

COMPONENT 5

RESEARCH AND DEVELOPMENT INTO FACTORS AFFECTING YIELD DECLINE

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Objective

This component's primary objective was to investigate causative factors contributing to yield decline with a view to facilitate a boost in productivity, on small farms, through the application of appropriate techniques.

Rationale

With the assumption that the primary cause of low yields is centuries of monoculture, one of the approaches taken was to introduce crop rotation as a corrective measure.

Yield decline, therefore, was viewed as caused, at least in part, by a reduction in soil fertility, deterioration in soil condition (compacted sub-surface layers), and pest and disease (primarily nematodes) build-up. The applied methods sought to remove sugar cane as a host for various soil organisms and could also possibly have resulted in a restoration of levels of nutrients favoured by sugarcane during the period the soil is occupied by alternate crops.

Project Initiation, Implementation, and Supervision

Since the start of the project in 2004, a number of growers on small-holdings were approached with the idea of introducing crop rotation on their farms. They were briefed that this was in an attempt to restore soil productivity while earning from alternate crops (for which markets had been identified). Most farmers, however, were not enthusiastic about undertaking the cultivation of crops other than sugar cane. The sensitization process therefore proved tedious and delayed project implementation among the farmers who eventually participated.

The project leader organised land preparation, provided seed material, fertilizers, herbicides, and sometimes supervised various operations. In addition, technical advice was sought to cultivate crops (inclusive of Sea Island cotton) used in the rotation.

Sea Island cotton, a high value crop with both a guaranteed market and high price was the crop of choice as it had the potential to be cultivated over vast acreages with little threat from praedial larceny. In 2004, seed obtained and planted were found to be of low viability. As a result, all but one of the plots (D. Smith's) failed. Concern was raised as the failed plots lacked facilities for irrigation when compared with the plot that was successfully cultivated which itself only approached an acceptable plant population after two attempts at replanting, figures 5.1, 5.2, and 5.3.

The procedure for the crop rotation scheme mandated that a legume be included to contribute to a boost in soil nutrient status. Hence, peanut was established on the two plots (Green and Mason's) in Trelawny where Sea Island cotton crops had failed, figure 5.4.

Initially, twenty farmers were targeted for participation in crop rotation schemes. Selection of farmers was facilitated by the SIRI Extension Services department. Eventually, four farmers were selected and plots ranging from 1 to 4 hectares were established on three holdings. Work was discontinued on the fourth where the farmer was not complying with requests to carry out certain activities in the recommended manner.

During 2005/2006 an additional eight farmers were selected for participation. They were located in St Thomas (5), Westmoreland (2) and Clarendon (1).

Collaborating Agencies

The PEA collaborated with the Jamaica Agricultural Development Foundation (JADF) which provided cotton seed and technical advice to participants. The PEA also collaborated with the Agriculture Unit at the University of the West Indies

Fig. 5.1: Failed Sea Island cotton plot at D. Mason's farm in Trelawny (Dry North coast area)



Fig. 5.2: Cotton at D. Smith's plot in Clarendon (Irrigated area)



Fig. 5.3: Cotton at D. Smith's plot in Clarendon



(UWI) which provided valuable advice on monitoring and control of cotton pests. Bodles Agricultural Research Station (Ministry of Agriculture) provided technical advice on the cultivation of vegetable crops introduced to various farmers. The station provided seed material (Scotch Bonnet pepper) and aided with pest and disease monitoring on pepper and June Plum plots. A contractual arrangement was established with the Jamaica Bauxite Institute (JBI) for the provision of Scotch Bonnet and West Indies Red pepper seedlings under their Land Rehabilitation Programme.

In addition, the PEA drew on the resources of equipment owners in procuring services for land developmental work. These facilitated the application of lime to correct soil acidity, addition of organic matter to correct alkalinity, and chiselling on heavy clay soils to improve sub-surface drainage.

The pooled resources of those units and laboratory facilities at the Sugar Industry Research Institute aided the periodic assessments of biological and chemical status of soils at study sites.

RESULTS

Impact on Target Group

The project targeted and impacted small-holders whose farms showed a sugar cane productivity decline over successive years prior to the start of the project. Although the number of farms targeted for inclusion was not achieved, farmers who participated were positively impacted as they benefited from project inputs. These took the form of technical advice, seeds and seedlings, improved sugar cane cultivars, crop establishment and care, and marketing arrangements, financial arrangements for the compensation of labour, and equipment and contractual agreements that pertained to soil improvement works. The project resulted in movement of large quantities of planting material of various crops across various zones in the island.

Thus, escallion, traditionally grown in dry areas of St Elizabeth was taken and introduced to growers in Trelawny on the Dry North Coast. A hardy variety of escallion, not supplied by the JBI, was chosen on the presumption that similar growing conditions existed in Trelawny. As was to be observed, the variety did not perform satisfactorily owing to the weather and soil conditions.

Escallion was introduced as an alternative crop to farmers at Braco, this after dialogue was concluded with the management of the Walkerswood

Processing plant regarding their guarantee to purchase what was produced. The introduction of the crop generated much interest among farmers and was subsequently planted on four farmers' holdings. The crop was totally lost at three sites.

Scotch Bonnet pepper seedlings were taken from Kingston to Trelawny and June plum from Portland to Trelawny and St Catherine.

Additionally, crop diversification activities as mandated under the Terms of Reference for the project positively impacted the earning potential of farmers. It also introduced a new skills-set among those participants keen on deriving benefits.

