Project of the Common Fund for Commodities to enhance viability and competitiveness of Caribbean Sugar Industries

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Abstract
Jamaica's Sugar Industry Research Institute conducted a project valued at US$2.5 million, funded by the Common Fund for Commodities, supervised by the International Sugar Organisation, between 2004-2007, aimed primarily at enhancing viability of small-holders growing sugarcane. The multifaceted project, aimed at small holders, involved a nursery seed cane programme speeding access of new elite varieties, farmer training, access to modern irrigation technology, crop rotation and soil amelioration to boost cane yields, diversification to alternate crops in areas in transition from sugar and a determination of viable farm modules.

The project succeeded in widespread distribution and increased availability of elite varieties such as J9501, BJ78100 and BJ7938 among small holders. It resulted in an appreciation of the features and potential of these cultivars, a better trained farmer in agronomy and harvest management with some gaining access and learning to operate modern irrigation systems (centre pivot and drip). Growers were introduced to reduced tillage technology to lower land preparation cost and walk-behind tractors to bring a degree of mechanisation to certain marginal areas. Better knowledge was gained of what constituted a viable farm module within the current context.

Execution was somewhat marred by an atmosphere of uncertainty about the future of sugar and the passage of hurricanes which set back growers. Participating growers nonetheless benefited from increased yields, increased earnings and were left better equipped to face challenges of the future.

Background & Context

For a period beginning roughly in the 1970s there has been growing concern that cane and sugar production are dwindling in the Caribbean (de Boer 1994, Wickham et al 1990, Hudson 1990, Davis 1997), despite all efforts to stem the decline. Jamaica, for instance, which had seen record production of half a million tonnes sugar in 1965 was down to just about 153,000 tonnes in 2003 (Little, 2003). The West Indies Central Sugar Cane Breeding Station (WICSCBS) sought to address the problem by increasing the productivity and especially ratooning ability of varieties generated (Kennedy 2000, 2001 and 2002). Various studies initiated comparing productivity of current and older varieties seemed to suggest that significant strides had indeed been made in developing more productive varieties through breeding. Yet, yields continued to decline raising the possibility that perhaps soils had become depleted and/or that pathogens could be playing hitherto undetected roles in depressing yields. These concerns were shared by the Technical Committee of the Sugar Association of the Caribbean (SAC) which started a hunt for funding of a regional project to address the problem. SAC countries comprised Barbados, Belize, Guyana, Jamaica, St Kitts and Trinidad & Tobago.

It was against this background that the presenter learned of the role and function of the Common Fund for Commodities (CFC) (an Agency of the United Nations, headquartered in Amsterdam) in financing commodity related projects when he attended a "Roundtable Discussion on Commodity Development in Latin America and the Caribbean Region," in Guatemala in 2000.

Immediately on returning home, outlines for a project to conduct studies on Yield Decline were drafted and sent to the CFC for assessment. Response from the Fund was that it was not in favour of financing purely research projects. However, although the project proposal did not gain immediate acceptance, it was not rejected out of hand. The proposed project was then modified to meet the Fund's main criteria for project funding:

* A project should not be based purely on research
* It would best be geared at benefiting small holders (as against a single large farm)
* It should foster rural development
* It should be environmentally sustainable
* Findings should be of relevance to a region or group of countries rather than to an individual entity or country
* It should meet the approval of the relevant international commodity organization , in this case, the International Sugar Organization

In close collaboration with the CFC Project Manager, the project was redrafted to reflect those concerns. There was an attempt to widen participation in the proposed project to include other members of SAC. However, it was then discovered that, of these countries, only Jamaica and Trinidad were members of the CFC. Accordingly, the project was fashioned around Jamaica primarily, with Trinidad as Collaborating Agency. Others of the SAC group, it was envisaged, would benefit from result dissemination. At the same time the project's scope was widened to "Enhancing the viability and competitiveness of Caribbean Sugar Industries" with a study on yield decline being just one of six components.

In its final configuration, the project's aim was to enhance the competitiveness of the industries by

way of an increase in income to farmers (especially smallholders) through use of improved varieties, improved agronomic practices and cost reduction strategies. Implementation of the project would be carried out by a designated Project Executing Agency (PEA), namely the Sugar Industry Research Institute (SIRI) of Jamaica, in conjunction with a Collaborating Institution - Caroni Ltd of Trinidad & Tobago

Funding
By the end of 2003 a Project Agreement was signed with the CFC. Overall cost of the project was budgeted at US$2.538 million of which $1.5 million would be provided by the CFC in the form of a grant. The remainder of $1.038 million would be counterpart funding, primarily in the form of local technical and operating expenses by the PEA.

