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FINAL (68)
REPORT

on

BAHAMAS AGRICULTURAL RESEARCH,
TRAINING AND DEVELOPMENT PROJECT

by

THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PA

under

CONTRACT No. AID/CM/ta-C-73-28
(Contract Period: July 1, 1973 to January 18, 1978)

PROJECT No. 931-11-130-989-73

FINAL REPORT

Prepared By

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and

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A. BASIC INFORMATION

1. Project Title and Contract Number: Bahamas Agricultural Research, Training and Development (BARTAD) Project, North Andros Island, The Bahamas; Contract No. AID/CM/ta-C-73-28.
2. Contractor and Mailing Address: The Pennsylvania State University, University Park, Pennsylvania, 16802 (It is suggested that correspondence regarding the Project be directed to Campus Coordinator, 204 Agricultural Administration Building, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania, 16802).
3. Contract Period: July 1, 1973 to January 18, 1978.
4. Total A.I.D. Funding of Contract: \$2,012,905.
5. Total Expenditures and Obligations:
(Residual funds in this Contract plus \$1,715,420 addition are to be used for extension of Contract until January 18, 1979).

B. SUMMARY OF ACCOMPLISHMENTS

A 500 acre Experiment Station was established with research groups in Agricultural Economics and Rural Sociology, Agricultural Engineering, Agronomy, Animal Science and Horticulture. An office building, machine shop, warehouses, training center, staff houses and other buildings were built and equipped.

A counterpart staff was trained on site and twelve were sent to Penn State University for professional training.

Many research trials were conducted. The results of 57 were published as Final Reports. Emphasis was on forage crops, field crops, grazing of livestock and the economics of livestock enterprises.

Three farmer training courses were conducted and nine pilot test farmers established on 40 and 80 acre family farms. Seven other 40 acre farms have been cleared, houses and fences have been built and pastures established.

C. GENERAL BACKGROUND

Stimulus for this project grew out of the world-wide red meat shortage of the early 1970's. The Bahamas imports approximately 80 percent of it's

food supply with red meats amounting to over \$18,000,000 annually. Thus it was hoped that this project would provide the initial help needed to establish a more viable commercial agricultural sector in the Bahamas. To do this trained people would be needed and scientific research conducted in all phases of agriculture. Hopefully agricultural development will create employment and reduce the dollar exchange needed for food purchases.

D. THE PROJECT OBJECTIVES WERE TO:

1. Establish a Research and Training Center.
2. Develop 16 Pilot Test Farms.
3. Conduct Research on the Best Types of Grasses and Legumes and Conduct Fruit and Vegetable Research.
4. Study the Economic and Marketing Aspects of Livestock Enterprises.
5. Conduct Sociological Research.
6. Determine The Most Economical Means of Bringing Land Into Production.
7. Find Out The Best Pastures and Feed Crops For Livestock Production.
8. Determine The Best Livestock Breeds For The Bahamas.
9. Provide and/or Make Arrangements for Academic Training for Selected Bahamian Candidates.

E. ACCOMPLISHMENTS TO-DATE:

1. Results:

The physical objectives of the Project have all been accomplished, however, there was insufficient time to establish farmers on the last seven farms. Over 57 research trials were conducted to meet the objectives outlined in the Project Agreement. These trials are summarized briefly in Appendix A with a section devoted to each major objective. Detailed results of all research trials have been published in individual reports and copies were submitted to AID. A list of the publications is given in Appendix B. Also, a film has been produced which describes the program and provides some information on results.

The significance of the research results can be summarized in a few brief statements. It is possible to grow many crops successfully. All of the livestock look good and have performed well. Making a profit over total costs of production is very difficult given current conditions, however, several winter vegetable crops look promising. Livestock enterprises with very high levels of management can nearly cover costs, but the G. C. O. B. will need to provide special assistance and perhaps some subsidy to encourage family farmers to expand livestock production.

The biggest negative aspect of the Project was insufficient time to accomplish the stated objectives. Another two years would have obtained results which were more definitive and reliable.

During 1976 AID requested the services of a Penn State staff member assigned to the BARTAD Project to assist in the development of the Cooperative. Although this activity was not a responsibility of Penn State under the original Contract, arrangements were made to permit the Team Member to become Manager of the Cooperative during October, 1976. Since this date, considerable progress has been made by the Coop but it was late in getting established. A copy of the "Report" on the Establishment and Implementation of the North Andros Agricultural Cooperative Society Limited" is provided in Appendix C.

2. Interpretation of Data:

Each research project was fully interpreted and reported in the published findings. This is too complicated to report again, but brief summaries of results are indicated in Appendix A. Copies of published findings have been submitted to AID Washington and G.C.O.B.

3. Project Design:

The basic Project design was satisfactory after the re-organization of the management structure. Gradually the original objectives of a "Cattle Project" were modified to a more meaningful "agriculture for the Bahamas" concept. A five year time frame proved to be inadequate. Seven years would have been much better even with the same total outlay of money. Assuming the G.C.O.B. is still concerned about agricultural development, and it is, the basic Project organization can be carried on in the future with G.C.O.B. funds or by additional funds from other sources. There would be no reason to continue with two prime contractors under most foreseeable objectives. One would be sufficient to provide continuing support with research specialists, consultants and to provide student training in the United States.

Responsibility for the design and implementation of the research during the early phase of the program was handled by an inter-disciplinary group of staff members from Penn State. A core group was selected from the disciplines of Animal Science, Agricultural Engineering, Agronomy, and Farm Management. Others participating in the Program were from Marketing, Rural Sociology, Veterinary Science, and Agricultural Communications. As the research progressed at the BARTAD Site, the activity of this group declined with more responsibility placed on the on-site Penn State and Bahamian scientists. However, with a few adjustments, made mainly to meet the needs of the Project, this group continued as advisors, not only providing needed campus back-up for the program, but also from periodic visits to the Project upon request of the Project Management, to make recommendations on on-going research, training and development activities. These scientists also assisted in the writing of a large number of the publications mentioned previously. The core group also acted as an advisory committee to Penn State in administering the Project.

F. DISSEMINATION OF RESEARCH RESULTS:

1. Use of Findings:

The research results were used during the life of the Project to guide the enterprise decisions and production practices used on the pilot test farms. Some of the findings are now being used by off-site farmers on North Andros. A few students in the farmer training courses have returned to other islands and are using the findings.

Copies of all Final Reports (57) have been sent to USAID, GCOB and are on file at the BARTAD Project Site on North Andros Island. In addition special extension type leaflets are being prepared for dissemination to local farmers. It is hoped that many of the research results will be extended to other islands in the Bahamas through a more active Extension program in the Ministry of Agriculture and Fisheries.

2. New Ways to Expand Use of Results:

Experimental results that appeared promising were immediately put into use on the pilot farms. Few projects have had such a short time schedule for establishing a research station and introducing the results on pilot farms. Researchers of the Station assisted with the transfer of technology to the farms and worked closely with the Farm Superintendent and farmers whenever necessary. Although the use of research results on pilot farms is not new, there was an acceleration of the rate of introduction of results on these farms when compared to most projects.

3. Follow-up with the G.C.O.B.:

Approximately \$500,000 of unexpended funds will remain on January 18, 1977. Approximately \$335,000 of this is for use in extending the technical assistance portion of the program. A proposal was made to extend the contract with Penn State University for one year. The funds will be used to support three professionals and numerous short time consultants for one year in areas which will be of most use to the Project. Emphasis will be placed in the areas of horticulture, field crops and extension. Also all students studying in the United States will receive support for one more year, if necessary in their programs.

G. STATEMENT OF EXPENDITURES AND OBLIGATIONS:

Salaries of personnel and costs associated with overhead, fringe benefits and allowances comprised the greatest proportion of the expenditures under the Contract. Personnel assigned to the BARTAD Project and time of assignments are shown on Table 1. The distribution of personnel assigned to Andros Island is noted in Table 2. The number of field staff assigned to the Bahamas gradually increased during the period of the Contract. The increase in number of positions started during the second year when an

Agricultural Economist was added. During the third year a Chief-of-Party (and Research Director) was added. Positions of Farm Superintendent and Cooperative Manager were included during the fourth year. Expenditures shown in Table 4 reflect the increases in personnel assigned to the BARTAD Project during the Contract period.

The AID Project Manager requested Penn State to purchase some livestock during the second year and fertilizer during the second and third years under our Contract. However, all later purchases of these items were handled by the Western Institute of Science and Technology in accordance with their AID Contract, although Penn State personnel were involved in the selection of all livestock purchased for the Project, and also indicated the analyses of fertilizers purchased.

Participant training under the Project got underway in September 1974 with the greatest influx of training activity occurring during the fourth year (Table 3). Difficulty was encountered in finding Bahamians trained in agriculture for participating in the degree training programs in the U.S. By the fourth year, ten Bahamians were enrolled at Penn State for training and nine were enrolled during the fifth year. These numbers of participants are reflected in increased participant costs during the last two years of the Project (Table 4).

A significant change in project management occurred early in the third year of the Project. The position of AID Project Manager was shifted from Washington to the Project Site on Andros Island. At that time, Penn State was permitted to have a Chief-of-Party and Research Director. This change permitted better liaison between all parties concerned and all aspects of the program functioned more smoothly following this reorganization.

H. APPENDICES:

Appendix A - Discussion of Accomplishments in Relation to Project Objectives.

Appendix B - List of Publications Issued During Contract Period.

Appendix C - Report on the Establishment and Implementation of the North Andros Agricultural Cooperative Society Limited.

Table 1. Personnel of The Pennsylvania State University assigned to BARTAD Project.

<u>Name</u>	<u>Area of Expertise</u>	<u>Dates of Assignment</u>
Mr. Garry Allshouse	Agricultural Engineer	7/7/73-11/10/73
Mr. Newton Bair	Farm Superintendent	3/7/76-1/18/78
Dr. Charles Haines	Animal Scientist	7/16/75-1/31/77
Mr. David Johnson	Agricultural Engineer	1/11/76-1/18/78
Mr. Theodore Katsigianis	Animal Science	1/10/77-3/7/77 3/20/77-8/2/77 8/15/77-1/18/78
D. Leonard Kyle	Agricultural Economist, Chief-of-Party and Research Director	1/1/76-10/14/76 10/15/76-1/18/78
Mr. William Lazarus	Agricultural Economist	1/1/77-1/18/78
Mr. William Elliot	Agricultural Engineer	3/1/74-9/30/75
Dr. Ronald Guyton	Agronomist (Forages)	8/6/73-1/18/78
Mr. Daniel Orr	Animal Scientist	7/1/73-6/30/75
Dr. J. Harold Stern	Agronomist (Soils & Crops)	3/1/74-2/29/76
Dr. John Thompson	Agronomist (Crops)	3/1/76-9/30/77
Mr. Laurence Yager	Agricultural Economist Chief-of-Party & Research Director Cooperative Manager	4/29/74-2/28/75 3/1/75-10/14/76 10/15/76-1/18/78
<u>SHORT TERM ADVISORS</u>		
Dr. John Baylor	Agronomist (Forages)	*
Dr. Donald Crider	Rural Sociologist	*
Dr. William DeTar	Agricultural Engineer	*
Mr. William Folwell	Communications	*
Dr. Samuel Cuss	Veterinarian	*
Mr. Frederick Hughes	Farm Management	*
Dr. Willis McClellan	Agronomist	*

Table 1. cont'd

<u>Name</u>	<u>Area of Expertise</u>	<u>Dates of Assignment</u>
Mr. H. Louis Moore	Marketing	*
Mr. Frank Peikert	Agricultural Engineering	*
Dr. Lowell Wilson	Animal Science	*
<u>ADMINISTRATIVE & SUPPORT STAFF (Campus Based)</u>		
Dr. R. H. McAlexander	Campus Coordinator (Part time)	7/1/73 - 1/18/78
Dr. R. H. Cole	Assistant Coordinator (Part time)	7/1/73 - 3/31/76
Mrs. Gladys Dibble	Secretary	7/1/73 - 1/18/78

* Short-Term Advisors spent from 2 - 12 weeks per year on assignments in the Bahamas or at the Campus with the BARTAD Project; Trips to the Bahamas were made upon request from Project Management.

Table 2. Man Months of Field Staff Provided by The Pennsylvania State University for BARTAD Project during the Period of July 1, 1973 through January 18, 1978.

Discipline	Year 1	Year 2	Year 3	Year 4	Year 5
	7/1/73 - 12/31/73	1/1/74 - 12/31/74	1/1/75 - 12/31/75	1/1/76 - 12/21/76	1/1/77 - 1/18/78
Chief-of-Party & Research Director	--	--	10	12	12.5
Agronomist (Forages)	4	12	12	12	12.5
Agronomist (Soils & Crops)	--	9	12	12	10
Animal Scientist	6	12	12	12	11.5
Agricultural Economist	--	8	2	12	12.5
Agricultural Engineer	4	9	10	12	12.5
Farm Superintendent	--	--	--	12	12.5
Cooperative Manager	--	--	--	3	12.5

Table 3. Bahamian Participants Handled by Penn State During Period of July 1, 1973 through January 18, 1978.

Participants by Disciplines	1973 Year 1 (July-Jan.)	1974 Year 2	1975 Year 3	1976 Year 4	1977 Year 5
Agronomy	--	--	2	4	3
Plant Protection	--	--	--	1	1
Animal Science	--	--	2	3	2
Agricultural Economics	--	--	--	2	2
Cooperatives	--	--	--	--	1

Note: See Appendix A for more detailed information on Participant Training Programs

Table 4. Expenditures by Major Categories Under The Pennsylvania State University Contract for Period July 1973 Through January 18, 1978.

<u>Category</u>	Year 1 July - Dec. '73	Year 2 Jan. - Dec. '74	Year 3 Jan. - Dec. '75	Year 4 Jan. - Dec. '76	Year 5 ¹ Jan. 1, '77 Jan. 17, '78	Total
SALARIES	\$33,896	\$108,170	\$124,392	\$174,662	\$209,504	\$ 650,624
OVERHEAD	12,050	39,506	49,049	63,548	80,091	244,244
FRINGE BENEFITS	3,640	12,633	19,813	34,029	40,370	110,485
TRAVEL & TRANSPORTATION	10,206	33,069	19,760	23,169	34,040	120,244
ALLOWANCES	5,200	52,775	54,335	76,245	77,609	266,164
OTHER DIRECT COSTS	1,567	7,139	17,854	9,323	13,470	49,353
LIVESTOCK	---	49,225	---	---	---	49,225
FERTILIZER	---	44,961	34,817	---	---	79,778
PARTICIPANT TRAINING	---	<u>2,102</u>	<u>17,091</u>	<u>56,345</u>	<u>69,765</u>	<u>145,303</u>
	\$66,559	\$349,580	\$337,111	\$437,321	\$524,849	\$1,715,420

¹Amounts indicated are for actual expenditures plus obligations (a few final billings for the period have not been received for final processing at date of preparation of this report and estimates have been made).