Sophisticated drip irrigation systems were installed on farmers' holdings introducing them to irrigation for the first time and transforming their abilities to produce crops at periods when production would have been otherwise not possible.

With the implementation of the project the employment of labour within the areas was increased. As a result, benefits accrued to individuals and their families. The project saw major role played by women in field activities.

The physical environment also benefited, as the application of lime resulted in the reduction of acidity at two sites (Green and Mason's plots). Further, in attempts to address alkalinity, poultry manure was applied at two sites (Rhoden and Smith's plots). Finally, improved sub-soil drainage was achieved as a result of chiseling that was done to break hard soil layers.



Fig. 5.4: Peanut harvested from D. Mason's plot in Trelawny

DISSEMINATION OF PROJECT RESULTS

Periodic updates of work in progress have been disseminated to the industry through Annual Reports distributed by the PEA. Two field days were held to provide requisite training to farmers on methods of planting, care of unfamiliar alternate crops, and management of irrigation systems. The media, along with personal contact facilitated by the Extension services, will continue to be used for sustaining effort started under the CFC project.

Crop Rotation

Given the nature and duration of the project, this component was not laid as a formal experiment. Instead, there was focus on the immediate application of proven, adaptable techniques. The PEA intended to establish plots on a number of farms, sufficient to provide for replication; the outcome of which would be evaluated under local conditions. However, the tedious sensitization process and delay in farmer acceptance of crop rotation led to a late start-up on the farms involved. Twenty farmers were targeted; of those, 12 were selected for participation. Of these, 5 farms were earmarked for St Thomas. Unfortunately, the unscheduled removal of the Extension Officer for that area resulted in abortion of those plans.

Of the farmers in the project, four soon became noted for their absence from the plots and reluctance to make inputs of any kind, to the extent that the project leader was forced to discontinue work on these plots. Table 5.1 details crop rotation plots established over the duration of the project.

The intention was to ascertain a base yield for a plot from historical data. Yields following changes brought about by crop rotation and various other introduced practices would then be compared with this base yield. It turned out that historical yield data are largely unavailable on a per field basis as small-holders tend not to keep records. Checks were made with local extension and cane farm officers in efforts to ascertain previous cane delivery from participating farms. This was at best a farm average and not the specific plot information desired for the exercise but was the only compromise under the circumstances. These farm averages were therefore compared with sugar cane yields after crop rotation.

Increased yields have been recorded for two of the plots returned to sugar cane for two crop cycles (plant cane and a first ratoon) after a one-year break. Yields from the crop rotation plots showed an increase over the 5-year average historic yields, though plant and first ratoon yields are traditionally the highest. Furthermore, at either of the two sites it was difficult to attribute the increased yields to crop rotation alone since the alternative crops (cotton and peanuts) were not

Table 5.1: Crop Rotation plots established during project years 1, 2 & 3

Farmer	Location	Area (ha)	Outcome
Donovan Smith	Content, Clarendon	1.22	Sea Island Cotton and red peas successfully cultivated, harvested, and marketed. Delayed re-establishment with sugar cane.
David Mason	Dumfries, Trelawny	2.83	Lost Sea Island Cotton to poor quality seed and extended drought. Low peanut yield in 2005; plot re-established in sugar cane.
Oliver Green	Biddiford, Trelawny	4.67	Lost Sea Island cotton to poor quality seed and extended drought; low peanut yield achieved in 2005; plot re-established in sugar cane.
Astil Sangster	Dean's Valley, Westmoreland	4.45	Sweet potato, and carrot successfully cultivated; crop lost at harvest discontinued for reason of farmer lack of commitment
Mary Reid	Bullhead, Westmoreland	4.04	String bean, red peas, and sweet potato successfully grown but work discontinued for reason of lack of commitment
Gladstone Hewitt	Gravel Hill, Clarendon	1.22	Sorrel crop established but destroyed by goats then remainder flooded; discontinued because of problems with stray animals
R. Brown	Duckenfield, St. Thomas	0.82	Nematode and soil sampling done but further work discontinued because of resignation of Extension Officer
N. Green	Duckenfield, St. Thomas	2.83	Nematode and soil sampling done but further work discontinued because of resignation of Extension Officer
Norma Beckaroo	Vernamfield, Clarendon	2.02	Established under Crop Diversification
A. Thomas	Duckenfield, St. Thomas	2.02	Nematode and soil sampling done but further work discontinued because of resignation of Extension Officer
A. Lewis	Duckenfield, St. Thomas	1.22	Nematode and soil sampling done but further work discontinued because of resignation of Extension Officer
R. Campbell	Duckenfield, St. Thomas	2.83	Nematode and soil sampling done but further work discontinued because of resignation of Extension Officer
Dennis Flowers	Dumfries, Trelawny	2.02	Nematode and soil sampling done but further work discontinued because of lack of farmer commitment
Alfred Rhoden	Content, Clarendon	2.83	Soil improvement done but further work discontinued because of lack of commitment

successfully grown to utilize the fertilizer added at planting. In addition, the soil nutrient status at both plots had been improved by addition of fertilizers at the re-establishment of sugar cane. Also, Green and Mason's plot benefited from being re-established with an improved cultivar, BJ78100. The plots previously had B49119 (a relatively old, smut susceptible variety) and BJ7015, respectively. Plots at both locations were also treated with lime applied at 8 tonnes of marl per hectare to correct acidity problems.

