

FOREWORD

This is the first edition of CARDI Review for well over 1 year. CARDI Review is an occasional publication with the objective of helping CARDI staff present some of their research which has not been published elsewhere. Articles are peer reviewed by anonymous referees who are also CARDI staff members. Because of the nature of the objective and the fact that much of the work of CARDI staff is published elsewhere, the CARDI Review will continue to appear at irregular intervals, sometimes more frequently than others.

There are three articles in this issue. The first article is agronomic research, but the other two show completely different sides of CARDI's work.

The agronomic research paper, by Reginald Andall of CARDI, Grenada with co-authorship from Shiva Baldeo highlights some of the work that CARDI, Grenada has been doing over the years in attempting to make the golden apple (*Spondias cytherea* Sonn) fruits easy to harvest without reducing the size of the fruits from what is demanded by the market.

The last sentence enforces that CARDI's research is market driven and as such actual market research is undertaken. The second paper in this edition of CARDI Review looks at the possibilities for marketing vegetables in convenience packs. This is a practice which is being adopted more and more in supermarket outlets in the Caribbean; the study here relates to Barbados.

Finally Pathleen Titus (CARDI, St. Vincent and the Grenadines) has written a paper with the results of an examination of the banana industry in St. Vincent and the Grenadines. The approach for the examination is one that has been developed by our partner CTA (Technical Centre for Agriculture and Rural Cooperation EU/ACP) and two other institutions.

These three papers are very different in scope and content and give some idea of the wide range of work in which CARDI is involved.

Bruce Lauckner
Editor

The effect of fruit and inflorescence pruning on fruit size and yield of dwarf golden apple (*Spondias cytherea* Sonn.)

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ABSTRACT

An experiment was conducted to determine the effects of eight combinations of fruit and inflorescence pruning on fruit size and yield of dwarf golden apple (*Spondias cytherea* Sonn) grown in Belvedere, Grenada, W. I. Pruning treatments were 1: 0% fruit + 50% inflorescence, 2: 25% fruit + 50% inflorescence, 3: 50% fruit + 50% inflorescence, 4: 75% fruit + 50% inflorescence, 5: 0% fruit + 0% inflorescence, 6: 25% fruit + 0% inflorescence, 7: 50% fruit + 0% inflorescence, 8: 75% fruit + 0% inflorescence. Fruit pruning increased fruit size. At 75% it was highly significantly different ($P < 0.001$) from the 25% and 0% levels but was not significantly different from pruning at 50%. There was a significant interaction between fruit pruning and inflorescence pruning on fruit size with inflorescence pruning giving smaller fruits at 75% fruit pruning, but not at other levels of fruit pruning. Fruit and inflorescence pruning reduced fruit weight and number thus yield. 0% and 25% fruit pruning had a highly significant difference ($P < 0.001$) from 75% on total number of fruits. 0%, 25% and 50% had a highly significant difference ($P < 0.001$) from 75% on total weight of fruits. Generally pruning led to larger fruits but lower total yields.

INTRODUCTION

The golden apple (*Spondias cytherea* Sonn.) is native to the Society Islands of the South Pacific (Weir et al, 1982). From there it has been widely distributed around the tropics. It was first introduced into the Caribbean in the 18th century (Morton, 1961) where it has adapted well to local conditions and become a natural part of the agricultural landscape. It is grown on a small scale in many tropical and subtropical areas like Indonesia, Florida Keys, Hawaii, the Caribbean, Venezuela and Suriname (Popenoe 1979; Weir et al. 1982, Morton 1987). In other countries the golden apple is also referred to as June Plum, Pomme-Cythere, Ambarella, Mokak, Coe, Hevi, among others (Morton 1987; Geurts et al 1986).

Even though the golden apple is distributed worldwide and has become a popular fruit for West Indian consumers it has received little recognition from the scientific community of the region (Bauer et al, 1993). This may be attributed to the fact that historically it was a fruit of insignificant commercial importance. In Grenada, the importance of golden apple as a commercial export crop has been realised since 1985 when extra-regional export to the USA began.

Keywords: Grenada, Pruning, *Spondias cytherea*

Formerly small quantities of the crop were exported by hucksters to the neighbouring island of Trinidad. After 1985, the golden apple quickly rose to prominence as one of the major non-traditional export crops. In 1996, 368 tonnes of golden apple were exported and it was the second most important non-traditional export crop after mango. Despite the increased importance of golden apple, the crop still continues to be grown mainly in a disorganised manner as scattered trees among the more important tree crops like cocoa and banana. The Grenada Agricultural Census of 1995 estimated pure stand national cultivation at 10.9 hectares.