Appendix A

DISCUSSION OF ACCOMPLISHMENTS AND INTERPRETATION OF DATA IN RELATION TO PROJECT OBJECTIVES

I. ESTABLISHMENT OF RESEARCH ENTER ON ANDROS ISLAND (Objective No. I)

Introduction:

An agreement was signed on January 19, 1973 between the United States Agency for International Development and the Government of the Commonwealth of the Bahamas to establish the Bahamas Livestock Research and Development Project. This agreement was for five years and involved a commitment of \$10,000,000 from the United States. The Government of the Bahamas was to provide a 2,000 acre site, professional assistance and some matching funds.

Early Development:

It took until August 1973 for a site to be selected and clearing to begin. By this time two prime contractors had been committed. The Pennsylvania State University was to provide the research scientists for the research activities and the Western Institute for Science and Technology of Waco, Texas was to provide the logistical support and business organization. The first full time professional workers arrived in July, 1973 although several consultants were on North Andros earlier and a Preliminary Resource Survey Committee met at Nicoll's Town in early May, 1973.

By October, 1973 150 acres of pine land had been cleared, however it was the spring and summer of 1974 before the first research plots of grasses and legumes were planted. At the same time production pastures were planted for livestock feed.

The first animals to arrive were horses on April 19, 1974. These were kept off site on leased property. On June 26, 1974 the first shipment of 43 cattle arrived from the Callan and King Ranches in Texas. Five sheep were received from the Central Agricultural Station on December 11, 1974 but the first big shipment of 75 sheep and 15 goats from Eleuthera did not arrive until April, 1975.

Early Project Management was divided between USAID Washington, the Ministry of Agriculture and Fisheries, Nassau and a resident manager on site plus the involvement of the personnel from Penn State and W.I.S.T. By October, 1974 a detailed Project plan of work was completed. A complete re-alignment of managerial responsibility which vested more decision making power in two on-site project Co-Directors was made during the second year. One Co-Director represented USAID and the other GCOP. In addition arrangements were made for Penn State to have a Chief-of-Party who also was designated as Research Director.

The Research Program in 1977:

During 1977 over fifty research projects were underway in five discipline areas. The original concept of a "Livestock Project" gave way to a broader based mixed agricultural concept during later 1975. The following research areas were included:

1. Agriculture Economics and Rural Sociology: Research in this area has concentrated on an analysis of costs. This includes enterprise analysis for all crops and livestock grown. Also studied has been the costs of clearing land, irrigation, fencing and the costs of using machinery. Research in Bahamian attitudes and aptitudes toward agriculture has been done. Also studies of households to learn more about eating habits and food preferences has been completed. Feasibility studies in the marketing area have been done on livestock slaughter facilities, feed milling facilities, packing shed facilities for fruits and vegetables and marketing products to the resort hotel trade.

2. Agriculture Engineering: Besides the work done on land clearing, research in ground water hydrology was designed to monitor the fresh water lens. Also accurate daily records of temperature, rainfall, wind speed and hours of sunlight were recorded and analyzed.

3. Agronomy: Early in the life of the Project many of the important tropical grasses and legumes were tested in small plots. The better yielding varieties were planted in one acre blocks and then eventually in large fields. Forage samples were taken to check yields and quality of the forage. Also grazing trials were established with cattle and sheep. Two years of data have been accumulated for some trials. Small plot research in field crops has emphasized corn, grain sorghum and soybeans. The main effort has been to find the high yielding varieties which will do well under local conditions. In the process, varieties provided by international research centers have been used. A small amount of work has been done with pigeon peas, peanuts and cassava.

4. Animal Science: Currently the experiment station has over 201 Santa Gertrudis cattle, 482 sheep and 115 goats. The foundation cattle were imported from Texas. Most of the original female sheep and goats came from other family islands in the Bahamas and are bred using imported males to increase the size and quality of meat in the off-spring. In addition to gaining valuable data on weaning weights, rate of gain, etc., many of the animals are being used in grazing trials to determine which forage species will produce the most meat. Animals on these trials were weighed monthly.

5. Horticulture: Research blocks of several varieties of all of the common citrus fruits, mangoes and avocado trees have been planted. All are being irrigated with a "drip" irrigation system. Important research in varieties and date of planting is being carried on for all of the common winter vegetable crops.

The Physical Plant:

Approximately 515 acres have been cleared and developed as a site for the Experiment Station. In addition there are small areas used as sites for the training center, eight staff houses and a apartment house with eight units for single staff members. Roads were built and most of the fields are fenced and have wells either for irrigation or watering livestock. A communication system has been installed, also electric lines.

The following buildings and facilities have been constructed:

1. Headquarters office
2. Eight staff houses
3. Eight unit apartment house
4. Training center
5. Machine shop
6. Fertilizer warehouse (400-500T)
7. Supply and parts warehouse
8. Crops drying and processing building
9. Livestock corrals.

Converted trailers are being used for:

1. Animal Science field office
2. Animal Science supply shed
3. Agronomy field supply shed
4. Horticulture field supply shed.
5. Pesticide storage shed.

II. DEVELOPMENT OF SIXTEEN PILOT TEST FARMS (Objective No. 2)

Introduction:

The end product of an effort in agricultural research and development is the establishment of viable farms and the resulting expansion in agricultural output. Thus the original Project Agreement provided that sixteen family-sized farms should be established. This proved to be a major undertaking within the five year time frame of the project. Considering that the Project started with the clearing of "raw" pine land, it has been a major accomplishment to have progressed so far in such a short time span. Land has been cleared and prepared, houses and fences built, wells drilled and pastures established for 16 farms.

A. Pilot Test Farm Research:

The plan was to utilize the Pilot Test Farms as a means of testing both the research data and training programs of the Project. The first year farmers were under probation. All inputs, machinery services and technical assistance was provided by BARTAD. Farmers were guaranteed a net income of \$100 per week. Records were kept of all income and expenses and quarterly statements of accounts compiled. After each year of operation a detailed farm business analysis summary was completed for each farmer. Since only four farmers completed two years of operation and five farmers completed one year, this research was severely hampered by the short time frame of the project. The last seven farms will be settled just prior to the projects completion if applicants are available and approved by the G.C.O.B. Hopefully this developmental part of the Project will be continued by the G.C.O.B. during 1978 and 1979.

A complete description of the history and development of the Pilot Test Farms has been published in Final Report #49.

B. Pilot Test Farm Evaluation:

1. Production Increase

On a basis of expanded agricultural output the Pilot Test Farm development was moderately successful. During 1976 and 1977 approximately \$75,000 of produce and livestock were sold.

2. Economic Viability:

By the end of 1977 none of the farms had demonstrated that it would generate sufficient income to cover all costs of production especially when the use cost of all investments is included. If the government would provide the initial investment and then rent the unit to a farmer for a nominal rent for twenty years, it would be possible for these farm families to generate a positive net cash income which would cover modest family living expenses. The business and financial analysis for the first four farms was published in Final Report #51.

3. Recruitment of Farmers:

Although a major effort was made by the Ministry of Agriculture, it was very difficult to generate interest in very many people who could be developed into successful livestock farmers. One farmer in the first four was terminated after about six months because of his failure to sign the operating agreement. Another in this group passed probation after much discussion and a close vote by the Mid-Level Management Committee. Another farmer had his probationary year extended for three months before management decided that he had passed probation and was on his own. The last five farmers have progressed reasonably well, however, one definitely has some personal problems. Two have demonstrated considerable potential as independent future operators.

4. Managerial Ability:

The people recruited as farmers have had very little previous experience with commercial agriculture, mechanized farming or handling of livestock enterprises. Thus it should be no surprise that their managerial skills are relatively low for the level required for successful operation. Modern agriculture has progressed so far that it may be very difficult for Bahamian farmers to "catch up." Thus trying to establish competitive, profitable, commercial ventures may be held back by the lack of people who can be attracted into agriculture. For those who do plan to begin farming, the Government of the Bahamas will need to furnish competent, highly trained technical personnel to advise farmers on new technology and improved management.

5. Production Efficiency:

For many reasons the Pilot Test Farmers have demonstrated a wide gap in production efficiency as compared to the results obtained by the BARTAD research personnel. This has been very striking in the carrying capacity of pastures for livestock and livestock productivity. Skilled management does make a difference.

6. Financial Returns:

The first four farms generated produce and livestock sales ranging from \$4,182 to \$15,246 for the second year of operation, from October, 1976 to September, 1977. In addition, all farmers returned livestock to BARTAD. The farmers received some inputs from BARTAD and others from the farmer cooperative.

The return for labor and management of the operator and his family ranged from \$-7,536 to \$11,293 after subtracting cash expenses, operating accounts, and GCOB rental and ownership costs of capital assets owned by the farmers. The high looks quite favorable while the low give reason for grave concern. (See Final Report #51)

Financial Summary - First Four Farmers-Second Year of Operation.

	Average
Produce and Livestock Sales	\$11,318
Value of Livestock herd increase and growing crops at end of second year	7,040
Total farm income	<u>\$18,358</u>
Total costs of production including rental cost of capital assets.	<u>\$16,560</u>
Labor and management income	\$ 1,798
Average capital investment (80 acres)	\$79,790

Second Five Farms - First Year of Operation.

Produce and Livestock Sale	\$ 3,474
Operating expenses	7,917
Net return over operating expenses	<u>\$-4,443</u>
Average capital investment (40 acres)	\$49,493

7. Staff Evaluation of Nine Pilot Test Farmers.

Fourteen BARTAD staff members used a 22-item questionnaire to evaluate the first nine Pilot Test Farmers in July of 1976. Numerically the farmers as a group rated 2.6 on a scale of four. This was considered to be on the high side of fair. Individually, they ranged from an average score of 1.7 to 3.4. The implications of this study, published as Final Report #52, should be drawn with extreme caution. However four of the nine farmers appear to be better than their peers.

III A. RESEARCH ON THE BEST TYPE OF GRASSES AND LEGUMES FOR NORTH ANDROS (Objective No. 3)

Introduction:

Since the establishment of livestock enterprises was a primary goal of the BARTAD Project, some of the first research trials were designed to determine the best yielding types of grasses and legumes. This was needed to form the feed base for forage consuming livestock. During the summer of 1974 research plots of grasses, alfalfa and tropical legumes were established. The soils and growing conditions are quite similar to those found in Dade County Florida.

Soils and Weather

Soils at the BARTAD site are composed of oolitic limestone sediments formed during the Pliocene Era. Solution of the limestone by rain and sea water during the ice age resulted in the typical flat topography containing numerous sink holes and solution channels. The water table at the experimental site is approximately 4 feet below the soil surface. (See Final Report #44).

The pH values of the soil on site range from 7.8 to 8.2. Typically for the site soil phosphorus levels are very low, potassium levels are low to medium, calcium levels are very high and magnesium levels medium. Typical soil levels of several micro-nutrients are: aluminum .20 ppm (very low), manganese 3.00 ppm (very low), iron 10.00 ppm (low), copper 14.00 ppm (normal), zinc less than 20.00 ppm (low) and sodium less than 50.00 ppm (normal).

Precipitation at the site is normally 46-52 inches annually with the dry season beginning in December and ending in May. However, seasonal rainfall from year to year may be highly variable and has a marked influence on total and seasonal crop production. (See Final Report #53).

Grass Species Evaluated:

The following grass species have been evaluated using two years of harvest data:

<u>Scientific Name</u>	<u>Common Name & Variety</u>
1. <i>Panicum maximum</i>	Common Guinea grass
2. <i>Panicum maximum</i> var. <i>trichoglume</i>	Green Panic
3. <i>Panicum antidotale</i>	Blue Panic
4. <i>Setaria anceps</i>	Kazungula Setaria
5. <i>Setaria anceps</i>	Nandi Setaria
6.	Brown seeded Paspalum
7. <i>Paspalum plicatum</i>	Rodds Bay Paspalum
8. <i>Cenchrus ciliaris</i>	Numbank Buffelgrass
9. <i>Cenchrus ciliaris</i>	Gayndah Buffelgrass
10. <i>Cenchrus ciliaris</i>	Biloela Buffelgrass
11. <i>Cenchrus ciliaris</i>	T4464 Buffelgrass (unhulled)
12. <i>Cenchrus ciliaris</i>	T4464 Buffelgrass (hulled)

13. Paspalum dilatatum	Dallisgrass
14. Melinis minutiflora	Mollisses Grass
15. Brachiaria decumbens	Signalgrass
16. Panicum coloratum	Selection 75 Kleingrass
17. Chloris guyana	Common Rhodesgrass
18. Paspalum notatum	Paraguayan 22 Bahiagrass.

The results of this research trial are fully documented in Final Report #21 "Performance of Several Perennial Grass Species and Varieties Propagated by seed at the BARTAD Project". These results indicate that with adequate fertility and management at least nine of the tested grasses will produce an average of 4.5 or more tons dry matter per acre per year. These grasses are: Signalgrass, Rhodesgrass, Guineagrass, T-4464 Buffelgrass, Rodds Bay Paspalum, Brown Seeded Paspalum, Biloela Buffelgrass, Green Panicgrass, and Numbank Buffelgrass.

Based on initial observations from this trial a total of nearly 210 acres of the BARTAD site and 265 acres of the pilot test farms have been sown using T-4464 uffelgrass, Green panicgrass, Guineagrass, and Rhodesgrass. These grasses have usually been sown in mixtures containing one or more of the grasses and one to three legumes. These mixtures have appeared to be quite productive and have produced a very good rate of gain in cattle, goats, and sheep.

Alfalfa Varieties Evaluated:

Prior to the initiation of the BARTAD Project there was no history of growing alfalfa on the limestone soils of the Bahamas. However, because of it's deep root system and the presence of water at a 4-5 foot depth, Penn State Scientists felt that this species might have potential as a productive, high protein pasture and hay legume for both cattle and sheep on Andros Island.

Five varieties were evaluated over a two year period. These were Mex-Son R. Mesa-Sirsa, Sonora 70, Hayden and Mex-Son. The full report of this research was published in Final Report #19 "Performance of Five Alfalfa Varieties at the BARTAD Project."

The results of this study indicated that with adequate fertility and management adapted alfalfa varieties will yield eight to nine tons of dry matter per acre per year for at least two and possibly three harvests years, with nearly 50 percent of that production occurring during the cooler, dryer months of the year.