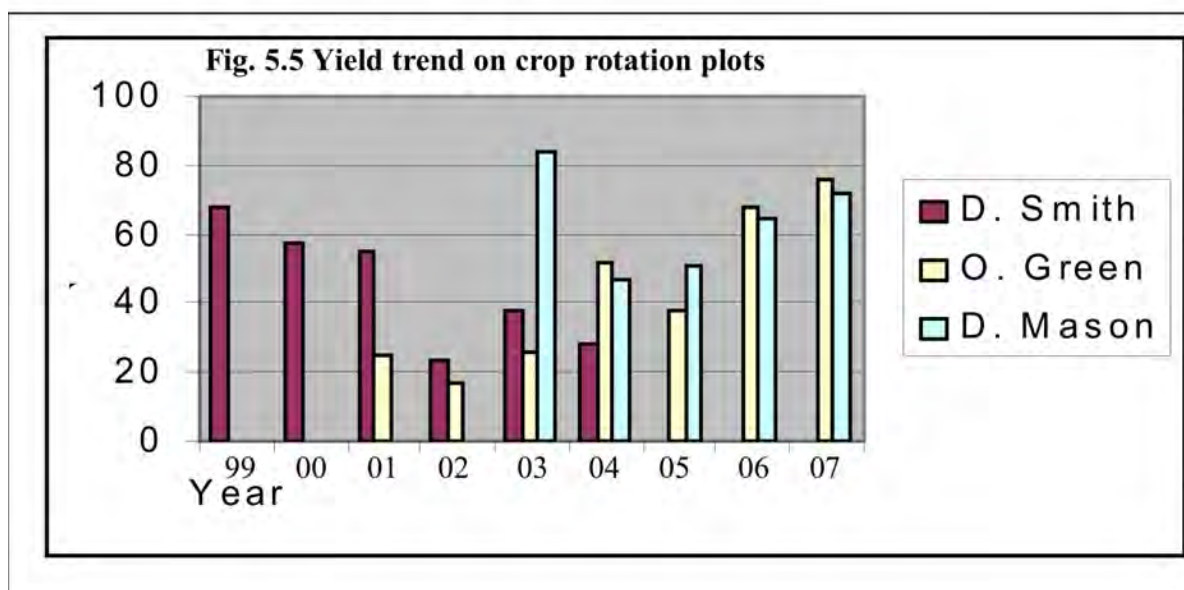
Cane yield (sold as cane seed at 7 months) at Mason's first harvest after rotation was 64.25 tonnes cane per hectare (tc/ha) and at second harvest (12 months) 71.66 tc/ha. Green's plot yielded (average) 67.75 and 75.66 tc/ha, harvested at 10.5 and 12.5 months, respectively.

The two plots to which lime was applied at Green's farm yielded 82.16 and 79.07 tc/ha compared to the plot to which lime was not applied that yielded 64.86 tc/ha. Cane yield at Mason's plot, to which lime was applied, was 71.66 tc/ha. The outcome is detailed in figure 5.5.

Economic Impact of Sea Island Cotton

Initially, hopes were strung on establishing Sea Island cotton as a high value crop in planned rotation schemes across the sugar industry. Several farmers expressed interest in cultivating the crop. In the first year, the experience was that seeds provided by the Jamaica Agricultural Development Foundation (JADF) were not viable. This, coupled with an extended period of drought resulted in crop losses and only Smith's plot survived (detailed below). The decision was taken, back in 2005, not to re-establish cotton until the viability of seeds was guaranteed.

In 2006, the PEA was assured by the JADF that seeds of good quality were available. Sea Island cotton, however, was not established on any plot owing a general unwillingness among farmers to make inputs of any nature.



The cost of production for Sea Island cotton at D. Smith's plot is summarised as follows:

- ★ Projected cost of production per hectare = USD \$3348.00 (initial)
- ★ Actual cost of production = USD \$2564.00
- ★ Returns = USD \$3895.00 (954 kg cotton from 1.22 hectares @ USD \$4.08 per kg)
- ★ Profit = USD \$1331.00

Value of Crops Established

Crops produced under Crop rotation projects and their values are listed in Table 5.2. At the outset SIRI identified and established crops based on each crop's potential to be marketed. Final arrangements for harvest and marketing were to be undertaken by the farmers. In several instances spoilage of produce occurred in the fields as farmers either failed to act in a timely manner or their absenteeism resulted in praedial larceny.

Table 5.2: Approximate value of crops produced under Crop Rotation projects

Farmer	Hectares	Crop	Yield per plot	Value (\$USD)
David Mason	1.4	Peanut	43 bushels	1905.00
David Mason	1.4	Cotton	0 kg	0.00
Oliver Green	3.9	Peanut	89 bushels	3943.00
Oliver Green	1.0	Cotton	221 kg	861.00
Austil Sangster	0.4	Carrot	1527 kg	1033.00
Austil Sangster	1.0	Sweet potato	2895 kg	2450.00
Austil Sangster	0.4	Cow peas	364 kg	862.00
Donovan Smith	1.2	Cotton	954 kg	3503.00
Donovan Smith	1.2	Cow peas	772 kg	1831.00
Total				16,388.00

Correction of Soil Acidity

Samples of soil were analysed prior to the establishment of alternative crops at selected sites. Acidic conditions were diagnosed at several sites. Intervention was made by utilizing marl at 8 tonnes per hectare to effect soil pH correction on three farmers' holdings. The process benefited farmers who lacked financial and equipment resources to apply lime.

