the agricultural GDP.

3. Some degree of autonomy outside of the bureaucratic structure of Ministry of Agriculture.

4. Internal links to national planner, policy-makers (Land

survey, waterworks, forestry, science).

5. External links to Universities (UWI, Florida, Hawaii) CARDI, other institutions, World Tropical Institutions, International Research Centres.

6. Problem oriented adaptive research with stated objectives at the outset.

7. Recognition that technology transfer is still possible against the background of limited or unskilled manpower and weak national research effort.

8. Externally acquired technology information can be transferred initially and to be followed up and updated with local adaptive research taking care to ensure that there is an active participation by research officers in translating research results into recommendations for farmers.

9. There should be clearly defined job descriptions for personnel who are supervised and evaluated on the basis of job specifications.

10. Training to be carried out at the three research centres and in the field at differing islands.

11. In the implementation plan is built in provision for monitoring the efficiency and usefulness of ongoing research programme and the extension service.

5.2 Research and Extension Projects

Soil/Plant/Water Relations

A very strong research capacity will be required in this area. Inadequate utilization of soil and water reduces the potential production of all crop plants. It will be most desirable to ascertain and determine how agricultural production can be maximized under rainfed conditions as exists in the Southeastern islands as well as under irrigated conditions where the volume of water that can ba apportioned to farming is limited.

Upgrading and maintenance of the soil fertility status and efficient irrigation and drainage procedures will ensure production increase for all major crops (Table V-11)

This research should be of an applied nature so as to permit immediate commercial use of experimental results. All activities should be conducted in sites which represent very closely the

soils and environment of the major producing areas.

Recommended research activities should include:

- Phosphorus fixation in a calcareous medium.
- Soil fertility experiments varying time, methods and amounts of macronutrient application. In all cases crop response must be measured and economic analysis be considered.
- Evaluation of the effects of micronutrients in crop production.
- Studies with organic sources of nutrients such as green manure, animal waste and bio-fertilizers.
- Mulching practices to maximize water use.
- Development of methods of soil preparation which maximize water absorption and retention.
- Development of simple irrigation methods which are efficient in water utilization.

Strong and close cooperation with crop ;and pasture specialists will be necessary in order to plan and conduct adequate soil research for these crops.

Cooperation with the Farm Systems Research effort will be required for the formation of efficient cropping systems.

Complete technical reports should be submitted at the end of each year. They will be used for evaluation of progress being made in the programme and also for the evaluation of the output of each research staff.

Plant Protection Research

The objective of research in plant protection is to develop control methods which can keep at low levels the incidence of diseases and pests on the major crops of economic importance.

The research should be of an applied nature with possibilities of immediate use. In some cases, some basic information may be needed in terms of casual agents and the biology of insects.

Research should focus on pest and disease problems of the twenty-nine (29) selected crops shown in Table V-1.

The principal areas of concentration in Plant Protection

research should be Plant Pathology, Entomology and Weed Science. With Nematology and Virology assuming importance in the longer term recommended research activities are as follows:

Plant Pathology

- Survey of the most important diseases limiting production of the twenty-nine (29) selected crops (Table V-1) and the six (6) specialty crops.

- Development of efficient methods of disease control which are environmentally safe. Integrated pest management approach should be used. Biological and cultural control methods should have higher priority.

Entomology

- Survey of the most important insects limiting production of the selected crops.

- Study of population dynamics of most important insects.

- Development of efficient methods of insect control which are not inimical to the environment. Biology and cultural methods should have higher priority.

Weed Science

- Survey of weeds occurring in the most important production sites of the project areas.

- Establishment of levels of damage caused by weed compatition.

- Development of methods of weed control giving emphasis to biological and mechanical methods.

Nematology

- Survey of occurrence of nematodes in the most important production sites.

- Establishment of levels of damage caused by nematodes.

- Development of efficient methods of control which are environmentally safe.

Virology

- Survey of occurrence of virus in major crops of the most

important production sites.

- Establishment of the levels of damage caueed by virus.

- Development of methods of virus control, giving emphasis to varietal resistance and tissue culture techniques for production of virus-free planting material.

- Identification of virus vectors and their control.

The impact of pest and disease control on the environment should be constantly and closely monitored.

Crops Research

Vegetables

There is a wide range of vegetables currently grown in the sub-project areas and for those of priority interest (Table V-1) the recommended research activities are as follows:

- Introduction of varieties, evaluation and selection over a range of environments.

- Studies on soil fertilization using chemical and organic sources of nutrients.

- Survey of pest and disease occurrence in the most important production sites.

- Studies of insect population dynamics and disease evolution.

- Development of methods of disease and insect control giving emphasis to environmentally safe procedures.

- Studies on inter-cropping systems including a variety of companion crops. Soil fertilization for mixed crop systems should also ba addressed.

- Studies on crop rotation with the objective to maintain crop yields at higher levels for longer periods of time. Monitoring of soil borne pathogens will be necessary.

- Formulation of production packages for tests on farms.

The preparation of technical reports at the end of each year should be mandatory so as to evaluate the progress of the programme and the output of each scientist.

The Asian Vegetable Research and Development Centre (A.V.R.D.C.) has a long tradition of research on tropical

vegetables and should be very helpful in providing information related to possible research activities.

Tree Crops:

The major agronomic problems which limit tree crop production in the sub-project areas are the occurrence of diseases, nematodes and insects. Inadequate production systems characterized by inadequate plant density, fertilization procedure, weed control and pest and disease control was obvious.

Research in tree crops should be of an applied nature in such a way that results may be obtained in a relatively short period of time and be of immediate use to farmers. Research activities should be conducted in locations which are representative of the production sites. Recommended activities are as follows:-

- Introduction of varieties and species from other countries.
- Evaluation and selection of varieties and species introduced to different production sites.
- Soil fertility and plant nutrition studies in order to develop efficient fertilization procedures.
- Development of efficient cropping systems including inter-cropping, plant spacing and density, weed control.
- Methods of nematode control particularly as it relates to bananas, papaya and citrus, giving priority to biological and cultural procedures.
- Studies of combination of root stocks and scions in order to identify the most adopted and efficient combinations particularly for mangoes.
- Methods of control of virus diseases particularly for papaya.
- On-farm testing of technological packages assembled in light of actual knowledge including, later, new research findings from the programme.

The preparation of complete technical reports at the and of each year should be a requirement facilitating an assessment of the development of research programmes and an evaluation of the research personnel

Corn

One of the major subsistence crops grown in the sub-project areas, severe problems exist that limit production including, cultivation of low yielding varieties susceptible to diseases and pests, utilization of inefficient cropping systems with inadequate crop mixtures, little or no use of fertilizers and poor weed control.

The following research activities are recommended:

- Introduction and evaluation of germ plasm from international research centres.
- Evaluation and selection of superior material based on a multiple stage selection scheme conducted over differing environments.
- Systematic pest and disease survey with studies on insect population dynamics and disease evolution.
- Development of methods of disease and pest control which are efficient and environmentally safe.
- Inter-cropping experiments involving several other annual species as well as tree crops as companion crops. Fertilization treatments should be included in these experiments.
- Crop rotation studies involving root crops and food legumes.
- On-farm tests of production systems based on proven technology.
- Multiplication and maintenance of seed stocks of selected varieties.

The submission of technical reports at the end of each year with comprehensive analysis and interpretation of experimental data should be used in the evaluation of research personnel

Pigeon Pea

Pigeon pea is the most widely grown crop in the sub-project areas. Its higher quality and content of proteins is a very important factor as far as human nutrition is concerned and especially in the project area where it is the major subsistence crop. Current yields are extremely low due principally to a high incidence of disease infestation, lack of use of fertilizers, inefficient production systems and the lack of selected varieties.

Research activities recommended are as follows:

- Systematic introduction of varieties from international centres.

- Evaluation of varieties in different environments and selection of the most promising for further studies.

- Studies of plant density and spacing arrangements for differing climatic conditions with the sub-project areas.

- Evaluation of efficient inter-cropping systems using corn, cassava, and other companion crops.

- Soil fertilization studies giving emphasis to organic and inorganic nutrient sources.

- Experiments of planting and harvesting time.

- Survey of the most important insects and diseases occurring in the producing regions. Insect distribution, population dynamics and development of efficient methods of insect and disease control giving emphasis to procedures which are environmentally safe.

At the end of each year, a complete and comprehensive technical report must be submitted by each team member. All data should be fully analyzed and interpreted.

Cassava

One of the major subsistence crops grown in the sub-project areas, cassava has been treasured for its ability to survive under rigorous conditions. Yields are much lower than actual potential due to use of low yielding varieties susceptible to pests and diseases as well as inadequate production systems.

Research activities to be carried out are as follows:

- Introduction of varieties from International Research Centres.

- Evaluation of varieties in different environments with selection of the best material considering overall performance.

- Experiments on plant density, spacing arrangements in differing producing regions using, first, the local varieties and later the best varieties which have been identified.

- Evaluation of inter-cropping systems using an array of companion crops and planting arrangements.

- Soil fertilization experiments using a combination of chemical fertilizers in varying dosages. Fertilizer tests in inter-cropping systems, with the objective to increase production and reduce the total amount of fertilizers should be embarked on.

- Studies of planting and harvesting time.

- Survey of diseases, and pests limiting cassava production.

- Studies of population dynamics and disease evolution of the most important insects and diseases.

- Development of efficient cost-effective methods of weed control giving emphasis to procedures which use little or no chemical products. On-farm tests of technological packages.

It is mandatory that at the end of each year a comprehensive technical report of all experimental activities be submitted by each investigator to the team leader. All results must be fully analyzed and interpreted with suggestions to the Extension Service on how to diffuse more efficiently each conclusive result that may contribute to improvement of cassava production in the sub-project areas.

Farming Systems Research

The main components of a farming system are: environment, crops, livestock, social and economic components. These components plus their interactions will determine the nature and magnitude of each specific farming system.

The purpose of the Farming System Research Programme, which should be located principally at CIAREC, is to increase crop and livestock production at the subsistence and small farmer level, develop management technologies suitable for these farmers, increase the employment level in the rural sector and improve the general level of nutrition of the rural people while increasing the overall quality of farmers' life.

The nature of FSR should be the adaptation of scientific knowledge and technologies developed by the disciplines and crops research in such a way that an economical and efficient production system is developed.

Results of this research must reach the small farmer. Therefore through the Research and Extension service most

activity should be conducted in the farmers' holdings or in similar conditions.

The FSR group will be the natural link between experimental centre research and the extension service.

A well conceived FSR should:

- identify, describe and characterize the most important production systems of the sub-project areas.
- Identify proven technological innovations which could alleviate specific constraints.
- Design and test, on the farm, improvements in existing systems or newly developed systems.

Extension

The following will be necessary for the extension institution being proposed as a sub-project covering the two project areas.

1. An operational and functional linkage between extension and research must be in place in the Ministry of Agriculture.
2. There is a need for technical information documentation, and library service for professional staff in differing disciplines.
3. In the absence of formalized research activity in the Ministry, extension activity can progress and be effective by making use of imported technology initially.
4. There should be operational or functional linkages between extension and marketing. The size of the market being aimed for and the size of the production base is a major strategic issue to be resolved and communicated to the farming public.
5. An up-to-date farm level data base arising from information collected and analysed to understand what is happening in Bahamian Agriculture is to be facilitated by way of extension agents.
6. In the determination of government policies impacting on social and economic factors, appropriate technical and economic structures for farms is a prerequisite to contain external market power.

7. Clearly defined job descriptions to ensure efficient utilization of professional and para-professional expertise must be in place.

8. Extension personnel with advisory services taking a priority position should be a requirement for each individual island.

9. The acquisition of motor vehicles and their subsequent upkeep will be a necessary and costly initial investment facilitating a proper extension service.

5.3 Staffing

Against the background of current professional staff as shown in Table V-17 the detailed professional staff requirements for the Research service was developed and is shown in Table V-18. The major responsibilities and the necessary academic qualifications for the incumbents are shown in Tables V-19 and V-20 respectively.

A detailed list of the professional and paraprofessional staff for the Extension Service is presented in Table V-21. The major responsibilities and the necessary academic qualifications are shown in Tables V-22 and V-23 respectively.

At the differing regional institutions within the Ministry the Professional Staff and its required support staff will be as follows:

The following Research and Extension personnel will be located at the Head Office (R= RESEARCH ; E= EXTENSION).

POSITION	DESCRIPTION
1R	DEPUTY DIRECTOR RESEARCH
1E	DEPUTY DIRECTOR EXTENSION
2E	ASST. DIRECTOR TRAINING
3E	ASST. DIRECTOR VETERINARY SERVICES
4E	SENIOR EXTENSION OFFICER PLANT SERVICES
5E	EXTENSION OFFICER COMMUNICATIONS
12E	TRAINING OFFICER
13E	TRAINING OFFICER
15E	ENTOMOLOGIST
16E	PLANT PATHOLOGIST
17E	PLANT PROPAGATION (SALES)
18E	BOTANICAL GARDENS - SUPERINTENDENT
19E	ANIMAL CONTROL & ABBATTOIR (VET. SERVICES)
21E	EXTENSION (VET. SERVICES)
22E	EXTENSION (VET. SERVICES)
	10 SECRETARIAL/CLERICAL SUPPORT
	8 OTHER SUPPORT

SUMMARY

CLASSIFICATION	NUMBER
PROFESSIONAL	15
SECRETARIAL/CLERICAL SUPPORT	10
OTHER SUPPORT	8

Associated with GRAC will be the following personnel:

POSITION	DESCRIPTION
2R	SENIOR ASST. DIRECTOR
5R	RESEARCH OFFICER-SOIL FERTILITY
6R	" " PLANT PROTECTION
7R	" " LIVESTOCK
8R	" " FOOD TECHNOLOGY
9R	" " LAND AND WATER DEVELOP.
11R	" " HORTICULTURE/FRUIT
14R	" " PLANT PROTECTION
16R	FOOD TECHNOLOGIST-FOOD TECHNOLOGY
17R	RESEARCH OFFICER SOIL FERTILITY
22R	" " VEGETABLES
25R	" " POST HARVEST PHYSIOLOGY
26R	" " ENTOMOLOGY
27R	" " PLANT PATHOLOGIST
30R	" " PLANT BREEDING
31R	CHEMIST - FOOD TECHNOLOGY
32R	MICROBIOLOGIST - FOOD TECHNOLOGY
33R	STANDARDS - FOOD TECHNOLOGY
34R	PRODUCT DEVELOPMENT - FOOD TECHNOLOGY
6E	SUPERVISOR EXTENSION SERVICES
9E	SENIOR EXTENSION OFFICER
20E	ANIMAL HEALTH - VETERINARY SERVICES
19	TECHNICAL
10	SECRETARIAL/CLERICAL
15	OTHER SUPPORT
26	LABORERS (EQUIVALENT)

SUMMARY

CLASSIFICATION	NUMBER
PROFESSIONAL	19
TECHNICAL	19
SECRETARIAL/CLERICAL	10
OTHER SUPPORT	15
LABORERS (EQUIVALENT)	26

Associated with BARC will be the following personnel:

POSITION	DESCRIPTION
3R	ASSISTANT DIRECTOR
10R	RESEARCH OFFICER-SOILS/PLANT
12R	AGRICULTURAL ENGINEER
13R	RESEARCH OFFICER-VEGETABLES
15R	RESEARCH OFFICER-VET. SCIENCE
19R	RESEARCH OFFICER-TREE CROPS
21R	RESEARCH OFFICER-VEGETABLES
24R	RESEARCH OFFICER-AGRO HYDROLOGY
28R	RESEARCH OFFICER-ANIMAL SCIENCE & PASTURE
7E	SUPERVISOR OF EXTENSION SERVICES
10E	SENIOR EXTENSION OFFICER RESEARCH LINK
23E	EXTENSION OFFICER ANDROS
29E	EXTENSION AGENT SOUTH ANDROS
30E	EXTENSION AGENT ANDROS
8	TECHNICIANS/HERDSMEN
5	SECRETARIAL/CLERICAL
8	OTHER SUPPORT STAFF
16	LABORERS (EQUIVALENT)

SUMMARY

CLASSIFICATION	NUMBER
PROFESSIONAL	12
PARA-PROFESSIONAL	2
TECHNICAL	8
SECRETARIAL/CLERICAL	5
OTHER SUPPORT	8
LABORERS (EQUIVALENT)	16

Associated with CIAREC will be the following personnel:

POSITION	DESCRIPTION	LOCATION
4R	ASST. DIR. RESEARCH	CIAREC
8E	SUPERVISOR OF EXTENSION SERVICES	"
18R	RESEARCH OFFICER-FARMING SYSTEMS	"
20R	" " -HORTICUL./FRUIT	"
23R	" " -VEGETABLE CROPS	"
29R	" " -RUMINANTS & NUTRITION	"
11E	SENIOR EXT. OFFICER-RESEARCH/EXTENSION LINKAGE	"
28E	EXTENSION OFFICER-LONG ISLAND & OTHERS	"
36E	EXTENSION AGENT-LONG ISLAND	LONG IS.
37E	" " -EXUMA	EXUMA
38E	" " -CROOKED ISLAND CROOKED	ISLAND
39E	" " -ACKLINS	ACKLINS
40E	" " -MAYAGUANA	MAYAGUANA
	4 TECHNICIANS	LONG IS.
	4 SECRETARIAL/CLERICAL SUPPORT	"
	4 OTHER SUPPORT STAFF	"
	8 LABORERS (EQUIVALENT)	"

SUMMARY

CLASSIFICATION	NUMBER
PROFESSIONAL	8
PARA-PROFESSIONAL	5
TECHNICAL	4
SECRETARIAL/CLERICAL	4
OTHER SUPPORT	4
LABORERS	8

A composite staffing for the Research and Extension Services is shown in Table V-24.

N.B. An organizational chart for the Ministry was developed by the Institutional Specialist and forms part of the presentation above.

TABLE V-17 LIST OF CURRENT (1989) AGRICULTURAL POSITIONS WITH MINIMUM REQUIREMENT OF TRAINING TO THE BACHELOR'S LEVEL MINISTRY OF AGRICULTURE, THE BAHAMAS

CLASSIFICATION	NUMBER OF POSITIONS	VACANCIES
DIRECTOR	1	
SENIOR DEPUTY DIRECTOR	1	
DEPUTY DIRECTOR	1	
SENIOR ASSISTANT DIRECTOR	1	
ASSISTANT DIRECTOR	3	
SENIOR AGRICULTURAL OFFICER	4	
SENIOR VETERINARIAN	1	
VETERINARIAN	5	1
TRAINEE VETERINARIAN	1	
AGRICULTURAL OFFICER	15	2
ASSISTANT AGRICULTURAL OFFICER	11	4
TRAINEE AGRICULTURAL OFFICER	2	
SENIOR CHEMIST-FOOD TECHNOLOGY	1	1
CHEMIST-FOOD TECHNOLOGY	1	
ASST. CHEMIST-FOOD TECHNOLOGY	2	1
FOOD TECHNOLOGY	1	
TRAINEE FOOD TECHNOLOGY	1	1
ASSISTANT FOOD TECHNOLOGY	2	2
TRAINEE ASST. FOOD TECHNOLOGY	2	
MICROBIOLOGIST-FOOD TECHNOLOGY	1	
ASSISTANT MICROBIOLOGIST-FOOD TECHNOLOGY	1	1
T O T A L	58	13

TABLE V-18 COMPOSITE LIST OF PROFESSIONAL EMPLOYEES FOR AGRICULTURAL RESEARCH SERVICES

POSITION	D E S C R I P T I O N
1R	DEPUTY DIRECTOR RESEARCH
2R	SENIOR ASSISTANT DIRECTOR (GRAC)
3R	ASSISTANT DIRECTOR (BARC)
4R	ASSISTANT DIRECTOR (CIAREC)
5R	RESEARCH OFFICER (SOIL FERTILITY)
6R	RESEARCH OFFICER (PLANT PROTECTION)
7R	RESEARCH OFFICER (LIVESTOCK)
8R	RESEARCH OFFICER (FOOD TECHNOLOGY)
9R	RESEARCH OFFICER (LAND AND WATER DEVELOPMENT)
10R	RESEARCH OFFICER (SOILS PLANT)
11R	RESEARCH OFFICER (HORTICULTURE/FRUIT)
12R	SENIOR AGRICULTURAL RESEARCH OFFICER ENGINEER
13R	RESEARCH OFFICER HORTICULTURE (VEGETABLES)
14R	RESEARCH OFFICER (PLANT PROTECTION)
15R	RESEARCH OFFICER (VET SCIENCES)
16R	RESEARCH OFFICER (FOOD TECHNOLOGY)
17R	RESEARCH OFFICER (SOIL CHEMISTRY)
18R	RESEARCH OFFICER FARMING SYSTEMS (AGRONOMIST)
19R	RESEARCH OFFICER (TREE CROPS)
20R	RESEARCH OFFICER (HORTICULTURE AND FRUIT)
21R	RESEARCH OFFICER (VEGETABLES)
22R	RESEARCH OFFICER (VEGETABLES)
23R	RESEARCH OFFICER (VEGETABLES)
24R	RESEARCH OFFICER (AGRO. HYDROLOGY)
25R	RESEARCH OFFICER (POST HARVEST PHYSIOLOGY)
26R	RESEARCH OFFICER (ENTOMOLOGY)
27R	RESEARCH OFFICER (PLANT PATHOLOGY)
28R	RESEARCH OFFICER (ANIMAL SCIENCE AND PASTURE)
29R	RESEARCH OFFICER (SMALL RUMMINANTS & NUTRITION)
30R	RESEARCH OFFICER (PLANT BREEDING)
31R	RESEARCH OFFICER (CHEMIST)
32R	FOOD MICROBIOLOGYST TECHNOLOGY
33R	FOOD STANDARDS TECHNOLOGY
34R	FOOD PRODUCT DEVELOPMENT TECHNOLOGY

MAJOR RESPONSABILITIES OF RESEARCH PERSONNEL

TABLE V-19
1 OF 2

POSITION	MAJOR RESPONSABILITIES
1R	(a) OVERALL RESPONSABILITY FOR RESEARCH AND ADMINISTRATIVE ACTIVITIES OF DEPARTMENT OF THE (AGRICULTURE). (b) ENSURES THE CLOSEST POSSIBLE LINK WITH THE DEPUTY DIRECTOR OF EXTENSION TO ENABLE TWO-WAY FLOW OF PROBLEM ORIENTED ADAPTIVE RESEARCH AND DISSEMINATION OF RESEARCH RESULTS. (c) DIRECT RESPONSIBILITY FOR ANNUAL PREPARATIONS OF RESEARCH ACTIVITIES AND RESULTS. (d) COMMITTE MEMBER FOR APPRAISAL OF RESEARCH STAFF. (e) MEMBER OF THE MANAGEMENT COUNCIL RESPONSIBLE FOR IMPLEMENTATION OF INSTITUTIONAL STREGTHENING OF THE RESEARCH AND EXTENSION SERVICES.
2R	(a) OVERALL RESPONSABILITY FOR THE RESEARCH ACTIVITIES AT THE MAIN RESEARCH CENTRE AT GRAC, AND THE RESEARCH CENTRES AT BARC/CIAREC (b) IN CONSULTATION WITH ASSISTANT DIRECTORS AT BARC/CIAREC ENSURES THAT RESEARCH ACTIVITIES AT ALL THREE CENTRES PROPERLY AND ADEQUATELY ADDRESSES THE RESEARCH NEEDS OF THE BAHAMAS. (c) SUPERVISES THE ACTIVITIES OF 3R AND 4R FACILITATES TWO WAY FLOW OF RESEARCH PROBLEM AND SOLUTION BY DIRECT LIASION WITH ASSISTANT DIRECTOR OF EXTENSION (GRAC).
3R	(a) DIRECT RESPONSIBILITY FOR ADMINISTRATIVE AND RESEARCH ACTIVITIES AT THE BARC RESEARCH CENTRE (b) DIRECT RESPONSIBILITY TO ENSURE CONDUCT OF RESEARCH AND SPECIFICALLY THE ANNUAL REPORT PREPARATION OF RESULTS FOR PRESENTATION TO THE SENIOR ASSISTANT DIRECTOR (GRAC). (c) FACILITATES TWO WAY FLOW OF RESEARCH PROBLEMS AND SOLUTION BY DIRECT LIASION WITH ASSISTANT DIRECTOR OF EXTENSION (BARC). (d) CONDUCTS RESEARCH INVESTIGATIONS AT THE CENTRE
4R	(a) SIMILAR TO 3R EXCEPT THAT IN RELATES TO CIAREC

POSITION	MAJOR RESPONSABILITIES
5R	(a) MAJOR RESPONSABILITY IS RESEARCH IN SPECIFIC DISCIPLINE (90% OF THE WORK PERIOD) OF THE DEPARTMENT. (b) RESEARCH PRODUCTIVITY IS BASIS FOR INCREASED EMOLUMENTS AND ADVANCEMENT. (c) PROVIDES RESEARCH LEADERSHIP AND INTERACTS WITH FARMERS OR INDUSTRY VIA-TRAINING AND OTHER COMMUNICATIVE EXERCISES. (d) CO-ORDINATES PREPARATION OR RESEARCH BUDGETS AND PROGRAMMES. (e) ESTABLISHES STRONG INTERNAL LINKAGES WITH THE EXTENSION SERVICE AND EXTERNAL LINKAGES WITH INTERNATIONAL RESEARCH CENTRES AND AGENCIES.
6R	(a) SEE 5R.
7R	(a) SEE 5R.
8R	(a) SEE 5R.
9R	(a) SEE 5R.
10R	(a) RESEARCH IN SPECIFIC DISCIPLINE OF ASSIGNMENT. (b) PROVIDES SUPPORT AND LEADERSHIP TO AGRICULTURAL RESEARCH OFFICERS AT A MULTIDISCIPLINARY LEVEL. (c) PROVIDES TRAINING BY CONDUCTING WORKSHOPS, FARMERS MEETINGS OR INDUSTRY CONFERENCES AUTHOR OF EXTENSION BULLETINS, ATTENDING INTERNATIONAL SCIENTIFIC CONFERENCES. (d) RESEARCH PRODUCTIVITY WICH IS THE BASIS FOR ADVANCEMENT TO BE ADDRESSED. PARTICIPATION IN COMMUNICATING RESEARCH TO FARMERS AND OTHER MEMBER OF THE PUBLIC WICH IS A BASIS FOR ADVANCEMENT. (e) MEMBER OF INTERNATIONAL SCIENTIFIC RESEARCH BODIES. (f) IN CO-OPERATION WITH EXTENSION SERVICE INDENTIFY FORMULATE AND PRESENT RESEARCH PROJECTS RELATED TO ECONOMIC PRODUCTION AND TECHNOLOGY.
11R-16R	(a) SEE 10R.
17R-34R	(a) THE RESPONSIBILITIES ARE SIMILAR TO THOSE OF 10R. (b) ADVANCEMENT TO SENIOR AGRICULTURAL RESEARCH OFFICER POST IS BASED PRODUCTIVITY IN RESEARCH.

TABLE V-20 REQUIRED ACADEMIC QUALIFICATIONS OF RESEARCH PERSONNEL

POSITION	Q U A L I F I C A T I O N S
1R	TRAINING TO THE PHD LEVEL OR AT LEAST TO THE MATER'S LEVEL IN AGRICULTURE OR EQUIVALENT IN A RELATED FIELD. ADMINNISTRATIVE EXPERIENCE AND CAPABILITY . 10 YEARS WORK EXPERIENCE.
2R	SEEE I ABOVE EXCEPT LESS YEARS OF ADMINISTRATIVE EXPERIENCE.
3R	M.SC DEGREE IN AGRICULTURAL SCIENCE OR BACHELOR'S AND EVIDENCE OF RESEARCH CAPABILITIES, 5 YEARS ADMINISTRATIVIE EXPERIENCE.
4R	SIMILAR TO 3R
5R	M.SC DEGREE IN AGRICULTURAL OR RELATED FIELD. BACHELOR'S DEGREE AND SEVERAL YEARS EXPERIENCE WITH RESEARCH ORGANIZATION.
6R	SEE 5R
7R	SEE 5R
8R	SEE 5R
9R	BACHELOR'S DEGREE IN AGRICULTUAL ENGINEERING OR MASTERS DEGREE IN AGRO-HYDROLOGY.
10R	M.SC DEGREE IN AGRICULTURAL OR RELATED FIELD. RESERCH ACTIVITY AS EVIDENCE BY PUBLISHED REFEREED IN FORMATION.
174-34R	M.SC DEGREE IN AGRICULTURAL OR RELATED FIELD. B.SC. DEGREE WITH SEVERAL YEARS EXPERIENCE IN A RESEARCH ORGANIZATION.

TABLE V-21

COMPOSITE LIST OF PROFESSIONAL AND PARA-PROFESSIONAL EMPLOYEES FOR AGRICULTURAL EXTENSION SERVICES

POSITION	D E S C R I P T I O N
1E	DEPUTY DIRECTOR EXTENSION
2E	ASSISTANT DIRECTOR (TRAINING)
3E	ASSISTANT DIRECTOR (VETERINARY SERVICES)
4E	SENIOR EXTENSION OFFICER (PLANT SERVICES)
5E	EXTENSION OFFICER (COMMUNICATIONS)
6E	SUPERVISOR EXTENSION SERVICES
7E	SUPERVISOR EXTENSION SERVICES
8E	SUPERVISOR EXTENSION SERVICES
9E	SENIOR AGRICULTURAL EXTENSION OFFICER GRAC (SUBJET MATTER CROP CARE)
10E	SENIOR AGRICULTURAL EXTENSION OFFICER BARC (SUBJET MATTER CROPS)
11E	AGRICULTURAL EXTENSION OFFICER CIAREC (SUBJET MATTER LIVESTOCK)
12E	TRAINING OFFICER
13E	TRAINING OFFICER
14E	LIBRARIAN
15E	ENTOMOLOGIST
16E	PLANT PATHOLOGIST
17E	PLANT PROPAGATION (SALES)
18E	BOTANICAL GARDENS
19E	ANIMAL CONTROL & ABATTOIR (VET SERVICES)
20E	ANIMAL HEALTH (VET SERVICES)
21E	EXTENSION (VET SERVICES)
22E	EXTENSION (VET SERVICES)
23E	EXTENSION OFFICER (ANDROS)
24E	EXTENSION OFFICER (ABACO)
25E	EXTENSION OFFICER (ELEUTHERA)
26E	EXTENSION OFFICER (GRAN BAHAMA)
27E	EXTENSION OFFICER (CAT ISLAND)
28E	EXTENSION OFFICER (LONG ISLAND)
29E	EXTENSION OFFICER (SOUTH ANDROS)
30E	EXTENSION AGENT (ANDROS)
31E	EXTENSION AGENT (ABACO)
32E	EXTENSION AGENT (ELEUTHERA)
33E	EXTENSION AGENT (ELEUTHERA)
34E	EXTENSION AGENT (GRAN BAHAMA)
35E	EXTENSION AGENT (CAT ISLAND)
36E	EXTENSION AGENT (LONG ISLAND)
37E	EXTENSION AGENT (EXUMA)
38E	EXTENSION AGENT (CROOKED ISLAND)
39E	EXTENSION AGENT (ACKLINS)
40E	EXTENSION AGENT (MAYAGUANA)

MAJOR RESPONSABILITIES OF EXTENSION PERSONNEL

TABLE V-22
1 OF 5

POSITION	MAJOR RESPONSABILITIES OF EXTENSION PERSONNEL
1E	(a) OVERALL RESPONSABILITY FOR EXTENSION AND TRAINING ACTIVITIES, VETERINARY SERVICES AND THE ADMINISTRATION OF THE DEPARTMENT (AGRICULTURE) (b) ENSURES THE CLOSEST LINK WITH THE DEPUTY DIRECTOR OF AGRICULTURE TO ENABLE TWO-WAY FLOW OF PROBLEM ORIENTED ADAPTIVE RESEARCH AND DISSEMINATION OF RESEARCH RESULTS TO THE BAHAMAS. (c) DIRECT RESPONSIBILITY FOR ANNUAL PREPARATIONS OF EXTENSION ACTIVITIES REPORT, HIGHLIGHTING RESEARCH NEEDS AS WELL AS OTHER PROBLEMS IN BAHAMAS. (d) COMMITTEE MEMBER FOR APPRAISAL OF EXTENSION STAFF. (e) MEMBER OF THE MANAGEMENT COUNCIL RESPONSIBLE FOR IMPLEMENTATION OF INSTITUTIONAL STREGTHENING OF THE RESEARCH AND EXTENSION SERVICES.
2E	(a) OVERALL RESPONSABILITY FOR REGION AGRICULTURAL TRAINING PARTICULARILY IN-SERVICES TRAINING, RELATIVE TO ADMINISTRATIVE, TECHNICAL AND GENERAL EXTENSION SEVICES (b) SUPERVISES THE ACTIVITIES OF 12E AND 13E
3E	(a) OVERALL RESPONSABILITY FOR ALL VETERINARY SERVICES IN THE BAHAMAS. (b) DIRECT RESPONSIBILITY FOR SUPERVISING THE ACTIVITIES OF POSITIONS 19E, 20E, 21E, 22E. (c) REPORTS DIRECTLY TO THE DEPUTY DIRECTOR OF EXTENSION. (d) PREPARE AND SEEK APPROVAL FOR HE TERMS OF REFERENCE FOR ALL VETERINARY PERSONNEL. (e) TO ADMINISTER THE ORGANIZATIONL AFFAIRS ENSURING THE SMOOTH RUNNING OF HEAD OFFICE.