Trinidad & Tobago
By the time of signing of a Project Agreement however, Caroni Ltd was undergoing radical restructuring. Personnel and support services critical to that country's participation were lost and in the end Trinidad never got involved in the project.

Project Launch
The project was eventually launched in January 2004 against the backdrop of concerns within sugar producing countries of the English speaking Caribbean about the future of the industry. Looming on the horizon were the twin prospects that:

1. a challenge before the World Trade Organisation (WTO) to the legality of preferential sugar markets in Europe for ACP sugar producers (under the Lome/Cotonou agreements) might succeed and
2. proposals emanating within the EU itself for promulgation of the Everything But Arms (EBA) treaty would see the opening up of access to the EU market for Special Preferential Sugars (SPS) to Lesser Developing Countries (LDC), to the detriment of ACP producers.

Since then, the WTO ruled against the maintenance of preferential markets and the EU responded by introducing a stepwise reduction in sugar price resulting in price being scheduled for lowering by 36% between 2006 and 2010, in keeping with measures to its own beet producers, while maintaining the quota under the protocol. Then in September 2007 the EU denounced the treaty (effective October 2009) under which ACP countries had been selling sugar to Europe.

The net result was that the project was executed in an atmosphere of gloom. In short order, St Kitts, a partner within the Sugar Association of the Caribbean, closed its one remaining sugar factory while another, Trinidad, carried out the aforementioned restructuring.

Implementation
At SIRI, the project was divided into 6 components each the responsibility of specific members of the Institute's technical staff who then functioned as project leaders. However, since the project's emphasis was on growers on small holdings, special mention must be made of the role of the Extension Department which had the responsibility to identify and sensitise various potential participants in the various cane growing regions. Once the grower was selected, the Extension

Officer often needed to organise and supervise diverse operations from land preparation to procurement and supplying of inputs, to the monitoring and harvesting of plots.

Responsibility for the various components was distributed among the Institute's staff as follows:

1. Establishment of nurseries of improved varieties of seed cane – Project leader: Malcolm Bennett-Easy
2. Farmer participatory evaluation of improved cane varieties – Project leader: Malcolm Bennett-Easy
3. Farmer participatory training in improved agronomic practices – Project leader: Derek Little
4. Pilot testing of a pivot centre irrigation systems – Project leader: Lancelot White
5. Applied research and development into factors affecting yield decline – Project leader: Uriel Green
6. Financial and economic evaluation of optimum farm modules for viability – Project leader: Cecil Woolery

At the time of approval of the project, the CFC recommended insertion of a Crop Diversification component. This was appended to Component 5.

Each project leader was given the latitude to devise and execute his component within the parameters set out in the project document. With the emphasis on the smallholder, attempts were made to involve as wide a range of growers and in as many cane growing communities, *Fig.1,* as possible. An important criterion for eligibility was that the grower should display a detectable commitment to being a cane farmer and have a track record of being cooperative and following instructions from SIRI's Extension Service.

Certain components of the project, such as crop diversification, demanded expertise in areas in which the Institute had little hands-on experience. This was addressed by collaborating with various subject area specialists in the Ministry of Agriculture. That agency also was instrumental, in some instances, in providing seed of alternate crops, and in pointing to probable sources at other times. In the case of Sea Island cotton, seen as a potential viable substitute for, or as a feasible crop in rotation with sugar cane, an invaluable collaborative relationship with the Jamaica Agricultural Development Foundation (JADF) was developed as also with an entomologist from the University of the West Indies (UWI) who was doing work in control of cotton pests. Similarly, the UWI provided assistance in the area of soil nematode analyses. Meanwhile, SIRI's soil and foliar diagnostic services were called on to do all the routine soil and foliar diagnoses for nutrition control. In addition, what is known as a Reduced Tillage Machine (RTM), recently developed by SIRI engineers was replicated under the project. SIRI also provided the personnel, a tractor and the tube-laying device used in establishing various drip irrigation plots.