Nematodes

Of the biotic soil factors that could limit production, soil nematodes were thought to be among the leading candidates. Several participating farmers' fields were therefore assessed for nematodes. Among species identified, in collaboration with the University of the West Indies' Agriculture Unit, *Pratylenchus* and *Helicotylenchus* were the species most often regarded as parasitic on sugar cane roots. However, numbers found tended to be far below levels normally considered damaging. The economic damage threshold for *Pratylenchus*, for instance, is usually in the vicinity of 250/cc of soil. In this study levels rarely exceeded 50 per 100cc, except on some plots at A. Sangster's farm where *Pratylenchus* species (per 100 grams of roots) approximated 43000, Table 5.3.

Table 5.3. Counts and species of nematodes at study sites

Sample	Per 100 cc soil	Per 100 gram roots
Heavy clay, cotton	<i>Pratylenchus</i> sp. = 40 Non-parasites > 400	Non-parasites = 560
Heavy clay, sugar cane	<i>Helicotylenchus</i> sp. = 30 <i>Pratylenchus</i> sp. = 18 Non-parasites = 350	<i>Helicotylenchus</i> sp. = 119 <i>Pratylenchus</i> sp. = 240 Non-parasites > 3000
Light clay, Jackson Town, sugar cane	<i>Pratylenchus</i> sp. = 18 <i>Pratylenchus</i> sp. = 18 Non-parasites = 195	Non-parasites > 350
Light clay, Jackson Town, cotton	<i>Pratylenchus</i> sp. = 17 Non-parasites > 400	Non-parasites > 800
Dumfries Pen, light clay, sugar cane	<i>Pratylenchus</i> sp. = 16 <i>Helicotylenchus</i> sp. = 16 <i>Pratylenchus</i> sp. = 16 Non-parasites > 700	Non-parasites > 4500
Dumfries Pen, light clay, cotton	Non-parasites > 18	<i>Pratylenchus</i> sp. = 20 Non-parasites > 2000
Frome, Dean's Valley, clay, sugar cane	Non-parasites = 118	No sample
Fontabelle, heavy clay, sugar cane	<i>Rotylenchulus</i> = 8 <i>Helicotylenchus</i> = 8 Non-parasites = 8	Non-parasites = 10
Dumfries Pen, light clay, sugar cane	Non-parasites = 16	none
St. Thomas, R. Brown, sugar cane	Non-parasites = 90	No sample
St. Thomas, K. Green, sugar cane	Non-parasites = 75	No sample
St. Thomas, A. Thomas, sugar cane	Non-parasites = 80	No sample
St. Thomas, A. Lewis, sugar cane	Non-parasites = 120	No sample
St. Thomas, R. Campbell, sugar cane	<i>Helicotylenchus</i> = 18 Non-parasites = 70	No sample
Astil Sangster Dean's Valley, Westmoreland, Plot #1, sweet potato	None	Non-parasites 10362 <i>Pratylenchus</i> sp. 942
Astil Sangster Dean's Valley, Westmoreland, Plot #2, sugar cane (J9501)	None	Non-parasites 20800 <i>Pratylenchus</i> sp. 3200
Astil Sangster Dean's Valley, Westmoreland Plot #3, sweet potato	Non-parasites 95	None
Astil Sangster Dean's Valley, Westmoreland Plot #4, sugar cane (J9501)	None	Non-parasites 38983 <i>Pratylenchus</i> sp. 43220
Astil Sangster Dean's Valley, Westmoreland Plot #7, sweet potato	<i>Criconemoides</i> sp. 18	Non-parasites 12830 <i>Pratylenchus</i> sp. 1925

Table 5.3. Counts and species of nematodes at study sites (contd.)

Astil Sangster Dean's Valley Westmoreland Plot #10, sugar cane (J9501)	Non-parasites 20	Non-parasites Numerous Pratylenchus sp. 767
Astil Sangster Dean's Valley, Westmoreland Plot #11, sugar cane (J9501)	Non-parasites 67 Hoplolaimus sp. 187	Non-parasites 5000 Pratylenchus sp. 13333
Astil Sangster Dean's Valley Westmoreland Plot #12, sugar cane (BJ78100)	None	Non-parasites 15000 Pratylenchus sp. 10714
Astil Sangster Dean's Valley, Westmoreland Plot #13, sweet potato	None	Non-parasites 6642 Pratylenchus sp. 3221
Astil Sangster Dean's Valley, Westmoreland Plot #14, sugar cane (J9501)	None	Non-parasites 23914 Pratylenchus sp. 771
Astil Sangster Dean's Valley, Westmoreland Plot #15	Non-parasites 77 Helicotylenchus sp. 19	Non-parasites 22000
Astil Sangster Dean's Valley, Westmoreland Plot #16	None	None
Astil Sangster Dean's Valley Westmoreland Plot #17	None	Non-parasites 4094 Pratylenchus sp. 18765
Astil Sangster Dean's Valley, Westmoreland Plot #18	None	Non-parasites 36000 Pratylenchus sp. 36000
Astil Sangster Dean's Valley, Westmoreland Plot #19	Non-parasites 142	Non-parasites 19200 Pratylenchus sp. 3200
Astil Sangster Dean's Valley Westmoreland J9501	None	Non-parasites 4186 Pratylenchus sp. 2605
Astil Sangster Dean's Valley, Westmoreland Carrot	Non-parasites 84 Helicotylenchus sp. 21	None
Astil Sangster Dean's Valley,	None	No sample