Of the five varieties evaluated, Mesa-Sirsa and Hayden appeared to be more persistent and were similar in yield and quality. Thus, until more information is available on other varieties, these two varieties should be used on pilot test farms and other farms on the Island.

Based on initial observations from this trial a total of nearly 175 acres of either alfalfa or alfalfa-grass mixtures have already been sown on the research station and pilot test farms to the Mesa-Sirsa variety. To date there is no evidence of any serious variety related disease or insect problems. Nevertheless it would be desirable to include at least one more variety (Hayden) in any future seed orders.

Another trial comparing several alfalfa-grass mixtures has also been completed at BARTAD. While Mex-Son was the alfalfa variety used in that trial there were several mixtures that produced dry matter yields equal to or superior to yields of pure alfalfa. Quality-wise, protein levels of mixtures were two to three percent lower than straight alfalfa but IVDMD levels were similar. From a management standpoint, therefore, it would seem that either straight alfalfa or suitable alfalfa-grasses mixtures can be grown for hay. However for pasture the inclusion of a compatible grass would be desirable.

Alfalfa Grass Mixtures Evaluated:

Five alfalfa-grass mixtures were evaluated which could be used for pasture or hay. This experiment was reported in Final Report #20. Mex-Son alfalfa was combined with Buffelgrass, Green Panicgrass, Guineagrass, Rhodesgrass, and Setaria. All are perennial grasses adapted to warm climates.

The results of this study indicate that with adequate fertility and management, mixtures of adapted varieties of alfalfa and grass will yield 6 1/2 to 8 1/2 tons of dry matter per acre for at least two and possible three harvest years. From 30 to 50% of this production would occur during the cooler, dryer months of the year.

Of the five mixtures evaluated, T4464 Buffelgrass and Kazungula Setaria were the highest yielding. Both of these mixtures appear suitable for either grazing or hay making.

Evaluation of Vegetatively Propagated Grasses:

This experiment evaluated ten vegetatively propagated grasses. The detailed summary was reported in Final Report #22. The grasses included were:

- Bigalta
- Redalta
- Paragrass
- African Stargrass
- Pangola
- Ruzigrass
- Coast Cross 1
- Transvala
- Stargrass 2341
- Palisadegrass

The results of this study indicates that with reasonable fertility and management several of the vegetatively propagated grasses have the potential to yield 5 or more tons dry matter per acre per year with Bigalta being the most productive. Over a 2 year harvest period, the top yielding vegetatively propagated grasses and the top yielding grasses established from seed were very similar.

In general crude protein values, even when fertilized with approximately 300 pounds per acre per year of nitrogen, would be considered inadequate except for non-lactating beef cows and ewes. While there was considerable variation in IVDMD values for the various grasses, Bigalta appeared to be consistently high whereas Stargrass and Bermudagrass were usually low.

On the basis of this and other studies at BARTAD, Bigalta and African targrass would be considered two of the most promising vegetatively propagated grasses for use on Andros. The advantage of these grasses over seeded grasses would be that planting material could be made available from nurseries maintained on the research station. The disadvantage is the high labor input required for establishment. In any case, if these grasses are used for pastures on Andros, they should be established in combination with legumes such as Siratro, Greenleaf Desmodium, or Glycine.

Evaluation of Four Cultivars of Elephantgrass:

Four cultivars of Elephantgrass were evaluated in an experiment. These included Common, Merker, Merkeron and U.S.D.A. Experimental (from A.J. Oakes).

The results of this study indicated that dry matter yields from 5 to 6 tons per acre per year could be expected under normal conditions. These yields are comparable to those from other vegetatively propagated grasses. The details of this experiment are reported in Final Report #23.

Several small fields of Elephantgrass have been established on the research station (approximately 20 acres total) and grazed with cattle. To date the forage production from these fields does not appear to equal the production of many of the other grasses or grass-legume pastures on the farm.

Based on the results from small plot trials, field observations, and the amount of labour needed to plant Elephantgrass, it appears that under Androsian conditions Elephantgrass should not be considered for pastures since other grasses can be established easier and will produce equal or better yields.

One possible problem with using the cultivar Merkeron is that under Androsian conditions it produces viable seed which can be spread several hundred feet by wind. This feature makes it a potential weed.

Evaluation Of Harvest Interval And Nitrogen On Yield Of Forage:

This experiment evaluated the effects of harvest interval and nitrogen fertilization on Green Panic Grass as compared to legumes to improve production. The legumes planted with Green Panic Grass were Centro, Siratro and Stylo. The results of this trial were published in Final Report #25.

The results indicate that with weather conditions such as those during the sixty weeks of the experiment, irrigation did not significantly increase the total dry matter production of any of the four species grown. In fact, irrigation reduced the percentage of Townsville Stylo in a grass + Stylo mixture because the Stylo seedlings died and therefore reduced the yield of the mixture.

A 3-week harvest interval resulted in the highest total yields of dry matter, digestible dry matter, and protein for all of the four species used. The difference in yield, protein and digestible dry matter would not be significantly different between irrigation and non-irrigation treatments except in the case of a grass + stylo mixture and then it would be significantly higher when not irrigated. For an Andros farmer the best forage in this trial would be non-irrigated Green Panicgrass plus Siratro harvested or grazed every three weeks.

Tropical Forage Grass Responses To Nitrogen:

This trial evaluated the response of Transvala Digetgrass, Elephantgrass and Guineagrass to several sources and rates of nitrogen fertilization. The complete results have been published in Final Report #43.

The results of this study indicate that on newly cleared land with high rates of nitrogen (800 lbs/A/yr), plus high rates of phosphate and potash, together with an intensive cutting management system, grasses such as Transvala Digetgrass have the potential to produce 9 or more tons of dry matter per acre per year. It must be emphasized, however that a total of 700, 440 and 440 pounds/A of N, P₂O₅ and K₂O respectively were applied to this area during the three months prior to the initiation of the study. In addition to the N treatments another 800 pounds/A of P₂O₅ and 600 pounds/A of K₂O were applied in 10 equal applications during the course of the study.

Of the 3 grasses evaluated in this study, Transvala was the most productive. In a later BARTAD study comparing the performance of several vegetatively propagated grasses (Final Report #22) Bigalta (*Harmarhria Altissima*) and Common Pangola (*Digitaria Decumbus*) both outyielded Transvala. During the first year of a 2 year trial Bigalta, Pangola and Transvala averaged 9.7, 7.1 and 6.0 tons/A of dry matter respectively. Rates of N, P₂O₅ and K₂O applied in the latter study (establishment plus maintenance) were approximately 425, 500 and 375 pounds/A respectively. These results suggest that under similar extremely high fertility levels other grasses such as Bigalta and Common Pangola may produce higher yields than those reported here.

Nitrogen recovery in terms of yield and nitrogen level in plant tissue decreased as the nitrogen level increased. In all three grasses the nitrogen recoveries of sulphur coated urea and ammonium sulphate were similar, even though the ammonium sulphate was applied five times more frequently. As found in other studies, seasonal variation on dry matter yield of these grasses was marked. Periods of low production occurred in winter and late summer.

Crude protein levels increased with increased nitrogen application on all 3 grasses, with the increase of crude protein with increased nitrogen generally less marked at lower nitrogen application levels. Increasing nitrogen levels also tended to increase the digestibility of Transvala and Guineagrass, but not of Elephantgrass.

Observations On The Performance of Tropical Legume Pastures:

The legumes which appear to be the best for long term pasture are Greenleaf Desmodium, Siratro, and Tinaroo Glycine. There are several others which can also be used for long term pastures but may not be quite as productive. These are Stylo, Verano Stylo, Townsville Stylo and Leucaena. All of the legumes named above can be grown in mixtures with other legumes and grasses or in pure stands. At the BARTAD Project a total of approximately 530 acres has been planted using mixture or pure stands of the aforementioned legumes. Siratro and Tinaroo Glycine have been planted on a much larger acreage than

Greenleaf Desmodium but this is due only to availability of seed. Lablab can be used for short term pastures or as a green manure crop. The local cultivar of Lablab has been used on the research center and the pilot test farms for both of these purposes. It has performed satisfactorily when given adequate levels of fertilizer. Leucaena, especially the cultivar Hawaiian Giant, appears to have potential for use as windbreaks along vegetable fields.

The above research was published as Final Report #24.

III B. FRUIT AND VEGETABLE RESEARCH (Objective #3)

Introduction:

Early Project emphasis was on pasture research and the introduction of livestock. Eventually plans were made to establish family farms with other enterprises to combine with livestock. Such a system would permit better utilization of labor and provide a quicker cash flow from vegetable crops.

Establishment of An Orchard:

Citrus orchards have been important enterprises in the Bahamas since the 19th century. However production does not match the current domestic demand. Soil conditions on Andros are similar to Dade County, Florida. Minimum temperatures are usually higher. Thus an expanded research effort should be made at the BARTAD station.

In the latter part of 1975 an experimental orchard was established. The following number of varieties of each species were planted:

Limes - 3	Tangerine - 2
Lemon - 1	Mango - 4
Orange - 4	Avacado - 4
Grapefruit - 3	

The orchard was pruned, fertilized and irrigated with a drip system. Regular applications were made of insecticides and fungicides to control pests and diseases. Records were kept of growth characteristics. The complete details of this research have been published as Final Report #35.

Vegetable Research:

In the summer of 1975 a decision was made to begin research for vegetables. Many questions relating to the choice of species, varieties, date of planting and other practices did not seem to be well known. On October 28, 1975 the first plantings were made. These were continued on a monthly basis until hot weather made production impractical. All crops were irrigated and protected from pests and diseases using the best information available.

In November 1976 another set of irrigated winter vegetable trials was started. These continued through the spring. By this time considerable new information was available to use in the selection of crop varieties to plant on pilot test farms. The complete results of this vegetable research has been published in Final Report #36.

Economic Analysis of Vegetable Enterprises:

Nine crops were grown by Pilot Test Farmers to provide some economic evaluation of their profitability. These results were summarized in Final Report #38.

Vegetable production can be profitable on Andros. Yields and prices will be the major determining factors as to whether a particular crop is profitable. Yields should increase as farmers improve their management techniques and practices. Yields have been quite variable. Some crop yields may improve while others decline as pest problems change. At present import and consumption levels, cabbage and tomatoes have the greatest potential for profitable increased production. Cucumbers, field corn and squash are profitable but the market is limited. Irish potatoes, onions and sweet peppers have a large potential market but improvement in yield and price will be necessary for profitable production. Marketing, including the development of export markets, might become important as crop acreage increases. An export market will increase the need for quality produce.

IV A. ECONOMIC ASPECTS OF LIVESTOCK PRODUCTION AND MARKETING (Objective #4)

Introduction:

This initial and main focus of the original project agreement between USAID and GCOB stressed the importance of trying to establish viable systems of livestock production in the Bahamas. In fact the project was called "The Livestock Project" during the first two years. This emphasis is understandable as the Bahamas imports over \$18,000,000 of beef, pork, goat, mutton and lamb annually. This includes processed products. Thus any effort to expand agricultural output must consider the economic feasibility of establishing new livestock enterprises.

Traditionally not many livestock have been raised in the Bahamas. Although statistics are generally not available, swine are the most common, being raised on imported feed or garbage and waste products. Beef cattle are practically non-existent. There are several small flocks of sheep and goats on some of the out islands. When the Project tried to buy native sheep and goats from Bahamian sources, many problems were encountered both in quantity and quality. During 1975, 5,251 hogs, 1,103 sheep, 737 goats and 291 cattle were slaughtered at the abattoir in Nassau. Many people keep and slaughter a few animals in their backyards. This includes all species except cattle. Relatively few Bahamians have had any experience handling livestock in commercial operations. This includes animal care and management as well as the problems associated with establishing and managing improved pastures.

The BARTAD Project Experience:

The first efforts of the Project were to clear land and to establish research trials which would guide decisions for establishing pastures for livestock. It was the summer of 1974 before grass, tropical legumes and alfalfa species trials were started. The following summer some vegetatively propagated grass trials were planted.

Sufficient production pastures were available on the Project to introduce cattle in June of 1974. Thirty-four Santa Gertrudis heifers and six cows with calves made up the initial shipment. A few sheep from the Central Agricultural Station, New Providence arrived in December, 1974. In April of 1975, 73 sheep and 15 goats were obtained from North Eleuthera. Other animals were purchased and the herds expanded during the remainder of the Project. By October 1, 1977 there were 201 cattle, 482 sheep and 115 goats at the Project site valued at \$142,060. In addition, Pilot Test Farmers had 128 hogs, 330 sheep and 204 goats. These were valued at \$50,518.

From the initial grass and legume research plot results, species and combinations were selected for establishment as livestock grazing trials. By late 1975 two trials were in progress. During 1976 seven additional livestock grazing trials were established mainly using cattle and sheep.

In the late spring and summer of 1976 the first cattle, sheep and goats were placed on Pilot Test Farms. It was September 1976 before a decision was made to place hogs on one farm using imported feed. Numerous attempts to establish a home-raised feed base of corn or grain sorghum on Pilot Test Farms have not been successful.

Experimental Results:

During most of the year visitors to the Project were surprised at the abundance and quality of the Project's pastures. Also the livestock herds are in excellent condition and seem to be expanding rapidly. Many problems of production and management for both pastures and livestock have been overcome. The results of the research on pastures and livestock are summarized in many final reports which are listed in Appendix B. These results demonstrate what can be done with sufficient expertise and money. The real issue still must be resolved. Can family operated Bahamian farms produce livestock at a profit? Or what conditions of subsidy or support from the Bahamian Government will be necessary to insure an expansion of the production of livestock products?

The Difficulties of Accurate Evaluation:

An accurate evaluation of the long range economic feasibility of livestock enterprises in the hands of typical Bahamian farmers is difficult, especially with the limited information available. Different analysts could interpret and utilize this information with divergent results. Thus a knowledge of the problem areas and issues is important.

Inadequate Research Time

By the end of the five year contract period, only one year of research grazing trials will have been completed and analyzed. Two years of basic agronomic research will have been completed on pasture grasses and legumes. Four Pilot Test Farms will have completed two years of effort, but livestock operations span only 18 months and only one dry, cool winter season (1976-77). This produced the lowest January temperatures on record. Since weather patterns vary, there is no assurance the pasture carrying capacity estimated are accurate for the next five years. Several more years of experience would answer this question. Fertilizer needs and pest problems will also change after farming has progressed for several years. An additional problem of evaluation existed since the pastures for the first four farms were established on poorly prepared ground in late October. Thus they poorly established by May when stocking began.