Introduction of new irrigation technology (centre pivot) required tapping into water supplies and modification of structures under the control of the National Irrigation Commission (NIC). This required early and continual consultation and cooperation to achieve a smooth interfacing. At times this proved particularly challenging as a number of participating farmers had outstanding debt with that institution.

MATERIALS & METHODS

Component 1: Establishing Seed Cane Nurseries on small holdings

The main objectives of the Nursery Cane project were:

* To fast track the delivery of newer high yielding, disease resistant, recommended varieties to growers on small holdings
* To facilitate more rapid multiplication and distribution of newer varieties across the industry
* To increase the supply of pure stand, seed cane for commercial use

SIRI, through its relationship with the WICSCBS does variety selection for the industry. After new varieties have been developed and rigorously tested, they are multiplied in primary nurseries. From such nurseries SIRI then established secondary nurseries on farmers' holdings (in addition to those on traditional estates) across the industry.

The nursery programme was developed along the following lines:

1. SIRI Extension Agronomists identified reliable farmers with desirable aptitude for and track record in cane growing, an attitude of cooperation and a history of following recommendations
2. Land was prepared to satisfactory standard under the supervision of SIRI Agronomists
3. The Component leader then provided the selected growers with seed cane to establish secondary nurseries on plots typically between 1 and 4 ha in size
4. The grower was required to follow recommendations with respect to roguing (if necessary) to ensure pure-stand, fertilizer usage, weed control and general agronomy to provide seed cane of the highest quality
5. At maturity in 7-9 months, the grower was required to first make available to SIRI an equivalent quantity of seed cane, as was received, to establish tertiary nurseries elsewhere
6. SIRI then assisted the growers to identify potential purchasers of the rest of the seed cane for establishing commercial fields

Component 2: Farmer participatory evaluation of varieties

The main objective of this component was to create awareness of distinguishing features and potential of newer released varieties among small holders

Selection of the sites was done by SIRI mainly with the advice of SIRI Extension agents. With the growers' participation, plots were established with two to three recently released elite varieties planted in contiguous strips of 6 to 25 rows, running the entire length of the field. The farmers were thus afforded the opportunity to observe the growing habits and productive capabilities of the varieties on their holdings. As each variety exhibits varying adaptability to a particular niche, the farmer was able to choose, with the assistance of the SIRI variety specialist, the one(s) better suited to a particular farm.

Component 3: Farmer Participatory Training in Improved Agronomic & Management Practices

Training was clearly needed in the area of agronomy, to increase cane yield, and in harvest management to ensure the best price possible. Training took the form of pre-crop seminars/workshops in each of the seven factory areas and was followed up by field days when the crop was in progress. The main message was to identify steps that could be taken such as shortening "kill-to-mill" time and reduction of extraneous matter (trash, tops, suckers, dirt, debris) in loads to improve quality. Demonstration plots were set up at various sites across the industry for three main purposes:

(1) to show that economic yields could be obtained by applying recommended practices
(2) to introduce to growers five recently released, high yielding varieties adapted to various areas – BJ8532, BJ78100, BJ7465, BJ7938 and J9501
(3) to demonstrate a new high density planting technique to ensure higher field population and thus greater yield

Later farmers were introduced to the use of the Reduced Tillage Machine shown in earlier studies by the Institute to be effective in lowering land preparation cost and Walk Behind Tractors - a more affordable alternative to conventional tractors for cultivation work on very small holdings and in less readily accessible areas.

Demonstration plots were established under drip irrigation as well as under conventional furrow irrigation. Farmers benefitting from the CFC funded Centre Pivot scheme received special training in agronomic as well as management practices to enable their use of this technology.

Component 4: Introducing small holders to modern irrigation technology

Modern irrigation technology in the form of centre pivot and drip irrigation schemes were installed on several farms in the irrigated zone of southern St Catherine and Clarendon as well as on former sugar cane farms venturing on the growing of alternate crops in Trelawny. For the centre pivot scheme, GIS technology was used to identify a suitable site that would benefit as many farmers as possible, that would be free of physical impediments and which would have convenient access to adequate and reliable irrigation water and electricity.

Participants in the centre pivot irrigation scheme were encouraged to form a Water User Group to manage the system. A Chairman and Executive of the Group were elected and persons (also from within the Group) selected for training for operating the system. The group was then assisted to put in place arrangements for collection of proportionate fees from cane sales to cover payment of operators, utility bills and repairs and maintenance.