Sub-surface Drainage

A cone penetrometer was used to collect representative soil samples from fields ranging from light to heavy clays. Readings were recorded to a depth twice that achieved by using a disc plough under conventional tillage methods. As expected, soil hardness increased with increasing depth, figures 5.6 and 5.7. At the depth beyond the plough layer, soil hardness on the heavy clay soil (this was at high soil moisture content) increased sharply, figure 5.7. These soils therefore clearly exhibited evidence of hard pan development below 30 cm. The lighter clays on the Dry North Coast also showed some evidence of soil compaction in the lower layers.

Excessive soil moisture retention was observed on the heavy clays. For the purpose of observation, soil pits were dug at select sites and the condition known as gleying (indicative of slow water infiltration rate) was noted on soil of heavy clay texture especially on the Irrigated Plains of Clarendon. The problem was addressed by deep chiselling (Figure 5.8) on 11 farmers' plots within the project.

The diagnosis was that a hardpan was present in this lower layer - resultant of the soil's physical properties and the impact of heavy equipment traversing the fields over time. The light clay soils also showed evidence of soil compaction in the lower layers.

Further, excessive soil moisture retention was observed on soils of the heavy clay texture. Intervention was made by chiselling (using a specialized deep-tillage implement to break hard soil layers and facilitate sub-surface drainage) on plots owned by eleven farmers at various project sites. This is not routinely practiced among resource-poor farmers as it is an added cost. The method was extended to other small farmers' holdings.

Soil Nutrient Status

In general, an observation of historical data on plots to be included in the developmental programme showed varying

Fig. 5.6 Soil Hardness Profile Rhymesburry Clay (soil type)

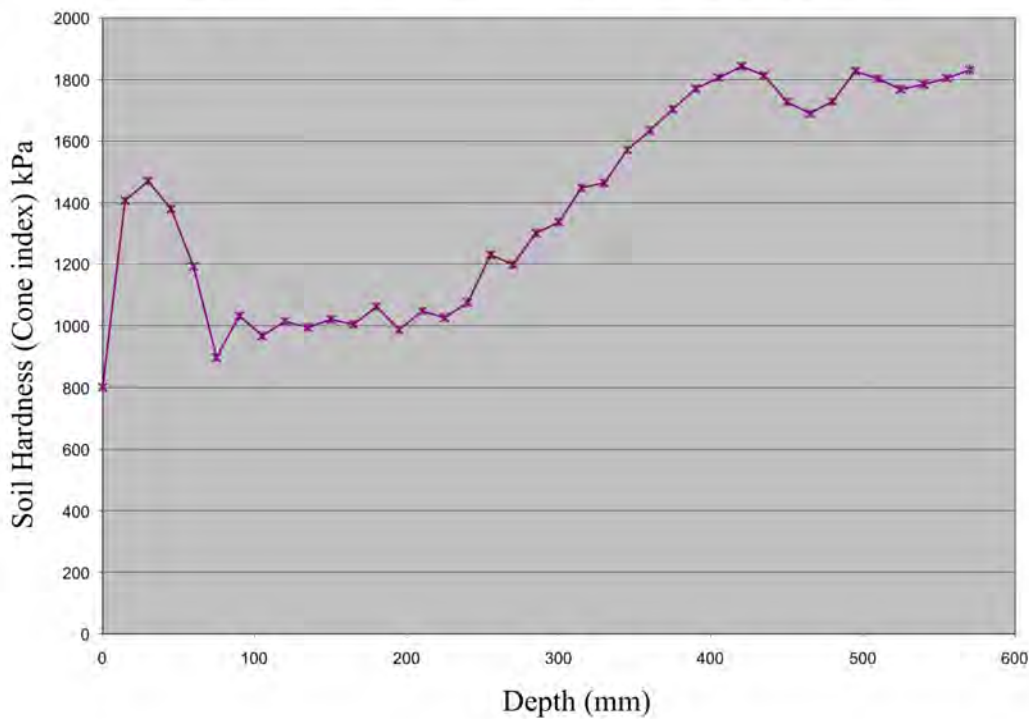
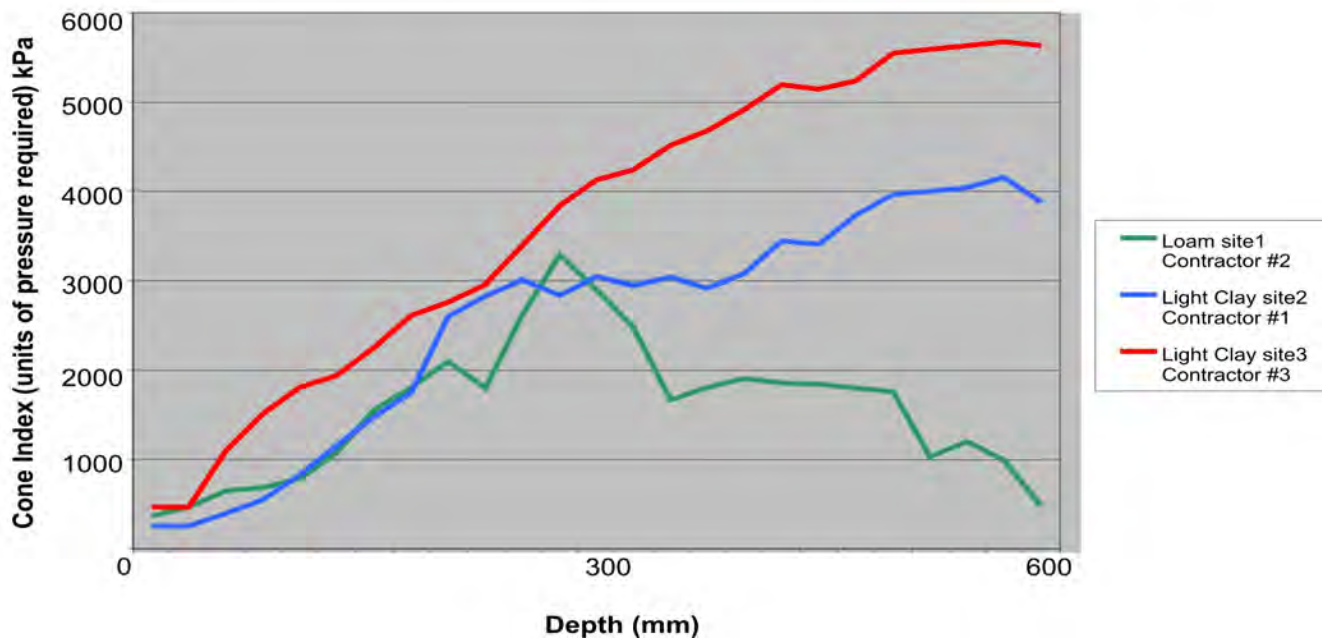