In the present system of golden apple production, no formal method of crop production is practiced. As a result, trees grow very tall making harvest difficult and dangerous, leading to increased incidence of fruits damaged during harvesting and also increased postharvest losses (Daulmerie, 1994). In 1993, the Inter-American Institute for Co-operation on Agriculture (IICA) introduced a dwarf type of golden apple which bears relatively small fruits on a short tree. This introduction was viewed as a means to obtain a larger proportion of undamaged fruits since the dwarf trees are easily harvested at the ground level. One disadvantage of the dwarf type is that the fruits are smaller than the traditional type and these fruits are not readily accepted on the local and export markets.

This experiment was aimed at increasing fruit size of the dwarf golden apple through fruit and inflorescence pruning so that larger fruits can be obtained from the dwarf trees to facilitate easier marketing of the fruits.

MATERIALS AND METHODS

The trial was superimposed on 2-year old dwarf golden apple trees growing on a private farm in the Belvedere, St. John's region of Grenada. Soil type was of the Capitol clay loam series.

The trial consisted of eight treatments in a 4 x 2 factorial arrangement. The factors are four levels of fruit pruning and two levels of inflorescence pruning. Treatments were set out as follows:

<u>TREATMENT NO.</u>	<u>DESCRIPTION</u>
1	0% fruit pruning, 50% inflorescence pruning.
2	25% fruit pruning, 50% inflorescence pruning.
3	50% fruit pruning, 50% inflorescence pruning.
4	75% fruit pruning, 50% inflorescence pruning.
5	0% fruit pruning, no inflorescence pruning.
6	25% fruit pruning, no inflorescence pruning.
7	50% fruit pruning, no inflorescence pruning.
8	75% fruit pruning, no inflorescence pruning.

The trial was laid out in a randomised block design. There were 13 blocks of eight trees. Each block received each of the experimental treatments. The trees were grown on a slope at the side of a ravine therefore each block was selected based on geographical proximity along the contours and relative uniformity of size.

At the beginning of the experiment, the mature fruits from each tree were harvested, weighed and counted. The following week the treatments were applied. Further application of the treatments was done every 2 weeks while further harvesting of mature fruit was done as necessary. One application of

12.8.24 fertilizer at the rate of 190 kg/ha was made. Manual and chemical weed control with paraquat and glyphosate were practised.

At each harvest the fruits were weighed and counted. Harvesting was performed on nine occasions.

RESULTS AND DISCUSSION

Analyses of variance for the main and interaction effects were conducted on average fruit weight, total fruit weight and total number of fruits over the whole period.

Fruit Size

For ease of measurement average fruit weight was used as an indicator of fruit size.

Analysis of the effect of fruit pruning regime revealed that fruit pruning tended to increase fruit size. Fruit pruning at 75% with no inflorescence pruning gave the largest fruit size of 58g followed by fruit pruning at 50%, with 54g (Table 1). The fruit size obtained by the former pruning regime was 9g greater than the no pruning regime. Fruit pruning at 75% and 50% levels were highly significantly different ($P < 0.001$) from the 25% and 0% levels. There was no significant difference between the 75% and 50% fruit pruning levels.

Inflorescence pruning at 50% tended to reduce fruit size but the effect was not significant ($P > 0.05$).

The interaction effect between fruit pruning and inflorescence pruning on fruit size, was significant ($P < 0.001$). At the fruit pruning level of 25% there was a small increase in fruit size, the 50% level had no effect while the 75% level reduced fruit size. Fruit pruning at 75% together with no inflorescence pruning gave larger fruits than those from fruit and inflorescence pruning combinations at 25% and 0% fruit pruning levels.

Table 1 Effect of fruit and inflorescence pruning on average fruit weight of dwarf golden apple

Fruit Pruning (%)	Average Fruit Weight (AFW) (g)		Mean AFW (g)
	Inflorescence Pruning		
	0%	50%	
0	49	49	49
25	49	51	50
50	54	54	54
75	58	53	55
Mean AFW (g)	53	52	

SEM Overall fruit pruning = 0.87
 (84 d.f.) Overall Inflorescence pruning = 0.62
 Body of table = 1.23

Total Fruit Weight

No fruit pruning (0%) gave the highest yield (Table 2). Fruit pruning regimes of 0%, 25% and 50% were highly significantly different ($P<0.001$) from 75%, the latter producing the lowest yield.