Arrangements were made to have CFC Funds, used in rehabilitating fields, collected from cane sales over a 3-year period and deposited in a Water Users' account, opened at a local bank, thus providing a financial foundation for continuity of the project when funding ceased. Some growers would also have to give up areas of land to allow for parking of the system, building a pump house and laying of underground conduits for water and electricity. Systems to compensate growers who made such sacrifices were also set up.

The pivot comprises seven serially connected 18-foot tall aluminum towers covering a span of 440 m. This travels in a circular path from a central point like an arm of a clock. Each tower gives rise to an average of 22 tubes spaced 3 m apart at the end of which are sprinklers which deliver water in a circular pattern from roughly one meter above ground level. The reach of the pivot is extended by an end gun pitching water a further 20 meters approximately. A computerized operating system is located at the central point around which the arm rotates. Water delivery may be varied as required but is usually set at roughly 7 mm per revolution. A revolution is usually completed in roughly 24 hours.

Ten drip irrigation plots totaling 30 ha were laid down and planted to sugar cane within the traditional irrigated zone on the southern coastal plains. Meanwhile, under the Crop Diversification component of the Project, a total of 3 ha of drip irrigation was established for 8 former sugar cane growers who were being guided in alternate crop production where a factory was earmarked for closure in the parish of Trelawny (a relatively arid zone on Jamaica's north coast). A single tube (occasionally double tubes) was laid atop each bank. Plot size ranged from 0.2-0.4 ha. Plots were planted to crops such as carrot, escallion, cantaloupe, Caribbean red pepper, Scotch Bonnet pepper etc.

Component 5: Research and development into factors affecting yield decline

With the assumption that the primary cause of low yields is centuries of monoculture, one of the approaches taken to address yield decline 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 build-up of pest and disease (primarily nematodes). Sugar cane was therefore removed with the expectation that associated deleterious organisms would largely disappear. Differential nutrient requirements could also presumably result in restoration of levels of nutrients favoured by sugarcane during the period the soil is occupied by alternate crops. Soil amelioration was also carried out at various sites by liming to correct acidity, addition of poultry manure to boost fertility and deep ploughing to break hard pans. Changes in soil biota were monitored mainly by nematode counts of species known to be sugar cane parasites. Alternate crops were grown for periods of 1-2 years then differences in cane yield were measured after re-establishment.

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 large areas with little threat from praedial larceny. A legume was often included in the crop rotation scheme to boost soil nutrient status. For instance, peanut was established on two plots in Trelawny.

Diversification

Some of the crops used in rotation trials (escallion, hot peppers, sweet peppers, June plum, carrot, red kidney beans) were also promoted in diversification efforts. As the focus was on a relatively arid area of Trelawny, participating farmers were provided drip irrigation systems connected to pressurised water serving the area.

Component 6: Determining viable farm modules

A technical and economic evaluation of different farm modules was conducted to establish requirements for viability in the Jamaican sugar industry in the context of the existing economic environment.

For this study, growers within the industry were first stratified in accordance with the following:

(1) Farm Size
(2) Farming Systems
(3) Rain-fed Conditions
(4) Irrigated Conditions
    - Traditional furrow irrigation
    - Technologically more efficient irrigation systems
(5) Machinery – owned or rented services

In the absence of readily available data, a survey was conducted with farm visits to gather directly information needed on the crop years 2004 - 2006. A total of 200 farms were selected for the survey. Data was collected on inputs used, cost of production and yields obtained on the various farm configurations permitting analyses of profitability.

RESULTS & DISCUSSION

Component 1: **Establishing Seed Cane Nurseries on small holdings**

During the course of the project nurseries totaling 79.03ha were established on small holdings distributed among every major ecological cane producing zone. This fell short of the original target set with greater expectation of farmer cooperation than encountered and without anticipation of the onslaught of hurricanes. For instance, it was expected that farmers could be relied on to inject much higher levels of inputs than turned out to be the case. More resources from the Fund were therefore utilised in individual plot preparation and maintenance than planned. This limited the number of plots that could be set up.

Nurseries established yielded approximately 2 768 tonnes seed cane. The value of this seed cane was estimated at approximately US$81,500. Both agronomic and cultural practices on farms on which nurseries were established tended to be improved over previous years resulting in increased levels of productivity and potential earnings.