Evaluation of Managerial Capacity

Any evaluation of economic feasibility presupposes a given level of managerial ability in handling livestock and pastures. This ability in typical farmers has been observed to be low. Also it is known that learning these skills takes considerable time and experience. The limited data available have demonstrated a much wider gap between research levels of accomplishment and Pilot Test Farmers than would be true in the United States. For example, the BARTAD pastures have been managed to carry approximately twice as many livestock as on the Pilot Test Farms. Since feed costs represent 75-80 percent of the cost of producing cattle, sheep and goats, this productivity factor and the cost of producing pasture more or less determines the answer for profits. In the final analysis the question is how many farmers can approach the levels of efficiency achieved at the Experiment Station or, if not, what lower level of efficiency should be expected. This will be partly determined by the quality and quantity of technical assistance and support given by the Government's Extension Service. All research analyses completed to-date have used efficiency levels quantified from research trials, pilot test farms or an assumed intermediate level which hopefully Bahamian farmers will be able to achieve.

The Market and Price Factor

Currently there is no organized livestock market in the Bahamas which will buy farmers production at a competitive price. A few surplus animals on Andros Island can be slaughtered and sold illegally without inspection for a fairly favorable price - cattle 65¢ per pound (liveweight basis) hogs 70¢ and sheep and goats, 55¢. Nearly 80 percent of domestic demand is found in Nassau, New Providence and Freeport, Grand Bahamas. Here the net value per pound (liveweight basis) after deducting transportation may be as low as 40¢ for cattle, 42¢ for sheep and goats and 40¢ for hogs. Clearly until conditions change it will be very unprofitable to produce livestock on Andros for shipment to Nassau. Local buyers of livestock for these markets utilize only a few head each week. This part of the trade represents less than five percent of the market. The bulk of the retail trade is fresh and processed meat imported from other countries. The hotels can buy exactly the retail cuts they need for their guests, mainly tourists.

Another problem of livestock producers is the lack of a protected market. Fruit and vegetable production is marketed under government price protection due to high tariffs and embargoes. Beef, pork, mutton and goat meat chilled or frozen can be imported without duty by paying a one percent stamp tax. Dried, smoked or salted products, such as bacon are also duty free. Canned sausages, corned beef and other similar products have a duty ranging between 20 and 32 1/4 percent. The net results is that Bahamian livestock farmers must compete with foreign producers.

In the Bahamas there is no large-scale processor of meat and meat products. Thus it is impossible to realize much value from the by-products and offal. Even the fat on a hog carcass is not trimmed and rendered for lard by the vendor selling locally produced animals. There seems to be a preference for carcasses weighing 65 to 100 pounds.

Any attempt to quantify the expected sale price and marketing costs for livestock animals raised on North Andros for the future is very difficult to determine. Cost and scheduling of transportation between islands will depend on the volume of product and future development of the transportation system. Lack of refrigerated transport is also a problem.

The Size Factor

Research in the United States continually calls attention to the costs and economics associated with the size of farms and specific enterprises. The research conducted by BARTAD and the published results have been for small sized operations. This has been mandated by the project agreement, the availability of resources and the beginning inexperience of Bahamian farmers. A different evaluation of the economic feasibility of livestock enterprises would be needed for units which would compare in size with large scale commercial ventures in the United States. Such operations could not be attempted without the input of considerable capital and management and would probably require some changes in policy on the part of the Government.

A Summary of the BARTAD Results:

Detailed final reports have been published giving the economic analysis for the production of cattle, sheep, goats and hogs on North Andros Island. These are Final Reports #15, 16, 17 and 18. These reports contain all of the specific assumptions and calculations made in an attempt to evaluate the economic viability of livestock enterprises using the best available data.

The overall evaluation is not optimistic. The high costs of establishing pastures and low carrying capacity during the cold, dry winter months tends to produce discouraging results even with fairly favorable selling prices, for livestock animals. With higher levels of management and pasture carrying capacity, sheep and goat enterprises will nearly cover all costs except operator's labor and management when marketed locally. Cattle enterprises are the least profitable, create initial cash flow problems for low equity farmers and complicate the problem of training Bahamians to handle such large animals.

Swine enterprises have a separate perspective. Current research has demonstrated that purchased, imported feed will be less expensive than home-raised feed unless much higher yields of grain crops can be obtained. However, there is a good possibility of producing hogs for a profit as long as the number marketed can be consumed on the island where they are raised. However only a few head can be marketed each week on North Andros or other less densely populated islands.

The lack of sufficient volume of livestock on one island to justify a modern packing plant and the additional problems of inter-island transportation will seriously hamper the development of future expansion in livestock production. The poor profit prospects for livestock enterprises shown in Table I would appear even less feasible if they are marketed in Nassau given current problems and transportation costs. Live sheep and goats can be shipped easily aboard existing mailboats. Hogs are more difficult to load and unload unless specialized shipping trailers are used. Cattle can only be shipped using a larger boat which would probably need to be chartered. Shipping costs might be as high as \$1.00 per head for sheep and goats, \$10 for hogs and \$50 for cattle.

The economic feasibility of livestock enterprises would be materially enhanced if the Government would make all of the initial investment; turn over a going operation to a farmer; and then charge only a nominal cash rent for the farm for twenty years. This would provide a substantial initial subsidy and encourage the development of livestock operations. If such a scheme were fostered on Andros, perhaps in 10 years enough animals could be produced to support a modern abattoir and meat processing facility. In the meantime, the Government would be required to buy and market all livestock produced in a manner parallel to the operations of the Produce Exchange for fruit and vegetables. Also some method of price protection to protect new producers from foreign competition might be needed.

Table I. Returns for the Operator's Labor and Management For Livestock Grown and Marketed on Andros, BARTAD Project, North Andros Island, Bahamas.

	<u>Returns Per Breeding Animal</u>			
	<u>Beef</u>	<u>Sheep</u>	<u>Goat</u>	<u>Swine</u>
High Level Management	-\$61.53	-\$28.22	-\$18.65	\$343.63 ¹
Present Management	-\$367.43	-\$63.02	-\$53.58	

¹ Hogs marketed in Nassau at a lower selling price with additional transportation costs would return -\$970.77 per sow for the operator's labor and management.

Note: See Final Reports Nos. 15, 16, 17 and 18 for details in computing returns.

IV B MARKETING RESEARCH

Early in the life of the Project marketing was recognized as a problem for an island economy. Transportation costs are high and boat schedules are very uncertain. Five separate final reports were published dealing with some aspect of marketing. It has only been in the last quarter of 1977 that sufficient slaughter livestock have been available to exceed the demand on North Andros. This includes sales from both Pilot Test Farms and the Project.

Demand For Meat, Fruit and Vegetable on North Andros:

In 1974 a survey was made of all 748 households on North Andros. This included a summary of the foods eaten. The results were published as Final Report #4. This analysis projected that the people on North Andros could consume all of the livestock raised through mid 1978 even though it was expected that livestock production would increase at a faster rate than has actually occurred.

Economic Feasibility of Slaughter Facility:

Initial Project plans called for the construction of a facility to slaughter livestock at the Project site. The economic feasibility of a facility was reported in Final Report #5. However, when initial bids came in at a much higher figure, a new feasibility study was made by a different economist. Using more recent projections of livestock production and higher construction costs, this study determined that the new facility would operate at a big loss for at least ten years. Thus plans were made to assist in the improvement of the abattoir at Nassau rather than build such a facility on Andros Island.

Selling Meats, Fruits and Vegetables To Resort Hotels:

In anticipation of the eventual production of more livestock, fruits and vegetables than could be consumed on North Andros, a study was made of the products used by resort hotels in Nassau. This was done in 1975 and published as Final Report #9. Although it will be more difficult to sell meat than fruits and vegetables to the hotels, nearly all managers expressed a willingness to encourage local production if inspection, grade standards and prices were competitive.

Marketing Experiences and Problems of BARTAD Pilot Test Farmers:

During their first year of operation the first four farmers had great difficulty in marketing vegetables in Nassau because of transportation and handling problems. After the GCOB Produce Exchange opened a packing house on North Andros, the more difficult problems were solved.

Once local demand for meat was supplied, great difficulty was encountered in marketing livestock in Nassau. The mail boats were not designed to carry live animals, especially hogs and cattle. Also there is no established market for livestock in Nassau. The few small buyers have little ability to completely process and utilize the entire carcass and offal. (See Final Report #55).

V SOCIOLOGICAL RESEARCH (Objective No. 5)

A knowledge of the attitudes and aptitudes of the Bahamian people was needed to aid in planning for agricultural development. Thus several surveys and other sociological research was necessary.

BARTAD Household Survey:

During 1974, 748 households in 20 settlements in North Andros were surveyed by 31 interviewers. The responses to this survey provided findings about dwellings, appliances used, household composition (name, age, sex), community participation, agricultural experience, household finances and food preferences. The results of this research were published as Progress Report #1.

Attitudes and Aptitudes for Farming:

During 1975, 268 questionnaires were returned from high school students in 15 settlements in North and Central Andros. In 1976, 229 useful replies were received. Both sexes reported that farm work is decidedly unpleasant. Also the students view farming as more conducive to bodily injury and more time consuming than other manual labor. On the favorable side, farming is associated with good income and is highly rated as the best measure of success in life. The complete results of this study were published in Progress Report #20 and Final Report #56.

VI DETERMINING THE MOST ECONOMICAL METHOD OF BRINGING LAND INTO PRODUCTION (Objective No. 6)

Introduction:

The site on North Andros Island selected for the BARTAD research center and pilot test farm development was covered with pine trees up to eight inches in diameter. The soil is mainly oolitic limestone. There are a few hard rock ridges with rock castles. The area had been logged for pulpwood from four to twelve years earlier. Over 1,500 acres of land was cleared. Since limited information was available on the most suitable and economical methods for land clearing and preparation, this became one of the first major activities of the project.

Early Clearing:

Eighteen blocks of land destined to be the experiment station were cleared using one D-8, one D-5, farm tractors and wagons. The methods involved various combinations of dozing trees and stumps, raking into heaps, cutting posts, burning trash, picking and hauling stumps, dragging, rolling and disking. This was expensive, hard and dirty work. From the records kept the costs averaged \$178.79 per acre. The details were reported in Progress Report #2 "Land Clearing and Preparation."

Later Development In Land Clearing:

Later research tested the use of the rotary plow, the D-8 Multi-application rake, the D-5 trash rake and various combinations of rolling, disking and dragging. This work was summarized in Progress Report #2A. Gradually a standardized method of clearing and preparation was adopted and used for the land to be put into Pilot Test Farms. This eliminated nearly all hand work and piled up rocks and trees in trash rows every 270 to 300 feet. The methods included clearing using a D-8, rock raking using a modified D-5 and grid rolling using a D-8. This series of steps costs \$100.58 per acre using BARTAD's equipment and labor force. If new equipment had been purchased in 1977, costs would be approximately \$146 per acre. This was mainly due to rapidly rising machinery prices. A completed discussion of all research on "Land Preparation and Development" is covered in Final Report #12.

Results of A Land Clearing and Preparation Experiment:

Block 4-9 was used in a land preparation experiment in 1976 and 1977. Part of it was cleared and raked (Treatment No. 4) one year before final preparation and planting to pasture and grain sorghum. The other three treatments were as follows: No. 1-doze, disk, grid roll and disk before planting; No. 2-doze, rock rake, disk and plant; and No. 3-doze, rock plow, disk and plant. These three treatments were all carried out shortly before planting the first crop.

The four treatments used have different machinery costs and also a quality difference for the work done. Treatment No. 1 left more small rocks on the field. The costs for the land clearing and treatment are shown in Table 2. The results of the first crop of grain sorghum harvested in February, 1977 do not show any significant difference in yields for the four methods of land clearing and preparation.

The results from the harvest of mixed, tropical legume-grass pastures from the four treatments showed a considerable advantage in yield from treatment No. 4 where the land had been left idle for a year (See Final Report #12).

Table 2. Costs of Four Different Treatments of Land Clearing and Preparation.

<u>Treatment</u>	<u>Cost Per Acre</u>
#1-Doze, Disk, Grid Roll, Disk	\$ 74.32
#2-Doze, Rock Rake, Disk	81.99
#3-Doze, Rock Plow, Disk	136.19 ^a
#4-Doze, (idle one year) Disk	56.19 ^a

^aPlus rent and interest on investment for waiting.

The Cost of Fence Construction:

Total costs of constructing fence on field 3-10 consisting of 26 acres amounted to \$3,992. Materials accounted for 48 percent of the total; labor 41 percent and machinery, 11 percent. The cost per lineal foot was 90 cents; cost per rod, \$14.00 and cost per acre, \$151.50. Since materials, other than posts, and machinery account for 45 percent of total costs, the cash outlay by a Bahamian farmer will only be 40 cents per lineal foot of fence. The complete results of this research was published in Progress Report #9.

VII BEST PASTURES AND FEED CROPS FOR LIVESTOCK PRODUCTION (Objective No. 7)

Any plan to expand livestock production must be based on the ability to provide a relatively inexpensive source of feed for livestock. This can be either pastures or feed grains. A considerable part of BARTAD research efforts were to provide and test various crops which could be used for feed.

Comparison Of Transvala, Stargrass and Bigalta Pastures For Growing Cattle:

Growing-finishing yearling Santa Gertrudis steers and heifers were used in a grazing trial to compare the performance of Transvala, Stargrass and Bigalta pastures. The pastures were evaluated under grazing conditions for yield, forage quality, seasonal carrying capacity and cattle performance.

Annual dry matter production per acre was 6.37, 9.88 and 10.4 tons for Transvala, Stargrass and Bigalta, respectively. The average percent digestibility of the dry matter was highest for Bigalta (56%) and similar for Transvala (50%) and Stargrass (50.8%), resulting in 6,575, 9,991 and 11,571 pounds of digestible dry matter produced per acre for Transvala, Stargrass and Bigalta, respectively. The average percent crude protein during the entire trial was highest for Transvala (10.34%) and Stargrass (8.91%) and lowest for Bigalta (6.5%). Stargrass yielded the most pounds of crude protein per acre per year (1,819) followed by Transvala (1,318) and Bigalta (1,314). The percent crude protein in Bigalta during the period from March 15, 1976 to August 30, 1976 was less than the NRC recommendations for growing-finishing steers and heifers and borderline or less for mature, non-lactating beef cows.

Performance and carrying capacity of both heifers and steers followed the trends that would be expected from the agronomic data.

The average annual carrying capacity was highest for Stargrass and Bigalta. In practically all cases, there were few significant differences noted between average weights of both steers and heifers on Transvala and Stargrass pastures, although average weights of cattle grazing Bigalta were less than cattle grazing the other two treatments. Based on these limited observations it is apparent that when forage yield and quality, and animal performance and carrying capacity are considered, Stargrass out performed both Transvala and Bigalta under these conditions. The results of this research were reported in Final Report #39.