Inflorescence pruning had a negative effect on yield. The best yield was obtained with no inflorescence pruning. The effect on yield by pruning of inflorescences at 50% was significantly different ($P=0.007$) to no inflorescence pruning.

The interaction between inflorescence pruning and fruit pruning was significant ($P<0.001$). At 25% fruit pruning, inflorescence pruning had no effect on total fruit weight, but at other levels of fruit pruning, inflorescence pruning gave lower yields.

Table 2 Effect of fruit and inflorescence pruning on total fruit weight of dwarf golden apple

Fruit Pruning (%)	Total Fruit Weight (kg) (TFW)		Mean TFW (kg)
	Inflorescence Pruning		
	0%	50%	
0	17.57	14.12	15.85
25	13.44	13.38	13.41
50	14.74	12.34	13.54
75	12.31	5.94	9.13
Mean TFW (kg)	14.51	11.45	

SEM Overall Fruit Pruning = 1.11
(84 df) Overall Inflorescence Pruning = 0.79
Body of table = 1.57

Total Number of Fruits

Analysis of the effect of fruit pruning on total number of fruits harvested showed that 0% and 25% fruit pruning were highly significantly different ($P<0.001$) from 75% fruit pruning. The highest mean total yield of 326 fruits came from 0% fruit pruning while 75% fruit pruning resulted in the lowest mean total yield of 165 fruits (Table 3). Fruit pruning therefore tended to reduce total number of fruits harvested. As severity of fruit pruning increased total number of fruits harvested decreased.

For the inflorescence pruning effect, 50% pruning was significantly different ($P<0.001$) from 0% pruning. No pruning produced the higher number of fruits.

The interaction between fruit pruning and inflorescence pruning was significant ($P<0.001$). Generally inflorescence pruning increased the negative effect of fruit pruning on total number of fruits harvested with the exception of fruit pruning at the 25% level.

Table 3 Effect of fruit and inflorescence pruning on total number of fruits of dwarf golden apple

Fruit Pruning (%)	Total No. of Fruits (TNF)		Mean TNF
	Inflorescence Pruning		
	0%	50%	
0	358	293	326
25	271	270	271
50	278	227	253
75	217	112	165
Mean TNF	281	226	

SEM Overall Fruit Pruning = 21.7
(84 df) Overall Inflorescence Pruning = 15.3
Body of table = 30.7

As we have seen the fruit size of dwarf golden apple was successfully increased through the influence of fruit pruning while yield was reduced. The increased fruit size was expected since the removal of some fruits allowed the plant to distribute the available nutrients to a fewer number of fruits hence increasing individual fruit size.

Although no record of pruning work on dwarf golden apple was discovered in the literature, this result is similar to that obtained by Pawar et al (1994) on pomegranate, where fruit size improved with increasing severity of pruning and total yield was reduced by pruning.

CONCLUSIONS

The best pruning regime to increase fruit size of dwarf golden apple was 75% fruit pruning. Increased fruit size through this practice is however obtained at the expense of a reduction in yield both in terms of weight and number of fruits harvested. Therefore the recommendation of the practice of pruning would depend on whether cost/benefit analyses indicate that marketing of the increased fruit size would compensate for the reduced yield experienced. This is unlikely as the largest increase in fruit size obtained was only 9g which would not be significant in the market place. The development of the dwarf golden apple industry therefore depends on finding market niches which uses the fruit in its normal size.

Fruit and inflorescence pruning both reduced fruit yield while the latter reduced fruit size. Inflorescence pruning therefore is not a worthwhile practice.

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Opportunities within the farming sector for convenience foods (pre-packed vegetables) in Barbados

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ABSTRACT

Globally, the market for pre-packed convenience foods has been showing an increasing trend. Supermarkets and food manufacturers have been working together to exploit the affluent and increasingly diligent consumers who are running out of time to purchase, prepare, cook and consume their food in traditional ways. Small farmers contribute by far the largest share of agricultural production in the Caribbean Region. However, in many Caribbean islands the small farmers, be it crops or livestock, still appear to be struggling to meet their subsistence needs. This paper attempts to identify a growing market segment that small producers in Barbados can participate in and contribute to sustainable small scale agriculture: “The Convenience Food Sector (Pre-packed Vegetables)”.