Small holders who got hold of these varieties tended to utilise the material received much more efficiently than did traditional estates. Many small holders were still prepared to use manual planting methods which, though relatively tedious, gave superior germination and were therefore less wasteful. The level of attention given to small holders' plots also tended to be greater because of the close working relationship with the SIRI area agronomist. Stands therefore tended to be well maintained and provided seed cane of desired quality.

Prior to this programme, small holders were at the tail end of the variety distribution process which was usually started on major estates. Small holders therefore tended to have on their farms older varieties many of which would have outlived their more productive phases. This project rapidly reversed that position. By the second year, small holders had become the prime source of good

nursery stock of newer varieties in the industry and the large estates (several of which were not maintaining adequate nurseries) were often looking to the small holders for seed cane.

Component 2: Farmer participatory evaluation of varieties

A total of 26.1 ha comprising 11 plots were planted in variety evaluation plots on farmers' holdings. Six were in rain-fed and 5 in irrigated areas. These nurseries were sited within communities of small holders and functioned as demonstration plots for exhibiting features of the new varieties. Participating farmers were shown the improved productive potential of the new varieties on their own farms and allowed to determine their own preferences. Largely as a consequence of this, the variety J9501 achieved rapid expansion across the industry as other growers, introduced to it at Field Days, aggressively sought to have it established on their own farms.

One grower in the parish of Westmoreland on whose farm such a plot was established, was so impressed by the project that he spared no effort in extolling the virtue of new varieties at various fora and succeeded in giving publicity to the project on the national airwaves.

Component 3: Farmer Participatory Training in Improved Agronomic & Management Practices

There was widespread participation in seminars aimed at improving agronomic and harvesting techniques for greater profitability. Many growers attempted to follow recommended practices. For the most part, profitable yields exceeding 75 tc/ha were obtained in demonstration plots with one achieving a yield as high as 110 tc/ha. Fire damage resulted in only 44 tc/ha being salvaged from one plot. Plots that were rehabilitated also gave outstanding results and recorded yields up to 91tc/ha. In summary, achievements were as follows:

* Cane yields obtained from various plots were outstanding, compared with a national average of some 60 tc/ha, and demonstrated the importance of timely application of adequate resources for viability.
* In general plots performed satisfactorily and in many instances yields were above projected targets. By straight comparison yields were elevated from the region of 50 tc/ha to well over 80tc/ha in most of these plots.
* New varieties expanded under the project performed satisfactorily and found favour with the farmers.
* The use of the Reduced Tillage Machine gained acceptance in Clarendon, St. Elizabeth and St. Thomas where farmers actually requested its use following demonstrations. It is expected that similar responses will be obtained wherever the machine is demonstrated in other in other areas.
* Farmers in the Clarendon hills were excited about the Walk Behind Tractor and were eager to gain possession of similar units.
* In St. Catherine two farmers who benefitted under the drip irrigation project bought into the technology and invested in expanded systems on their farms.

Component 4: Introduction of modern irrigation technology

Centre pivot: The area selected for the centre pivot scheme was a zone in Content, Clarendon comprising some 60.8 ha and involving 16 individual cane growers. Farms under the influence of the pivot ranged in size from 0.5 to over 18 ha.

Given their initial state, although farms under the pivot showed increased yields and were, for the most part, noticeably more productive than neighbouring farms, there was still much room for improvement. Yields varied from a high of 109 tc/ha in a well established field to a low of 31.75 tc/ha in one that was badly in need of replanting. To be truly profitable growers needed to produce in the region of 100 tc/ha. Much more progress would have been made had growers shown the requisite application in maintaining a satisfactory standard of husbandry. Variations were largely in proportion with the degree of attention to farming by the respective growers. Some plots were owned by absentee operators who displayed little interest in cane farming.

Cost of equipment, installation, land preparation, planting, cultivation, irrigation, field infrastructure etc amounted to some US$4,770 per hectare. This was somewhat inflated by extra costs incurred when a hurricane forced dismantling and storage of the partially built system during installation. Given capital and operational costs, an average break even yield of 101 tc/ha at a predetermined bank interest rate of 9% was calculated.

Drip Irrigation: All but one of 10 drip irrigation plots established to sugar cane exhibited impressive growth. The single failure was due to theft of a portion of irrigation main and illicit fire which together crippled operation on that particular plot.

Performance of plots of drip irrigated alternate crop are discussed under Component 5.