Mineral Composition of Plant Tissue and Supplementation of Livestock:

As a part of the livestock-forage projects, mineral profiles on blood serum, animal organs (obtained in post-mortem evaluations) and plant tissue were obtained and used to determine mineral status of the livestock and the mineral supplementation program. Within the first six months after cattle arrived on the project, blood serum mineral composition was within normal ranges for all mineral elements.

Forage analyses indicated (the liver tissue analysis from a calf which had died confirmed) that there was selenium deficiency. Sheep blood serum copper levels also indicated a copper toxicity with resulting isolated cases of sheep deaths. The trace mineral salt mixture was changed to consider these two possibilities.

However, performance has continually increased, and health problems which were generally infrequent since the start of the livestock phase (particularly with cattle) have lessened. It is strongly recommended that the closest possible relationship and liaison be maintained with veterinarians from the Ministry of Agriculture and Fisheries and with a U.S. diagnostic laboratory, and that periodic plant tissue, blood and organ monitoring be continued. A complete report of this area was published as Final Report #41.

Performance of Lambs on Pasture:

Two trials comparing alfalfa, alfalfa/buffelgrass, and transvala (transvala included in only one trial), alfalfa and alfalfa/buffelgrass were quite similar with regard to average daily gains for newly weaned lambs. Significant and important differences were noted between the transvala and the alfalfa pure and mixed stands, indicating that pastures containing alfalfa were more desirable for finishing lambs during the "dry" season. Average daily gain for the alfalfa containing pastures averaged 0.31 pounds per head per day, which is satisfactory considering that no additional supplement was provided. There was an apparent difference in condition or fatness of the lambs in the transvala and alfalfa-containing pastures at the end of the trial, although carcass data were not collected. In trial 1, two bull calves were added to the alfalfa/buffelgrass sward, resulting in an acceptable rate of gain for the bull calves, without depressing rate of gain of the lambs or production of lambs per acre. This is one of the indications obtained from the livestock-forage trials which suggest that mixed livestock species can be grazed together and increase total productive efficiency. These trials were reported in Final Report #27.

Improved Pastures For Goats:

Four different land pasture treatments were compared using mature does: (1) unimproved; (2) burned and seeded; (3) land cleared, root-raked, windrowed and seeded; and (4) same as (3) but grid-rolled without windrowing. Initially, 5-acre pastures of each treatment were stocked with 5, 10, 13 and 19 does, respectively. At these stocking rates, treatment (2) and (4) were over-stocked and treatments (2) and (3) tended to be under-stocked. Average weight of all groups increased, although approximately one-half of the does kidded in January-February. According to these results, treatments (2), (3) and (4) should carry approximately 150, 190 and 225 percent more does per acre than the unimproved treatment (1). This research was reported in Final Report #33.

Irrigated V.S. Non-Irrigated Pastures Supplemented With Green Chop and Silage:

A trial to compare the effects of irrigation and non-irrigation on mixed grass-legume pastures was conducted. The trial included two irrigated groups, one originally designed to receive green chop when necessary, and an irrigated treatment to receive only pasture. Each treatment was stocked with seven beef cows in November (calving in April-May). Although there were significant cow weight differences within each monthly weigh period, calf weights and average daily gains did not differ. The non-irrigated group required an estimated 2,862 pounds per head of additional forage dry matter. According to the results of this trial, 100 acres of irrigated pasture maintained 86 cows per acre, and 100 acres of non-irrigated pasture maintained 67 cows per year.

In each of these cases, it is assumed that the calf would be at the side of the cow through eight (8) months of age. In an economic evaluation, the cost of additional forage produced by irrigation was more than the cost of forage on a non-irrigated pasture with hay supplementation. When the results were considered in terms of increased animal production, the results did not favor irrigation. There are other factors which were not studied in detail in this analysis, such as reduced fencing and land requirements with irrigation, a possible over-feeding which apparently occurred within the irrigated treatment groups, and the possibility of a less expensive, more effective types of irrigation systems. This research was published in Final Report #34.

The Productivity of Mixed Tropical Pastures Grazed By Sheep or Cattle:

The productivity of sheep and cattle grazing mixed tropical legume-grass pastures alone or in combination was excellent. However, major differences in the forage stands between treatment blocks prevented examination of true differences in productivity due to species grazing regime. Based on these limited observations, combined grazing of sheep and cattle resulted in more efficient forage utilization than when cattle were grazed alone. However, the ratio of sheep to cattle was lower than that usually used in companion grazing trials. Sheep grazed alone produced the greatest actual pounds of liveweight produce per acre during the 364-day trial period. Future grazing systems at BARTAD should combine the use of both cattle and sheep for maximum efficiency. This trial was published in Final Report #45.

Productivity of Sheep Grazing Guinea Grass Receiving Nitrogen Fertilization:

Guinea grass pastures fertilized with three rates of nitrogen and grazed by breeding ewes were evaluated for forage production, carrying capacity and lamb production per acre. Increasing the rate of nitrogen fertilization (75, 150, and 300 lbs/acre/year) markedly increased the dry matter yields (4.14, 4.8 and 6.13 tons/acre, respectively). Percent crude protein also increased on the two highest nitrogen fertilization treatments. (See Final Report #46).

The productivity of sheep grazing Guinea grass pastures was poor. Sheep were inefficient grazers of this forage species and could not meet their nutritional demands. These factors resulted in low pasture carrying capacity, ewe health problems and poor productivity when compared to ewes on different pasture mixes. Based on these data it is not recommended that breeding ewes be maintained on pure Guinea grass pastures.

Productivity of Rhodesgrass, Bigalta and Buffelgrass with Legume Mixtures and Grazed with Cattle:

First-calf Santa Gertrudis heifers were used in a comparison of Rhodesgrass, Bigalta and Buffelgrass, each of which was planted with the same tropical legume mixture. Although the Buffelgrass-legume mixture supported more animal units per acre essentially throughout the entire trial and overall seasons, the average 165-day weight of calves born to and raised at side of the first calf heifers from the Rhodesgrass and the Bigalta pastures were significantly greater than calves produced from the Buffelgrass-legume treatments. All of the pastures were legume-dominant through all the seasons, with crude protein percent, dry matter production, and digestibility of dry matter least desirable during January-February for all three treatments. The complete results of this research were published in Final Report #47.

Performance of Feed and Food Grains at the BARTAD Project:

Rice is not well adapted to Bahamian conditions. If commercial rice production were attempted, the costs of harvesting, drying, processing, storing and marketing would undoubtedly greatly exceed the cost of importing this commodity.

Grain sorghum yields up to 2 3/4 tons per acre were achieved in plot trails. However, field trials with the same hybrids did not produce more than 1 1/2 tons per acre. Bird damage was severe. It is possible sorghum would produce better on land after several vegetable crops.

Plot yields of corn had some varieties yielding up to 90 bushels per acre. However, in field trials it was difficult to get yields which were half as much. Insect and disease problems are very serious. More research is needed, but for the current expectations corn can be imported cheaper than it can be grown here. For the complete results see Final Report #31.

VIII. LIVESTOCK FOR THE BAHAMAS (Objective No. 8)

Introduction:

A major emphasis of the project was to introduce and test suitable breeds of livestock for the Bahamas which would form the basis for future research and development. A related objective was to identify improved methods for training Bahamians to work with livestock.

Beef Cattle Selection and Performance:

Information obtained on the performance and relative productivity of various breeds and crosses was used to determine the breed most likely to achieve an acceptable performance level on the BARTAD Project. It was realized from the initiation of the research, that the numbers of animals available, and the duration of the Project, would not be sufficient for meaningful beef cattle breeding experiments. Therefore the following factors were considered in selecting a breed of beef cattle:

- 1) Animals with a recorded or registered ancestry were selected, so as to have a more well defined parentage than if non-registered or grade animals were to be obtained.
- 2) Animals with proven performance in tropical areas (containing Zebu blood).
- 3) The breed selected should have sufficient milk production to result in moderate to heavy calf weaning weights, so as to maximize the production of weaned calf per unit of cow body weight. It was anticipated that quality and quantity of forage production would be relatively high, and can best be utilized by cows with a relatively high production level.
- 4) It was initially assumed that the cattle production program would be based primarily on forages. Therefore, a breed of cattle having the above characteristics, but also with acceptable carcass quality when raised under a predominantly grass regime was selected. Although the end point of beef production was not necessarily high-quality carcasses, a minimum level of marbling and carcass quality was desired in order to meet anticipated consumer acceptance.
- 5) Breeds selected should be available in Florida and other convenient areas for importation, semen should be available if artificial insemination is to be utilized, and the animals should be the type that through culling and selection could be manageable by trained Bahamians.

The Santa Gertrudis breed has been used and tested on practically all of the continents containing tropical areas. In practically all cases they have performed acceptably as straight-bred, in comparison with indigenous cattle, and have performed acceptably in crosses with other breeds. They have been selected within a relatively closed population for heat tolerance, insect resistance, and performance. In addition, one of the economic characteristics in which they have excelled in comparisons in other tropical countries has been for weaning weight. Limited trials including carcass characteristics, particularly carcass desirability, have also indicated that Santa Gertrudis straight-bred cattle yield acceptable carcasses under grass-finishing regimes. The breed has markedly increased in numbers in Florida, although the original BARTAD stock was obtained from Texas because of availability of individual groups of animals deemed at that time to be the most feasible with which to start the beef program. However, there are many registered Santa Gertrudis herds in Florida which would serve as sources of subsequent registered cattle if it is desired to carry on a straight-breeding program. If it is the intention to crossbreed with the base Santa Gertrudis herd, previous research has indicated there is sufficient Zebu influence in the Santa Gertrudis for sufficient heat tolerance under conditions in the Bahamas. However, this is still subject to conjecture; as Angus-Santa Gertrudis offspring produced on the Project have performed acceptably in comparison to purebred Santa Gertrudis.

The beef cattle selected have adapted well to the BARTAD climatic conditions and husbandry systems. Cow fertility, calf livability and rate of growth have been acceptable and in some cases improved with each crop as management and nutritional regimes are perfected. From a husbandry standpoint, there is little doubt that cattle can be a successful livestock enterprise on North Andros. A complete description of the productivity of Santa Gertrudis and Santa Gertrudis-Angus cross cattle has been published in Final Report #50.

Sheep and Goat Selection and Performance:

The sheep flock and goat herd were formed with considerations similar to those upon which the cattle herd development was based, although there was less emphasis on importation of purebred, registered stock. The primary reason for initiating the sheep and goat operations with native stocks was to determine performance of the native stocks under a higher management and nutritional regime. Previously there had been few attempts to provide adequate nutrition for native stocks and to record performance levels. In addition to determining production levels (or ceilings) of native stocks, there was also an opportunity for selection of high-performing individuals and families with which to form "elite" herds and flocks. Formation of the elite units should allow more rapid progress through selection. Too many times, native strains are not properly considered in development and improvement programs, and many times the integrity of the native is lost without a definition of potential production under more optimal conditions. For these reasons, straight-bred native sheep and goats have remained a part of the project, with relatively high production levels observed, and with the formation of "elite" units.

There were importations of other sheep and goat breeds, including:

- 1) Black Belly Barbado1 - a hairy sheep breed developed in the Caribbean, and raised in Texas and Latin America; imported from the U.S. to possibly increase heat tolerance, various performance criteria and to add hybrid vigor when crossed on Bahama natives.
- 2) Suffolk - A black, open-faced woolled breed with a highly desirable muscle thickness and growth rate originally considered as a possibility for correcting muscle and growth deficiencies in the native stocks.
- 3) Improved Florida Native Sheep Strain - a relatively large strain that has been selected intensely for production and internal parasite resistance under commercial condition in Florida.
- 4) Nubian - a dual-purpose goat breed with high growth rate, larger mature size and increased milk production.

Two of the above imported strains or breeds have contributed to increased performance compared to the natives; the Nubian and the improved Florida Native. The Nubian is of benefit when used as a "terminal" sire, since there is an increased growth of the first-cross kid compared to the full-blood native kid when both are suckling the native doe. There is an additional increase in production when the first-cross does are compared to native does. However, because of teat size and the possibility of lowered fertility, it is doubtful that does with more than one-half Nubian breeding would maintain a production advantage.

The Florida Native rams have produced lambs with more muscling and growth rate than the straight-bred natives, although a tendency for resistance to internal parasite infection has not been measured as yet.

Sheep have the potential of being a successful livestock enterprise in the Bahamas mixed farming system. A complete report on the productivity of sheep was published in Final Report #32. The following general conclusions and suggestions for the future should be noted:

- 1) Performance of Native ewes and rams is equal to or better than introduced Barbados Blackbelly, Florida Native and Suffolk sheep. Therefore, future breeding programs should stress the use of Native stock, particularly by identifying and selecting the highest producing ewes and concentrating the most desirable seedstock in elite herds.
- 2) Selection programs should aim at improvement of ewe prolificacy and lamb rate of growth from birth to weaning, without sacrificing the ewe lambing interval. This can be accomplished by using fast-growing twin-born ram lambs from ewes with lambing intervals of 250 days or less. A great deal of emphasis should not be placed on ewe phenotypic characteristics.

Goats have the potential of being a successful livestock enterprise in the Bahamian mixed farming system. A complete report on the performance of goats has been published in Final Report #37. The following general conclusions and suggestions for the future should be noted:

- 1) First-cross Anglo-Nubian kids performed more desirable than Native-sired kids. However, three-fourths Anglo-Nubian kids showed no growth rate advantage over half-bloods.
- 2) Caution should be exercised in the addition of too much improved dairy type breeding. This will likely result in teat structure and size too large for unhampered nursing by newborn kids.
- 3) Selection programs should emphasize improvement of kid rate of growth from birth to weaning without sacrificing doe prolificacy and kidding interval. The highest producing does and bucks should be indentified and concentrated in elite, seedstock producing herds.
- 4) When compared to Native sheep, goat enterprises will be less profitable. This is due to the higher capital costs (fencing) and lower annual weight of product produced by does (49.9 pounds) when compared to ewe (103.9 pounds). However, as indicated in Final Report #33, goats can attain an acceptable performance level on undisturbed land with minimal fertilization and seeding.

Swine Selection and Performance:

The swine phase of the BARTAD Project was conducted entirely on two pilot test farms. Seventeen Yorkshire - Hampshire crossbred gilts were obtained from Florida. Two purebred Yorkshire boars were imported from Georgia.