INTRODUCTION

Small farmers contribute by far the largest share of agricultural production in the Caribbean Region. However, in many Caribbean islands the small farmers, be it crops or livestock, still appear to be struggling to meet their subsistence needs. The reasons suggested for this lack of prosperity in the agricultural sector in particular, and many of the economies in the Region that are heavily dependent on agriculture are too numerous to be discussed here. However, one reason for the continued subsistence existence of small farmers in the Caribbean that is frequently cited is “inadequate small scale producer market linkages”.

Growing international markets for high value agricultural products such as fruits, vegetables and fish have attracted the attention of many of our development planners. Consequently, the new thrust in the Region is on non-traditional agricultural exports. However, while growth in the international horticultural sector presents many opportunities for growing rural economies and improving the livelihoods of many small-scale producers in the Region, the rapidly changing dynamics of international horticultural markets often acts as barriers to small producer participation.

Agriculture in the Caribbean has a long tradition of being commodity oriented, with an emphasis on efficiency and a focus on production. However, food markets are increasingly calling for more differentiated and value added products.

Keywords: Convenience foods, vegetables, marketing

The more products become differentiated, and the higher the degree of processing, the more important it becomes that production-related competencies become supplemented by market-related competencies. This paper attempts to identify a growing market segment that small producers in Barbados can participate in and contribute to sustainable small scale agriculture: “The Convenience Food Sector (Pre-packed Vegetables)”.

The current transformation in the food industry worldwide is driven by numerous factors including technology, international market integration and environmental concerns. However, the greatest impact may be due to changing consumer food demand. Consumers today are demanding healthier products, more convenience, and value for money.

Globally, the market for pre-packed convenience foods has been showing an increasing trend. Supermarkets and food manufacturers have been working together to exploit the affluent and increasingly diligent consumers who are running out of time to purchase, prepare, cook and consume their food in traditional ways (Fearne and Hughes 1999). Improvements in post harvest handling and processing technology have improved the quality, presentation and shelf-life of fresh-cut vegetables in the marketplace.

Fresh agricultural produce is also increasingly being used to perform a more strategic role at attracting and preserving customers’ loyalty in various supermarkets. Within this trend lie two key factors which need further examination in the interest of growers and the retail chain:

- (i) factors which drive consumer demand for convenience foods and
- (ii) supermarket strategies with reference to rationalisation of the supply base.

In this regard, it is critical to have a greater understanding of the supermarket approach to vertical co-ordination and their tendency towards consolidation with a few large suppliers operating in dedicated (if not exclusive) supply chains.

OBJECTIVES AND METHODOLOGY

This paper is part of a larger study which sought to increase the production of vegetables and incomes of farmers in the Caribbean including Barbados. The results of this study will provide pertinent data for the development of sustainable trading arrangements among farmers, marketing intermediaries, supermarkets and other retail outlets.

The study entailed a desk review of secondary data as well as discussions with key policy makers in the Ministries of Agriculture, other related public sector agencies and producers/ groups to determine the existing policy orientation and any modifications that may be required to facilitate growth of the sub-sector. Field visits were conducted to the fresh cut / pre-packed vegetables processors in various countries including Barbados.

RESULTS

In Barbados over the last two decades there has been considerable change in how food is grown, packaged and where it is sold. The emergence of supermarkets as dominant players and their rapid growth and capture of significant market share not only offers small producers lucrative outlets for their produce

but also means that erosion of the role of public wet markets must be monitored. Accessing the supermarket marketing channel and adding value to raw produce offers an exciting opportunity for sustainable small producer agriculture.

The market for pre-packed/fresh-cut vegetables

Generally, the study found that the convenience foods segment has experienced varying levels of development in terms of the range of vegetables which are pre-packed and / or fresh-cut, the level of processing and innovation, the level of awareness as it relates to food safety issues and the processor-farmer relations. The study utilized the supply-side measure at the retail level of the convenience vegetable market segment. Average retail market prices were used to convert volume to value statistics.

