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INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE
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S E C O N D D R A F T

THE GENERATION AND TRANSFER OF TECHNOLOGY TO SUPPORT COTTON PRODUCTION IN THE CARIBBEAN

VOLUME II of 111

REVIEW OF THE COTTON INDUSTRY IN THE PARTICIPATING COUNTRIES

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VOLUME II

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CHAPTER IV

CHAPTER I

1. INTRODUCTION

1.1 Background to Feasibility Study

The tremendous potential for a Sea Island Cotton Industry for contributing to the diversification of regional economy, in terms of its contribution to import substitution activities, establishing inter-sectoral linkages, the generation of foreign exchange, and the creation of employment has been recognised. However, the industry has not been able to achieve its potential due to high production costs; low production and productivity; pest and disease problems; lack of organic linkages with processing and manufacturing activities; as well as low investment in research and development activities.

Cotton production, in the region has exhibited an erratic but generally downward trend over the last decade, with the production of clean lint following a similar trend. Several factors have been identified as responsible for this situation. Among these are:

(a) Price: the reduction in the price offered in 1983 of US$4.20/lb lint to US$3.22 in 1986 was deemed unrealistic in view of the high production cost of seed cotton.

(b) The subsistence nature of production and the resulting low yields: It is evident that inadequate pest control and poor quality planting material limited fertilizer application and plant density factors contributed to low yields.

(c) Shortage of labour: With the relative decline in the agricultural labour population, cotton farmers have found it increasingly difficult to secure labour for agronomic practices and harvesting.

(d) Government Policy: The governments of the existing producing countries seemed unable to mobilize resources or the commitment for production at adequate levels. This is so despite a clearly stated policy favouring the production of Sea Island Cotton as an element of their agricultural sector diversification plans and programmes, a powerful sugar lobby which feared, in the case of Barbados, that the support programme for sugar would be diluted to include cotton as well as other non-sugar crops, magnified erosion problems and the failure of statutory bodies to engage in efficient production.

(e) An unclear picture by growers and private investors in producing countries and in the Region of the incredible potential of the Sea Island Cotton to produce significant

foreign exchange earnings, because of the increased value added possible to every stage of the processing cycles between lint and the final product, generate employment, upgrade the cut and sew industry of the region and create permanent clothing and textile manufacturing industries.

The production of Sea Island Cotton in the Caribbean carries with it a new perspective which reflects the firm commitments of Caribbean governments to establish an integrated Sea Island Cotton industry within the region. Agreement was reached among the four Sea Island Cotton producing countries - Antigua and Barbuda, Barbados, Montserrat and St. Kitts and Nevis - on the establishment of a joint venture company in which a private sector extra-regional company was permitted to be the majority shareholder and involving a Japanese Company with a long history in the cotton processing and the technology to spin other varieties of long staple cottons. Caribbean Sea Island Cotton Co. Ltd (CARSICOT) was established in 1988 to develop, process and market all yarns and items manufactured from Sea Island Cotton produced in the four producing countries. This company ceased operating because the government of Barbados, in January 1990, decided that it could no longer permit the extra-regional company involved in the joint venture any further participation in any aspect of the proposed integrated Sea Island Cotton industry. this action followed the discovery of extra-rgional of serious infilicites, perpetrated by persons involved in the that company which threatened the long term viability and commercial success of the venture.

The responsibility for developing the integrated Sea Island Cotton industry has been assigned by the governments of the four producing countries to a new company. This new company Caribbean Cotton Industry Incorporated (CCII) in which the government of Barbados has a 51% shareholding, also has among its shareholders, the Government of Antigua and Barbuda (8%) St. Kitts/Nevis (4%), Montserrat (4%), Nitto Boseki & Co. Ltd (a Japanese textile company (25%). The remaining 8% is reserved for cotton producers in Barbados and any of the other Sea Island Cotton producing countries whose governments are equity shareholders in the venture. So far only one (1) cotton grower has purchased shares in the company. The Barbados Cotton Growers Association has, however, proposed that shareholding be acquired with financing from other sources and assigned to it. A proposal which should not be considered since growers in all producing countries should be treated equally and the importance of an independent private sector involvement in the proposed industry.

Adopting the same basic objective in the creation of the Caribbean Sea Island Cotton Company, which were inter alia;

i. a cotton yarn spinning facility be established to convert West Indian Sea Island Cotton fibre in yarn for export

where appropriate and for processing locally into a variety of high quality fabrics for export or manufacture into garments and other items for local, regional and extra-regional markets;

ii. a cotton yarn knitting facility be established to convert West Indian Sea Island Cotton yarn into a variety of knitted fabrics garments and other items for local, regional and extra-regional markets.

iii. establish a Cotton Research Centre for the purpose of maintaining and improving the best genetic qualities of West Indian Sea Island Cotton, develop new varieties from the MSI and V135 varieties, enhance cotton growing technology and advise and assist growers to improve existing growing practices and adopt new methods.

iv. grow cotton on lands under its own control specially reshaped for cotton growing, employing proving management and tested technological approaches including pest control and eradication, and assisting local contract farmers to apply such methods.

v. the production of cotton by-products such as cotton seed oil, cotton seed meal, cotton seed linters.

vi. establish a centre which will develop and acquire the technologies of fabric and fashion design and the manufacture of clothing and other items from Sea Island Cotton and support the garment and other textile manufacturers in the producing countries.

Participating countries through the newly created company, Caribbean Cotton Industries Inc (CCII) has decided to promote Sea Island Cotton production in order to meet a world wide demand which has continues to exist even though Sea Island Cotton lint has been limited in both production and distribution.

A technical study undertaken for the government of Barbados at its own expense by the British company, Tootals Textiles International operations, on the feasibility of establishing a spinning, weaving and dyeing facility in Barbados to process Sea Island Cotton lint from the producing countries, fully supported the economic , political and cultural reasons for discontinuing the practice of producing a primary product for processing elsewhere. Moreover, that study which was completed in 1987, proposed a site for cotton processing complex and recommended that its size be limited to the processing of the equivalent of six hundred 9600) bales of cotton per annum.

A "feasibility study" undertaken by Messrs. Nitto Boseki & Co. Ltd of Japan of the costings and operation of such a facility has

shown that it can become profitable after the four years of operation. Because of the contribution which Nitto Boseki & Co. Ltd has made in improving the processing of Sea Island Cotton into counts not previously produced by any textile manufacturer as well as expanding the variety of fabrics and garments, the governments of States holding equity in the joint venture agreed to the participation of this Japanese company in the venture. Consequently, Nitto Boseki & Co. Ltd has pledged and is committed to put at the disposal of CCII the benefit of its long accumulated experience in the construction, equipping and management of the processing complex. In addition it has also pledge to ensure the transfer of up-to-date technology in spinning, weaving, knitting and dyeing of yarns and fabrics and the other finishing procedures that enhances the quality, feel and appearance of fabrics only to nationals of the four (4) producing countries.

Because of these commitments and understandings given and arrived at with the Japanese company, it will be allowed to purchase the equivalent of nine hundred bales (900) of lint annually in order to keep in operation the Sea Island Cotton processing facility it has developed so that it can continue to satisfy the demands of the various companies involved in the future of Sea Island Cotton yarns in Japan. This arrangement will maintain in being the structure and operation of the market for Sea Island Cotton goods and other items in the Far East which has been developed.

It is estimated that world wide demand for West Indian Sea Island Cotton is about 3.5 million pounds or 1,600 mt of lint per year. Initially a production level of 840,000 pounds or 1500 bales of lint will be required to meet the optimum processing levels of the local plants as well as the Japanese counterpart. In order to achieve a sustainable supply of yarn at the lower level of demand indicated and, over a time, to ensure an increasing level of supply in keeping with world demand, the establishment of a research and development programme is an urgent and necessary requirement.

Sea Island Cotton production is a very worthwhile activity, there being an assured outlet and an attractive price for this high quality fibre. The CCII wants to encourage and increase farmers' participation in cotton production. The return of private farmers to the production of cotton should be welcomed, since their participation is vital in the overall context of increasing regional production. It will, however, be necessary to develop an efficient technical assistance programme at the farmer level, aimed at consolidating the active participation of farmers in the production process. The selection of better varieties that can increase yield and fibre quality, the formulation of a technology package, more efficient harvest and post harvest arrangements and a better pest control management regime, should secure their participation. The technology package recommended to farmers must be based on research findings and should guarantee better farm

returns. The suggestion that the present commercial variety of Montserrat Sea Island Cotton has become variable in terms of its fibre length and premium quality confirms the urgent need for a genetic improvement and maintenance programme. It is therefore, important to reiterate the need to develop an appropriate comprehensive research and development programme designed to remove constraints to production and to improve genetically the quality of Sea Island Cotton. Processors of West Indian Sea Island Cotton lint have detected a decline in those special attributes which gives this fibre its "spinnability".

During the year 1988 aspects of a cotton research and development programme were funded by the Barbados government, with some technical assistance from the Natural Resources Institute (ODNRI) and funded by the British Development Division. Additionally, in 1989 funding was obtained through a World Bank Programme for two experts from Israel to work on aspects of agronomy and genetics. However, a much more coordinated and comprehensive approach is needed for the generation and transfer of technology so vital to the development and successful operation of an Integrated Sea Island Cotton Industry in region.

At the Thirteenth Meeting of the Standing Committee of Ministers Responsible for Agriculture, it was agreed that a project entitled "The Establishment of an Integrated Sea Island Cotton Industry" should be prepared for possible funding under the European Development Fund LOME IV regional allocation. Through the government of Barbados, the assistance of the Inter-American Institute for Cooperations on Agriculture (IICA) was requested for the elaboration of the project.

The decision to examine the feasibility of implementing a comprehensive Cotton Research and Development project is justified because:

(a) The cotton industry is of great importance to the national economies of the participating countries, in terms of its potential for import substitution, establishing inter-sectoral linkages through the development of secondary industries, creating employment, and generating foreign exchange. The establishment of a viable, productive and efficient cotton industry that is totally integrated within the agricultural and other productive sectors can see substantial benefits accruing to producing countries.

(b) The generation and transfer of cotton technologies can play a key role in ensuring high and sustainable levels of production through increased yields. Productivity growth is needed to increase the profitability to growers, the processors and to exploit the existing world wide market for fine, high quality fabrics and garments

which can be manufactured from Sea Island Cotton.

(c) A well structured, adequately staffed regional cotton research and development centre would provide the institutional framework necessary for addressing the research and development needs of the cotton industry as identified in national plans and policies and by the farming communities.

(d) There is a need to arrange for the acquisition and adaptation of technologies from within and outside the region and their application to the production, processing, manufacture, packaging, marketing, storage and distribution of cotton products.

(e) A regional sea island cotton research and development programme would permit the coordination and integration of research, development and production efforts of member countries where possible and feasible, and avoid duplication of effort.

(f) Develop a comprehensive integrated pest management, control and eradication programme.

(g) Give greater attention to the post harvest problems of the cotton production.

(h) Look at the possibility of adapting existing mechanical cotton harvesters to harvest Sea Island Cotton thereby avoiding the twin problems of damage through staining and breaking of the Sea Island Cotton lint which reduces its "spinnability" and value.

1.2 Objective

1.2.1 General Objective

The general objective of this study is to analyse the factors contributing to the cotton industry development or lack of it over years, to identify and prioritise research, development and extension problems, and formulate feasible solutions to these problems, indicating the resource implications.

1.2.2 Specific Objectives

(a) To evaluate the importance of the cotton sub-sector within the agriculture sector in particular, and the national economy in general. Identify constraints (economic, social, technological).

(b) To review on-going research, development and production programmes and projects, and identify and prioritise problems.

(c) To evaluate the capacities of principal research and development units/institutions concerned with this sub-sector to implement desired programmes and projects.

(d) To identify areas for research and development actions based on the priority problems areas identified and limitations in the institutional arrangements.

(e) To formulate a feasible research and development programme for funding.

1.3 Terms of Reference

The specific terms of reference were as follows:

(a) Assess the principal policies and development strategies that have influenced the recent performance of the cotton sub-sector and to examine and explain how these policies and strategies have impacted on levels of production, productivity, prices, income, profitability, employment and investment in the industry.

(b) Evaluate the resource base available for cotton production, including an evaluation of ecological conditions in the participating countries.

(c) Undertake micro-economic evaluation of cotton production including production and marketing cost determinations.

(d) Identify principal markets for primary and secondary products: international, regional and domestic, and characterise the marketing systems.

(e) Analyse price/market information and identify main constraints to the marketing of cotton and by-products (level of production price indices and price fluctuations causes; relationship between price, quantity, quality; and postharvest losses; size of the domestic market for by-products; market channels; post harvest handling; market system deficiencies; export requirements, policies, etc).

(f) Identify and propose actions, and development strategy and policy measures, where appropriate, to overcome production and marketing constraints identified in order to exploit this sub-sector potential to the fullest.

(g) Review and analyse the capabilities of existing relevant institutions to generate and transfer cotton technology, and to make the necessary recommendations for improvement in the institutional arrangements in order to provide better services to the cotton farming community.

(h) Review the existing situation with respect to genetics/breeding, seed production, and agronomic aspects of cotton production in the participating countries and to make necessary recommendations on genetic improvement programmes as well as priority agronomic research areas.

(i) Review the existing situation with respect to cotton pests and diseases in the participating countries and to make the necessary recommendations for combatting this constraint to cotton production, in terms of formulating an ecologically sound, cost effective integrated pest management research programme for Sea Island Cotton.

(j) Review existing agricultural engineering facilities available for and services provided to the research development, production and processing efforts of the cotton industry of each participating country and to make necessary recommendations for improvement of these services to the farming community.

(k) Formulate and present a feasible research and development programme for funding.

1.4 The Study Team

The feasibility study was conducted by a multi-disciplinary team of professionals drawn from the Ministry of Agriculture, Barbados, CARDI, IRCT-CIRAD, and IICA as follows:

1.	Vincent Little	IICA	Team Coordinator/Project Specialist
2.	Antonio Pinchinat	IICA	Technology Generation and Transfer Specialist
3.	Sam Parasram	CARDI	Technology Generation and Transfer Specialist
4.	Gilbert McSween	CARDI	Agricultural Engineer
5.	Guy Pauly	IRCT-CIRAD	Plant Breeder/Agronomist
6.	Jeffrey Jones	Ministry of Agriculture, Barbados	Plant Protection Specialist

Four countries were targeted for participation in this initiative as follows: Antigua and Barbuda, Barbados, Montserrat

and St. Kitts and Nevis. At the country level logistic and technical support was provided by counterpart staff drawn from the Ministries of Agriculture and CARDI's country offices.

1.5 The Work Programme

Working visits were made to participating countries to conduct field evaluations and for consultations as follows:

	Date	Activity
1.	Sunday 13 October	Team assembled in Barbados
2.	Monday 14 October to Wednesday 16 October	Review of the cotton industry in St. Kitts and Nevis
3.	Thursday 17 October to Monday 21 October	Review of the cotton industry in Antigua and Barbuda
4.	Tuesday 22 October to Friday 25 October	Review of the cotton industry in Montserrat
5.	Monday 28 October to Friday 01 November	Review of the cotton industry in Barbados
6.	Saturday 2 November to Friday 8 November	Report writing in Barbados

Time constraints prevented the team from completing the project document by November 9, 1991.

1.6 Governmental and Business Contacts

The following government officials and business men were consulted about various aspects of the assignment:

(a) **Antigua and Barbuda**

Lennox Weston	-	Permanent Secretary, Ministry of Agriculture
Frank Henry	-	Director of Agriculture
Norris Abbott	-	General Manager, Antigua Sugar Industry Corporation (ASIC)
Jerry Fernandez	-	Technical Officer, ASIC
Lazman Webson	-	Technical Officer, ASIC

Alfred Lewis	-	Principal Administrative Officer, Ministry of Agriculture
McKenzie Edwards	-	Director of Extension Services
Lesroy Grant	-	Cotton Specialist, Ministry of Agriculture
Vincent Belle	-	Entomologist, Ministry of Agriculture
Ralston Ferguson	-	Extension Officer, Ministry of Agriculture
Henry Francis	-	Extension Officer, Ministry of Agriculture
Florita Kentish	-	Consulting Entomologist
Ifteker Ameen	-	CARDI Representative, Antigua

(b) **Barbados**

Ruall Harris	-	Permanent Secretary, Ministry of Agriculture, Food and Fisheries
Carson Simmons	-	Deputy Permanent Secretary, Ministry of Agriculture, Food and Fisheries
Lionel Smith	-	Chief Agricultural Officer, Ministry of Agriculture
Winston Small	-	Deputy Chief Agricultural Officer, Ministry of Agriculture
Cephus Gooding	-	Chief Economist, Ministry of Agriculture
Peter Bell	-	Agronomist, Ministry of Agriculture
Michael Grant	-	Agronomist, Ministry of Agriculture
Ian Gibbs	-	CARDI, Barbados Office
Al Knight	-	Managing Director, Caribbean Cotton Industries Incorporated (CCII)
Atlee Brathwaite	-	General Manager, Barbados Agricultural Development Corporation (BADC)
Brian Crichlow	-	Agronomist, BADC

Frank Pilgrim	-	Senior Field Manager, BADC
Trevor Rudder	-	Barbados Cotton Growers Association
John Spence	-	Barbados Cotton Growers Association
Leroy Ward	-	President, West Indian Sea Island Cotton Association Inc. (WISICA)

(b) **Montserrat**

Rueben Meade	-	Chief Minister
Charles Kirnon	-	Minister of Agriculture
Anthony Maloney	-	Permanent Secretary, Ministry of Agriculture
Eugene Skerrit	-	Acting Director of Agriculture
Thomas Farrel	-	Extension Officer
Teresila Bodkin	-	Statistician, Ministry of Finance
Doris Dorsette	-	Store Manager, Montserrat Sea Island Cotton Co. Ltd.
Julius Ross	-	CARDI Representative, Montserrat

A group of cotton farmers were also interviewed.

(c) **St. Kitts and Nevis**

(i) Nevis

Elmo Liburd	-	Permanent Secretary, Ministry of Agriculture
Augustine Merchant	-	Director of Agriculture
Kelvin Swanson	-	Cotton Development Officer, Ministry of Agriculture

(ii) St. Kitts

Valdemar Warner	-	Permanent Secretary, Ministry of Agriculture
Keith Archibald	-	Director of Agriculture
Sherman Weekes	-	CARDI Representative, St. Kitts and Nevis

CHAPTER II

2. IMPORTANCE OF THE COTTON INDUSTRY IN THE REGION

2.1 History of Cotton

The cotton grown in the Caribbean Region belongs to the Sea Island Cotton type. But what is Sea Island Cotton and how is it linked to the Caribbean. The following commentaries by internationally renown cotton experts should help to clear up existing confusion about this variety of cotton.

Dr. Carl V. Feaster, who was Research Agronomist with the United States Department if Agriculture in Phoenix, Arizona when he retired from the service in January 1985 noted in an affidavit filed in the United States District Court, Southern District of New York and dated 11th May 1990 noted:

> "all cottons of economic importance which originated in the western hemisphere are either of the Gossypium Barbadense or gossypium hirsutum genus and species. Gossypium barbadenes's origin is from South America and gossypium hirsutum's origin is from Southern Mexico and the Guatemala area.
>
> For many years gossypium Barbadense was grown as a perennial plant in the western portions of South America. It was grown by the Incas and other natives of the area and eventually became a commercial crop in the coastal valleys of Peru. It continued to the grown as a perennial plant for many years, but eventually was modified to be an annual plant for the purpose of more intensive cultivation and better pest control.
>
> A gosspyium Barbadense variety known as brasilienne is believed to have been developed subsequently from Peruvian cotton to meet the requirements of the moist tropical forest areas of Brazil. This brasilienne form of gossypium Barbadense became common in the moist areas of North Western South America and then spread through the Lesser and Greater Antilles of the West Indies. By the eighteen century, the Gosspium barbadense variety of brasilienne and other varieties of gossypium barbadense were established in the West Indies as a perennial crop.
>
> The gossypium barbadense then prevalent in the West Indies appears to have naturally crossed with a wild species of gossypium hirsutism. Seeds from the longer and finer fibered plants from the natural crossing was then taken to the Sea Island area off the coast of Georgia and South Carolina and to the coastal area of South Carolina. Once moved to the Sea Island area, natural selection pressure for earlier types (cottons

that are ready for harvest earlier in the year) eventually resulted in plants better adapted to the area and for annual production.

Seeds from these varieties of Sea Island Cotton subsequently was returned to the West indies and used to establish the Sea Island Cotton industry in that area. Production of Sea Island cotton also continued in South Carolina, Georgia and the Sea Islands into the twentieth century. By about 1920, boll weevil infestation became so severe in Georgia, South Carolina and the Sea Islands, that production of Sea Island Cotton there greatly declined and eventually ceased.

As a result of the cessation of growth of Sea Island Cotton in the United States, the West Indies have become the only commercial source of the gossypium barbadense cotton know as Sea Island. There have been attempts over the years to commercially grow Sea Island cotton in other parts of the world, including Egypt, but those efforts failed".

At the time of his retirement Dr. Feaster was Research Leader for the Cotton Breeding and Production Group for USDA in Phoenix and Technical Adviser for cotton production research, Agricultural Research Service. Since 1980 Dr. Feaster was responsible for the development of four (4) new pima cottons (extra-long staple gosspium barbadense cotton grown in the Southwest United States) cultivars. The releases of the farm cultivars for commercial production have provided up to a 60% increase in yield potential for the crop and or fibre quality improvement making it suitable for high quality thread and high quality textiles.

Mr. S. G. Stephens, in an article entitled "The Origin of Sea Island Cotton" in Volume 50 No. 2, April 1976 published quarterly for the Agricultural History Society by the University of California Press, stated:

"Overlooked in these late eighteenth century accounts, and in later discussions based on them, is the historical fact that the first cottons grown on the eastern seaboard (of the United States) were introduced from the West Indies. Cotton plants from the West Indies were grown during the settlement of the Jamestown Colony in 1607. Sixty years later, records of the Cape Fear Colony, founded by adventurers from Bermuda and Barbados in 1664, state that "they planted and produced very excellent tobacco, indeco (indigo), cotton and potatoes and other root crops proper to the Barbadoes, Virginia and Barmoodos" The Cape Fear settlement was short lived, but a permanent settlement at the mouth of the Ashley River, near the future Charleston, was established in 1670.

Immigrants from Barbados and Bermuda formed a large portion of the early settlers and attempts were made to grow several West Indian plants, including cotton"

Mr. Stephens in his article continued "It is almost certain that these early West Indian cotton introductions were forms of Gossypium Barbadense. Barbados was the first West Indian colony to grow cotton on a sufficient scale for export. It was settled in 1627, the island being uninhibited previously. The land was in virgin's forest and after clearing had begun seed and roots for planting (yams, cassava, indian corn, plantains, tobacco, cotton an annotto) were obtained from the Dutch settlements in the Guianas through direct barter with the native Arawak inhabitants. The cotton still grown on native indian settlements in the interior of the Guianas are perennial forms of Gossypium Barbadense, which are strongly "short-day-sensitive" i.e. incapable of maturing seeds during the long summer days of temperate latitudes. Thus the cottons planted in Barbados in 1627 would most likely have been perennial short-day-sensitive forms of Gossypium Barbadense. By 1640, thirty years earlier than the first Carolina Settlements, "cotton and cotton-wool ranked equal with tobacco among Barbadian exports" and this, presumably, was the reason why the earliest Carolina plantings by Barbadian planters included cotton. Again during the later seventeenth century, there was considerable emigration from both Barbados and Bermuda to the Carolinas and there were early attempts to grow cotton in Bermuda. It may be significant that the cotton plants which still survive in Bermuda door yards are forms of Gossypium Barbadense while in most other West Indian islands forms of Gossypium hirsutum predominate. Finally the eighteenth-century Linnaean epithet "barbadense" derives from Barbados.

Two other internationally renown cotton experts, Professor N.C. Innes then Deputy Director, Scottish Crops Research Institute, Invergowrie Dundee, Scotland and Mr. John J. Mitchell, Spinning and Cotton Consultant, the Shirley Institute, Didsbury, Manchester States in a joint deposition made in 1987 and entered for the defense in a WISICA Trade Mark hearing in 1988, wrote:

"High quality cotton varieties from Gossypium Barbadense (a species to which Sea Island cotton belongs) have also been developed for cultivation under irrigation in Egypt and the Sudan from where they are collectively sold as Egyptian-type cotton. Although Sea Island and Egyptian cotton have a common ancestry, reaching back to the early 19th century (Stead, Pyramid Surveys) the characters of current day Sea Island varieties as grown in the West Indies and Egyptian cotton are different. In evolutionary genetical terms disruptive selection for different characters in different environments in a variable original stock (or population of plants) produces divergent genotypes (or varieties). Such

divergent selection has been achieved in all plant crops as well as in cotton. In cotton itself it can also be seen by the marked differences in plant type and lint quality of African and USA varieties of Upland (Gosspium hirsutum) cotton despite the fact that African varieties are largely derived from an Upland variety called Allen introduced from the USA to Uganda in the first decade of the present century (Innes & Jones, 1972). In highlighting the differences between Sea Island and Egyptian cottons, Hutchinson, Silow and Stephens (1947) stated (p. 103) "The establishment of the Sea Island cottons in South Carolina in the latter part of the eighteenth century marks the beginning of the modern commercial types of G. barbadense. The annual habit was perforce established immediately, since all strains that did not fruit before winter were eliminated by frost, and it is evidence of the great variability existing in the perennial G. barbadense cottons of the time, that it was possible to select early cropping plants in the original introductions. The agricultural advantages of the annual habit of the Sea Island Cottons have made possible the establishment of a stable cotton-growing industry in the West Indian islands, in the face of pest that rapidly reach epidemic proportions on perennial types. Owing to their specialization to meet a small demand for extreme length and fineness, they have not spread widely, and their most important contribution to the world's cottons has been the production, from Sea Island x perennial G. barbadense hybrids (Balls 1919), of the fine cottons that now constitute the Egyptian crop. In response to the environment of the Nile valley, a definite Egyptian type has been evolved, so that the Sea Islands and Egyptians must now be regarded as geographically and ecologically distinct."

From an agronomic point of view, the Sea Island Cotton is characterized by its annual growing habit (as differentiated from the perennial wild G. barbadense) with a long crop cycle of 6 to 7 months. The selection of the Sea Island Cotton type has also resulted in a morphological change from the original G. barbadense plant in that its plants grow fewer or no vegetative branches. Under optimal growing conditions, Sea Island plants are generally tall (between 1.5 and 2.0 m) due to their tendency of growing vegetatively. The fruiting period is usually long and boll maturing slow. Sea Island cotton is also characterized by rather small and "storm proof" type bolls. Another feature of this cotton is that it is highly susceptible to bacterial blight (Xanthomonas campestris malvacearum).

- Compared with other cultivated cottons, the yield potential of the Sea Island Cotton lines ranges between (1,500 to 2,500 lbs of seed cotton/acre or (1,600 to

2,300 kg/ha). Its lint recovery (or ginning percent) is very low (between 20 and 33% depending on the lines).

- The exceptional quality of the fibre, marked by its extreme silkiness, length, strength and fineness, has made the Sea Island Cotton the best cotton in the world; its unique quality has given it worldwide recognition. The "West Indian Sea Island Cotton" became the trademark of the Sea Island Cotton produced in the Caribbean countries. It is also interesting to note that the SI cotton tends to produce a fibre significantly less mature than the other "barbadense" cottons.

Mr. J.H. Saunder, a noted Cotton Breeder/Cotton Geneticist, of Pear Tree Cottage, Hogdale Lane, Ashford, kent, UK. in a statement on the difference between Sea Island Cotton and Egyptian Giza 45 dated 18th December, 1987, wrote:-

> "Genuine Sea Island Cotton is a Unique fibre and from it is produced the finest (both quality and physical character) thread and cotton fabric obtainable. The decline in demand for Sea Island Cotton in the 1950's was due in part to the enduring quality of the product, manufacturers required a more rapid consumer turnover in their products. Sea Island Cotton has always been synonymous with the best quality.
>
> Egyptian Cotton is produced on a vastly greater scale than Sea Island and caters for the market's need for high quality cotton goods but falling short of that achievable with Sea Island Cotton.
>
> Sudan Cottons of which VSI is one variety serve a similar purpose and their utilisation by manufacturers is determined by availability within a class and grade and competitiveness with Egyptian Cotton.
>
> Thus Sea Island Cotton is unique and can only truly be said to derive from cotton crops grown on islands of the Antilles in the Caribbean. The fibre characteristics are in fact its fingerprints and will always be distinguishable from other cottons of different origin claiming to be the same thing. Thus Giza 45, an undeniable quality Egyptian Cotton cannot be claimed as equal to or even similar to Sea Island Cotton.
>
> So far as the records show and my experience goes no one has grown Sea Island Cotton as well outside its indigenous environment of the Caribbean. As stated earlier it was grown for some years in Egypt without much success".