Component 5: Research and development into factors affecting yield decline

Of all components, that entailing use of alternate crops proved most challenging. Unfortunately, Sea Island cotton seed supplied for planting in the first two years was of low viability resulting in poor germination and unacceptable field populations. In addition, several other alternate crop plots failed and were abandoned through lack of timely basic care from farmers too timid (it seemed) to act on their own initiatives. Crop failures also resulted from flooding or wind damage during the period of repeated hurricane strikes. Growers tended to display a degree of helplessness and be dependent on the PEA to carry out the most basic functions restricting themselves to only minimal involvement. Along the way, the PEA was forced to shed many of these growers as they showed little capacity to adapt. Nonetheless, the few outstanding examples of successful adaptation provided encouragement that diversification may indeed be profitably achieved. However, many growers, having spent their whole lives in sugar cane, were found to be not readily adaptable to provide the much greater level of dedication and attention to detail required for successful alternate crop production.

Escallion, Scotch Bonnet and Caribbean red pepper were introduced as alternative crops to farmers at Braco, Trelawny, after guaranteed purchasing was assured by the Walkerswood jerk seasoning processing plant. Farmers willingly entered the programme and, for the most part, showed much interest but tended to be extremely tentative in their approach to crop care. Crops were totally lost at some sites due to flooding and some plots were damaged from

improper use of herbicides or became over-run by weeds as growers began the learning curve. It also soon became apparent that the variety of escallion used was poorly adapted to that area of Trelawny.

Many participants demonstrated a tendency to be absent from their farms and this stretched the resources of SIRI personnel as some were seemingly totally dependent on the PEA, especially with regard to crop-care. Others exhibited an attitude born of lifelong experience with sugar cane which is less demanding of day to day attention. With crops such as escallion and pepper a few days of neglect (of little consequence to sugar cane) often proved disastrous.

The short duration of the project affected 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 - installation of drip irrigation, soil amelioration. However, more information 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.

Nematodes did not appear to be a major problem on the soils observed. There was nonetheless a possibility that pockets of high infestation detected 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.

Component 6: Determining viable farm modules

The study concluded that farms, irrespective of their size, may realize positive net returns on income, though marginal in some instances. However, only farms 8 ha and above in rain-fed areas may be considered viable where viability is viewed as the ability to generate sufficient income to cover recurrent farm expenses while meeting basic living expenses. Minimum productivity levels for viability were estimated at 65 tc/ha, but this must be achieved at normal production cost. In irrigated areas higher yields (than 65 tc/ha) must be achieved.

Preferably, farm machinery services should be hired rather than owned as the study indicated underutilization of owned machinery in most cases.

Nearly all growers in the sample earned additional income from other sources, including cash crops and semi-permanent crops as well as fixed and salaried income. Some farmers were also service providers to the industry, mainly in the areas of tillage and harvesting operations.

This study indicated that of the 158 farms showing positive net income, 43 or roughly 30% earned below the US$1 054 basic minimum for an individual as suggested by Government's Survey of Living Conditions. The majority of those that fell short comprised small farms in the 0.4 to 2 ha category, although farms of larger size also occasionally fell short.

SUMMARY & CONCLUSIONS

Despite the failure of Trinidad & Tobago to get involved, the project met most of its major goals. The overall goal of enhancing viability and competitiveness of smallholders was negated somewhat by the combination of adverse weather, climate of uncertainty, increasing input costs and looming price reductions on the EU market.

Nonetheless, farmers were shown that economic yields were possible, given proper application of inputs. The project stimulated renewed interest and triggered belief that cane farming among small-holders can indeed be viable.

The project brought the small-holder abreast of major estates in the possession of the newest elite cultivars Timing of this project was fortuitous in that it permitted variety propagation despite a slowdown of activities on Government owned estates. By year 2 small-holdings were the main source of good quality seed cane within the industry.

Given the brief duration of the project, a full assessment of the impact of crop rotation as a means of reversing yield decline was not achieved. This was compounded by the several instances of farmers failure to adapt to the demanding regimes of alternate cropping systems. In light of the possibility of the industry being restructured to leave some areas out of economic reach of the nearest factory, the crop diversification exercise would have left farmers with greater knowledge of potential alternative crops.

Farmers gained access to highly efficient centre pivot and drip irrigation systems. The fact that there were instances of farmers subsequently investing there own resources to expand on drip systems was testament to the impact of these technologies.

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