Market size: The value of the convenience vegetable market segment in Barbados is estimated at USD 4,846,233 / annum. The most popular convenience-packed vegetables were the mixed vegetable pack category, valued at USD 1,058,304 or 22% of the market (Figure 1 and Table 1). This is followed by salad beans USD 848,110 or 15%, lettuce USD 790,910 or 16% and tomato at USD 709,293 or 15%. Spinach also captures a significant share of the market at USD 403,372 or 8% and cabbage USD 368,946 or just about 8%. Pumpkin, mixed herbs, sweet peppers and other vegetables comprise a total of 13% of total.

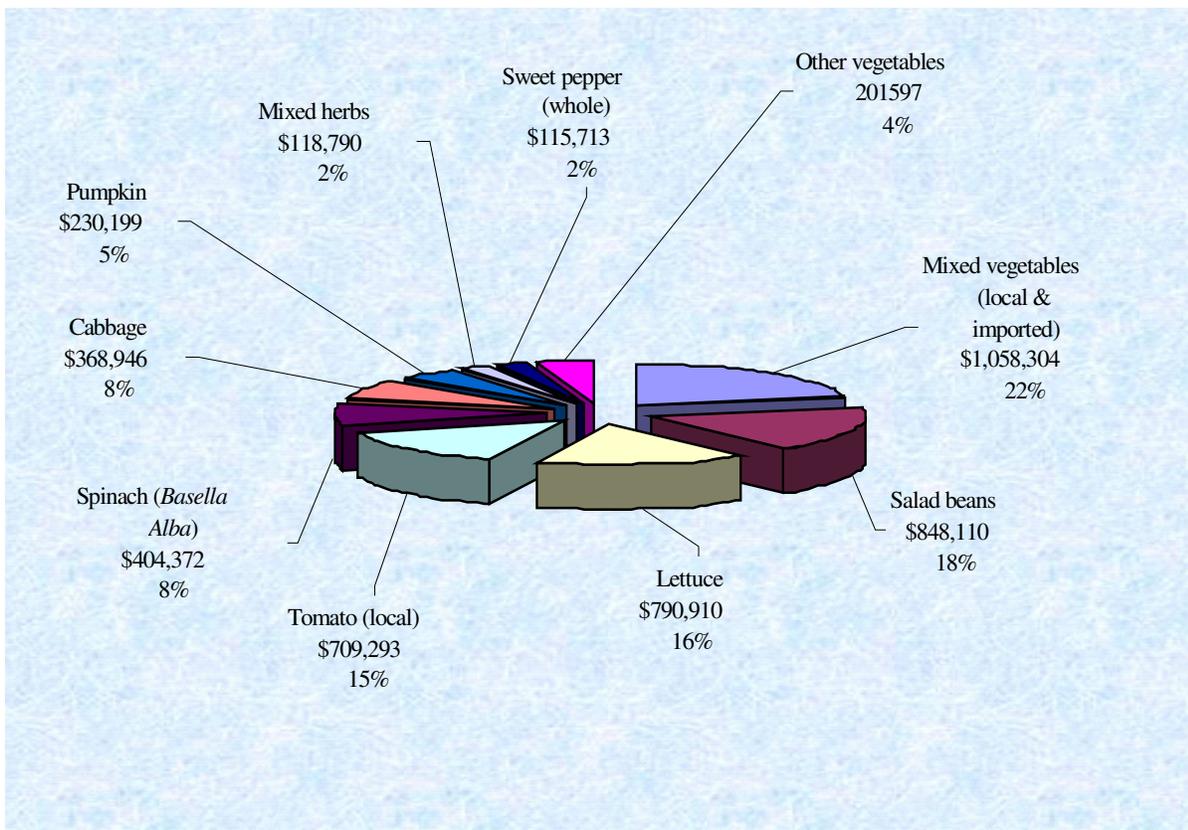


Figure 1: Barbados Convenience Vegetables Segment Market Share - Percent to Total and Value 2006 (USD)

Table 1 Estimated Market Size of the Pre-Packed Processors' Segment of the Vegetable Market

Commodity /product	Quantity (kg)	Value (USD)
Basil	1,664	\$2,080
Cabbage	92,352	\$368,946
Chive	15,600	\$19,500
Cilantro	3,328	\$9,967
Dill	1,664	\$2,488
Hot pepper	41,444	\$37,092
Lettuce	117,520	\$790,910
Mint	1,664	\$1,248
Mixed herbs	37,180	\$118,790
Mixed vegetables	176,384	\$1,058,304
Okra	5,200	\$19,994
Pakchoi	58,968	\$88,452
Parsley	2,600	\$10,205
Pumpkin	115,388	\$230,199
Rosemary	2,600	\$1,950
Salad beans	106,080	\$848,110
Spinach (<i>Basella Alba</i>)	115,700	\$404,372
Sweet pepper (whole)	23,400	\$115,713
Thyme	6,656	\$8,620
Tomato	101,400	\$709,293
Total	1,026,792	\$4,441,861