TABLE V-22 (CONT'D)

POSITION	MAJOR RESPONSABILITIES
4E	(a) OVERALL RESPONSIBILITY FOR PLANT QUARANTINE FACILITIES AND SERVICES. (b) DIRECT RESPONSIBILITY FOR PROMOTING AND FAMILIARIZING THE PUBLIC CONCERNING AVAILARILITY OF PROPAGATED PLANTS. (c) RESPONSIBLE FOR MANTIAINING INTERNATIONAL CONTACTS AND ENSURING THE INTRODUCTION OF NEW PLANT SERVICES. (d) RESPONSIBLE FOR OVERSEEING MANAGEMENT OF THE BOTANICAL GARDENS. (e) RESPONSIBLE FOR SUPERVISING THE ACTIVITIES OF POSITIONS 15E, 16E, 17E AND 18E.
5E	(a) OVERALL RESPONSIBILITY FOR INFORMATION AND COMMUNICATION SYSTEMS WITHIN THE EXTENSION SERVICE. (b) RESPONSIBILITY FOR SECURING MARKETING INFORMATION OF RELEVANCE AND IMPORTANCE TO THE FARMING AND AGRO-INDUSTRIAL SECTOR. (c) RESPONSIBILITY FOR SUPERVISING THE DIFFERING COMMUNICATION MEDIA ACTIVITIES DIRECTED TO FARMERS AND POTENTIAL FARMERS. (d) SUPERVISES THE ACTIVITIES OF THE DEPARTMENT LIBRARIAN.
6E	(a) OVERALL RESPONSIBILITY FOR THE REGIONAL EXTENSION SERVICES OF NEW PROVIDENCE, ELEUTHERA , AND CAT ISLAND. (b) RESPONSIBILITY FOR INTER-ACTING WITH OTHER REGIONAL SUPERVISORS TO ENSURE THAT THE COUNTRY AS A WHOLE IS ADEQUATELY AND FAIRLY SERVED. (c) RESPONSIBILITY TO ENSURE THAT TWO-WAY FLOW OF RESEARCH AND EXTENSION ACTIVITIES ARE APPROPIATE FOR THE REGION SUPERVISED.
7E	(a) SIMILAR TO 6E BUT FOR NORTH AND SOUTH ANDROS, GRAND BAHAMA AND ABACO.

TABLE V-22 (CONT'D)

POSITION	MAJOR RESPONSABILITIES
8E	SIMILAR TO 6E BUT LONG ISLAND, EXUMA, CROOKED ISLAND, ACKLINS AND MAYAGUANA.
9E	(a) THE PRIMARY REPONSIBILITY AT THIS LEVEL IS TO BE INFORMED ON THE MOST INTIMATE TERMS CONCERNING THE PROBLEMS IN THE AREA REQUIRING RESEARCH ATTENTION (CROP CARE) AND ENSURING THAT RESEARCH INFORMATION CONCERNING SOLUTIONS IS TRANSMITTED TO FARMERS ON A TIMELY BASIS. (b) DEVELOPMENT OF DETAILED INFORMATION SECURED FROM THE LITERATURE IN THE AREA OF SUBJECT MATTER SPECIALIZATION AND ENSURE THAT IT IS COMMUNICATED TO THE FARMING PUBLIC. (c) IN ASSOCIATION WITH RESEARCH PERSONNEL DEVELOP A PROTOCOL TO ADDRESS PROBLEMS DESTINED FOR RESEARCH INVESTIGATIONS.
10E	(a) SIMILAR TO 9E FOR PARTICULAR SUBJECT MATTER (CROPS).
11E	(a) SIMILAR TO 9E FOR PARTICULAR SUBJECT MATTER (LIVESTOCK).

TABLE V-22 (CONT'D)

POSITION	MAJOR RESPONSABILITIES
12E	(a) UNDER THE DIRECT SUPERVISION OF THE ASSISTANT DIRECTOR TRAINING (2E) TO BE RESPONSIBLE FOR DEVELOPMET OF TRAINING IN TECHNICAL OR SUBJECT MATTER SPECIALITIES.
13E	(a) UNDER THE DIRECT SUPERVISION OF THE ASSISTANT DIRECTOR TRAINING (2E) TO BE RESPOONSIBLE FOR DEVELOPMENT OF TRAINING IN THE ADMINISTRATIVE OR SUPERVISORY CATEGORIES.
14E	(a) TO BE RESPONSIBLE FOR DEVELOPING AND EFFICCIENT LIBRARY FACILITATING THE REQUIREMENTS OF RESEARCH AND EXTERNSION WORKERS IN AGRICULTURE. (b) TO PREPARE ACEPTABLE BUDGET, AND IN AN EQUITABLE MANNER ENSURE THAT ACQUIRED LIBRARY VOLUMES MEET THE NEEDS OF THE BROAD CROSS SECTION OF RESEARCHERS AND EXTENSION WORKERS. (c) TO MAINTAIN INTERNATIONAL CONTACTS WITH SPECIALIZED INFORMATION CENTRES DEVOTED TO AGRICULTURAL RESEARCH AND EXTENSION.
15E	(a) UNDER THE DIRECTION OF SENIOR EXTENSION OFFICER (4E) TO BE THE RESOURCE PERSON MONITORING THE ENTRY OF PLANTS OR PLANTING MATERIAL INTO THE BAHAMAS. (b) TO PARTICIPATE IN FIELD SURVEYS AIMED AT ACQUIRING INORMATION RELATIVE TO LOCAL PESTS AFFECTING PLANTS. (c) TO PROVIDE AS NEEDED INFORMATION CONCERNING CONTROL MEASURES TO MINIMIZE PLANT INFESTATION.
16E	(a) SIMILAR TO 15E BUT IS FIELD OF PLANT PATHOLOGY.
17E	(a) UNDER THE DIRECTION OF THE SENIOR EXTENSION OFFICER (4E) ACQUIRES AND MAKES AVAILABLE TO FARMERS PLANTING MATERIAL FROM INTERNATIONAL SOURCES. (b) DEVELOPS LOCALLY AND MAINTAINS APPROPIATE SEEDLINGS REQUIRED FOR TREE CROPS DEVELOPMENT PROGRAMMES IN ALL ISLANDS. (c) RESPONSIBLE FOR THE SALE OF SEEDLINGS TO THE PUBLIC.

POSITION	MAJOR RESPONSABILITIES
18E	(a) UNDER THE SUPERVISION OF THE SENIOR EXTENSION OFFICER (4E) HAVE OVERALL RESPONSIBILITY FOR THE BOTANICAL GARDENS ENSURING ITS PROPER ADMINISTRATION AND MAINTENANCE. (b) ACQUIRES EXOTIC PLANT MATERIALS AND PARTICIPATES IN ENSURING THE COLLECTION AND MAINTENANCE OF LOCAL PLANT OF COMMERCIAL AND BEAUTIFICATION VALUE.
19E	(a) TO OVERSEE THE ADHERENCE TO THE CODE OF OPERATION BY THE ABATTOIR ENSURING THE DELIVERY OF WHOLESOME MEAT AND MEAT PRODUCTS TO THE PUBLIC. (b) RESPONSIBLE FOR THE ADMINISTRATION OF THE DOG CATCHING ACTIVITIES WITH HUMANE HANDLING AND DISPOSAL.
20E	(a) RESPONSIBLE FOR THE VETERINARY SURVEILLANCE PROGRAMME ENSURING UP TO-DATE METHODOLOGY FOR DIAGNOSIS AND THE APPROPRIATE ACTION FOR CONTROLS.
21E	(a) TO BE RESPONSIBLE FOR THE DELIVERY OF ON-FARM HEALTH CARE AND THE INSTITUTION OF PREVENTATIVE PROGRAMMES IN THE NORTH SUB-PROJCET AREA.
22E	(b) SIMILAR TO 21E FOR THE SOTHEASTERN SUB-PROJCET AREA.
23E-28E	(a) TO ENSURE THE DISSEMINATION OF INFORMATION RELATED TO CROP PRODUCTION, LIVESTOCK, MANAGEMENT, PEST AND DISEASE CONTROL ON AN ISLAND-WIDE BASIS. (b) IN CO-OPERATION WITH THE RESEARCH BRANCH, ESTABLISH AND MAINTAIN DEMOSTRATION AND EXPERIMENTAL PLOTS IN FARMERS' FIELDS. (c) IN SUPERVISING EXTENSION AGENTS ENSURE THE COLLECTION OF DATA RELEVANT TO ALL AGRICULTURAL ACTIVITIES ON THE ISLAND. (d) TO SUPERVIBE THE APPLICATION FOR CREDIT AND PREPARE PROGRESS REPORT ON EACH BURROWER. (e) TO APPRAISE THE RESEARCH BRANCH OF SERIOUS PROBLEMS NEEDING CORRECTIVE ATTENTION

REQUIRED ACADEMIC QUALIFICATIONS OF EXTENSION PERSONNEL

TABLE V-23
1 OF 2

POSITION	MAJOR RESPONSABILITIES
1E	(a) TRAINING TO THE PHD LEVEL OR AT LEAST MASTER'S LEVEL EN AGRICULTURE OR EQUIVALENT IN A RELATED FIELD. ADMINISTRATIVE EXPERIENCE AND CAPABILITY. 10 YEARS WORK EXPERIENCE.
2E	(a) SEE 1E ABOVE EXCEPT LESS YEARS OF ADMINSTRATIVE EXPERIENCE
3E	(a) DOCTOR OF VETERINARY MEDICINE AND AT LEAST 5 YEARS OF ADMINSTRATIVE.
4E	(a) TRAINING TO MASTER'S DEGREE LEVEL ADMISTRATION OR MANAGEMENT FIELD. AGRICULTURAL BACKGROUND DESIREABLE.
5E	(a) TRAINING TO MASTER'S DEGREE LEVEL MAKING OR COMUNICATIONS FIELD. 5 YEARS WORK EXPERIENCE.
6E	(a) BACHELOR'S DEGREE IN AGRICULTURE WITH AT LEAST 10 YEARS EXPERIENCE IN ADMINISTRATION. FAMILIARITY WITH AGRICULTURAL REGIONS OF THE BAHAMAS.
7E-8E	(a) SIMILAR TO 6E.
9E	(a) TRAINING TO MASTER'S DEGREE LEVEL IN AGRICULTURAL WITH SPECIALIZATION IN PLANT PATHOLOGY OR ENTOMOLOGY FIELD. EXPERIENCE IN EXTENSION NECESSARY.
10E	(a) SIMILAR TO 9E EXCEPT WITH SPECIALIZATION IN VEGETABLE CROPS, TREE CROPS OR AGRONOMY.
11E	(a) SIMILAR TO 9E EXCEPT SPECIALIZATION IN ANIMAL SCIENCE.
12E	(a) BACHELOR'S DEGREE.
13E	(a) BACHELOR'S DEGREE.
14E	(a) BACHELOR'S DEGREE IN LISRARY SCIENCE WORK EXPERIENCE NECESSARY.
15E	(a) BACHELOR'S DEGREE IN AGRICULTURAL WITH SPECIALIZATION IN ENTOMOLOGY.

TABLE V-23
2 OF 2

POSITION	QUALIFICATIONS
16E	(a) BACHELOR'S DEGREE IN AGRICULTURAL WITH SPECIALIZATION IN PLANT PATHOLOGY.
17E	(a) BACHELOR'S DEGREE IN AGRICULTURAL WITH SPECIALIZATION IN HORTICULTURE.
18E	(a) BACHELOR'S DEGREE IN AGRICULTURAL WITH SPECIALIZATION IN HORTICULTURE OR MARKETING.
19E-22E	(a) DOCTOR OF VETERINARY MEDICINE.
23E-28E	(a) BACHELOR'S DEGREE IN AGRICULTURAL WITH SPECIALIZATION IN EXTENSION.
29E-40E	(a) DIPLOMA IN AGRICULTURAL FROM AN APPROVED INSTITUTION WITH AT LEAST THREE YEARS WORK EXPERIENCE IN AGRICULTURE. MANAGERIAL TRAINING AND ASSET.

TABLE V-24 COMPOSITION FOR RESEARCH AND EXTENSION SERVICES

CLASSIFICATION	HEAD OFFICE	GRAC 1/	BARC 2/	CIAREC 3/	ABACO	ELEUTHRA	GRAND BAHAMA	CAT ISLAND	TOTAL
PROFESSIONAL	15	19	12	8	1	1	1	1	58
PARAPROFESSIONAL			2	5	1	2	1	1	12
TECHNICAL		19	8	4					31
SECRETARIAL/CLERICAL	10	10	5	4	1	1	1	1	33
OTHER SUPPORT	8	15	8	4					35
LABOURER (EQUIVALENT)		26	16	8					50

1/ GLADSTONE ROAD AGRICULTURAL COMPLEX
2/ BAHAMAS AGRICULTURAL RESEARCH CENTER
3/ COPPICE ISLAND AGRICULTURAL RESEARCH AND EXTENSION CENTER

5.4 The Coppice Islands Agricultural Research and Extension Centre (CIAREC)

Given the expanded role agriculture is to play in the development and diversification of the Southeastern islands an agricultural research and extension centre should be in place. The development of this sub-regional research and extension facility should provide a new breed of farmers with greater access to technical information and timely input supply that are relevant and appropriate to specific Southeastern island needs.

The following services will be provided:

Research information having a direct bearing on the Southeastern islands.

Extension specialist assistance to farmers in all Southeastern islands.

Facilities and expertise to ensure short courses in agricultural production, livestock management and market information.

Seminars on agricultural issues peculiar to the area that affect farmers.

Serve as a base for input supplies when necessary.

This centre to be located in Long Island will serve the Research and Extension needs of the Southeastern Island specifically and in a general way the needs of the Bahamas as a whole.

It is desirable that sufficient land space be included on the site to accommodate some field experiments involving crops and livestock. A minimum area of ten (10) acres is proposed.

The buildings to be constructed will include:

Research/Extension Station

Staff housing

Storage/Machinery shed

a. Research/Extension Station

The station building will be designed to accommodate both Research and Extension Personnel. A total of 4,800 sq. ft. as set out below will be needed.

4,800 sq. ft. to include:

*	Reception/Waiting	300 sq. ft.
*	2 Executive offices	500 " "
*	6 Standard offices	900 " "
*	Multi-purpose laboratory	1,000 " "
*	Conference Room	300 " "
*	Library	200 " "
*	Toilet Facilities	500 " "
*	General storage	300 " "
		4,000 x 20% circulation etc.

b. Staff Housing

Staff housing for the professional research and extension personnel will be provided. The total of 13,000 sq. ft. required will be as follows:

13,000 sq. ft. to include:

*	2 three-bedroom houses for Directors	3,000 sq. ft.
*	6 townhouse type apartment block for officers	9,000 sq. ft.
*	Central wash-house, garbage etc.	1,000 sq. ft.
		13,000 sq. ft.

c. Storage/ Machinery shed

A storage shed to house fertilizers, seeds and other agricultural inputs as well as provide parking for machinery will be required.

A total of 1,000 sq. ft. is adequate.

The total cost of $1.133 million for land and buildings is shown in Table V-25.

With respect to the multi-purpose laboratory, it is envisaged that sufficient and appropriate equipment will be provided from the agricultural budget.

TABLE V-25 LAND AND BUILDING COSTS FOR COPPICE ISLAND AGRICULTURAL RESEARCH AND EXTENSION CENTRE

COMPONENTS	FOREIGN EXCHANGE	LOCAL FUNDS	GRAND TOTAL
LAND (10 ACRES)	-	20,000	20,000
RESEARCH/EXTENSION BUILDING (4,800 SQ. FT.)	192,000	96,000	288,000
HOUSING (13,000) 2 HOUSES, 6 TOWNHOUSES	520,000	260,000	780,000
STORAGE/MACHINERY SHED (1,000 SQ. FT.)	30,000	15,000	45,000
TOTAL	742,000	391,000	1,133,000

5.5 Graduate Training

Critical to the successful implementation of the project relating to an organized Research Extension and Training Division is the provision of sufficient trained personnel and expertise to implement the project and assure its continuing operation.

It is proposed that over the initial five (5) year period of the project, a total of twenty five (25) selected candidates from the Ministry of Agriculture be sent for training in Researcha nd Extension in specific areas of specialization at selected Universities as outlined in Table .

This would be on a phased basis with eight candidates in each of the first and second years of the project and nine candidates in the third year of the project. With a projected requirement of two years to complete the Master's degree programme, all twenty five (25) candidates would be trained within the five-year period.

The estimated cost of $267,058, all of which is in foreign exchange is shown in Tables V-26A to V-26C, and summarized in Table V-27 as twice the cost to accommodate two years of research training.

5.6 Technical Assistance

At the project implementation stage, much of the current staff would not have had the experience or training to adequate levels that would ensure leadership in determining designing and prioritizing research extension and training activities. In this period technical cooperation will be required. A schedule of the proposed consultants is shown in Table V-28. The two central positions (A and B) relating to the setting up of a Research and Extension organization are relatively short-term, but with some continuity on an intermittent basis. The additional five positions are of longer term to ensure firstly, proper start-up and continuation of initiated projects in the differing disciplines and secondly, allowing for some interaction with research personnel returning after being trained for research.

Total costs for technical cooperation are estimated at $690,000 over the project period (Table V-28). All costs are in foreign exchange. A summary is provided in Table V-27.

5.7 Transportation Needs

Arising out of the increased activity of extension services on all islands in the project area as a whole, it is to be expected that transportation will be needed to facilitate access and communication with farmers.

A total of thirteen (13) pick-up trucks at a cost of $195,000 foreign exchange will be required and is shown in Table V-27.

5.8 Technical Cooperation in Training

Against the background of limited exposure by the current staff in the Ministry to extension training, an efficient and speedy process to achieve both objectives would be an organized programme developed and conducted with technical assistance. The UNDP as an international agency is disposed to offer such assistance.

The categories of extension personnel to be accommodated should be:

(a) Administrative/supervisory.

(b) Technical or subject matter specialists.

(c) Extension officers.

(d) Extension agents (para-professionals)

6 SUMMARY OF COSTS

A summary of the costs related to the Research, Extension and Training Services sub-project is shown in Table V-27.

7 BENEFITS

Within the context of the overall objectives of the project, research extension and training have been treated as related functions instrumental in increasing productivity and production in the agricultural pursuit of the islands individually and collectively.

Immediate support and long-term institutional building beyond the investment period has therefore been the focus.

Under current conditions of major deficiencies in research information relating to increased productivity, the adaptation of research results and material generated elsewhere can only be viewed as a temporary measure needing verification under specific local conditions. This verification is designed in the research programmes outlined above.

An effective extension service is not possible with absentee participants. The need for day-to-day interaction with farmers on each island has therefore been the design. Operational and functional linkages between research and extension is mandatory and should devolve from the project outlined.

The absence of an institutionalized training programme for extension personnel as well as external training for the farming public has been addressed in the project design.

The socio-economic considerations and benefits relative to the development of an agricultural sector have been dealt with in great detail by other mission specialists. What is being emphasized here is the fact that the most serious constraint to the development of a productive agricultural sector in the Bahamas lies in the absence of research extension and training facilities. Unless this is addressed immediately and given the highest priority, much that follows in an attempt to provide other support services will be a total waste.

In most countries the principal agent to ensure such facilities is the government since the benefits derived are not merely restricted to farmers - the most active participants - but the country as a whole. The matter of maintaining agricultural residents of the differing islands in their present abode and

diminishing the appeal of urban drift needs to be restated as a solution to a grave problem.

8 BENEFICIARIES

There are three major farming systems in the Bahamas consisting of subsistence farmers, medium and small-scale commercial farmers and large-scale corporate farming.

The structuring of the Research Extension and Training Division and the execution of the components of the Project would be of benefit to all farming enterprises. While the number of corporate farmers are few, the enterprises nevertheless are on a scale that dwarfs the total area occupied by subsistence, small and medium commerical farmers whose numbers are shown in Table .

While corporate farmers in most instances bring in their own technologies and rely on external technical consultations, the other beneficiaries cannot afford this option and are therefore the primary beneficiaries. It is to be expected that as research efforts are widened, corporate farmers will increasingly come to rely on local expertise.

FIRST YEAR RESEARCH AND EXTENSION TRAINING PROGRAMME AND COSTS FOR SELECTED CANDIDATE IN THE MATI

TABLE V-26A
1 OF 3

POSITION	RECOMMENDED INSTITUTION	AREA OF SPECIALIZATION	COURSES	RESEARCH ACTIVITY	EXPENSES (ANNUALLY)		
					TUITION	ROOM AND BOARD	BOOK TRAVEL INCIDENTALS
1. SOIL FERTILITY YEAR I	UNIVERSITY OF FLORIDA USA	SOILS MAJOR, CROPS MINOR	SOIL CHEMISTRY SOIL FERTILITY PLANT NUTRITION STATISTICS	CROPS RESPONSES TO MACRO AND MICRO ELEMENTS IN HIGHLY CALCAREUS SOILS	5,480	4,800	1,200
2. HORTICULTURIST YEAR I	UNIVERSITY OF FLORIDA USA	CITRUS CROPS	TREE CROPS STATISTICS	NUTRITION, CULTURAL PRACTICE AND MANAGEMENT	5,480	4,800	1,200
3. HORTICULTURIST YEAR I	UNIVERSITY OF WEST INDIES	ROOT CROPS	VEGETABLES AND ROOT CROPS STATISTICAL DESIGN	CULTURAL PRACTICES PHYSIOLOGY	50	4,550	1,200
4. AGRICULTURAL ENGINEER YEAR I	UNIVERSITY OF CALIFORNIA USA	IRRIGATION	SOILS, IRRIGATION	NONE	8,635	5,512	1,600
5. LIVESTOCK YEAR I	TEXAS A. & TEXAS M.	LIVESTOCK	ANIMAL SCIENCE PARASITOLOGY VIROLOGY	CONTROL OF DISEASES IN TROPICAL ANIMALS	6,255	5,330	1,500
6. EXTENSION YEAR I	UNIVERSITY OF WEST INDIES TRINIDAD	EXTENSION ANIMAL SCIENCE	EXTENSION ANIMAL SCIENCE	EXENSION SERVICES DIRECTED TO ANIMAL CARE AND PRODUCTION	50	4,550	1,200
7. EXTENSION YEAR I	CRNELL UNIVERSITY ITHACA NEW YORK	EXTENSION AGRONOMY	EXTENSION AGRONOMY	EXENSION SERVICES AND THE EDUCATION RATE	7,320	6,030	1,400
8. HORTICULTURIST YEAR I	UNIVERSITY OF WEST INDIES TRINIDAD	VEGETABLE CROPS HERBICIDE	AGRONOMY VEGETABLE CROPS STATISTICS	HERBICIDE ACTIVITY DIVERSE VEGETABLE CROPS	50	4,550	1,200
S U B - T O T A L					33,320	40,122	10,500

SECOND YEAR RESEARCH AND EXTENSION TRAINING PROGRAMME AND COSTS FOR SELECTED CANDIDATE IN THE MATI

TABLE V-26B
2 OF 3

POSITION	RECOMMENDED INSTITUTION	AREA OF SPECIALIZATION	COURSES	RESEARCH ACTIVITY	EXPENSES (ANNUALLY)		
					TUITION	ROOM AND BOARD	BOOK TRAVEL INCIDENTALS
9. ENTOMOLOGY YEAR II	CORNELL UNIVERSITY	ENTOMOLOGY	TREE CROPS ENTOMOLOGY	INSECT CONTROL ON TREE TREE CROPS	7,320	6,030	1,400
10. EXTENSION YEAR II	PURUDE UNIVERSITY LAFAYETTE, INDIANA	EXTENSION CROP CARE	AGRONOMY COMMUNICATIONS	EXTENSION COMMUNICATION METHODS	8,080	4,185	1,500
11. HORTICULTURIST YEAR II	UNIVERSITY OF HAWAII	TREE CROPS (NON-CITRUS)	HORTICULTURE PLANT PHYSIOLOGY STATISTICS	MANIPULATION OF FLOWERING BY CHEMICAL OR OTHER	5,610	2,850	2,000
12. FOOD TECHNOLOGIS YEAR II	MICHIGAN STATE UNIVERSITY EAST LASING	FOOD TECHNOLOGY	FOOD CHEMISTRY ENGINEERING	NON-DESTRUCTIVE PROCESSING PROCEDURES	9,470	3,950	1,500
13. PLANT BREEDING YEAR II	IOWA STATE UNIVERSITY AMES	PLANT BREEDING	AGRONOMY GENETICS STATISTICS	VARIETAL SELECTION AND ADAPTATIONS	4,900	2,242	1,500
14. PATHOLOGIST YEAR II	TEXAS A & M TEXAS	PATHOLOGY	VEGETABLES CROPS TREE	CONTROL OF TROPICAL FRUIT OR VEGETABLE PESTS	4,170	3,554	1,500
15. AGRICULTURAL ENGINEER YEAR II	UNIVERSITY OF GUELPH ONTARIO, CANADA	FARM MACHINERY AND LAND PREPARATION	SOILS AGRICULTURAL MACHINERY ENGINEERING	NONE	5,000	4,500	2,000
16. LIVESTOCK YEAR II	UNIVERSITY OF WEST INDIES TRINIDAD	RUMINANT PRODUCTION AND NUTRITION	ANIMAL SCIENCE NUTRITION	RUMINANT NUTRITION	50.	4,550	1,200
S U B - T O T A L					44,600	31,861	12,600

THIRD YEAR RESEARCH AND EXTENSION TRAINING PROGRAMME AND COSTS FOR SELECTED CANDIDATE IN THE MATI

TABLE V-26C
3 OF 3

POSITION	RECOMMENDED INSTITUTION	AREA OF SPECIALIZATION	COURSES	RESEARCH ACTIVITY	EXPENSES (ANNUALLY)		
					TUITION	ROOM AND BOARD	BOOK TRAVEL INCIDENTALS
17. LIVERSTOCK YEAR III	UNIVERSITY OF WEST INDIES TRINIDAD	PASTURES FORAGE UTILIZATION	ANIMAL SCIENCE PASTURE	TROPICAL PASTURE DEVELOPMENT	50	4,550	1,200
18. SOIL CHEMISTRY YEAR III	READING UNIVERSITY UNITED KINGSTON	SOIL CHEMISTRY	ANALYTICAL CHEMISTRY SOILS	ACTIVITY OF MAJOR AND MICRONUTRIENTS IN A CALCAREOUS MEDIUM	4,000	5,400	2,000
19. AGRONOMIST YEAR III	UNIVERSITY OF WEST INDIES TRINIDAD	FARMING SYSTEMS	AGRONOMY STATISTICS	FARMING SYSTEMS TROPICAL CONDITIONS	50	4,550	1,200
20. MICROBIOLOGIST YEAR III	UNIVERSITY OF GUELPH ONTARIO, CANADA	FOOD MICROBIOLOGY	MICROBIOLOGY FOOD CHEMISTRY	MICROBIAL TECHNIQUES OR SPECIAL IMPORTANT TO FRUIT AND VEGETABLE CROPS	7,035	4,476	1,400
21. PHYSILOGIST YEAR III	UNIVERSITY OF WEST INDIES	POST- HARVEST PHYSIOLOGY	TREE CROPS VEGETABLE PHYSIOLOGY	PRESERVATION OF TROPICAL ROOT FRUIT OR VEGETABLE CROPS	50	4,550	1,200
22. EXTENSION YEAR III	IOWA STATE UNIVERSITY AMES	AGRICULTURAL EDUCATION	AGRICULTURE EDUCATION JOURALISM	EXTENSION EDUCATION AND TRAINING METHODS	7,350	3,360	1,500
23. HORTICULTURIST YEAR III	UNIVERSITY OF CALIFORNIA GAINSVILLE	VEGETABLE CROPS	VEGETABLE CROPS STATISTICS	CULTURAL PRACTICES VARIETIES	5,484	4,800	1,200
24. AGRO-HYDROLOGY YEAR III	UNIVERSITY OF FLORIDA DAVIS	AGRO-HYDROLOGY	SOILS AGRO-HYDROLOGY	WATER TABLE STUDIES	8,635	5,500	1,600
25. CHEMIST YEAR III	RUTGERS UNIVERSITY NEW JERSEY	ANALYTICAL CHEMISTRY	INSTRUMENTAL METHODS BIOCHEMISTRY	METHODOLOGY IN ANALYTICAL PROCEDURES RELATING TO BIOLOGICAL MATERIAL	7,035	4,480	1,400
S U B - T O T A L					39,689	41,666	12,700
T O T A L					117,609	113,649	35,800
T O T A L (PER 2 YEARS)					534,116		

TABLE V-27 SUMMARY OF PROJECT LOAN FACILITY REQUIREMENTS FOR RESEARCH AND EXTENSION SERVICES

1.	CODRICE ISLAND AGRICULTURAL RESEARCH AND EXTENSION CENTRE	1,133,000
2.	POST GRADUATE TRAINING PROGRAMME	534,116
3.	CONSULTANCIES	690,000
4.	MOTOR VEHICLE PURCHASES	195,000
	TOTAL	2,552,116

MANPOWER STRENGHTENING AND COSTS IN RESEARCH EXTENSION AND FOOD TECHNOLOGY DEPARTMENTS

TABLE V-28

POSITION	SPECIALTY	YRI MAN MTHS	YRII MAN MTHS	YRIII MAN MTHS	TOTAL MAN MTHS	TOTAL COST
A	RESEARCH MANAGEMENT	12	3	1	16	120,000
B	EXTENSION DESING AND MANAGEMENT	12	3	1	16	120,000
1	SOIL FERTILITY	12	12	3	27	90,000
2	LIVESTOCK	12	12	3	27	90,000
3	CROP PRODUCTION	12	12	3	27	90,000
4	CROP PROTECTION	12	12	3	27	90,000
5	FOOD TECHNOLOGY	12	12	3	27	90,000
T O T A L		84	66	17	167	690,000

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CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

Common Name	MALATHION
ther Name	
hysical Characteristics	Liquid
olubility in water	145 mg/litre
esticide property	Non-systemic insecticide an miticide (acaricide).
rops	Wide range of horticultural and agricultural crops
te	Variable
D 50	2800 mg/kg rats.
Comment	Known to damage cucumber. string beans and squash in the green house Effective against mosquitoes.
ormulations and Source	EC 25-1000 g. ai/litre WP 250-500 g/kg. CYANIMIDE

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL
TO BE OF WIDE USE IN THE BAHAMAS
1989

Common Name	DIAZINON
Other Name	Basudin
Physical Characteristics	Liquid
Solubility in water	40 mg/litre
Prsticide property	Non-systemic insecticide for sucking and leaf eating insects.
Crops	Corn, potatoes, fruit trees, horticultural crops
Rate	Variable
LD_{50}	300-400 mg/kg rats.
Comments	Used in household at high concentrations against roaches.
Formulations and Source	Basudin 60EC 600 g/litre Basudin 40WP 400 g/kg. GEIGY

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

ommon Name	CARBARYL
ther Name	Sevin
hysical Characteristics	Crystalline Solid
olubility in water	120 mg/litre
esticide Property	Contact and stomach insecticide with slight systemic properties.
rops	Fruits, vegetables and other crops
ates	0.25 - 2.0 kg ai/ha
LD 50	850 mg/kg rats.
omment	Toxic to bees
ormulation and Source	WP 500 to 850 gm ai/kg UNION CARBIDE

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

Common Name	BENOMYL
Other Name	Benlate
Physical Characteristics	Crystalline Solid
Solubility in water	4 mg/kg
Pesticide property	Systemic fungicide with miticide properties
Crops	Fruits, vegetables, ornamentals
Rate (Kg/Ha)	Vegetable crops 140 - 550 g. ai/h.
LD 50	10,000 mg. ai/kg rats.
Comment	Decomposes under moist conditions in soil. Used as a post harvest dip for fruit and vegetables 2 -200 g/100l.
Formulations and Source	WP 500 gm ai/kg. DUPONT

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

ɔmmon Name	MANCOZEB
ther Name	Dithane M-45
ɲysical Characteristics	Powder
ɔlubility in water	Insoluble
esticide property	Fungicide, effective against a wide range of fungi.
·ops	Potatoes, tomatoes, ornamental tree crops.
ıte	Generally used 1.4 to 1.9 kg ai/ha.
50	8,000 mg/kg rats.
·mment	Contains zinc and manganese.
ɔrmulations and Source	WP ROHM AND HAAS

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

6. Common Name	BORDEAU MIXTURE
Other Name	Tribasic Copper Sulphate
Physical Characteristic	Blue precipitate
Solubility in water	Insoluble
Pesticide Property	Protective fungicide
Crops	Used as a foliar application for potatoes, bananas and most crop plants at stages of growth when its phytotoxicity
Rate	1Kg $CuSO_4.5H$ +1.25 KG. $Cu(OH)_2$ in 100 litres water for HV application and (4kg+2kg+100 litres for LV application.
Comment	It is incompatible with alikali sensitive pesticides such as organophosphorus compounds or carbamates.
Formulation	WP

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

Common Name	METALDEHYDE
Other Name	Slug Bait
Physical Characteristic	Crystalline
Solubility in water	200 mg/litre
Pesticide property	Molluscicide
Crops	Vegetables, tree crops.
Rate	Variable
LD 50	600 - 1000 mg/kg dogs
Source	HOECHST

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

Common Name	PARAQUAT
Other Name	Gramoxone
Physical Characteristics	Crystalline
Solubility in water	Completely soluble
Pesticide property	Herbicide
Crops	Destroys green plant tissue
Rate	Inter row vegetable crops 560 - 1120 g/ha Inter row tree crops 280 - 560 g/ha Pastures 140 - 2210 g/ha
LD 50	150 mg/kg rats.
Comment	Rapidly inactivated on contact with soil particularly if alkaline
Formulation and Source	Gramoxone ICI irSOPRA 276 1 Gramoxone Special (SOPRA) 55g/ litre IMPERIAL CHEMICAL INDUSTRIES

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL
TO BE OF WIDE USE IN THE BAHAMAS
1989

9. Common Name	GLYPHOSATE
Other Name	Round-up
Physical Characteristics	Crystalline
Solubility in water	12 g/litre
Pesticide property	Post-emergence herbicide
Rate	0.34 - 1.12 kg ae/ha* for annual species 1.68 - 2.24 kg ae/ha for perennial species
LD 50	4050 mg ae/kg rats.
Comment	Strongly absorbed by soil
Formulations and Source	480 g/litr MONSANTO
	*ae = acid equivalent

CHARACTERISTICS OF RECOMMENDED AGROCHEMICAL TO BE OF WIDE USE IN THE BAHAMAS 1989

Common Name	CARBOFURAN
Other Name	Furadan
Physical Characteristic	Crystalline Solid
Solubility in water	700 mg/litre
Pesticide property	Systemic acaricide, insecticide and nematicide.
Crops	Corn, brassicas, citrus, banana
Rate	Foliar at 0.25 - 1.0 kg ai/ha for insects and mites. 0.5 - 4.0 kg/ha in the seed furrow for soil and foliar feeding insects. 6 - 10 kg/ha broadcast for the control of nematodes.
LD 50	8 - 14 mg ai rats.
Comment	It is unstable in an alkaline media.
Formulation and Source	WP 750 g ai/kg. FMC CORPORATION

CROP MODEL: PERSIAN LIME

COST OF PRODUCTION AND
ESTIMATED REVENUE PER ACRE.