From that discription of the SI cotton, it appears that the high fibre quality is the determining factor in promoting the Sea Island Cotton production in the Caribbean. However, some of its inherent agronomic characteristics can act as serious limiting factors to its continued cultivation. The characteristics include:

- A long growing cycle is a serious dis-advantage compared with that of the other cultivated cottons. In addition to the fact that SI cotton cannot generate "quick income" for the farmers, the SI crop is also exposed to more pest and weed problems and/or adverse climatic conditions which can result in lower yield potential and higher costs of production.

- Plant height and tendency to vegetative growth on the one hand, and its long fruiting period with a slow boll maturing on the other hand as well as staining of the fibre and its damage to its staple length during the cleaning process are factors limiting mechanization of the harvest can be limiting factors to the mechanization of the harvest.

- "Storm proof" boll makes the cotton harder to harvest.

- The problem of fibre maturity is related to the slow maturing of the bolls; any factor that will force the maturing process of the boll, such as drought, spraying of defoliant, or soil fertility problem, will result in the production of immature fibre.

- Sea Island cotton appears to be a low yielder/lint producer compared with other cultivated cottons, does not encourage intensive cultivation at the farmer level.

- Its susceptibility to bacterial blight can jeopardize the Sea Island cotton production in case of outbreak of this disease.

Therefore, in order to develop a rational programme for Sea Island cotton production, it is recommended that these limiting factors be taken into account in order to reduce their possible incidence on the crop or on the management of the crop. The elaboration of an integrated "technology package" specifically designed for Sea Island cotton, will eventually make this crop more manageable and competitive at the farmer level. This should include the following:

- Selection of varieties with better agronomical and technological characteristics,

- Production and distribution of pure and good quality seeds,

- Improvement of Pest and Weed Control,

- Improvement of agronomical techniques (plant population, spacing, fertilization, etc.), and

- Mechanization of crop production as much as possible.

2.2 Sea Island Commercial Variety

The variety grown in all producing countries is the Montserrat Sea Island, better known by its initials, MSI.

This variety has been cultivated for several decades since the 30's without any genetic amelioration, with the resulting decline in those attributes which make Montserrat Sea Island Cotton the most exclusive and highly valuable raw material recognised by the textile industry worldwide. Another unique factor is that the production of MSI seeds has always been undertaken by the Central Cotton Station of Antigua which, up to the present, continues to supply the other Sea Island cotton producing islands with MSI pedigree seeds.

2.2.1 Origin of the MSI Variety

The generic origin of this variety is quite uncertain aside from the theory that this genetic material was developed over the years from the SI cotton that was once introduced on the island of Montserrat, the same way that other lines were developed on each of the other islands, such as V135 in Saint Vincent, KSI in St. Kitts, and BSI in Barbados. The MSI variety has been grown commercially in Antigua since 1931. Due to its better yield potential, MSI has gradually displaced all the other SI commercial lines (V135, VH8 and VH10 material) in the different islands and is known today as the only SI commercial variety in the region. In order to preserve its genetic purity, the Central Cotton Station of Antigua developed the "MSI Seed Selection and Multiplication Programme" which is still operational.

2.2.2 Description of the MSI Variety

From an agronomic point of view, the MSI variety falls under the general description of the SI cotton given in paragraph 2.1 with maybe a more compact and shorter plant configuration. Based on the yield data obtained by the Central Cotton Station, the MSI variety can produce up to 2,500 lbs of seed cotton per acre (2,700 kg/ha) under optimal growing conditions. However, this yield level was seldom attained in commercial crops; yields recorded by farmers or estates were much lower, ranging from 400 to 800 lbs/Ac (440 to 900 kg/ha), mainly because cotton was not grown under the most

favourable conditions. The main constraints to a higher production levels were climatic and soil factors, land preparation, date of planting, plant population , weed and pest control and poor fertilization.

Regarding lint production, MSI ginning percentage varies between 30% and 33%. MSI has shown a significantly higher lint recovery than the other commercial SI varieties once grown in the region, namely V135 and VH8. It was a potential lint production of about 800 lbs/Ac (900 kg/ha) but field reports, however, show that the average lint yield ranges between 120 and 400 lbs/Ac (130 to 45 kg/ha).

MSI fibre characteristics are generally extremely good. Although its fibre length has been classified as shorter than the fibre length of other SI lines (VH8 and V135), MSI produces extra long staple fibres. Based on old results of fibre analyses conducted at the Shirley Institute between 1941 and 1977, its effective fibre length average 44.3 mm, but it can vary from very long (39 mm) to extra long (45 mm). The most recent fibre testing conducted in 1991 at the IRCT-CIRAD laboratory on 79 fibre samples of MSI progeny rows (issued from a single plant selection implemented in the first multiplication of the Pedigree seed in Barbados in 1989/90), has yielded an average length of only 38.2 mm. The uniformity of the fibre length was low (43.0%) while its fibre tenacity (or strength) was shown to be extremely high (average of 28g/tex from the Shirley Institute tests and 30.8 g/tex g/tex from the IRCT analysis). Its fibre is fine to very fine: with a standard fineness (Hs) average of 179; all tests indicate the average micronaire index at 3.30. The fibre maturity appeared rather average, and as a result it is highly probable that the MSI will produce immature fibres when growing conditions are not optimal.

There is little data available about bolls and seeds except that the MSI variety produces rather small and conical bolls with an average of 3.4 locs while the boll weight ranges from 3.0 to 3.5 g. The seed index is usually very high, 12 to 14 g, and its lint index can vary from 5.5 to 6.3 g.

All data given above are mean values and should therefore be taken as indicative figures more than standard values of the MSI agronomical and technological descriptors. These figure can be subject to considerable variations depending on the location (island and area on the island), climatic conditions and local growing conditions.

It is unfortunate that, after growing the MSI variety for so many decades, only a limited number of lint test results are available either for commercial cotton (WISICA commercial samples) or for progeny selections. Fibre test should be conducted regularly at both levels, commercial and research, to get a better

appreciation of the specificity of the MSI lint characteristic and the influence the environment has on its fibre quality. Also, regular gathering of data on lint quality would help confirm whether the MSI variety has indeed deteriorated over the years.

The real yield potential of the MSI variety, low as compared with other cultivated cottons, has rarely been exploited, mainly because the commercial MSI crop has never been intensively cultivated. Although the variety seems to be very adapted to the Caribbean region, the success of the cotton crop depends largely on the local growing conditions just as with any other crop. It is thus assumed that maximum yield could be achieved under optimal growing conditions.

Compared with other SI varieties, the MSI line has shown a significant improvement in yield (quantity of seed cotton per Acre) and lint recovery; but as to fibre quality, it produces shorter staple length.

2.2.3 MSI genetic deterioration problem

Although the lint characteristics of the actual MSI variety remain good, lately there have been feedback indicating a decline of its fibre quality.

The study conducted in Barbados in 1990/91 on the lint recovery and fibre quality of the MSI progenies issued from a single plant selection conducted in the first multiplication of the Pedigree Seed shows a wide range of values: lint recovery ranging from 25 to 30%; staple length ranging from 34.6 to 39.8 mm; strength from 27.4 to 33.6 g/tex; and standard fineness (Hs) from 158 to 192. Considering that all these MSI progenies constitute one population representing the MSI variety, we can conclude the MSI variety actually grown in Barbados has a wide genetic variability with respect to lint quality and ginning percentage. This is expressed phenotypically by the wide range of values. Having been given the following study results: MSI lint recovery is lower than the given standard of 33%; the staple length, with values lower than 40 mm, seems shorter; and the fibre strength appears higher than in earlier fibre tests, it is still difficult to conclude that the actual MSI seeds have deteriorated genetically due to lack of sufficient data in the past.

While the assumption of deterioration of the MSI variety still needs to be scientifically verified, it gives weight to the fact that the MSI variety may no longer have its original genetic purity due to the kind of selection implemented during the seed production process.

2.3 Relative Importance of the Crop

2.3.1 Introduction

Sea Island Cotton is of tremendous importance to the economies of Caribbean countries because of its potential to earn foreign exchange, generate employment, create inter-sectoral linkages particularly with tourism, create new activities, ensure the long-term viability of the clothing industry and adapt to the drier crop growing areas of the region. Sea Island Cotton has been grown in the region for many decades but production levels have increased or decreased depending on the fortunes of sugar. Because of the very poor outlook for the future capacity of sugar cane to generate the level of foreign exchange and further economic activity so necessary if the producing countries are to adequately cater to the needs of their populations. The development of another crop to increase foreign exchange earnings and economic development is a vital and urgent necessity.

2.3.2 Foreign Exchange Earning Potential

2.3.2.1 Production and Export Revenue

(a) Introduction

At one time, Sea Island Cotton growing in the Eastern Caribbean States produced close to 3,000,000 pounds of lint annually, from 6,300 acres of land. Today, about 1,000 acres of cotton are being cultivated in the countries surveyed. The reasons for this drastic reduction in production are as follows:

(i) strong inroads by synthetic fibres and lack of competitiveness of The British Textile Industry - and lack of market development.

(ii) Infestation by the pink boll worm, resulting in reduced yields.

(iii) Poor cultivations practices.

(iv) High costs of labour and supplies.

(v) A failure to provide adequate and timely technical support to farmers.

(vi) A lack of appreciation of the potential of cotton production to generate further economic activity and increased national wealth because of the high value added earning potential possible from the further processing of Sea Island Cotton.

(b) Foreign Exchange Earning Potential

In Barbados and the Eastern Caribbean where agricultural commodities with foreign exchange generating potential are very limited, the advantages of cotton production based on financial and economic criteria become obvious when compared with sugar cane, the major export crop. As shown in the table below, cotton shows vast superiority in terms of net revenue per acre, plus the fact that the cotton crop cycle is 3-4 months shorter.

FOREIGN EXCHANGE POTENTIAL OF SUGAR AND COTTON

	Sugar	Cotton Lint
Yield per acre	25 tonnes	500 lbs
Price per acre ($)	1000	1100
Gross Revenue ($)	2500	5500
Leakage (%)	15	20
Net Foreign Exchange ($)	2125	4400

Production in the region since 1984 has varied from a low of 37287 lbs lint from 291 acres to 440651 lbs from 1568 acres with consequent variation in foreign exchange generated at the primary product level - see table below. The extent to which profit can be generated at the primary level depends heavily on both the extent and efficiency of production. Historical data shows that at one time the region had over 14000 acres under cotton cultivation.

At the present attractive price of US$5.50 per lb for lint, the Caribbean can capitalise on this for foreign exchange generation, with a current potential for growing about 9,000 acres of cotton.

REGIONAL* PRODUCTION AND REVENUE (1984-91)

YEAR	ACREAGE	LINT (lbs)	REVENUE (Lint Only) (US$)
1983-84	291	37287	120,219
1984-85	426	71856	542,718
1985-86	952	362360	1,599,371
1986-87	1568	440651	1,328,934
1987-88	1456	290390	977,155
1988-89	1110	227365	785,395
1989-90	819	109182	457,990
1990-91	1088	88093	413,625

*(Barbados, Antigua, Montserrat, Nevis)

Royalty payments and licensing fees for users of Sea Island

Cotton and the WISICA trade mark provide a source of additional income. The royalty amounts to US$1.70 approximately and is paid in Japan at yarn stage of the processing line. Additional income would accrue with an increase in the present level of those fees or when it is possible to calculated the Royalty payment on the retail price of the item.

In a study on the feasibility of establishing a spinning, weaving, knitting and dyeing facility financed by the Government of Barbados undertaken by a team of experts from Tootal Textiles International Operations it is recorded:-

> "Until decline late 70's and early 80's the traditional market was the United Kingdom when one or two spinners bought the entire crop for onward processing into fabrics and garments which were sold in domestic and export markets. The main products were woven shirting fabric, knitted underwear and leisure wear.
>
> Interest in North America led to the establishment by one united States of America textile manufacturer who developed a not insignificant market in italy, the USA and the Far East for a product made from Egyptian cotton which was marketed as sea island".

A legal action to stop this misdiscription is expected to succeed.

In discussing the constraints affecting the viability of the project and with specific reference to the supply of raw materials to the proposed facility. The Tootal study states as follows:

> "Discussion with a prominent Swiss Company on the future possibility of Sea Island Cotton products regaining their former position in the world market were encouraging and positive. However, it is worth re-emphasising the three essentials for success which were specifically mentioned.
>
> - a stable supply of cotton lint
> - improvement and maintenance of the quality of the cotton fibre
> - a realistic pricing policy.
>
> If these three essentials are not forthcoming over a period of years, the substantial sums of money required for the promotion of Sea Island Cotton products would not be justified. For valid reasons this situation does not obtain at the present time and if countries other than

Japan are to take up the marketing of Sea Island cotton, firm assurances would need to be given on the above points.

The same essentials would apply in the event a textile plant being established in Barbados. The plant would be designed to run 24 hours per day, 7 days per week for 48 weeks and any interruption in production would have a drastic effect on output and manufacturing costs, as modern textile mills need an activity factor of 85% or more if the are to be viable. Lack of supply of locally grown cotton may necessitate the import with consequent use of foreign exchange"

Establishing an integrated industry in the region offers, in the medium and long term, even greater possibilities for value added and foreign exchange generation. Thus processing leading to finished products and by-products as shown in the chart below are eagerly anticipated.

The demand in the market place for genuine sea island cotton and products made from it is said to be almost insatiable and an integrated industry in the region sustained by production levels of 1,500-2,000 acres (1500-2000 bales) could yield $20,000,000 per annum for the first three years of operation. This figure would increase significantly with increase in production levels.

The blending of sea island cotton fabrics with other national fabrics such as wool, silk, irish linen is an option for exploitation against the background of the large quantities of varied fabrics utilised by the clothing industry world wide.

(c) Transfer of Technology

The development of technical expertise to successfully cultivate large acreages and process efficiently the unit and by-products are key elements in the formula.

Genuine sea island cotton lint is being processed in Montserrat from low count yarns into finished products much as knitted shirts, table cloths, table mats etc. This embryonic yet ambitious venture is clearly a step in the right direction, but is constrained by Montserrat's technology and equipment which does not permit processing beyond 20 counts.

Since the serious revival of Sea Island cotton growing in 1983/84, Japanese interest (Messrs Nitto Boseki & Co. Ltd through the Sumitomo Corporation and recently Toyo Cotton Co. Ltd) has been purchasing the entire Sea Island cotton crop. The Company has set up a special Sea Island Cotton Division and it supplies yarn or fabric to the forty five (45) Japanese

companies manufacturing items from Sea Island cotton. These items include:

Menswear: Socks, (Japanese), dress shirts, casual shirts, pajamas, neckties, coats, sports shirts, suits, slacks, casual jackets, casual coats, swinwear, blazers, golf wear and beach wear, handkerchiefs, scarfs.

Womenswear: Socks (Japanese), shirts, blouses, pajamas, knit blouses, skirts, coats, blazers, golf wear, night gowns, lounge wear, foundation ensembles lingerie, handkerchiefs, scarfs/

Fabrics: A large variety of ladies fabrics, ladies and gents velvet materials.

Yarns: Hand knitting yarns

Other: Blankets, towels and bathrobes.

Lint is spun into yarn count ECC 15, 20, 40, 50, 60, 70, 90, 120 and 140 and single and double yarns are available. In 1990 Nitto Boseki succeeding in spinning yarn count ECC 260 and now yarn at this count is technically possible. Counts higher than 180/2 are new to the market, therefore Nitto Boseki has become a market leader in the spinning of very high count. Moreover, the 260/2 yarn was woven into handkerchiefs after the technical difficulties in yarn spinning, yarn doubling/winding, sizing and weaving were resolved. A handkerchief made from this yarn, which is comparable to natural silk filaments is retailed in Japan for 15,000 yen.

In the medium and long term, the transfer of technology that will accompany the establishment of an integrated industry in the region will ensure that the Caribbean acquire the expertise and move independently towards greater product diversification and the development of the various skills involved in spinning, weaving and dyeing high count yarns. Once the infrastructure for spinning, weaving and dyeing is available in producing countries, activity in the cut and sew industry, which has demonstrated the capacity to manufacture garments and other items of the highest international standards, will be accelerated. The relocation to the producing countries of many of the forty five(45) companies presently manufacturing items in Japan would be possible since access to the European and North American markets would be easier.

Nitto Boseki & Company is committed to the development of a spinning, weaving and dyeing facility in Barbados in concert with CCII. The Company's technical staff undertook a

feasibility study into the operation of a facility which could require an annual input of 600 bales of cotton. They have concluded that it would be profitable after the fourth year of operation. The Japanese are committed to help develop a modern facility and to train nationals from the four (4) producing countries as well as ensure the transfer to nationals from these countries only of the technologies developed over a long period of time. One constraint to the successful implementation of the project is the failure to reach the minimum level of raw material production necessary.

(d) Employment Generation

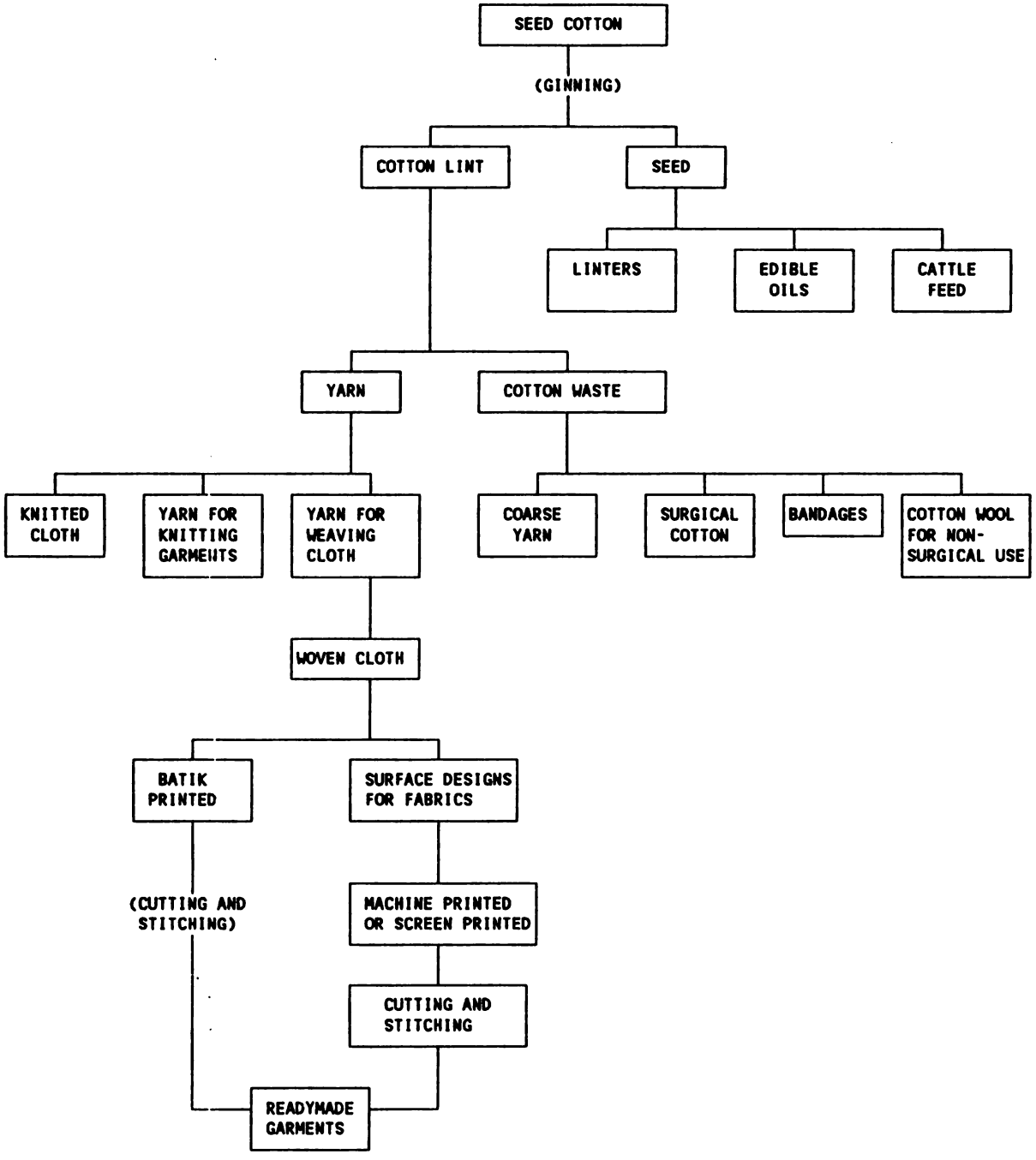
Cotton has a great potential for employment generation and this is even more important because of the low physical demands of harvesting in relation to the availability of varied units of labour force. It is very labour intensive and presently a large numbe of women are employed at every level of the operation from growing to processing and management.

A comparison of percentage labour cost to total cost per acre for cotton and sugar cane shows 77% for cotton compared with 51% for sugar cane. Cotton requires nearly daily on farm management. The marketing arrangements with the Japanese specifies a hand-picked product, because a suitable mechanical harvester for Sea Island Cotton is not available and the damage to it's "spinnability" caused by existing equipment. In an environment with a high unemployment rate, unskilled labour for crop maintenance and harvesting can be mobilised within the region as is currently done for sugar cane harvesting in St. Kitts and Barbados. Most of the unskilled labour force at the moment comes from Guyana, St. Vincent, Trinidad and Northern Windward Islands.

Employment generation will be further realised from downstream processing - spinning, knitting, weaving, sewing, frabric design, surfacing printing, clothing manufacturing and the processing of by products from cotton seed. At all levels of activity therefore cotton maintains a decisive advantage in employment generation.

FIGURE 2.1

INDUSTRIAL LINKAGE OF COTTON PRODUCTION



CHAPTER III

3. PRE-PRODUCTION AND PRODUCTION

3.1 Genetic Improvement

3.1.1 Introduction

In contrast to other cotton types (medium staple cotton or upland cotton and barbadense cotton like Pima, Tanguis or Egyptian cotton), little breeding work has ever been done with respect to Sea Island cotton; consequently only a few SI genetic stocks have been created and a very limited number of commercial varieties grown over the past decades. The actual MSI commercial variety which has been grown for the past 60 years without any major improvement, is now the only existing SI commercial variety.

It is assumed that following the introduction of the SI cotton in the Caribbean region, different SI genetic material were gradually developed on each island according to individual local growing conditions thus resulting in the selection of stable SI lines. Within the first phase of this process several lines, such as the MSI in Montserrat, V135 in St. Vincent, etc. were identified. The second phase consisted in the implementation of a few crosses between the different lines, and the selection of hybrid SI genetic material. The VH8 material (V135 included material) and the VH10 material (MSI inclined) were derived from a V135 x MSI cross from which consequently several VH8 and VH10 lines became commercial varieties. We can distinguish a third phase where some massal selection work has been carried out in the best SI lines, such as V135 (the last selection of V135 was done by H.A.L. Francis and J.R. Spence in 1974/75).

Reports have indicated also the occurrence of hybridization between SI cotton and the native Marie Galante cotton including the mechanical mixing of the two in the field level; this contamination of the SI cotton by the native cotton has been responsible for frequent claims of lint quality deterioration.

3.1.2 Sea Island Cotton Germplasm Collection

3.1.2.1 Inventory of the SI genetic material

There is a very limited amount of Sea Island genetic material available in all the islands. The local SI Germplasm collection is now reduced to a few accessions concentrated in the Central Cotton Station in Antigua and at the Ministry of Agriculture Barbados. Nevis and Montserrat have never maintained any SI Germplasm Collection although both islands participated very actively in the selection of several lines. St. Vincent has continued to maintain a few lines.

a) Antigua SI Cotton Germplasm Collection

Since 1945, the Central Cotton Station has served as the SI Cotton Research Center for the Caribbean Region and as such, it has developed over the years a unique SI Germplasm Collection. From a maximum of about 50 different SI entries in the 70's the Germplasm Collection has been reduced considerably over the past years with only 12 accessions in 1991, as follows:

Line/Variety	Origin
(1) V135 T 38	St. Vincent SI selection
(2) MSI 4208	Montserrat SI selection
(3) VH8 4620	V135 x MSI hybrid (V135 inclined
(4) VH10 4415	V135 x MSI hybrid (MSI inclined)
(5) VH10 4416	V135 x MSI hybrid (MSI inclined)
(6) VH10 4419	V135 x MSI hybrid (MSI inclined)
(7) VH	From original V135 x MSI cross
(8) SEABROOK 12 B2	American type SI with single stalk habit
(9) BD	St. Vincent Ordinary SI
(10) RUSSIAN	SI type sent to Russia and seeds returned
(11) SIND	SI type sent to SIND INDIA and seeds returned
(12) MSI	Original MSI selections

Most of the SI material was lost during the last decade mainly due to bad storage conditions of the genetic material, as the activities of the Central Station gradually decreased. In addition to the SI genetic material the Antigua Cotton Germplasm Collection also includes 3 non-SI accessions (namely WESTBERRY and 2 BAR lines).

(b) Barbados SI Cotton Germplams Collection

The SI Cotton Germplasm Collection in Barbados is relatively new since it was only started in 1989. In the same year, the Cotton Research program of Barbados introduced several SI lines from the Antigua Cotton Germplasm Collection (16 lines out of which only 8 germinated, these are known as the Old Collection). In 1990 the Barbados Collection was augmented with the addition of 20 more SI accessions from the IRCT-CIRAD International Cotton Germplasm Collection (this material constitutes the new Collection). The following year, IRCT-CIRAD introduced a second set of SI lines (16 accessions).

It is unfortunate to note that the Antigua SI lines as well as the 20 varieties introduced by IRCT-CIRAD in 1990 were

subjected to some form of selection process that, instead of preserving the original state of the genetic material has resulted in the loss of their genetic variability. Each of the original line is now represented by a certain number of sub-lines which, in turn, represent the seeds of individual plants selected within the original line.

To guard against the loss of the unique Antigua SI material, which is difficult to replace from the Central Cotton Station, each line has been reconstituted by bulking all its sub-lines. With respect to the IRCT SI material, it was decided to re-introduce the original seeds in 1991.

As of 1991, the Barbados SI Cotton Germplasm Collection consists of the following entries:

Table 3.1
Barbados SI Cotton Germplasm Bank

line/variety	Origin	Represented by:
V135 (37) 11	CGC-Antigua	83 sublines and bulk
V135 (74) 15	CGC-Antigua	45 sublines and bulk
PSI	Puerto Rico SI, CGC-A	91 sublines and bulk
BD	CGC-Antigua	30 sublines and bulk "naked seed" and bulk "fuzzy seed"
RSI	Red SI, CGC-A	43 sublines and bulk
SIW	SI White, CGC-A	49 sublines and bulk
RSI X V135	CGC-Antigua	41 sublines and bulk
SEABROOK	CGC-IRCT (1990)	7 sublines
MSI	CGC-IRCT (1990)	7 sublines
MSI-Antigua	CGC-IRCT (1990)	7 sublines
SI-MSI Barbados	CGC-IRCT (1990)	7 sublines
SI-MSI WISICA	CGC-IRCT (1990)	7 sublines
V135 (30) 46	CGC-IRCT (1990)	7 sublines
V135 (37) 11	CGC-IRCT (1990)	5 sublines
MSI 4208	CGC-IRCT (1990)	6 sublines
MSI 4210	CGC-IRCT (1990)	5 sublines
VH8-4602	CGC-IRCT (1990)	4 sublines
VH8-4620	CGC-IRCT (1990)	5 sublines
VH8-4621	CGC-IRCT (1990)	5 sublines
VH8-4623	CGC-IRCT (1990)	7 sublines
VH10-4415	CGC-IRCT (1990)	6 sublines
VH10-4416	CGC-IRCT (1990)	8 sublines
VH10-4419	CGC-IRCT (1990)	10 sublines
SI JAM	CGC-IRCT (1990)	7 sublines
Barbados SI	CGC-IRCT (1990)	8 sublines
RSI	CGC-IRCT (1990)	8 sublines
V135 Type 18	CGC-IRCT (1990)	8 sublines
MSI-MS 91-A	Massal Selection in MSI	Bulk of 80 progenies evaluated in 90/91
MSI-MS 91-B	Massal Selection in MSI	Bulk of 136 plants selected in 90/91
SEA BROOK	CGC-IRCT (1991)	original seed stock
MSI	CGC-IRCT (1991)	original seed stock
MSI-Antigua	CGC-IRCT (1991)	original seed stock

SI-MSI-Barbados	CGC-IRCT (1991)	original seed stock
MSI-WISICA	CGC-IRCT (1991)	original seed stock
V135-(30)-46	CGC-IRCT (1991)	original seed stock
V135 (37)-11	CGC-IRCT (1991)	original seed stock
MSI-4208	CGC-IRCT (1991)	original seed stock
MSI-4210	CGC-IRCT (1991)	original seed stock
VH8-4602	CGC-IRCT (1991)	original seed stock
VH8-4620	CGC-IRCT (1991)	original seed stock
VH8-4621	CGC-IRCT (1991)	original seed stock
VH8-4623	CGC-IRCT (1991)	original seed stock
VH10-4415	CGC-IRCT (1991)	original seed stock
VH10-4416	CGC-IRCT (1991)	original seed stock
VH10-4419	CGC-IRCT (1991)	original seed stock

CGC-A = Cotton Germplasm Collection-Antigua
CGC-IRCT = Cotton Germplasm Collection-IRCT (year 1990 or 1991)

Aside from the SI lines, the Barbados Germplasm Collection also contains non-SI genetic material, mainly composed of Israeli hybrid varieties (and/or their respective segregating progenies) and by 3 local wild cotton.