Fig 5.7 Variation in Soil Hardness at Three Sites on Two Soil Textural Classes



levels of nutrients available. The range was from low to high; indicating the requirements for different management practices across the plots. The results, Table 5.4, are indicative of farmers' practices; given, perhaps, their attitude or resources available to fund crop care.

Table 5.4 Summary of soil analyses		
Project Area	Soil pH	Nutrients available
Content, Clarendon, heavy clay	Mildly alkaline to alkaline	Low to very low
Jackson Town, Trelawny, light clay	Highly acidic	Low to very low
Dumfries Pen, Trelawny, light clay	Highly acidic	Moderate to high

Development of Database

The results of analyses of soil, leaf, and water samples submitted by farmers were routinely stored as paper files. Other data relating to, for example, results of nematode assessments have been stored similarly. Researching data in such format proved to be arduous work. In order to reduce the associated level of tedium, an electronic database was developed using the extensible mark-up language (XML) capability of Microsoft Excel. Work has begun on the migration of this database using an open source code.

The premise is that the data, in electronic format, can be used to yield a wealth of information in less time than it now takes. The database is being developed on an information service framework to support crop, and farmer profiles. This is being coupled with scientific knowledge about soil properties. Over time it will be coded to reflect input and output variables such as fertilizers and yield responses, respectively. This should assist in the process of making recommendations. In addition, it will facilitate changes to the way information is relayed to those farmers who experience difficulty understanding the current worded format.

Component 5B: CROP DIVERSIFICATION

Objective: To offer alternatives to sugar cane on small holdings in areas facing factory closure and foster competence in cultivation and marketing non-sugar cane crops

Background: Uncertainty regarding the future of the Jamaican Sugar Industry intensified over the duration of the project. The Jamaican Government's announcement of an intention to close two sugar factories and announced price cuts on sugar sold to the European market (and negotiations for setting up Economic Partnership Agreements) were strong indicators of upheavals to come in the lives of cane farmers and their respective communities unless reliable and viable alternatives are found to sugar cane growing. The Crop Diversification component of the project was therefore timely in that it assisted participating farmers to explore possibilities in the face of the rapidly changing environment.

After an initial delay, the Crop Diversification aspect of the project, inserted on the recommendation of the CFC, got fully underway in 2006. This sought to provide an alternative to farmers who had either discontinued by choice or were forced to get out of sugar cane production. The primary zone selected was the Dry North Coast area of Trelawny where one sugar factory, Hampden, had closed and the other, Long Pond, seemed on the verge of closure. The other main area was the southern irrigated plains but activities spanned four of five major cane growing zones as detailed in Table 5.5.



Fig. 5.8: Chiselled field at Content in Clarendon

METHOD

The programme began with a farmer sensitization process which resulted in several farmers expressing their interest to