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8
LABOUR OPERATIONS MACHINERY OPERATION											
LAND CLEARING	ac.	1	300	0	0	0	0	0	0	0	0
LAND PREPARATION	ac.	1	1200	0	0	0	0	0	0	0	0
LILNING AND PLANTING	m. day	12	25	300	0	0	0	0	0	0	0
FERTILIZING	m. day	1	25	25	25	25	25	25	25	25	25
WEEDING/MOULDING	M. DAY	12	25	300	300	300	300	300	300	300	300
SPRAYING	m. day	8 - 16	25	200	200	200	400	400	400	400	400
HARVEST & TRANSPORT	M. DAY	8 - 16	25	0	0	0	200	250	300	350	400
GRADE AND PACKAGE	m. day	2 - 6	25	0	0	0	50	75	100	125	150
TRANSFER TO POINT OF SALE	lb.		.01	0	0	0	48	72	96	120	144
SUB- TOTALS				825	525	525	1023	1122	1221	1320	1419
MATERIAL INPUTS											
PLANTING MATERIAL ea.		190	6.00	1140	0	0	0	0	0	0	0
FERTILIZER	lb	400	.155	62	62	62	62	62	62	62	62
SPRAY MATERIALS HERBICIDE				0	0	0	0	0	0	0	0
FUNGICIDE	lb.	2 - 4	14	0	0	28	28	56	56	56	56
INSECTICIDE	ct.			0	0	0	19	38	38	38	38
TAXES		135 - 489	1.00	0	0	0	135	270	360	435	489
TOTAL				1202	62	90	244	426	536	591	645

cont'd CROP MODEL: PERSIAN LIME

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS		TOTAL COST							
		YR 1	YR 2	YR 3	YR4	YR 5	YR 6	YR 7	YR 8
CONTINGENCIES (10%)		202.70	58.70	61.50	126.70	154.80	175.70	191.10	206.40
SPRAYER AND SMALL TOOLS		0	0	0	0	0	0	0	0
SUPERVISION (25% L + M)		506.75	146.75	15.38	31.68	38.70	43.93	47.78	51.60
LAND CHARGES		0	0	0	0	20	20	20	20
INTEREST ON WORKING CAPITAL	12% Year for 12 Months	328.37	95.09	83.03	213.05	211.38	244.87	229.32	281.04
SUB-TOTAL		1037.82	300.54	159.91	721.43	424.88	484.90	488.20	559.04
TOTAL COST OF PRODUCTION		3064.82	887.54	774.91	988.43	1972.88	2241.50	2399.20	2623.04
REVENUE $/[illegible] 48c/lb.		0	0	0	2280	4560	6384	7296	8208
NET RETURNS		(3064.82)	(887.54)	(774.91)	1291.58	2587.12	4142.50	4896.80	5584.96

CROP: GRAPE FRUIT

COST OF PRODUCTION AND
ESTIMATED REVENUE PER ACRE.

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST YR 1	YR 2	YR 3	YR -	YR 5	YR 6	YR 7	YR 8
LABOUR OPERATIONS											
LAND CLEARING	ac.	1	300	0	0	0	0	0	0	0	0
LAND PREPARATION	ac.	1	1200	0	0	0	0	0	0	0	0
LILNING AND PLANTING	m. day	12	25	300	0	0	0	0	0	0	0
FERTILIZING	m. day	1	25	25	25	25	25	25	25	25	25
WEEDING	m. day	12	25	300	300	300	300	300	300	300	300
SPRAYING	m. day	8 - 16	25	200	200	200	400	400	400	400	400
HARVEST & TRANSPORT	m. day	8 - 16	25	0	0	0	200	250	300	350	400
GRADE AND PACKAGE		2 - 6	25	0	0	0	50	75	100	125	150
TRANSFER TO POINT OF SALE	lb.		.01	0	0	0	90	180	240	300	330
SUB- TOTALS				825	525	525	1065	1230	1365	1500	1605
MATERIAL INPUTS											
PLANTING MATERIAL	ea.	190	8.00	1520	0	0	0	0	0	0	0
FERTILIZER	lb.	400	.155	62	62	62	62	62	62	62	62
SPRAY MATERIALS HERBICIDE				0	0	0	0	0	0	0	0
FUNGICIDE	lb.	2 - 4	14	0	0	28	28	56	56	56	56
INSECTICIDE	qt.	1 - 2	19	0	0	0	19	38	38	38	38
BOXES		260 - 950	1.00	0	0	0	260	520	694	866	950
SUB-TOTAL				1582	62	90	369	676	850	1024	1106

cont'd CROP MODEL: GRAPE FRUIT

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

ITEMS		TOTAL COST							
		YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8
CONTINGENCIES (10%)		240.70	58.70	61.50	143.40	190.60	221.50	241.10	271.10
SPRAYER AND SMALL TOOLS		0	0	0	0	0	0	0	0
SUPERVISION (25% of Labour Materials		60.18	14.68	15.38	35.85	47.65	55.36	60.28	67.78
LAND CHARGES		0	0	0	0	0	0	0	0
INTEREST ON WORKING CAPITAL	12% Year for 12 Months	324.95	79.25	83.03	235.59	259.71	301.43	327.89	368.39
SUB-TOTAL		625.83	152.63	159.91	418.8	497.9	578.3	629.3	707.3
TOTAL COST OF PRODUCTION		3032.83	739.63	774.91	1852.8	2403.9	2793.3	3153.3	3418.3
REVENUE $/ 50c/lb.					4560	9120	12160	15200	16625
NET RETURNS		(3032.83)	(739.63)	(774.91)	2707.1	6717.0	9366.7	12046.7	13206.7

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

APPENDIX 2C
1 of 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST							
				YR 1	YR 2	YR 3	YR -	YR 5	YR 6	YR 7	YR 8
LABOUR OPERATIONS											
LAND CLEARING	ac.	1	300	0	0	0	0	0	0	0	0
LAND PREPARATION	ac.	1	1200	0	0	0	0	0	0	0	0
LILNING AND PLANTING	m. day	12	25	300	0	0	0	0	0	0	0
FERTILIZING	m. day	1	25	25	25	25	25	25	25	25	25
WEEDING/MOULDING	m. day	12	25	300	300	300	300	300	300	300	300
SPRAYING	m. day	8 - 16	25	200	200	200	400	400	400	400	400
HARVEST & TRANSPORT	m. day	8 - 16	25	0	0	0	200	250	300	350	400
GRADE AND PACKAGE	m. day	2 - 6	25	0	0	0	50	75	100	125	150
TRANSFER TO POINT OF SALE	lb.		.01	0	0	0	43	86	114	142	150
SUB- TOTALS				825	525	525	1018	1136	1239	1342	1425
MATERIAL INPUTS											
PLANTING MATERIAL	ea.	190	8.00	1520	0	0	0	0	0	0	0
FERTILIZER	lb	400	.155	62	62	62	62	62	62	62	62
SPRAY MATERIALS HERBICIDE				0	0	0	0	0	0	0	0
FUNGICIDE	lb.	2 - 4	14.00	0	0	28	28	56	56	56	56
INSECTICIDE	ct.	1 - 2	19.00	0	0	0	19	38	38	38	38
BOXES				0	0	0	163	326	435	543	570
SUB-TOTAL				1582	62	90	272	482	591	699	726

cont'd CROP MODEL: _____ ORANGE

APPENDIX 2C
2 OF 2

COST OF PRODUCTION AND ESTIMATED REVENUE PER AC

ITEMS		TOTAL COST							
		YR 1	YR 2	YR 3	YR 4	YR5	YR 6	YR7	YR 8
CONTINGENCIES (10%)		240.70	58.70	61.50	129.00	161.80	183.00	204.10	215.10
SPRAYER AND SMALL TOOLS		0	0	0	0	0	0	0	0
SUPERVISION (25% L+M)		60.18	14.65	15.38	32.25	40.45	45.75	51.75	53.78
LAND CHARGES		0	0	0	0	20	20	20	20
INTEREST ON WORKING CAPITAL	12%Year for 12 months	324.95	79.24	83.02	156.99	220.83	249.45	284.06	299.24
SUB-TOTAL		625.83	152.59	159.90	318.2	443.08	498.20	559.91	588.12
TOTAL COST OF PRODUCTION		3032.83	739.59	774.90	1608.2	206108	232820	2600.9	2739.12
REVENUE $/- 42c / lb					2394	4788	6384	7980	8379
NET RETURNS		(3032.83	739.59)	(774.90)	785.76	272692	4055.80	5379.09	5639.80

CROP MODEL: TOMATO

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

APPENDIX 2E
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	15	25	375	375	375	375
FERTILIZING	m. day	3	25	75	75	75	75
WEEDING	m. day	12	25	300	300	300	300
SPRAYING	Appl.	12	25	300	300	300	300
HARVESTING & GRADING	m. day	30	25	750	750	750	750
TRANSFER TO POINT OF SALE	lb.	25000	0.01	250	250	250	250
SUB-TOTAL				3550.00	2150.00	2150.00	2150.00
MATERIAL INPUTS							
PLANTING MATERIALS (SEEDLINGS)	ea.	7260	10c	726	726	726	726
FERTILIZERS	lb.	1200	.155	186	186	186	186
SPRAY MATERIALS (A) HERBICIDE		0	0	0	0	0	0
(B) FUNGICIDE	LB.	15	5	75	75	75	75
(C) INSECTICIDE	LB.	12	5	60	60	60	60
SUB-TOTAL				1047.00	1047.00	1047.00	1047.00

cont'd CROP MODEL: TOMATO

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

APPENDIX 2E
2 OF 2

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		459.70	319.70	319.70	319.70
OTHER COSTS (BOXES)	834 at 0.75 ¢ each	625	625	625	625
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20	20	20	20
SUPERVISION (25% OF LABOUR & MATERIALS)		1149.25	799.25	799.25	799.25
INTEREST ON WORKING CAPITAL	12% YEAR FOR 4 MONTHS	280.46	198.44	198.44	198.44
SUB-TOTAL		2694.91	1962.89	1962.89	1962.89
TOTAL COST OF PRODUCTION		7291.91	5159.89	5159.89	5159.89
YEILD		25000	25000	25000	25000
PRICE (POINT OF FIRST SALE)	25¢				
GROSS REVENUE		6250	6250	6250	6250
NET REVENUE		(1041.91)	1090.11	1090.11	1090.11

CROP MODEL: CABBAGE

APPENDIX 2F
1 OF 2

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	10	25	250	250	250	250
FERTILIZING	m. day	2	25	50	50	50	50
WEEDING	m. day	5	25	125	125	125	125
SPRAYING	m. day	8	25	200	200	200	200
HARVESTING & GRADING	m. day	15	25	375	375	375	375
TRANSFER TO POINT OF SALE	lb.	25000	0.01	250	250	250	250
SUB-TOTAL				2750.00	1350.00	1350.00	1350.00
MATERIAL INPUTS							
PLANTING MATERIALS(SEEDLINGS)		14,500	0.05	725	725	725	725
FERTILIZERS	lb.	800	.155	125	125	125	125
SPRAY MATERIALS (A) HERBICIDE		0	0	0	0	0	0
(B) FUNGICIDE	lb.	15	5	75	75	75	75
(C) INSECTICIDE	lb.	12	5	60	60	60	60
SUB-TOTAL				985.00	985.00	985.00	985.00

cont'd CROP MODEL: CABBAGE

APPENDIX 2F
2 OF 2

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		373.50	233.50	233.50	233.50
OTHER COSTS - BAGS	500 at 50¢ each	250	250	250	250
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20	20	20	20
SUPERVISION (25% OF LABOUR & MATERIALS)		933.75	583.75	583.75	583.75
INTEREST ON WORKING CAPITAL	12 % YEAR FOR 3 MONTHS	128.64	102.67	102.67	102.67
SUB-TOTAL		1865.89	1189.92	1260.34	1260.34
TOTAL COST OF PRODUCTION		5600.89	3524.92	3524.92	3524.92
YEILD lb. -		25000	25000	25000	25000
PRICE (POINT OF FIRST SALE)	16¢				
GROSS REVENUE		4500	4500	4500	4500
NET REVENUE		(1100.89	975.08	975.08	975.08

CROP MODEL: SU PE R

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

APPENDIX 2G
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	12	25	300	300	300	300
FERTILIZING	m. day	2	25	50	50	50	50
WEEDING	m. day	6	25	150	150	150	150
SPRAYING	Appl.	12	25	300	300	300	300
HARVESTING & GRADING	m. day	20	25	500	500	500	500
TRANSFER TO POINT OF SALE	lb.	2000	.01	200	200	200	200
SUB-TOTAL				3000	1600	1600	1600
MATERIAL INPUTS							
PLANTING MATERIALS	ea.	11,600	0.05	580	580	580	580
FERTILIZERS	lb.	1000	.155	155	155	155	155
SPRAY MATERIALS (A) HERBICIDE		0	0	0	0	0	0
(B) FUNGICIDE	lb.	15	5	75	75	75	75
(C) INSECTICIDE	lb.	12	5	60	60	60	60
SUB-TOTAL				870.00	870.00	870.00	870.00

cont'd CROP MODEL: SWEET PEPPER

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

APPENDIX 2G
2 OF 2

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		387.00	247.00	247.00	247.00
OTHER COSTS	800 boxes at 1.00	800	800	800	800
SPRAYER AND SMALL TOOLS		160	0	0	0
AND CHARGES		20	20	20	20
UPERVISION (25% OF LABOUR & MATERIALS)		967.50	617.50	617.50	617.50
NTEREST ON WORKING CAPITAL	12 % YEAR FOR 4 MONTHS	248.16	166.18	166.16	166.18
UB-TOTAL		2582.66	1850.68	1850.66	1850.68
OTAL COST OF PRODUCTION		6452.66	4320.68	4320.66	4320.68
EILD lb.		20000	20000	20000	20000
RICE (POINT OF FIRST SALE)	30c				
ROSS REVENUE		6000	6000	6000	6000
ET REVENUE		(452.66)	1679.32	1679.32	1679.32

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COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

APPENDIX 2H
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	3	25	75	75	75	75
FERTILIZING	m. day	1	25	25	25	25	25
WEEDING	m. day	5	25	125	125	125	125
SPRAYING	Appl.	6	25	150	150	150	150
HARVESTING & GRADING	m. day	12	25	300	300	300	300
TRANSFER TO POINT OF SALE	lb.	25000	0.01	250	250	250	250
SUB-TOTAL				2425.00	1025.00	1025.00	1025.00
MATERIAL INPUTS							
PLANTING MATERIALS	lb.	2	8.50	17	17	17	17
FERTILIZERS	lb.	400	1.55	62	62	62	62
SPRAY MATERIALS (A) MOLLUSCICIDE	lb	4	1.00	4	4	4	4
(B) FUNGICIDE	lb.	6	3.00	18	18	18	18
(C) INSECTICIDE	ct.	2	9.50	19	19	19	19
SUB-TOTAL				120.00	120.00	120.00	120.00

cont'd CROP MODEL: CUCUMBER

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS		TOTAL COST			
		YR0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		254.50	114.50	114.50	114.50
OTHER COSTS		0	0	0	0
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20	28	20	20
SUPERVISION (25% OF LABOUR & MATERIALS)		636.25	286.25	286.25	285.25
INTEREST ON WORKING CAPITAL	12 % YEAR FOR 2 MONTHS	73.32	31.32	31.32	31.32
SUB-TOTAL		1144.07	452.07	452.07	452.07
TOTAL COST OF PRODUCTION		3650.07	1558.07	1558.07	1558.07
YEILD lb.		25000	25000	25000	25000
PRICE (POINT OF FIRST SALE)	13c				
GROSS REVENUE		3250	3250	3250	3250
NET REVENUE		(400.07)	1691.93	1691.93	1691.93

CROP MODEL: WATERMELON

APPENDIX 2J
1 OF 2

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	4	25	100	100	100	100
FERTILIZING	m. day	1	25	25	25	25	25
WEEDING	m. day	5	25	125	125	125	125
SPRAYING	Appl.	8	25	200	200	200	200
HARVESTING & GRADING	m. day	6	25	150	150	150	150
TRANSFER TO POINT OF SALE	lb.	20000	.01	200	200	200	200
SUB-TOTAL				2300	900	900	900
MATERIAL INPUTS							
PLANTING MATERIALS	lb.	3	8.33	25	25	25	25
FERTILIZERS	lb.	800	.155	124	124	124	124
SPRAY MATERIALS (A)HERBICIDE	qt.	2	10	20	20	20	20
(B)FUNGICIDE	lb	6	3.00	18	18	18	18
(C)INSECTICIDE	qt.	2	9.50	19	19	19	19
SUB-TOTAL				206	206	206	206

con'd CROP MODEL: WATERMELON

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

APPENDIX 2J
2 OF 2

ITEMS		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		250.60	110.60	250.60	250.60
OTHER COSTS					
SPRAYER AND SMALL TOOLS		160.00	0	0	0
LAND CHARGES		20	20	20	20.
SUPERVISION (25% OF LABOUR/MATERIALS)		626.50	276.50	276.50	276.5
INTEREST ON WORKING CAPITAL	12 % YEAR. FOR 4 MONTHS	427.57	60.52	60.52	60.52
SUB-TOTAL		1484.67	467.62	467.62	467.62
TOTAL COST OF PRODUCTION		3990.67	1573,62	1573,62	1573.62
YEILD lb.		20,000	20,000	20,000	20,000
PRICE (POINT OF FIRST SALD) lb.	15¢				
GROSS REVENUE		3000	3000	3000	3000
NET REVENUE		(990.67)	1426.38	1426.38	1426.38

CROP MODEL: [redacted] IRISH POTATO

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

APPENDIX 2K
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m.day	10	25	250	250	250	250
FERTILIZING	m. day	2	25	50	50	50	50
WEEDING & MOULDING	M.day	10	25	250	250	250	250
SPRAYING	Appl.	8	25	200	200	200	200
HARVESTING & GRADING	m.day	20	25	500	500	500	500
TRANSFER TO POINT OF SALE	lb.	15000	0.01	150	150	150	150
SUB-TOTAL				2900.00	1500.00	1500.00	1500.00
MATERIAL INPUTS							
PLANTING MATERIALS	lb.	3500	0.23	805	805	605	805
FERTILIZERS	lb.	1000	0.155	155	155	155	155
SPRAY MATERIALS (A)HERBICIDE	lb.	1	10	10	10	10	10
(B)FUNGICIDE	lb.	4	3	12	12	12	12
(C)INSECTICIDE	lb.	6	5	30	30	30	30
SUB-TOTAL				1012.00	1012.00	1012.00	1012.00

cont'd CROP MODEL: IRISH POTATO

APPENDIX 2K
2 OF 2

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		391.20	206.20	206.20	206.20
OTHER COSTS BAGS	300 at 75¢ each	225	225	225	225
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20	20	20	20
SUPERVISION (25% OF LABOUR & MATERIALS)		978.00	515.50	515.50	515.50
INTEREST ON WORKING CAPITAL	12% YEAR FOR 3 MONTHS	170.59	90.86	90.86	90.86
SUB-TOTAL		1944.79	1057.56	1057.56	1057.56
TOTAL COST OF PRODUCTION		5856.79	3569.56	3569.56	3569.56
YEILD (MARKETABLE) LB.		1500	1500	1500	1500
PRICE (POINT OF FIRST SALE) LB.	27.8¢				
GROSS REVENUE		4170	4170	4170	4170
NET REVENUE		(1686.79)	600.44	600.44	600.44

CROP MODEL: CORN

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	6	25	150	150	150	150
FERTILIZING	m. day	2	25	50	50	50	50
WEEDING	m. day	4	25	100	100	100	100
SPRAYING	Appl.	6	25	150	150	150	150
HARVESTING &(GRADING) STORING		8	25	200	200	200	200
TRANSFER TO POINT OF SALE	lb.	4000	.01	40	40	40	40
SUB-TOTAL				2190.00	790.00	790.00	790.00
MATERIAL INPUTS							
PLANTING MATERIALS	lb.	15	2.00	30	30	30	30
FERTILIZERS	lb.	1200	.155	186	186	186	186
SPRAY MATERIALS (A) HERBICIDE	lb.	2	10	20	20	20	20
(B) INSECTICIDE	lb.	2	10	20	20	20	20
(C) INSECTICIDE	qt.	2	10	20	20	20	20
SUB-TOTAL				276.00	276.00	276.00	276.00

cont'd CROP MODEL: CORN

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		246.60	106.60	106.60	106.60
OTHER COSTS — BAGS	40 at 50¢ each	20.00	20.00	20.00	20.00
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20.00	20.00	20.00	20.00
SUPERVISION (25% OF LABOUR & MATERIALS)		616,50	266.50	266.50	266.50
INTEREST ON WORKING CAPITAL	12 % YEAR FOR 3 MONTHS	105.87	44.37	44.37	44.37
SUB-TOTAL		1168.97	457.47	457.47	457.47
TOTAL COST OF PRODUCTION		3634.97	1523.47	1523.47	1523.47
YEILD Lb.		4000	4000	4000	4000
PRICE (POINT OF FIRST SALE) LB.	40¢				
GROSS REVENUE		1600	1600	1600	1600
NET REVENUE		(2034.97)	76.53	76.53	76.53

CROP MODEL: PIGEON PEA

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

APPENDIX 3B
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m. day	3	25	75	75	75	75
FERTILIZING	m. day	2	25	50	50	50	50
WEEDING	m. day	3	25	75	75	75	75
SPRAYING	Appl.	4	25	100	100	100	100
HARVESTING & GRADING	m. day	12	25	300	300	300	300
TRANSFER TO POINT OF SALE	lb.	2000	.0075	15	15	15	15
SUB-TOTAL				2115.00	715.00	715.00	715.00
MATERIAL INPUTS							
PLANTING MATERIALS	lb.	10	1.00	10	10	10	10
FERTILIZERS	lb.	400	.155	62	62	62	62
SPRAY MATERIALS (A) HERBICIDE				0	0	0	0
(B) FUNGICIDE	lb.	3	3	9	9	9	9
(C) INSECTICIDE	qt.	2	8.50	17	17	17	17
SUB-TOTAL				98	98	98	98

cont'd CROP MODEL: PIGEON PEA

APPENDIX 3B
2 OF 2

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		221.30	81.30	81.30	81.30
OTHER COSTS (STORAGE UNITS)	8 at 7.50 each	60.00	60.00	60.00	60.00
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20.00	20.00	20.00	20.00
SUPERVISION (25% OF LABOUR & MATERIALS)		553.25	203.25	203.25	203.25
INTEREST ON WORKING CAPITAL	12% YEAR FOR 9 MONTHS	290.48	105.98	105.98	105.98
SUB-TOTAL		1305.03	470.53	470.53	470.53
TOTAL COST OF PRODUCTION		3518.03	1283.53	1283.53	1283.53
YEILD (LBS.)	2000	2000	2000	2000	2000
PRICE (POINT OF FIRST SALE)	1.00				
GROSS REVENUE		2000	2000	2000	2000
NET REVENUE		(1518.03)	716.47	716.47	716.47

CROP MODEL: CASSAVA

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

APPENDIX 3C
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING & DROPPING STICKS	m. day	8	25	200	200	200	200
FERTILIZING	m. day	1	25	25	25	25	25
WEEDING	m. day	5	25	125	125	125	125
SPRAYING	m. day	2	25	50	50	50	50
HARVESTING & GRADING	m. day	12	25	300	300	300	300
TRANSFER TO POINT OF SALE	lb.	18000	8.01	180	180	180	180
SUB-TOTAL				2380.00	980.00	980.00	980.00
MATERIAL INPUTS							
PLANTING MATERIALS	STICKS	4000	0.05	200	50	50	50
FERTILIZERS	lbs.	400	.155	62	62	62	62
SPRAY MATERIALS (A)HERBICIDE	qt.	1	10.60	10.00	10.00	10.00	10.00
(B)MITICIDE	lb.	5	2.75	13.75	13.75	13.75	13.75
(C)FUNGICIDE	lb	3	8.25	8.25	8.25	8.25	8.25
SUB-TOTAL				294.00	144.00	144.00	144.00

cont'd CROP MODEL: CASSAVA

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		267.40	112.40	112.40	112.40
OTHER COSTS					
SPRAYER AND SMALL TOOLS		160	0	0	09
Land Charges		20	20	20	20
Supervision	15-25% of labour and materials	668.50	281.00	281.00	281.00
Interest on Working Capital	12 % year for 12 months	454.78	184.49	184.49	184.49
Sub-Total		1570.68	597.89	597.89	597.89
TOTAL COST OF PRODUCTION		4244.68	1721.89	1721.89	1721.89
YIELD LB.	18000				
PRICE (Piont of First Sale) LB.	13¢				
GROSS REVENUE		2340	2340	2340	2340
NET REVENUE		(1904.68)	618.11	618.11	618.11

CROP MODEL: SWEET POTATO

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST			
				YR 0	YR 1	YR 2	YR 3
LABOUR OPERATIONS/MACHINERY (HRS)							
LAND CLEARING	ac.	1	300	300	0	0	0
LAND PREPARATION	ac.	1	1200	1200	100	100	100
PLANTING	m.day	9	25	225	225	225	225
FERTILIZING	m. day	1	25	25	25	25	25
WEEDING & MOULDING	m. day	6	25	375	375	375	375
SPRAYING	Appl.	3	25	75	75	75	75
HARVESTING & GRADING	m. day	16	25	400	400	400	400
TRANSFER TO POINT OF SALE	lb.	10000	0.01	100	100	100	100
SUB-TOTAL				2700.00	1300.00	1300.00	1300.00
MATERIAL INPUTS							
PLANTING MATERIALS	BAGS	25	5	125.00	125.00	125.00	125.00
FERTILIZERS	lb.	600	.155	93.00	93.00	93.00	93.00
SPRAY MATERIALS (A) FUNGICIDE	Lb	8	2.50	20.00	20.00	20.00	20.00
(B) INSECTICIDE	Lb	2.5	8.00	20.00	20.00	20.00	20.00
(C) INSECTICIDE	GAL.	0.5	36.00	18.00	18.00	18.00	18.00
SUB-TOTAL				276.00	276.00	276.00	276.00

cont'd CROP MODEL: SWEET POTATO

APPENDIX 3D
2 OF 2

COST OF PRODUCTION AND ESTIMATED REVENUE PER ACRE

ITEMS		TOTAL COST			
		YR 0	YR 1	YR 2	YR 3
CONTINGENCIES (10%)		297.60	157.60	157.60	157.60
OTHER COSTS BAGS	200 at 50c each	100	100	100	100
SPRAYER AND SMALL TOOLS		160	0	0	0
LAND CHARGES		20	20	20	20
SUPERVISION (25% OF LABOUR & MATERIALS)		744.00	394.00	394.00	394.00
INTEREST ON WORKING CAPITAL	12 % YEAR FOR 3 MONTHS	128.93	67.43	67.43	67.43
SUB-TOTAL		1450.53	739.03	739.03	739.03
TOTAL COST OF PRODUCTION		4426.53	2315.03	2315.03	2315.03
YEILD (MARKETABLE) LBS.	10,000				
PRICE (POINT OF FIRST SALE) LB.	27.6¢				
GROSS REVENUE		2760	2760	2760	2760
NET REVENUE		(1666.53)	444.97	444.97	444.97

CROP MODEL: BANANA

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

APPENDIX 3E
1 OF 2

ITEMS	UNIT	NO. OF UNITS	RATE PER UNIT	TOTAL COST				
				YEAR I	YEAR II	YEAR III	YEAR IV	YEAR V
ABOUR OPERATIONS/MACHINERY (HRS)								
AND CLEARING	ac.	1	300	300	0	0	0	0
AND PREPARATION	ac.	1	1200	1200	0	0	0	0
LANTING LINING DROPPING	m. day	12	25	300	0	0	0	0
ERTILIZING	m. day	2 - 4	25	50	100	100	100	100
EEDING & PRUNING	m. day	3	25	75	75	75	75	75
PRAYING	m. day	2	25	50	50	50	50	50
ARVESTING & GRADING	m. day	6	25	150	150	150	150	150
RANSFER TO POINT OF SALE	lb.	20000	.01	200	200	200	200	200
UB-TOTAL				2325.00	575.00	575.00	575.00	575.00
ATERIAL INPUTS								
LANTING MATERIALS	ea,	680	1.00	680	0	0	0	0
ERTILIZERS	lb.	1000	.155	155	155	155	155	155
PRAY MATERIALS (A)INSECTICIDE	Lb.	16	2.50	40	40	40	40	40
(B)FUNGICIDE	Lb.	2	8.50	17	17	17	17	17
(C)NEMOTICIDE	Lb.	40	2.50	100	100	100	100	100
B-TOTAL				992.00	712.00	12		

COST OF PRODUCTION
AND ESTIMATED REVENUE
PER ACRE

APPENDIX 3E
2 OF 2

ITEMS		YEAR I	YEAR II	YEAR III	YEAR IV	YEAR V
ONTINGENCIES (10%)		331.70	88.70	88.70	88.70	88.70
THER COSTS (BOXES)	667 at 1.00 ea.	667.00	667.00	667.00	667.00	667.00
SPRAYER AND SMALL TOOLS		160.00	0	0	0	0
LAND CHARGES		20.00	20.00	20.00	20.00	20.00
SUPERVISION (25% OF LABOUR/MATERIALS)		829.25	221.75	221 75	221.75	221.75
NTEREST ON WORKING CAPITAL	12% YEAR FOR 12 MONTHS	639.00	226.10	226.10	226.10	226.10
SUB-TOTAL		2646.95	1223.58	1223.58	1223.58	1223.58
TOTAL COST OF PRODUCTION		5963.95	2110.58	2110.58	2110.58	2110.58
YEILD	20,000	20,000	20,000	20,000	20,000	20,000
PRICE (POINT OF FIRST SALE)	27¢					
GROSS REVENUE		5400	5400	5400	5400	5400
NET REVENUE		(563.95)	3289.42	3289.42	3289.42	3289.42

PHYSIOGRAPHIC REGIONS OF THE BAHAMAS 1\

There are 17 islands or groups of islands in The Bahamas which can be deemed to have some measurable agricultural output. For agricultural assessment, there are significant differences between islands in terms of rainfall, vegetation, soil, surface deposits, presence of ground water and capabilities for ground water replenishment. The discussion which follows is based on Little et. al. (1977).

The most obvious distinction between the islands is in vegetation, leading to the division between the Pine Islands and the Coppice Islands. The Pine Islands are the four larger northern and central islands: Grand Bahama, Andros, New Providence and the Abacos. These have natural forests of Caribbean pine, and, generally a wetter, cooler climate. The pine forests occupy the soily rock plains, which are rough slightly elevated, ground and minor rigdes where the density of the forest and size of the timber is a useful indicator of the agricultural potential of the underlying land.

The remaining islands, which are in the southeastern Bahamas, were originally covered with hardwood forests and shrubland. Continuous occupation and exploitation over several hundred years have reduced this to closely spaced stands of narrow-stemmed, semi-deciduous and evergreen broad-leaved trees, often only 10 to 15 feet (3-4.5 metres) high, and rarely exceeding 35 feet (10 metres). The density and size of this woodland vary according to the quantity and seasonality of the rainfall, so that in the southeast it is reduced to sparse cover more closely resembling thorn woodland or desert scrub than the more abundant cover of the wetter central islands.

The classification of the islands can, therefore, be summarised as:

Pine Islands:	Rainfall - 40 to 60 in, Grand Bahama, the Abacos, Andros and New Providence
Coppice Islands:	Rainfall - 40 inches, Eleuthera, Cat Island, San Salvador
	Rainfall - 30 to 40 in, Long Island, the Exumas, Crooked Island, North and Central Acklins, Mayaguana
	Rainfall - 30 inches, South Acklins Inagua.

1\ This section is based on Little et. al. (1977) Land Resources of The Bahamas, Land Resources Division, Ministry of Overseas Development, U. K., and FAO Report.

Rainfall

In the Northern Islands the rainfall pattern is characterized by high annual falls which are unevenly distributed between a warm, wet summer season from May to October and a dry, cooler winter from November to April. Reliable long-term rainfall records are limited, and data used are from the 20 year summary (1951-1970) prepared by the Meteorological Office.

The preceding is set out in Table 1, below, for a series of selected locations throughout the Islands, and arranged in a north-south sequence. All the data are for a consistent period (1951-1970), except that for BARC (North Andros). There were no long-term data available for North Andros; however, considering its agricultural significance, the data for BARC were used despite the discontinuity of that data and the other information.

In assessing the agricultural potential of the various islands, the key parameters are the total rainfall, the distribution of the rainfall and the effective rainfall. The four northernmost islands all have between 50" and 60" of rain per year. In contrast, the four southernmost islands are the driest, with 45-55% of that amount, or 27.5" to 35.7" per year.

The absolute rainfall is not as important as is the reliability, so that farmers can plan their production and investment with some certainty. The reliability of the rainfall can be demonstrated by data prepared by Little et. al. (1977) on the expectation of a given amount of rain. (See Table 2).

The next important parameter is distribution. On a year-round basis, all islands share the same pattern, with a drier period of six months from November to April and a wetter period from May to October. The distributions vary from as little as 20% of total rain in New Providence in this period, to 35% to 40% in Mayaguana and Great Inagua. As a consequence of this variable distribution, the most favoured islands for winter rainfall are Abaco, Grand Bahama and North Andros, with 14.5" to 18" in this milder period, while all other islands fall in the range of 9.5" to 13.5". By contrast, of course, are the much larger amounts of rain in the summer, which, coupled with high temperatures, make growing conditions more difficult, especially for temperate crops.