The study found that increasingly, pre-packed vegetables are being offered in the large modern supermarkets as can be observed in Plate 1. These are packaged to promote local fresh produce, increase competitiveness, reduce the need for sorting and enhance shelf life. Pre-packing may also be done where it is necessary to offer smaller retail-sizes packages. When local vegetables are in season, they are packed and promoted as “Bajan vegetables” (Plate 2). Sales of attractively packaged mixed vegetable / recipe packs have also been increasing in popularity as can be observed in Plate 3.

Most of the processing is done in-store. This permits the operators to better match packaging sizes with consumer demands.



Plate 1: Local beans presented alongside imported vegetables (Barbados)



Plate 2: Promotion of local vegetables “Bajan Carrots” (Barbados)



Plate 3: Attractive mixed vegetable recipe packs (Barbados)

Processor survey

Listed below the major findings of the survey conducted among fresh cut / pre-packed vegetable processors in Barbados.

- (i) Most of the fresh-cut/pre-packed processing units were located within the supermarkets.
- (ii) Most of the supermarkets/processors visited expressed a preference for purchasing directly from farmers and packing the vegetables in-house. This practice allows for appropriate sizing of packages to suit the consumer expressed demand.
- (iii) The issue of traceability has not been highlighted as a major issue in the pre-packed/fresh cut vegetable convenience foods industry as yet. All processors indicated however that they have records or would be aware of source of supplies.
- (iv) Maintenance of freshness and shelf life of products remains a major concern. The use of humidifiers in display chillers was uncommon and this may accelerate the rate of dehydration of fresh, loose vegetables.
- (v) Formal contracts for the supply of vegetables in all countries of the study were not widely used. Further, where contracts were used, getting farmers to honour them remain problematic.
- (vi) Stir fry and/or mixed vegetables have been exhibiting an increasing level of acceptance.
- (vii) The study found that fresh vegetables which have been bagged as well as those which have been chopped in various sizes, or shredded, and sometimes mixed with other types of vegetables compete in the marketplace with those (some of which are frozen for extended shelf life) which have been imported to satisfy shortfalls and/or deficit in supply.

Business opportunities exist in areas of vegetable production, procurement and supply from growers and imports, packing and fresh-cut processing, supply of packaging and other material including processing equipment. The processors also identified some critical factors that impact on the success and expansion of the industry:

- Guaranteed and steady supply year-round at competitive prices
- Honouring of contracts and/or supply relationships
- High quality vegetables, free of soil, pesticides and other residues
- Sturdy packages to prevent post harvest losses and to increase shelf life
- Attractive and appropriately labelled packaging to effectively compete with imported brands

Vegetables must always be delivered fresh, should be graded and standardised

Policy makers

Policy makers in Barbados were surveyed with focus on policies that have been designed to impart impetus and benefits to actors in the supply chain. The key areas of interest were marketing, support services, incentives and research and development. Discussions were also held with chief policy makers and marketing personnel. The major findings were as follows:

- (i) Work programmes: Generally, the pre-packed vegetables segment is relatively new and has been largely driven by the private sector.
- (ii) Special training programmes: The field research did not locate any ongoing training programme for packers or supermarket personnel with respect to the preparation, chemical treatment, sanitation standard operating procedures, product handling, storage and marketing of pre-packed vegetables.
- (iii) Incentives: Generally, incentives were available to the farming and agro-processing sectors. No specific incentives however, were made exclusively to producers/processors of pre-packed vegetables as part of a developmental package.
- (iv) Hospitality sector: Freshness and wholesomeness were major attributes and thus preference was shown for fresh whole vegetables.
- (v) Special convenience vegetable processing programmes: The country had no special ongoing programme for development of the convenience vegetable segment.

Generally, the study found little readiness of the policy envelope as it relates to convenience vegetables to drive the sector further into the globalization era. The policies were broad in scope and sometimes all-encompassing. If this segment is to take off as desired, the elements of these policies would have to be refined and revised towards a more targeted approach to provide for the needs investors while providing a more facilitatory environment in support of the sub sector.