The first farm was stocked entirely with imported hogs, and the second farm was stocked with progeny from the original importation. Number of pigs born per litter was less for the second farm than from the first (8 versus 10 pig litter). This indicates that reproductive performance, especially if measured in terms of total number pigs born per year, may be less in subsequent Andros swine herds than in commercial U.S. herds. However, the performance is still acceptable. Growth rate has been relatively high with lightweight and medium-to-heavy-weight carcasses produced at about 125 and 160 days of age, respectively. There remains additional opportunities to reduce feed cost by better management of alfalfa pastures and use of locally produced feeds or waste products. A complete report on swine performance was published in Final Report #42.

Procurement and Early Handling of Livestock:

Relatively few problems have arisen in the importing, isolation, early handling and adaptation of cattle, sheep, goats and swine. However, considerable effort was expended by all personnel involved in designing and communicating animal needs, pre-shipment health tests and treatments, coordinating unloading of animals on Andros, transporting the animals to the BARTAD Project site and minimizing early handling and stress. It is strongly recommended that any future animal importations to the Bahamas, but particularly to Andros, are similarly designed and carried out. Records of health and performance status, and treatment are extremely important and have been the responsibility of Penn State and Bahama Resident Animal Scientists in collaboration primarily with Veterinarians from the Bahamas Ministry of Agriculture and Fisheries. For a continually successful animal health program, this cooperation must be strengthened or at least maintained. A complete report on procurement and early handling of livestock was published in Final Report #40.

Training of Non-traditional Livestock Workers:

The temperament of large animals has at times been a problem in developing confidence in handling of cattle by Bahamian trainees. This is particularly true of Bahamians with only limited experience and direct activity with the cattle, such as in the case of the farmer trainees. Although each farmer trainee, during the three-months training session, had access to various husbandry practices and actual working animal contact, the length of time apparently was not sufficient to adequately train them and to overcome a natural fear of large animals such as cattle. Of all the cattle carrying Zebu parentage, Santa Gertrudis are probably most docile of these types of breeds in the U.S. There have been successes in training relatively young Bahamians who have had experience with beef cattle and other livestock species for two or more years. It has been determined that concentrated training periods of at least one year in length apparently are required for adequate training.

Routine husbandry practices such as dehorning, castrating, worming, foot trimming, record keeping, etc., have been taught primarily through on-hand types of demonstrations with trainee involvement. However, again the training period was not of sufficient length to develop in-depth proficiency in all livestock management practices. The trainees and on-site livestock herdsman apparently mastered the various animal husbandry techniques, although as indicated on the pilot test farms, there is difficulty in scheduling and carrying out of routine practices on the pilot test farms, even though rather close supervision and technical assistance has been available from the BARTAD station.

There have been several occasions when various herd management techniques and skills have been demonstrated to participants in training courses, and on occasions these various practices have been photographed and made into visuals for use by Extension personnel and others in other Bahama locations. There are probably more of these types of efforts than can be made in the future.

It is apparent that the Bahamian farmer (or potential farmer) can adapt to handling of the small ruminants (sheep and goats) more quickly and more adeptly than he can adapt to cattle. This probably is related to previous animal experience, size and temperament of the animal, and potential for enjoyment of the livestock. However, there are examples of young herdsman who have worked with beef cattle for 18 months or more in which the level of proficiency, enthusiasm and confidence in working cattle is moderately to highly acceptable. In order to result in a similar level of competency, the cattle training period would have to be longer than the small ruminant training period. But apparently a lower percentage of the Bahamians can adapt to handling of cattle, regardless of the length of the training period.

IX. OTHER RESEARCH

AGRICULTURAL ECONOMICS

Machinery Cost Analysis:

In commercial agricultural production machinery costs represent a significant item of cost. Thus for most of the enterprise cost analyses made a key component was based on the research published in Final Report #14. The usual applications of machinery costs from the United States were very inadequate. Rates of annual use, depreciation and repair all had to be adjusted to the conditions at BARTAD and North Andros Island.

The hourly cost of operating 30 different prices of equipment were completed and based on BARTAD costs of buying and importing machinery and equipment. Also the costs of operating the central machinery repair shop were analyzed. These costs were used in computing charges for pilot test farmers.

Irrigation Costs Using - "The Big Gun":

Andros Island has a dry winter period which ranges from four to six months in any given year. The early assumptions were that pastures would be irrigated. Early research by Stern and Guyton proved in small plots that yields of tropical grasses could be doubled by using more fertilizer and irrigation. The analysis in Final Report #11 determined that irrigation by using the "Big Gun" was very costly - \$362 per acre per year for 40 inches of water or \$253 for 28 inches of irrigation water. With this level of costs it is cheaper per unit of feed produced to produce pasture without irrigation.

In Progress Report #18, "Analysis of Pasture Production Programs Which Farmers Can Use" concluded that farmers should not use irrigation for pasture. Rather alfalfa-grass mixtures which produce better during the cool dry months should be used in a system which utilized tropical grass-legume mixtures for the warmer months with more rainfall.

Agricultural Experience on North Andros:

Early in the life of the Project (1974) a household survey was conducted on North Andros. Some of the questions related to the families current involvement in agriculture. The results were reported in Final Report #2.

This survey concluded that a large portion of the households have had some experience in raising fruits, vegetables and some non-pet animals. However, their experience has not provided the background for most to become modern farmers.

Costs and Sources of Agricultural Inputs:

This research published as Final Report #3 analyzed the current sources and methods of distributing inputs to farmers in the Bahamas. Farmers on North Andros as well as other out islands, have had difficulty in obtaining the inputs needed for expanded agricultural output.

The Economic Feasibility of A Feeding Milling Facility:

In 1975 Project Management asked for an analysis of the economic feasibility of a feed milling facility to aid in livestock and meat production. The results were published as Final Report #7. The end result of this analysis was to recommend the purchase of a New Holland #354 portable mixer-grinder. This would handle the feed grinding needs for the first five years of development.

The Economic Feasibility of A Facility For Use In Assembly, Grading, Packing, Storage and Selling of Fruits and Vegetables.

This feasibility study was published as Final Report #8 recommended that construction of a facility to aid in future agricultural development. This was not done by the Project, however, in January 1976 the government opened this type of facility on North Andros Island.

AGRICULTURAL ENGINEERING

Weather Data:

A necessary part of the research on any experiment station is the recording of the observations concerning the weather. The compiled weather data on temperature, rainfall, hours of sunlight and wind velocity must be utilized in analyzing other aspects of crop and livestock research.

The first report of weather observations for North Andros Island were published as Progress Report #17. A complete summary of the weather data was published as Final Report #53.

Water Hydrology:

The fresh water lens under much of North Andros Island is a very important resource which can be used for expanded agricultural output. However, it must be protected from misuse or over use. The research in water hydrology and usage has been set up to monitor the impacts of BARTAD on the lens. The results published in Final Report #54 conclude that the Project and pilot test farms have had very little noticeable effect.

Preliminary hydrological observations on hydrology for Andros Island were published as Final Report #10.

Pasture Irrigation:

During the winter of 1974-75 three mixed pastures received various amounts of irrigation using a "Big Gun". There was no apparent increase in productivity for irrigated as compared with non-irrigated pastures. Salinity of the irrigation water increased throughout the season with a greater increase in the wells pumped most heavily. The results of this research were published in Progress Report #16.

AGRONOMY AND SOILS

Early research plans for the Project were not very specific concerning all of the research which should be conducted in the broad spectrum of "food and feed" crops. Over time several research trials were initiated.

BARTAD Soils After Four Years of Cropping:

An analysis of the soil resources and the changes which take place when virgin "pine land" is converted to agricultural uses was published as Final Report #44. This details the beginning soil test results and the test in various fields after several years of use with heavy applications of fertilizer and the incorporation of plant residues.

Performance of Starchy Root and Tuber Crops:

The crops included in these areas of research included cassava, Irish potatoes and yams. The results of this research were published in Final Report #30.

Six of the most promising cassava cultivars were introduced from C.I.A.T. in Colombia, South America. These were selections from 2,500 on test there. They were planted in August, 1976 and utilized in special propagation plots. The freeze in January 1977 severely set back these plants, however, they were harvested and evaluated in August 1977. A bitter variety was discarded and the other five used to plant new trials.

One trial of irrigated potatoes was conducted using various levels of fertilization. This was done in the spring of 1976. With high level management and ample water and irrigation, potatoes would break even at 11.9¢ per pound. However, for lower yields from average results potatoes are not profitable.

Performance of Large Seeded Legume Crops:

The crops included in this area of research were soybeans, pigeon peas and peanuts. The complete results were published as Final Report #29.

During 1975 and 1976 soybeans were tested as part of the International Soybean Variety Trials. Each year 15 varieties were tested. Several had yields over 40 bushels per acre. The yields of the soybean plot trials were impressive, but before commercial ventures are started it would be advisable to try some field scale trials to determine if production problems can be solved at a reasonable cost. There is a problem of insect control which could require spraying from an airplane. Also harvesting operations need to be timed to coincide with the dry season to facilitate drying and storage without damage. Also there is no market in the Bahamas.

Twenty different cultivars of pigeon peas were tested during 1974. In March 1976 cultivar Paraguay N-3 was selected as superior and propagated as seed increase. It has pods which are borne in bunches which makes harvesting Also the yields are better.

In 1976 eight varieties of peanuts were tested in plot trials. The yields except for one local variety were not very good.

ANIMAL SCIENCE

Horses were imported to assist in the handling of livestock. The observations made and the management practices used were published as Final Report #14.

X ACADEMIC TRAINING FOR BAHAMIANS (Objective No. 9)

Twelve candidates from The Bahamas were selected for training at the Bachelors and Masters Degree levels at Penn State. Five of these candidates were enrolled for Masters programs in the areas of Animal Science, Agronomy and Agricultural Economics, with three completing their training and returning to the Project by January 1978. Seven participants were enrolled in baccalaureate programs in Animal Science, Agricultural Economics and Agronomy. Three were unable to complete their programs due to academic difficulties. With the exception of two, all others are expected to complete their programs by the end of the Contract (January 1979). Names of participants, areas of specialization and program dates are shown in Table 3.

TO STRUCTURE ALL ACTIVITIES FOR TRANSFER TO OTHER ISLANDS AND COUNTRIES

The BARTAD Project was organized as a specific new approach to agricultural development. The management structure as it evolved was unique since a representative of USAID and the GCOB served as Co-managers. Also two prime contractors were involved, The Pennsylvania State University for research and the Western Institute of Science and Technology for construction and logistical support.

The on-going plans for the Project after the initial project agreement were modified by special committee meetings twice a year. One "High Level" management met to decide policy issues and priorities. The other, a "Mid-Level" management group, met to discuss operational aspects and to pinpoint issues which should go before the High Level Group.

During the entire Project every effort was made to structure the research and training for its widest application to all islands in the Bahamas. The research station and training center was visualized as future centers for these activities for the entire country. However, insufficient time was available to test the transfer of information to other areas. Numerous students in the farmer training program came from other islands and some farmers from other areas visited the site.

Table 3. Summary of Training of Bahamian Participants by The Pennsylvania State University

<u>Name</u>	<u>Type Degree</u>	<u>Area of Specialization</u>	<u>Date Program Initiated</u>	<u>Program Completion Date</u>
Michael Brennen	B. Sci	Agronomy	September, 1976	June, 1977/Terminated
Valerie Carey	Masters	Agron. (Plant Prot.)	August, 1976	November, 1977
T. C. Cathopoulos	Masters	Animal Science	February, 1975	December, 1976
Earl Deveaux	Masters	Ag Economics	August, 1976	August, 1977
Arnold Dorsett	Masters	Animal Science	November, 1976	May, 1978/Est.
Ayret Lightbourne	B. Sci.	Animal Science	September, 1975	March, 1978
Charles Maillis	B. Sci.	Ag Economics	May, 1976	May, 1978/Est.
Simeon Pinder	B. Sci.	Agronomy	November, 1975	March, 1978/Est.
Benjamin Rahming	-----	Cooperatives	May 15, 1977	July 31, 1977
Leon Smith	B. Sci.	Agronomy	September, 1975	March, 1976/Terminated
Roger Smith	Masters	Agronomy	August, 1977	November, 1978/Est.
Lewis Symonette	B. Sci	Agronomy	March, 1976	March, 1977/Terminated
Camilla Thompson	B. Sci.	Agronomy	November, 1977	August, 1980/Est.

Appendix B

BARTAD PROJECT FINAL REPORTS

1. Household Food Preferences on North Andros.
H. L. Moore, June, 1975.
2. Agricultural Experience on North Andros.
H. L. Moore, June, 1975
3. Costs and Sources of Agricultural Inputs.
H. L. Moore, L. L. Yager, Audley Greaves, July, 1975
4. Demand for Meat, Fruits and Vegetables on North Andros.
H. L. Moore, L. L. Yager, A. Greaves, July, 1975
5. The Economic Feasibility of a Livestock Slaughter Facility to Aid in
Agricultural Development.
H. L. Moore, L. L. Yager, July, 1975
6. Archive Nôtes on Agricultural Enterprises in the Bahamas.
P. Bethel edited by D. M. Crider, July, 1975 (Limited Distribution)
7. The Economic Feasibility of a Feed Milling Facility to Aid in Livestock
and Meat Production.
H. L. Moore, L. L. Yager, A. Greaves, August, 1975
8. The Economic Feasibility of a Facility For Use in Assembly, Grading,
Packing, Storage and Selling of Fruits and Vegetables.
H. L. Moore, A. Greaves, L. L. Uager, November, 1975.
9. The Feasibility of Selling Quality Meats, Fruits and Vegetables to The
Resort Hotel Trade.
H. L. Moore, L. R. Kyle, L. L. Yager, February, 1976.
10. Hydrological Observations on Andros Island.
W. J. Elliot, W. R. DeTar, December, 1975
11. An Analysis of Irrigation Costs Using - The "Big Gun."
L. R. Kyle, June, 1976
12. Land Clearing and Preparation.
L. R. Kyle, A. Greaves and W. Lazarus, October, 1977
13. Machinery Cost Analysis - Hourly Rates.
W. Lazarus, A. Greaves, D. Johnson, F. Hughes, May, 1977.
14. Management and Use of Horses in the BARTAD Project,
T. C. Cathopoulis, L. L. Wilson, T. S. Katsigianis, A. A. Dorsett & S. B. Guss
August, 1977

15. Economic Analysis of Beef Production On North Andros Island, Bahamas, 1977.
William Lazarus, Audley Greaves, Leonard R. Kyle and Fred Hughes.
16. Economic Analysis of Hog Production On North Andros Island, Bahamas, 1977.
William Lazarus, Audley Greaves, Leonard Kyle and Fred Hughes.
17. Economic Analysis of Goat Production On North Andros Island, Bahamas, 1977.
Audley Greaves, William Lazarus, Leonard Kyle and Fred Hughes.
18. Economic Analysis of Sheep Production On North Andros Island, Bahamas, 1977.
Audley Greaves, William Lazarus, Leonard Kyle and Fred Hughes.
19. Performance of Five Alfalfa Varieties at the BARTAD Project, North Andros Island, Bahamas.
John E. Baylor and Ronald F. Guyton.
20. Performance of Five Alfalfa-Grass Mixtures at the BARTAD Project, North Andros Island, Bahamas. Ronald F. Guyton and John E. Baylor.
21. Performance of Several Perennial Grass Species and Varieties Propogated by Seed at the BARTAD Project, North Andros Island, Bahamas. John E. Baylor and Ronald F. Guyton.
22. Performance of Several Perennial Grasses Propogated Vegetatively at the BARTAD Project, North Andros Island, Bahamas.
John E. Baylor and Ronald F. Guyton.
23. Performance of Four Napier Grass Varieties at the BARTAD Project, North Andros Island, Bahamas. Ronald F. Guyton and John E. Baylor.
24. Observations on the Performance of Several Tropical Legumes at the BARTAD Project, North Andros Island Bahamas. Ronald F. Guyton and John E. Baylor.
25. The effects of Harvest Interval and Irrigation on Green Panicgrass with Nitrogen Fertilizer or Selected Tropical Legumes. Ronald F. Guyton, John B. Washko and John E. Baylor.
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38. Economic Analysis of Vegetable and Vine Fruit Enterprises, William F. Lazarus, Audley Greaves and Fred Hughes.
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Appendix C

REPORT .