The other aspect of distribution which is important is the way in which the rain falls. Most of the summer rain in The Bahamas falls in intense local storms which can produce wide variations in incident rain at close locations and which create local problems for producers.

TABLE 1 Summery of Mean Annual Rainfall (inches) at selected locations in The Bahamas, All stations 1951 - 1970 except BARC, 1974 - 1983

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
Green Turtle Cay Abaco												
3.00	3.27	3.21	2.93	6.00	8.94	5.44	5.25	8.91	8.41	3.24	2.30	60.90
West End Grand Bahama												
2.18	3.31	3.22	2.48	4.01	8.07	5.60	6.40	7.46	6.93	1.76	1.87	53.29
Bahamas Agricultural Research Centre Andros												
2.74	2.79	1.35	1.90	6.29	8.40	4.96	6.68	7.21	8.24	3.79	1.76	56.10
Nassau New Providence												
1.90	1.57	1.38	1.89	4.83	9.23	6.08	6.30	7.52	8.31	2.29	1.52	52.82
Harbour Island Eleuthera												
1.83	1.62	1.74	1.28	4.10	6.91	3.38	4.83	6.29	8.51	2.46	1.95	44.90
Rock Sound Eleuthera												
2.40	1.81	1.39	1.30	4.35	6.32	3.07	5.43	5.46	9.29	3.10	1.97	44.89
GeorgeTown Exuma												
1.81	1.01	0.74	1.22	4.97	7.17	3.16	4.05	4.47	6.63	2.33	2.22	39.78
Clarence Town Long Island												
1.86	1.01	0.97	1.31	4.06	5.21	2.29	2.67	3.85	7.16	3.30	1.96	35.65
Long Cay Crooked Island												
1.28	0.71	0.96	2.06	4.05	4.90	2.87	3.42	4.42	5.92	2.75	1.34	34.67
Abraham's Bay Mayaguana												
1.60	1.86	1.32	1.93	3.04	3.49	1.85	2.53	4.15	5.42	4.48	2.33	34.00

Source: Meterological Office Nassau and BARC Andros

TABLE 2 Mean and Expected Rainfall for Selected Northern and Southeastern Islands in the Project Area

No	Island	Mean Annual Rainfall Inches	Minimum Annual Rainfall expected 8 yrs out of 10	Estimated % probability of receiving less than 40 in.	30 in.
1	Eleuthera	45.0	37	12.0	3.0
4	Abaco	62.1	51	4.3	0.62
5	Grand Bahama	50.8	42	16.0	3.0
				30 in.	20 in.
6	Long Island	35.7	28	26	3.0
7	Cat Island	40.0	33	13	1.2
8	Exuma	37.7	31	19	2.0
11	Mayaguana	34.0	25	35	9.0

Source: Little et. al., Table 1., page 10.

There is the difficulty of maintaining steady growth in crops when rainfall occurs in brief high intensity storms followed by periods of dry weather. The soil and base rock are receptive to intense falls of rain and there is little runoff, so moisture is rapidly lost to the plant. It is for this reason, especially, that farmers like to crack open the rock by ripping, before planting tree crops, so that the trees can tap the underground reserves through deep root growth. It also reinforces the need for supplementary irrigation.

From the point of view of productive agriculture, distribution of rainfall does not tell the complete story. There is a temperature gradient between the north and south, so that the evaporation is much higher in the warmer southern islands, which are up to 400 miles closer to the equator. Definitive data are not available; however, Little et. al (1977) suggest that for Abaco and Grand Bahama, the rainfall may equal the annual evaporation, while in the Southeatern Islands evaporation greatly exceeds rainfall by as much as 2 times in Mayaguana and 2.5 times in Inagua.

It would appear that this situation has two important consequences for productive agriculture. First, growing conditions are much more favourable in the Northern Islands on a year-round basis. Second, there is a much greater capacity for replenishment of natural underground fresh water reserves in the Pine Islands, which will allow greater use of irrigation to combat the inevitable short-term variability of the rainfall.

Temperature

A most important feature for Bahamian agriculture is the remarkably stable temperatures year round and the complete absence of frost. As shown in Table 3, mean daily temperatures in New Providence vary between a maximum of 77 deg F. to 89 deg F., and a minimum of 62 deg F. to 75 deg F. In Great Inagua, maxima can vary between 82 deg F. to 91 deg F., but minima are virtually the same as New Providence, in the range of 67 deg F. to 76 deg F.

Mean relative humidity varies between 75% and 82% in New Providence and marginally higher, at 79% to 88%, in Great Inagua. This figure conceals the fact that absolute humidity is much lower in the winter (Dec.-Mar.) period, which makes this an ideal period for production of many temperate food crops, particularly vegetables.

TABLE 3 Monthly Variation in Temperature Extremes for Abaco (wet north-west), Exuma (central) and Inagua (dry south-east)

Month	Mean Maximum Temperature			Mean Minimum Temperature		
	Abaco	Exuma	Inagua	Abaco	Exuma	Inagua
January	78.3	79.1	83.7	64.5	69.0	67.5
February	76.7	78.5	82.3	62.7	67.4	67.3
March	79.5	80.9	84.6	66.0	69.1	68.7
April	81.1	84.1	87.6	69.0	71.9	70.2
May	83.7	86.2	87.6	72.1	74.1	73.8
June	86.1	87.4	89.2	75.1	76.1	75.8
July	87.3	88.7	91.2	76.9	78.1	76.3
August	86.9	90.0	91.0	77.1	77.8	75.6
September	86.6	88.1	90.6	76.2	77.0	73.8
October	84.4	86.1	88.8	74.0	75.4	73.8
November	80.9	82.5	86.6	69.6	72.3	70.3
December	78.9	79.4	84.1	66.6	69.8	68.3

Source: Little et. al., Table 3., Page 11.

Moving from winter to summer (May-Sep), with much higher humidity and rainfall, it becomes much more difficult to produce the same group of crops. This is because of higher susceptibility to disease in the more humid atmosphere, and the prospect of crop damage from excessive rain.

The absence of frost because of the small land mass of each island is a unique feature of The Bahamas. With an average of 7 hours of sunshine/day year round and the mild, moist atmosphere, The Bahamas have a production advantage over many other locations which can produce similar crops, but only on a seasonal basis. The close location of The Bahamas to mainland USA, and the regular transport connections to Canada and Europe, provide specific market opportunities to capitalize on the beneficial climate for agricultural production.

Wind

Prevailing winds throughout the islands are from the easterly quarter. In the northerly sector, the prevailing winds are from the northeast from October to April. Although mean wind speed is in the range of 7-10 knots, it is not uncommon to have periods with wind speeds of 15 knots or more, during the winter. Moving southward, the period of northeasterly winds becomes shorter and less pronounced, so that in the southernmost islands the predominant wind direction is east-southeast all year.

Wind creates some specific problems for farmers. There is the loss or damage of fruit and flowers, the breaking of fruit laden boughs or overturning of loosely rooted plants such as bananas, and the loss of soil and plant moisture through the evaporative effect of wind.

Wind appears to be a limitation on banana production, generally, and plantain production, specifically. Farmers appear to adopt certain farm practices, which limit the quality of bananas, as a defence against wind losses. Farmers cite potential wind damage as a reason for growing the smaller Jamaican dwarf banana rather than the taller and heavier plantain, despite the potentially higher income from plantain.

They leave multiple suckers at the base of bearing stems rather than trimming back to one fruiting stem and one sucker, so as to have the greatest chance of a replacement, should the fruiting stem blow over.

Various defenses are adopted against the wind problem. Trees, especially bananas, are planted in deep potholes or in deliberately small clearings in the scrub. Multi-story cropping is adopted, with bananas, citrus and vegetables together, to increase the density of plant material and, hence, reduce the potential for wind damage. In the large vegetable farms, fields are broken into narrow rectangles by growing dense, tall plants such as sugarcane, as windbreaks.

Hurricanes are a special Bahamian problem. While they are not exceptionally frequent, the potential for hurricane damage should be taken into account for long-term agricultural planning. Little et. al (1977) cite data on the frequency of hurricanes over a 92 year period from 1871 to 1963 as follows:

TABLE 4 Incidence of Hurricanes in The Bahamas

Island	Number passing across an island	Number passing within 200 nautical miles
Abaco	8	91
Grand Bahama	16	70
Andros	9	90
Eleuthera	6	85
Cat Island	7	39
Exuma	5	45
Long Island	7	45
Crooked Island, Acklins	9	45
Mayaguana	5	45
Great Inagua	3	45

Source: Little et. al., Table 2., page 7.

The importance of the data is that Grand Bahama, with its otherwise high potential for tree crops, has double the chance of hurricane damage as Abaco or Andros. The crude statistics for incidence of hurricanes are:

Island	Hurricane	Within 200 miles
Grand Bahama	1: 5.7 years	1:1.3 years
Andros	1:10.1 years	Every year
Abaco	1:11.4 years	Every year
Cat Island	1:13 years	1:2.3 years
Eleuthera	1:15.2 years	Nearly every year

The fact that Grand Bahama has a hurricane less than once every six years and that one passes within 200 miles virtually every year does not mean that farmers should not invest in tree crops, or that farmers can expect regular significant losses from hurricane damage. Tree crop production is successfully carried out on a large scale in all the northern islands. In Abaco there is one permanent citrus/avocado orchard more than 16 years old, with a consistent record of regular high production.

It does mean, however, that orchard sites should be selected with care, and that farms should be laid out with an eye to the prevention of possible hurricane damage. Part of any overall plan to mitigate hurricane damage should be the maintenance of national mother stocks of the principal commercial tree plants, which should include improved varieties of citrus, bananas, plaintain, papaw, mango and avocado. The present citrus canker prohibition on Florida citrus is proof that suitable material may not be available when it is most wanted.

At the same time, for their own protection, large tree crop farms, such as those run by citrus growers, should always keep reserves of nursery stock and budding material, which should be regularly replenished.

Soils and Landform

The landforms in each island are a composite of dunes, beach ridges, marshes and plains, some of which are actively forming, and others in various stages of decomposition from prior ages. With the highest point on land being 207 feet (63.7 m) above mean sea level, micro-relief and local conditions are important in determining suitable locations for agriculture in The Bahamas.

Virtually all the land is limestone-based, though the limestone is by no means uniform in structure, density or strength. The limestone vary according to their origin and age, the most important variations being in the type of limestone and degree of hardness. The soluble nature of limestone means that most of the soil is eventually lost in the normal degradation process, and that natural soils are thin and of little structural strength. They are strongly alkaline, of low natural fertility and have a high capacity to lock up applied fertilizer.

Little et. al. (1977) suggest that observed soil differences may be related to minor differences in the base limestone. They describe four general classes of soils:

Limestone Residues - Red and brown lateritic soils

Aluminous Lateritic Soils ("red soils", "pineapple soils", Bahamas red loam"

Occur in low spots and valley bottoms varying from 1-5 acres, between dune ridges and on hillsides held in irregular rock surfaces. Always associated with hard rock, usually shallow, and with poor retention of water and applied fertilizer.

Immature Lateritic Soils ("Brown mineral soils", "Bahamas stony loam")

Occasionally found as shallow continuous soils, they are more often interrupted by rocky outcrop and lie on irregular rock surfaces. Occur widely in the Coppice Island, where they are deepest in "banana holes" and at the foot of ridges, and are widely distributed over the Pine Islands. They are never deep and have low water retention. However, as they are closely associated with soft rock, they can draw water from rock reserves. The better man-made crushed rock soils of the Pine Island plains are of this category.

Organic Soils (Leafmould soils on rock, muck soils)

Substantially fine grained dark-coloured humus covered by less rotted leaves, but may also contain minor amounts of mineral soils. Under natural bushland, the leafmould may cover the entire rock surface, but after slash and burn farming, the rocky outcrops are exposed. These soils rapidly waste away on exposure and are depleted of nutrients. Traditionally cropped for 1 or 2 years and then abandoned. They are unsuitable for sustained farming land preparation or merchandised farming.

Sedimentary Soils (Sandy soils with humus, sandy soils with caliche; limesilt soils)

Of variable character, depending on degree of coarseness of the sand, localized salinity and vegetation cover, which influences the amount of retained humus. Useful agriculturally, as they provide a continuous planting medium, allow plenty of room for root growth and are suitable for the use of light machinery. Most frequently used when located adjacent to fresh water ponds or above fresh groundwater. Potentially subject to salt intrusion.

These soils were historically important for maize production in the central and southern islands. These lands, however, often have great tourist development potential as they are almost invariably adjoin a present day beach, and are suitable for developments such as the golf course at Cotton Bay Eleuthera. (Little et. al. Vol 2a 1976)

Man-made soils (Quarry pit soils, artificially augmented soils of Exuma, heaped up marsh soils of North Eleuthera, prepared rockland (crushed rock) soils)

Muck Soils. Deep peaty soils in periodically flooded hollows. Often deep, though generally waterlogged past one foot. In Exuma they are built up with rock and sand to lift the rooting zone above the water table. In North Eleuthara they are partially drained with local trenches, and built into raised beds for vegetable farming.

Crushed Rock Soils. Created on the open soily rock plains of the Pine Islands by removing the timber, pushing the larger rocks into rows and cracking and crushing the softer base rock with mechanical rippers and heavy disc ploughs. The final result is a soil/rock mixture which can successfully be used for broad acre mechanized agriculture if the soil/rock ratio is suitable. It is also used for permanent tree crops on a minimum tillage basis.

Land Capability Classification

Little et. al. (1977) devised a Land Capability Classification to draw together the results of their various analyses of the land, soil and water situation in The Bahamas.

In Summary, the Classification is:

Tillage Land:

Class 1:	Small individual area of deeper red and brown soils together with "whitelands" (humic sands)
Classes 2 and 3:	Intimate associations of soil and rock (occupying the top 3-18 inches of the ground surface) suitable for preparation as ploughland; Class 2, gravelly; Class 3, stony.

Non-Tillage Land:

Class 4:	Rockland not suitable for ploughing. 4A not steep, 4B steap or rocky ridges.
Class 5:	5A High Watertable hardened rockland 5B Sandy land excluding 5C Steep sand dunes
Class 6:	6A Bare rock land pitted with caves 6B Steepest rockland (> 1:10)
Class 7:	Land susceptible to flooding. 7A Freshwater flooding, 7B Saltwater flooding

Notes

The Survey defined Tillage Class land as:

Class 1. Land with an essentially gravelly or finer (natural) tilth, nowhere less than 6 inches deep.

Class 2. Land which can at varying, but not excessive cost, be reduced by standard heavy tillage implements to a continuous gravelly or finer tilth, nowhere less than 6 inches deep.

Class 3. As for Class 2, but the word stony is substituted for gravelly.

Class 1 applies to soils and sands. Classes 2 and 3 apply to various forms of rocklands.

Suffix letters S, T, W and X indicate land limitations corresponding to;

S, Soil
T, Minor topographic uneveness (<6 feet relative relief)
W, High water table, alternatively an absence of irrigation water
X, Inclusion of scattered, exceptionally hard rock

Double suffixes, i. e. SS, indicate a more severe limitation.

Practically all the land which can be used for agriculture falls into Classes 1-4A. In the Land Capability Map (2), published with their report, Little et. al. (1977) provide some estimates of the areas of the various land capability classes for the principal islands.

The most obvious feature of the data in Table 5 is the predominance of agricultural class land in the three islands of Abaco, Grand Bahama and Andros. Of the estimated total of 164,094 acres, some 132,152 acres, or 80.5%, are found in these three islands. By comparison, Eleuthera and Cat Island, which have historically been big suppliers of farm produce to New Providence, contain an estimated 9127 acres, or only 5.5%, of the agricultural land in the principal islands of The Bahamas.

TABLE 5 Distribution of Agricultural Land by Island and Land Class
All areas acres

Land Class	Abaco	Grand Bahama	Andros	Eleu thera	Cat Isl	Exm	Crkd Ackl	May Ina	Total Each Class	% Each Class
Level										
Sand			270	1169	378				1817	1.11
1				42		90			132	0.08
1S				234					234	0.14
1SW			110	40					150	0.09
1SWW				793			890	3410	5093	3.10
1SSW				313					313	0.19
1SSWW				80					80	0.05
1WW				145	476		420		1041	0.63
1/4A						215			215	0.13
S/tot	0	0	380	2816	854	305	1310	3410	9075	5.53
2	1775	14451	8158	24					24408	14.87
2S			11008						11008	6.71
2SS	600		5568						6168	3.76
2SST	1213								1213	0.74
2T			390						390	0.24
2W	6285		170		410				6865	4.18
2WW	1103								1103	0.67
2 (3)		2476							2476	1.51
2-3		950							950	0.58
2T-3T		1195							1195	0.71
S/tot	10976	19072	25294	24	410	0	0	0	55776	33.99
3-2		1725							1725	1.05
3(2)		9173							9173	5.59
3	5405	5638	15460	190					26693	16.27
3S	13513			697					14210	8.60
3SS	9848		125	1233	313				11519	7.02
3SSX			9815						9815	5.98
3SW				38			480		518	0.32
3SWW				95			150		245	0.15
3SSW				329	130				459	0.28
3SSWW									0	0.00
3T	4823								4823	2.94
3W			115	1359					1474	0.90
3WW	330				131				461	0.28
3WWSS	460			55					515	0.31
S/tot	34379	16536	25515	3996	574	0	630	0	81630	49.75
4A							1750	12600	14350	8.74
4A(C)							2810		2810	1.71
S/tot	0	0	0	0	0	0	4560	12600	17160	10.46
Modif				453					453	0.23
Total	45355	35608	51189	7289	1838	305	6500	16010	164094	100
%Area	27.6	21.7	31.2	4.4	1.1	0.2	4.0	9.8	100.0	

Source: Little et. al. (1977) Map 2. Land Capability.

TABLE 6 Principal Physical Limitations on Class 1-3 Land for Selected Islands in The Project Area

No.	Island	No. Limitation		Principal Limitation						Total
		Ac	%	Soil		Water		Topography		
				Ac	%	Ac	%	Ac	%	Ac
1	Eleuthera	1688	23	3555	49	2046	28	-	-	7289
2	Andros	23798	46	26516	52	285	1	390	1	51189
4	Abaco	7180	16	25174	55	8178	18	4823	11	45355
5	Grand Bahama	34413	97	-	-	-	-	1195	3	35608
7	Cat Island	378	21	443	24	1017	55	-	-	1838
Total		67457		55688		11526		6408		141279
Percentage		48%		39%		8%		5%		

TABLE 7 Comparison of Estimated Area Class 1 to 4A Agricultural Land by Island with Island Area and Census recorded area of Total Farm Land

	Unit	Abaco	Grand Bahama	Andros	Eleu thera	Cat Isl	Exm	Crkd Ackl	May Ina
Land Area	Sq Mile	649	530	2300	200	150	72	132	755
Class 1-4 Agric Land	Acre	45355	35608	51189	7289	1838	305	6500	16010
% Class 1-4 to all Land		10.92	10.50	3.48	5.69	1.91	0.66	7.69	3.33
Census Total Farm Land	Acre	20791	743	6795	9404	29921	2760	2570	na
Class 1-4 as % all Census Farm Land		218.1	4792	753.3	77.5	6.1	11.1	252.9	

An important aspect to consider is the rated quality of the land. Of the 35,608 acres in Grand Bahama, some 34,413 acres, or 97%, have no limiting factor related to soil condition, topography or water. Table 6 recasts the data from Table 5, on the basis of the principal limitation identified by the original survey.

The obvious implication from the figures in the preceding tables is that there are not only greater areas of usable land in the Northern Islands, but also a greater proportion of usable or better class land in these islands. The exception to the rule may be Abaco, where only 16% of the 45,355 acres is rated as free of restraints. This is in marked contrast to Grand Bahama and Andros, with 97% and 46% respectively, of land free of significant physical limitations.

To find a further perspective for the distribution of agricultural areas between the islands, the total areas of Class 1-4A land are compared with total land area of the respective islands, and with the area shown as total farm land in the 1978 Agricultural Census. (See Table 6). It is acknowledged that there have been some developments since that time in land use; however, the comparisons are again revealing. In Eleuthera, only 75% of the land used for farming in 1978 was Class 1-4A land, whereas Grand use for farming in 1978 was Class 1-4A land, whereas Grand Bahama had 48 times as much good agricultural land as was in use at that time. The analysis is set out on the next page.

Overall land area is no criterion of agricultural capability. No island has agricultural class total area, and none of the traditional agricultural islands land equalling more than 11% of has Class 1-4A land equalling more than 5.7% of total area. Some islands, such as Cat Island and Long Island, record larger areas of land in agricultural use than that estimated as being of agricultural capability. That is, they are farming on Class 5 hard rock lands and Class 6 flood land. While farmers appear to have overcome this adversity with some success in the past, the situation does not offer any scope for significant agricultural expansion in the future.

The final issue in assessing agricultural capability for an "Action Plan" is to determine what land is immediately usable. While there are said to be 164094 acres of agricultural class land outside New Providence, the 1978 Agricultural Census recorded only 17706 acres of arable land in all the islands, and a further 4861 acres in permanent tree crops. That is a total of 22567 acres in use, or 14% of the agricultural class land. The census recorded a further 4491 acres in permanent meadows, and the balance of 62510 acres as "wood, forest or other land".

The fact is that the greater part of the potential agricultural land is not immediately usable, as it is under pine forest or coppice. In the case of the pine forest land, there is time lag to be considered in bringing it into use for the full range of agricultural activities which might be warranted.

It takes time to make a soil in The Bahamas. The early experience of BARTAD was that clearing the timber and crushing and ploughing the rockland did not immediately make usable crop land. Early cropping efforts produced poor results, and it was only after several years of cultivation and incorporation of organic material that suitable soil/rock ratios were achieved. The process also required that the excess free calcium carbonate be overcome and soil fertility built up with repeated heavy applications of fertilizer. Once this process had been completed, crop yield began to reach satisfactory levels.

Most of the land currently in use on the Pine Islands for mechanised agriculture has a long history of cultivation. In Abaco, the Sawyer, BAIL, Estates land all have between 12 and 20 years of cultivation. The same applies to the several thousand acres adjacent to the San Andros aerodrome in Andros. If the use of these areas is to be expanded, then it cannot be done overnight.

There is probably little more than 20000 acres of this class of land in Abaco and Andros combined, plus perhaps 1000 acres in Freeport. Of this area, 10000 acres in Abaco has been leased on a long term basis for tree crop development. Of the balance, some 3000 acres in Andros is mostly occupied by squatters and short-term tenants, while some 7000 acres of the BAIL Estate remain uncommitted.

For tree crops, the situation is not so demanding. It is not necessary to have such a high soil/rock ratio, as is the case for cereal and vegetable crops. It is, therefore, possible to envisage clearing, ploughing and planting, on say a 2 year cycle. Timing, however, remains paramount. If the Action Plan foresees an increase in cropped area beyond the immediately useable area of 11000 acres, then it will be necessary to take a long term view of agricultural development in order to be ready when the additional agricultural land is required.

THE FARMING SYSTEMS OF THE BAHAMAS

It is nearly 500 years since Columbus first brought European settlement to The Bahamas, and 357 years since The Bahama Islands were first permanently settled by the Eleutherian Adventures. The fact that the settlers survived, despite the many difficulties created by the poor rocky soils and the scarcity of water, indicates that they eventually developed a sound agricultural system adapted to the local conditions.

Early settlement was concentrated in the central islands, San Salvador, Eleuthera, Cat Island, Long Island, Exuma and Rum Cay. These islands have limited areas of agricultural soils, many of which have restrictions imposed by excessive amounts of rock or poor access to water. The early farmers used the sandy soils or the organic leafmould soils, both of which deteriorate with use and require long periods of fallow under bush revegetation to rebuild the leafmould, which is the source of their nutrient base for plant growth.

As a consequence, the early settlers rapidly developed a shifting agriculture system. Small pockets of better soils were selected, the woodland vegetation cut back, and the cleared land used for two or three years. Without fertilizers, the soil nutrients and structure were rapidly exhausted and the farmer would move on to another area nearby, leaving the land to regenerate. It is estimated by Little et. al (1976 Vol. 2a) that at one time or another, the whole of Eleuthera has been cleared for farming.

It is only in the last 30 years, with the advent of mineral fertilizers, agricultural chemicals and large-scale farm machinery, that alternative forms of land use have ben possible.

Survival has been the historical keynote of Bahamian agriculture. While there have been brief periods where export markets have provided farmers with substantial cash earnings, the small production areas and the transport difficulties between the islands have meant that the overall emphasis of agriculture has been in production of food crops for home use and domestic sale.

In their 1970-76 survey of the land resources of The Bahamas, Little et. al. recognized three farming systems in The Bahamas. The classification is still valid and provides a useful basis for examining future possibilities in Bahamian agriculture.

The No-Investment (Traditional) System

The traditional system continues to be important on the Family Islands, particularly in the drier areas such as Cat Island and islands further south. The system involves selecting an area of scrub or coppice land with a suitable depth of leafmould. The small scrub is cut to ground level and the boughs are lopped off the larger bushes at shoulder height.

The cut scrub is made evenly over the ground to dry, and after a suitable period, of up to several months, is burned. The aim is to burn the weeds and seeds and to sterilize the ground. If the fire is too hot, it may burn some of the leafmould, and thus reduce the available "soil". The residual ash provides an initial fertilizer dressing.

The field is then planted in a mixture of crops. The traditional aim was to maintain a constant supply of fresh food for as long as possible, together with a surplus of storable grain. The grain supplemented the fresh food through most of the year, but became vital in the first few months of the growing season while waiting for the cycle of short-term crops to begin.

The planting season begins with the advent of cooler weather in October, at the end of the summer rainy period. It continues with a series of crops through to the end of winter, when the summer crops are planted. First there are short term vegetable crops; tomatoes, sweet peppers, cucumbers, cabbage, peas and beans. With sequential plantings, these can continue for 4 months, from December to April. At the same time, banana suckers are planted at suitable locations throughout the clearing, so that they will begin to bear fruit at the end of the first year.

Immediately after the first group of vegetable plantings, come the hard vegetables; Irish potatoes for harvest in March-April, and onions for April-May. As the early winter crops mature, they are replaced by summer crops such as maize, which will be ready for harvest by August. The maize is followed by the root crops, cassava and sweet potato. The storable grains, maize and pigeon peas, together with the cassava and sweet potato, will provide the basis for family food survival in the critical October-January period, until the fresh cycle of short-term crops begins again.

The cycle of land use varies over the two to three years for which the piece of land is used. In the first year it is fresh, and the emphasis is on solanaceous, cucurbit and leaf vegetable crops followed by grains. In the second year there is more emphasis on legumes such as pigeon peas, black eyed peas and lima beans, together with root crops, cassava, sweet potato, yams and eddoes.

At the end of this cycle, the pigeon peas, root crops and bananas can remain and be harvested in the third year, without much effort being required to keep the land weed-free. At the same time that bananas are planted, citrus, mango or other fruit trees may be introduced. These will take two or more years to come into bearing, but in the interim, the land is producing food and income from the shorter term crops.

There is, therefore, a cycle of opening a fresh piece of ground each year while continuing with second and third year land. On the better class land, such as that in North Eleuthera, once the land is exhausted for use with short-term crops, it can be used for a longer period under tree crops, which needs considerably less care.

The whole system operates without machinery. The only equipment required is a "cutlass" (machete), which is used for cutting the bush and then for the weeding and planting. A hoe may also be used, especially for weeding on sandy land. Other than the cutlass, the only investment is in the time to cut and burn the bush to prepare the land for use. Historically, where the opportunity cost of labour was little or nothing, and all labour was family labour, the system could be operated on virtually zero cash investment.

The Low-Investment System

A number of things have happened in recent years to change the historical situation of farming in The Bahamas. First and foremost has been the greatly increased opportunity for, and value of, off-farm employment. The loss of family labour has meant that farmers have to use paid labour, which immediately raises the investment threshold for the traditional system of farming by at least the value of the time taken to prepare the land and the cost of labour in crop production.

On the basis of data collected in farmer interviews in Eleuthera, it is estimated that it requires 10 to 15 mandays/acre to cut and burn scrub. At a present value of $15/manday this would set the minimum investment in cut and burn agriculture at $150 to $225/acre, which, over a two-year cropping period, would be $75 to $115/acre/year.

For short term intensive cropping, the general labour requirement is estimated to be on the order of 1 man/3 acres. For semi-permanent crops such as pineapples this could more than double to 7-10 acres/man, while, for permanent tree crops (citrus mangoes), and vegetables and livestock, the labour requirement may reach to 12 to 15 acres/man.

The other significant change has been the advent of modern agricultural inputs - bagged fertilizer, herbicides, pesticides and improved seed varieties. All these inputs cost cash, so the farmer must re-examine his cycle of production to at least recover the cash investment. This implies the selection of crops on the basis of greatest cash return, rather than on the criterion of year round food supply, mentioned earlier.

It has had the effect of increasing the proportion of the farm put under vegetables, at the expense of root crops and, to a lesser extent, maize. This, in turn, has meant that more of farm output is perishable and that there is less emphasis on the food security aspect of grain and root crops to feed the family. There is also the fact that with substantial out-migration of people from the Family Islands, farmers have fewer mouths to feed, which reinforces the trend towards the cash economy, and away from the self-sustaining style.

Modern agricultural inputs have also had a beneficial technical impact on the traditional slash and burn system. The traditional system moved to fresh land each year because it had to. Fertility was naturally low, and

was rapidly depleted by intensive land use. Heavy use of fertilizer now allows for much longer periods in the one location, and a farmer can look for longer payback periods for higher investment.

The combination of technical opportunities and economic pressures has led to the emergence of the "Low Investment" system of farming, which could now be considered the predominant system of land use in The Bahamas. While it retains elements of the slash and burn system, it is much more stable in relation to given pieces of land.

A farmer may now continuously occupy a much larger area of land, within which he rotates his crop production. New land will be simultaneously planted in vegetables, bananas and permanent tree crops. The vegetables provide the initial cash flow, the bananas and root crops follow, and after three to four years the land can become a permanent orchard, with perhaps a 20 year life span. The farmer can afford to fence the land, as he has sufficient time to recover the cost of doing so. He may, therefore, run sheep in the orchard to control the weeds and to diversify his income and reduce his dependance on labour intensive production.

One benefit of this system is that it allows the farmers to concentrate on the best land, and to undertake longer term strategies such as green manure cropping or the incorporation of organic material into the soil. In Long Island, the advent of heavy tractors has allowed farmers to crack open the hard rock surface and create pits or low level gardens where the fresh water table is just below the surface.

In Exuma, farmers have built substantial gardens on mulch soils or "shag pond land" where they have filled in low-lying land above the water table and created permanent crop land. Other investments may include deep ripping lines prior to planting orchard areas, to allow deep rooting of permanent trees to the water table, or the hand clearing of rock to create clear fields, so that plastic mulch weed control can be used under pineapples.

Additional study must be done in order to have an updated picture of the investment/cost of the production/revenues situation within this group of farmers. That will be crucial for the design of an appropriate strategy for agricultural development, especially on the Southeastern Islands.

The High-Investment System

Since the 1930's there have been a small number of non-Bahamian investors who have attempted large-scale mechanised agriculture in The Bahamas. Austin Levy at Hatched Bay, and A. V. Davis at Rock Sound were two pioneers of this style of farming. A number of entrepreneurs attempted large-scale vegetable farming in Abaco and North Andros, only to withdraw after a few years.

The most successful venture of this type has been Key and Sawyer Farms, which until recently were Bahamian-owned and are still Bahamian managed. This farming business has a 16-year history of successful large-scale production of export vegetables, and more recently has moved into permanent tree crop production.

This style of farming is modern, mechanised, broadacre agriculture. It requires clearing relatively large areas of land, by Bahamian standards, ploughing up the rock to make soil, and laying out a flat land farm. The costs of doing so are quite high. However, if a sufficiently long time period is available to recover the investment, the development costs can be worth-while. This system is more appropriate for export agriculture, although the domestic market could also be supplied by farms operating on a high-investment system.

LAND TENURE AND SETTLEMENT ISSUES

The Bahamas comprises an area of about 100,000 square miles (227,320 sqr. km.), representing an archipelago of over 700 islands and cays. Most of the territory therefore consists of water. The land area is estimated at only about 5% of the territory of 5,353 square miles (13,864 sqr. km.). Of the total island area, about 170,000 acres are considered to represent arable land, suitable for agricultural use. However, it is estimated that only about 25,500 acres or 15.0% are being exploited at the present time.

Although commercial agricultural activities already take place in about eleven of these islands, which themselves demonstrate potential for increased production of certain crops, the most promising opportunities for improved productivity and output lie in the Northern Islands, commonly referred to as the Pine Islands.

The major constraints to the expansion of commercial agriculture among the Southeastern (or Coppice) Islands consist primarily of marginal soils and limited water availability. In addition, relatively high land preparation costs, an inevitably high dependence on fertilizers and chemical applications, and above-average unit cost for transportation (for both input supplies and farm products), further limit the prospects for commercial farming in these islands.

Farm Size and Distribution

The Agricultural Census of 1978 recorded 4246 individual farming enterprises utilizing 89,611 acres of land in The Bahamas. In designing an appropriate programme to promote further development of agriculture, it is necessary to examine more closely the distribution of farm size, the location of farming in the islands and the intensity of land use.

Farming land is unevenly distributed among farmers in The Bahamas. To interpret the situation, Census data have been condensed into five farm-size categories. These categories are intended to represent the likely farming systems employed and the potential for future development.

The categories selected are:

Less than 2 acres	Most likely to be a part-time farmer operating in the Low Investment system.
2 - 5 acres	A one-man farming operation.
5 - 20 acres	More than a one man farming operation. Will need labour assistance at least for harvesting. Some opportunity for capital accumulation and investment.

20 - 200 acres	Potentially a farming business with paid wage labour and sufficient cash flow to permit investment in mechanized farming methods.
Greater the 200 acres	Mostly large scale professional farms, all paid labour, mechanized and technically sophisticated.