Table 5.5 Crop Diversification plots established during Project Years 1,2, and 3

Participant	Field Size (ha)	Location	Crops Planted	Comments
Vinnel Menzies	0.4	Hyde, Trelawny	June plum, and passion fruit	Established and harvested; no data
Clive Bennett	0.4	Clarks Town, Trelawny	June plum	Established and harvested; no data
	2.0	Fontabelle, Trelawny	Sweet potato, and carrot	Established and harvested; no data
Valentine Silvera	0.4	Brampton, Trelawny	June plum	Established and harvested; no data
Sylvester Green	0.4	Hampden, Trelawny	Hot pepper	Established but lost because of lack of irrigation and crop disease
Melvin Ennis	0.4	Hampden	Hot pepper	Established but lost because of lack of irrigation
Vionie Hines	0.4	Hampden	Hot pepper	Established and harvested; no data
Vincent Headley	0.4	Hampden	Hot pepper	Established but lost because of lack of irrigation and crop disease
Lewis Forbes	0.4	Hampden	Hot pepper	Established but lost because of lack of irrigation
Tashley Baugh	0.4	Braco, Trelawny	Hot pepper	Established and harvested; 1170 kg West Indies Red pepper from 0.1 hectare
James Downer	0.4	Braco	Hot pepper, and escallion	Established and harvested 2206 kg Scotch Bonnet pepper from 0.2 hectare; escallion crop lost to flooding
Dugal Johnson	0.4	Braco	Hot pepper, and escallion	Established and harvested; 1181 kg Scotch Bonnet pepper from 0.1 hectare; escallion crop lost to flooding
Winston Kellyghan	0.4	Braco	Bell pepper (Early Sunstation variety), escallion, and cantaloupe	Established and harvested; 1181 kg cantaloupe from 0.06 hectare, and 2272 kg sweet pepper from 0.1 hectare
Joe Hinds	0.4	Braco	Hot pepper	Established and harvested; 1480 kg West Indies Red pepper from 0.2 hectare
A. Ramdatt	0.4	Braco	Carrot, and hot pepper	Established and harvested; no data
Laurence West	1.2	Braco	Carrot, and escallion	Harvested 909 kg carrots from 0.2 hectare; escallion crop lost to flooding
Anthony Fullwood	0.2	Braco	Hot pepper	Established and harvested; 2340 kg Scotch Bonnet pepper from 0.2 hectare
Donovan Smith	1.0	Content, Clarendon	Hot pepper	Established but lost because of lack of irrigation
Beriah Morris	0.8	Rhymesbury, Clarendon	Sweet potato, and hot pepper	Established and lost because of lack of care (despite hydrant located on premises)
Norma Beckaroo	2.0	Vernamfield, Clarendon	Melon, sorrel, and corn	Established and harvested; no data
Pazel Johnson	1.5	Rhymesbury, Clarendon	Sweet potato, hot pepper	Established but lost both crops because of farmer's reluctance to purchase water for irrigation (despite irrigation canal located on premises)
Basil Jackson	0.8	Lluidas Vale, Worthy Park, St. Catherine	June plum, and cow peas	Established but yield was observed to be suppressed because of crop disease; no data
Ian Henry	1.5	Townhead, Frome, Westmoreland	Hot pepper	Yielded 5,538 kg from 1.0 hectare; farm is without irrigation facilities
Total	16.60			

participate. Stemming from this, a total of 22 farmers established plots during the year.

To overcome the problem of unreliable rainfall in Trelawny, on the Dry North Coast, a joint effort with Component 4B saw the establishment of eight drip irrigation systems on small-farmers' holdings. This supplemented rainfall for the cultivation of vegetable crops.

Two field days were conducted to demonstrate the cultivation of various vegetable crops with suggestions on techniques from the United States Agency for International Development (USAID), Rural Agriculture Development Agency (RADA, Jamaica), and local personnel.



Fig. 5.9: Method demonstration in establishing escallion plot at Braco



Fig. 5.10: Training in the operation of a drip irrigation system at Braco

RESULTS

The success of established alternative crops across all sites was affected by varied levels of farmer involvement in crop-cultivation activities. Many farmers demonstrated a tendency to be absent and this stretched the resources of SIRI personnel as some farmers were seemingly totally dependent on the PEA, especially with regard to crop-care. Others exhibited an attitude borne of life long experience with sugar cane which does not require day to day attention to crop husbandry and is able to withstand considerable weed competition. With crops such as escallion and pepper a few days of neglect (of little consequence to sugar cane) often proved disastrous.

In Clarendon, one of the unexpected challenges faced was that farmers, though they had access to irrigation facilities, failed to irrigate their plots - as a cost saving measure, given the high water cost. The result was a loss of various crops.

At Braco in Trelawny, there was a general need especially for timely weed control on most vegetable plots. This led to a suspension of expenditure of CFC funds on some affected plots until the farmers sought to demonstrate greater ardour to maintain a satisfactory level of crop husbandry. This action actually stimulated effort on the part of some to resuscitate their plots. A few achieved encouraging results but the majority failed to satisfactorily adapt. Despite the setbacks, there was evidence that a few may make the transition towards becoming vegetable growers. Some of the problems were beyond the control of growers. No sooner had plots of escallion, for example, been established with drip irrigation installed than the plots were subject to severe flooding and scouring. In the Hampden area of Trelawny some participants (for example S. Green and V. Headley) lost their crops due to the combined effects of plant disease and a lack of irrigation facilities.

Lessons Learned

Development Lessons

The short duration of the project impacted the outcome. Much time had to be spent on farmer sensitization, acceptance, and implementation. There was a favourable outcome for the developmental works done on farms. However, more infor-

mation could have been gleaned had the targeted number of participants been realized. In addition, it was not foreseen that there would be such poor attitude among some farmers that led to their disqualification. This limited the quantity of useful data collected and robbed the exercise of the comprehensive analysis that was expected. Strengthening of research capacity should probably be considered for future projects of this nature.

Operational Lessons

The sugar cane farmers approached for participating in crop rotation and crop diversification, for the most part, were reluctant to attempt growing the other crops suggested, especially once they were asked to make counterpart contributions. By the time some were persuaded to participate, they had only just established certain crops when plots were buffeted by hurricane Ivan in September 2004. Many plots were badly scoured and rendered uneconomic, by the combination of wind and excessive rain.