(c) St. Vincent SI Cotton Germplasm Collection

Lines maintained in St. Vincent are:

V135	BSI	Seabrook $12B_2$
VH8	MSI	

3.1.2.2 Maintenance of the SI Cotton Germplasm Collection

In Antigua, the maintenance of the SI Collection is a yearly routine: each of the SI accessions is multiplied by selfing the flowers; each line which consists of one row of 20 plants is sown with selfed seeds using wide planting distance of 4 ft. between rows and 2ft. between plants.

At harvest, selfed bolls are picked on a per plant basis and after evaluating the lint and seed characteristics plant by plant, all the selfed seeds of the 20 plants belonging to the same line are bulked to reconstitute the original genetic composition of that line.

Aside from multiplying the seeds to maintain the genetic purity of the different SI lines, each line is evaluated with respect to plant characters, such as height of the first fruiting branch expressed in number of nodes, number of locs per boll, number of flowers, boll weight, as well as the ginning percentage, fibre length, seed and lint indices. This is done on a plant per plant basis. Mean value is then calculated for each character on a per line basis in order to assess the characteristics of each line.

During 1989 and 1990 the Barbados SI Cotton Germplasm Collection was not multiplied according to standards for genetic

maintenance. All accessions were multiplied by selfing the flowers and sowing one row per SI line (variable row length was used) and further more, selfed cotton was harvested on a per plant basis. The collection was not handled as a Germplasm Bank but rather as breeding material, since some form of selection process has been applied (evaluation of progenies or sublines implemented in the Antigua Cotton Germplasm Collection). During this period, very few plant characters had been evaluated and fibre testing was only conducted in 1990/91.

For crop year 1991/92, the evaluation and maintenance of the Cotton Germplasm Collection follows the IBPGR/IRCT methodology, namely,

- one row of 15m long per variety;
- self pollination of the flowers;
- MSI check lines planted every 10 varieties;
- evaluation of the genetic material using the international descriptors.

3.1.2.3 Storage Facility

There is no adequate storage facility in Antigua, nor in Barbados, to conserve the Cotton Germplasm Collection. Seeds are kept in bags (paper or plastic) under room temperature and without humidity control. These inadequate storage conditions can accelerate deterioration of the seed quality (seed viability), and this is the main cause for the loss of genetic material in the Antigua Cotton Germplasm Collection.

3.1.2.4 General Comments

The Germplasm Collection is essential in the development of breeding work; therefore it is important to maintain its genetic purity by means of proper handling and storage conditions. Several unique SI lines were lost in Antigua because of inadequate storage conditions while the Barbados SI Collection lacked the appropriate methodology to preserve the original genetic stock.

It is recommended that the maintenance of the cotton collection also include a complete evaluation (botanical, agronomical and technological) of the genetic material. Based on observations, Antigua does not conduct any fibre tests and Barbados does not evaluate its cotton germplasm collection except for fibre quality.

In order to generate comparative data (from year to year and island to island) it is recommended that a common methodology be applied specifically by using the cotton descriptors defined by the International Board for Plant Genetic Resources (IBPGR) in the evaluation of the genetic material.

The expansion of the Germplasm Collection through self pollination each year will gradually reduce the existing genetic variability within each line with the result that the objective of the genetic maintenance programme will not be realised. In order to maintain the genetic identity of each line, as close as possible, to the original genetic stock, it is advisable to reduce the frequency of seed multiplication; and this can be achieved easily by conserving the genetic material in a cold storage.

3.1.3 Current Breeding/Selection Programme

3.1.3.1 Generally

There is no real breeding/selection programme being undertaken in the region. Breeding work is actually limited to some breeding activities recently initiated in Barbados. Although Antigua carries out a very sophisticated programme of seed selection and production which is a form of selection activity, its Cotton Station is not involved in any breeding programme. Nevis and Montserrat on the other hand have no research programme.

3.1.3.2 Barbados genetic improvement programme

In 1989, with the objective of improving the yield and fibre quality of the Sea Island Cotton and optimizing cotton production, the Ministry of Agriculture of Barbados, through its Cotton Research Department, embarked on a breeding and selection programme for the SI cotton. In this connection, they received the technical assistance of the Agricultural Development Company (International) Ltd. of Israel, which had been contracted by the Government of Barbados (under a World Bank loan agreement) for a 2-year period (1989/1990 and 1990/1991). The Institute de Recherches du Cotton et Textiles (IRCT-CIRAD), under the Technical Cooperation Programme of France to Barbados, also rendered some technical assistance during the start of crop year 1990/91 and continues to provide its technical expertise to the cotton research programme.

The on-going SI breeding and selection programme consists of 3 main activities, as follow:

(a) MSI massal selection work

With the objective of purifying the MSI Pedigree Seed received from Antigua (which showed some plant variability in its first stage multiplication in Barbados) in order to generate locally a MSI pedigree material,a so called "maintenance programme" has been started in 1989/90 under the Israeli programme. This programme, which involved the selection of single plants in the first multiplication stage of MSI and the evaluation of their progenies, is in fact more related to massal selection work than genetic maintenance activity.

Three successive waves of single plant selection have been carried out as follows:

selection of 170 plants in 1989/90 and evaluation of their progenies in 1990/91, out of which 80 progenies were kept because of their conformity to MSI agronomical characteristics and bulked to form the MSI-MS91-A line.

selection of 136 plants implemented in the above 170 progenies in 1990/91; the bulk of their seeds constitutes the MSI-MS91-B line.

An additional 150 plants were selected from the border rows of the progeny row plot in 1990/91.

The analysis of the few available ginning data from this programme and of the lint quality of the 80 progenies shows that the MSI seeds still present a high genetic variability which seems to contradict the theory of J.R. Spence that the MSI has reached some degree of uniformity after so many years of self pollination.

Finally, this programme was concluded in 1991 with the establishment of a "super" bulk, incorporating all the selfed seeds of the 80 progenies and 136, to produce the breeder seed that will be used to initiate the seed production in 1991/92. The seeds of the 150 plants were bulked to form a buffer breeder seed stock.

(b) Creation of genetic variability in the SI stock

With the purpose of creating new SI lines exhibiting better characteristics than the current MSI commercial variety, a programme of crosses, involving MSI and the most interesting SI material identified in the 1990/91 Germplasm Collection, is programmed this Crop Year 1991/92. This is as follows:

VH10 4416 x MSI
VH10 4415 x MSI (IRCT Collection)
V135 (30) 46 x MSI

(c) Exploitation of F2 SI populations

Four (4) F2 SI populations issued from the programme of crosses that were carried out in 1989/90 under the Israeli breeding programme, were planted in 1991 to implement a single plant selection:

MSI x SI W
MSI x PSI
MSI x V135 (74) 15; and
MSI x BD

A review of the breeding programme initiated by the Israeli experts shows that non-SI varieties/lines, specifically long staple hybrid varieties from Israel, have been evaluated and that a programme of crosses between SI genetic material (MSI and the Antigua Germplasm Collection) and Israeli hybrid varieties has been carried out with the objective of improving the MSI variety and of initiating a breeding programme.

3.1.3.3 Comments

(a) With regard to the "MSI maintenance programme"

Unfortunately, all this work has been conducted without considering some basic data such as yield recovery and fibre quality. The selection was solely based on some agronomic characteristics, which shows the inadequacy of such an approach to this activity.

The programme was concluded leaving all the material mixed up prematurely. It would have been more judicious to handle the progeny material separately from the single plants and to continue the study of the single plants selected in 1990/91 with the evaluation of their progenies. It ended before all the potential of the genetic material issued from the work could be exploited.

The programme could have achieved better results if the lint recovery and quality data had been considered in the process. In addition to having more information on the MSI performance, these data could have been used in creating a superior MSI genetic material, especially since this variety seems to show a high genetic variability.

(b) With regard to the Israeli breeding work

Based on the programme that was developed under the Israeli assistance project, it is clear that emphasis was put on the study of non-SI genetic material and on the development of SI hybrids which is not consistent with the basic objective of maintaining and improving the SI cotton type. This breeding procedure merits the following comments:

- It is a known fact that Barbados and the neighbouring island, which grow only SI cotton, are reputed for the special attributes of a unique cotton; and not for volume of production. The very limited area available for growing cotton, Caribbean producers should continue to grow cotton which produces the most sought after fibre in the world rather than try to produce large quantities of varieties, the price of which can be effected by world supply and demand fluctuations. It would therefor be prudent to continue the production of rare and valuable

cotton. Any breeding work should be geared towards the preservation of the SI lint quality.

- The SI cotton with its tetraploid genetic characteristic possesses sufficient genetic variability in its genome in order to continue to be selected in a conventional breeding technique, without resulting in the development of a hybrid programme, more difficult to implement, particularly in the hybrid seed production level. It should be taken into account that any hybrid state of the SI cotton can jeopardize the original quality of the SI fibre while this can at the same time improve other factors (yield, lint recovery, etc.)

- There is, within the available cotton Germplasm collections sufficient SI material to develop a specific SI improvement programme after evaluating the existing genetic variability of the SI genetic stock. After having exhausted all the possibilities of improving the SI type within its genetic stock, we can resort to other breeding techniques (involving crosses between SI and other cotton types, backcrosses with SI cottons, etc..) to come up with a new SI genetic stock.

- Regardless of the care given to the handling of the genetic resources, the introduction of any cultivar other than the SI type entails the risk of contaminating its genetic purity and could result, in the long-run, in the loss of the SI lint characteristics. This is specially true since this problem has already been mentioned in previous reports concerning local wild cottons and is evidenced by the presence of SI off type plants in the Barbados seed multiplication fields.

It should be noted that aside from the fact that its scientific approach to the breeding work is questionable this programme had to be discontinued due to the lack of proper orientation and procedural guidelines which could have permitted its turn-over to the Barbadian counterparts.

The Barbados breeding programme has just been initiated and is waiting to be put into action. A definite breeding model has not yet been designed mainly due to the confusion as to which approach should be taken in order to improve the SI cotton; one approach is to create SI hybrid material as presented by the Israeli Experts and the other is to implement a conventional breeding programme based on the available SI genetic resources as conceived by IRCT-CIRAD.

3.1.4 Regional variety trials

There is presently no SI breeding/selection programme in the region for the creations of new genetic material, consequently, no SI variety trials have been conducted.

However, it should be mentioned that during the course of the Israeli mission a few variety trials were conducted in Barbados but limited to non-SI cotton (hybrid varieties introduced from Israel). The said trials took place within the research station of the Ministry of Agriculture with the objective of evaluating their performance against those of MSI.

3.2 Seed Production

3.2.1 Introduction

The production of planting seeds has always been a main concern in the development of the SI crop because of the risk of deterioration of the inherent genetic properties of the SI cotton during seed multiplication. This has led to the establishment of a comprehensive "seed selection and multiplication programme" which has been based in the Antigua Cotton Station for many years. One of the main functions of the Station has been to produce the Pedigree Seeds which is used as the initial source of genetic material for producing planting seeds for the region. This activity continues even though SI cotton production in Antigua has almost disappeared. Nevertheless, Antigua has played an important role in maintaining the Sea Island genetic material.

The Antigua Cotton Station is responsible for supplying the Pedigree seeds to Antigua, Barbados, Nevis and Montserrat, where it is multiplied to produce the specific requirements for planting material. However, Barbados started in 1991 to produce its own Foundation seed (equivalent to the Pedigree Seed).

The production of planting seeds is limited to the MSI variety which is the only SI variety grown in the region.

3.2.2 Current seed multiplication programme

3.2.2.1 Production model for the Pedigree Seed

With the objective of maintaining the genetic and physical qualities of SI cotton, and ensuring that the planting material has present the best possible characters, a unique seed selection and multiplication programme has been designed to produce pedigree seed.

The various stages of the pedigree seed production process in Antigua are summarized in Annex 5. Following is a brief description of each of these stages:

(a) Multiplication and evaluation of Progeny rows

This system involves the evaluation of progeny rows (usually totalling 30 with 30 plants per row), each planted with selfed seeds from a single plant selected from a progeny row of the previous year. The progeny rows, which are not replicated, are grown with self pollination under optimal growing condition. Plant characteristics, such as height of the first fruiting branch (expressed in number of nodes form the cotyledonary node) and number of locs per boll, are evaluated on a per plant basis. At harvest, the selfed bolls are picked plant by plant and the characteristics of their seed cotton (ginning %, seed % estimation of lint length, seed index, lint index) are evaluated on the same basis. Unselfed bolls are harvested per progeny row and their seed cotton is used to determine the average performance of each progeny in terms of lint recovery and other seed cotton characters. Based on the standards set for the variety, the off-type progenies are systematically discarded.

(b) Single plant selection

A single plant selection is implemented in the remaining rows. The selfed seeds from a selected single plant are used to sow a progeny row the following year.

(c) Constitution of progeny stocks or major bulks (MB)

The remaining selfed seeds from the selected rows are bulked according to their plant parentage (or progeny relation) to form yearly a total of 8 different progeny stocks locally called Major Bulks or "MB's". The seed of each MB will be used for yield testing and seed multiplication.

(d) Evaluation of the MB progenies

A replicated trial, using a randomized complete block design (RCB) with 6 replications, is carried out to assess the yield and the main seed cotton characteristics (similar to those evaluated for the progeny rows) of the progenies of the 8 MB's. The study of the MB's is completed with a flower count during the crop cycle. The selection process takes into account the performance of the MB material along with that of the progeny rows. It consists of selecting the best genetic stocks and discarding progenies producing plants that do not conform to the original description of the variety.

(e) First multiplication

Each MB material is grown with open pollination in separate plots (there are 8 multiplication plots corresponding to the 8 MB's). These plots representing the first stage of the

multiplication of the variety, are also used as control plots to verify the uniformity of the crop. Each plot is harvested and processed separately. Only the seeds of the selected MB (based on the results of the MB trial) are kept for further seed multiplication. These seeds, either taken separately (per MB plot) or mixed together, form the Pedigree Seeds which are then issued to each of the islands for further multiplication.

3.2.2.2 Production of Planting Seed

Planting seeds is generated from the pedigree by multiplying them in one or two successive stages depending on the planting material requirements.

3.2.2.3 Organizational Arrangements for Seed Multiplication

Generally speaking, in each of the islands the Ministry of Agriculture is responsible for the seed multiplication programme.

The Central Cotton Station of Antigua provides Pedigree Seeds of the current SI commercial variety(ies) which is distributed to the other cotton growing countries. Each Ministry of Agriculture then undertakes the production of the planting seeds from the Pedigree Seeds.

The Pedigree Seed is planted either on the research stations (as in Antigua or Barbados) or on selected government estates (as in Nevis and Montserrat) to produce the first stage multiplication seeds. The second multiplication stage is usually effected on larger government estates to generate planting material. The private sector is involved in various stages of the seed multiplication. This applies in Antigua and Barbuda and in Barbados.

There is no seed certification system for the SI island cotton in the region. The planting seeds are normally sold on the basis of good germination results and the absence of pink boll worms. In some cases the Ministry of Agriculture can provide services in evaluating seed quality (as in Barbados).

3.2.2.4 Operating Procedures

The multiplication of the Major Bulks to generate the Pedigree seeds, is carried out under optimal growing conditions (good weed and insect control and adequate fertilization). Seed cotton from each MB plot is harvested and ginned separately using the ginning facility of the Station (one industrial type roller gin PLATT). The Pedigree seeds are mechanically delinted and fumigated against the pink boll worm) before distribution to the different islands.

During the multiplication process, fields are inspected at intervals to verify their compliance with production recommendations and to discard any off-type plants. Unfortunately, this is not always carried out as required, especially in the case of large states, resulting in a failure to produce satisfactory cotton crop suitable for seed production.

In each island seed cotton from multiplication fields is processed under the supervision of the Ministry of Agriculture at the existing industrial ginning facility. It is assumed that only clean seed cotton is used in the production of planting seeds. It is not delinted but is treated or fumigated before distribution to the growers.

Germination tests are usually conducted to evaluate seed quality, and only high quality material is released to the farmers. However, it seems that, at present, only Barbados is systematically conducting germination tests.

Planting seeds are usually sold by the Ministry of Agriculture directly to the cotton growers. However, in Barbados, seeds are processed and distributed by the Caribbean Cotton Industries Inc.

3.2.2.5 Planting Seed Availability

At present, the Central Cotton Station of Antigua is producing yearly the pedigree seed requirements of the region, broken down as follows:

200 lbs (91 kgs)	for Antigua,
300 lbs (136 kgs)	for Barbados,
150 lbs (68 kgs)	for Nevis, and
100 lbs (48 kgs)	for Montserrat
TOTAL 750 lbs (340 kgs)	

The Station has always been able to produce sufficient pedigree seeds to satisfy the needs of the regional market. However because of reduced commercial production, there is more pedigree seed available than is required.

3.2.2.6 Seed Processing Facility

With the exception of Barbados, all the other countries have very little or no seed processing facility. Generally speaking, this consists of small and inadequate storage facility for the planting seeds, primitive seed treatment equipment and inadequate bagging system.

In the case of Barbados, CCII is equipped with a new integrated seed processing plant composed of :

- mechanical delinting machine
- seed classifier,
- chemical treatment equipment, and
- bagging equipment.

This plant is perfectly equipped to produce high quality planting seeds.

3.2.3 Seed Multiplication Scheme in Barbados

This year, Barbados has initiated its own seed production programme without having to depend on the introduction of the Antigua Pedigree Seed.

Basically, this programme follows the international seed production model involving four (4) seed classes: Breeder, Foundation, Registered and Certified seeds.

This new seed production programme, under the direct responsibility of the Cotton Research Department of the Ministry of Agriculture, has used as an initial source, the genetic material that was generated from the MSI maintenance programme. This genetic material which corresponds to the breeder seed category, is being multiplied this crop year to produce the Foundation seed which can be considered as the Pedigree seed.

It is important to note that this seed multiplication programme does not involve any seed selection during the seed multiplication process as is the case in the seed production model of Antigua.

3.2.4 General Comments

The seed multiplication programme that was set up for the Sea Island cotton has a unique regional approach, while only one country supplies the pedigree seeds, all SI-four producing countries share a common seed multiplication scheme. This is made possible because there is only one commercial variety being grown in the entire region.

The production of the pedigree seeds seems to be a long, laborious and complicated process. It is more the result of selection work than of a genetic maintenance programme. The repetitive selection of single plants in the MSI genetic stock and the subsequent evaluation of the progenies for seed production purposes, can result in genetic deviation from the original variety. However, since the methodology being used involves verifying whether selected plants/progenies comply with the standards set for the MSI variety, the margin of any genetic

deviation is narrowed down. Still it is not too risky to assume that, after 40 years of such seed selection and multiplication process, the actual MSI variety is no longer genetically identical to the original MSI material.

The seed selection process takes account mainly of agronomic characteristics. Fibre quality, for example, has never been considered except with regard fibre length which is usually evaluated using the halo method. It would have been advisable to complement the study of progenies and MB's with fibre tests in order to follow the evolution of lint quality. In the absence of fibre analysis results, it is difficult to make definite conclusions concerning the MSI deterioration problem.

The system of bulking the seeds to form the different MB's can help in conserving a certain amount of genetic variability within the MSI variety. This may explain why the % fibre and the quality of the lint of the actual MSI variety still remain variable.

- With the exception of the fields directly managed by the Ministry of Agriculture, seed multiplication fields are not better managed than commercial fields. Seed multiplication fields should be managed under optimal conditions in order to secure high quality seeds and good yields.

- Due to the lack of adequate facilities and expertise, handling, storage and processing of the seed cotton intended for seed production do not strictly comply, with the standards set for seed multiplication, due to the lack of adequate facilities and expertise.

- At present, there is no system of seed certification in effect in the region, seed quality tests are either incomplete or non-existent.

3.3 Agronomic Practices

3.3.1 Agronomic Research Programme

3.3.1.1 Introduction

In order to develop a comprehensive technology package for farmers which answers their needs and address the problems related to cotton production, an agronomic research programme has been developed over the years in the different SI producing islands. The main aspects of the programme include:

- fertilization
- planting date
- spacing and density
- crop rotation

- intercropping
- weed control
- land preparation for soil and water conservation

An important part of this research study has been carried out over the past decade and only a limited number of agronomic experiments is still being conducted. This programme is concentrated in Barbados.

Agronomic problems which impede the attainment of optimum yields are evident in the different islands even though recommendations to counter, bad land preparation, inadequate fertilization, poor plant density and inefficient weed control practices, are made available to growers. Each country appears to have developed its own set of agronomic practices and it is difficult to understand how the bad practices have continued after so many years of research and production of this crop.

3.3.1.2 Agronomic Experimentation in Barbados

Specific studies have been conducted for the past two years on:

- date of planting
- plant spacing and density
- growth regulators; and
- defoliation

The experiments with respect to date of planting and plant spacing address the specific problem of growing SI cotton within a sugar cone "milieu" as in Barbados. The studies on defoliation and growth regulators are conducted in relation to mechanical picking. The experimentation on defoliation is not considered a priority since mechanical harvesting is not suitable or recommended for SI cotton.

With regard to the growth regulators experiment, pertinent results are already available in other countries which can be applied. Therefore is it unnecessary to conduct similar experiments.

No fertilizer experiments or weed control studies are conducted although these activities were included in the proposed Agronomic Research Programme. It was apparent therefore that actual agronomic experimentation is giving more weight to certain studies which are secondary to the main concerns, i.e. fertilization and weed control, the serious limiting factors to the production of SI cotton.

3.3.1.3 Review of the Agronomic Research Work Conducted in the Other Islands

Although no agronomic research work is undertaken in the other countries (Nevis, Montserrat and Antigua) it would be useful to review past research activities to get a better picture of the agronomic efforts made to improve the cotton production.

(a) Agronomic Research activities in Antigua

The Central Cotton Station resumed its agronomic activities in the mid 80's under a Chinese technical assistance programme. Several basic agronomic aspects of cotton production was evaluated in order to maximize yield, as follows:

- Plant population

  This study showed that the normal recommendations of 10,000 plants/acre was often inadequate to achieve high yields. Higher plant populations of 15000 to 21000 plants per acre were recommended according to soil fertility.

- Fertilizer application

  The experimentation showed that the rate of application of complete fertilizer (NPK) should increase according to the soil fertility level.

- Weed control

  The proper use of herbicide had increased the profitability of the crop.

(b) Agronomic experimentation in Nevis

The most recent activities were undertaken by CARDI (1982 - 1986). These consisted of agronomic experimentation focused mainly on the intercropping to optimize the benefits of the cotton production system within the farmer's intercropping practice. It did not yield any significant results in a cotton-peanut intercropping system.

(c) Agronomic experimentation in Montserrat

Intensive research work was conducted in the area of intercropping Sea Island Cotton with legumes (cowpea and peanut) in 1983/84 without achieving any special results.

3.3.2 Existing Cultural Practices

3.3.2.1 General

Each of the SI producing countries has developed its own technology package which is updated yearly based on gathered research data.

It seems that farmers have not followed the recommended technology package in full but instead have developed their own cultural practices over the years, often ignoring even the most basic suggestions.

Furthermore, it was evident that the late implementation of recommendations with regard to land preparation, pest and weed control due to a shortage of manpower were serious constraints to attaining good yields.

3.3.2.2 Soil Conservation Measures

The Ministries responsible for Agriculture of the different countries have always promoted measures designed to conserve soil and water, not only for cotton, but for all crops. These islands, characterized by sloping topography, experience severe soil erosion, especially after heavy rainfalls. As a result, a contour system has been implemented with a measure of success. Large estates, as well as small farmer settlements are contoured, and cotton has been planted on "terraces" as is still evident in Nevis and Montserrat.

However, due to the expansion of mechanical cultivation, soil conservation practices have been so ignored that even basic anti-erosion measures were gradually abandoned on large estates. The displacement of the cotton crop (as well as the sugar crop) by grass for cattle grazing has alleviated the problem of soil erosion in most of the islands.

Small farmers still practice the contour cropping system, although they are no longer well maintained. Farmers also plant cotton on ridges which offer some protection against soil erosion when correctly aligned.

Problem of soil erosion is not linked only solely to the cotton production, but its cultivation has contributed to it especially when the crop was grown on very large areas. Sound agricultural practices must include conservation of the soil and this applies particularly to cotton. Basic measures to prevent or minimize soil erosion should include:

- Selection of land should take account of fertility as well as topography. The ideal topography for cotton growing should be flat or slightly sloping areas;

- Implementation of the contour system or delimitation/demarcation of broad base terraces in sloping areas;

- Sowing on ridges or banks perpendicular to the direction of the slope;

- Implementation of crop rotation: if a second crop is planted the land will not remain bare and idle after the cotton harvest. On large estates (Barbados) where sugarcane is still grown, it is recommended that sugar cane be planted as a rotation crop.

3.3.2.3 Improvement of the Existing Cultural Practices

Reviewing current cultural practices used by farmers in growing Sea Island Cotton, the following recommendations for improving yields were suggested:

(a) Land preparation

On estate land: ploughing, reploughing and harrowing to produce a good seed bed and allow mechanical planting.

Small farmer plots: Small farmers should plough and ridge the land to allow for hand sowing.

From observations, it is apparent that land preparation is not always properly carried out due to adverse weather conditions, time constraints or type of soil (presence of stones or weed problems). Delays in the provision of services particularly to small farmers result in planting after the recommended data.

Land must be prepared on time using adequate equipment to produce a good seed bed. Land preparation can be facilitated by burning weeds before ploughing. Optimal land preparation is essential in reducing the incidence of weeds during the first stage of plant growth.

(b) Sowing

It has been observed that too many seeds are sowed per hole (6 to 10 seeds) when done by hand. This practice results in a waste of seeds and additional expenditure for thinning. If the seeds distributed to farmers comply with seed quality standards, only 4-5 seeds should be planted in each hole.

(c) Planting distance/plant density

The spacing distance used in planting the same MSI variety varies from one country to country as follows:

Table 3.2
Spacing Distance in Countries

COUNTRY	TYPE OF PLANTING	BETWEEN ROWS		WITHIN ROWS		PLANT/ HOLE	PLANT POP.
Barbados	Machine	60"-66"	(152-167 cm)	9"-10"	(23-25 cm)	1	10000
	Hand	60"-66"	(152-167 cm)	9"-10"	(23-25 cm)	1	10250
Antigua	Machine	38"-40"	(96-100 cm)	12"	(30 cm)	1	13000
	Hand	48"	(122 cm)	24"	(61 cm)	2	11000
Nevis	Hand	36"-48"	(19-122 cm)	24"-36"	(61-9 cm)	2-3	10000
Montserrat	Hand	36"	(91 cm)	24"	(61 cm)	2	14500

Machine sowing is employed extensively in Barbados and Antigua. In Barbados, a one row planter is normally used for sowing; its wide row spacing is directly linked to the use of sugar cane cultural practices for cotton. With the exception of Barbados, the usual practice is to leave 2 plants per hole. Plant population is generally low and unevenly distributed within the rows; this is a limiting factor to optimal production.

The different spacing and density experiments conducted in Barbados and Antigua have indicated that higher plant populations generally gives better yields (except for very fertile soils where a normal density of 10000 plants/Ac. would be ideal). However no recommendations can be given in this respect without appropriate data on soil fertility and fertilization level. Nevertheless, it is safe to recommend that the planting distance between plants be reduced to 10-12" with one plant per hole. This plant density would allow a better distribution of space, light, nutrients and water between plants. In addition, such a plant distribution can help in limiting the growth of weeds.