Table 1 Number and Area (in acres) of Farm Holdings in The Bahamas by Farm-Size Category

Farm Size Class	Unit	Farms <2ac	Farms 2-5ac	Farms 5-20	Farms 20-200	Farms >200	Total Farms
Total Farms	NO	1806	1188	983	227	42	4246
	Area	1548	3563	8651	10091	65758	89611
Percentage by Farm Size Class	NO	42.5	28.0	23.2	5.3	1.0	100.00
	Area	1.7	4.0	9.7	11.3	73.5	100.00

The data demonstrate sharply uneven farm size distribution. About 43.0% of individual farms measured less than 2 acres and about 71.0% less than 5 acres. Collectively they comprised not much more than 500 acres or 5.7% of the recorded farm area in The Bahamas. At the other end of the scale, there were 42 farms (1% of the total) said to be greater than 200 acres and these occupied 65,758 acres or 73.4% of aggregate farm area. Farm land is not only unevenly distributed among farmers, it is also unevenly distributed among islands. The general distribution among the islands is given in Table 3 which reveals the difference between the Northern and the Southeastern Islands.

Table 2 Number and Area of Holdings by Island Group and Farm Size Category

Farm Size Class	Unit	Farms <2ac	Farms 2-5ac	Farms 5-20	Farms 20-200	Farms >200	Total Farms Island	Percent
Northern Islands	NO	958	340	273	57	9	1637	38.6
	Area	732	981	2228	2326	27634	33901	37.8
Southeastern Islands	NO	848	848	710	170	23	2599	61.4
	Area	816	2582	6423	7765	38124	55710	62.2
Total	NO	1806	1188	983	227	32	4236	
	Area	1548	3563	8651	10091	65758	89611	

Source: Agricultural Census, 1978/FAO Report

About 81% of the better agricultural class-land is in the northern Islands of Abaco, Grand Bahama and Andros. Yet the fact is that 62% of the land used for agriculture is in the Southeastern Islands. This has, however, been of a traditional pattern and does not provide a basis to guide development of the agricultural sector.

In order to take advantage of modern agricultural practices and potential, it will be necessary to shift the focus of Bahamian agriculture in order to exploit the better conditions in the Northern Islands.

Table 3 Number and Area of Holdings by Island and Farm Size Category

	Unit	Farms <2ac	Farms 2-5ac	Farms 5-20	Farms 20-	Farms >200	Total Farms	Percent Island
New Providence	NO	141	118	153	23	2	437	10.3
	Area	116	355	1322	1015	1764	5572	6.2
Grand Bahama	NO	116	11	6	1	1	185	4.4
	Area	76	32	53	34	548	743	0.8
Abaco	NO	224	47	24	7	2	304	7.2
	Area	172	136	167	186	20130	20791	23.2
Andros	NO	427	164	90	26	4	711	16.7
	Area	368	458	686	1091	4192	1795	7.6
Cat Island	NO	86	181	137	36	10	450	10.6
	Area	97	592	1048	1301	16883	29921	33.4
Eleuthera	NO	230	187	195	39	6	657	15.5
	Area	182	568	1807	1876	1971	1404	10.5
The Exumas	NO	201	179	56	12	3	451	10.6
	Area	216	546	427	466	1105	1760	3.1
Long Island	NO	81	168	281	71	6	607	14.3
	Area	76	479	2783	3501	1378	8217	9.2
Rest of Bahamas	NO	250	133	41	12	3	444	10.5
	Area	245	397	358	621	3787	5408	6.0
Total Farms	NO	1806	1188	983	227	42	4245	100.0
	Area	1548	3563	8651	10091	15758	89611	100.0
Percentage by Farm Size Class	NO	42.5	28.0	23.2	5.3	1.0	100.0	
	Area	1.7	4.0	9.7	11.3	73.4	100.0	

Source: Agricultural Census/FAO Report.

Table 4 above sets out in more detail tha number of farms and the areas used in the individual islands. In terms of the numbers of farm holdings, the dominant islands are Andros, Eleuthera and Long Island. Cat Island and the Exumas have among them 2165 farms (51%) and 50,302 acres (56.2%) of the land area in use for farming. The Land Resources Surveys had estimated that these islands had only 9463 acres of agriculturally suitable lands. The implication, therefore, is that much of Bahamian agriculture is being carried out under conditions of great difficulty and, in terms of available land resources, on very marginal lands.

The FAO Report cautions that the reported amount of land in agricultural use must be intepreted with care. It seems quite apparent that there is not necessarily the same intensity of land use between the smaller and larger farms. Many of the larger holdings can be identified individually as having either only a small portion in use or even no effective agricultural use of the land at all.

The example of under-utilization was given for the BAIL Estate on Abaco. The property consists of 17,200 acres and is shown in the Census as one of the two properties on Abaco being greater than 200 acres. However, the fact is that the BAIL Estate was out of production and the land was idle between 1971 and 1984. Currently 10,000 acres of the Estate have been leased for a long-term export citrus development.

Another example is the 10 properties said to total nearly 27000 acres on Cat Island. No farming on this scale has taken place in Cat Island since the 18th Century. These large holdings are in part a residue of the plantation cotton farming period and do not in any way reflect the presence of large-scale farming on Cat Island in 1978.

The FAO country mission attempted to clarify the situation of large farms in The Bahamas. Of those farms said to have over 200 acres in production or active use, fifteen were identified to be either in production or in some stage of development as of 1986. The area and location can be estimated as set out in Table 4.

No large agriculturally productive holdings actively in use existed on any other island. At the time of the Agricultural Census it was estimated that of the 65,758 acres in the large-farm sector (greater than 200 acres), 54,404 acres or 83% of the land was "wood, forest or other land." In 1978, of the 11,354 acres in productive use, only 2950 was in short-term crops and 699 acres in tree crops. The balance of 7706 acres was comprised of meadows or fallow.

Table 4 Estimate of Number, Location and Total Area (acres) of Operational Farms over 200 acres in The Bahamas -September 1986-FAO Report

Island	Number	Area (acs)	Activity
Grand Bahama	3	2900	Export orchards, 1900 acs bearing and 1000 acs in development.
Abaco	2	8000	Export orchards; 3000 acs in production and 5000 acs in development.
Andros	4	4000	Land not farmed by owners. Some of the area farmed by tenants and squatters for local market production.
Cat Island	1	5400	Extensive grazing.
Eleuthera	5	3800	Local and export production. Does not include 1200 acs of Hatchet Bay Estate now abandoned.
Total	15	24100	

The aggregate figure of 89,611 acres recorded as agricultural lands may therefore be misleading. The data may overstate the "real" agricultural land by as much as 54,000 acres, or more than half the area of 89,611 acres recorded. It can only be said that at all times the data for the large-farm category should be interpreted with care, especially when assessing the resources available for Bahamian agriculture.

The Structure of Farm Holdings (and the Tenure of Agricultural Land)

The difficulties of attempting to farm the hardrock lands of the southeast represents a unique Bahamian problem. Naturally available arable lands are quite limited in the south and it is therefore necessary for farmers to operate non-contiguous parcels of land.

Table 5 illustrates the fragmentation problems, presenting the distribution of land parcels cultivated with respect to acreage. Only 41% of farms are in one parcel, 45% are in 2 or 3 parcels and another 11% are in 4 to 5 separate parcels. Seventeen farms were recorded as having more than 10 different pieces of land in use at one time.

Operating on small pockets of land at scattered locations places a specific restriction on the capacity of farmers to improve farm efficiency through mechanization and capital investment.

TABLE 5 Fragmentation of Farm Holding

Farm Size Class	Unit	Farms <ac	Farms 2-5ac	Farms 5-20	Farms 20-200	Farms >200a	Total Farms	%
1 Parcel	NO	1028	342	275	57	12	1714	40.9
	Area	734	969	2134	2701	13244	19782	22.1
2-3 parcels	NO	649	636	486	108	19	1898	45.3
	Area	692	1892	4585	4346	27832	39347	43.9
4-5 parcels	NO	79	184	138	38	9	448	10.7
	Area	104	605	1155	2006	11119	14989	16.7
6-9 parcels	NO	5	25	66	18	2	116	2.8
	Area	8	90	640	751	13564	15053	16.8
>10 parcels	NO	1	1	9	6		17	0.4
	Area	1	5	108	310		424	0.5
All Farms	NO	1762	1188	974	227	42	4193	100.0
	Area	1539	3561	8622	10114	65759	89595	100.0

Source: Agricultural Census, FAO Report

Land Tenure

Another feature of Bahamian agriculture causing difficulties for development is the matter of land tenure. It affects both the way in which the land is held by farmers for their current operations and the access to additional land of persons wishing to become farmers or to expand their farming activities.

In The Bahamas there are four categories of land tenure, classified on the basis of occupancy and ownership status. These are:

Generation property: These lands are essentially "family lands" which have remained occupied by successive generations over time. These lands cannot be sold or transferred outside of the family although there could be some element of fragmentation with respect to occupancy.

Commonage lands: These lands are available for use by all individuals within a community, but are owned by none. Collective community decision-making may be applied in ratifying or vetoing the use of these lands by other parsons within a particular community. The communal exploitation of commonage land does not serve to prevent fragmentation into small uneconomic units and there is usually a limited willingness and ability on the part of

individual farmers to invest in fixed capital improvements. Fragmentation usually results from inadequate capital and labour resources to exploit large areas. These constraints have served to limit the full exploitation of these land resources. The principle of holding such lands in common, however, provides a very promising framework within which government support of agricultural development can be effectively carried out, for example, as in land preparation for large contiguous parcels, crop care and protection and post-harvest activities.

Crown lands: These are lands owned by the government. It is estimated that there are about 2.0 million acres of these lands. Further, these lands provide the most promising land resource potential for agricultural development. About 400,000 acres of these lands are in natural forests, which will require that the issue of land-use rationalization be addressed.

Private property: This is usually occupied on a freehold basis with the owner having a registered title to the land.

It is necessary to establish the extent of possibilities (as regards specific crops, acreages, marketing and agronomic requirements) for expanded commercial agriculture in the Southeastern Islands and to organize a system for wide-scale preparation, since the present scale of operations is considered to be too small and uneconomic.

Table 6 presents data on land tenure for farmers in The Bahamas. Seventy-two percent of farmers own their land or hold it in ownerlike possession. This in fact overstates the position as "ownerlike possession" mostly means "generation land."

TABLE 6 Number and Area of Farm Holdings by Farm Size Class and System of Land Tenure (Acres)

Farm-Size Class	Unit	Farms <2ac	Farms 2-5ac	Farms 5-20	Farms 20-200	Farms >200	Total Farms	% Each Class
Farm owned consisting of:								
1 Parcel	NO	779	264	240	33	9	1345	44.8
	Area	565	746	1856	1547	11692	16406	26.7
2-3 Parcels	NO	461	428	365	90	12	1356	45.1
	Area	505	1262	3600	3437	23281	32085	52.3
4-5 Parcels	NO	54	101	57	25	3	240	8.0
	Area	74	319	472	1487	9108	11460	18.7
6-9 Parcels	NO	4	18	23	10	1	56	1.9
	Area	6	62	238	452	548	1306	2.1
>10 Parcels	NO	1	1	5	1		8	0.3
	Area	1	5	47	50		103	0.2
Total owned or in ownerlike possession	NO	1319	812	690	159	25	3005	71.6
	Area	1151	2394	6213	6973	44629	61360	68.5
Farms rented rental system:								
mixed money/ produce	NO	50	45	39	5	2	141	82.9
	Area	29	137	358	216	1352	2092	95.3
Share-crop	NO	7	3	4			14	8.2
	Area	7	8	31			46	2.1
Other	NO	6	5	4			15	8.8
	Area	7	16	35			58	2.6
Total Farms	NO	63	53	47	5	2	170	4.0
	Area	43	161	424	216	1352	2196	2.5
Other Tenure Squatter	NO	220	111	50	5	3	389	9.3
	Area	186	329	387	200	681	1783	2.0
Other Single Form Tenure	NO	21	21	33	26	2	103	2.5
	Area	19	65	274	1456	400	2214	2.5
Mixed Tenure > 50% Owned	NO	47	67	62	16	7	199	4.7
	Area	54	225	514	661	15683	17137	19.1
Other	NO	92	123	99	16	3	333	7.9
	Area	88	348	789	590	3014	4865	5.4
All Farms	NO	1762	1187	781	227	42	4199	100.0
	Area	1541	3558	8601	10096	65759	89555	100.0

Source: Agricultural Census, 1978/FAO Report

The Bahamian government promulgated a policy of non-alienation with respect to the commercial exploitation of those land resources owned by the government. This policy prohibits the transfer of public property to private ownership on a fee-simple or freehold basis, but rather on a leasehold basis. The disposal of Crown Lands has always been a controversial subject and the Department of Lands and Survey has the responsibility of executing the Government policy in this respect.

Crown Lands are transferred by conditional Purchase Leases, which require the fulfillment of specific conditions, such as carrying out developments of a particular type and value. These leases are usually issued for land in the larger islands. At present they apply mainly to residential allotments for expanding of settlements and townships.

Alternatively, long leases of Crown Lands are also granted. They may be for residential, recreational or commercial projects and are granted for a period varying from five (5) years to twenty-one (21) years, depending on the size of the investment and, the nature of the development proposed. Land required for agricultural use is granted under leasehold tenure, which can normally be extended for a period of five (5) years.

Another form of tenure, the Annual Tenancy, is popular. It is more readily granted than any other form of tenure, since it does not give permission to plant permanent crops or erect permanent structures. Tenure on the basis Annual Tenancy can be terminated at any time after the first year. Generally, this type of tenure is issued to small-scale peasant farmers for subsistence farming and rural homesteading on a non-permanent basis. Annual tenancies are made available at a low cost in order to meet the needs of the people in the Family Islands.

The terms and conditions relating to the availability of government lands for private sector agricultural development in The Bahamas need to be much more clearly articulated within the context of a ganeral land-use policy. The agricultural component of such a policy should, among, other things, consider:

a. The locational possibilities for devoting increased acreage of arable lands to agricultural development, bearing in mind soil, water and other environmental considerations.

b. The precise terms and conditions of leasehold occupancy in the case of Crown lands (e.g. size of holding, administrative procedures, period of occupancy, conditions for transfer of capital improvements, etc.), by location if necessary. In cases where government assistance would be required for capital improvement, such as in the case of commonage lands, the main would concern land-use in order to ensure that cropping patterns fulfill the requirements of an overall financing and marketing strategy.

c. The establishment of a special unit within the Department of Agriculture or the Department of Land and Surveys to expedite the major requirements for an improved land policy, with particular reference to agricultural development.

d. The extent to which land use arrangements involving leasehold could provide a basis for accomodating improved provision of credit for capital development. Under the present system, leased lands cannot be used as collateral security for credit. The possibilities in this area need to be further investigated with a view to developing appropriate mechanisms within a government dominated leasehold environment to facilitate agricultural credit.

Project Implications

The extent of the possibilities for increased commercial agricultural production in the Northern Islands has to be precisely established (on the basis of agronomic assessment, marketing possibilities and physical land-use surveys) and the necessary land requirements made available to investors on a programmed basis. The relevant project inputs will be:

a. A forestry, soil and water conservation expert to address the issue of land-use rationalization.

b. The provision of international technical assistance either by way of training or with personnel to expedite such requirements as preparation of physical land surveys, designing appropriate leasehold conditions, developing the administrative and supervisory aspects of a national leasehold system, land management, etc.

c. The provision of assistance by the Government in initial land preparation. Adjustments to the present structure tenure physical of land will be inevitable, but this will have to be made on a well structured and rational basis, taking into consideration labour supply and capital availability.

In the Southeastern Islands, the focus will be on areas where land preparation represents high capital cost, but where there is scope for working with contiguous parcels. Areas having no unsurmountable physical or social constraints to a viable agricultural development programme will have to be given priority. Development or upgrading of necessary support infrastructure such as water supply and access roads is required.

THE BAHAMAS

AGRICULTURAL SERVICES DEVELOPMENT PROJECT

(BH-0011)

ANNEX 2

THE IMPORTANCE AND USE OF LIVESTOCK IN THE BAHAMAS

This report was prepared by Dr. Aston S. Wood, assisted by Dr. Basil Sands (counterpart) Dr. Keith Campbell, Mr. Komal Smith, Mr. W. Wallace, Mr. Simeon Pinder, Mr. Audley Greaves, Mr. Arnold Dorsett and Mr. G. Knowles.

INTER - AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE

November, 1989

THE BAHAMAS

AGRICULTURAL SERVICES DEVELOPMENT PROJECT
(BH-0011)

ANNEX 2

THE IMPORTANCE AND USE OF LIVESTOCK IN THE BAHAMAS

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THE IMPORTANCE AND USE OF LIVESTOCK IN THE BAHAMAS

EXECUTIVE SUMMARY

1.0 Background

The Bahamian agricultural sector is responsible for about 5% of the GDP and employs 5.6% of the workforce. The livestock sector in particular contributed over the last 10 years 60-80% of the agricultural production or between $17-34 million. The poultry industry has been a dominant contributor to the sector by generating between 94-98% of the value of production. This reflects a very minimal contribution by cattle, sheep, goats and pigs.

The most critical feature of the livestock industry is the sharp dependency on imported inputs. As such it is classified into:

a) Intensive operations such as poultry and pig enterprises which are supported wholly by imported feedstuffs and other inputs, and

b) The non-intensive operations which include small and large ruminants such as sheep, goats and cattle which survive on local forages.

Both the poultry and pig industries are sited primarily in the northern islands of New Providence and Grand Bahama. The easy access to imported feedstuffs and the markets serve as the major factor influencing their location of operation.

The core of the productive sheep and goat population and the small number of cattle are well distributed in the southeastern islands with their vast acreage of scrub lands with forage trees and shrubs.

According to the above-mentioned pattern, the respective livestock groups have structured their operations around access to their prime source of feedstuff. However, only the poultry industry has shown a tightly organized structure to meet the market requirements. The pig industry is not organized, and its profitability is dependent on supplementary feed inputs. Sheep and goat production dominate the ruminant sector as very little cattle-rearing is pursued. The importation of livestock products, with the exception of poultry, asummes therefore a large portion of the import bill. Table A presents the volume of meat imports and the extent of local supplies.

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TABLE B.

ITEM
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The project area includes the uncultivable coppice lands in the Southeastern Islands in particular. The production system involves an allocation of 2 does per acre, a grain feeding programme for pregnancy and weaning stages, the encouragement of a grass/legume undergrowth in the Coppice areas, the use of electric fencing with solar cell units, and the introduction of improved breedstock as the Barbados Blackbelly, Katahdin, Wiltshire and Florida Native Sheep and the Nubian, La Mancha and Saanen goats.

TABLE B. PROJECTED 5-YEAR MUTTON PRODUCTION

ITEM	PROJECT YEARS 1	2	3	4	5
	('000 LB.)				
SHEEP MEAT	118.5	167.4	237.7	336.7	476.7
% 1988 CONSUMPTION	3.5	5.0	7.1	10.1	14.0
GOAT MEAT	120.8	161.3	215.2	286.6	382.3
% 1988 CONSUMPTION	33.6	45.1	60.1	94.0	133.2
TOTAL ('000 LB.)	239.3	328.7	452.9	623.1	859.0
% 1988 CONSUMPTION (SHEEP & GOAT MEAT)	6.5	8.9	12.3	16.9	23.2

Based on herd models of 50, 100, 150 and 200 doe units, the proposed development of herds/flocks over the 5-year period among the respective islands is presented in Table C. A total of over 5,500 acres are to be involved.

TABLE C. - CAPITAL COSTS, OPERATING COSTS AND REVENUES AT FULL DEVELOPMENT FOR FOUR SHEEP/GOAT HERD MODELS

HERD SIZE	CAPITAL REQUERIMENT		MEAN OPERATING COST		MEAN REVENUE	
	TOTAL	PER DOE	TOTAL	PER DOE	TOTAL	PER DOE
50 DOES	6,081	122	6,063	121	8,185	164
100 DOES	8,750	88	7,791	78	16,220	162
150 DOES	11,909	79	12,372	83	23,768	158
200 DOES	13,293	67	14,381	72	31,595	158

The financial support required for this national sheep and goat herd improvement programme is $1,106,000, of which $774,200 would be loan facility and the remaining $331,800 representing equity participation by the farmers involved. In Table 4 are presented the capital operating costs and revenues for the respective unit sizes.

A total of $746,000 would be required for the importation of improved stock over the 5-year period from the U.S.A. and the United Kingdom.

A summary of the project output is presented in Table D.

3.0 Support services required

The sheep and goat industry will require the following services:

i) The introduction of new bloodlines of sheep and goats and the registration of pedigree stock for development of superior stock rearing based on economic production parameters.

ii) The generation and evaluation of performance data for line selection within breed groups at the Research Centres.

iii) The sale of high quality seedstock to farmers through the development of livestock improvement centres among the islands (3 centres).

iv) Training in sheep and goat husbandry to both extension agents and farmers.

v) The organization of appropriate quarantine measures on-farm or otherwise by the Veterinary Division.

vi) The development of slaughter slabs with appropriate facilities to produce wholesome meat on the islands with high concentration of sheep and goats as Andros, Exuma, Long Island, Eleuthera. Estimated cost is $40,000 each.

vii) Extensive training and demonstration will be required at the extension agent and farmer levels. Facilities are basically in place at GRAC and BARC to accommodate such sessions. More effort will be required on the part of the Department of Agriculture to execute these already budgeted programmes.

viii) It is expected that the new extension thrust will be working closer with farmers to collect and disseminate information and assess performance.

ix) The multiplication programme to be brought under the supervision of an animal breeder at the Research Station. (New Staff)

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IMPORTANCE AND USE OF LIVESTOCK IN THE BAHAMAS

I. BACKGROUND

The prospects for a rapid development of the agricultural capability of The Bahamas are dependent on the ability to bring into full use the immediately accessible lands. Such a process calls for the adaptation of appropriate farming systems which incorporate grazing animals for their contribution to organic build-up and, to a lesser extent, to land clearing. This suggested pattern of development is proposed as the greater part of the potential agricultural lands are calcareous soils covered with pine forest and coppice vegetation. To bring these lands into productive use requires a lag time of many years of incorporating organic material to achieve levels of fertility which can support economic crop production.

It is generally assumed that 81% of the better lands for agriculture are in the northern group of islands of Abaco, Grand Bahama, Andros and Eleuthera. However, 62% of the lands traditionally used for agriculture are in the southeastern islands of Cat Island, Acklins, The Exumas, Long Island, Crooked Island and Mayaguana. Because of the land capability of these islands, Bahamian agriculture has been traditionally carried out on very marginal lands which are generally fragmented. Furthermore, the possibility for expansion from subsistence into commercial agriculture in these islands is restricted by factors which include marginal soils, limited water supplies, high land dependence on fertilizers and chemical applications and above average cost for the transportation of inputs and produce. These circumstances contribute to the predominance of a low income system of production.

It is to be noted according to the 1978 Agricultural Census that 41% of the farms are on one parcel of land, 45% on 2-3 parcels and 11% on 4-5 parcels. Furthermore, that access to large tracks of land is otherwise restricted by virtue of the systems of land tenure which may assume one of the following forms:-

a) Generation property or family land
b) Commonage lands or collective community land
c) Crown lands or Government-owned lands, and
d) Private proparty with registered titles

According to these circumstances, formal access to lands poses a serious constraint to agricultural development.

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II. THE LIVESTOCK SECTOR

The Bahamian agricultural sector contributes about 5% of the Gross Domestic Product and employs approximately 5.6% of the work force. This situation is accommodated primarily because the economy is based on tourism and resort development. Such services as tourism as well as construction activities succeed in providing adequate employment. At least 80% of the national food requirement is imported which is currently affordable in that it may cost less to import than to produce locally. Furthermore, by sheer volume to support the seasonal demand of the tourist industry, it would be impossible to provide the profile of foods required. Notwithstanding this blatant situation, every effort to venture into profitable agricultural pursuits to reduce the import bill or to be an exporter of agricultural produce should be encouraged. The livestock sector has demonstrated profitable production of poultry meat and eggs although the inputs are predominantly imports. Within the agricultural sector over the last 10 years livestock production contributed between 60-80% of the value of production which ranged from $17-34 million.

The poultry industry dominated the contribution of the sector by generating from 94% to 98% the value of production. This reflects a very minimal contribution by cattle, sheep, goats and pigs to the sector. On further scrutiny, there could be a slight under estimation of their contribution as only animals which pass through the official slaughter facilities were projected in national reports. Against this background, it could be assumed that at least another 30% volume was produced, consumed and unrecorded. Irrespective of these prospects, there is scope for much growth in the livestock sector outside of the poultry industry.

A. The Structure of the livestock Industry

The structure of the livestock industry may be classified into:-

a) Intensive operations as poultry and pig enterprises, which are supported almost totally by imported feedstuffs and other inputs;

b) The non-intensive operations which include small and large ruminants which survive on local forages.

The poultry industry is the most organized of the livestock sector with integrated operations spanning from hatchery to processing and marketing activities. The industry is dominated by a few large farms and numerous small operations in both broiler, meat and egg production.

The pig industry is not organized and consists of a similar pattern of large and small operations. Currently they are the prime producers for the fresh pork market and there is little or no processing activity in the industry. Both the poultry and pig industries are sited primarily in the northern islands of New Providence and Grand Bahama. The easy access to imported feedstuffs and the markets they serve are the major factors influencing their choice of site for operation.

The Ruminant Sector is dominated by the small ruminants, sheep and goats, with a very small cattle population. The core of the productive small ruminant population is distributed among the Southeastern or Coppice Islands which consists of vast areas of scrub lands with forage trees and shrubs. The structure of the production operation assumes one of the following forms:-

a) A predominance of up to 20 head sheep and goats held under tethered conditions on small holdings.

b) Herds/flocks in excess of 50 head which roam commonage and generation lands or crown lands.

c) A few organized operations with fenced properties carrying up to 500 head sheep and goats.

d) A few farmers with cattle tethered or otherwise left to roam commonage or crown lands.

Based on the foregoing, the respective livestock groups have naturally structured their operations around access to the prime source of feedstuff. However, it is only in the poultry industry that there is evidence of a tightly organized structure to meet market requirements.

e Livestock Industry

LE 2 - SLAUGHTER DATA FROM THE NASSAU ABATTOIR

YEAR	NUMBER OF ANIMALS				TOTAL OF ALL ANIMALS
	SHEEP	GOAT	PIGS	CATTLE	
1979	692	539	4375	159	5765
1980	590	502	4465	55	5612
1981	568	321	4575	150	5614
1982	480	304	5112	104	6000
1983	357	262	5942	20	6581
1984	133	122	3971	19	4145
1985	128	188	3496	19	3831
1986	107	202	3091	87	3487
1987	97	193	2405	26	2721

partment of Agriculture, 1989.

ence of a formal system of livestock marketing or a stock census, there are no discrete numerical data to describe and quantify the livestock industry. However, of activity in the sector, the slaughter data from the er 9 years is used to provide some insight on trends. ics presented in Tables 2 and 3 reflect to a greater t transpires in New Providence Island which has the ulation density of the nation. As such, the trends are ndicators of the livestock industry excluding poultry. the trends would suggest that there is a marked he livestock population. However, recognition must be ban on the slaughter of females by the Department of to arrest the decline in population as well as the laughter of a large number of small stock, especially ppice Islands.

TABLE 3. FRESH MEAT PRODUCTION, 1979-1988
(1000 POUNDS)

	1979	1980	1981	1982	1983	1984
TOTAL LBS.	576.8	530.4	582.8	613.0	653.4	575.5
SHEEP	22.5	19.2	18.5	15.6	11.6	5.9
GOATS	16.2	15.1	9.6	9.1	7.9	4.8
PIGS	459.4	468.9	480.4	536.8	24.0	558.0
CATTLE	78.7	27.2	74.3	51.5	9.9	6.8

	1985	1986	1987	1988
TOTAL LBS.	410.5	333.3	333.5	182.7
SHEEP	4.5	4.4	4.0	4.4
GOATS	3.0	4.6	4.7	6.6
PIGS	395.0	318.0	287.0	158.7
CATTLE	8.0	6.3	37.8	13.0

Source: Planning and Statistical Unit,
Department of Agriculture 1989

Estimates of Current Population

Estimates of the current livestock population are presented in Table 4 and were derived from the pattern of slaughter, data gathered during visits to the respective islands and assumptions which included the 1978 Census data. These estimates are consistent with the trends established from the slaughter data and reaffirm the pattern of distribution in the 1978 Census which showed dominance of Long Island, Eleuthera, Cat Island and The Exumas as the sheep and goat producers of the nation, whereas, New Providence and Grand Bahama serve as major producers of poultry and pigs.

TABLE 4: ESTIMATES OF LIVESTOCK POPULATION AND DISTRIBUTION

ISLAND	SHEEP	GOATS	PIGS	CATTLE
ABACO	264	70	48	60
ANDROS	1,330	535	380	256
ACKLINS	68	120	29	20
CAT ISLAND	467	2,474	80	55
CROOKED ISLAND	128	210	25	5
ELEUTHERA	1,827	1,940	510	110
EXUMAS	620	1,732	180	35
GRAND BAHAMA	20	48	280	40
LONG ISLAND	3,267	1,896	120	22
NEW PROVIDENCE	806	918	2,800	280
MAYAGUANA	205	420	30	10
OTHERS	180	920	40	120
TOTAL	9,182	11,283	4.522	1,013

B. SUB SECTOR STATUS

Feedstuff

Forages: The Coppice Islands or southeastern islands are characterized by having accessible range lands with shrubs and forage trees which can support a large population of sheep and goats, whereas the Pine Islands of the north have very poor naturally occurring feedstuff resources. Either of these circumstances is not very supportive of cattle rearing as there are no naturally occurring grasslands. However, the Pine Islands, with their mild climate and good underground water, have great potential for organized fodder production for cattle, sheep and goat production. Moreover, the possibility exists for using cattle and sheep to control the underbrush in the forest areas.
A list of the more common forage plants is presented in Table 5. The carrying capacity of these forage materials is not readily quantified as a result of which animals are turned out for varying periods in fenced or unfenced areas depending on the density of the brush. By a system of grazing scrub bush and chopped boughs from forage trees, the flocks or herds are maintained. However, as a means of management as well as supplementation, a mixed grain ration is sometimes fed which serves to upgrade the nutritional status and as a means of rounding-up the stock in the evenings. Any form of grain feed proves expensive due to the additional transportation cost from Nassau to the respective islands. As a result, grains are used sparingly. Moreover, in the absence of a proper deworming programme, such additional feed would not prove productive.

Table 5: Some Forage Trees and Shrubs Identified On The Islands as Feedstuffs for Sheep and Goats

Common Names	Scientific Names
Lignum vitae	(Guaiacum Officinale)
Pigeon Plum	(Cocolobis Floridana)
Jumbey	(Leaucaena Leucocephala)
Rams Horn	(Pithecellobium Keyensis)
Wild Tamarin	(Lysiloma Sabicu)
Cinnecod	(Acacia Choriohylla)
Red Shank	
Lopperhead Breath	
Rice Weed	
Blue Flower	
Gumelemi	(Bursera Simaruba)
Shepherd's Needle	(Bidens Spinosa)
Hog Breakfast	
Quick Stick	(Glyricidia Sepium)
Bees Foot	
Tamarind	(Tamarindu Indicus)
Rattle Box	

Source:- Personal Communications

Research Work, BARTAD No. 18, 1977, indicated that intensive sheep production is possible in Andros through improved pastures, consisting of mixtures of Guinea, Buffel and Rhodes grasses and Legumes as Siratro, Greenleaf Desmodium, Glycine and Alfalfa. The production of these tropical grass/legume mixtures ranged from 7.2 to 8.3 tons dry matter per acre with carrying capacities of up to 5.9 ewes per acre. However, the high capital and management costs required a carrying capacity of 11.2 ewes per acre to break even with the total cost of the operation.

Based on the foregoing, the report suggested that profitable sheep production was not possible under those conditions. Enabling conditions would include substantially reduced capital costs or no costs to the farmer for land clearing, fencing, pasture establishment and possibly breeding stock.

In principle, those conditions have not changed to date as a result of which any proposal for sheep and goat production must give due consideration to nominal or no cost for those capital items

identified. The use of Coppice lands with some upgrading of the underbrush as the means of supporting production is described in Section III.

Grain Diets: Concentrate grain diets for livestock are all imported. Some common feed ingredients imported for local mixing by the Department of Agriculture with 1988/89 prices are listed below:-

Wheat Middlings	-	B$232.00/short ton
Soybean Meal	-	$389.00/ " "
Corn #2	-	$187.00/ " "
Alfalfa Meal	-	$248.00/ " "
Dicalcium Phosphate	-	$426.00/ " "

Retail prices per 50 lb. bag in Nassau for pig, poultry, horse and beef cattle rations 1989, are as follows:-

		Crude Protein
Broiler Starter	B$ 11.50	21.0%
Broiler Grower	11.50	20.0%
Broiler Finisher	11.00	20.0%
Layer Starter	11.00	20.0%
Layer Grower	11.00	15.0%
Layer Finisher	11.00	16.0%
Pig Starter	11.00	20.0%
Pig Grower	11.00	18.0%
Pig Finisher	10.00	16.0%
* Horse Chow (2% fat)	10.00	10.0%
Horse Chow (3.5% fat)	11.50	10.0%
Beef Cattle (4% NPN)	9.00	13.5%

*used also for goats

There is usually a charge of up to $2.00/50 lb. bag for transportation ex Nassau to the respective islands. These additional costs to an already high priced feedstuff result in a restricted use of concentrates.

With a minimum order of 5,000 lbs. the FOB prices ex Palm Beach, Florida for some of the aforementioned diets are:

Pig Starter	- $13.13/100 lb.	Broiler Starter	- $13.82/100 lb.
Pig Grower	- 11.91/100 lb.	Broiler Finisher	- 13.32/100 lb.
Beef	- 11.02/100 lb.	Horse 10% Cp	
Sow Chow	- 11.01/100 lb.	Horse 12% Cp	
Leyer	- 12.66/100 lb.	Horse 14% Cp	- 14.92/100
Layer Starter	- 13.44/100 lb.	Hog Finisher	- 10.79/100 lb.