ON

THE ESTABLISHMENT AND IMPLEMENTATION
OF THE
NORTH ANDROS AGRICULTURAL COOPERATIVE SOCIETY LIMITED

by: Laurence L. Yager
Earl D. Deveaux :

INTRODUCTION:

The North Andros Agricultural Cooperative Society was planned as a phase of the overall BARTAD Project to assist the Government of the Commonwealth of the Bahamas (GCOB) to achieve its long-term National Development Goal for Agriculture. This goal is to "Establish, as rapidly as possible and as an expanding development process, an efficient, stable and economical viable commercial agricultural sector in the Bahamas, based on family-type production system."

The specific objective of the Cooperative is to provide the organizational vehicle for supplying the pilot test farmers called for in the BARTAD Project Agreement and other family farmers with production inputs and custom services.

JUSTIFICATION FOR COOPERATIVE:

Justification for the establishment of the Cooperative is as follows:-

The Project Agreement called for the establishment of 16 pilot test farms. In order to achieve sustained growth and financial success, these farms must be supplied with inputs and machinery services, as well as other custom services related to farm development and production. Limited input supply, custom farm services, physical infrastructure existed on North Andros. Thus, to accomplish the Project objectives related to agricultural development, funds were provided to establish a multi-purpose cooperative to assure that such services and physical structure came into being.

As a measurement of goal achievement the Project Agreement specified that final success can be judged on the basis of the outreach and the establishment of economically viable farms.

The most probable and efficient method for meeting the needs described above, given infrastructure on North Andros, appeared to be to organize and assist a cooperative type farmer's entity which was preferred over individual entrepreneurs due to the more equitable ownership of providing integrated services. In addition one of the goals of the Government is the establishment of cooperatives.

ESTABLISHMENT AND PROGRESS:

The Cooperatives Act and Regulations approved by the GCOB in 1974, were adequate to serve as the legal base for organizing the Cooperative.

Farmers, and potential farmers on North Andros were informally interviewed in July, 1975 and found receptive to active support and participation in a Farmer Service Cooperative. They had indicated a basic understanding of cooperative concepts and the responsibilities related to being a member of a cooperative. Sufficient support appeared to be available to justify moving forward on a pilot basis.

Page 2.

In August, 1975 a training seminar was conducted at the North Andros High School for prospective Co-op members. These sessions were under the direction of Earl D. Deveaux, BARTAD Co-manager, assisted by Audley Greaves, BARTAD Agricultural Economist; Robert Hall, Director of Cooperative Development and Laurence L. Yager, BARTAD Research Director and Chief of Party. As a result of this seminar and the interest shown in organizing a Cooperative, a steering committee was appointed to develop by-laws for the Cooperative.

With the assistance of the Director of Cooperatives, his United Nations Adviser, John Wilson and Co-op Consultant Henry Bradford, a set of by-laws were developed. Meetings were held with interested farmers and the by-laws were studied, reviewed, changed and adopted.

A total of 39 members were inscribed and the North Andros Agricultural Cooperative Society, Ltd. was officially registered November 12, 1975. The Executive Committee of nine was elected, but the Co-op was not ready to commence field operations as it did not have a Manager or facilities to conduct business operations.

About that time the BARTAD Co-op group was named. This group comprised the two BARTAD Co-managers and the Penn State Chief-of-Party. The purpose of the group was to administer and supervise all matters relating to the Cooperatives. Arrangements for the services of Henry W. Bradford, a Cooperative Consultant were made.

Since BARTAD was providing most of the capital to get the Cooperative started an agreement was necessary to cover the terms and conditions for providing such capital. Mr. Bradford assisted in preparing and negotiating an Assistance Agreement and a Management Agreement. These Agreements were signed by the GCOB and U.S. Governments in July, 1976.

While the Assistance Agreement provided the guidelines for use and accounting of funds provided by AID, the Management Agreement provided for BARTAD hiring a Co-op Manager and Co-op Manager trainee. Additional training in the U.S. was provided for the trainee under this agreement.

A principal key to implementing the plans and getting the many minor and major jobs completed in preparation for the opening of business operations was the hiring of a full-time manager. Although BARTAD made considerable efforts to obtain a Manager, after the signing of the Management Agreement, one could not be arranged for until October, 1976 which was almost one year after the registration of the Co-op. As a consequence, many important aspects of the Co-op were delayed at least one year. This meant there was only about one year until the termination of the Project Agreement and the Co-op Assistance Agreement.

The Co-op Executive Committee had not functioned effectively to this point, mainly because of dissatisfaction of a majority of the committee members with the Chairman. This problem was resolved with a reorganization of the officers and stronger direction from the BARTAD Co-op Group.

Page 3.

Mr. Laurence L. Yager was transferred from the PSU Chief-of-Party position to the position of Manager. One month later in November, 1976 Mr. Benjamin Rahming was hired as the Co-manager Trainee. He was given three months of specialized training in Agricultural Cooperatives in the United States from May to August, 1977.

Since October, 1976 substantial progress was made, due primarily to the combined efforts of the Co-op Manager, BARTAD Co-op Group, the Co-op Committee and the Co-op Consultant.

The major activities that were completed during that period are as follows:-

A site for the Co-op headquarters was selected one mile South of the San Andros Airport and the land cleared in October, 1976.

A porta-camp (on loan) from BARTAD was moved onto the site and served as a temporary office from October, 1976 to September, 1977.

A fence was installed around the perimeter of the Co-op site primarily with the labor provided by Executive Committee Members.

Two large trailers (on loan) from BARTAD were moved on site to serve as temporary storage and store.

A survey of members was conducted to determine the products and services they would purchase from their Co-op.

Several orders were prepared, placed and shipments received for fertilizer, feed, seed, pesticides, farm supplies, tools, office furniture, fixtures, office supplies, bookkeeping forms and farm machinery.

A well was drilled, pump house built and water pump installed.

Two fuel tanks were installed on site and two 55 gallon drums provided at the satellite farms for fueling vehicles and tractors

Electrical service was connected.

A store, maintenance and office building, 30' x 60' was designed and the building completed and occupied in September, 1977.

A large machine shed 30' x 128' was constructed. A portion of it being 58' x 64' with two 28' x 16' bays enclosed to provide additional storage for pesticides, fertilizers and farm supplies.

Another machine shed 28' x 76' was constructed at a satellite farm to store machinery used in that area.

A custom slaughter slab with meat chilling and cutting facilities was constructed at the Co-op Site.

Orders were placed for equipment and supplies which were to be rented and sold to farmers.

- 2 Ford 3600 Tractors
- 3 John Deere 2440 Tractors
- 1 Potato Digger
- 2 Vegetable Planters
- 2 Disc Plows
- 3 Big Guns PTO Irrigation Pumps
- 1 Post-Hole Digger
- 1 3/4 - ton Pick-up Truck
- 1 5 Ton Truck
- 1 Pea Huller
- 2 Fertilizer Applicators
- 2 200 Gallon Sprayers
- 1 Herbicide Sprayer
- 6 Water Pumps
- 2 Offset Discs
- 2 Precision Vegetable Planters
- 1 Rotary Mower
- 1 Goose-Neck Trailer
- 1 Hay Baler
- 1 Mower Conditioner
- 1 Hay Rake
- 2 Farm Wagons.

Though the Co-op officially opened for business in January, 1977 using the temporary office and trailer facilities it was not ready to offer a full lines of farm supplies or farm machinery services. The Co-op made arrangements with BARTAD to borrow fertilizer and seed for sale to members. As expected, business activities of the Co-op were very minor during the first months of operation. Lack of land, or rather, the delay in distribution of land considerably lowered the estimated business volume.

Another reason for low sales volume during the early months was that the first four pilot test farmers, who were among the largest potential patrons of the Co-op were not released from their probationary period from the BARTAD Project until January, 1977. Most of them had reserve inventories of supplies from BARTAD thus it was not necessary for them to begin patronizing the Co-op until those inventories were depleted.

OPERATING RESULTS:

A brief analysis is given of the operating results of the Co-op for the period January 1 to December 31, 1977. The results are as follows:-

Income:

Farm Supply Sales	\$37,400
Less Cost of Purchases	34,150
Gross Margin on Sales	<u>3,250</u>
Commissions	200
Membership Fees	150
Farm Machinery Revenue	5,100
Agents Fee (MINAG)	1,700
Total Income	<u>\$10,400</u>

Expenses:

Depreciation*	9,260
Repair Parts	6,500
Property Improvements	5,900
Office and Plant Supplies	5,050
Office Salaries	2,700
Operating Labour	4,920
Fuel, Power, Water	1,740
All other Expenses	1,980
Total Expenses	<u>\$38,050</u>

Net Savings (Loss) (\$27,650)

*This figure represents the total of three expenses as listed in the audit report-depreciation, machinery operating and truck operating expenses. The only item accounting for machinery and truck operating expenses was depreciation.

Two expenses listed above - repair parts and office and plant supplies - represent original purchase cost, but a large share of those items are still in stock and unused. Property improvement is a one-time type of expenses and should not be repeated in future years. These latter three expenses and depreciation expense are the four highest expenses of the Co-op, totalling \$26,710 or 70 percent of the total. We present this explanation because it is helpful in analyzing the reasons for the relatively high loss.

However, it must also be understood that the salaries for the Manager and the Co-Manager Trainee are not included in the expenses. Until the termination of the Co-op Agreement on January 18, 1978 these salaries might be considered as research and experimental costs of the overall BARTAD Project.

Analyses could be made of certain operating ratios such as total sales to total assets, but these do not appear warranted or meaningful at this early date because of unusual circumstances in the beginning operations of the Co-op and due to the fact that most of the members still do not have land with which to farm effectively.

FINANCIAL CONDITION:

A summary of the estimated financial conditions of the Co-op as at December 31, 1977 was as follows:-

Current Assets	\$42,000
Fixed Assets	174,773
Total Assets	<u>\$216,773</u>
Current Liabilities	1,800
Long-term Liabilities:	
Undistributable Capital	175,890
Goods and Services from AID	65,900
Members' Equity	1,425
Net Savings (Loss)	27,650
Total Liabilities and Members' Equity	<u>\$216,773</u>

The financial condition of the Co-op is relatively sound. It is recognized that to-date members have invested only \$1,425 in the form of share capital. But the Co-op has a sound programme of raising share capital and capital will be increased in direct proportion to the business of the Co-op.

The Co-op's cash accounts, (office and bank) are estimated at \$30,000. AID and other officials realized from the beginning that the Co-op would need reserves in order to withstand minor losses for a few years, if that be the case, and more important to have available cash for a substantial down payment on the purchase of assets.

REQUIREMENT FOR SUCCESS:

The North Andros Co-op is a business organization. Like any other business, certain conditions must prevail for it to be successful. These conditions relate to economic need for the Co-op, the degree of competency of Co-op management, how well members and other farmers support their Co-op, and the type and level of support provided by the Government of the Bahamas.

ECONOMIC NEED:

An economic need for the Co-op must exist, otherwise there would be no justification for its being. In this section we discuss several of those needs.

NUMBER OF MEMBERS AND OTHER FARMERS:

The Co-op was registered in 1975 with a total of 39 members. It now has 75 members and the estimated number of 1985 is 90. In addition to members, the Co-op may serve a number of other farmers in the present operating area of the Co-op, or in a wider geographical area should the area of the Co-op be expanded. The relatively large number of present and potential patrons evidences a strong need for the Co-op.

LAND AVAILABLE FOR FARMING:

The amount of land presently under cultivation and that which might become available in the years ahead determine to a large degree the need for a Co-op. For example, if only 100 acres were available for crop and livestock production, farmers would need limited supply inputs and farm machinery services. If 10 times the amount of land were

available, then farmers' needs would likewise increase about 10 times.

It is estimated that the following amounts of land by usage, would become available for farmers in North Andros by the designated years. This assumes that Government grants Crown Land leases to farmers more expeditiously.

Table 1. Land Usage Projections for North Andros

Year	Fruits and Vegetables	Pastures	Field Crop	Total
<u>Acres</u>				
1977	235	220	13	468
1980	675	340	26	1,041
1985	1,408	540	46	1,994

The acreages, or even smaller acreages if the figures were over-estimated, are adequate to justify a cooperative business. In other words, farmers would need a reliable source of production inputs and farm machinery services to farm those acreages. The amount of land that becomes available will largely determine the degree of operating efficiency of the Co-op, assuming that most farmers patronize their Co-op.

USE OF LAND:

According to resource personnel, farmers would use the land to produce a variety of crops and livestock. The major types of vegetables they produce are cucumbers, cabbage, sweet peppers, onions, Irish potatoes and tomatoes. The majority of fruit orchards are located on BARTAD Pilot Test Farms.

At present, members have a combined total of about 800 head of hogs, sheep, goats and beef cattle. By 1985 estimated production will reach approximately 5,035 head. It was further estimated that production of eggs and broilers would be started by 1978 and that by 1985 their production might be adequate to meet the demands of North Andros. In addition, farmers would have reasonably high volumes or acreages of hay, field crops and pasture. Table 2.