(d) Thinning

Thinning is essential in limiting, if not avoiding competition for light, nutrients and water between plants. Thinning should be undertaken when seedlings are about 3 weeks old, but this is usually delayed by farmers.

(c) Weed Control

Weed control is important in the effort to maximize yields. Unfortunately, control measures are not properly carried out due to a lack of manpower and inappropriate use of herbicides. Weeds should be controlled especially during the early stage of plant growth.

The following recommendations have been formulated to help control weeds:

- control weeds during the close season (use of herbicide or mechanical cultivation).
- ensure proper land preparation
- implement crop rotation.
- use an appropriate plant density
- implement mechanical cultivation between rows whenever possible.
- strictly follows recommendations in the use of pre and post emergence herbicides.
- weed manually within the row when needed.

(f) Fertilization

Existing fertilization practices are serious constraints to the production of SI cotton.

These are summarized as follows:

(i) No fertilizer application: this practice is common among small farmers of Montserrat and Nevis.

(ii) Application of Sulphate of Ammonia (1 to 1.5 bag/Acre or 110 to 165kg/ha) at 5 to 6 weeks; then NPK (whose exact formula is unknown) at flowering stage (1 to 1.5 bag/Acre or 110 to 165kg/ha), practiced on the Government Estates of Nevis.

(iii) Application of 300 lbs of Ammonium Sulphate per Acre (324 kg/ha) at 5-6 weeks. This method was implemented by MSICC in Montserrat.

(iv) Application of triple superphosphate (120 lbs/Ac or 130 kg/ha) during land preparation, then sulphate of ammonia (120 lbs/AC or 130 kg/ha) at 5-6 weeks, in Antigua.

(v) Application of triple superphosphate (200 lbs/Ac or 216 kg/ha) during land preparation; NPK (24:0:18) at planting (200 lbs/Ac or 216 kg/ha) and then sulphate of ammonia at flowering stage, in Barbados.

Although there are numerous fertilization practices in the region, most of them do not follow official recommendations. The following are some observations and comments in this respect:

- Small farmers do not use fertilizer. This could be a very serious deterrent to achieving high yields especially where soil fertility is low and crop rotation is not practiced.

- Sulphate of ammonia is the most utilised fertilizer. In some instances it is the only fertilizer applied to the cotton crop.

- The practice of applying sulphate of ammonia before the complete fertilizer is not very appropriate. Early application of Nitrogen induces vegetativeness, while late application of NPK might prevent phosphorus from reaching the plant in time. As a rule, it is always better to apply the complete fertilizer at planting time since it takes time for P and N to reach the plants. Nitrogen, which gets to the plant quickly, should be applied at the flowering stage when it is most needed.

Fertilizers are not systematically applied to the cotton crop, fertilization practices, when applied, appear to be irrational and inappropriate. There is, therefore, an urgent need to improve existing fertilization methods in order to optimize cotton production.

Pending the formulation of a new fertilizer technology package based on the results of experimentation, the following are some recommendations which may help improve on existing practices:

- systematize the use of fertilizers at the farmer level.

- apply complete fertilizer (2 bags of NPK/ac) at planting and top-dressing with Nitrogen (total of 1 to 2 bags/ac) of Ammonium Sulphate at the beginning of the flowering and bolling stages. (Additional nitrogen can be applied depending on the crop stand).

- forego application of Nitrogen at planting and during the early stages of the cotton crop.

- avoid excessive application of Nitrogen during the vegetative stage of the crop since it induces vegetativeness and rankness of the plants resulting in increased susceptibility to pests and delay of fruiting.

- implement crop rotation.

- recycle cotton debris by chopping stalks into small pieces and ploughing them under to increase the organic matter content of the soil.

3.4 Crop Protection

3.4.1 Cotton Pests and Diseases

The production of Sea Island Cotton in the islands of Barbados, Antigua, St. Kitts & Nevis and Montserrat is constrained tremendously by a formidable pest complex. The main economic pests are listed and categorised according to their importance in Table 3.3. The most dangerous is designated the maximum unit of importance of 5.

Table 3.3
The relative importance of economic pests of Sea Island Cotton in different territories

PEST	Economic Importance Barbados	Antigua	Nevis	Montserrat
Pectinophora (pink bollworm)	5	5	5	5
Alabama (greater leafworm)	4	4	2	3
Bemisia tabaci (whitefly)	3	-	-	-
Heliothis (bollworm)	4	3	3	4
Mirids	1	1	-	-
Dysdercus (cotton stainers)	-	1	2	2
Spodoptera/Anomis (leaf feeders)	2	1	1	1

Historically Pectinophora gossypiella - the Pink bollworm has been the major pest in the region, and was largely responsible for the cessation of cotton production in Barbados in the late 70's. In 1984 when cotton production was revived, yield losses to pink bollworm was 35%. In 1989 losses ranged from 25 - 45% except for a single estate where losses were less than 10%.

In Antigua, damage to bolls on farm ranged from 5% to 90%, variable but significant averages were recorded over the years. Similar levels were recorded for Montserrat and Nevis of 40 - 50% and 28% respectively.

Throughout the 70's and 80's, reports tell of severe pest attack causing serious losses. Involved were almost all pests recorded, each exerting varying pressure at different times. The bollworm Heliothis virescens caused heavy boll shedding each year. Most recent figures show a range of 18 - 40% in 89/90 in the region. High population levels were sustained by alternate hosts crops such as corn and pigeon peas.

Large areas of estate cotton were defoliated by leafworms particularly Alabama in Barbados and Antigua during 70's and 80's, while sporadic infestation occurred in Nevis and Montserrat. In Barbados, Alabama was able to remain on regrowth cotton during the off-season.

Cotton stainers, Dysdercus species, were very abundant in all territories except Barbados, and contributed significantly to stained substandard cotton lint. The whitefly Bemisia tabaci gained pest status on cotton in Barbados in 1987 when it ravaged several fields in some parts of the island. It has since become established throughout the island, and in large concentrations may affect lint quality and general plant health.

3.4.2 Control Strategies

Depending on the target pest, farmers have depended heavily on chemical insecticides such as ULV malathion, sevin, thiodan, sherpa, and decis in combatting pest problems.

In the case of the pink bollworm, more comprehensive measures were adopted, namely:

- control of alternate host plants (okras & wild cotton spp.)
- population monitoring with pheromone traps (B'dos & Antigua)
- destruction of cotton residues after harvest
- observance of a close season
- fumigation of stored seeds using methyl bromide or carbon disulphide.

Legislation with respect to plant pest and disease, quarantine, and pesticide registration, distribution and control is harmonized within the region, and procedures conform to generally accepted international standards. The cotton close season is legally enforced and seeks to ensure that for at least 3 months of the year there is no standing cotton or alternate host plants available to serve as refuges or reservoirs for diapausing pink bollworm.

In Barbados and Antigua the close season is observed from May 1st to August 1st. Similar periods exist in Nevis and Montserrat where the close season is observed between June 1st and August 31st.

Particularly in Barbados and Antigua, pink bollworm has flourished on okras during the close season. The policy of the Barbados government, to permit the growing of okras provided farmers register with, and follow guidelines of the Ministry of Agriculture, has been counterproductive because it is difficult to police this policy.

Disease problems on Sea Island Cotton are few and generally insignificant and depend largely on environmental and agronomic factors. Occasional episodes of damping off and boll rot may occur where the humidity is high and with high plant densities.

3.4.3 Entomological Research

Pest problems accompanied the re-introduction of sea island cotton cultivation in the West Indies in the early 1900s. The main scourge has remained the pink bollworm even though the pest complex has widened. Research efforts until the 1970s were conducted largely by the British Development Division and the Overseas Development Agency in collaboration with local counterparts.

In 1974, the Centre for Overseas Pest Research in the U.K. appointed an Entomologist to assist the governments of the Eastern Caribbean countries for a four-year period under Technical Assistance Arrangements. Initially the Entomologist was to initiate a full research programme on pests of cotton in Barbados, to establish population levels at which major pests was less damaging to the cotton crop, and establish the most appropriate means, biological, chemical or agronomic, for combatting each species and establish pest scouting techniques, based upon economic damage levels, giving decisions on where to apply pesticides.

There were later modified as follows:

1. Evaluate various pesticides in both low-medium volume and ultra low volume formulations in a search for a single product to control Alabama, Spodoptera, Plusia and Bucculatrix.

2. Evaluate various methods of crop residues destruction with regard to the carrying over of Pectinophora.

3. Continue research into pest distribution within cotton fields and their damage levels in order to try to establish a sequential sampling scheme.

4. Continue the evaluation of the American formulation of the sex pheromone of Pectinophora gossypiella as a population monitoring tool and a possible control technique.

5. Continue studies on the biology and annual cycle of Alabama in an attempt to elucidate whether outbreaks were of local or foreign origin.

6. Studies on Plusia, Bucculatrix and other pests as and when outbreaks occur.

7. Assist in training plantation scouts and the Ministry of Agriculture Extension Officers.

8. Continue working on material for a cotton handbook.

During that time research:

- identified the insect pests and natural enemies associated with cotton

- evaluated insecticides against various pests, so that there was a departure from the use of Class 1 chemicals which are highly toxic and unsafe to more acceptable pyrethroids, carbamates and some organophosphates

- supplemented the traditional tractor boom and nozzle sprayers, motorised knapsacks or hydraulic knapsacks used by cotton farmers with other sprayers, notably the hand-held battery-operated spinning disk ULV sprayers, mist blowers and the high clearance Hahn Highboy

- studied the biology/ecology of major pests for the formulation of control strategy

- introduced a close season and cultural practices based on the biology of pink bollworm

- introduced pheromone monitoring of pink bollworm, having confirmed the superiority of gossyplure over hexalure. A trapping height of 0.2 to 0.3m above the canopy, and an efficient trapping system were put in place, a threshold level of 8 months per trap per night was established for pink bollworm

- put in place a scouting/sampling system for guiding treatment decisions.

The fluctuating fortunes of cotton in the late 1970's and early 80's were accompanied by a decline of or a complete absence of further entomological research. Pest control proceeded simply by selecting and applying the best available chemical, and no research was done in any of the islands.

Following the revival of the cotton industry in 1983/84 in Barbados, a comprehensive research package aimed at removing

production constraints was put in place. The areas of entomological research addressed included:

- population cycle studies of major pests
- studies aimed at establishing action threshold levels for the major pests
- testing pheromone formulations against pink bollworm
- isolating Alabama pheromone from Barbadian populations of Alabama (done by ODNRI, U.K.) for monitoring Alabama populations
- developing action threshold levels for major pests
- identification and biological studies of new economic pests of sea island cotton
- exploring alternative methods of control of major cotton pests.

3.4.4 Technical and professional capabilities

Present technical and professional capacity vary from country to country and are summarised as follows:

NEVIS

Staff:	1 cotton officer 4 extension officers
Lab. Facilities:	none
Equipment:	4 ULV sprayers, 3 knapsnack sprayers

ANTIGUA

Staff:	1 plant protection officer 2 extension officers
Lab. Facilities:	Small lab modestly equipped is available
Equipment:	10 ULV sprayers, 2 high volume knapsack sprayers and two motorised mist blowers

MONTSERRAT

Staff:	1 plant protection officer 1 extension officer
Lab. facilities	none
Equipment:	6 motorised sprayer, knapsack and mist blowers

BARBADOS

Staff:	2 entomologists 6 technical assistants
Lab facilities:	available
Equipment:	20 ULV and 10 knapsack sprayers, 4 motorised mist blowers, 3 tractor-mounted sprayers and 1 fogging machine.

3.5 Production Factors and Services

3.5.1 Lands

The four participating countries have in the past utilised large acreages in the production of Sea Island Cotton. Highest historical average under production as presented in Table 3.4 were realised in the 1940's. Acreages under production have fallen drastically since and currently represent 0.6%, 1.6% and 27.8% of that achieved in the 1940's in Nevis, Antigua and Barbuda and Barbados, respectively. Presently Montserrat and St. Kitts are not engaged in Sea Island cotton production.

Table 3.4
SEA ISLAND COTTON PRODUCTION AVERAGES

	ACREAGES (ACRES)		
	CURRENT	HIGHEST HISTORICAL	POTENTIAL
Antigua	95	6,000	3,000
Barbados	1,000	3,600	4,000
Montserrat	0	5,300	320
Nevis	25	4,000	250
St. Kitts		1,000	500
TOTAL	1,020	19,900	8,070

Some of the former cotton lands have been loss to activities within the agricultural sector (livestock and sugar cane production) as well as to other sectors (e.g. housing). However, several thousand acres of former cotton lands are lying idle and/or highly underutilized.

The estimated area likely to be available for cotton production is approximately 8,000 acres. These lands are readily available for cultivation and a significant proportion is controlled by governments. A further 2,000 acres, might be made available if major policy changes relating to current usage are adopted.

3.5.2 Water Supply

Agriculture in the growing countries suffers from a lack of water for crop and livestock production. There are few "untapped" water supplies in these countries and catchment facilities are very limited. The Water Authority controls all water resources on the island, and the commercial cost of water make it uneconomical to use for irrigation purposes. In areas where irrigation water is available, farmers are engaged in the production of high price vegetables such as onions, tomatoes, sweet peppers and melons.

Sea Island Cotton is a semi-arid crop. Consequently, it should never be considered as a replacement crop for vegetables or sugar cane. It should be included in the menu of crops which can be planted in drier areas. Historically, cotton has been a rain-fed crop and the selection of August/September as the beginning of the planting season coincides with the onset of the rainy season in all growing countries.

3.5.3 Labour Availability

The labour required for cotton production varies but depending on the time of the cropping season, a maximum of one (1) worker per acre in addition to supervisory management is adequate. The need for workers peaks at the beginning and the end of the season (August/September and March/April, respectively) and is at its lowest mid-season (December). By phasing the planting season over a period of 4-6 weeks, the labour force required at this critical stage can be more effectively controlled and deployed.

Because of the dynamic growth of tourism, construction and the public sectors of the participating countries, wages have risen rapidly, nearly doubling in the last five years. But wages in the agricultural sector have stagnated, increasing only slightly, if at all during the same period. The agricultural sector is, therefore, losing workers to growth sectors. Closely related to this labour "out-migration" from agriculture is an attitudinal problem. Farming is considered a "low status job" which is neither attractive nor sufficiently remunerative to workers. The negative attitude towards working in agriculture is largely a legacy of the use of slave labour in the industry during the first 200 years of the colonial period.

Additionally, ever increasing opportunities for education and rising aspiration in all countries, discourages acceptance of the hard physical labour involved in cotton production, especially harvesting.

The achievement of full employment in some countries, with the attendant labour shortages especially at harvest time threatens substantial expansion of the cotton industry. There are policy options available to Governments to resolve this constraint. There

is an abundance of labour available from some Caribbean countries such as Jamaica, Guyana and St. Vincent and the Grenadines. In fact, there has been importation of labour from the latter two countries into Barbados and St. Kitts and Nevis to assist in the harvesting of sugar cane. Antigua also has a substantial pool of immigrant labour and there are social and economic consequences of uncontrolled importation of labour.

3.5.4 Farm Machinery Services

3.5.4.1 General

An assessment of farm and field equipment in all countries indicates that, in a number of cases, land preparation equipment presently in use i.e. ploughs, harrows and ridgers (bankers) are not efficient and effective in preparing seedbeds.

Deep ploughing is needed for cotton growing. Particularly if cotton is to be followed by a second cotton crop. The plough, therefore, should have a large disc diameter to enable it to plough to a depth between 12 and 14 inches, thus ensuring that all cotton residue from the previous crop is completely buried.

Seed drills (planters), are often not of the correct type because seed plates or other seed regulating devices are sometimes most inadequate for dealing with cotton seeds.

Boom sprayers also sometimes most ineffective because the type of nozzles used do not perform adequately, thus, resulting in very costs with low efficiency.

3.5.4.2 Farm Machinery Services Assessment on a Country Basis

(a) Antigua and Barbuda

The farm machinery hire service provided by government through the island's former sugar factory, and the Ministry's workshop at Dimard estate is now almost nonexistent, because of a change in the fortunes of these undertakings. However, there are a number of private farm machinery contractors providing services to the farming community. These operators do not appear to be well organised and, therefore, the timely delivery of the required services remain a problem.

(b) Barbados

Hire services for all machinery are in place in Barbados. They are available for growers needing such services, either from the Ministry of Agriculture or through private contractors, farming companies and individual farmers. Nevertheless, it would appear that some areas need to be

strengthened to make these services better able to respond to farmer's needs on a timely basis.

(c) Montserrat

Except for one small private contractor, the only service available to growers of crops, including cotton, is the government tractor service administered by the Ministry of Agriculture. This has been adequate for current production levels.

The Unit hires its service to farmers for land preparation activities, i.e. ploughing, harrowing and ridging. The problems encountered with land preparation in Montserrat are identical to those pertaining to Nevis, therefore measures to effect the necessary improvements would be the same, i.e. Government incentives to mount stone clearing and crushing programmes for larger fields.

Inventory or machinery and equipment owned and operated by the service are as follows:

Main Equipment Inventory

- Six (6) Tractors ---------- all functioning
- Two (2) Tractors ---------- down
- Five (5) 3-disc plough ---------- all operational
- One (1) 3-disc plough ---------- down
- Two (2) Disc harrows ---------- all operational
- Two (2) Disc ridgers ---------- all operational
- Two (2) Disc ridgers ---------- down
- Two (2) Mist blowers ---------- down
- Two (2) Mist blowers ---------- down
- Four (4) knapsack sprayers ------- operational

The total available facilities for the operation and maintenance of the service as given include, in addition,

- One (1) small repair workshop staffed by one (1) mechanic and an assistant under the control of the Department of Agriculture.

- Six (6) tractor operators.

In addition to the above workshop facilities, tractors are serviced at the Workshop operated by the Ministry of Construction and Works.

The day to day supervision and management of the service is done by the Plant Protection Officer. There is also on the establishment an Agricultural engineer who concentrates mainly

in the area of soil and water management but is also available to the service as requested.

(d) Nevis

Agriculture in Nevis in general tends to suffer from two main natural constraints:

1. Stony ground condition.

2. Lack of adequate water supply for crop and livestock production

Except in a few areas such as Potworks the vast majority of the farming areas are severely constraint by stones and boulders on the surface. In addition, it is not uncommon to have sheets of bed-rock lying within two or so inches underneath the surface of the land. Smaller rock obstructions also are very common features. Naturally, with such ground conditions, mechanical land preparation becomes really difficult to carry out.

There is, therefore a need to have suitable fields cleared of stones on the surface by using tractor raking and clearing equipment. Boulders and stones removed in this manner can either be utilized to form stone wall borders on the edges of the fields, or crushed for other uses. Fields treated in this manner are better suited for mechanical cultivation and are much more productive.

Land or field clearing in the manner described above is also beneficial to small holder (farms of half acre to one acre) who have easy access to equipment if hand labour for this works is not available.

In the case of smaller fields where equipment cannot be utilised, land clearing is still important because of its impact on production and field productivity.

The only available mechanical land preparations service on the island is provided by the government owned Farm Equipment Pool. This unit was set up in the Department of Agriculture some years ago with assistance from the Caribbean Development Bank, and has the responsibility for undertaking land clearing activities.

The Pool functions reasonably well but is often constrained by a lack of spares.

The Farm Equipment Pool is located in a building housing a poorly maintained tractor, an equipment repair shop, storage

sheds for equipment and spares as well as a yard area where soil working attachments are kept.

The inventory list includes:

- 5 Massey Fergusson tractors
- 1 Transport vehicle
- 1 D.6 Crawler tractor
- 3 3 - Furrow Disc ploughs
- 2 Tractor mounted Rotavator
- 2 Disc Harrows
- 2 Tine Harrows
- 2 Bed/Bank making units (Tractor
- 2 Tractor Trailers
- 2 Mist Blowers
- 15 ULV Sprayers

The above items of equipment are all operational. Those items consigned to the Pool are:

- Four (4) Tractor Operators
- One (1) Good Mechanic Foreman
- One (1) Assistant

Routine supervision of the Pool is carried out by the Cotton Officer attached to the Department of Agriculture. While the mechanic and his assistant occasionally perform the duties of tractor operators.

3.5.4.3 Programmes of Farm Machinery and equipment Maintenance and Care

Historically, with the exception of the large sugar estates, which need to have their mills operating on a 24 hour basis, the agricultural sector has not given farm machinery maintenance and care the serious attention it deserves. Owners and operators of agricultural machinery have also neglected this vital area in the overall farm operation.

Maintenance programmes for machinery and equipment are not properly structured. In all countries, except one, the only facilities available for machinery maintenance are those operated by the government, either through the Ministry of Agriculture or the Public Works Department Central Workshop.

- Lack skills at the Public Works Department Workshops to deal with agricultural tractors and equipment.

- Lack of proper tools and equipment.

- Lack of spare parts.

- Lack of facilities to carry-out certain types of repairs.

The programmes in place for Barbados are adequate, since equipment agents and dealers stock a certain volume of spare parts and also operate fairly elaborate repair facilities, many with specialists in areas such as hydraulics and transmission. In addition, they employ equipment sales personnel who, look after their clients spare parts needs.

The following recommendations if adopted would improve in the operation of maintenance programmes:-

1. Government should insist that local equipment dealers keep constantly in stock a supply of spare parts equivalent to 20% of the total value of the range of equipment which is being offered for sale in any one calendar year. Such an arrangement would help to reduce the time that the equipment is awaiting maintenance and repairs because spare parts are not available.

2. Agricultural machinery repair work-shops operated by Ministries and Departments of Agriculture, should be sufficiently well equipped to handle both preventative and corrective maintenance on the range of tractors and equipment operated by that Ministry or Department. These facilities should be properly managed and manned by experienced and skilled personnel.

3. A proper system of preventative maintenance must be established and proper schedules of service drawn up for each item of equipment, especially tractors and transport vehicles.

4. An incentive scheme to benefit both operators and repair servicemen should be introduced.

5. A training award scheme should be initiated by governments so that interested persons particularly young persons are properly trained in the area of agricultural maintenance.

6. The private sector should be encouraged, as far as possible to invest in ventures which provide contract ploughing and related services, as well as repair workshops.

7. All tractor operators should be properly trained. However, it is important that all fields should first be inspected before equipment is dispatched.

8. All field operations be closely supervised and properly managed to ensure efficiency of operation at minimum cost, to both the farmer and the owners of the equipment.

3.5.4.4 Recommendations on the Acquisition of New and More Effective Machinery

Equipment and machinery to enhance the efficiency of the cotton production must be carefully selected. It should be appropriate for the area and conditions under which it will be operated. For this reason, before full scale acquisition of equipment is undertaken it would be necessary to determine the most appropriate and cost effective items for the different operations. Such an exercise could be a part of the proposed Research and Development Programme.

Cotton production requires a wide range of machinery which must be sturdy enough to operate effectively in heavy and difficult soil and ground conditions.

The tractor for example, should have among its main features, a high degree of stability to enable it to operate safely on gentle slopes, while land preparation equipment must be able to withstand a high degree of shock loading without causing too much damage to its components. Inter-row cultivation equipment should as far as possible be fitted with adequate safety devices and heavily spring loaded to minimize equipment damage.

In view of the above, the range and types of equipment to be acquired suitable for cotton production should be:

Tractors:

- Heavy duty 4-wheel drive tractors with a horse power range between 70-100.
- Medium duty 4-wheel drive tractor between 60-90 H.P.
- Two-wheel drive tractors within the power range of 50-70 H.P.
- High clearance tractors between 50-70 H.P. - suitable for inter-row cultivation and crop spraying activities, etc.
- Special purpose, high clearance tractor/sprayer suitable for row-crop spraying operation on flat lands in large fields.

Ploughs:

- Heavy duty 3-furrow reversible disc ploughs capable of ploughing to a depth of 14 inches.

- Special ploughs for land preparation in stony areas.

- Medium duty 3-furrow reversible disc ploughs.

- Heavy duty mouldboard ploughs - both the reversible and fixed types.

The above ploughs must be of the mounted type.

Harrows:

- Heavy duty trailed Tandem disc harrows.

- Heavy duty mounted offset disc harrows.

- Special tine harrows for working in stony areas.

Cultivators:

- Medium and heavy duty mounted spring loaded rippers.

- Heavy duty mounted chisel cultivators.

- Heavy duty mounted spring tine cultivators.

- Heavy duty mounted tool bar cultivators for inter-row work.

Ridgers:

- Heavy duty mounted disc ridgers.

- Heavy duty mouldboard type ridgers for operating in selected areas.

Seed Drills:

- Heavy duty ground wheel drive seed drills.

- High output pneumatic drills suitable for drilling holes for cotton seeds.

- Heavy duty unit row drills.

- Combined fertilizer/seed drills.

Fertilizer Distributors:

- Heavy duty mounted spinning disc fertilizer distributor capable of distributing fertilizer evenly - it should be constructed of non-ferrous materials whenever possible.

Spraying Equipment:

- Low and medium volume tractor mounted boom sprayers - made of non-ferrous material if possible.
- Motorised mist blowers.
- Knapsack sprayers.
- ULV sprayers.

Equipment for land cleaning:

- Bush cutter/rotary slashers.
- Flail type rotary shredders for dealing with cotton stubble.

All mounted equipment must have a direct relationship between the hydraulic linkage category and the attachment itself.

3.5.5 Seed Production Facilities

The production of Sea Island Cotton seeds takes place in Antigua on the government station at Friars Hill (formerly the West Indies Sea Island Cotton Research Station) where maintenance of the germplasm is the primary objective, followed by distribution of good seed material to the other three producing countries where multiplication is done for local distribution.

Over a long period of time the station has provided a commendable service to Sea Island Cotton Growers of the region. However, it is very poorly equipped for the important work it has to undertake. Laboratory and cold storage equipment and facilities as well as ginning and delinting equipment are non-existent and if available can only be operated at slightly over 50% of actual capacity. The same applies to available farm machinery and attachments.

A plant protection laboratory which is reasonably well equipped and provided by an FAO assistance programme, is presently being set up at the Plant Protection Unit on the station. This laboratory will deal with plant protection problems throughout the

island, and could be of great value to the work being done on cotton at the station and to local growers.

The governments Central Laboratory could also be valuable to the island's cotton industry.

Station Inventory:

The following is an inventory of equipment in use on the station.

- One (1) 12 inch gin.
- One (1) seed decanter.
- One (1) M.F. Agricultural tractor 14 years old - together with attachments such as plough, harrow, ridger and other small items.

A list of the persons directly employed in the production of Sea Island Cotton seeds is as follows:

- One (1) Research Officer (Agronomist/station)
- Four (4) Lab/Field Technicians
- One (1) Tractor Operator
- Two (2) Office Clerks
- Ten (10) Farm Workers

In Barbados, the production of seeds and the development of pedigree seeds takes place on lands under the control of the Ministry of Agriculture, Food and Fisheries. The work is under the supervision of the Ministry's professional staff with assistance from a Consultant provided under an assistance programme between the Republic of France and Barbados.

The seed production programme requires the following pieces of equipment which can be constructed locally:

1. Small capacity units to facilitate delinting of cotton seeds in preparation for machine planting.

2. Small scale solar drying units to ensure a more controlled and efficient seed drying operation.

Item one (1) above can be designed on the revolving principle, using one half of a sound empty oil drum or a similar cylindrical receptacle capable of holding 30 to 50 pounds of cotton seed. The drive is taken up through a vertical shaft via a pinion powered by either a small internal combustion engine, or by a fractional horse power motor fitted with the necessary reduction gears, pulley, sprocket and chain, etc. A 3/4 lid arrangement is placed on the top around a central cylinder. Agitation is provided by paddles which could either be chain or belt driven from the power source. Water is introduced into the machine through PVC piping or a tube

system running alongside the machine. The water is controlled by a lock-off valve and a syphon arrangement is provided for drainage.

Item two (2) can also be constructed locally using the following material, lumber, continuous galvanized zinc sheeting, corrugated zinc sheeting, wire mesh, 16 oz. plate glass and a small quantity of black paint.

The unit is made up in two sections, the inlet or duct section made to permit disconnection from the main body of the drier for ease of storage.

The main body is enclosed by using continuous galvanized zinc sheet over the wooden structure. A series of manageable drawer trays are then made with wooden sides and ends and mesh wire of the desired grade affixed to the bottom. There are air vent spacings at the upper end of the main unit. The top of both the duct section and the main section of the unit are covered with corrugated zinc sheets, to the top of these are the glass sheets.

Drying can either take place at very slow rate or at quite a rapid rate. The former, would be more appropriate for seed drying.

Additionally, driers of similar design can be build with small radial fans which blow either slightly warm or cold air through the dryer for even and sometimes slower drying of the seeds.

Small tunnel-type batch driers can also be built locally to facilitate better drying of seed during the seed production operation.