Freight charge from Palm Beach Florida to Nassau at the rate of $56.00 par ton.

Molasses: Molasses is imported by the alcohol distillery industry in The Bahamas from the Caribbean area. In the process of distillation, the fermentable sugars are extracted leaving only a residue of non-fermentable sugars and other solids. As a result of this prccess, the product is relatively bitter. At full operation, up to 60,000 gallons 'molasses' is produced per day. The product which consists of 8 Bricks is concentrated to 60 Bricks and called Concentrated Molasses Soluble (CMS) which is disposed of at $10-20.00/ton. CMS is exported for reblending with regular molasses and sold in Southern USA. Locally, CMS is sometimes used for inclusion in pig and cattle rations. Reblending is usually done at the rate of 15% inclusions of molasses to restore some of the original flavour.

The nutritional value of CMS "slop" has been assessed to have a crude protein value of 6.18% and energy value of 3.634 kcal/gram.

Brewers Grain: Spent brewers grain is produced by the Brewery in Nassau. An average of 20 tons of wet material (80% moisture) is produced per week. The product is available at no cost and forms a useful ingredient in cattle, sheep, goat and pig rations.

The brewery is located at an equidistance of approximately 16 miles between two boat docks.

Corn: The local production of corn is encouraged especially among small farmers. Government, through the Department of Agriculture, offers $0.40/lb. and the response has been encouraging. Local production in 1988 was over 491,000 lb. and 137,000 lb. up to August 1989. Local corn yield is estimated at 3,000 lb. per acre.

The local corn is used primarily by the feedmill at the Gladstone Road Agricultural Complex in the production of animal feeds which are sold at subsidized rates to livestock farmers.

Over 525 short tons of corn were imported at the rate of $189 per short ton in 1986-1987. Portions were used in the livestock industry as cracked corn and ground corn for blended feed.

Livestock Performance and the Industry

Small Ruminants

a) Sheep

Throughout the respective islands there is a predominance of the native Caribbean sheep crossed with the Barbados Blackbelly, Suffolk, Florida native, Katahdin, and Persian Blackhead bloodlines in various crossbreeding combinations. These sheep are very hardy and competitive with goats on rough terrain and may be regarded as more productive than goats. Two lambing seasons are generally observed, in February to May and October to November.

Some performance parameters are presented in Table 6 highlighting some comparisons between sheep and goats. Because of the varied breed background, the native sheep show a wide variation in size. The average 90 day adjusted weaning weight is 45 lb. and 6 month adjusted average weight is 56 lb. with mature does weighing up to 100 lbs.

b) Goats

Goats are also predominantly native Caribbean stock with crossbreeding primarily to the Nubian. Increased Nubian blood in the offsprings usually increased birth weight and rate of growth. There is one farm in New Providence on which the La Mancha breed has been introduced in the herd to upgrade milk production and body size. Purebred kids from this farm are sold as breeding stock.

The native goats produce kids which weigh approximately 28 lbs. at 120 days of age and the native does weigh over 78 lb., and bucks achieve 45-48 lb. at 6 months of age. Some comparative performance with sheep are presented in Table 6. It is to be noted that both sheep and goats give up to 3 kidding in two years.

TABLE 6 COMPARATIVE PERFORMANCE OF SHEEP AND GOATS IN THE BAHAMAS ON SOWN PASTURES

PARAMETERS	COEFFICIENTS	
	SHEEP	GOATS
LIVE BIRTHS PER BREEDER/PREGNANCY	1.4	1.6
WEANED BIRTHS PER BREEDER/PREGNANCY	1.2	1.4
BIRTH WEIGHT OF YOUNG (LB.)	7.3	5.5
90 DAY WEANING WEIGHT (LB.)	54.7	26.2
AV. DAILY WEIGHT GAIN (LB.)	0.5	0.23
PERIOD BETWEEN PARTURITION (DAYS)	227.0	268.0
WEANED YOUNG/BREEDER/YEAR	1.9	1.9
LIVE WEIGHT MEAT/BREEDER/YEAR (LB.)	103.9	49.9

Source: Bahamas Agricultural Research Training and Development Project (BARTAD), Report Nos. 27,32 and 37, 1977.

In spite of this position within the industry there has been a decline in production especially since 1983-84 which may be attributed to various reasons, the more important of which are:-

a) Disincentives to farming due to better economic possibilities in the informal sector;
b) Praedial larceny in the farming community due to reduction in the rural population because of the urban drift;
c) Heavy predatory losses due to attacks by packs of dogs;
d) Imported mutton at a cheaper price than local mutton.

The comparative production performance of the haired sheep to that of the goats has been satisfactory. Furthermore, there is a greater demand for sheep mutton versus goat of the order of 931 lb. sheep meat: 1 lb. goat meat, according to the 1988 report (Table 7). In view of this pattern of consumption and the more compatible nature of sheep to crop operations, the emphasis must be placed on sheep production. Under improved management and nutrition, sheep and goats have shown satisfactory response in terms of fertility, lambings or kiddings/pregnancy birth weight and growth performance. However, one of two circumstances militate on the economics of production, (i) either the cost of improved management exceeds the returns from annual offtakes therefore non-economical and would therefore require instead of 5.7/doe to the acre, 11/doe to break even or be profitable; or (ii) on low intensity management system the cost of pasture establishment and maintenance for the low carrying capacity causes the operation to be unprofitable.

To produce against these two backgrounds requires a low input extensive type operation with only critical high-costing inputs e.g. grain feed for fertility and early growth, organized deworming supported by discrete crossbreeding programmes with regulated breeding practices.

An expansion of the sheep and goat industries may therefore be pursued with due consideration to:-

(a) access to large tracts of land especially in the Coppice Islands where animals can thrive on shrubs and forage trees, or sheep in the forest reserves underbrush in an extensive manner;
(b) reducing fence costs through the use of electric fences which would also be a deterrent to dogs getting in fenced areas;
(c) organized feeding systems under extensive conditions with limited concentrate feed for ewes/does with multiple births to encourage rapid herd buildup and offtake;
(d) organized development around herd sizes ranging from 50 to 200 breeding does.

Details of the proposed national herd development programme are presented in Section 3.0 which recommend a strategy for a percentage herd replacement and offtake for slaughter, in order to achieve a modest herd buildup within 5 years to meet a percentage of the demand for mutton.

Cattle

The majority of cattle observed among the islands are dual purpose type animals. A small herd of purebred Charolais cattle herd in Eleuthera is being maintained until a dispersal sale can be arranged, whereas two Santa Gertrudis herds are being kept at the Research Centres for demonstration purposes.

Currently there is no dairy operation in The Bahamas. Furthermore cattle rearing is not a critical enterprise in the current livestock industry especially among the less densely populated islands, as much difficulty is encountered in the disposal of carcasses upon slaughter. Likewise, much stress is experienced in the management and containment of cattle in unfenced areas where crop cultivations are maintained. Since most lands are leased, any extra investment for protection against cattle, sheep or goats which is not part of the total farm operation is not considered.

a) Beef

Some performance data on the Santa Gertrudis cattle on improved pasture with supplemental feeding showed six month average adjusted weights of 421 and 510 lb. for first and second calf crops; mature cows average approximately 1100 lb., (BARTAD Report No. 19, 1977).

The production of fresh beef is less than 1% of the demand which in 1988 was 11.4 million pounds (Table 7). Accordingly, there is tremendous scope for growth and development in the subsector. However, there are a number of constraints which militate against development which include the following:

a) lack of cattlemanship as a part of the culture in agriculture;
b) the historic unprofitability of cow-calf operations against high cost input for land preparation and pasture establishment;
c) the disincentives of the cow-calf operation dampens the development of feed lot operations;
d) in most places where cattle are kept, the costs of establishment and maintenance of fencing and pasture are burdensome on such enterprises.

There are however, acceptable growth performance of cattle from the range of pasture forages grown in The Bahamas. Superior performance has been observed on grass/legume mixtures of Siratro and Buffel grass, according to the BARTAD Report 18, 1977.

From all reports reviewed and discussions held, there was general agreement that beef cattle rearing is more than a possibility. However there are some preconditions to encourage an investor which include:

a) land clearing costs must be minimal or non-existent;
b) access to large tracts of land without encumbrances of tenure;
c) land must be accessible in large blocks to allow an extensive low input operation;
d) veterinary services and treatments must be minimal or free;
e) transportation of stock and other inputs as feedstuff, must be at concessionary rates.
f) technical livestock manpower must be imported to implement and manage the operations while Bahamians are being trained;
g) the veterinary and livestock personnel in the Department of Agriculture must be exposed to refresher courses in beef cattle management;
h) concessionary banking rates including a moratorium of at least one year are required to facilitate the high start-up operation expenses.

prospects in beef production may occur on sites among
s National Forest Reserves in Andros. This is based on
ng assumptions for the short and long term:-

he lands, though not fully cleared are accessible;
arge tracts are available;
ecause of the expense of clearing land in brush, beef
attle can be used for brush control in a relatively low
nput operation to grow out from weaner to the fattener
tage;
asic capital costs would involve purchase of weaners,
olding pens for handling and minimal equipment and
ransportation for both weaner and fattening operations.

ic value of such a process of involvement lies in the
improve soil fertility, control brush and at the same
e protein from lands which are restricted in their use
fully produce anything else. The prospects of
ty become even more real when beef cattle rearing can
a companion enterprise for example with forestry.

a development project proposal are presented in Section
report.

MARKET SIZE FOR MEATS AND EGGS

	TOTAL MARKET	LOCAL SUPPLY '000 LB	FOREIGN SUPPLY	MARKET ($000)
	9,385	300	9,805	10,248
	3,954	-	3,954	4,310
	5,056	-	5,056	6,675
ILLED				
	11,711	39	11,672	21,286
N	3,333	5	3,228	3,735
	358	5	353	283
RY	26,386	18,338	8,048	23,946
DZ)	5,341	5,194	147	5,535
				76,018

rketing Section of this Series of Reports, 1989.

b) Dairying

Currently the full range of dairy products are imported in The Bahamas. In 1988 the fresh milk importation bill was in excess of $10.3 million (Table 8). Therefore the development of an industry for the fresh milk market is very attractive.

The fluid milk market consists of pasteurized whole standardized milk at 3.5 or 2.0 % butterfat as well as reconstituted milk at comparable fat levels.

In the event of developments in dairying, primary milk producers may be required to have an integrated operation which includes prccessing or the current processor of imported milk make adjustments in their operations to accommodate fresh milk of local origin. An intervention by the Government could be involved to ensure that would-be dairy farmers who are unable to integrate their operation would have a market for the volume of milk produced.

An investor is currently in the process of establishing a dairy unit in Grand Bahama. Projections are that the unit will have a capacity of over 200 milking cows and the necessary processing facilities for 1.1 million litres of milk per annum.

In support of development of dairying, indicative plans are presented in Section IV showing models and preliminary estimates for three sizes of operation.

TABLE 8 MARKET SIZE FOR DAIRY PRODUCTS

ITEMS	TOTAL MARKET (000LB)	IMPORTS (000LB)	LOCAL PROD.	TOTAL MARKET ($,000)	VALUE IMPORT ($,000)
MILK CREAM	16,000	16,000	0	6,810	6,810
MILK CREAM SOLID	1,430	1,430	0	715	715
FRESH MILK	8,760	8,675	85	10,224	10,224
BUTTER	2,636	2,636	0	2,095	2,095
CHEESE	3,476	3,476	0	4,407	4,407
TOTAL	32,302	32,217	--	24,251	24,251

Source: Marketing Section of this Series of Reports, 1989.

Poultry

The Bahamas is approximately 60-70 % self-sufficient in poultry meat and egg supplies. The industry enjoys being the most organized sector of the livestock industry.

There are four major producers of eggs and currently five broiler producers. (Tables 9 and 10). Since 1988 the sector has experienced expansions which include a new processing facility in Grand Bahama to kill up to 50,000 birds per day and the first hatchery in The Bahamas (New Providence) to produce baby chicks. The current production capability of the poultry industry is in excess of 15 million pounds of broiler meat and 4 million dozen eggs.

The poultry industry to a great extent meets the domestic requirements with minimal importation. It enjoys such success due to the close linkage between market with planned production and the maintenance of quality controls. The industry however is wholly dependent on imported feedstuffs, medication and up until recently, day old chicks.

A number of small farmer operations for both broiler meat and egg production are carried out throughout the islands. These small operations account for only 2% of national production.

By virtue of the size of the main producers there is no reliance on the Department of Agriculture for technical, husbandry or veterinary services, but for regulatory matters relating to importations. Feed supplies, health care and technical services are contracted with overseas agencies. With adequate laboratory facilities the Veterinary Division could assist, especially in the early diagnoses of clinical problems.

Pigs

The Pig Indust
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50 head/herd.
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C. Support S

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Bahamas Agric

Pigs

The Pig Industry is served by over 600 producers ranging in herd sizes from less than 5 heads to over 300 heads. The majority of producers (92%) are under the 20 head herd size and 3 % with over 50 head/herd. The predominance of small herd structure with non-breeding sows over six months of age would suggest poor breeding and management. On most islands, pigs are started with a starter ration then changed over to local feedstuffs as corn, cassava, potatoes and vines, which result in weights of 175-200 lbs. in 18-24 months. In general, standards of housing, healthcare and feeding are well below acceptable levels for economic production except among the large producers. The main problem of the industry is that of gaining access to low-cost feedstuffs.

At present, the local market can absorb all the fresh pork produced locally. However, it is perceived that any increment in production would result in the sale of only preferred cuts as chops and ribs and a problem would occur for the disposal of a major portion of the carcass. Although this problem could be resolved by processing into a range of pork products, recent assessment by Tropical Products Institute (UK) (1988), indicated that the cost per pound for local carcasses for processing is far in excess of what a processor can afford for such raw material.

Any effort to improve the pig industry has to address issues of improved husbandry and economic feed cost, likewise the prospects of developing an integrated commercial operation which includes processing.

C. Support Services for the Livestock Industry

Department of Agriculture

Recently (1987), the Department of Agriculture, Fisheries and Cooperatives, were made a part of the new Ministry of Agriculture, Trade and Industry.

The Department of Agriculture's main areas of responsibility include:- agricultural extension services and production, crop and livestock research and agricultural produce marketing through a network of produce exchanges in the islands. These different areas are monitored by senior technical officers at headquarters in Nassau, whereas daily operations on the respective islands are delegated to senior extension officers who report periodically to headquarters.

The Departments of Agriculture and Fisheries are encouraged to support private sector investments through the activities of The Bahamas Agricultural and Industrial Corporation which makes loans,

provides technical assistance in preparing proposals and markets through trade agreements made by the Government.

Government has also emphasised the role of cooperatives in agricultural development especially on the Family Islands.

The direct services of the Department of Agriculture to the livestock sector are described in the following sections.

Livestock Division: The Department of Agriculture's animal production unit is housed on the Research Stations at BARC and GARC. The staff structure consists of an:

- Agricultural Officer in charge of small ruminants
- Agricultural Officer in charge of pigs
- Assistant Agricultural Officer in charge of nutrition and feeding
- Superintendent in charge of pig husbandry
- Assistant Agricultural Officer in charge of livestock production at BARC
- Assistant Director of Agriculture in charge of all livestock and administration at BARC

Services provided include:-

- The multiplication of breeding stock, cattle, sheep, goats and pigs for sale to the farming community
- demonstrations in livestock rearing
- demonstration in pasture forage varieties and production
- technical extension work among farming communities
- production of poultry offal hydrolysate as a supplement for pig ration
- mixing of livestock ration (pig, sheep, goats, cattle) for sale to farmers at subsidized prices

a) Feedmill

A small feedmill is in place which is intended to serve for both the production of experimental diets as well as some commercial diets for sale to livestock farmers. It has a capacity of 3 tons mixed feed per day and is limited primarily by the size of the batch mixer (1/2 ton capacity). The mill however, is not working to capacity. An organized programme of service to the farming community needs to be established and pursued to put the facilities to full use. Currently there is only minimal activity to support the livestock programme on the centre (GARC).

b) Poultry Offal Hydrolysate Unit (POH)

This is an experimental prototype unit designed to hydrolyse poultry offal and other similar type waste material into a basic protein supplement for inclusion in pig diets in particular. The plant was designed and commissioned by the Tropical Products Institute of London, England, through a grant-in-aid. The unit has a capacity to process 13.6 tons of poultry offal weekly on a single shift. The poultry offal is produced and supplied by the Gladstone Poultry Farms Ltd. which is in close proximity to GRAC. It is estimated that over 20 tons of material is available weekly from the farm.

The process of production involves grinding, mincing of the offal material and treatment with acids in procassing holding tanks. After hydrolyzing for a prescribed time, the material is transferred to holding tanks for dispensing into 45 gallon drums for ultimate distribution to pig farmers.

The estimated proximate composition of the hydrolysate is:

Crude protein	-	18.6 %
Crude Fat	-	12.4 %
Digestible Energy	-	15.17 %
Crude Fibre	-	3.9 %
Lysine (total)	-	0.93 %
Methionine & Cystine	-	0.82 %
Calcium	-	0.71 %
Phosphorus	-	0.70 %

Source: D. Edwards, et al., 1979. The production and utilization of Poultry Offal Hydrolysate in the Bahamas. Tropical Products Institute, London, England

There is some difficulty in organizing farmers to adapt their feeding programme to the use of POH. More publicity and work are needed to promote this supplemental feedstuff. Furthermore, the liquid form for transportation and ultimate mixing on the farm poses some problems. The production of a dry material would be more welcome as a more transportable material. The addition of an extruder to the system is the recommended apprcach. Accordingly, a mixture of POH and wheat middlings could be made into a slurry with a consistency which can be processed by the extruder. The recently developed INSTAPRO manufactured in Iowa U.S.A. would be the preferred type of equipment.

Veterinary Division: Although there is no form of veterinary surveillance to cover animal health status on the respective islands, the Veterinary Division claims there are no reportable endemic diseases affecting the national herds of cattle, sheep, goats and pigs.

In The Bahamas, there are thirteen veterinarians, six of whom are employed by the Department of Agriculture. Five veterinarians are located in Nassau between the Department of Agriculture headquarters and the Gladstone Road Agricultural Complex and BARC in Andros.

In the Department of Agriculture, the six veterinary officers serve as follows:-

- Senior Veterinary Officer: Administration and Supervision
- Vet. Officer for Extension Service in Nassau and GRAC
- Vet. Officer for Extension Service in Andros and BARC
- Vet. Officer for Conservation and Family Island Extension Service
- Vet Officer for Abattoir and Canine Control
- Vet. Officer Assistant to GRAC.

The seven veterinarians in private practice serve primarily in New Providence and Grand Bahama.

The range of services provided by the Division include:-

- Extension services which cover periodic animal health treatments such as deworming and castrations among the islands
- Permits for importation and export of livestock including pets
- Abattoir antimortem inspection and carcass disposal
- Canine control
- Inspection of horses for the Carriage Unit of the Ministry of Transportation
- Research Centre healthcare programme for livestock
- Assistance with training programmes in the Ministry of Health

Critique of the Division

The unit administers very basic health care as there are inadequacies in the support facilities as a pathology and other diagnostic laboratory and surgery facilities as a result of which there are only clinical diagnosis work but no confirmative studies. However, a contingency programme to send specimen to USDA Plump Island, Ames, Iowa or the Centre for Disease Control in Atlanta, Georgia is arranged by the Government to cover emergencies and problem cases. There is no active work to determine the disease profile on the respective islands for preventative management routines.

the making for a diagnostic laboratory at a site in
.ty to the Abattoir in Nassau.

liseases and conditions for which treatment has been
ecies basis are as follows:-

'o virus, microplasmo pneumonea, atrophic rhinitis,
disease, sway back, transmissible gastro enteritis,

ts:- goitre, foot rot, pink eye, clostridia diseases,
tinomycosis, lice.

ncephalomylitis vaccination.

nge of common diseases including toroplacmosis in cats
affects humans.

he full range of common diseases.

bsence of laboratory support for clinical diagnosis
ates the Veterinary Division. Furthermore, the lack
ion in public health services for the general well-
:-looked. The incidence of Tuberculosis in humans and
e association and occurrence of tuberculosis in
not contemplated. TB tests are not undertaken for
Similarly, the incidence of leptospirosis among rats
lcation for human health are not investigated or dealt

roved health and production status have been observed
rch Station (GARC) through the vaccination programme
eep and goats, these practices have not been well
the wider farming community with their production
A major constraint to more widespread information and
f animal health care practices is the lack of technical
t. It is perceived that Animal Health Assistants with
m the Regional Education Programme for Animal Health
n Guyana, could be of much assistance.

toir

f the livestock industry, an abattoir was established
the 1940s to provide basic slaughtering and chilling
o date, the expanded facilities provide the following
ervices:-

utting into special cuts
ckaging
aking
d pickled products
ms

N.B. The veterinary services are employed only in antimortem examinations although they are the final reference for issues arising: the post mortem examinations are carried out by Public Health Inspectors.

Currently the Abattoir carries a staff of eleven (11) persons including the manager. The operations are supervised by a veterinary officer.

The work load of killing and chilling are the major exercises over a 3-day week the remaining time being used for clean-up. As such, the facilities are not utilized anywhere near capacity. Over the last 5 years the kill has been declining from 15 to 10 heads per day with pigs being the predominant of species.

Equipment List

1 Butcher Bay Large Meat Breaking Saw
(5,000 lb/day capacity)
1 Hobart Primal and Retail Cut Meat Saw
(10,000 lb/day capacity)
1 Butcher Bay Meat Grinder
(3,000 lb/day capacity)
1 Butcher Bay Meat Mixer
(1,000 lb/hour capacity)
1 Vacuum Meat Packer
1 Sausage Coker and Lard Renderer
3 Bonning and Trimming Tables
1 Smoke House
2 Coolers - 200 carcasses each

In terms of smoked products, the size of the smoke house is the only limiting factor for large throughputs (2 pig carcasses/day).

All staff working in the unit have food-handlers permits. In discussions with the manager, the area of weakness among tha staff was primarily in terms of attitude towards work, although technical skills needed some upgrading.

It is the view that the facilities could be a profit centre with an upgraded terms of reference. Within this context, the processing arm of the abattoir could contract with pig farmers to either:

a) purchase given quantities of pigs for direct slaughter and processing for sale up to 80 pigs/day;
b) slaughter and process on behalf of pig farmers at cost effective fees.

The current abattoir facilities and personnel are not fully utilized and the current low throughputs are grossly inadequate to

s operations. Moreover, the capability and facilities e to produce and encourage production in one of the most l areas of the livestock industry: processed meats.

:er Slabs

aughter slab facilities have been noted in the islands; Slaughter Slab at the Co-op. in North Andros and a wned unit at Union Stockyard in Eleuthera. The facility ıdros includes a hoist, bleeding slab and cool room (40 However, both units are not in use at present.

view that a slaughter slab with basic facilities as bove should be put in place as part of the packing house islands with livestock production activities of economic e. Currently such islands include Eleuthera, Long Exumas and Cat Island.

Control

trol activities are under the supervision of the Division. There is a staff of 3 dog catchers including .th a pick-up. The major dog catching activities are in Nassau and Freeport. There is the prospect of over 40-60 animals per week under conditions where kept in captivity for a minimum of 3 days for retrieval owners. In the event of no-claim, animals are humanely the Veterinary Division and disposed of via the al Health Department dump.

t of control does not occur in other islands. However, ary Division has a proposal to institute a programme ls the following:

aps with baits to be made available at the sioner's office on the respective islands,
ock raisers subjected to dog attack can request traps aits
h the Commissioner's office, trapped dogs to be turned o the police to be shot and disposed of immediately.

is yet to be put in place.

canine control is not readily pursued due to laws and irresponsibility by dog owners.

ntly perceived that there is an urgent need for an rogramme to highlight the responsibilities of owners ting of the law to invoke simple processes for legal ast owners of stray dogs which destroy animals or to lequate restraint at all times or face prosecution.

Other Support Services

The financial institutions with their perceptions and operatives to support agricultural development can make the difference in terms of encouraging expansion of the sector. Of immediate interest in support of business development are interest rates and incentives or concessions for obtaining capital goods.

Credit and Interest Rates: Credit is available to both large and small farmers. However, there are no concessions with respect to grace period or interest rates. Agricultural loans are offered at the same rate (17-19%) as other commercial loans.

To encourage new entrants to agriculture and livestock farming in particular, revisions of the credit system is required.

Incentives to Agriculture: Incentives offered to the livestock sector include the following:-

1. Duty-free permit on agricultural equipment.
2. Purchase breeding stock from Research Centres at cost.
3. Purchases made at Fish/Farm Supplies Stores allow credit to farms by requiring 25 % cash on purchase and the remainder paid over time.
4. Land clearing cost subsidized up to 50 % on up to 25 acres.
5. Agricultural credit guarantee programme of up to $50,000 at 11 % interest.
6. Concessionary rate of $2.00/head to slaughter and chill carcass at the Abattoir in Nassau.

Transportation

Transportation cost is perhaps the most pivotal item influencing economic production in agriculture.

The cost of inputs to the livestock sector, especially among the southeastern islands is increased by the cost of transportation to and from Nassau and or Freeport. These two locations are the centres of the distributive trade as well as the areas with 70- 80% of tha population density, which attracts the consumption of large volumes of farm produce. This situation reduces the degree of competitiveness with direct imports from North America or elsewhere.

Examples of transportation cost to the livestock farmer

To ship cattle, sheep or goats from Andros to Nassau, the following are basic charges:

a) $100.00/trailer on board
b) Cattle - 3 heads/trailer for $25.00 = $125.00
c) Sheep/Goats - 30 heads/trailer for $25.00 = $125.00

The cost for the trailer is doubled in that it has to be returned to the place of origin. In view of the restricted need for such a facility, there is no scope for redirecting the trailer to other islands, thus the costs have to be borne by the shipper. Currently there is a request by farmers for the Government to assist with 50 % cost.

D. CONSTRAINTS TO LIVESTOCK DEVELOPMENTS

Constraints to development in the livestock industry are being viewed from the following perspectives:- institutional, physical, financial and technical/human resource.

Institutional

Thare are no programmes which would reflect policy or policy direction with respect to development of the livestock industry. The need exists for appropriate national policies, implementable programmes, strategies and targets. Likewise, the development of the support services in the Department of Agriculture and venture financing in financial institutions.

Physical

Access to large acreages of land is restricted due to absence of roads or difficulties in gaining acceptable tenure to commonage, generation and Crown lands for bankable projects.

In terms of livestock resources for expansion of the industry there is a shortage of improved stocks, of sheep, goats, pigs and cattle.

Financial

Based on the cost of money, the rate of return is poorer for livestock projects involving the purchase or high leasing cost of land for new entrants to the business. The turnover time is relatively long for returns on basic investment. Moreover, there is a high risk involved if services to tha industry are not in place: for example, veterinary, feed supplies and technical management.

The high costs for improved technology involving housing mechanized operations to reduce unit costs of produce, are at such economies of scale that equity participation for appropriate financing poses a serious problem for investors. In most instances financial institutions require a minimum of 30% equity which is difficult to achieve by most new entrants to agriculture.

Technical

There is immediate need for improved technology to replace and upgrade traditional farming practices. This is associated with the lack of useful information to meet the needs of farmers because of the absence of a technical data base and an effective extension service. There is also a shortage of trained Bahamian managerial and technical manpower with special interest in livestock production.

E. RESEARCH, EXTENSION AND INSTITUTION STRENGTHENING

Research Objectives and Activities

The stated objectives of the research and extension activities of the Department of Agriculture are:-

i. To test locally the results of research carried out elsewhere in order to provide a sound basis for the transfer of such information to the extension programmes in the Bahamas.
ii. To serve as a demonstration centre for techniques in plant and animal husbandry.
iii. To provide a centre for instruction and training courses for field staff, farmers, school teachers and others.

There are two research centres, one located in Nassau, New Providence and known as the Gladstone Road Agricultural Complex (GARC) and the other at North Andros on Andros Island and known as the Bahama Agricultural Research Centre (BARC). Each centre is manned by an officer-in-charge and a team of specialist agricultural officers, assistants, superintendents, secretarial and clerical staff. The officer-in-charge reports to the Director of Agriculture.

Gladstone Road Agricultural Complex (GRAC)

a) Scope of work

This complex houses the Central Agricultural Station which was established in 1967 on 200 acres of pineland in Nassau, New Providence. By mid-1980 a food and technology and an animal nutrition unit were added to conduct research projects aimed at increasing crop and livestock production. With respect to livestock, the functions which are presently in evidence are:-

i. the development and management of multiplication herds of pigs, goats, sheep and cattle, for the selling of breeding stock to farmers at subsidized prices.

ii. the operation of a feed mill to produce cattle, pig, sheep and goat rations for the research centre herds and for sale to farmers at subsidized prices.

iii. the development of a hydrolysate plant to produce a protein supplement from poultry or fish offals for inclusion in pig diets as a means of reducing the cost of feed among pig farmers.

Within the context of the foregoing functions there are no research activities except for the development of the poultry offal hydrolysate operation (POH) as a pilot project.

b) Installed capacity

The installed capacity to pursue the programmes include the following staff and facilities:- Staff:

i) Small ruminants:
1 Agricultural Officer to supervise the Small Ruminant Section.
1 Herdsman for flock and pasture management
1 Herdsman for recording, pasture management and maintenance
2 Herdsmen for maintenance of fences

ii) Piggery:
1 Supervisor of the piggery
1 Assistant Supervisor

iii) Farm Equipment:
1 Supervisor for maintenance of farm equipment
1 Assistant for maintenance of farm equipment

iv) Animal Nutrition, Feedmill and POH unit:
1 Assistant Agricultural Officer
3 Assistants - 2 feedmill
1 POH unit

v) Cattle unit:
1 Herdsman in charge

c) Livestock Inventory:

i) Small ruminants:-
150 heads goats and 400 head sheep on 150 acres of pasture (pure stands of grass and mixed grass/legume)

ii) Pigs:-
60-sow unit currently 50 % capacity with farrowing, dryherd grower and finishing houses.

iii) Cattle:-
40 head Santa Gertrude's cattle of mixed sexes and ages.

d) Critique on the present situation:-

i) Administration

The objectives and general purpose of the Centre are still the terms of reference. However the administration of the respective units is very poor. Accordingly, the Centre in its present condition and style of management is not coping in even maintaining the operations satisfactorily, especially as a demonstration centre. There are manifestations of numerous management problems which include:

- lack of individual job descriptions and line function, consequently,
- lack of supervisory management
- poor record-keeping
- low self esteem/attitude as professionals on the job

The above-mentioned description of the state of affairs partially underlines the reasons for no research activities and essentially no extension work from the centre. Without the benefit of detailed study, some apparent underlying reasons for the status are:-

- poor leadership
- poor financial support
- limited professional exposure of the technical and managerial staff, and
- the absence of a tight system of accountability for the day to day operations of the centre

ii) Physical Facilities

Some repairs are in progress to upgrade the facilities.

Of immediate need in terms of serving the livestock farmer, is the addition of an extruder to the POH unit to produce dry feedstuff from the basic liquid supplement. This was referred on page 21 of the report. The estimated cost is $30,000.

Bahamas Agricultural Research Centre (BARC)

The centre is located seven miles south of the San Andros airport in Andros.

a) Scope of work

The centre consists of over 300 acres of established pastures for tha maintenance of multiplication herds of Santa Gertrudis and Charolais cattle and flocks of Native Bahamian and Barbados

Blackbelly Sheep. Part of the pastures is used for the production of hay. These pursuits are in support of selling stock and hay to farmers at concessionary prices. The livestock unit in conjunction with the veterinary unit are involved with the overall production and health care activities in North and Central Andros including satellite farms.

b) Installed capacity

The joint staff for livestock consists of:-

- 1 Veterinary Officer
- 1 Agricultural Officer in charge of all livestock
- 5 Herdsmen - cattle and sheep
- 3 Herdsmen for pasture and fence maintenance

The cattle herd consists of 192 head of varying sizes and sex, whereas the sheep flock is over 300 head.

Farm machinery and field equipment are in place for the range of tasks to be performed at the centre, but are in varying degrees of disrepair. This circumstance results in incomplete production and maintenance schedules.

To upgrade the physical facilities on the centre, estimates submitted for 1989-90 were as follows:-

- pasture replanting and renovation for 120 acres - $47,000
- veterinary and livestock facilities which include:-
  - Animal treatment centre
  - Slaughter Slab
  - Scales for weighing livestock
  - Holding pens, troughs, mineral boxes
  - Spray machine
  - Veterinary instruments

67,300

Total 114,300

c) Training needs at BARC

-The Centre staff requires an exposure to proper record- keeping, production operation and costings.
-Team building
-More "hands on" approach in manning the centre.

d) Critique

The operations at BARC are not involved in research. The centre is in poor condition due primarily to lack of financial support

and poor initiative in making the operations efficient. Insufficient staff and poor leadership assume a pivotal role in the state of affairs.

Research Priorities

To complement the development projects proposed in this report, the following are the priority areas for research.

i) Production economics of forages as an enterprise

To provide background data for the prospects of developing the idle, cleared and arable lands of Abaco and Andros as major forage production areas, particularly grass/legume mixtures as part of a long-term benefit.

Research in production and preservation in the forms of hay and silage to support both large and small ruminant production in economic farming systems.

ii) Characterization of the nutritional capability of Coppice lands

Assess and develop the nutritional capability of Coppice lands to make them more predictable range land resources for sheep and goat production through the introduction of compatible grasses and legumes.

iii) Expansion of POH into dry feedstuff production

Inclusion of POH in dry feedstuff for as wide a range of livestock and assess economic suitability especially for pigs.

iv) Improved production through breeding

Breed improvements in terms of production performance of both sheep and goats through organized breeding and evaluation programmes.

v) Forage production systems for beef and milk production

Feed-lot production management systems to get the most out of grass legume mixtures.