Experiences were hardly any better in 2005 when, between July and October, the island came under the influence of three hurricanes which effectively wiped out any chance of economic production. Sugar cane was observed to withstand severe weather associated with hurricanes much better than the alternate crops tried.

By 2006 when growers should have been returning plots to sugar cane, disenchantment with the industry had grown from the cumulative effects of hurricanes and the prospect of future reduced prices under the new sugar marketing regime in Europe. Many growers had turned their backs on the industry and showed little interest in co-operating with the project.

Suppliers of Sea Island cotton seed used in the project acknowledged that there was a problem associated with storage temperature of cotton seed resulting in poor germination for project years 1 and 2. This caused the PEA to take the decision to abandon cotton as a potentially viable alternate crop. The problem was subsequently corrected and germination in plots planted indicated much improved seed viability.

The reluctance of a farmer to make inputs in production of alternate crops may be just a reflection of the state of his bank account. Nonetheless, it was felt that the grower would gain very little from the exercise unless he was somehow directly involved and so learned from the exercise.

CONCLUSIONS AND RECOMMENDATIONS

The exercise showed that sugar cane was much better able to withstand the excessive wind, high rainfall, and extended drought, than other crops established under the project. This could account for the known resilience of sugar cane under condition in the Caribbean and explain why even with an increasing area of land available, with closure of sugar plantations, very little has been taken by producers of alternate crops. Vagaries of the weather will therefore have to be carefully taken into account in future Diversification endeavours.

The cultivation of vegetable crops requires considerably more time and attention than growing sugarcane. Many farmers were not prepared to devote the time and resources necessary for successful cultivation, harvest, and marketing. In addition, some farmers seemed to expect that every input would be provided by the project. This was taken to the point where the presence of PEA officers was seemingly required in the daily management and supervision of the plots. This would have stretched the staff resources of the PEA beyond capability. It was soon observed as well that many farmers were unable to manage plots larger than one-half of a hectare of the alternate crops tried.

Where farmers successfully took alternate crops to market, many were reluctant to reveal yields and income for reasons undisclosed. From limited observation and known product prices, it was however clear that with successful cultivation of vegetables and Sea Island cotton reasonable incomes may be earned. Henry's plot in Westmoreland was perhaps the best demonstration of the potential viability of alternate crops in supplementing income from sugarcane. If other farmers adopt a similar attitude, benefits could be accrued industry-wide.

It would appear that low yields of sugar cane may have been influenced by the lack of enthusiasm for cane farming observed on the part of some farmers. This attitude is assumed to have resulted in inadequate and untimely use of fertilizers, and below standard soil and variety management.

Nematodes did not appear to be a major problem on the soils observed. There is nonetheless a possibility that pockets of high infestation could be problematic especially on relatively rare lighter soils.

Cane yields obtained at Green's and Mason's plots following crop rotation were reasonable, given that these are located on acid soils in a relatively low rainfall zone. It was not possible to say how much was due purely to the crop rotation effect as against the impact of relatively well distributed rainfall during the growing season or liming (at 8 t/ha) or to the impact

of a new elite, high yielding sugar cane variety (BJ78100) to which the fields were replanted. In general, the combination of factors impacted favourably on cane yields. Benefits of replanting to an improved variety were evident on the plots observed. The practice of using improved cultivars in accordance with soil conditions should be continued. Although the project is at an end work should be continued and observations documented.

The project, through immediate application of proven methods, facilitated developmental work among select resource-poor farmers in Jamaica. In addition, it introduced and developed a new skills-set among some farmers while demonstrating the challenges relating to farmers' disposition. In general, though there were distinct differences in farmer approach, there was commonality of purpose in that each sought to benefit as much as he/she could. The PEA maintained that there should be some level of counterpart contribution (for example sweat equity and minor inputs) to promote responsibility in attitude. The project also shed light on the level of inputs that farmers were willing to make as this impacted the productivity of their farms.

The Crop Diversification component of the project was timely in that it assisted participating farmers to explore crop production alternatives in the face of the rapidly changing global production and trade environment.

The learning curve was steep but welcomed, given that a number of new initiatives were undertaken that could redound to the benefit of all in the long run. ☆

Scotch Bonnet pepper plot on Anthony Fullwood's farm at Braco, Trelawny



West Indies Red pepper seedlings established on Tashley Baugh's farm at Braco, Trelawny



Drip irrigation system being installed on Tashley Baugh's farm



Mature crop of hot peppers on Baugh's farm





Drip irrigation of Scotch Bonnet pepper at Braco site (Trelawny)



Drip Irrigation of carrot on A. Ramdatt's plot, Braco



Scotch Bonnet plot showing lack of weed control



West Indies Red pepper - poor weed control



Field of cantaloupes (foreground) and bell peppers (background) at W. Kellyghan's plot, Braco



Field limed to correct acidity and planted to sweet potato and carrot at C. Bennett's farm, Trelawny



Bell (sweet) pepper established on Kellyghan's farm plot at Braco in Trelawny



Canteloupe established on Kellyghan's farm plot at Braco



Canteloupe approaching maturity at Kellyghan's farm



Freshly established June Plum Seedling at V. Silvera's farm in Trelawny



June Plum seedling amongst weeds at V. Menzies' farm in Trelawny



Farmer Johnson's plot that was planted to escallion and hot pepper destroyed by heavy rainfall