CHAPTER IV

4. HARVESTING AND POST-HARVEST HANDLING

4.1 Harvesting

Cotton planted in August and September is harvested from January to March. Hand picking is practiced in all the producing countries. The usual method of harvesting is for the "picker" to wear an apron that is tied around the waist to form a "pouch". Seed cotton is picked and then placed in the pouch, from which it is transferred periodically to light crocus or hessian bags.

The picking of cotton is highly supervised to avoid wastage and inefficient harvesting which can reduce final yield. Pickers are not allowed to "run all over the field", but instead are assigned 2-3 rows at a time. Only the fully opened bolls are harvested, as immature (not fully opened) bolls when harvested can result in unacceptable high moisture content (>15%) of seed cotton being delivered to the ginnery. There have been cases, where seed cotton had to be rejected for too high a moisture content. Many small farmers have adopted the "bad habit" of harvesting stained cotton and trash together with the good quality cotton, which is later cleaned.

The fear that labour would either not be available, as cotton picking clashed with sugar cane harvesting in some countries, or labour becomes too costly led to a study of the feasibility of mechanically harvesting and cleaning of sea island cotton. The mechanisation study showed that while the crop could be harvested mechanically, this process can affect the high quality of the lint, especially by damaging the length of the fibre. The cleaning process was found to be imperfect leading to a drop in cotton quality cotton, so, hand-picked cotton would always command a premium price over machine picked cotton.

Cotton stalks are normally destroyed immediately after harvesting is completed. They are usually cut and piled and then burned.

Growers usually make provision through the use of pallets and tarpaulins, to sun dry their cotton after harvest. Fluffing is done by hand. Ventilated storage space of up to one-half the expected crop is usually provided. As a rough guide it requires about 1 sq. ft. of floor space to store 100 lbs seed cotton, provided the seed cotton is piled feet high. These operations rendered the seed cotton in acceptable condition for ginning.

All farmers sell seed cotton to the central government or government agency, which arranges for ginning, shipping and selling to a Japanese buyer.

4.2 Grading and Inspection

Seed cotton is graded at the ginnery level as clean or stained. Moisture content assessment is subjectively done accept in Barbados where meters are used in testing. In Nevis and Antigua, however, CARDI provides assistance in the area of quality monitoring.

4.3 Ginneries and Ginning

4.3.1 Antigua and Barbuda

During the hay-day of Sea Island Cotton production in Antigua, quite elaborate facilities were set up in the Casada Gardens area of St. John's to carry out the following activities:

(i) Purchasing and Ginning of seed cotton
(ii) Milling of cotton seeds
(iii) Producing Cotton cake for livestock feed
(iv) Producing cotton seed oil & washing soap

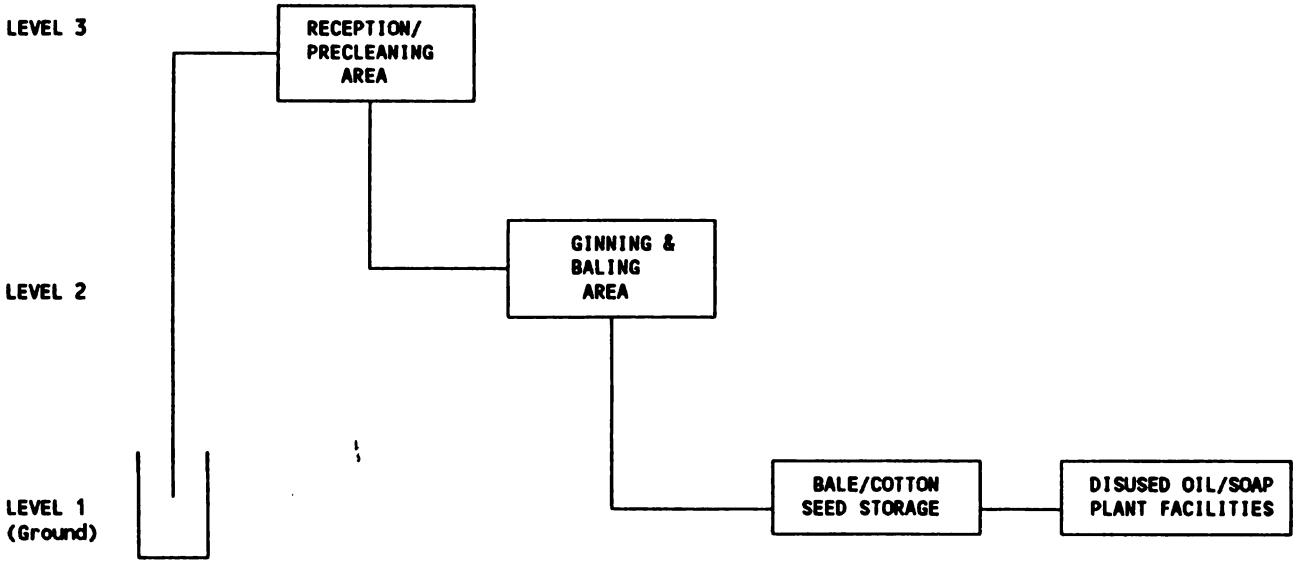
In addition to the facilities provided for the activities listed above, there was also a very well equipped machine/repair shop to service the ginning and associated equipment. Only the ginnery remains operational with less than 50% of the original gin stands functioning an extremely level of low efficiency.

The building housing the gins and related equipment is in a state of disrepair. The design and layout of the building suggest a degree of inefficiency in processing, due to cumbersome procedure for handling seed cotton.

The building is constructed on a level area and has three floors. Seed cotton is received, cleaned and stored on the top floor while ginning and baling of lint is done on the middle floor. Bales of cotton and seeds are then stored on the ground floor.

Cotton seeds are then conveyed by an auger to a pit from which a bucket elevator takes to the dehusking, milling and pressing machines and the oil is separated from the cake.

FIGURE 4.1
FLOW CHART SHOWING OPERATING IN GINNERY



of the original twelve (12) roller gin unit installed, only five (5) are still functioning. The others are all in an extremely poor state of disrepair because they were cannibalized to keep the others operational. They are all of the same vintage and were obtained from either Messes ASA Lee & Company Ltd or Platt Bros. & Company Ltd both of Oldham, England and was manufactured between 1903 and 1907. The working gins have a throughput capacity of 90lbs per hour each, although these can adequately deal with present production volumes, any significant increase would require more roller gins.

The kind of improvements needed would be:

(i) A completely redesigned building with a more efficient layout for equipment and located in a different area of the island (possibly in the cotton area)

(ii) The replacement of all ginning equipment and accessories, except for one Mitchells' seed cotton cleaning machine which can be rehabilitated and put back into operation.

Four (4) new gin units are required with one (1) being used exclusively for seed production work on the cotton station. One (1) horizontal baler and a full range of ancillary equipment.

The estimated cost of this equipment is US$43,000.

4.3.2 Barbados

The ginning operation has been conducted since 1991 by the new company, Caribbean Cotton Industries Incorporated. Supervision is provided by professionals attached to the Cotton Development Unit of the Ministry of Agriculture, and so far the system appears to be working fairly satisfactory.

There are 6 roller gin units PLATTs, 1975 model, in good working condition but installed in a poorly ventilated building.

These roller gins are quite ancient, and of the same vintage as in the other producing countries. They have become extremely costly to maintain in good working condition and their output is quite low.

Table 4.1 presents a summary of the ginning activities in Barbados for the last five seasons.

TABLE 4.1
GINNERY OPERATIONS, 1987-1991

GINNING ACTIVITIES	YEAR				
	1987	1988	1989	1990	1991
Ginning Started	27 Jan	25 Jan	6 Feb	15 Feb	4 Feb
Ginning Finished	14 May	4 May	2 May	16 May	30 April
Seed Cotton Received	1,142,316	875,124	671,651	282,301	241,024.4
Seed Cotton Ginned	1,141,816	873,662	670,421	281,851	240,554.4
Seed Produced	NA	603,662	447,179	183,379	174,265
Lint Produced	355,139	263,423	201,737	93,995	76,510.5
Running Bales	601	431	348	152	123
Standard Bales	634	470	376	168	136.6
Ginning out turn (%)	31.1	30.15	31.43	33.3	31.8
Gin Hours	4,601	3,273	2,622	1,236	1,165
Average Gin Rate	77	80.47	80.36	76.03	66.9
Gin Best Work Week	93.99	98.80	108.75	109.62	81.7
Gin Worst Work Week	62.55	50.46	61.02	50.95	47.7
Lost Due to Pick Out	NA	1,462	1,230	450	470
Lost Percentage	NA	0.17	0.18	0.16	0.2
Lost Due to Moisture and Dust	NA	7,014	12,505	4,477	3,183
Lost Percentage	NA	0.8	1.8	1.6	1.3

4.3.3 Montserrat

The ginning and its equipment was destroyed when Hurricane Hugo struck Montserrat in 1989, only portable platform scale and a building which it now being converted into a furniture factory remained.

It is envisaged that Sea-Island Cotton production will return to the island within a very short time, the necessary facilities must be put in place prior to the start of production.

A ginnery should be constructed to handle a projected 250 acres of seed cotton with sufficient capacity for the operation, plus two (2) gin units, ancillary equipment, and one (1) horizontal baler.

Estimated Cost would be US$20,000.

4.3.4 Nevis

Cotton production in Nevis has a long history and the equipment presently used are quite old and has become inefficient. in terms of output. The ginnery consists of 5 PLATT units, models 1943, 1950 and 1956 of which only 3 are operational. Other items of equipment include:

- Suction and belt conveyor system (the former conveying seed cotton from storage building to ginnery and then conveying cotton seeds to the bagging off point.
- One manually operated bale press
- Bagging off hopper.

The buildings comprising the ginnery complex are located in the heart of Charles Town the capital of Nevis near the port. These buildings are now very old and because cotton no longer plays the important role which it once did, the authorities have turn over to the Customs Department the major part of the seed cotton receiving building. There are a number of other reasons why this should be so, including the flooding of the plant by sea water.

The unavailability of spare parts to keep the gins operating efficiently is a major problem. Should Cotton regain some prominence on the island within the next couple of years, it would become absolutely necessary to acquire more modern gins to handle the crop. The ginnery should be located in the cotton production area.

Indeed, the authorities in Nevis have indicated that they would like to have the ginning removed to a new location, possibly designed and constructed on the Montserrat Model, and capable of

dealing with expected volumes of material should be constructed and two (2) new gin stands and ancillary equipment acquired. The cost would be US$20,000.

4.3.5 Summary and General Comments

As indicated earlier in the review section of this report, ginnery capacity in all producing countries is low ranging from 70-90 lbs lint/hour/unit. This is due to the low ginning capacity of the roller gin.

The Antigua ginnery need to be redesigned completely and new equipment installed as the present equipment is very old and replacement parts for models dating back to 1901 are extremely difficult to obtain.

The Barbados ginnery is by far the most recent of the ones inspected and is equipped with delinting and seed dressing equipment. The units are in fairly good mechanical condition but have now become costly to maintain. Upgrading/replacing of the equipment should the volume of work increase would be necessary.

Montserrat has no ginning capacity at the present time, except for the shell of the building which housed the ginnery prior to Hurricane Hugo. The building, however, is now being put to other use. The structure was appropriately designed and laid out for the purpose. It is suggested therefore, that any future ginnery building programme should follow the Montserrat model.

The ginnery in Nevis as indicated earlier has had a full life and the authorities would like to have the facility located elsewhere on the island. The equipment is rundown and have become very ineffective with very low levels of efficiency. Bales are still made using a manual baler. In addition, replacement parts are costly and are extremely difficult to access.

Ginnery machinery and equipment are highly specialised and close attention should be given to maintaining efficiency, durability and competitiveness, etc., especially in sourcing such equipment from a non-traditional supplier.

All ginnery equipment should be imported directly from the manufacturers.

4.4 Baling and Packaging

Cotton lint is baled by mechanical press and packed in either 300 lbs in Antigua or 500 lbs bales in Barbados and Nevis.

4.5 Lint Testing Facility

Presently there are no lint testing capability available in the region, although such equipment essential for cotton research and development. A line testing laboratory should be constructed at an early date or the accommodation available at the Barbados Standards Institute refurbished for this purpose.

The laboratory should have two rooms, one for preparing samples for testing and for use as a storage room. The other for housing the equipment. The storage/preparation room should be large enough to accommodate a large number of samples which should be prepared and stored overnight before testing.

The laboratory must be temperature and humidity controlled, i.e. 21 C ± 1 C and at 65 ± 2% relative humidity.

A minimum of two (2) persons would be required to operate the facility for servicing both the breeder and the commercial sector.

Main Equipment

Three pieces of high quality equipment are needed to equip the laboratory, they are as follows:

One (1) Fibrograph 630 for the determination of fibre length and uniformity of cotton fibre (with accessories including fibro sampler 192)

C1F US$ 37,000 +

One (1) spinlab Stelometer 154 for measuring fibre strength and elongation of the fiber.

C1F US$ 5,600 +

One (1) Instaweigh 485 (supporting equipment of the stelometer).

CIF US$3950

One (1) Fineness Maturity Tester Series II (to evaluate the fibre maturity and standard fineness)

One (1) SDL Electronic Balance Model E 400D (SDL 204 M)

One (1) Shirley Fiber Blender (SDL 009)

Test results should be sent to both breeder and growers during the ginning operation.

Samples of lint should be taken from each bale to be sent to the laboratory for testing fibre quality. Farmers should be advised of the results and whether any adjustments should be made to growing practices.

Central Seed Laboratory

A Central Seed laboratory is an essential component of a seed certification programme.

Appropriate accommodation, equipment and supplies to carry out the following seed quality tests are required:

- Germination test
- Humidity tests
- Purity tests
- Miscellaneous exercises

Cold Room Facilities

A cold storage area with a capacity of approximately 550 cu. ft. will be needed to keep Sea-Island Cotton germ- plasm and a collection of breeders materials.

CHAPTER V

5. MARKETS AND MARKETING

5.1 Introduction

Given the current globalization of competition, if a country or region wishes to trade in such a world market, a competitive advantage must exist and be maintained. A comprehensive advantage over other producers can be achieved due to lower costs or because the product is unique i.e. product differentiation.

The Caribbean region is considered a high cost producing area, therefore the competitive advantage cannot be achieved because of the lower cost factor.

Differentiation is the ability to provide a product that is unique and superior in quality, special feature or good after, sales services. Differentiation will allow a company to get the best prices which will obviously lead to overall profitability once costs are properly managed. The exceptional quality of the sea island cotton fibre, with its extreme silkiness, length and fineness has made it the best cotton grown in the world; its unique quality has given it worldwide recognition.

Since genuine West Indian Sea Island Cotton lint is now sold at US$5.50 per pound (US$12.20 per kilogram), the highest price for cotton in the World and a considerable price difference over other leading cotton example Giza 45 and Indian No. 1 Suvin at US$2.20 per pound (US$4.90 per kilogram) - a drop from US$2.90 per pound (US$6.40 per kilogram) and the Peruvian Pima and Chinese extra long staple - EX 146, which now sell at US$1.27 per pound lint (US$2.82 per kilogram). It is therefore logical to conclude that the competitive advantage of West Indian Sea Island Cotton is due to its unique qualities i.e. product differentiation.

The development of a regional integrated West Indian Cotton Industry starts out with the knowledge that the region produces the best cotton in the world and therefore the development of the market base for lint, yarn, fabric and garments should not be problematic if the quality is maintained.

5.2 Markets for Sea Island Cotton

5.2.1 Cotton Products

Several primary and secondary products are produced from seed cotton. These include:

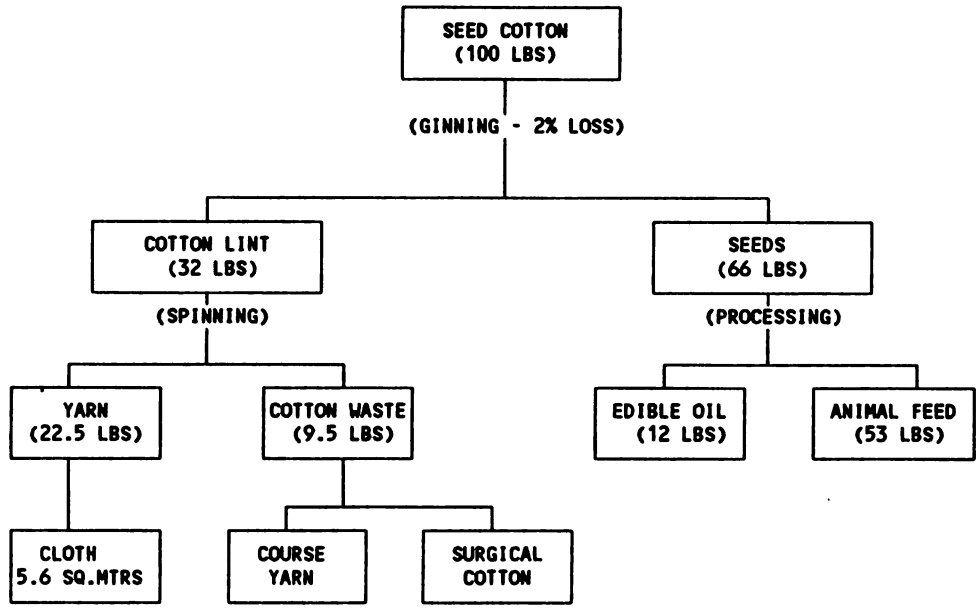
(a) Cotton lint for spinning into yarn, which is later woven into cloth;

(b) Cotton waste for producing coarse yarn and surgical cotton; and

(c) Cotton seed for producing edible oils and animal feed.

The flow of these products from seed cotton is shown in Figure 5.1 below:

FIGURE 5.1
FLOW OF COTTON PRODUCTS



5.2.2 Cotton Lint and Products

The marketing of Sea Island Cotton at the present level of production and the level envisaged during the next few years should present no difficulties. In fact, a firm of Consultants appointed by the Overseas Development Ministry estimated the potential market to be more than 3.5 million pounds of cotton lint per annum capable of producing approximately 2.5 million pounds of yarns. In terms of cloth, the potential was identified at more than 10 million sq. yds. The study pointed out that this demand could be sustained in spite of comparatively higher prices for fabrics made out of Sea Island Cotton and the potential market was even larger at lower prices. Fabrics made out of Sea Island Cotton have a special market appeal because of its very valuable properties. In spite of the phenomenal growth of synthetic and man-made fibres, there is a segment of the market where the demand by discriminating buyers and fashion conscious users is for 100% cotton fabrics of high quality. Sea Island Cotton can be spun into the finest cotton yarn because

of its extra long staple length and other related properties. The market is particularly remunerative in certain specialised areas like high count dress material. With a proper marketing strategy exploiting the natural advantages of the Islands because of easy access to markets in USA, Canada and Europe and the substantial demand from Japan as well as from tourists, no problem is seen getting best prices for Sea Island products. Of course, this will have to be sustained by stringent adherence to quality in manufacture.

Tourist traffic to the Caribbean has been increasing steadily and is expected to grow further because of the large investment in additional facilities for tourists. With the right type of marketing strategy backed up by competent design and quality control arrangements, there is a minimum demand of 2 million sq. yds. of cloth in various finishes at premium prices.

Presently, cotton lint produced in the Caribbean is sold, through the Caribbean Cotton Industries Incorporated (CCII), to Japan. The government of Barbados and the other share holding governments has invited Nitto Boseki and Company of Japan to participate as a shareholder in CCII. This decision brought to the industry the technology it needs for its development, since Nitto Boseki has been able to produce some of the highest quality products in the world from West Indian Sea Island Cotton. CCII's immediate aim is to produce 1500 bales of lint from a yield of 1500 pounds of seed cotton per acre while improving quality. This goal of 1500 bales of lint is agreed upon because it requires 900 bales to satisfy the Japanese market and 600 bales to ensure that spinning, weaving and knitting mills be constructed in the Caribbean are viable. Additionally, Nitto Boseki has provided a technical advisor, Mr. Fujimoto, to assist CCII in developing a marketing base in North America and Europe. To support this effort two Barbadian garment factories have been commissioned to produce samples from fabric produced in Japan for showing and promotion in these markets. Hand knitted sweaters are also being produced for these advanced markets.

Both Antigua and Montserrat were involved in downstream processing of cotton lint. In the case of Antigua, a small spinning and weaving operation was started by the Women's desk in the mid-1980's. Women are employed in the production of stoles, place mats, fabric for skirts and shirts, hand bags and belts.

The Montserrat Sea Island Cotton Company (MSICC) is charged with the responsibility of developing profitable superior quality products from locally grown sea island cotton for the export and local markets.

The processing facility in Montserrat, consisted originally of a spinning plant, a weaving plant and office and showroom. The spinning plant which was housed in a 10,000 square foot building

along with the cotton ginnery was destroyed by Hurricane Hugo in 1989. It has equipment to spin, double, and hand dye yarn to an average count of about 16 English cotton counts. The weaving plant is located in a 10,000 square feet plant. It is equipped with about 100 hand looms to make handicraft type goods of various widths. Some equipment is also available for minor amounts of serving and trimming. When the mission visited Montserrat the weaving operation was in process in a room adjacent to the office and showroom. The weaving operation is done with five (5) hand looms which are not appropriate for a large scale commercial operation. The use of handicraft looms for commercial production has led to low productivity and high cost. The type of loom has also restricted the company, MSICC, by limiting the range of products to be manufactured for the target market. Also, because of the relatively high cost of labour in Montserrat, the final products carry an additional high cost which has to be passed on to the consumer.

The range of products, presently being produced by MSICC include the following:

(a) Napery

The napery range is the "cash-flow" of the company. This product range was developed in the pilot project phase before MSICC was formed. The product range has been improved using 100% sea island cotton. The growth potential is steady due to the relatively low prices. The purchase of this range for gifts has maintained its saleability.

(b) Fabric

Fabric is manufactured for use in garments and furnishings. The quality of the fabric is variable due to the poor quality of the yarn used (was produced by the old spinning plant). Inconsistencies in the yarn led to imperfections in the fabric. The cost of the yarn and weaving cost per yard of the fabric are fairly high. The result is high prices for items produced and low sales volume.

(c) Garments

The demand for MSICC's garments in the Caribbean is mainly from the full range of boutique garments sold in the region. Whilst the MSICC garment range is hand made of the finest quality cotton fibre it does not have a distinctive market niche. This is primarily the result of the heavy weights of the fabric, and the relatively low quality of the manufacture and design. As a result of these factors, the target market segment where demand of high quality commands good prices is cannot be achieved. The distinctive features of West Indian Sea Island cotton are therefore not obvious and the garments

have therefore to compete with those made of regular cotton and cotton synthetic fabrics.

(d) Rugs

This product range was developed in 1988, utilising roving and yarn which would otherwise not be used in the production of items. Competition is largely from other high quality rugs. This product range is sold to MSICC's retail outlet and to furnishing stores in the Region.

The market of MSICC's products is divided into three distinct groupings.

(a) The local market for residents and visitors;

(b) the CARICOM market and the Virgin Islands (British and US); and

(c) the extra-regional markets in North America and the United Kingdom.

(e) Local Market

The local market is divided into two segments.

(i) Residents: This market is relatively small due to the size of the resident population. Most of the products purchased by this group are for gifts and export. There is however a small segment that purchase items for personal use. There is relatively little growth potential in this market. A conservative estimate of growth would be approximately 2% per year.

(ii) Visitors: This market is dependent on the number of tourist/visitors to the island. These visitors represent those staying overnight and those on cruise vessels. Sales to this market are also relatively small and growth is constrained by the seasonality of the tourist trade and the number of arrivals. Based on the projected growth in tourism as well as the number of Montserratians resident overseas who return for holidays, this market segment should generate a growth rate of 4-5% per annum.

(f) Regional Market

This market has been growing slowly, but re-ordering is not spontaneous and sales are only generated by sales visits and

promotions. The major problem encountered in this market is the relatively low quality of the manufactured garments. The margins earned on these products are low and do not contribute significantly to the full cost of selling, administration and factory overheads. The range however generates enough to influence the company's cash flow.

(i) The napery range provides a relatively small margin, but if the volume of sales was comparatively high, it could be the most profitable range.

(ii) Fabric sales are currently minimal in the regional market, accounting for less than 5% of sales. The potential for apparel fabric is not great because this low count fabric does not appeal to the few up-market manufacturers in the region.

(iii) A market for furnishing fabrics in regional institutions which includes exclusive hotels and restaurants.

(iv) Some of MSICC's apparel fabric designs have been selected for showing to potential garment manufacturers in the UK. Samples are held by a textile selling agent and are shown at the FABREX Trade Fair in London. These samples are finished by a commission finisher in the UK to maximise the visual and tactile appeal of the fabric. This is not possible at the MSICC plant.

(v) Hand woven rugs, a new product developed in the first quarter of 1988/89, have been exhibited at OECS Trade Expositions. Significant interest was shown in the samples and the main target markets appear to be furnishings retail outlets and the hotel sector.

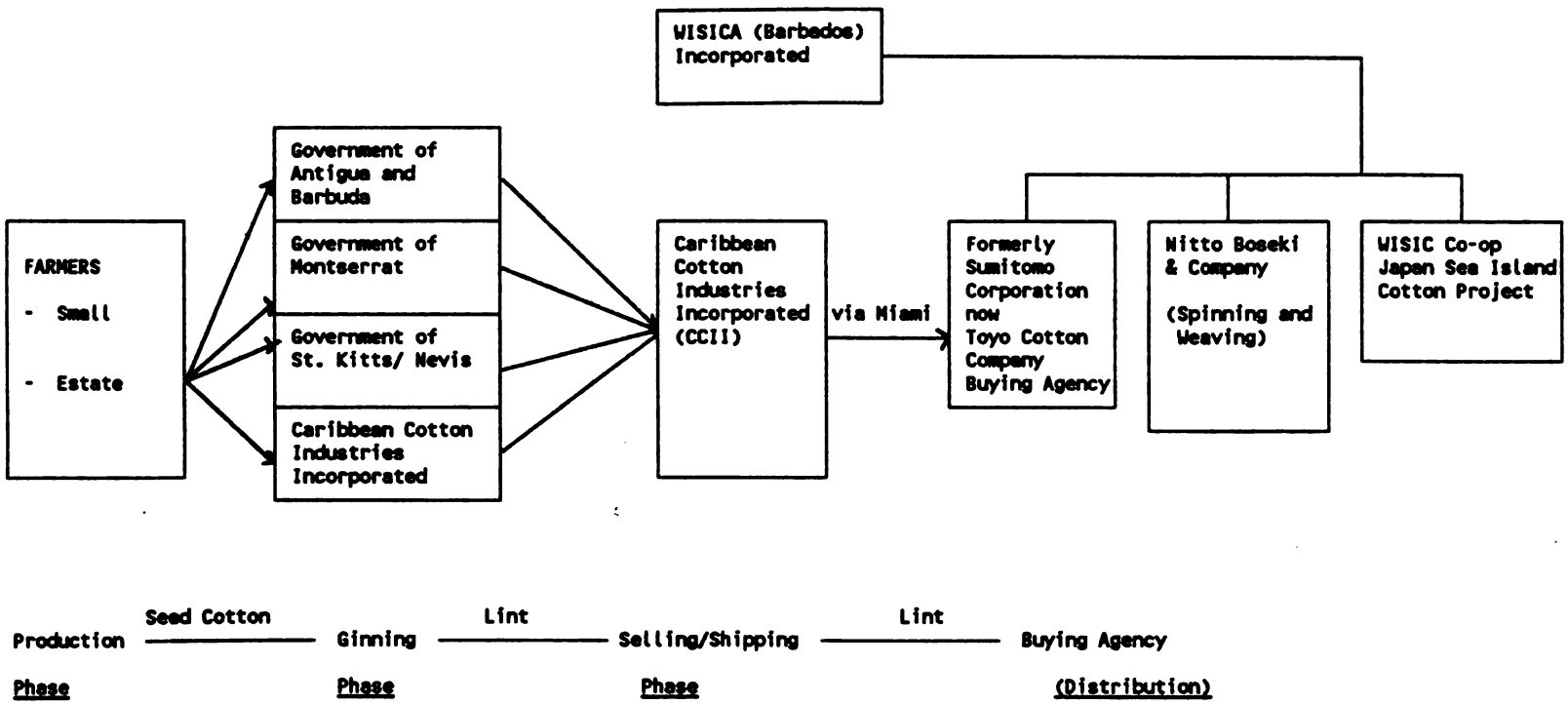
(g) Extra-Regional Market

The extra-regional markets for MSICC's products are North America and the UK. The main emphasis is currently on developing sales of knitting yarns for local consumption and specialist needle-craft retail outlets. This is attained through a mail order/wholesale distribution company in California. Advertising is done in the leading nation-wide needle craft magazine.