III. THE PROJECT: SHEEP AND GOATS

Although there are many posibilites for livestock development in The Bahamas, as this report and other previously written documents show, it seems more feasible that, at this stage of the overall agricultural development of the country and taking into consideration the scope of the Agricultural Services Development Project, only sheep and goats should be included as the livestock compoment of the project. A number of considerations, mostly in the economic, institutional and promotional areas, seem to indicate that focusing on sheep and goats would be a more rational and feasible way of starting a new phase of livestock production in The Bahamas. Furthermore, the implementation of this compoment appears to lead to two immediate benefits: first, it will reach the largest posible number of farmers, principally in the southeastern islands; second, it would serve as a training ground for the Departament of Agriculture to go into other areas of livestock development.

The Bahamas produces about 2.5% of the sheep meat and 25.4% of the amount of goat meat it consumes annually from a national herd of approximately 21,000 head sheep and goats. Given the presence of this herd which is well distributed in the Coppice lands of the Southeastern islands, it is perceived that with the application of appropriate husbandry practices there is much scope for these livestock resources to make a more significant contribution.

Estimates by this study indicate that there is a total population of about 3949 breeding does (goats) and 3214 ewes (sheep).

The Project Area

Coppice lands are located primarily in the Southern Islands as non-cultivable lands. The Coppice lands are characterized by being dense brush lands consisting of a range of forage shrubs and trees with a wide span of nutritional value to ruminants. These lands are usually rocky and inter-spersed with soil which can support undergrowths of other plant material. To the extent that space such as these exist it is planned that the quality of the undergrowth can be enriched by periodically sowing grass and legume seeds. These forms of forage resources are intended to ba the feed base for the expanded sheep and goat production programme.

Project Justification

While there will be support for the development of the goat herd, the major emphasis will be an expansion of the sheep industry because of the greater demand. Moreover sheep are more compatible as a companion animal to tree crops and yield greater weight per acre than goats.

Objectives

i) To encourage the development of a stronger sheep and goat industry to reduce the importation of mutton and increase local farm income especially in the Southern Islands.

ii) To encourage farmers to upgrade their stock to increase mutton production.

iii) To discourage the slaughter of females.

iv) To produce skins for use in crafts and other industries.

Production Targets

The production targets from the national breeding herd for the project 5 year period are presented in Table 11. The increments are held at approximately 3% units per annum since herd development and adjustments to the project will be relatively slow during the first 5 years of the project.

Table 11 Projected Five-year Mutton Production

Item	Project Years				
	1	2	3	4	5
Sheep meat (,000 lb) % 1988 consumption	118.5 3.5	167.4 5.0	237.7 7.1	336.5 10.1	476.7 14.0
Goat meat (,000 lb) % 1988 consumption	120.8 33.6	161.3 45.1	215.2 60.1	286.6 94.0	382.3 133.2
Total (000 lb.) % 1988 consumption (Sheep & Goat Meat)	239.3 6.5	328.7 8.9	452.9 12.3	623.1 16.9	859.0 23.2

Strategies of Incorporation into the Project

Research: The main areas of research will be on sheep/goat nutrition, husbandry and the behavioural pattern and production performance of breeds under various feeding regimen for economic production on Coppice Lands.

ıerd health care programmes and management systems for luction are the expected outputs from research.

ices: The sheep and goat industry will require the rvices:

istration of pedigree stock for the development of roups/organizations to support superior stock rearing ı economic parameters (Extension Service);

eration and evaluation of performance data for line ons with breed groups (Research Centre);

le of high quality seedstock to farmers and the ion of stock to livestock improvement centres (Research ;

y in sheep and goat husbandry to extension personnel ners (Extension Service);

rations in sheep/goat production under varied lon systems (Research Centre);

ıtroduction of Nubian bloodlines and meat type breeds ss-breeding with the native goats (Research);

tiplication of purebred flocks of the Native Bahamian, n, Barbados Blackbelly and Suffolk sheep to produce ock for sale, and the production of crossbreds for the market (Research Centre);

er slab facilities on islands with high population es (Veterinary Division).

e Services: To support the sheep and goat production tensive training and demonstrations will be required tension Agent/Officer levels and among farmers. re basically in place at BARC and GRAC to accommodate s. What is required is more effort on the part of the of Agriculture to execute these already budgeted

ted that part of the terms of reference of the new rust will be to collect performance data for evaluation ion retrieval in the field to upgrade the operations. hnical approach toward assessment of performance nder the direction of an animal breeder is proposed in ı and extension aspects. Similarly, multiplication hich are in progress at BARC and GRAC are to be brought ıpervision of the animal breeder for a more organized the introduction and maintenance of the improved breeds goats.

The development of registered pedigree stock and ultimate formation of organized groups is expected to be voluntary.

To accommodate the proposed increments in production in the areas of high sheep and goat concentration, the establishment of slaughter slabs is recommended. The estimated cost per unit is $40,000. The facilities proposed are a building with a yard, unloading ramp and holding pens, equipment which includes a hoist, racks and rails for small stock, scalding tank, cool room and appropriate tools for the slaughter of sheep and goats and pigs in particular.

Production

To effect a low-cost production system, the natural scrub lands or the Coppice lands with forage shrubs and trees will form the core resource for sheep and goat production. To facilitate or encourage nutritious undergrowth, the sowing of grass/legume seeds periodically will be standard practice.

The project seeks to incorporate on-going operations which have access to these lands and to use the stock and facilities as the basis for equity and financial support.

The expected increments in production are to be achieved mainly through the introduction of improved breeds and discrete feeding practices. To ensure that the right level of seriousness is brought to the project, herd sizes of 50, 100, 150 and 200 breeding does are proposed. With the introduction of electric fencing there can be more organized feeding of extensive areas while simultaneously having reasonable protection from predators, especially packs of wild dogs.

Production model simulation for start-up situations: In Schedule I four production models are developed, 50, 100, 150, 200 doe units, with prescribed costings for a start-up operation.

Production model simulation for on-going situations: Based on the models developed in Schedule I, adjustments are made to reflect on-going situations which require upgrading of facilities, stock and feeding programmes. The models are presented in Schedule II and are used to form the basis for estimating the project development costs.

The strategy of incorporation is therefore based on the upgrading and putting new life in on-going situations.

SCHEDULE I

DEL I DOE HERD	a) IMPROVEMENT IN SAFETY WITH ELECTRIC FENCE UNIT b) FEEDING PROGRAMME UPGRADED c) IMPROVED BREEDING STOCK
EL II DOE HERD	a) ELECTRIC FENCING TO EXTEND TO EXPANDED AREAS b) FEEDING PROGRAMME UPGRADED c) UPGRADING OF EXISTING FACILITIES AS STOREROOM, WATER SUPPLY d) IMPROVED BREEDING STOCK
L III DOE HERD	SAME AS 100 DOE HERD
L IV DOE HERDS	SAME AS 100 DOE HERD

SCHEDULE OF ASSIGNED START-UP CAPITAL COSTS
50 DOE UNIT
(25 ACRES)

1. PASTURES - COPPICE LANDS WITH FORAGE SHRUBS AND TREES. SEEDING WITH GRASS/LEGUME AT $69/ACRE 50% AREA	$ 863.00
2. PURCHASE OF ANIMALS (CONCESSIONARY RATE) 50 EWES @ $100 2 BUCKS @ $150	5,000.00 300.00
3. BUILDINGS NIGHT PEN 250 SQ. FT. @ $6/SQ. FT.	1,500.00
4. WATER SUPPLY ABSTRACTION PIT PUMP	480.00 400.00
5. MACHINERY & EQUIPMENT KNAPSACK SPRAY ANIMAL TOOLS, NOSEHOLDER CLIPPERS, DRENCHER ROPE, BALLING GUN, ELASTICATOR, FOOT/SHEARS	125.00 230.00
6. FENCING, 5 STRAND WIRE FOR 25 ACRES 138 CHAINS WITH ACCESSORIES @ $2.4/CHAIN SOLAR PAK ENERGIZER @ $159.00	332.00 159.00
7. CONTINGENCIES 10%	922.00
	10,311.00

SCHEDULE OF ASSIGNED START-UP CAPITAL COSTS
100 DOE UNIT

1. PASTURE: 50 ACRES COPPICE LANDS SEEDING WITH GRASS/LEGUME @ $69.00/ACRE 50%	1,380.00
2. PURCHASE OF ANIMALS: (START WITH 75% HERD) 75 DOES @ $100.00 3 RAMS @ $150.00	7,500.00 450.00
3. BUILDING NIGHT PEN WITH 5 SQ. FT/DOES = 500 SQ. FT. 500 SQ. FT. @ $10.00/SQ. FT.	5,000.00
4. WATER SUPPLY 3 ABSTRACTION PITS @ $400.00 EACH PORTABLE 3.5 HP MOTOR WITH PUMP	1,200.00 400.00
5. EQUIPMENT KNAPSACK SPRAY, HOOFCLIPPERS, DRENCHING GUN ETC.	260.00
6. ELECTRIC FENCING UNIT INCLUDING NIGHT PEN ENERGIZER 255 CHAINS 4 STRAND WIRE WITH ACCESSORIES @ $2.40/CHAIN	158.00 612.00
7. CONTINGENCIES - 10%	1,696.00
	18,656.00

SCHEDULE OF ASSIGNED START-UP CAPITAL COSTS
150 DOE UNIT

1. PASTURE: 75 ACRES COPPICE LANDS SEEDING (50%) WITH GRASS/LEGUME @ $69.00/ACRE	2,588.00
2. PURCHASE OF ANIMALS: 66.6% OF ANIMALS REQUIRED = 100 HEAD 100 DOES @ $100.00 4 RAMS @ $150.00	10,000.00 600.00
3. BUILDING & FACILITIES NIGHT PEN WITH FEEDING 5 SQ. FT./HEAD = 750 @ $6.00 STOREROOM 10' X 10' @ $10.00/SQ. FT.	4,500.00 1,000.00
4. WATER SUPPLY 5 ABSTRACTION PITS @ $400.00 EACH PORTABLE 3.5 HP MOTOR AND PUMP	2,000.00 400.00
5. MACHINERY & EQUIPMENT KNAPSACK SPRAY, ROPE, DRENCHING GUN, NOSEHOLDER, TOE CLIPPER ETC.	150.00 300.00
6. FENCING REQUIRED, APPROXIMATELY 276 CHAINS OF 3 OR 4 STRAND ELECTRIC FENCING INCLUDING NIGHT PADDOCK - 3 SQUARES 276 CHAINS WITH ACCESSORIES @ $2.40 ENERGY SYSTEM	663.00 158.00
7. CONTINGENCIES - 10%	2,236.00
	24,595.00

SCHEDULE OF ASSIGNED START-UP CAPITAL COSTS
200 DOE UNIT

1. PASTURE: 100 ACRES COPPICE LANDS SEEDING (50% DENSITY) WITH GRASS/LEGUME @ $69.00/ACRE	3,450.00
2. PURCHASE OF ANIMALS: 50% OF ANIMALS REQUIRED = 100 HEAD 100 DOES @ $100.00 4 RAMS @ $150.00	 10,000.00 600.00
3. BUILDING & FACILITIES NIGHT PEN WITH FEEDERS (5 SQ.FT/HEAD=1000 SQ.FT) 1000 SQ. FT. @ $6.00 SQ.FT. STOREROOM 10' X 10' @ $10.00/SQ. FT.	 6,000.00 1,000.00
4. WATER SUPPLY 5 ABSTRACTION PITS @ $400.00 EACH WITH ONE 3.5 HP MOTOR AND PUMP @ $400.00	2,000.00 400.00
5. MACHINERY & EQUIPMENT KNAPSACK SPRAYER, NOSEHOLDER ROPE, DRENCHING GUN, ETC.	150.00 350.00
6. FENCING REQUIRED, APPROXIMATELY 327 CHAINS OF 3 OR 4 STRAND ELECTRIC FENCING INCLUDING NIGHT PADDOCK - 4 SQUARES 327 CHAINS @ $2.40/CHAIN ENERGY SYSTEM AND ACCESSORIES	 785.00 158.00
7. CONTINGENCIES - 10%	2,324.00
	27,217.00

SCHEDULE II
START-UP OPERATING COST ASSUMPTIONS
50-DOE UNIT

1. SUPERVISION BY FARMER	
2. LABOUR 3 MANDAY/WK @ $25/00/DAY	3,900.00
3. FEED MINIMAL GRAIN 40 LB./DOE LATE PREGNANCY AND EARLY LACTATION 25 LB./WEANER @ $0.22/LB.	 1,375.00
4. NO PASTURE MAINTENANCE FOR LEGUME/GRASS MIX ON COPPICE LANDS.	---
5. MAINTENANCE OF ELECTRIC FENCE @ $5% PER ANNUM	50.00
6. MAINTENANCE OF BUILDING AND FACILITIES @ $5%/ANNUM	120.00
7. VETERINARY COST AT $6.00/DOE	300.00
8. CONTINGENCIES AT 10%	575.00
	6,320.00

100 DOE UNIT SAME AS 50 DOE UNIT WITH ADJUSTMENTS FOR FEED	
150 DOE UNIT FARMER SUPERVISION PARTIALLY COMPENSATED 1 LABOURER FULL-TIME @ $25.00/DAY WITH ADJUSTMENTS FOR FEED	 6,500.00/ANNUM 6,500.00/ANNUM
200 DOE UNIT SAME AS 150 DOE UNIT WITH ADDITIONAL LABOUR FOR 3 MAN/DAYS @ $25.00/DAY	3,900.00/ANNUM WITH ADJUSTMENTS FOR FEED
REVENUE MATURE MALE BUCKS SOLD AT $100.00 EACH MATURE FEMALE DOES/EWES SOLD AT $90.00 EACH WEANERS/FATTENERS - MALES SOLD AT $55.00 WEANERS/FATTENERS - FEMALES SOLD AT $50.00 EACH	

Product

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Production projections from the respective islands

In Tables 12 (a) and 12 (b) are presented estimated outputs from the production system. The number of herds and the acreages involved on an island basis are presented in Table 13.

The projected number of animals to be slaughtered per week at full development are as follows:-

Long Island	139 heads
Andros	92 heads
Eleuthera	89 heads
Cat Island	50 heads
Exuma	45 heads
New Providence	40 heads

It is proposed that four slaughter slabs with chilling facilities be established at Long Island, Andros, Eleuthera and Exuma.

TABLE 12 (A) ESTIMATED PRODUCTION OUTPUT FROM THE MAJOR PRODUCING ISLANDS

ISLANDS	WITHOUT PROJECT	WITH PROJECT (LB) SHEEP MUTTON				
		1	2	3	4	5
ABACO	3,519	5,049	7,153	10,136	14,343	20,349
ANDROS	17,825	25,245	35,764	50,681	71,757	101,669
ACKLINS						
CAT ISLAND	6,234	8,874	12,584	17,825	25,245	35,764
ELEUTHERA	24,442	34,540	48,845	69,194	97,996	138,809
EXUMAS	8,300	11,857	16,792	23,753	23,660	47,660
GRAND BAHAMA						
LONG ISLAND	43,720	61,965	87,822	124,389	176,218	249,581
NEW PROVIDENCE	10,786	15,300	21,726	30,753	43,567	61,697
MAYAGUANA						
OTHERS						
TOTAL	114,826	162,830	230,686	326,731	398,186	655,529

TABLE 12 (B) ESTIMATED PRODUCTION OUTPUT FROM THE MAJOR PRODUCING ISLANDS

ISLANDS	WITHOUT PROJECT	WITH PROJECT (LB) GOAT MUTTON				
		1	2	3	4	5
ABACO	476	646	850	1,258	1,530	2,040
ANDROS	3,876	5,814	6,868	9,146	13,731	16,286
ACKLINS						
CAT ISLAND	19,852	23,528	35,267	47,009	55,726	74,290
ELEUTHERA	15,568	18,462	24,616	32,844	43,758	58,344
EXUMAS	12,308	16,422	21,896	29,206	38,930	51,918
GRAND BAHAMA						
LONG ISLAND	13,532	18,054	24,038	32,062	42,738	56,984
NEW PROVIDENCE	6,528	8,704	11,594	15,470	20,604	27,472
MAYAGUANA						
OTHERS						
TOTAL	72,140	91,630	125,129	166,995	217,017	240,614

TABLE 13 ESTIMATED NUMBER OF HERDS AND ACREAGES FOR PROJECT DEVELOPMENT

ISLAND	NUMBER OF HERDS	ACREAGE
EXUMA	11	425
ABACO	2	25
LONG ISLAND	39	1600
ELEUTHERA	39	1600
CAT ISLAND	42	1600
ACKLINS	5	125
CROOKED ISLAND	2	50
ANDROS	5	125
MAYAGUANA	2	50
OTHERS	2	20
149		5620

Estimated cost for the importation of Breeding Stock

The estimated cost for importing male and female stock to upgrade the national sheep stock is based on the following:

Sheep:-

Wiltshire from the United Kingdom	$600/head FOB Nassau
Barbados Black Belly from Barbados	$500/head FOB Nassau
Katahdin from Texas USA	$500/head FOB Nassau
Florida Native from Florida USA	$500/head FOB Nassau
Dorsett from Florida USA	$500/head FOB Nassau

a) Number of female breeding stock to be imported

	py1	py2	py3	py4	py5
Barbados Black Belly	25	33	44	59	78
Katahdin	25	32	44	59	77
Dorsett12	16	22	29	38	
Florida Native	25	33	44	59	78
Wiltshire13	16	21	29	39	
	100	130	175	235	310
	51,300	66,600	89,600	120,400	158,900
					$486,800

b) Number of male breeding stock to be imported

	py1	py2	py3	py4	py5
Barbados Black Belly	15	15	20	30	30
Katahdin	10	10	15	20	20
Florida Native	10	10	15	20	20
Dorsett	5	5	10	10	10
Wiltshire	10	10	15	20	20
	50	50	75	100	100
	26,000	26,000	39,000	52,000	52,000
					$195,000

c) Number of male breeding stock to be imported and cost.

Goats:-

Nubian from USA @ $500/head Nassau
Saanen from USA @ $500/head Nassau
La mancha from USA @ $500/head Nassau

	py1	py2	py3	py4	py5
Nubian	5	10	10	20	20
Saanen	2	4	4	8	8
La mancha	3	6	6	12	12
Total	10	20	20	140	140
	5,000	10,000	10,000	20,000	20,000
					$ 65,000

Total importation cost over 5 year period is $746,800.

Infrastructure required to accommodate imported stock:-

The Department of Agriculture will be required to arrange importation on behalf of the Government. Stock will be held for on-farm quarantining at GRAC. Upon approval by the Veterinary Division, animals will be sold to farmers from the Islands at a nominal price.

A nucleus herd of each breed is to remain at GRAC for purebred breeding. Similarly pairs of the respective breeds to be distributed to three islands and kept at the Breed Improvement Centers for breeding and sale of off-springs.

Breed Improvement Centers to be located on Eleuthera, Long Island and Cat Island. The basic facilities to consist of a shelter to accommodate up to 5 does and a ram located on one acre of land. The centers are to serve as DEMONSTRATION UNITS for improved technology and management showing in particular the use of electric fencing to restrain animals in prescribed areas and as a deterrent to dogs.

Estimated capital cost for facilities including fence $2,000 each x 2 = $4,000. (For Eleuthera and Cat Island - Long Island has the Res. Centre)
Operating cost excluding labour $200/annum.

Estimated benefits from the herd improvement include:

a) improvement in twinning
b) improved weaning weights due to the introduction of milk/dual purpose type breeds in the breeding programme
c) heavier carcasses with a projected 10 % increment in carcass weight.

Financial Assessment and Support Required for On-Farm Development

Herd development and cash flow: Appendices 2 and 3 present the herd development tables for the four models. It is to be noted that the herd base varied and accordingly had ultimate influence on the cash flow. Listed below are the associated herd bases and years taken to achieve a positive cash flow.

Herd Size	Herd base start-up	Years to positive cash flow
50 does	50 does	2 years
100 does	75 does	2 years
150 does	100 does	3 years
200 does	100 does	4 years

Details of the operating costs are presented in Appendix 4.

Capital, operating costs and revenue: The production operations proposed for the four models indicate that the 200 doe herd has the lowest capital and operating costs per doe (Table 14-A). One of the main features recognized in the build up of the models is

the need to have larger herd size per man input. Under practical conditions a full-time person for a 200 doe unit is economically feasible. This condition however requires organized infrastructure such as water, gates, handling facilities and proper fencing.

Financial Support for On-Farm Development

The financial support required to initiate the national sheep and goat herd improvement programme is $1,106,004. Based on a 70:30 loan equity ratio a total of $779,203 are required for loans. By virtue of variations in loan requirement based on equity participation, loans are prorated according to herd size as follows:

50 doe unit	$ 3,000
100 doe unit	$ 5,000
150 doe unit	$ 9,500
200 doe unit	$ 10,500

This process reduces the loan requirement to approximately $617,000.

Details of a proposed allocation of development loan facility on an island basis is presented in Appendix 1.

VETERINARY SERVICES

This section refers to veterinary services to be provided not only to the sheep and goats project but also to the other livestock development proposals presented in section IV of this report.

Increases in the number of farmers engaged with large herds or flocks and the adaptation of more technical approaches to production will put more strain on the Veterinary Services. Historically the Veterinary Division has found itself engaged primarily in Regulatory Veterinary Medicine and Disease Control than clinical medicine. This condition is associated with the lack of Veterinary Laboratory facilities.

To accommodate developments in the livestock industry, strategies and resources must be developed in an orderly and timely manner.

Objectives

a. To provide effective service for the farming community.

b. To foster and nurture increases in livestock production.

c. To control and/or contain and/or eradicate local animal diseases.

d. To prevent and/or contain alien animal diseases.

e. To educate farmers on the prevention and control of diseases.

Strategy

a. Institute herd health management programmes.
b. Intensify activities to ensure adequate disease control through programmes as-
   - Leptospirosis control
   - Screw worm control
   - Tick and other ectoparasites control
c. Regulatory disease programmes
   - Tuberculosis eradication
   - Equine Encephalomyelitis programme
   - Vaccination programmes
d. Emergency disease preparedness plan
e. Quarantine services
f. Import regulations
g. Collaboration with and strengthening of ties with international agencies associated with veterinary public health.

Herd health management programmes

Clinical assistance is critical to the productivity and well being of livestock. With the projected increase in small farmer activity in livestock rearing, the veterinary resources will be unable to cope with clinical work. A shift in emphasis to herd health education and management programmes through veterinary extension services must be pursued. Assistance should be sought to develop and implement a dynamic comprehensive health programme in the Division.

Disease Control

Livestock development programmes must take into account the prospects of increased incidence of mastitis, screw worm, ticks and leptospirosis as the industry develops. Accordingly, control programmes especially among sheep and goats will be necessary.

Leptospirosis as a disease which affects the human by way of rats has to be controlled. Measures to be pursued are systematic rat control and vaccination programmes. Efforts should be put in

place to initiate action in this regard based on the increased appearance of rats in the immediate urban centres and the diagnosis of leptospirosis in one reported incidence in Nassau.

Tuberculosis (TB)

The monitoring of the few cattle herds in particular is of importance in the prevention, detection and control of TB.

Vaccination programmes

Herds/flock vaccination against clostridial diseases particularly Blackleg, as a preventative programme is essential in support of the expansion of the national sheep and goat herds. Death losses can be minimized or avoided by timely vaccination.

Quarantine

In view of the proposed importation of livestock to boost the industry, adequate quarantine facilities will be necessary and/or on-farm quarantining action pursued. An update on existing orders and regulations and amendments pertaining to "Animal Disease and Importation Law" as they relate to animal quarantine procedures, would be advisable so as to be instructive to the Department of Agriculture.

Constraints to Veterinary Services

a. The performance efficiency of the Veterinary Division is dependent on the efficiency of a diagnostic laboratory as the core of the entire service. To have a viable livestock industry requires the support and reliability of such services.

The Veterinary Division is currently unable to function satisfactorily due to the lack of such facilities.

b. Investigation and research are usually pursued by Veterinarians who have received additional training in specialized disciplines. Such investigatory and research work can only be done when there are sufficient trained Veterinary Personnel and Medical Technologists. In the absence of Veterinary Personnel with post-graduate training, the Division is encouraged to develop some research capability and initiate development of the required facilities to retain such services. The services of a Veterinary Pathologist to operate the proposed laboratory is of immediate importance in initiating and piloting the developments within the Division.

INSTITUTIONAL STRENGTHENING

Veterinary Facilities

Proposals prepared by the Division are for a building to be sited in close proximity to the Abattoir in Nassau.

Estimates of the size unit is 546 sq. feet to accommodate-

- animal observation area
- work area
- necrospy laboratory
- parasitology/serology lab.
- veterinary microbiology lab.

Estimated cost for the facility including furnishing is $200,000. Details are not yet in place. The expected benefits are:-

- confirmative diagnoses
- disease surveillance
- routine diagnostic tests for domestic species groups

Professional Support Staff (Livestock)

The livestock sector development strategies and projects in the forseeable future will require competencies in the following areas:-

- Animal breeding
- Dairy husbandry and technology
- Beef cattle husbandry and feedlot management
- Meats and carcass evaluation and grading
- Forage production and preservation

At the para-professional levels there is need for

(a) Animal Health Assistants to give support and practical assistance to the Veterinary Service requirement with the increments expected in livestock production. This service will be even more critical for the Southern Islands.

(b) Agricultural Extension Agents at the Diploma in Agriculture level.

This group of personnel is required to give "hands-on" help to farmers in improving their technology and business management. Likewise to assist with an intelligent information generation and retrieval system for research and development work.

equired:

Assistant	4
n Agents (Dip. Level)	7
ng MSc. level	1
ry MSc. level	1
t. al. MSc. level	1
level	1
tion MSc.	1

tered in recruiting and maintaining extension
e to deliver at a satisfactory level of
slowed development in the agricultural
te requirement for staff especially in the
is a major concern.

uation, it is proposed that negotiations be
COM Secretariat to serve as a regional agent
on a contract basis to serve as extension
nical agriculture in the Southern Islands.
bs would be required to have a Diploma in
num of 4 years working experience plus
e CARICOM middle management training in
lines of authority accountability and
rked out to mutual satisfaction.

Istants

a) with graduates having REPHA Diploma

lucation

of Bahama is the only institution in the
al training at a recognized academic level.
degree (Agric.). A cursory examination of
es the following strengths and weaknesses:-

gical science background
serve more at the laboratory and peripheral

b) Weaknesses

- lack of practical agricultural exposure to fix a "hands-on" approach to the production and service activities related to crops, livestock, farm machinery and equipment, extension or any other area of agriculture.
- agri-business and farm management
- rural sociology and extension methods.

It is therefore proposed that further assessment be made as to how the COB programme is meeting the need for graduates in practical agriculture, and make recommendations as to how the facilities of GRAC and BARC may be utilized to strengthen the programme. Likewise, to seek alternatives to the COB programme.

INTERVENTIONS TO SUPPORT THE INDUSTRY

Government Intervention

It is recommended that the Government of the Bahamas support the development of the sheep and goat industry as it is a resourceful part of the livestock profile, which can make a significant contribution. The program of support involves loans, to 149 farmers, importation of improved stock and improvement in services.

Estimated costs are:-

a)	Development program	$ 617,000
b)	Importation of stock	746,000
c)	Slaughter slabs	160,000
d)	Livestock Improvement Centres (3)	6,000
e)	Extruder for POH unit	30,000
		$1,559,000

N.B. Cost of training and research station development are presented in the Agronomy Section of this series of reports.

A summary of the project production output is presented in Table 14-B.

TABLE 14-A. - CAPITAL COSTS, OPERATING COSTS AND REVENUES AT FULL DEVELOPMENT FOR FOUR SHEEP/GOAT HERD MODELS
(BH $)

HERD SIZE	CAPITAL REQUERIMENT		MEAN OPERATING COST		MEAN REVENUE	
	TOTAL	PER DOE	TOTAL	PER DOE	TOTAL	PER DOE
50 DOES	6,081	122	6,063	121	8,185	164
100 DOES	8,750	88	7,791	78	16,220	162
150 DOES	11,909	79	12,372	83	23,768	158
200 DOES	13,293	67	14,381	72	31,595	158

TABLE 14-B LIVESTOCK PROJECT OUTPUT

ITEMS	PRE-PROJECT	PROJECT
SHEEP		
CURRENT POPULATION	9,182	9,182
BREEDING HERD POPULATION	3,214	3,214
OFFSPRING SALE 50%	1,890	2,677
YIELD (LB.)	71,814	120,465
5-YEAR BREEDING POPULATION	9,011	12,940
OFFSPRING SALE	5,298	10,779
5-YEAR YIELD (LB.)	201,324	485,056
GOATS		
CURRENT POPULATION	11,283	11,283
BREEDING HERD POPULATION	3,949	3,949
OFFSPRING SALE 50%	2,322	3,290
YIELD (LB.)	74,304	131,580
5-YEAR BREEDING POPULATION	11,071	12,475
OFFSPRING SALE	6,510	10,392
5-YEAR YIELD (LB.)	208,320	415,680

PROJECT LOAN FACILITY REQUIREMENTS FOR A 5-YEAR DEVELOPMENT PLAN

PROJECT ISLAND	YEAR	HERD SIZES				CAPITAL ALLOCATION
		50	100	150	200	
EXUMA	1	1	0	-	-	3,000
	2	2	2	-	-	16,000
	3	1	1	-	-	8,000
	4	1	3	-	-	18,000
	5	0	0	-	-	
	TOTAL	5	6			45,000
ABACO	1	1	-	-	-	3,000
	2	-	-	-	-	-
	3	1	-	-	-	3,000
	4	-	-	-	-	-
	5	-	-	-	-	-
	TOTAL	2	-	-	-	6,000
LONG IS.	1	4	3	-	-	27,000
	2	5	5	1	1	60,000
	3	6	3	1	-	42,500
	4	3	2	-	1	24,500
	5	2	2	-	-	16,000
	TOTAL	20	15	2	2	170,000
ELEUTHERA	1	4	3	-	-	27,000
	2	5	3	1	-	39,500
	3	6	5	-	1	53,500
	4	3	2	-	1	24,500
	5	2	2	1		25,500
	TOTAL	20	15	2	2	170,000
CAT ISLAND	1	4	3	-	-	27,000
	2	5	5	1	-	49,000
	3	6	3	-	-	42,000
	4	5	2	1	-	34,000
	5	5	2	-	-	25,000
	TOTAL	25	15	2		178,000
SUB-TOTAL						569,000

LITY REQUIREMENTS FOR A 5-YEAR
VELOPMENT PLAN

HERD SIZES (EWES/DOES				CAPITAL
50	100	150	200	ALLOCATION
1	-	-	-	3,000
1	-	-	-	3,000
2	-	-	-	6,000
1	-	-	-	3,000
	-	-	-	
5	-	-	-	15,000
1	-	-	-	3,000
-	-	-	-	-
1	-	-	-	3,000
-	-	-	-	-
-	-	-	-	-
2	-	-	-	6,000
1	-	-	-	3,000
2	-	-	-	6,000
1	-	-	-	3,000
1	-	-	-	3,000
-	-	-	-	-
5	-			15,000
1	-	-	-	3,000
1	-	-	-	3,000
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
2	-	-	-	6,000
1	-	-	-	3,000
1	-	-	-	3,000
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
2	-	-	-	6,000
				48,000
				617,000

PROJE
KIDDING

BUCKS
OPENING (BOP)
PURCHASES
DEATHS
SALES
CLOSING (EOP)

MATURE DOES
OPENING (BOP)
RECLASSIFICATION (IN)
PURCHASES
DEATHS
SALES
CLOSING (EOP)

EMALE KIDS/LAMBS
BIRTHS 100%
DEATHS 2%
RECLASSIFICATION (OUT

IALE KIDS/LAMS
BIRTHS 100%
DEATHS
RECLASSIFICATION (OUT

EMALE WEANERS
RECLASSIFICATION (IN)
DEATHS
SALES
RECLASSIFICATION (OUT

ALE WEANERS
RECLASSIFICATION (IN)
DEATHS
SALES

1 @ 45 lb/doe/lambs + 60 lb

BAHAMAS LIVESTOCK PROJECT
SHEEP AND GOAT HERD DEVELOPMENT TABLE
100 DOE UNIT MEDIUM MANAGEMENT

1	2		3		4		5		6		7		8		9		10	
1	2	3		4	5	6		7	8	9	10	11		12	13		14	15
		3	4	4	4	4		4	4	4	4	4	4	4		4	4	4
3		1				3		1						3		1		
						3		1						3		1		
3		4	4	4	4	4		4	4	4	4	4	4	4		4	4	4
		73	100	100	100	100		100	100	100	100	100	100	100		100	100	100
		44	22	22	22	22		22	22	22	22	22	22	22		22	22	22
75																		
2		2	2	2	2	2		2	2	2	2	2	2	2		2	2	2
		15	20	20	20	20		20	20	20	20	20	20	20		20	20	20
73		100	100	100	100	100		100	100	100	100	100	100	100		100	100	100
75		73	100	100	100	100		100	100	100	100	100	100	100		100	100	100
2		2																
73		71																
75		73	100	100	100	100		100	100	100	100	100	100	100		100	100	100
2		2	2	2	2	2		2	2	2	2	2	2	2		2	2	2
73		71	98	98	98	98		98	98	98	98	98	98	98		98	98	98
		73	71	98	98	98		98	98	98	98	98	98	98		98	98	98
		2	2	2	2	2		2	2	2	2	2	2	2		2	2	2
		27	47	74	74	74		74	74	74	74	74	74	74		74	74	74
		44	22	22	22	22		22	22	22	22	22	22	22		22	22	22
		73	71	98	98	98		98	98	98	98	98	98	98		98	98	98
		2	2	2	2	2		2	2	2	2	2	2	2		2	2	2
		71	69	96	96	96		96	96	96	96	96	96	96		96	96	96
12045		13020	16260	16260	16260	16260		16260	16260	16260	16260	16260	16260	16260		16260	16260	16260

PROJECT YEARS
KIDDINGS/LAMBING

BUCKS
- OPENING (BOP)
- PURCHASES
- DEATHS
- SALES
- CLOSING (EOP)

MATURE DOES
- OPENING (BOP)
- RECLASSIFICATION (IN)
- PURCHASES
- DEATHS 2%
- SALES
- CLOSING (EOP)

FEMALE KIDS/LAMBS
- BIRTHS 100%
- DEATHS 5%
- RECLASSIFICATION (OUT)

MALE KIDS/LAMS
- BIRTHS 100%
- DEATHS
- RECLASSIFICATION (OUT)

FEMALE WEANERS
- RECLASSIFICATION (IN)
- DEATHS 2%
- SALES
- RECLASSIFICATION (OUT)

MALE WEANERS
- RECLASSIFICATION (IN)
- DEATHS
- SALES

ed @ 45 lb/doe/lambs + 60 lb/weaner 4!