Table 2. Estimated Agricultural Production in Co-op Area*

Type	1977	1980	1985
Fruits and Vegetables (acres)	235	675	1,408
Hogs (head)	300	1,600	2,166
Beef Cattle (head)	10	20	36
Sheep (head)	300	725	1,433
Goats (head)	200	650	1,400
Eggs (dozen)	-	17,500	35,000
Broilers (head)	1,500	4,750	9,500

Pasture (acres)	220	340	540
Hay (tons)	10	50	100
Field Crops (acres)	13	26	46

* Assumed a straight line growth rate from 1980 to 1985.

With the production of those crops and livestock, it was estimated that farmers by 1985 would require about \$325,000 worth of production inputs, \$70,000 worth of farm machinery services, or a total of about \$395,000 per year. These relatively large volumes substantiate the need for a Co-op and the fact that it could be operating at a net savings by 1980. Table 3.

Table 3. Estimated Business, Net Savings and Members of North Andros Co-op, by Designated Fiscal Years*

Items	1977	1980	1985
Number of Members	69	80	90
Farm Supply Sales	\$32,650	\$201,975	\$324,160
Farm Machinery Revenue	4,580	33,750	70,400
Total Sales and Revenue	37,230	235,725	394,560
Net Savings	(20,000)	23,572	39,456

* Assumed a straight line growth rate from 1980 to 1985.

NEED FOR PRODUCTION INPUTS AND FARM MACHINERY SERVICES:

The preceding section indicates the extent of farmers' needs for a reliable source of production inputs and farm machinery services. Such services will be commensurate with the amount of land they have and the intensity of their farming practices. If these two basic services, inputs and machinery services were not available to them, they would be restricted to hand operations, pot hole or traditional farming and very limited production.

Thus, it is concluded that a strong need exists for farmers to have a reliable source of production inputs and farm machinery services. In the years ahead some of the larger producers may justify and buy certain types of machinery for their own use, such as tractors. If and when most farmers reach that stage, there may be little need for the Co-op to offer machinery services, at least of the variety and extent now available.

SOURCES OF SUPPLIES AND SERVICES:

As of to-date farmers in North Andros have limited sources of supplies and machinery services, other than through the Co-op. Other sources for farm machinery services are virtually non-existent except for heavy equipment.

Convenient sources for a wide variety of production inputs are also virtually non-existent.

However, two outlets exist in Andros for a very limited variety of tools and hardware. Several sources are available in Nassau. Some of those in Nassau also furnish feeds and fertilizers. See Table 4.

Table 4. Alternative Sources of Supplies and Farm Machinery Services for Farmers in North Andros.

Agricultural Supplies:

Frank Hanna - Lumber and Hardware - Rakes, etc.	Andros
Johnny Saundres - Lumber and Hardware	Andros
Farm & Fish Store (MINAG)	Nassau
** Home Auto and Farm Supply Store - Mackey St.	Nassau
* Bahamas Feed Supply - Mackey St.	Nassau.
* Furrow's Feed Supply	Nassau
*** John S. George & Co. - Palmdale	Nassau

Farm Machinery Rental Services:

BARTAD - Heavy Equipment	North Andros
Albert Whitney - Heavy Equipment	Nicoll's Town
Big Yard Construction (Cecil Gaitor) - Heavy Equipment	
Taylor's Trucking - Heavy Equipment	Nassau
Earth Movers	Nassau
Bahamas Pavers - Heavy Equipment	Nassau
Mike Stubbs	Nassau

Feed:

Agro - Tech.	Miami, Fla.
Broward Grain & Supply	Dania, Fla.
J & L Feed Supply	Dania, Fla.

Fertilizer:

Agro Tech.	Miami, Fla.
Atlantic Fertilizer	Homestead, Fl
International Mineral & Chemical	Melrose, Fla.
Hector International Supply	

Seed:

Ferry Morse	Tampa, Fla.
Dessert Seed	El Centro, Ca
Burpee Seed Co.	Stanford, Fla

Farm Supplies:

Hector International Supply	Miami, Fla.
Bode's Exports	Miami, Fla.
Atlantic Fertilizer	Homestead, Fl
Agro-Tech.	Miami, Fla.

* Animal Feeds

** Animal Feeds and Agr. Supplies, Agri. Equipments

*** Pesticides, farm tools, fertilizer.

Thus, it was concluded that if farmers did not have the Co-op as a source of basic services, there would not be other adequate nor convenient sources available to them.

NEED FOR PROCESSING AND MARKETING SERVICES:

It has been unnecessary for the Co-op to engage in marketing to-date. because of the complexity, high costs and requirements for competent personnel in marketing, this has been futinate. Furthermore, the Co-op is new and has been occupied with other responsibilities in its formative period.

When interviewing 15 members, a question was asked, "How can the Co-op be more helpful to you: (a) next year, and (b) during next five years.

Among the responses relating to marketing six (6) members said the Co-op should have a slaughtering house, and six (6) said it should process and market fruits and vegetables.

COMPETENT MANAGEMENT:

Of the requirements for success of the Co-op, competent management is probably the most important consideration. The Co-op committee and the Co-op manager comprise the management team. This team has the responsibility of directing and managing the business activities of the Co-op. The success of the Co-op will be determined to a large degree by the competency of this management team.

CO-OP COMMITTEE:

The Co-op Committee consists of nine members, all have served on the committee for two years except one who has served only one year and one who begins a new three year term. The standard of education for all members is the primary level except one has a high school certificate and one a graduate degree. Some members hold leading positions in local churches and one is a member of the School Development Committee.

The management committee meets monthly on a fixed date and time. A cooperative training programme in management was started. This forms a part of the ordinary committee meetings and in addition they meet every fortnight. In the past some irregular participation by some of the members was observed. This might be a consequence of limited business experience. The irregularity has now improved with the training course. Two committee members were replaced in the general meeting of the Society on October 13.

The Committee has the responsibility of establishing cooperative policy and ensuring that its policies are carried out by the manager. Committee members have never been previously exposed to business management of this nature and lack technical know how and confidence to perform their duties.

CO-MANAGER TRAINEE:

The Co-manager was employed in November, 1976. Considering the limited time he had for adjusting himself to this new field of work and environment, he had adapted himself to the situation very well. He is well accepted by members and farmers.

In general, the Co-manager Trainee has been reasonably trained and is reasonably competent to serve as Co-op Manager. However, we also believe that due to the late start of the Management Agreement and his limited experience, the new Manager will need further assistance and qualified consultancy in business management and in agriculture.

TRAINING AND EXPERIENCE:

The Co-op Committee obtained no special training before taking office except a short seminar on cooperative organization. Three members participated in BARTAD's Farmer Training Course for three months.

The questionnaire revealed that all committee members want and will participate in further education and training. The majority emphasized the following fields as priorities.

Cooperative and business management
Agricultural production
Technical service to farmers, eg. livestock management.

It may be noted that all professionals interviewed strongly recommended further training be made available to improve the committee's ability to plan, control and maintain the cooperative business operations and also extend pertinent information and knowledge to regular members.

The ongoing training course in cooperative management was outlined to the end of 1977, and is planned to continue with the assistance of the Director for Cooperative Development.

The Evaluation Committee suggested that the whole Co-op committee take part in one-week of field training to Florida to be planned and organized by the Manager. This will enable the committee to study and observe other cooperatives in action. If budgets do not permit the full committee's participation, then the number could be limited.

SUPPORT OF MEMBERS AND OTHER FARMERS:

One of the keys to the success of the Co-op is the degree that members and other farmers support their Co-op. This support should come in the form of partonizing the Co-op, providing necessary share capital, giving moral support and learning their responsibilities by receiving more training and experience.

PATRONAGE:

Farmers on North Andros have very few choices of where to obtain production inputs or farm machinery services. In other words, the Co-op has virtually a monopoly in those services. Farmers can obtain some inputs from other sources such as local hardware stores and through the Ministry of Agriculture. For all practical purposes, however, it can be assumed that members and other farmers in the operating areas of the Co-op will use the Co-op for virtually all inputs needs

and farm machinery services unless its services become so poor and its prices so high that they will refuse to patronize. The latter conditions are not likely nor expected to prevail. The extent of patronage will depend on conditions as described in the Economic Need section.

SHARE CAPITAL:

Members accumulate equity in the Co-op by investing five percent of the value of business done with the Co-op - five percent of input purchases and five percent of machinery revenue. This is a sound and equitable method of accumulating equity. It is assumed that the Co-op will continue this practice and that members will support it. Members of the Co-op indicate that they would be prepared to put in more than five percent share capital in the Co-op if it were needed.

COMPOSITION OF MEMBERSHIP:

The majority of the members originate from North Andros. Four are from South Andros one is from Eleuthera. Some 10 percent cannot read or write. Of the remaining, 50 percent have primary and 40 percent some kind of secondary or equivalent education. Limited organized information or education have been extended to the general membership. However, a resolution has been passed to organize a meeting every second month with the general membership to provide more information and education to them.

Recently a cooperative NEWSLETTER has been prepared and circulated to the members. The intention is to keep them informed of the activities of their cooperative and also to include some educational aspects. The Co-op budget for 1977-78 includes provisions to print the NEWSLETTER.

SUPPORT BY THE GCOB:

Cooperatives in the Bahamas are new enterprises. The Cooperative Societies Act and the Regulations to the Act become operational on December 9, 1974.

Since then several Co-operatives have been organized including the one at North Andros. Primarily because of their newness, lack of experience, and lack of competent and trained personnel (Co-op Committee members, managers, key employees and members) Co-operatives will need encouragement and guidance. Thus the role of the Government can and should be a contributing factor to the success of Co-operatives in the Bahamas.

Furthermore, one of the goals of the Government is to become self-sufficient in agricultural production by 1980. To meet this goal it must adopt and follow programmes and policies that will encourage farmers to produce the required volume. Co-operatives can be effective tools in helping farmers increase and diversify production.

Some of the more important roles the Government can play include the following:-

1. Continue to encourage and support the organization and development of Co-operatives throughout the Nation.
2. In the near future, develop a corps of Cooperative specialists who can advise and assist cooperative business with their management, technical, research and educational problems.
3. Continue to develop a corps of various specialists in agriculture who can advise and help train farmers on technical matters relating to their production efforts and marketing.
4. Continue to support the Agriculture Credit Guarantee Fund Program so that all qualified farmers might be able to obtain proper production credit, and so that Co-operatives, themselves, might obtain proper loans for facilities and operations.
5. Continue to support land clearing and land distribution programmes so that farmers can bring more land into cultivation, thus helping the Government to become more self-sufficient in food production and to create more employment. Consumers will also benefit by the greater variety of food and increased production, giving them better diets and health.
6. Permit or give a duty free base to agriculture cooperatives on all agricultural tools, farm equipment and farm machinery sold to farmers.

If these policies and programmes are carried out properly, agricultural as well as community development throughout the Nation will be sound and reasonably rapid.

CONCLUSIONS AND RECOMMENDATIONS:

1. In compliance with ARTICLE IX of the Co-operative Project Agreement; the principal recommendation of the Evaluation Committee was that the Co-op is ready for financial and managerial independence from the Project Agreement with some additional assistance. The specific types of additional assistance recommended, and other related recommendations follow.
2. The Evaluation Committee concluded that competent management is the most important key to the success of the Co-operative; and that the management team is comprised of the Co-op committee and the manager.

The Committee recommended that efforts be continued to give the Co-op Committee additional training so members will become more capable of learning and carrying out their duties and responsibilities. This training should be organized and co-ordinated through the office of the Director of Co-operatives. The Director should consult with the Co-op Manager on training needs and programs. The Manager should participate in these training programs.

It is further recommended that members of the Co-op Committee be given one-week of specialized training in Florida observing and studying Co-operative in action. Should the budgets not be adequate for the full committee to participate then the number could be limited.

3. The Co-op now has the capability of providing very important farm machinery and production input services to farmers. It has a modern store and office, a reasonably good variety and stock of supplies, and an exceptionally valuable array of farm machinery to meet almost all of the machinery service needs of farmers on North Andros, except heavy land-clearing equipment. The financial condition of the Co-op is reasonably sound at present.

BARTAD, the Co-op Committee, the Co-op Managers and others responsible should be commended for getting the facilities and the services in shape to meet so many of the important needs of farmers in such a short time

The Committee recommends that the Co-op not be permitted to engage in any new service or activity which might restrict it from performing its basic services, and more importantly, which might jeopardize its financial position before it purchases the assets and inventories supplied by AID as referred to in ARTICLE V of the Project Agreement without the written permission of the Director of Co-operative Development. For example, the Co-op may desire to use Co-op funds to start a programme of making loans to members for production purposes or to extend credit to members on their farm supply purchases or farm machinery services. We believe these or similar type programmes should not be permitted in the immediate years ahead and until the Co-op has the expertise to administer them properly.

On the other hand, if arrangements can be made for the Co-op to assist in, or serve as an agent for, the Agricultural Credit Guarantee Fund Programme whereby the Co-op would not be liable in any way for collection of loans or losses that might occur in the credit programme, or that the Co-op's financial position would not be placed in jeopardy due to such assistance or service as an agent, then the Evaluation Committee would not be opposed to such an arrangement. Rather, it would encourage it.

4. The Committee concluded that Agricultural Cooperatives will serve as important tools in helping to achieve the goal of the Government in self-sufficiency in food production. In addition, they will serve as tools for mobilizing the people for social, cultural and economic development.

The Committee recommended that the Government of the Bahamas continue to provide support for the development of Co-operatives throughout the Nation including the North Andros Co-op. The type of support suggested is enumerated in the preceding section of this report.

5. The North Andros Agricultural Society should be given the exclusive agency for the Ministry of Agriculture, Fisheries and Local Government of North Andros, that is, the agency for the handling of supply inputs to farmers.
6. The services of a competent co-operative consultant be made available to the North Andros Co-op on a quarterly basis throughout 1978 for about two weeks each consulting trip; these duties should include a careful examination of the planning, budgeting, controlling and other management functions, as well as the policies, procedures and operations of the Co-op, including his giving detailed suggestions for improving such operations and management functions.
7. Communication and understanding among the general membership is vital for their motivation, participation and loyalty. It is therefore recommended that the Society obtain the assistance from the Director of Co-operative Development to carry out such educational programmes as deemed necessary.

The North Andros Cooperative Society has had a difficult time due in no small measure to political difficulties. The potential exists for a very satisfactory relationship with political representatives and it is urged that necessary efforts be taken by all concerned to meet and work out matters related to the continued success of the Co-op. In particular, it is urged that the land issue be resolved.