The target sector for products made from the fine count combed yarn is the top segment of the market. Due to the unavailability of West Indian Sea Island Cotton in the UK in recent years, the market changed to Egyptian and other short

FIGURE 5.2

DIAGRAM SHOWING MARKETING CHANNEL FOR SEA ISLAND COTTON



staple cottons. The appeal of WISIC remains in the market and premium prices will again be offered once supplies are available.

The experience of the Montserrat Sea Island Cotton Company in the downstream processing of cotton lint and the marketing of these value-added products, is very instructive in view of the stated objective of governments of the region to establish an integrated Sea Island cotton industry. Sea Island Cotton is such a premium commodity that it should not be used for the production of poor quality "second class" goods. Three critical areas must therefore be targeted as follows:

(a) Achieving and maintaining a high level of efficiency in the production and ginning of seed cotton in the region;

(b) attaining a high degree of sophistication in design and development of high quality Sea Island Cotton products; and

(c) developing, promoting and maintaining the existing upper market niche for Sea Island Cotton lint, yarn, fabrics and finished products in the Caribbean, North America, Europe, Japan and the Far East.

5.2.3 Cotton Seed

(a) General

A substantial amount of cotton seed will be produced at the ginning operation, the amount will be determined by the acreage ultimately devoted to cotton production. Theoretically every 100 acres of cotton, yield an average of 1,000 pounds of seed cotton per acre should produce 66,000 lbs of cotton seed. There are many uses for this seed - chief among them being the production of oil, margarine and shortening.

(b) Cotton Seed Oil

Cotton seed produces a semi-drying oil nearly all of which can be used for the manufacture of edible oil products. The fatty acid composition prevents flavour reversion, and it can therefore be used for making edible products such as shortenings, margarine, cooking oil and fatty products for confectionery.

Cotton seed oil can also be used for making non-edible products such as soap, lubricants, sulphonated oils,

pharmaceutical, protective coatings and rubber, toilet articles, printing ink, polishes and synthetic plastics and resins.

From every 100 pounds of cotton seed, about 18 to 20 pounds of cotton seed oil could be extracted for sale as cooking oil, thereby reducing cooking oil imports to the region.

Edible cotton seed oil was produced in Antigua, but operations were discontinued some eight years ago when the cotton industry virtually collapsed. The quality of the oil produced was coarse and needed further refining. Oil production efforts could be reviewed when Sea Island Cotton production rise again to a level, where the volume of seeds from the ginnery approaches the point where a reasonable size commercial oil and soap plant could be justified.

During the mid 1980's an attempt was made to process cotton seeds into oil and cake on a very small scale in Nevis. Equipment for this purpose was brought in and installed on a government owned estate. The equipment was later used for the purpose intended on a trial basis. However, owing to the quality of the oil produced, the scale of the operation and the lack of markets for the produce, the attempt was discontinued.

Extensive efforts were then made by the authorities in Nevis to secure further assistance from donor agencies for a much larger operation, with the capacity to refine the oil produced more fully as well as to manufacture soap. Assistance, however, has not been forthcoming so far. Meanwhile, production continues in a plant with a capacity of 45 gallons per day utilising:

1 Cotton seed delinter
1 Seed crusher
1 Oil extractor
1 Fibre oil press

Montserrat small oil extraction plant with a maximum capacity of 88 lbs of seed through put per hour or approximately 175,000 lbs per annum on one shift, was destroyed by Hurricane Hugo.

(c) Animal Feed

Cotton seed meal and cake can be produced as by-products of the cotton seed oil extraction process. Approximately 65-68 lbs of meal and cakes are produced per 100 lbs cottonseed. This is an excellent source of feed for ruminant livestock. The feed is highly digestible with an approximate protein content of 46% - higher than any other feed except soya beans.

Cotton seed cake is also a good source of vitamin B; however, it contains very little of either Vitamin A or D.

TABLE 5.1
VITAMIN AND MINERAL CONTENT OF COTTON SEED CAKES

Vitamins	Content kg/lb	Minerals	Content gm/lb
Riboflavin	4.08	Calcium	0.86
Pantothenic Acid	6.36	Phosphorus	5.04
Niacin	20.40	Sodium	0.18
Thiamin	6.13	Potassium	6.63

Due to the presence of a toxic substance, gossypol, monogastric animals are susceptible to cotton seed meal and cake and it should not be fed to them. It should be noted that the cotton seed can be crushed (without extracting the oil) and fed directly to cattle, as is practiced in some countries.

5.3 Marketing Systems

5.3.1 Marketing Channels and Participants

The marketing channels followed by cotton producers in the four producing countries are shown in Figure 5.2. Although there are some differences in the system used in the islands, in general they are quite similar.

Farmers sell seed cotton to the governments, and in the case of Barbados to CCII, which arrange for ginning and baling. The bales are then shipped to Japan, either directly via Miami, or though CCII in Barbados. Presently Nitto Boseki & Company Limited is the sole producer for Sea Island Cotton lint, while WISIC Co-op Japan Sea Island Cotton Project (comprising 45 countries manufacturing items from Sea Island Cotton yarn or retailing such products) is allowed to use the WISICA Inc Trade Mark on item and labels and other advertising materials.

5.3.2 System of Payments

(a) Farmgate and Market Prices

In Nevis and Antigua farmers are usually paid for seed cotton in two installments - an initial and a second payment or bonus, while in Barbados producers are paid a single contract price, which is negotiated from year to year.

Details of prices paid to farmers as well as market prices obtained by the various government from Japan are presented in Table 5.2 below.

TABLE 5.2
PRICE FORMATION
(US$ PER LB LINT)

	PRICE PAID TO FARMERS					Government's Gross Margins (including marketing Costs
	Seed Cotton			Lint Equivalent	Selling Price to Japan	
	Initial	Second	Total			
Antigua and Barbuda	1.04	0.28	1.32	3.96	4.20	0.24
Barbados	1.61	-	1.61	4.83	5.50	0.67
Montserrat	-	-	-	-	-	-
Nevis	0.93	0.28	1.21	3.63	4.50	0.87

(b) Marketing Cost

The average marketing cost for cotton lint in producing countries is presented in Table 5.3. This is estimated at US$0.213 per pound of cotton lint exported.

Under the Cotton Export Levy Act a cost of US$0.063 per pound is charged on the export of cotton lint from the participating countries to be divided as follows:

(i) US$0.056 cents/lb to WISICA (Barbados) Incorporated

(ii) US$0.007 cents/lb to the Growers Association in the various countries.

TABLE 5.3
AVERAGE MARKETING COST PER LB LINT
(US$)

	ITEMS	COST
1.	Ginning and Baling	0.044
2.	Export Duty	0.015
3.	Cess (Export Levy)	0.063
4.	Marketing Commission 2% of Gross)	0.028
5.	Handling of Bales	0.044
6.	Loading (US$3.33/bale)	0.011
7.	Inspection Fee	0.002
8.	Transportation to ginnery (US$1.10 per 100 labs seed cotton)	0.003
9.	Transportation to Wharf	0.001
10.	Bank Charges and Exchange	0.002
	TOTAL cost per lb lint	0.213

Table 5.4 presents an analysis of gross margins to the various governments after adjusting for marketing charges.

TABLE 5.4
GROSS MARGINS TO GOVERNMENT ADJUSTED FOR MARKETING COST
(US$)

COUNTRIES	GROSS MARGIN UNADJUSTED	MARKETING COST	GROSS MARGIN ADJUSTED FOR MARKETING COST
Antigua	0.240	0.213	0.027
Barbuda	0.670	0.213	0.457
Montserrat	-	-	-
Nevis	0.870	0.213	0.657

(c) Royalties

The West Indian Sea Island Cotton Association Inc owns a Trade Mark which is of the utmost importance to the Sea Island Cotton Industry in the Caribbean. By affixing the Trade Mark to a garment or to any other product as well as to labels or hang tags on such items at any time during the manufacturing process guarantees a significantly higher price worldwide, for Sea Island Cotton products over similar items manufactured from any other variety of cotton.

Use of the Trade Mark also provides a source of revenue from royalty and licensing fees. The present royalty fee is calculated at US$1.70 per pound of yarn and is levied on all yarn produced in Japan from the Sea Island Cotton lint sold to

Messrs Nitto Boseki and Co. Ltd. In addition, a licensing fee is also paid by each user. The present licensing fee is estimated at yen 100,000 per year.

Additional revenue would be realised when products manufactured from Sea Island Cotton become available for markets outside Japan. the level of the royalty payment would then be calculated on the wholesale price or some other point beyond the yarn stage depending on the jurisdiction.

The governments of the four (4) Sea Island Cotton producing countries, agreed in 1987, that revenues from royalty payments would be utilised as follows:

i. 60% - for promotion and protection of the Trade Mark in keeping with WISICA's constitutional obligation;

ii. 24% - to be divided among the four Sea Island Cotton producing countries in ratio to the level of lint exported;

iii. 15% - for research and development activities related to Sea Island Cotton in accordance with WISICA's constitution;

iv. 1% - to WISICA Inc. for use of its Trade Mark

The high allocation for promotion and protection is necessary because the Trade Mark needs to be widely recognised for obvious reasons, must be registered in major consuming countries and to defend its existence as was the case in 1987 and again in 1989. The action started in New York in 1989 is still before the courts. A satisfactory result for WISICA Inc. is anticipated.

It is projected that 2,000 acres of cotton producing an average 1200 lbs per acre will give 2,400,000 million seed cotton or approximately 800,000 lbs lint. With an estimated outturn of 70 lbs yarn per 100 lbs lint, then 560,000 lbs yarn would be expected from 2,000 acres of cotton. With Royalties calculated on the basis of US$1.70 per lb yarn sold, then the region could obtain US$952,000 annually in Royalties from 2,000 acres of cotton fields.

The achievement of a sustainable level of production would provide sufficient money through royalty payment and licensing fees to pay the cost of maintaining the proposed research and development programme after the initial funding period. The extent of the expenditure required for promotion, defence and operation of the Trade Mark would be considerable reduced

after five years of a programme directed at increasing lint yields and quality.

A longer term goal of WISICIA Inc should be the utilisation of part of the receipts from royalties and licensing , to set up a kind of "Venture Capital Fund" which is to be made available to growers and others in producing countries to get involved in manufacturing activities related to cotton. A fully integrated industry which covers production, processing, marketing, research and development as well as control of the Trade Mark would be one method of achieving this type of integration.

CHAPTER VI

6. INSTITUTIONAL STRUCTURE

6.1 General

They are several institutions operating at the national, regional and international levels, that are actively involved in efforts to foster and develop the Sea Island Cotton Industry in the Caribbean. While some of these institutions have been relatively effective in carrying out their mandate, the absence of an institutional working framework to coordinate their diverse activities has led to some measure of duplication of efforts and inefficiencies in the use of scarce resources. This clearly contributes to the very limited success achieved so far in the development of this vital sub-sector in the Caribbean.

These institutions primarily responsible for fostering and promoting the development of the cotton industry in the Caribbean in general and the four participating countries in particular are as follows:

(a) National Level

- Central Cotton Stations, Antigua
- Cotton Research and Development Unit, Ministry of Agriculture, Barbados
- Montserrat Sea Island Cotton Corporation Limited (MSICC), Montserrat
- Cotton Development Unit, Ministry of Agriculture, Nevis
- Cotton Growers Associations of Antigua and Barbuda, Barbados, Montserrat and St. Kitts and Nevis, respectively

(b) Regional Level

- The West Indian Sea Island Cotton Association Incorporated (WISICA)
- Caribbean Cotton Industries Incorporated (CCII)
- Caribbean Agricultural Research and Development Institute (CARDI)

(c) **International Level**

- The French Institute for Research of Cotton and Exotic Textiles (IRCT-CIRAD)
- Agricultural Development Company (International) Limited - AGRIDEV
- Natural Resources Institute (NRI), Chatham - Kent

6.2 Institutional Analysis

6.2.1 Central Cotton Station - Antigua

Background

The Central Cotton Station was established in Antigua in 1946, as the major breeding research and development center for Sea Island Cotton in the West Indies. The Station started in Trinidad and in 1930 was transferred to St. Vincent. It was funded by the British Colonial Development and Welfare Grant to serve the then colonies in the area. There was a number of sub-stations in islands such as St. Vincent, Montserrat, St. Kitts and Barbados, where sea island cotton was an important crop.

Cotton production in the region declined considerably in the 1960's and the relative importance of the station also declined. This resulted in the cessation of British funding for the station.

In spite of relative decline in production, the Government of Antigua and Barbuda considered the crop sufficiently important to fund, from its own resources, the continued operation of the station. Production of Pedigree seeds, maintenance of a wide range of cotton types, varieties and strains as well as bulking of commercial seeds remain the major role of the station.

It is Government's policy to continue the operation of the station as long as there is hope for the revival of the Sea Island Cotton Industry.

Objectives

The major objective of the station is to supply high quality planting material of MSI varieties for the cotton producing countries of the Caribbean.

Production of planting material of other varieties were also undertaken on request.

The station is also engaged in agronomic research/ investigation work with the object of improving the productivity

and profitability of land, labour and capital in the production of the crop.

Development of a cropping sequence/rotation systems of inter-cropping techniques will be undertaken, with the view of integrating Sea Island cotton in the long-term production process.

Sea Island cotton was once an important foreign exchange earner for Antigua and Barbuda; the immediate objective is for the industry to reassume this role.

The longer term objective is the development of an integrated industry providing maximum employment by processing the primary and secondary products from cotton.

Staffing

1 Research Officer (Agronomist) (MSc level)
4 Lab/Field Technicians
1 Tractor Operator
2 Office Clerks
10 Field Workers (Labourers)

Part time services of Department of Agriculture Plant Protection Officer

Facilities

There is office space of 179 square feet for the Manager of the Station, 128 square feet for the Clerk and Recorder/Technician, 96 square feet normally used for lint combing and measurement, laboratory space of 345 square feet. In addition there is 77 square feet for the storage of chemical (inside main building and annex). There is a toilet area of 28 square feet.

A cotton storeroom of 2,193 square feet with small gin for the ginning of experimental samples, a larger gin capable of ginning 296 lbs/hour as well as a seed delinter are housed therein. It is possible to store fertilizers and other supplies in this room. Within the cotton storeroom there is an area of 46 square feet which have been set aside for seed storage.

Shed space of 525 square feet is available for the storage of the tractor and some machinery.

A space of 206 square feet is presently being used for storage.

Another space of 468 square feet is being used as a seed storage shed, with little or no facilities. It is desirous that this area be developed into a seed storage and seed testing room,

not only for cotton but for upland grain crops as well as vegetable seeds.

The tractor which serves both Dunbars and the Cotton station along with the adjacent farmers is 14 years old and in need of replacement.

In view of the present quality of the equipment available for the fumigation of cotton seeds, it is recommended that equipment for the fumigation (treatment of seeds) be included in the package for the Cotton Station.

The level of government annual subvention (budgetary support) for the Cotton Development Programme is approximately US$102 thousand dollars (see Table 6.1).

Table 6.1
Antigua Annual Government Subvention for Cotton Industry

	Budget (EC$)		
	1989	**1990**	**1991**
1 Personnel Emoluments			
(a) Professional Support	50,400	83,933	89,450
2 Others			
(a) Salaries & Wages	165,231	146,000	153,352
(b) Materials etc.	16,152	26,500	22,202
3 Capital	Nil	10,720	10,037
TOTAl	211,783	267,353	270,504
US$ (1US = 2.7 E.C)	85,845	99,019	101,867

6.2.2 Cotton Research and Development Unit - Government of Barbados

Background

The Barbados Government is implementing a Cotton Research and Development Programme (1988-1992) with the main objective of improving the yield and fibre quality of Sea Island Cotton. The main activities are located at the Graeme Hall Research Station.

Objectives

a) To remove constraints to production and to improve genetically the quality of sea island cotton

b) To transfer these technologies to the target farmers in Barbados primarily and to farmers in other territories wishing to grow sea island cotton.

c) To make available sufficient quantities of high quality "certified" seed to participating farmers.

Present Staff

2 Cotton Agronomist full time - BSc Level
1 Cotton Agronomist part time - MSc "
1 Herbicide Agronomist Part time - BSc "
1 IPM Specialist full time - PhD "
1 Entomologist full time - MSc "
6 field assistants (Casual)
6 Technicians (IPM)
1 Tractor Driver
1 Driver

Consultants (see under funding)

Funding

Part funding is from a World Bank loan to the Government of Barbados. NRI (U.K) previously ODNRI has assisted in the Integrated Pest Management Project with funding from the BDD. Under the technical assistance programme of the Government of France, the services of Dr. Guy Pauly of CRST/CIRAD has been provided to assist in the genetic and breeding programme. A loan from the World Bank provided funding whereby the Israeli firm Agridev provided two consultants for the period 1988-1990. The rest of the funding is provided from the budget of the Ministry of Agriculture.

Manpower needed

Genetics	1 geneticist (to be trained)
	1 officer in charge of breeding and seed multiplication
	2 trained technicians (AA level)
	3 technicians for laboratory evaluations
	1 consultant Geneticist (two short visits per year for three years)
	2 Field attendants for processing experiments
Engineering	1 Agricultural Engineer

Under the Cotton Programme, the Government is developing a "Lint Laboratory". Several pieces of equipment have been ordered and the laboratory will be housed and operated by the Barbados National Standards Institute.

Physical facilities needed

(a) Laboratory equipment and supplies for cotton improvement and seed multiplication

- Fineness Maturity Tester (to be ordered Govt. of Barbados)
- Digital Balance 204 BCT (to be ordered Govt. of Barbados)
- Electronic torsion Balance 5DL 215B (to be ordered Govt of B'dos)
- Standard sample boxes for cotton grades determination
- Dehumidifier & Air-conditioned unit - const. temp & hum.
- HV1 (high volume instrument) set for the analysis of experimental and commercial fields.(HV1 includes nos 3,5 & 6).

(b) Greenhouse

(c) Equipment and supplies for other agronomic work
A soil and tissue analysis laboratory

Field Equipment Available

One (1) Hardi Boon sprayer

One (1) Massey Fergusson Tractor

One (1) Pcst emergent applicator (boon)

Two (2) Mist blowers

Two (2) Knapsack sprayers

Two (2) Rotovators

Two (2) Flair Shredders

One (1) Inter row cultivator

Two (2) Three two planters (need repairs (pneumatic)

One (1) single row planter (pneumatic)

One (1) single row Massey Fergusson planter

One (1) disc ridger (under repair)

One (1) uprooter shredder mulcher uprooter

Laboratory Equipment (available or ordered)

4" Gin for single plant analysis (ordered)

12" Gin for plot analysis (ordered)

One (1) Hollingsworth 12" Roller Gin

One (1) Spinlab fibrograph (ordered)

One (1) control environmental chamber

One (1) Spinlab Stelometer (ordered)

One (1) Labline LC oven

One (1) Spinlab instaweigh 485 (ordered)

Wild Cotton Destruction

One chain saw (available)

Extension

Constant contact must be maintained with the growers in order to assist them in resolving growing problems quickly. Extension should be based on:

(i) field days

(ii) field visits

(iii) written material sent to growers

(iv) radio programmes

(v) seminars

6.2.3 The Montserrat Sea Island Cotton Corporation Limited (MSICC)

The Montserrat Sea Island Cotton Corporation Limited (MSICC) is registered in Montserrat under Companies Act. The bye law of the company permits it to:

a. carry on the business of planting, harvesting, producing, processing and marketing of sea island cotton and cotton products including cotton seed and cotton oil and of designing, manufacturing and marketing fabrics and garments made out of sea island cotton.

b. own, lease or otherwise control arable land in Montserrat for the purpose of growing sea island cotton thereon and to manage such land in accordance with principles of good husbandry.

c. purchase sea island cotton grown in Montserrat and elsewhere.

d. own, lease or otherwise control and to operate ginning, spinning, knitting and weaving machinery and equipment capable of processing sea island cotton and cotton products.

e. carry on the business of importers, exporters, wholesalers and retailers in relation to the business of producing and marketing sea island cotton and cotton products.

f. carry on any other business which may seem to the Company capable of being conveniently carried on in connection with the business of producing and marketing sea island cotton and cotton products or to be likely to enhance the value of or render profitable the property of rights of the Company.

g. acquire by purchase or lease any land, building, warehouse, shop, mill factory, office, plant, machinery or other property for any estate or interest whatsoever for the purpose of efficiently carrying on the Company's business as aforesaid.

h. display, circulate or distribute advertisements, necessary or useful for establishing the Company's business as aforesaid.

i. borrow or raise money in such manner as the Company shall think fit and in particular by issue of debentures, or debenture stock, perpetual or otherwise and to secure the repayment or any money borrowed, raised or owing by mortgage, charge or lien upon all or any of the assets of the Company, present or future, including its uncalled capital and also by a similar mortgage, charge or lien to secure and guarantee the performance by the Company or any obligation undertaken by the Company in connection with its business as aforesaid, and to redeem or pay off such securities.

j. invest and deal with money of the Company not immediately required upon such securities and in such manner as the Company may from time to time determine.

k. enter into arrangements for joint working in business or for sharing of profits or for amalgamation with any other company, firm or person carrying on business similar to the business of the Company as aforesaid.

l. apply for and acquire any statutory or other rights, powers or concessions in connection with the business of the Company as aforesaid.

m. grant pensions, allowances, gratuities and bonuses to directors, officers, ex-officers, employees and ex-employees of the company and the dependents or connections of such persons, and to establish and maintain or concur in the establishing and maintaining of trusts, funds or schemes (whether contributory or non-contributory) with a view to providing pensions or other benefits for any such persons as aforesaid, their dependents and connections, and to institute and maintain any club or other establishment or profit sharing scheme calculated to advance the interests of the Company, its officers or employees.

n. obtain all powers and authorities necessary to carry out or extend any or all of the above objects.

o. do all other acts or thing conducive to or reasonably incidental to the attainment of any of its above objects.

The Company received major funding from the Caribbean Development Bank in the form of a loan, from the British Development Bank and the government of Montserrat. In 1987 the CDB liability was assumed by the government of Montserrat as equity in the company. It also benefitted from the OECS/EDF Common Services Fund and grants from budgetary and other support from the British Development Division (BDD) and CIDA (International). It was granted a 15 years tax holiday which expires in 1995.

In 1977, the government had set up the Montserrat Industrial Enterprises Limited (MIEL) to include a weaving component, leather component and a pottery/ceramics component. This company initially utilised Canadian cotton. Several of the components are no longer operational.

The company (MSICC) is still producing garments and other articles in Montserrat.

6.2.4 Cotton Development Unit - Nevis

The crop in Nevis fall within the responsibility of the Department of Agriculture. At present, there is one (1) part-time cotton officer and one entomologist is being trained at the MSc level and he is expected to provide part time technical assistance to cotton farmers.

6.2.5 Growers Association

The Cotton Growers Association of Barbados is a legal entity with about 40-45 active members all of whom are also sugar producers. The association is a member of WISICA (Inc) and under the Export Levy Act of Barbados receives 2ø (E.C.) for every pound of lint exported. This is in addition to the 15ø per pound of lint paid to WISICA.

Nevis, Antigua/Barbuda and Montserrat all had growers associations but these are at present non operational. As a result the respective departments of Agriculture have assumed responsibilities for the growing including technical assistance and varying field operations (government or state farmers plus private farmers) purchasing seed cotton, ginning and sale of lint. Generally the associations were responsible for marketing but the Governments are now acting on their behalf. In Antigua, there is a Marketing Commission of 2 1/2% plus 4ø (E.C.) per lb export duty on lint exported.

6.2.6 The West Indian Sea Island Cotton Association (Incorporated) (WISICA)

The constitution of WISICA makes it an association of cotton growers.

WISICA (Inc) was registered in Antigua under Companies Act Cap. 140 as a Company Limited by guarantee and not having a share capital. It took over all funds an assets of WISICA (Inc) Trinidad.

WISICA (Inc) was subsequently registered in Barbados under Companies Act 308. It took over all funds and assets of WISICA (Inc) Trinidad and WISICA (Inc) Antigua.

1. The objects of the Association are as follows:

   a. To take all funds and assets whatsoever of the West Indian Sea Island Cotton Association (Incorporated) of Trinidad and Antigua now in progress of being wound up and dissolved.

   b. To promote and protect the West Indian Sea Island Cotton Industry in the Islands of Antigua and

Barbuda, Barbados, Montserrat, Nevis, St. Christopher, Anguilla, St Vincent and the other islands and countries of the Commonwealth Caribbean.

c. To consider, discuss and take action on questions directly and indirectly relating to or affecting the Sea Island cotton industry, which expression wherever used in these presents shall be deemed to include any activity connected with the production of seed cotton and all products or by-products thereof manufactured or capable of being manufactured, to register and protect its trade mark world wide by taking Civil or Criminal action or by other appropriate means in accordance with the Laws, rules and practices of the particular jurisdiction and to collect and disseminate information concerning Sea Island Cotton and the Trademark.

d. To promote research and other scientific work in connection with the Sea Island Cotton and generally in connection with any branch of trade or commerce producing, using or handling Sea Island Cotton lint, yarn or fabric or any other product of the Sea Island Cotton plant or producing machinery, accessories, substance or appliances to be used in the Sea Island Cotton industry, and to provide and spend money as may be thought necessary or convenient for these purposes, and to encourage and improve the education of persons who are engaged or who are likely to be engaged in the Sea Island Cotton industry.

e. To retain or employ scientific or skilled persons in connection with the objects of the Association and such clerical and working assistants as may be found necessary and to pay for these purposes such fees or remuneration as may be thought expedient and also to fund, aid, maintain and endow scholarships and bursaries for the remuneration, instruction and support of scholars in research work.

f. To purchase, take on lease, or in exchange, hire or otherwise acquire, whether in the Commonwealth Caribbean countries or elsewhere, any real or personal property and any rights or privileges necessary or convenient for the purposes of the Association, and to construct, alter, pull down or

maintain any building, or part of a building, as may be required for the purposes of the Association.

g. To establish, equip, maintain and alter laboratories, workshops, experimental ginneries, factories and other processing plants and Sea Island Cotton fields and to cultivate land in connection with the same, whether in the Commonwealth Caribbean Countries or elsewhere and to establish, form and maintain museums, collections, libraries and collections of literature statistics and information relating to the Sea Island cotton industry or to matters of interest to members of the Association, and to translate, abstract, compile, publish and endeavour to secure, or contribute to the translation, abstraction, compilation, collection and publication by Parliament, Government Departments and other bodies or persons of any literature statistics and information and to sell or lend the same, or to permit the same to be used and to fund, manage control or support a journal or journals for the purposes of making known and advancing the objects, methods and results of the Association.

h. To adopt such means of making known the West Indian Sea Island cotton industry as may seem expedient and in particular by advertising in the press either in the Commonwealth Caribbean Countries or elsewhere in the works by circular, by exhibition or by publication of books and periodicals other forms of media advertising electronic or print or otherwise.

i. To establish, promote, co-operate with, receive into union, become a member of, act as, or appoint trustees, agents or delegates for, control, manage, superintend, afford financial assistance to, or otherwise assist the scientific and industrial research work of associations and institutions and other incorporated bodies, whose objects are similar to those of this Association, and which prohibit by their constitution and the distribution of their income and property amongst their members to an extend at least as great as is imposed on this Association by Clause 4 hereof, and to assist such bodies in obtaining any necessary extensions of power for the promotion of those objects.

j. To procure the Association to be registered or recognised in and to establish, maintain control

and manage branches of the Association in the Commonwealth Countries and elsewhere as may seem expedient, and from time to time determine the constitution, rights, privileges, obligations and duties of such branches and when thought fit to dissolve and modify the same.

k. To negotiate, arrange and make agreements for the carrying out of research work of any kind in connection with the West Indian Sea Island cotton industry either by individuals or in any ginning factory mill or works, notwithstanding that such ginning, factory, mill or works may be carried on for profit, and to make such terms for payment for the work so done, or for sharing in any knowledge or benefits resulting from such work as may be thought reasonable.

l. To promote, approve or lawfully appose legislation and other measures affecting the Sea Island cotton industry in the Commonwealth Caribbean Countries or elsewhere.

m. To encourage the discovery of, and investigate and make know the merits and nature of inventions, improvements, methods, operations, processes, designs and materials which may seem capable of being used for any of the purposes of the West Indian Sea Island cotton industry and to acquire any patents or licenses relating to any such inventions, improvements, methods, operations, processes, designs and material, or to acquire and register any standardisation marks or designs whether for general or standardisation purposes, with a view to the use thereof by members of the Association and others upon such terms as may seem expedient, to perfect, develop and turn to account such inventions, improvements methods, operations, processes, designs and materials, by manufacturing, exhibiting and selling or by permitting under license or otherwise the manufacture exhibition and selling of articles or substances to which the same may be capable of application or in any other way and to use the results of research work to benefit the Association and its individual members, both by the prior distribution of knowledge and by the preferential use of any patents or processes.

n. To apply for purchases or otherwise acquire any patents brevents d'invention, licenses, trade marks, concessions and the like conferring any exclusive or non-exclusive or limited rights to use

any secret or other information as to any invention which may seem capable of being used for any of the purposes of the Association or the acquisition of which may seem calculated directly or indirectly to benefit the Association and to license the use thereof by third parties.

o. To assign for legal protection and operation any patents brevets d'invention, licenses, trade marks, or concessions acquired in accordance with sub-paragraph (n) above, such assignments to be approved by a majority decision of the Board provided that the vote in such a proposition shall include the affirmative votes of the board members representing the governments of Barbados, Montserrat, Antigua and St. Kitts/Nevis.

p. To appeal for, collect and stand possessed of subscription and subtentation or endowment funds, the proceeds of which are to be devoted to the benefit of the Association.

q. To invest and deal with the moneys which the Association may not immediately require upon such securities and in such investments as may be from time to time determined.

r. To borrow any money that may be required by the Association upon such terms as may be deemed advisable, and to sell, improve, manage, develop, lease, mortgage, dispose of, turn to account or otherwise deal with all or any part of the property of the Association, with a new to the promotion of its objects.

s. To sell or dispose of the property or rights of the Association or any part thereof, for such consideration as the Association may think fit.

t. To support, contribute or to work in association with any body or bodies which may be working towards similar objects.

u. To elect as honourary members any persons of skill or distinction whose co-operation and assistance has advanced or may be thought likely to advance the objects of the Association.

v. To pay all expenses, preliminary or incidental to the Formation of the Association and its registration.

w. To receive License Fees and Royalties in respect of the Licensing of the use of any Trade Mark and to apply such fees or Royalties in accordance with the Regulations of the Association which said Regulations may provide for the payment to members of the Association of the income so received.

x. To make by-laws, rules and regulations as may from time to time by necessary for carrying out the above objects and for the proper administration of the objects of the Association.

y. To do all such other lawful things as are incidental or conducive to the attainment of the above objects of any of them. Provided that the Association shall not support with its funds any object or endeavour to impose on or procure to be observed by its members or other any regulation, restriction or condition which if an object of the Association would make it a trade union.