BAHAMAS LIVESTOCK PROJECT
SHEEP AND GOAT HERD DEVELOPMENT TABLE
200 DOE UNIT MEDIUM MANAGEMENT

PROJECT YEARS	1	2		3		4		5	6		7		8		9		10	
KIDDINGS/LAMBINGS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
BUCKS																		
OPENING (BOP)	4	4	7	8	8	8	8	8	8	8	8	8	8	8	8			
PURCHASES	4	3	1		4		4				4		4					
DEATHS																		
SALES	-				4		4				4		4					
CLOSING (EOP)	4	7	8	8	8	8	8	8	8	8	8	8	8	8	8			
MATURE DOES																		
OPENING (BOP)		98	174	200	200	200	200	200	200	200	200	200	200	200	200			
RECLASSIFICATION (IN)		83	65	44	44	44	44	44	44	44	44	44	44	44	44			
PURCHASES	100	-																
DEATHS 2%	2	2	4															
SALES		5	35	40	40	40	40	40	40	40	40	40	40	40	40			
CLOSING (EOP)	98	174	200	200	200	200	200	200	200	200	200	200	200	200	200			
FEMALE KIDS/LAMBS																		
BIRTHS 100%	100	98	174	200	200	200	200	200	200	200	200	200	200	200	200			
DEATHS 5%	5	5	7	10	10	10	10	10	10	10	10	10	10	10	10			
RECLASSIFICATION (OUT)	95	93	167	190	190	190	190	190	190	190	190	190	190	190	190			
MALE KIDS/LAMS																		
BIRTHS 100%	100	98	174	200	200	200	200	200	200	200	200	200	200	200	200			
DEATHS	5	5	7	10	10	10	10	10	10	10	10	10	10	10	10			
RECLASSIFICATION (OUT)	95	93	167	190	190	190	190	190	190	190	190	190	190	190	190			
FEMALE WEANERS																		
RECLASSIFICATION (IN)		95	93	167	190	190	190	190	190	190	190	190	190	190	190			
DEATHS 2%		2	2	3	4	4	4	4	4	4	4	4	4	4	4			
SALES		10	26	120	142	142	142	142	142	142	142	142	142	142	142			
RECLASSIFICATION (OUT)		83	65	44	44	44	44	44	44	44	44	44	44	44	44			
MALE WEANERS		95	93	167	190	190	190	190	190	190	190	190	190	190	190			
RECLASSIFICATION (IN)		2	2	3	4	4	4	4	4	4	4	4	4	4	4			
DEATHS		93	91	164	186	186	186	186	186	186	186	186	186	186	186			
SALES																		
Feed @ 45 lb/doe/lambs + 60 lb/weaner	4500	15810	18990	29040	31800	31800	31800	31800	31800	31800	31800	31800	31800	31800	31800	31800	31800	31800

50 doe unit

Labour	
3 md/wk @ $25.00/day	
Feed	
Veterinary Cost	
Maintenance structure 5%	
Maintenance fence 5%	
Contingencies 10%	
	3(
Revenue	

100 doe unit

	1
Labour	
3 md/wk @ $25.00/day	1950
Feed	1287
Veterinary Cost	600
Maintenance structure 5%	-
Maintenance fence 5%	-
Contingencies 10%	384
	4211
Revenue	

50 doe unit

	1	2	3	4	5	6	7	8	9	10
Labour										
3 md/wk @ $25.00/day	1950	3900	3900	3900	3900	3900	3900	3900	3900	3900
Feed	880	1362	908	1375	908	1375	908	1375	908	1375
Veterinary Cost	300	300	300	300	300	300	300	300	300	300
Maintenance structure 5%	-	75	75	75	75	75	75	75	75	75
Maintenance fence 5%	-	50	50	50	50	50	50	50	50	50
Contingencies 10%	313	574	528	575	528	575	525	575	525	575
	3443	6311	5811	6325	5811	6325	5811	6325	5811	6325
Revenue		10775	5390	10880	5490	10880	5390	10880	5490	10

100 doe unit

	1	2	3	4	5	6	7	8	9	10
Labour										
3 md/wk @ $25.00/day	1950	3900	3900	3900	3900	3900	3900	3900	3900	3900
Feed	1287	2057	1815	2750	1815	2750	1815	2750	1815	2750
Veterinary Cost	600	600	600	600	600	600	600	600	600	600
Maintenance structure 5%	-	250	250	250	250	250	250	250	250	250
Maintenance fence 5%	-	50	50	50	50	50	50	50	50	50
Contingencies 10%	384	686	662	755	662	755	662	755	662	755
	4211	7543	7277	8305	7277	8305	7277	8305	7277	8305
Revenue		14550	10780	21860	10880	21560	10780	121860	10880	21560

IV. OTHER A

Besides shee
livestock dev
medium and lo
in the areas
operation.
intended to
Project but a
preparation m
for its futur

A. Hay produc

In 1987 The Ba
the U.S.A. a
simultaneously
would indicate
volume. It is
reported as ea
forage combina
attractive as
months of Dece

Although the la
effort should b
competitive a p
develop a local

The Project Are

Locations in Ab
for hay product
lenses of 40 fe
of Irrigation Pr

Project Justific

1. There are v
   Abaco in par
   operations c
2. Legume/gras
   successful t
   organic mate
3. The project
4. The North
   unutilized a
   through cont

OF LIVESTOCK DEVELOPMENT: SOME PROPOSALS

and goat production there are other areas of
pment in the Bahamas which could be explored in the
r farms. The following sections present proposals
hay production, dairying and beef cattle feedlock
mentioned previously. These propasals are not
part of the Agricultural Services Development
rather to considered as contribution of the project
sion to the Ministry of Agriculture of The Bahamas
consideration and analysis.

lon

amas imported over 42.4 million pounds of hay from
a value of $5.97 million. This occurred
with some hay production at BARC, N. Andros which
that the country uses in excess of that importation
noteworthy that successful hay production has been
ly as 1977 by the BARTAD project in N. Andros. The
tion of Buffel Grass and Alfalfa was the most
he alfalfa continued growth during the dry winter
ber to April.

nded price of hay is approximately 14.5c/lb., every
e made to use existing resources to produce at as
rice as possible to reduce the outflow of funds and
industry.

a

aco, North Andros and Grand Bahama are well suited
tion on cleared lands located above fresh water
et thickness as described in Annex 3, Development
roject of this report.

cation

vast expanses of cleared, arable, idle lands in
articular and Andros on which mechanized production
can be successfully carried out.
ss hay production can be a beneficial precursor to
types of crop production being a contributor of
terial and nitrogen.
t can reduce the hay import bill.
Andros Coop Society has equipment which is
and this venture could be a source of income
ntracted services.

Objectives

1. To encourage the development of a local hay production industry.
2. To put to productive use idle lands with good production capabilities.

Production Targets

Hay production is based on projected yields of 10 tons of dry matter per acre which would give the following volume of production from 35 acre modular development over a 5-year period (Table 15).

TABLE 15 HAY PRODUCTION TARGETS

UNITS PROJECT YIELD	PY1 ADDED PER YR.	PY2	PY3	PY4	PY5	
		35-ACRE UNITS				
		1	2	2	3	1
1	1	115	350	150	280	280
2	2	-	560	700	700	560
3	2	-	-	560	700	700
4	3	-	-	-	840	1050
5	1	-	-	-	-	280
YIELD/YR. (TONS)		115	910	1410	2520	2870

To support this level of production, over 315 acres are required.

Strategies for incorporation

The major strategies for incorporation into the project would include promotions by BAIC and invitations to would-be investors including cooperatives to pursue commercial operations.

Research Support

- The major areas of research would be the determination of land capabilities of the respective locations for the optimal fertilizer application for best forage yields.
- Determination of the best irrigation and mowing cycles for optimal economic yields.

Support Services

1. Contract equipment services from the North Andros Cooperative.
2. Irrigation equipment suppliers and service.
3. Forage agronomist professional input.
4. On-farm transportation and storage facilities.
5. Laboratory services for forage analysis.
6. Transportation.

Of the services required, the following are in place, but need upgrading:

a) Equipment service at Andros Coop
b) Irrigation equipment suppliers
c) Laboratory services at CAS.

The other areas to be developed are forage agronomy and crop care specialist, and the farm facilities.

Presently there are no practising forage agronomists in the Department of Agriculture. Therefore the service would have to be contracted. The University of Florida, Gainsville is accessible and useful. Contracts can be made through their County Extension Agent for such assistance.

Production

Production will be based on modules of 35 acres each. This unit size maximizes the use and efficiency of a prescribed irrigation system. Accordingly 9 x 35 acre units would satisfy the project requirement. However economies of scale will spread the services of the management tractor and equipment. To determine the viability of the unit size which is a practical starting point, a detailed analysis is presented in the following sections:

Hay Production

Capital Costs

Total acreage - 315 acres in either Andros, Abaco or Grand Bahama.
Production unit - 35 acres.
Capital Expenditure.

Machinery Items	
1 Tractor & Trailer (3 ton)	18,000
1 Pick-up	10,000
1 Irrigation system with gun sprinklers	15,600
Building & Facilities	
1 work & storage shed with office 20' x 100' @ $10.00/sq. ft.	20,000
120 chains of roadway with marl at $160/chain	19,200
Establishment Cost - Year 1.	
a) Contract services including land preparation to harvesting with labour and gas oil costs (see assumptions)	26.542
Contingencies 10%	10,934
	120,276

Assumptions

Contract service for land preparation through to harvesting at the following rates using a D4 Tractor and a

a) John Deer 4130 or equivalent.	
Plough @ 2 acres/hr. @ $34/hr. D4	595
Harrow/disc twice @ 2 acres/hr. @ $34/hr. D4	1,190
Seed @ 2 acres/hr. @ $28/hr JD	490
Fertilizer @ 2 acres/hr. @ $28/hr. JD	327
Spray (three times) @ 2 acres/hr. @ $28/hr. JD	1,470
88 hours labour - tractor driver @ $5.00/hr.	440
88 hours petrol @ $8/00/hr.	704
Sub-Total	5,216
b) Harvesting (5 times per year)	
Mow twice @ 3 acres/hr. @ $28/hr. JD	654
Rake @ 3 acres/hr. @ 28/hr. JD	327
Bale @ 2 acres/hr. @ 28/hr. JD	490
Harvesting labour	330
Transportation	528
	11,795
Manual labour - 75 mandays	2,250

c) Crop care chemical treatment 3x/year

Sprayer unit	$ 327	
Chemicals	2,100	
	2,427 x 3	7,281
	Total	26,542

d) Replanting of alfalfa every 3 years i.e. years 4 and 5 and 8 and 9. Yields 80% regular volume.

e) Yields and Revenue @ $12/40 lb. bale.

TABLE 16 PROJECTED HAY PRODUCTION FROM 35 ACRE UNIT

PROJECT YEARS

ITEMS	1	2	3	4	5	6	7	8	9	10
RATE OF PRODUCTION	50%	----	100%---->	50%	<-----	100%	------>	50%	<----	100%
YIELDS	115	350	350	350	200	350	350	350	350	350
NUMBER OF BALES	5,750	17,500	17,500	14,000	14,000	17,500	17,500	14,500	14,000	17,500
REVENUE	$ 69,000	210,000	210,000	168,000	210,000	168,000	210,500	210,000	168,000	210,000

Operating Cost

The operating cost schedule is presented in Table - showing a range of $122,757 to $128,735 per annum employing a farm manager and 5 - 8 workers. The replanting schedule every three years minimally affects operating cost as it is anticipated an orderly exercise would be pursued so as to be able to harvest 80% of the regular volume within the year.

Financial Assessment

The capitalized cost for establishing a 35 acre unit including year 1 operating cost is $202,852. Accordingly equity participation at a debt equity ratio of 70:30 would require a minimum of approximately $60,000-70,000 to attract loan funding. The capital cost is estimated at $5,797 per acre with annual operating cost of $3678/acre and $5400 revenue/acre.

Estimated loan funding for the 315 acre project would be $1.85 million distributed over the 5-year period as follows on a 35 acre unit basis of expansion.

Years				
1	2	3	4	5
202,895	405,790	405,790	637,670	202,895

Table 17 Hay Production Operation (35 acre unit)

Operating Costs										
Manager	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Tractor drivers	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400
Labourers Irrigation	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000
Security	-	23,920	23,920	23,920	23,920	23,920	23,920	23,920	23,920	23,920
Pasture replanting	-	-	-	6,534	6,534	-	-	6,534	6,534	
Building road maintenance		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Tractor, pick-up oper. & maintenance	4,000	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Fertilizer 4 x/yr	-	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620
Irrigation maintenance	-	4,141	4,141	4,141	4,141	4,141	4,141	4,141	4,141	4,141
Harvesting & storage	11,645	11,645	11,645	11,645	11,645	11,645	11,645	11,645	11,645	11,645
Labour	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Crop Care	2,781	2,781	2,781	2,225	2,225	2,781	2,781	2,225		
Admin.										
Insurance	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Land rental @ $100/ac.	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Total	82,576	122,757	122,757	128,735	128,735	122,757	122,757	128,735	126,510	119,976
Revenue	69,000	210,000	210,000	168,000	168,000	210,000	210,000	168,000	168,000	210,000

B. Dairying

The Bahamas fresh milk market was valued at over $10.32 million in 1988. All supplies were imported as there are no local dairy production operations. An evolutionary process can be initiated to produce milk at a pace dictated by promotional programmes, Government concessions, infrastructural development and training.

Up to 25% of the current volume of milk consumption of 8.7 million pounds or 3.36 million quarts per annum can be achieved within a 5-year period with a modest population of 325 milking cows. This process can be initiated through a phasic expansion of clusters of milking herds ranging in size from 25, 50 and 100 cow units, on 36, 72 and 144 acres respectively.

The Project Area

Locations in North Andros, New Providence and Grand Bahama are appropriate.

Project Justification

- There is a strong demand for fresh whole milk in the population densities of New Providence and Grand Bahama in particular.
- The grass/legume forage production capabilities in the above-mentioned locations favour the support of economic levels of milk production with a minimal use of concentrate feed.
- The conversion of forage to protein is more efficiently done through milk production than through beef.

Production Target

Milk production target are based on the prospects of establishing 8 dairy units within 5 years which would give the following volume of production over that period.

	py1	py2	py3	py4	py5	Acres
25 cow unit	2	1	2	-	-	180
50 cow unit	-	1	1	-	-	144
100 cow unit	-	-	1	-	-	144
Production quarts	105120	247760	621965	713475	833970	
Value @ 79c/quart	83040	195730	491352	536645	658836	

level of production with herd replacements, 468
red. Should the production system bring in
ally the acreage would be reduced.

ncorporation

tegies for incorporation include promotional
:he BAIC inviting investors as well as the
orm investment or agricultural production project
commercial operation.

eas for research would be (i) forage production
)port economic milk production, and (ii) husbandry
Lze exposure to heat stress and encourage high dry

ry will require the following services:

services for herd health care programmes and
insemination.
power in dairy production.
n equipment and supplies.
source of in-calf heifers for herd replacements.
facilities for milk quality control.
facilities.
:ation in refrigerated units.
l service for technical advice and information.

s mentioned, the following are in place or are
ould require some upgrading:-

ry services as they relate to herd health and
e milk production.
neifers, irrigation equipment and supplies from the

ry facilities for milk testing at the C.A.S.

of service for which development must occur are:
training, extension service and access to milk
lities.

processing facilities, the likelihood exists that
commodations for whole milk marketing at the dairy
t in Nassau which reconstitutes milk solids and

packages imported whole milk. Similarly, the possibility of marketing of fresh milk to the proposed processing plant in Grand

Bahama. However, before any project in milk production can be formalized, there has to be firm understandings on this aspect of marketing.

With the proposed developments in marketing and transportation in the agricultural sector, the inclusion of refrigerated units for inter-island and within-island travel are proposed. Milk, being a very perishable product, will require specialized facilities.

Training and extension services as the means of upgrading the human resources involved in dairying would require a very special effort as a new enterprise in the livestock sector. Training of herdsmen, operators and extension workers can be accommodated either by local courses or in-service training overseas.

Based on the foregoing, dairying can be part of the long-term plans for the livestock industry.

Production

The physical profile for production involves the following:

(a) Feedstuff - the establishment of grass/legume pastures to match the respective herd sizes (25, 50 and 100 cow herds).
(b) Animals - imported in-calf heifers according to herd size.
(c) Infrastructure - milking units consisting either of floor bucket machine milkers for herd sizes of 50 and less or herring bone milking system for the larger herds, bulk coolers, feed storage, electric fencing, water trough, holding and calf pens.

Details of the herd development schedules, capital items and costs as well as the operating costs for the respective size units are presented in Appendices 5, 6 and 7.

Financial Assessment

Five production models were developed representing differing start-up bases for herd development, giving due recognition to capital cost and the reality of animal availability. The herd development schedules therefore influenced capital and operating costs, and ultimately the timing of a positive cash flow as a business investment ahown in the following:-

rd Development Base for
e Development Models

Herd Base Cash Flow	Years to Positive
25	5 years
50	9 years
75	8 years
100	8 years
150	8 years

esented a summary of the capital cost, operating
for the 5 models.

, COST WITH THE OPERATING COST AND REVENUE
, DEVELOPMENT FOR 5 COW HERD SIZES

REQUIRED	OPERATING COST		REVENUE	
PER COW	TOTAL	PER COW	TOTAL	PER COW
5,242	24,435	977	65,620	2,625
6,119	69,884	1,398	131,490	2,630
3,909	142,465	1,424	260,680	2,607
3,567	192,361	1,282	393,270	2,622
3,391	230,701	1,153	519,110	2,596

lels would indicate that there can be improvements
estment if a system of buying-in herd replacements
ued. This would eliminate the capital costs for
xample calf pens as follows:

5 cow-unit calf pen
0 " " " "
0 " " " "
0 " " " "
0 " " " "

:/annum

:5 cow-unit
;0 " "
)0 " "
;0 " "
)0 " "

Moreover, this approach to development would allow for a systematic build-up of cow numbers for other herd developments based on the sale of dry and pregnant cows.

The financial support required to initiate a dairy project of this size is $1,658,106. Based on a loan: equity ratio of 70:30 $1,160,674 are required for funding.

The role of Government

The role of Government includes:-

(a) Building and instilling confidence in investors regarding continuity of tenure through long-term leases on lands and secure immigrant status of foreign investors and technicians.

(b) Infrastructural development (water, roads, electricity).

(c) Provision of concessionary assistance in the importation of animals.

(d) Milk marketing regulatory function through a marketing committee in the Department of Agriculture representing public and private sector interests.

(e) Training at all levels.

(f) Duty-free concessions on the importation of capital goods.

(g) Provision of technical, veterinary and husbandry services, including quarantining facilities and services if necessary.

C. Beef Cattle Feedlot Operation

The new thrust envisioned in the agricultural sector seeks to reduce the import bill by putting to best use the accessible land and water resources. The proven ability to produce good quality forage mixes provide an opportunity to capitalize on the growth impetus of feeder cattle based on a strong forage programme.

Within the context of compatible companion enterprise it is proposed that hay-making and beef feedlot operations be carried out cojointly or within close proximity to each other. This may be best pursued on cleared idle lands in either Abaco, Grand Bahama, North or Central Andros, where mechanized farm operations can be pursued. This approach could form part of a long-term plan to upgrade and bring large tracts of poor soils into intensive crop production. Such an approach could assist in reducing the fresh

beef import bill which was at $21.3 million in 1988 and will continue to increase.

The Project Area

Beef feedlot projects may be sited in Abaco, Grand Bahama, North Andros, Central Andros and New Providence. The preference would be influenced by the ease in access to land and the transportation cost for bulk grain.

Project Justification

a. There is a demand for fresh beef and the infrastructure as an abattoir, strong distributive trade are in place supported by lands on which pasture forages can be very productive.
b. The feedlot aspect of the beef business is profitable.

Objectives

a. To encourage the development of a local beef industry.
b. To reduce the foreign import bill by participating in thet area of the production chain which can be accommodated.

Production Target

Beef production is based on the possible establishment of a minimum of 3 feedlot units each with a throughput capacity of 600 heads per annum within a 5-year period. The volume of production for that period would be as follows:

	py1	py2	py3	py4	py5
600 head units throughput at 1000 lb. per head live weight (lb.)	300000	600000	900000	1500000	1800000
Approx. carcass weight (lb.)	150000	300000	450000	750000	900000

This level of production would represent a contribution of 7.56% of the current level of importation. In 1988 the recorded level of local production was only 39,000 lb. of fresh beef.

To support this development approximately 500 acres of arable lands are required.

Strategies for incorporation

The major thrust would be through the BAIC and Cooperatives to promote and encourage would-be investors to pursue commercial operations.

Research

a. The major research thrust would be in grass/legume forage production programmes to support economic liveweight gains.
b. Husbandry systems to minimize exposure to heat stress and the encouragement for high dry matter intake.

Support Services

The beef industry will require the following services:-

a. Veterinary services for herd health care programmes and in particular on-farm quarantining.
b. Trained manpower in feedlot management.
c. A reliable source of weaner cattle in the USA.
d. Organized transportation of animals from the cattle sources in the USA to the site/s in the Bahamas.
e. Bulk transportation of grain feed from the port to the production site.
f. For non-New Providence production operation access to a slaughter slab with appropriate carcass chilling and holding facilities and Public Health post-mortem inspection.
g. Grading standards to ensure quality products to take advantage of price structures.
h. Agronomic services to ensure technical inputs for forage production.
i. Animal nutritionists services to formulate diets using local ingredients.

Among the services mentioned, the following are in place but require upgrading:-

a) Veterinary services as they relate to feedlot management, shipping of livestock and the attendant problems of on-farm quarantining.
b) In terms of procurement of feeder cattle from the USA, the logistics of timing and selection of quality stock for shipping to the Bahamas require only some upgrading. Similarly for the supply of bulk feed.
c) Local transportation of bulk feed already has a record of performance and therefore only requires some adjustments for the particular situation.
d) Slaughter slab in Abaco to be fully refurbished to accommodate such a development. Whereas everything is virtually in place at the abattoir in Nassau.
e) The Department of Agriculture, Livestock Division can assist with the nutrition programme.

Areas for which development and planning are required are:-

a) Feedlot management would have to be contracted and Bahamians trained during the interim.
b) Agronomic services for pasture forages would have to be contracted and training of personnel for replacement.
c) The legal aspects of slaughter house facilities and operation would require upgrading to include places other than Nassau. This process requires the intervention of the Veterinary Division.
d) Grading standards for meats would be required to attract premium price for beef produced. Training programmes to be pursued in this regard.

Production

The production profile involves:-

a) Feedstuff - the establishment of grass/legume pastures on farm sites selected within the potential agricultural lands located above fresh water lenses of 40 ft. thickness as described in the Report on the Development of Irrigation Projects. The demarcation of grazing plots to accommodate the electric fencing.
b) The importation of weaner cattle from the southern USA with appropriate vaccinations against shipping diseases.
c) the development of the prescribed infrastructure consisting of sheds, holding pens, water supply system according to the site's peculiar layout.

Details of the specifications are presented in the Schedule of Capital Cost inputs in Table 19.

Financial

In Table 2C
annual purc
as of year
the followi

FEED	
ANIMAL	
OPERAT	
MANAGE	

There is a n
$1,880/head
are possibl
ingredients
quality of t
brewers grai

The capital
cost of $1,5

Loan require
$638,000. T
therefore re
the 5-year p

The role of

The role of

a) Buildin
continu
secure

b) Continu
slab fa

c) Provisi
Livesto

d) Duty-f

e) Training
forage p
manage

Financial Assessment

In Table 20 is presented the operational cost which includes the annual purchase of weaners. With the full complement of animals as of year 2, the operational cost of $864,699 per annum reflects the following proportion of costs:-

FEED	-	34.3%
ANIMAL PURCHASE	-	33.4
OPERATIONAL AND ADMINISTRATIVE	-	26.6
MANAGEMENT PERSONNEL	-	5.7
		100.0

There is a net revenue of $892.00/head based on a gross revenue of $1,880/head less operating expenses of $988 per head. Reductions are possible in feed cost through the inclusion of local ingredients to extend the diets taking into account the high quality of the grass/legume forage intake. The inclusions of cheap brewers grain and CMS (molasses) could enhance profitability.

The capital cost of $910,806 for the operation represents a unit cost of $1,518 per head.

Loan requirement on a 70:30 debt equity ratio is approximately $638,000. The development of three units of this capacity would therefore require a minimum loan facility of $1.92 million, within the 5-year period.

The role of Government

The role of Government includes:-

a) Building and instilling confidence in investors regarding continuity of tenure through long-term leases on lands and secure immigrant status of foreign investors and technicians.

b) Continued improvement of infrastructure including slaughter slab facilities in production areas.

c) Provision of technical support from the Veterinary and Livestock Divisions of the Department of Agriculture.

d) Duty-free concessions on the importation of capital goods.

e) Training in discipline areas which affect the industry, e.g. forage production, carcass evaluation, beef cattle production management.

TABLE 20 FEEDLOT OPERATING COST AND ASSUMPTIONS

FARM MANAGER	20,000	20,000
LIVESTOCK ATTENDANTS @ $150/WK	7,800	15,000
WEEK-ENDS @ $60/WK	1,560	3,120
TRACTOR DRIVERS @ $200/WK	5,200	10,400
PASTURE MAINTENANCE @ $250/AC	-	37,500
VETERINARY CARE @ $30/HEAD	18,000	18,000
FENCING MAINTENANCE 5%	-	5,520
BUILDING MAINTENANCE 5%	-	11,950
MACHINERY & EQUIPMENT	-	21,600
WATER SYSTEM	-	200
UTILITIES	3,000	3,000
ANIMAL TRANSPORTATION	18,000	18,000
FEED 3300 LB/HEAD @ $0.15/LB.	99,000	297,000
PICK-UP & TRACTOR OPERATION COST	20,000	30,000
PURCHASE OF CATTLE	-	289,000
MISCELLANEOUS	5,000	5,000
CONTINGENCY	19,756	78,609
	217,316	864,699

Assumptions

1. Annual throughput of 600 weaners per year
2. Initial weight = 450 lb. final weight 1000 lb.
3. System semi-intensive with back grazing on a total of 150 acres
4. Average concentrate fed = 15 lb./head/day
5. Average liveweight gain = 2.5 lb/day
6. Days on feedlot = 220
7. Period to establish pasture = 6 months
8. Revenue at $ 1,880/head

Private sector intervention

The prospects exist to pursue financially viable enterprises in hay production, feedlot operations and dairying as indicated in Section IV.

Estimated financial requirements are:-

a) Hay production on 315 acres would require over $1.85 million investments in the 5-year period to produce approximately 2,870 tons per annum by year 5.

b) Feedlot operation would require over 500 acres and up to $1.92 million investments to produce up to 900,000 lb. beef by year 5.

c) Dairying would require over $1.65 million investment to initiate development on approximately 470 acres to produce over 3.36 million quarts per annum by year 5.

Appendices

CALVING %

BREEDING COWS (BOY)
CALVES (F)
CALVES (M)
 1 YR HEIFERS
 2 YR HEIFERS
BREEDING COWS (EOY)

MORTALITY
     COWS 2%
     CALVES 10-5%
      1 YR HEIFERS 2%

PURCHASES
     IN-CALF HEIFERS

SALES (QTY)
     CULLED COWS
     MALE CALVES
      2 YR HEIFERS
     MILK (QTYS)

REVENUE ($)
     CULLED COWS
     MALE CALVES
      2 YR HEIFERS
     MILK @ 79¢/QT

TOTAL

AV NO. OF COWS MILK
AV DAILY PRODUCTION
CONCENTRATED FED (L
TOTAL FEED (S.T.)

BAHAMAS LIVESTOCK STUDY
DAIRY HERD DEVELOPMENT - TABLE, PRODUCTION & REVENUE
50 COW UNIT

YEARS	1	2	3	4	5	6	7	8	9	10
		100	70	70	75	75	80	80	80	80
		50	49	47	50	50	50	50	50	50
		25	17	16	19	19	20	20	20	20
		25	17	16	19	19	20	20	20	20
		-	22	16	14	18	17	19	19	19
		-	-	21	16	14	18	16	19	19
		49	48	50	50	50	50	50	50	50
		1	1	1	1	1	1	1	1	1
		5	3	3	3	3	3	2	2	2
			1				1			1
	50									
			1	14	18	18	18	18	18	18
		23	15	15	17	18	18	19	19	19
				3	5	3	7	5	8	8
		186750	99280	105120	146000	146000	146000	146000	146000	146000
	500		500	7000	5000	5000	5000	5000	5000	5000
ea	250	5750	3750	3750	4250	4500	4500	4750	4750	4750
	800			2400	4000	2400	3500	4000	6400	6400
		84330	78430	83045	115340	115340	115340	115340	115340	115340
		90000	82600	96195	128590	127240	128340	129090	131490	131490
		50	34	32	40	40	40	40	40	40
S)		7	8	9	10	10	10	10	10	10
M/DAY)		3	4	5	6	6	6	6	6	6
		22.9	24.8	29.2	43.8	43.8	43.8	43.8	43.8	43.8
	$	3435	3720	4380	6570	6570	6570	6570	6570	6570

PASTURE ESTABLISHMENT 36

ELECTRIC FENCING 100 CH
ENERGY UNIT

BUILDINGS
MILKING PARTOUR 30'x
STOREROOM 10'x10' @
CALF PEN 200 sq.ft
HOLDING AREA/HANDLIN
[

EQUIPMENT
1x2 BUCKET SYSTEM @
1x600 gal.COOLER
1 SPRAY UNIT
1x0.5 h.p DIESEL PU
MISCELLANEOUS BUCKET
FEED BIN 40 TON CAP

WATER SUPPLY
DIGGING 3 WELLS @
[ABSTRACTION

PURCHASE HEIFERS 25 @

CONTINGENCY 10%

BAHAMAS LIVESTOCK PROJE
DAIRY CATTLE CAPITAL COST
25 COW UNIT

@	$1200/ac	43,200
	$ 2.40/chain	452
		159
@	$ 21.00/sq.ft	12,600
	$ 30.00/sq.ft	
	$ 21.00/sq.ft	4,200
CILITIES @ sq.ft]	$ 10.00/sq.ft	5,000
	$1604	3,200
		8,000
		100
		100
T'S SCALE		1,600
f		6,000
	$ 480/ea	1,440
]		
	$1320/ea	33,000
		11,914
		$131,853

PASTURE ESTABLISHMEN

FENCING 556 CH @
2 ENERGY UNITS

BUILDINGS
MILKING PARTOUR
STOREROOM 20'x1
CALF PEN 800 sq
HOLDING AREA/HAN
[2

MACHINERY EQUIPMENT
2x6 HERRING BON
2x600 gal.COOLE
1 SPRAY RACE
1x47 h.p TRACTO
1 FERTILIZER SP
1 PICK-UP
MISCELLANEOUS
1x8.5 h.p DIESE
FEED BIN 40 TO

WATER SUPPLY
DIGGING 7 WELLS
..
PURCHASE IN-CALF HEIF

CONTINGENCY 10%

BAHAMAS LIVESTOCK PROJECT
DAIRY CATTLE CAPITAL COST
100 COW UNIT

		YEAR 1	YEAR 2
144ac @	$1200/ac	120000	52800
	$ 2.40/CH	1335	
	$ 159	318	
'×20' @	$ 21/sq.ft	12600	
@	$ 21/sq.ft	4200	
t @	$ 21/sq.ft	16800	
ING FACILITIES @	$ 10/sq.ft	20000	
0 sq.ft]			
		18000	
SYSTEM @	$8000ea	16000	
[COMPLETE]		8000	
		15000	
WITH TRAILER		4000	
AD		7000	
		1600	
PUMP			
		3360	
	$ 480ea	99000	
S 50 @	$1320	35539	
		384752	52800

VISION
R
RE MAINTENANCE @ $193/ac
: " 5%
DING " 5%
WERY EQUIP MAINTE 10%
RIMARY COST @ $ 80/COW
COST
MILKING COWS
CALF/HEIFER REARING
SERVICE
TATION
ITIES

NO. OF CALVES
$

BAHAMAS LIVESTOCK PROJECT
DAIRY CATTLE-OPERATING COSTS
50 COW UNIT

YEARS	1	2	3	4	5	6	7	8	9	10
	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
	5460	10920	10920	10920	10920	10920	10920	10920	10920	10920
E	-	13895	13895	13895	13895	13895	13895	13895	13895	13895
	-	50	50	50	50	50	50	50	50	50
	-	1700	1700	1700	1700	1700	1700	1700	1700	1700
	-	1900	1900	1900	1900	1900	1900	1900	1900	1900
DW	2000	4000	4000	4000	4000	4000	4000	4000	4000	4000
		3435	3720	4380	6570	6570	6570	6570	6570	6570
		4320	2938	2765	3283	3283	3456	3456	3456	3456
		1250	1250	1250	1250	1250	1250	1250	1250	1250
		300	300	300	300	300	300	300	300	300
	400	1000	1000	1000	1000	1000	1000	1000	1000	1000
	32860	67786	66689	67176	69884	69884	70057	70057	70057	70057

(FEED COSTS FOR CALVES)

	-	50	34	32	38	38	40	40	40	40
	-	4320	2938	2765	3283	3283	3456	3456	3456	3456

50 COW UNIT