2. The income and property of the Association, whensoever derived, shall be applied solely towards the promotion of the objects of the Association as set forth in this Memorandum of Association and no portion thereof shall be paid or transferred directly or indirectly, by way of dividend, bonus or otherwise howsoever by way of profits to the members of the Association, save in respect of the distribution of Royalties and License Fees by Regulation referred to in Clause 3(W) hereof. Provided that nothing herein shall prevent the payment, in good faith, of reasonable and proper remuneration to any officer or servant of the Association, or to any member of the Association in return for any services actually rendered to the Association, nor prevent the payment of interest at a rate not exceeding six per cent per annum or money lent or reasonable and proper rent on premises demised or let by any member of the Association but so that no member of the Board of Directors of the Association shall be appointed to any salaried office of the Association or any office of the Association paid by fees, and that no remuneration or other benefits in money or moneys worth shall be given by the Association to any member of such Board of Directors except repayment of out-of-pocket expenses and interest at the rate aforesaid on money lent or reasonable and proper rent for premises demised or let to the Association; provided that the provision last aforesaid shall not apply to any payment Railway, Gas, Electric Lighting, Water, Cable or Telephone Company of which a member shall hold capital, and such member shall not be bound to account for any share of profits he may receive in respect of such payments.

3. No addition, alteration or amendment shall be made to or in the regulations contained in the Articles of Association for the time being unless the same shall have been approved by a simple majority of the representative of the Government of Barbados, Antigua and Barbuda, St. Kitts/Nevis and Montserrat present at an annual General Meeting of the Association at which the additions, alterations or amendments are considered.

4. WISICA is entitled to royalties which is at the moment approximately US$1.70 per lb of yarn sold. Royalties will be used to (a) fund research and development (15%) (b) provide a bonus to cotton farmers and as revenue to governments (24%) (c) provide income to WISICA (1%) and (d) provide for promotion of sea island cotton and protect the WISICA trade work (60%). The Royalty is paid on yarn sold. Several figures have been given ranging from US$1.79 to $2.50 per lb. of yarn sold.

   WISICA at present receives a cess of 17ø (E.C.) per pound of lint shipped.

6.2.7 Caribbean Cotton Industries Incorporated (CCII)

Caribbean Cotton Industries Incorporated was incorporated in Barbados on March 30, 1991 with Companies Act Cap 308 and with the following objectives:-

Objectives

1. The growing and ginning of seed cotton in Barbados, Antigua/Barbuda, St. Kitts/Nevis and Montserrat with the possibility of extending field operations to St. Vincent and Grenada.

2. The construction and operation of a knitting mill.

3. The construction and operation of a spinning and weaving mill.

4. The marketing of lint, yarn, fabrics and finished products in the Caribbean, North America and Europe.

5. Upgrading the cut and sew industry in Barbados and the participating territories.

6. The establishment of a research centre.

Shareholders

The Government of Antigua/Barbuda, St. Kitts/Nevis and Montserrat were invited to continue their participation in the

joint venture along with Nitto Boskei Co. Ltd. of Japan and private farmers. The proposed shareholding is:

Government of Barbados	51%
Government of Antigua/Barbuda	8%
Government of St.Kitts/Nevis	4%
Government of Montserrat	4%
Nitto Boseki Co. Ltd. of Japan	25%
Private Cotton Farmers in the four growing countries	8%
	100%

To date, only three shareholders have paid their share capital, the Government of Barbados, Nitto Boseki Co. Ltd of Japan and a private farmer. The Governments of St.Kitts/Nevis and Antigua/Barbuda have responded positively and set out a payment programme for acquiring their proposed shareholding.

CCII has established Bye Laws and has registered a Statement in lieu of Prospectus. It was agreed at a Board of Directors meeting that the Board should comprise:

Barbados	4
Antigua/Barbuda	1
St.Kitts/Nevis	1
Montserrat	1
Japan	2

The Bye Laws however provide for eleven (11) Directors.

The Government of Barbados in inviting Nitto Boseki & Company Limited to participate in the venture, sought to have within the operation, the technology to develop the industry since Nitto Boseki Co. Ltd., has been able to produce some of the highest quality products in the world from West Indian Sea Island Cotton. To secure this technology, as well as to make sure that the region does not remain primary producers, a Memorandum of Understanding has been prepared and is currently with the Attorney General's Office for review. This Memorandum of Understanding details the basis for moving the project forward and the involvement of Nitto Boseki & Co.

CCII's primary objective at present is to produce 1500* bales of lint from a yield of 1200 pounds of seed cotton per acre, while improving the quality of lint. CCCI is hoping to meet this objective by the 1993 crop. Thus, the co-ordination of field operations in Barbados and the participating countries, as well as a research capability with the main components of pest and disease control, a fertilizer regime to improve yields, a herbicide

programme, growth regulation, genetic improvements, the optimum spacing/densities for cotton production, harvesting and post-harvest technology are seen as vitally important.

The goal of producing 1500 bales is the minimum amount of lint required to maintain processing facilities in Japan (900) as well as those projected for Barbados and the other growing countries. It is important to maintain a very profitable already developed in Japan and other Asian countries.

Proposed Cotton Areas

CCII's main objective for 1992/93 is to produce 1500 bales of cotton lint which at 500 pounds per bale is 750,000 pounds of lint. Approximately three pounds of seed cotton will give one pound of lint. Therefore the yield should be 2,250,000 pounds of seed cotton. With an average yield of 1200 pounds per acre, 1875 acres will have to be put into cotton. To achieve this, the target areas are:

*The Barbados bale is approximately 500 lbs.

Springhall (Barbados)	300
B.A.D.C (Barbados)	300
Private Farmers (Barbados)	800
Antigua	350
Nevis	50
Montserrat	75
	1,875 acres

CCII's Managing Director is of the view that the Company can achieve its goals in three years if an efficient research centre serving regional producers and able to co-ordinate growing in larger areas is available, especially since the Japanese joint venture partner is prepared to transfer its considerable technology of spinning, weaving and knitting.

The present thrust however, is concentrating on growing and ginning a good crop. The research and development aspect required for the cotton industry should be developed as a separate entity dedicated to provide the technical support growers need to move cotton production to the sustainable level required to maintain a processing capability. CCII should therefore be structured in such a way as to give it the capability of properly carrying out what it was incorporated to do.

6.2.8 Caribbean Agricultural Research and Development Institute (CARDI)

Background

The small size and relatively homogeneous agricultural of Caribbean countries has long been recognized as conducive to co-operation in research and development. The breeding of sugar cane in Barbados led to establishment in 1888 of the still-active West Indies Central Sugar Cane Breeding Centre.

The Imperial College of Tropical Agriculture was founded in Trinidad in 1921, and provided expert services to the English-speaking countries of the Caribbean, as well as training a cadre of West Indian agricultural officers. The College became the Faculty of Agriculture of the University of the West Indies in 1963.

Special schemes for regional research in soils, banana and cocoa were begun in the 1940's and in 1955 a regional Research Centre was founded, which 20 years later became the Caribbean Agricultural Research and Development Institute (CARDI), and autonomous movement known as the Caribbean Community (CARICOM).

Other regional initiatives in co-operation include the Caribbean Food Corporation and the Caribbean Development Bank.

The members of the Caribbean Community and the regional organisations which service it, are partners in a Regional Action Plan which aims to promote greater self-sufficiency in food through co-operation in agricultural planning and development.

Governing Body

CARDI Governing Body is the Standing Committee of Ministers responsible for agriculture in the Caribbean Community. The Board of Directors comprise representatives of the member countries, the Universities of the West Indies and Guyana, the Caribbean Development Bank, the Caribbean Food Corporation and the CARICOM Secretariat.

Objectives

The main objective are:

- To provide for the research and development needs of the region as identified in national plans and policies.

- To provide and extend the application of new technologies in production, processing, storage and distribution of the agricultural products of member countries.

- To provide for the co-ordination and integration of the research and development efforts of member countries where this is possible.

To achieve these objectives CARDI has staff and facilities in all 12 member countries. However, since national capacities to conduct research differ, a greater proportion of resources is devoted to the countries with least population, i.e. to Belize and the seven members of the Organisation of Eastern Caribbean States (OECS).

CARDI's organisational structure has been shaped by the wide geographical distribution and broad responsibilities of the Institute's staff, together with the need for close collaboration with many national and international organisations. The structure is based on decentralization, which gives operational responsibility to CARDI representatives in each country, and on a matrix approach that supports each project with a team of technical specialists.

Research and Development

The selection of projects seeks to balance the differing needs of many diverse, small groups of farmers in CARDI's 12 member countries within the constraints imposed by restricted resources. Whenever possible, as befits a regional organisation, projects are combined into programmes in order to improve the cost-effectiveness of the research and facilitate the transfer of results. But many projects are also undertaken in response to the needs of individual countries, especially in those smaller member states in which CARDI is the main agricultural research entity.

The work is entirely applied, focused on problem solving. It seeks to improve the productivity of crop and animal enterprises, in order to lower the costs and increase the profitability of farm production. As a development organization, it also has been given wider and longer-term goals, namely to increased agricultural diversification and to expand the utilization of products in agroindustries.

The Strategic Plan, 1988-93, formulated in consultation with Ministries of Agriculture, statutory bodies, farmers' organisations and regional agricultural development agencies, identified the key sectors being addressed.

The Technology Adaptation and Transfer Programme is at the heart of CARDI's strategy. It adopts a holistic, multidisciplinary approach that begins by identifying farm constraints and alternative technologies and ends with inducements to commercialistaion.

Where technical problems cannot be resolved using present knowledge, they are referred to the Crop and Animal Production Programmes where applied research is undertaken to resolve them. The solutions are fed back for testing and validation on representative farms before CARDI co-operates with the national extension services and farmers' organisations in promoting the technologies to farmers.

The recent merger with the Caribbean Agricultural and Rural Development, Advisory and training Service (CARDATA) is strengthening the understanding of the non-technical challenges faced by small farmers and assisting in the delivery of relevant information.

The Crop Production Programme continues to focus on the root crops, legumes and vegetables, with fruit crops and ornamentals being new areas of attention. Root crops such as yam, sweet potato and the aroids are important as food security as well as minor non-traditional exports. Peanut is the main grain legume of interest, but there are also locally important programmes for soyabean and pigeon pea.

Programmes to increased vegetable productivity have been relatively successful, and attention is now directed at particular problems such as the year-round production of tomato and onion. The work in fruit crops and ornamentals is mainly in support of efforts to diversify the exports to 'niche' markets in Europe and North America.

Evaluation of genetic resources and integration pest management are fundamental strategies in the execution of the Crop Programme. And, where improved planting material is not available from commercial sources (especially for legumes, root crops, ornamentals and some vegetables), CARDI is now expanding its capacity to produce and sell this material to farmers.

Increasing forage productivity has been the main thrust of the Animal Production Programme. To this has now been added the improvement of small ruminant production systems. There are also local programmes to better utilize local feed stuffs and to improve cattle production systems.

Commercial firms, commodity associations, institutions and international agencies are increasingly turning to CARDI for consultancy services. No other organisation has such a wide range of skills or a similar length of experience in tackling agricultural developmental problems in the Caribbean. CARDI also has a wide range of linkages with other organizations on which it can draw to supplement its in-house expertise if necessary.

Technical feasibility studies are the primary focus, but prospects for commercial viability have also been examined. In

addition, research projects have been undertaken, on contract, for commercial firms. Recent examples include:

- Investigation of technical and economic prospects for oilseed production in Belize, for Chemonics Limited.

- Refinement of measures to control the foccee berry borer in Jamaica, for the Coffee Industry Board.

- Monitoring of sugar cane and other crop pests for Barbados Sugar Industries Ltd.

- Assessment of demand for fertilizer in the Commonwealth Caribbean, for the National Energy Corporation of Trinidad and Tobago.

- Provision of financial management services to Windward Islands Tropical Products Project, for USAID.

CARDI has been designated by the Standing Committee of Ministers of Agriculture of the Caribbean Community as the administrative agency for the Caribbean Agricultural Research Co-ordinating Committee. It also serves as the regional branch office of the Technical Centre for Agricultural and rural Co-operation, an international agency specializing in technical information transfer.

Since CARDI is funded in part by the governments of the Caribbean Community, its consultancy charges can be adjusted in accordance with the benefits to the region which might accrue from its participation in any activity.

6.2.9 IRCT/CIRAD

Institut de Recherches du Coton et Textiles Exotiques (IRCT)

(a) Organizational Set-up

The cotton and textile Research Institute (IRCT) was created in France in 1946 and, since then, has contributed to the development of the cotton crop in numerous countries. At present, it forms a department of the Centre for International Cooperations in Agronomic Research for Development (CIRAD) Specilizing in cotton and other fibre crops.

It represents the only kind of cotton research network in the world which works with, or has scientific relations with most of the cotton producing countries in all countries.

IRCT personnel consists of about 80 researchers and qualified technicians either based in the different cotton areas of working in the Research Centre of CIRAD in Montpellier,

France, where all the main laboratories and Research facilities are located; these include:

- A fibre testing and micro-spinning laboratory which belongs to the group of international laboratories that formulates the universal fibre characteristics standards;

- A chemistry laboratory equipped to analyse the composition of cotton seeds (proteins, oil, etc.);

- A soil and tissue laboratory;

- An insect breeding laboratory;

- A department specializing in the study and mass-production of entomopathogens and in the evaluation of pest resistance to insecticides (LD 50% laboratory);

- A department of statistics and computerization;

- A weed laboratory;

- A scientific and technical library.

At the request of IBPGR/FAO, IRCT is also incharge of the International Cotton Germplasm Collection which is housed in the Centre of Montpellier; evaluation and seed multiplication of the Collection are conducted in the IRCT Research Station in Costa Rica.

IRCT publishes a quarterly scientific journal, "Coton et Fibres Tropicales", which is circulated in more than 40 countries in three (3) languages (French, English and Spanish).

In line with its research and development activities, the Institute also maintains relations with international organizations such as FAO, World Bank, European Economic Community, Inter-American Development Bank, Asian Development Bank, IICA, etc.

From a scientific and technical point of view, IRCT is recognized internationally by organizations such as the International Cotton Advisory Committee (ICAC), the International Cotton Institute (IIC) and ITMF of Bremen with whom it works closely.

(b) IRCT Worldwide Activities

IRCT is currently conducting, or has conducted, activities in the following countries:

-	In Asia:	Philippines, Thailand, Cambodia, Vietnam and Laos.
-	In Africa and Madagascar:	Senegal, Mali, Niger, Ivory Coast, Benin, Togo, Chad, Cameroon, Burkina Faso, Zambia, Burundi, Republic of Central Africa and Madagascar;
	Mission of evaluation in:	Angola, Mozambique, Nigeria, Guinea, Bissau and Zaire.
-	In Middle East:	Syria and Iran; and
-	In Latin America:	Paraguay, Argentina, Brazil, Ecuador, Peru, Nicaragua, El Salvador, Honduras and Costa Rica.

The Institute also maintains scientific contacts with USA, China, Spain, Greece, Turkey, Egypt, etc.

IRCT has helped put up research stations and organize cotton research and development programmes in many countries. It has likewise designed and installed various laboratories such as fibre testing laboratory in Nicaragua, Ivory Coast and Chad; Cytogenetic laboratory in Ivory Coast; Trichogramma mass-production laboratory in El Salvador and Senegal; experimental ginning plant in Nicaragua, Chad, Cameroon, Ivory Coast, etc., and has worked in the area of commercial ginning to improve lint recovery.

The Institute has created, as well as helped create, numerous varieties, in Africa, it has developed a cotton technology package including recommendations for pesticide application specifically designed for each country. In addition, IRCT has a wide experience in seed production and certification (Africa, Philippines, Costa Rica, Ecuador, Honduras).

IRCT conducts its activities overseas either by means of maintaining long-term cooperation agreements in which experts work within the framework of the country's existing research programme, or by means of rendering technical assistance through regular missions.

Finally, one of its most important activities is to train researchers and technicians in order to assure an effective transfer of technology in the countries where the Institute is involved.

Since 1985 IRCT has developed a regional programme called "Meso America", specialized in technical assistance to the cotton producing countries of central America, the Caribbean and the Peru-Eucador zone. The said programme has been based in Costa Rica since the start of 1988.

The Institute which has the World's largest Sea Island Cotton germplasm and CIRAD are providing technical assistance to the Cotton Development Unit, Barbados, as part of a scientific cooperation programme between the government of France and the government of Barbados. Additionally, CIRAD and CARDI are negotiating a Memorandum of Understanding which inter-alia will allow the two institutions to exchange staff. This Memorandum will allow CARDI to use expertise from IRCT to support research and development in cotton.

6.2.10 AGRIDEV - Agricultural Development Company (International) Limited

Agridev (International) Ltd., a public company under the auspices of the Israel's Ministry of Agriculture, is responsible of the transfer of agricultural technology world wide. The firm has accumulated considerable experience in all aspects of agricultural development both in Israel as well as in the Caribbean region and has operated in more than fifty countries worldwide. Agridev is registered as a consulting company with the world Bank and Inter-American Development Bank and has been involved with many projects funded by these institutions. Agridev has gained much experience in the Caribbean in agricultural diversification with projects and studies carried out in Barbados, Grenada, Dominica, Dominican Republic, Antigua, Haiti, Jamaica and some of the smaller islands.

The Company maintains a pool of experts, comprising some 3,000 professionals covering a wide range of disciplines. Of particular importance to Agridev's success in the implementation of projects overseas is the employment of highly qualified members of Israel's farming community. The main areas of specialisation include: (1) Crop production (2) Post Harvesting for domestic consumption and export (3) Agro-industrial Processing (4) Market surveys and information and (5) Export Marketing and Distribution to mention a few of significance to this study. Specific technologies have been developed and strategies designed aimed at resolving a host of problems found in the agricultural sector. The main activities have included advanced agricultural technologies, export promotion of products, inputs and equipment, agricultural planning and development activities.

Agridev plays a coordinating role in the provision of specialised marketing services through the activities of a number of institutions including the Marketing Research Unit of the Processing Industries. Agridev's marketing work has ranged from planning the market potential for fresh fruit and vegetables in

selected markets in North America, Europe, Japan and other countries of S.E. Asia to institutional strengthening and marketing components at the implementation stage.

Agridev has assisted in cotton research in Barbados in the areas of agronomy and genetics. In 1989/90 as well as 1990/91. An agronomist was employed for about 7 months while a consultant geneticist has 3 visits each of a 2 week duration. These consultancies were funded by the World Bank.

6.2.11 National Resources Institute (NRI) (Chatham-Kent)

The Natural Resource Institute is an internationally recognised centre of expertise on the natural resources NRI in developing countries.

NRI has a tradition of multidiciplinary problem solving research and development which goes back through the tropical Products Institute, the Land resources Development Centre, the Centre for Overseas Pest Research and others to the Imperial Institute founded in the late nineteenth century.

NRI's main areas of expertise are:

- Resource Assessment and Farming Systems
- Integrated Pest Management
- Food Science and Crop Utilisation

Within these strategy areas, the Institute carried out research and surveys; develop pilot scale plant machinery and processed, identify, prepare, manage and execute projects' provide advice and training; and publish scientific and development material.

NRI has assisted in pheromone research in Barbados - 2 months in 88/89 and 3 weeks in 89/90. On both occasions, this technical assistance was funded by the British Development Division and involved the movement of a specialist entomologist to Barbados. In collaboration with MAFF personnel, formulations of pink ball worm pheromones were evaluated for efficiency vs pink bollworm. Pheromone from the leafworm Alabama was also isolated from local pest populations by NRI Scientists and is now in use here in Barbados.

6.3 Information Services

6.3.1 Antigua and Barbuda

The Ministry of Agriculture library is managed by a clerical assistant who needs professional help and guidance in organizing

the collection. Some technical assistance was given by the regional co-ordination centre for agricultural information (The University of the West Indies, St. Augustine Library). Further assistance is difficult presently since there is no qualified Librarian at the national documentation centre. The information is not easily accessible.

The Government Chemist's Department has a collection of information which includes agricultural-related information. This collection is managed by a clerical assistant. The information is not readily accessible.

The Organisation of Eastern Caribbean States (OECS) library in Antigua has a component of agricultural information to support the OECS Secretariat's activities relating to agriculture in the sub-region. This library has a computerized database of its holdings using the CDS ISIS. The collection is used by other scientists in Antigua. There is one professional and one support staff assigned to this library.

Equipment:

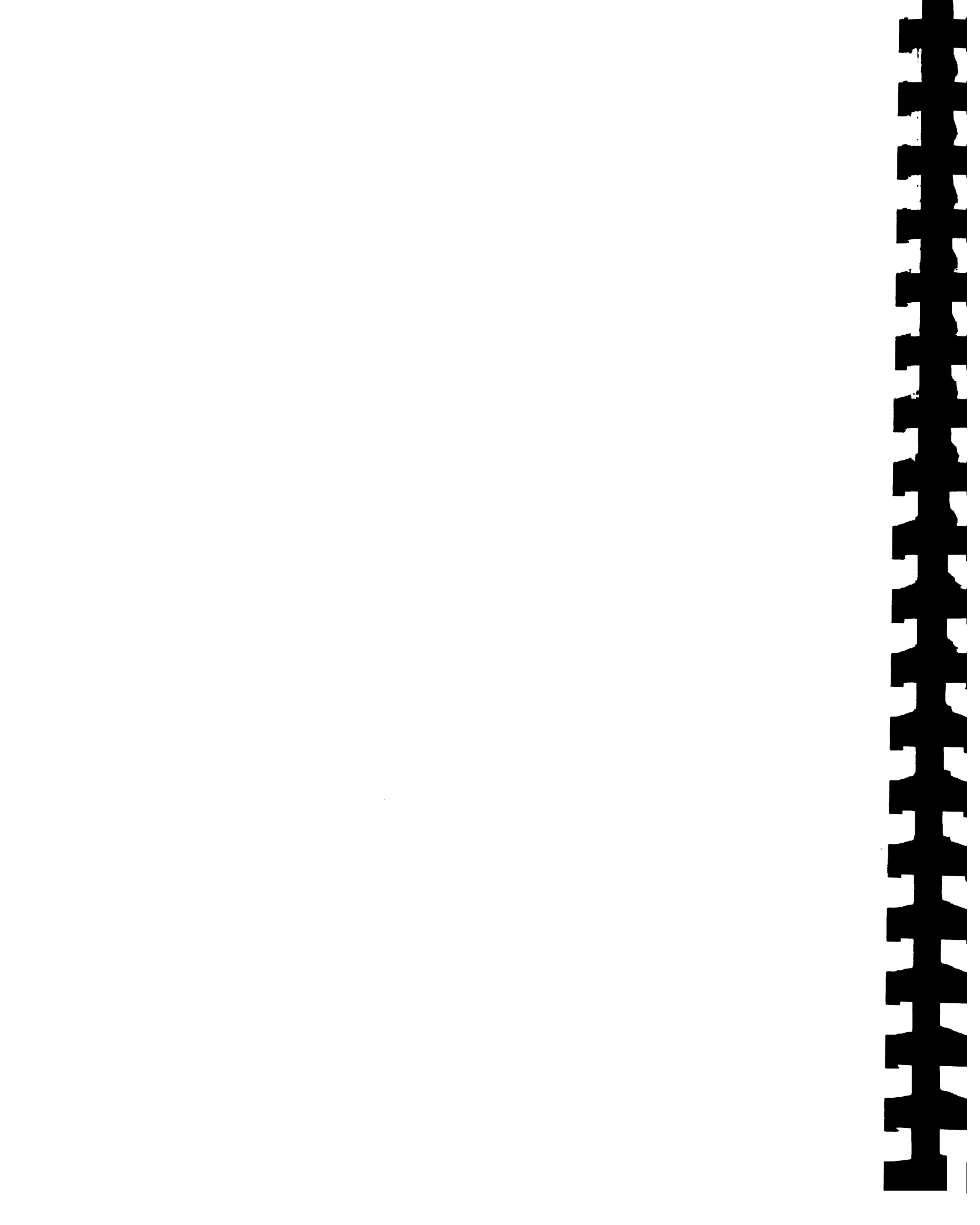
IBM System 2 80 Computer
Access to Photocopier

The following are users and/or producers of agricultural information in Antigua:

Antigua and Barbuda Development Bank
Antigua Commercial Bank
Caribbean Agricultural Research and Development Institute
Commercial Suppliers of Agricultural Inputs
Government Chemist Department
Ministry of Agriculture
National Development Foundation
Organization of American States
Organization of Eastern Caribbean States

6.3.2 Barbados

The Ministry of Agriculture has a library with a collection of agricultural information. It is the national focal point for the regional information system for agriculture (CAGRIS). The library functions are carried out by a library assistant who has some help from the Co-ordinator of Library Services who is a trained librarian. However, she has the responsibility to oversee all the government departmental libraries. The collection is not organized and not easily accessible. There is professional help and one support staff.



Equipment
Sampson Computer
Access to Printer

The National Library Service is the depository of all documents published in Barbados. It is the national focal point for the regional information system on economic and social planning - CARISPLAN - and is therefore responsible for data input to the CARISPLAN database. It produces the Barbados National Bibliography. There is an agricultural component in the collection consisting of Barbados and the Caribbean agricultural information collected over the years. There are 17 professional and support staff assigned to this library.

Equipment
1 Mini Computer
3 PC IBM Computers
WYSE IBM Computers
5 Printers
1 Photocopier
Video Recorder and Monitor
Microfiche Reader/Printer

The West Indies Cane Breeding Station has an informal network with all sugar cane researchers in the region. This organization has a small collection of information on sugar cane. The collection supports the research activity of the organization. Information is not organized.

Food and Agricultural Organization (FAO) has a library consisting of a specialized collection of FAO documents relating to Caribbean agriculture. This collection of more than 1,800 documents is being organized and computerized with the help of a consultant. This information can be accessed at the FAO office.

Equipment
Computer
Printer
Photocopier

The Inter-American Institute for Cooperation on Agriculture (IICA) has a specialised agricultural library consisting mainly of those documents produced by IICA on Caribbean agriculture. This collection is being organized and computerized with the help of a local consultant. IICA is developing a database of information on its projects.

Equipment
IBM Compatible Computer
Printer
Photccopier

The University of the West Indies Library has agricultural and agriculture-related components of information to support the need for information by its Faculty of Natural Sciences. This information is accessed by agricultural scientists of Barbados. The library's holdings and systems are in the process of being computerized. The library has facilities for on-line searches.

Equipment
M300 Computer
Printer
Photocopying Machine
Microfiche Reader/Printer
Microfilm

The Agricultural Extension Service has four professionals. There is a Communications Unit with two professionals.

Equipment
1 Slide Projector
1 Photocopier
1 Overhead Projector
1 VCR and Monitor
1 Double Cassette Recorder

Documents are either printed at the Government Printery or put out to tender.

The Caribbean Development Bank is involved in the economic development of the region, including agricultural and rural development. Its library has a well organized and computerized collection which includes a component of agricultural information. This is generated by the bank and collected from external sources in support of the bank's own work. This information is also accessed by agricultural scientists in Barbados. There are two professionals and four support staff assigned to this library.

Equipment
Mainframe Computer
Access to Printer
Access to Photocopier

The following are users and/or producers for agricultural information in Barbados:

Barbados Agricultural Society
Barbados Marketing Corporation
Barbados Sugar Industry Limited
Barclays Bank
British Development Division
Caribbean Agricultural Research Development Institute
Caribbean Development Bank
Ministry of Agriculture

Suppliers of Agricultural Inputs
West Indies Sugar Cane Breeding Station

6.3.3 Montserrat

The Montserrat Ministry of Finance Library has the responsibility for the acquisition, processing and dissemination of information including agricultural information. This library is the national focal point for the regional networks on economic and social planning and agriculture, and is responsible for data input to the INFONET data base, from where it is exported to the regional information co-ordination centres. This information is accessed by the public. This library's holdings are being computerized. One professional and one support staff are assigned to this library.

Equipment
IBM PS 2 Computer
Data Mini
Printer
Photocopier

Montserrat's Ministry of Agriculture Extension Service has eight professionals. The Communication Unit's function is carried out by the Chief Extension Officer who is trained in agricultural communications.

Equipment
Tape Recorders
Camera

6.3.4 St. Kitts/Nevis

The Public Library in St. Kitts is the national focal point for the regional information networks. The library is responsible for the acquisition, processing and dissemination of the information, including agricultural information. Data input is sent to INFONET from where it is exported to the regional information co-ordinating centres. Computerization is being done using the CDS ISIS. The information is accessible to the public. One professional and two support staff are assigned to this library.

Equipment
Computer
Printer
Photocopier

The Ministry of Agriculture Extension Division has eight professionals. Work in agricultural communications is done within this division.

Equipment
Tape Recorder
Camera
Video and Editing Facilities
Duplicator
Scanner

The following are users and/or producers for agricultural information in St. Kitts/Nevis:

Ministry of Agriculture
Foundation for National Development
Marketing Corporation
Investment Promotion Agency
St. Kitts Sugar Manufacturing Corporation
Development Bank
Nutrition Surveillance
Caribbean Agricultural Research and Development Institute
St. Kitts/Nevis Ministry of Women Affairs Projects.

ANNEX 1

Glossary of Textile Terms Used

1. Yarn Count. Yarn count is a measure of the linear density or weight per unit length of a yarn, and indirect methods of measuring the "thickness" of a yearn which is used because of the practical problems of measuring yarn thickness or diameters directly. the figures quotes in the text refer to English cotton count and is based on the number of 840 yarn lengths which weigh one Imperial pound. Consequently, the higher the yarn count, the finer the yarn.

2. LCSP. These initials stand for less count strength product which is obtained by multiplying the force required to break a 120 yd. skin of yarn by the yarn count. As such it is a crude method of correcting yarn strength results for any difference between actual and nominal count.

Effective Fibre Length

In general terms this is the average length of the longest fibres in a cotton fibre array and is determined by use of the graphical construction described in BS 4044. For long stapled cottons such as Sea Island or Egyptian the effective length is very close to the staple length determined by hand stapling. The units quoted in the table are thirty seconds of an inch.

Cotton Fibre Fineness

This is a measure of the mean linear density of cotton fibres. The figures quoted are the weights of 1cm lengths of fibre in terms of hundred millionths of a gramme, 10^{-8} g.

Fibre Strength

This property is more accurately described as a fibre tenacity in that it is a breaking strength corrected for the linear density of the tuft of fibres tested. The figures quoted refer to a test where a tuft of cotton is placed in a pair of clamps held 1/4" apart. The tuft is then broken by applying a load to one of the clamps. The force required to achieve this is recorded and divided by the linear density of the tuft to obtain the breaking tenacity.

ANNEX 2
MSI LINT CHARACTERISTICS
(based on Shirley Institute Tests)

YEAR	ORIGIN	LOCATION	EFFECTIVE 1/32"	LENGTH mm	MATURITY RATIO	IM *	STRENGTH AT 1/8"
1948/49	C	Antigua	56	44.4	0.900		
	C	Montserrat	56	44.4	0.910		
1949/50	C	Montserrat	54	42.8	0.905		
	C	St. Kitts	55	43.6	0.855		
	C	Antigua	54	42.8	0.960		
	C	St. Lucia	54	42.8	0.945		
	C	Antigua	51	40.5	0.870		
1950/51	C	Antigua	56	44.4	0.905		
1960/61	C	Antigua	49	38.9	0.915		
1958/59	PR (7)	CCS	56.0	44.4	0.835		26.7
1959/60	PR (6)	CCS	57.3	45.5	0.862		26.4
1960/61	PR (11)	CCS	54.6	43.3	0.794		28
1961/62	PR (6)	CCS	56.0	44.4	0.848		26.8
1962/63	PR (8)	CCS	53.3	42.3	0.828		28.3
1963/64	PR (8)	CCS	55.3	43.9	0.826		28.9
1966/67	PR (6)	CCS	55.3	43.9	0.859	3.1	29.1
1967/68	PR (6)	CCS	56.2	44.6	0.873	3.4	28
1972/73	PR (11)	CCS	56.9	45.1	0.824	2.9	28.2
1973/74	PR (17)	CCS	56.6	44.9	0.889	3.4	27.5
1976/77	PR (13)	CCS	57.8	45.9	0.826	3	28.4
MEAN VALUE			55.9(1)	44.3(1)	0.848(1)	3.2(2)	27.9(3)

(1) Mean value of 108 samples
(2) Mean value of 53 samples
(3) Mean value of 99 samples
*IM = Micronaire Index
PR (7): Mean value of 7 progeny rows
C: Commercial Cotton
CCS: Central Cotton Station of Antigua

ANNEX 3
BARBADOS MSI PROGENY ROW LINT CHARACTERISTICS
CROP YEAR 1990/91
Based on HVI and FMT 3 results (IRCT-CIRAD)

Progeny Row #	IM	Maturity Ratio	% Fibre Maturity	HS	Staple 50%	Length 2.5%	UR %	Strength at 1/8"	Elongation
1	3.3	0.81	72.10	179	17.7	38.90	45.4	31.2	5.9
2	2.9	0.74	65.70	180	16.1	36.50	44.0	28.4	6.2
3	3.1	0.76	67.20	186	17.3	39.10	44.3	31.3	5.9
4	3.4	0.81	72.30	182	17.3	38.90	44.4	27.4	6.1
5	3.2	0.78	69.80	180	16.3	37.60	43.3	28.4	5.9
6	3.4	0.80	71.20	187	17.1	38.70	44.1	31.6	5.9
7	3.4	0.83	73.60	174	16.5	39.00	42.4	30.0	5.9
8	3.0	0.76	67.40	180	17.5	39.10	44.8	30.8	6.0
9	3.6	0.87	77.30	174	17.0	39.80	42.7	32.0	5.9
10	3.2	0.78	69.60	182	17.0	37.90	44.7	30.7	5.9
11	3.2	0.80	71.50	175	17.4	38.80	44.8	31.1	5.8
12	3.2	0.78	69.60	184	17.0	38.50	44.1	31.1	5.9
13	3.3	0.81	72.00	179	18.0	39.00	46.2	30.1	5.8
14	3.3	0.81	72.10	179	17.3	38.60	44.9	31.3	5.9
15	3.3	0.79	70.70	181	15.8	36.70	43.1	28.2	6.0
16	3.3	0.83	73.60	169	17.7	39.30	45.2	31.3	5.9
17	3.3	0.82	73.00	174	16.9	38.30	44.2	30.8	5.9
18	3.3	0.78	69.60	186	17.3	39.10	44.2	30.2	5.9
19	3.4	0.86	76.40	166	16.3	37.90	43.2	29.6	5.9
20	3.4	0.81	72.30	181	17.2	39.20	43.8	31.5	5.8
21	3.4	0.81	72.00	182	18.1	39.40	45.8	29.6	6.0
22	3.3	0.81	71.80	179	16.9	38.60	43.7	30.4	6.0
23	3.4	0.84	74.90	171	16.4	38.80	42.4	31.0	5.8
24	3.4	0.83	73.70	173	17.0	38.80	43.7	31.4	5.9
25	3.6	0.87	77.70	172	16.2	35.80	45.3	28.7	5.9
26	3.2	0.80	71.00	178	16.7	38.00	43.9	29.6	6.0
27	3.4	0.83	73.60	174	12.9	35.70	36.0	31.4	5.8
28	3.5	0.89	78.90	158	13.3	35.80	37.0	31.9	5.8
29	3.3	0.82	72.90	176	16.0	37.80	42.4	32.2	5.8
30	3.3	0.81	72.00	175	16.0	37.80	42.3	31.9	5.9
31	3.2	0.77	68.70	187	16.2	39.20	41.3	32.7	5.9
32	3.3	0.80	71.50	178	16.7	37.80	44.3	29.0	5.9
33	3.2	0.78	69.50	182	16.2	37.80	42.9	31.4	5.9
34	3.4	0.79	70.50	189	15.8	38.00	41.4	30.0	5.9
35	3.3	0.81	72.00	175	15.7	38.30	40.9	32.8	5.9
36	3.1	0.76	67.80	179	15.7	37.70	41.6	31.2	5.9
37	3.5	0.83	74.40	179	14.5	37.10	39.0	29.9	5.8
38	3.5	0.86	76.70	168	16.6	38.20	43.2	31.6	5.9
39	3.2	0.76	67.60	189	13.2	35.70	36.9	32.1	5.9
40	3.2	0.77	69.00	185	15.7	38.00	41.2	32.3	5.9
41	3.4	0.82	72.80	177	16.0	38.50	41.7	32.0	5.8
42	3.3	0.83	73.60	173	16.0	37.70	42.6	32.5	5.8
43	3.3	0.83	74.10	168	16.6	38.00	43.6	30.4	5.9
44	2.8	0.71	62.60	182	16.6	38.00	43.7	33.2	5.9
45	3.5	0.81	72.40	186	17.2	39.70	43.3	33.5	5.9
46	3.4	0.82	73.40	174	16.0	38.10	41.9	30.0	5.9
47	3.5	0.83	73.50	181	14.4	36.70	39.2	31.7	5.9
48	3.4	0.81	72.50	181	16.1	37.50	43.0	29.4	6.0
49	3.3	0.77	68.80	193	16.9	38.80	43.7	32.2	5.9
50	3.5	0.83	73.90	181	15.1	38.40	39.3	30.4	6.0
51	3.6	0.83	73.90	187	15.5	38.20	40.7	32.0	5.9
52	3.4	0.80	71.10	189	16.7	38.80	42.9	29.5	5.7
53	3.6	0.85	75.80	176	17.8	39.30	45.2	31.0	5.9
54	3.3	0.79	70.60	183	16.8	38.30	43.8	27.7	5.9
55	3.3	0.80	70.90	182	16.8	38.30	43.9	29.7	5.8
56	3.4	0.81	72.40	181	16.6	37.10	44.7	27.4	5.8
57	3.6	0.86	76.90	174	16.9	39.20	43.0	30.4	5.7
58	3.5	0.84	74.60	176	17.6	38.80	45.2	32.3	5.8
59	3.6	0.85	75.60	179	16.5	37.70	43.9	30.0	5.8
60	3.8	0.90	80.10	170	17.7	38.90	45.6	29.6	5.7

Cont'd

Progeny Row #	IM	Maturity Ratio	% Fibre Maturity	HS	Staple 50%	Length 2.5%	UR %	Strength at 1/8"	Elongation
61	3.7	0.87	77.00	182	17.9	39.30	45.6	29.4	5.8
62	3.2	0.77	68.70	183	17.1	38.80	44.0	30.1	5.7
63	3.3	0.78	69.70	188	16.9	38.90	43.4	30.6	5.8
64	3.5	0.81	72.20	192	16.9	39.00	43.3	30.7	5.7
65	3.4	0.82	72.90	183	16.6	38.50	43.0	28.2	5.8
66	3.4	0.85	75.90	168	17.4	38.70	45.0	30.3	5.7
67	3.3	0.80	71.30	182	17.0	39.10	43.4	31.1	5.6
68	3.5	0.86	77.00	166	18.0	39.20	45.9	33.0	5.8
69	3.1	0.74	65.70	191	15.3	37.20	41.2	33.6	5.7
70	3.0	0.81	71.80	180	16.4	38.40	42.7	32.9	5.7
71	3.7	0.85	75.40	190	15.1	34.60	43.8	31.5	6.3
72	3.6	0.87	77.20	172	17.6	39.10	45.0	29.3	5.7
73	3.2	0.76	67.60	193	16.5	38.30	43.2	32.0	5.8
74	3.6	0.85	75.30	179	16.8	38.50	43.7	30.5	5.8
75	3.4	0.83	74.40	173	16.9	39.10	43.1	32.5	5.7
76	3.5	0.81	72.10	188	16.5	38.10	43.3	29.0	5.8
77	3.7	0.87	77.70	175	17.0	39.20	43.5	31.4	5.7
78	3.5	0.88	78.30	163	13.8	37.30	37.0	32.7	5.7
79	3.5	0.87	77.60	163	13.4	36.10	37.1	30.6	5.8
MEAN VALUE	3.4	0.815	72.50	179	16.4	38.20	43.0	30.8	5.8

ANNEX 4
MSI CHARACTERIZATION OVER THE YEARS
(Taken from J.R. Spence report (1))

SOURCE	HEIGHT 1st. FB (NODE No.)	Locs/Boll	Boll weight (%)	Ginning %	SI	LJ
H & H (2)	11.5	3.38	3.25	30.4	14.0	6.10
CCA 1976/77 (3)	11.6	3.42	3.62	31.3	13.74	6.26
CCS 1982/83 (3)	NA	3.44	4.38	31.9	13.52	6.32

SOURCE	Effective 1/32"	Lenght mm	Micronaire Value	Strength g/tex	Maturity ratio
Lord (4)	55.9	43.6	NA	NA	0.835
CCA 1975/76	57.1	45.3	3.1	26.7	0.828
Barbados 1989/90 (5)		38.2	3.4	30.8	0.815

(1) J.R. Spence: Report on cotton in Antigua (1983)
(2) Hutchinson, J.B. and Manning H.L.: the Sea Island Cottons. Memoirs of the Cotton Research Station, Trinidad, Series A. No. 25 London (1945)
(3) CCS: Central Cotton Station, Antigua
(4) Lorde E.: The production and characteristics of the World's Cotton Crops Part I: The West Indies. Shirley Institute Memoirs. Manchester (1945)
(5) Data issued from a study on MSI progeny rows conducted in Barbados in 1990/91 (See Annex 2)

Height 1st. FB: Height of the first fruiting branch expressed in number of nodes

SJ: Seed index or weight or 100 seeds - LI - Lint index

ANNEX 5
COTTON DESCRIPTORS
(To evaluate the Cotton Germplasm Collection)

General Information:

1. Accession number in the seed bank
2. Name of variety/line
3. Species of cotton (in case other types of cotton are included in the collection): HI=hirsutum; BA=barbadense; AR=arboreum; HE+herbaceum and IN=interspecific crosses
4. Country of origin (according to the U.N. code)
5. Year of the first entry in the bank
6. Year of the last evaluation
7. Name of variety used as check-line
8. Number of seed multiplications from its first introduction in the bank

Botany
Plant Canopy

9. Canopy: slender, bushy (goblet) or compact (pyramidal)
10. Average insertion height of the first sympodial branch (expressed) in number of internodes between the cotyledonary node and the first fruiting branch)
11. Average number of vegetative branches (below the first sympodial)
12. Stem color: green, purple-red or purple-green

Leaves

13. Shape: entire; lobed (hirsutum type) ver lobed (barbadense type), okra or super okra
14. color: green, purple, purple-green
15. Hairiness: glabrous (smooth leaf), slight, medium, high or super hairy (velvet-like)
16. Number of nectarines

Bracts

17. Shape: slightly or deeply dentate or frego character
18. Size: small, medium or long

Flowers

19. Petal color: white, cream, light or bright yellow, red
20. Petal spot: absence or presence of slightly, medium or highly red spot
21. Pollen color: white, creamy or yellow
22. Length of the pistil: longer or shorter than the staminal column

Cotton Ball

23. Size: small, medium, large
24. Shape: round, oval, conical
25. Mucron: non, slightly or highly mucronate
26. Color: green, deep green, red
27. Insertion: normal, semi-cluster or cluster
28. Position: upward, intermediate, downward
29. Gossypol glands: none, scarse, noraml, numerous
30. Dehiscense (opening): open, storm resistant, stormproof
31. Number of locules

Seeds

32. Size: small, normal, big, "kidney" seeds
33. Hairiness: nakes, tufted, slightly hairy, hairy
34. Fuzz color: white, green, grey, brown combinations between the 4 basic colors
35. Lint color: white, creamy, yellowish, khaki, reddish brown.

Agronomy

Vegetative Cycle

36. Number of days between emergence and flowering stage
37. Number of days between emergence and bursting stage
38. Earliness (first harvest expressed in % of harvest total)

Harvest

39. Mean ball weight (g)
40. Yield (lbs/ac)
41. Line recovery (% Fibre)
42. Seed index (weight of 100 fuzzy seeds)
43. Plant height (cm)

Technology

44. % linter
45. Weight of 100 delinter seeds (in grammes)
46. Oil content
47. Protein content (total N x 6.25)

Fibre

48. Finrograph: 2.5% S.L. (in mm)
49. Fibrograph: uniformity (US %)
50. Stelometer: tenacity (Tl)
51. Stelometer: elongation (El)
52. Pressley (1000 PSI)
53. Maturity IIC: micronaire
54. Maturity IIC: maturity ratio

55. Maturity IIC: % mature ribre
56. Maturity IIC: Intrinsic fineness (Hs)
57. Colorimeter: % Rd
58. Colorimeter: yellow index (+b)

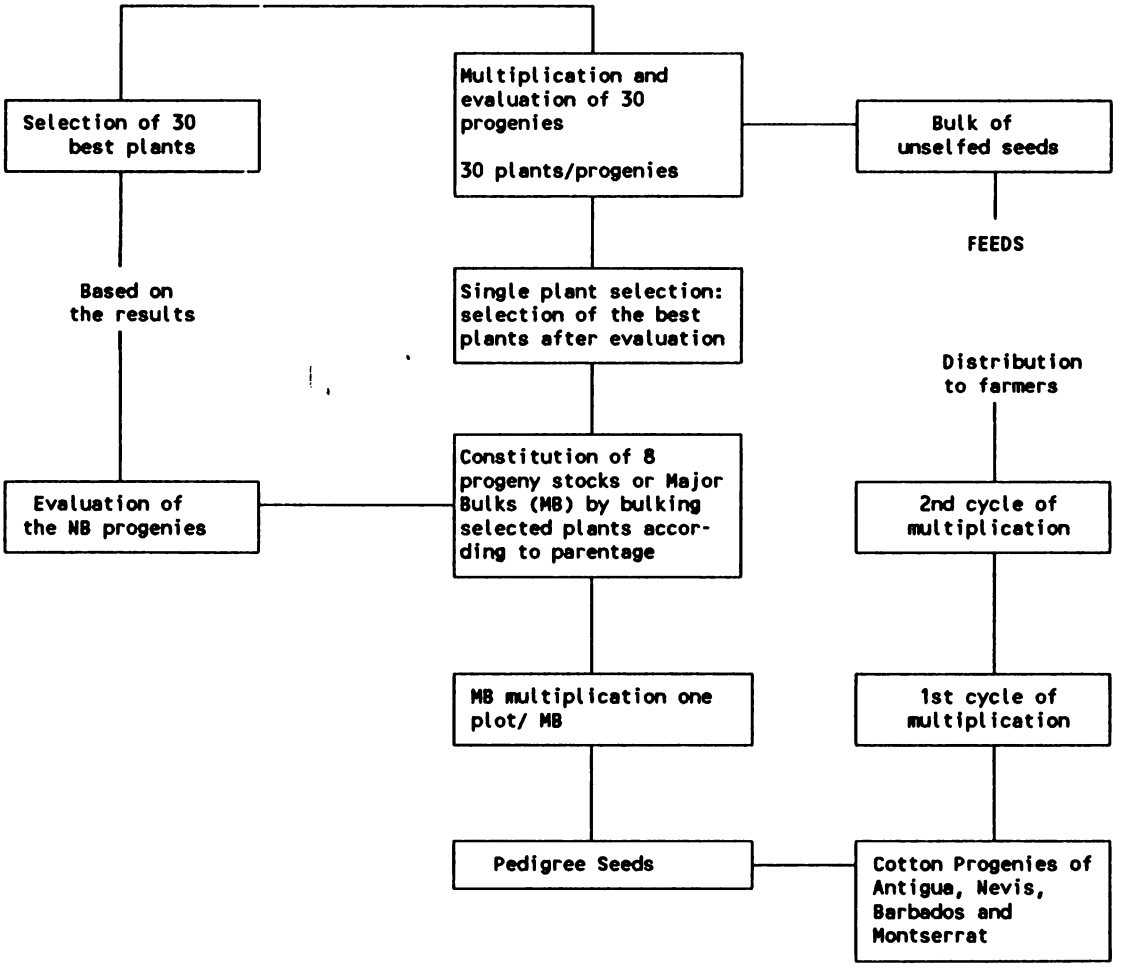
Tread

59. Microspinning: uster tenacity
60. Microspinning: uster elongation
61. Microspinning: total neps
62. Microspinning: finre neps
63: Microspinning: seed coat fragment

Phytosanitary

64. Lodging susceptibility
65. bacterial blight suscepitibility
66. Other disease susceptibility

ANNEX 6
PEDIGREE SEED PRODUCTION SCHEME
(as implemented on the Cotton Station of Antigua)



ANNEX 7
TABLE A7.1
COTTON PRODUCTION IN ANTIGUA
1967/68-1989/90

YEAR	ACREAGE	BALES	LINT LBS
1967/68	1290	371	116438
1968/69	70	13	3855
1969/70	140	34	11431
1970/71	75	23	6801
1971/72	230	125	38682
1972/73	830	748	240633
1973/74	883	481	153525
1974/75	848	684	208438
1975/76	1035	656	178804
1976/77	880	485	149640
1977/78	872	557	174362
1978/79	258	38	12329
1979/80	478	113	34912
1980/81	332	41	13211
1981/82	346	27	8875
1982/83	30	17	4987
1983/84	35.5	14	4456
1984/85	201	191	60925
1985/86	393.5	208	66035
1986/87	166	45	13150
1987/88	50	32	9943
1988/89	47	28	7985
1989/90	37	34	7792

ANNEX 7
TABLE A7.2
Cotton Production in Barbados over 8 seasons

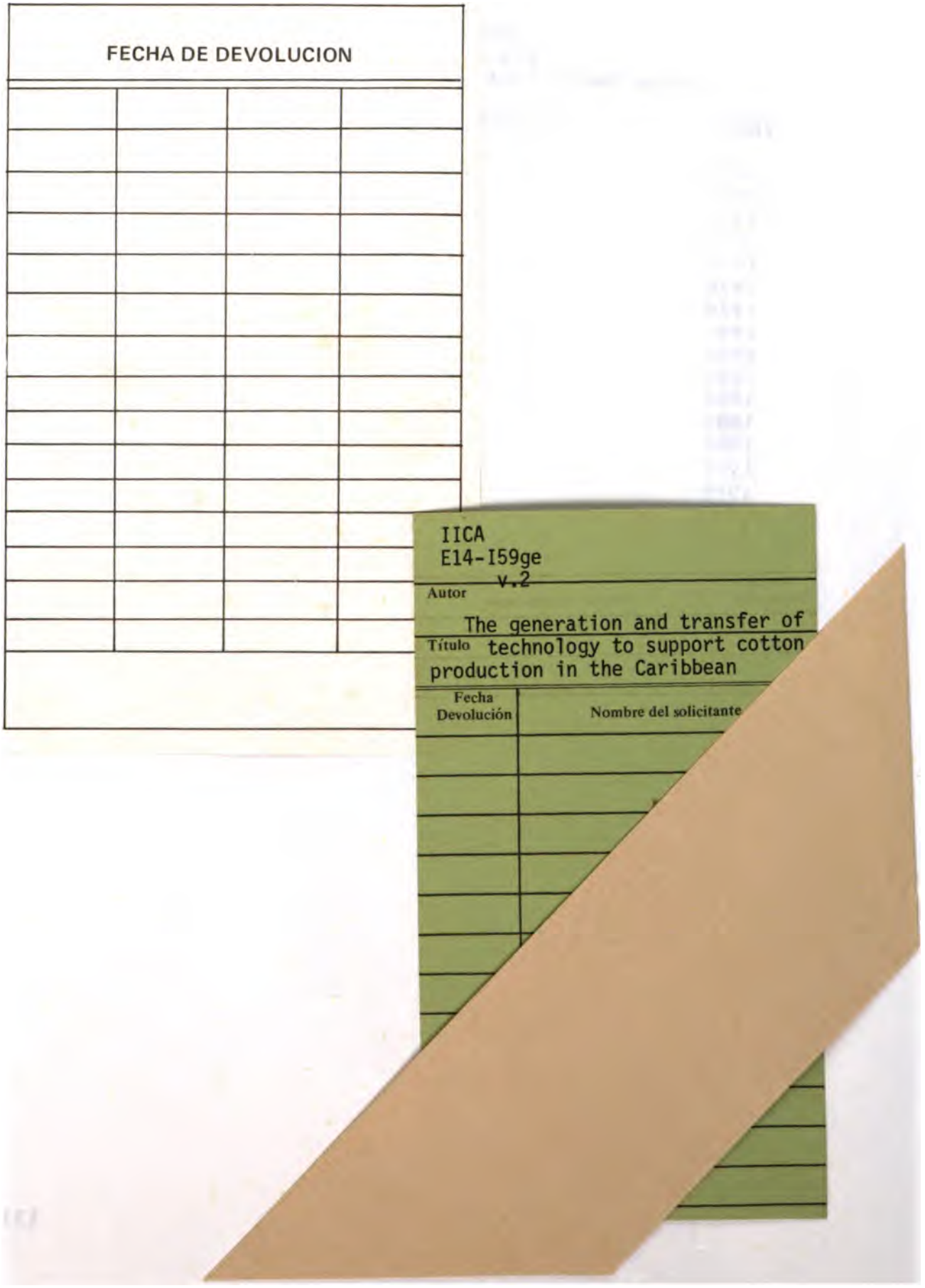
Season	Acres Harvested	Lbs Seed Cotton Total	SC/A	Gin %	Total Production Lint	Seed
1983-84	50	47,509	950.18	31.8	15,089	31,435
1984-85	243	136,819	674.15	30.4	50,116	112,965
1985-86	625	914,678	1,463.15	30.7	280,909	610,814
1986-87	1,041	1142316	1,095.0	30.1	355,139	644,650
1987-88	1,190	875,124	734.9	30.2	262,798	602,225
1988-89	992	671,651	677.0	31.4	210,737	447,179
1989-90	732	283,301	385.7	33.3	93,995	183,379
1990-91	1,016	241,024	237.2	31.8	76,511	174,265

ANNEX 7
TABLE A7.3
COTTON PRODUCTION IN MONTSERRAT

YEAR	ACREAGE	TOTAL PRODUCTION COTTON LINT (LBS)
1975	NA	120000
1976	NA	200000
1977	NA	110000
1978	NA	60000
1979	82	20000
1980	NA	10000
1981	NA	75000
1982	NA	50000
1983	125	NA

ANNEX 7
TABLE A7.4
COTTON PRODUCTION IN ST. KITTS/NEVIS

YEAR	ACREAGE	LINT (LBS)
1974	329	31537
1975	522	49469
1976		
1977	315	20889
1978	205	13089
1979	72	2998
1980	37.5	2213
1981	202	23864
1982	230	166030
1983	171	9419
1984	113	9492
1985	91	12734
1986	99	11492
1987	65	6457
1988	68	6685
1989	40	7202
1990	35	3790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production in the Caribbean
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