Emerging trends

Emerging trends in the convenience vegetable segment was also examined. The study found that increasingly, pre-packed vegetables were being offered in the large modern supermarkets. These were being packaged to promote local fresh produce, increase competitiveness, reduce the need for sorting and enhance shelf life. Pre-packing may also be done where it is necessary to offer smaller retail-sizes packages. Whenever local vegetables are in season, they are packed and promoted as “Bajan vegetables”.

Expressed needs of buyers/processors in this market segment

Discussions were held with the major processors and wholesale buyers of convenience vegetables in Barbados in an effort to find out the concerns and constraints that may be limiting the growth and expansion of the industry. Despite the volume requirements identified by wholesale buyers/processors, they have listed the following as critical for the success and expansion of the industry:

- Guaranteed and steady supply year-round
- Competitive prices
- Honouring of contracts and/or supply relationships
- Constant or minimal variability of prices throughout the year
- High quality vegetables, free of soil, pesticides and other residues
- Sturdy packages to prevent post harvest losses and to increase shelf life
- Attractive and appropriately labelled packaging to effectively compete with imported brands
- Vegetables must always be delivered fresh
- Vegetables should be graded and standardized
- Identification and sourcing of appropriate processing and packaging equipment and packaging material.

SUMMARY

Globalisation and trade liberalisation have been increasing the volume and variety of convenience vegetables available year-round. Regional producers are therefore facing increasing competition which is expected to intensify in the future. In this regard, all facets of competitiveness must be addressed in order to compete successfully.

Producers will face the challenge of ensuring year-round production, competitive prices and high quality. Thus, appropriate infrastructure such as those for irrigation, drainage, water and temperature control as well as appropriate varieties and new agronomic practices are critical for retention of market share.

The climate in Barbados can permit successful agronomy of many of the vegetables currently being imported. The range of vegetables included in various “Mixtures of Vegetables” should also be examined. Okra, cabbage, tomato, carrot, cauliflower, broccoli, sweet pepper, lettuce (Romaine), spinach (*Basella alba* and *Amaranthus spp*) show potential for further development within the short term.

Although consumers in some countries showed a higher preference for imported convenience vegetables, and some were indifferent about the source of origin, most processors in the region were inclined to choose the locally produced vegetables. Marketing campaigns should take this factor into consideration and work to further nurture such allegiances.

Should producers wish to grasp and retain this opportunity, they should follow approved crop protocols to address the quality and safety of vegetables that enter the convenience vegetable segment.

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Agriculture Science Technology Innovation (ASTI) systems for the banana industry in St Vincent and the Grenadines

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ABSTRACT

The ability to create knowledge and innovate is essential for the realisation of improvements in productivity and global competitiveness. The agricultural sector in the Caribbean region and St. Vincent and the Grenadines by extension is no longer being insulated from the effects of changes occasioned by globalisation and trade liberalisation. Preferential trading arrangements have given way to free market competition consistent with the regulations of the World Trade Organisation (WTO). Within this context, the banana industry in St. Vincent and the Grenadines was examined using the CTA/UNU-INTECH/KIT Agricultural Science Technology and Innovation (ASTI) approach. The diverse factors that shape the interactions among actors and how they interact in the policy environment were also looked at. The science and research capacity to meet the challenges of the dynamic agricultural sector was also examined. Banana remains the major export crop of St Vincent and the Grenadines. Surveys and interactive workshops held with both farmers and organizations involved in the industry, revealed that there were several limitations to innovation. These included, lack of or weak collaboration among the major players, insecure land tenure arrangements, poor access to financing and a dearth of information on research and development in bananas in the Caribbean region. The organisations more inclined to innovate did so to a limited extent. The study made several recommendations for improving the incidence and sustainability of innovation and the innovation process in the banana industry. The system analysis identified areas where policy changes coincided with small surges in production. However, the industry performance has declined drastically

Key words: Innovation, banana, science, technology, interaction

INTRODUCTION

In St Vincent and the Grenadines, the agricultural sector is no longer insulated from globalisation and trade liberalisation. Preferential market access has given way to competition within the trading arrangements of the World Trade Organisation (WTO), as a consequence a steady decline in the banana industry and an overall decline in gross agricultural output have resulted.

The ability to create knowledge and innovate is essential for continued productivity and competitiveness. The CTA/UNU-INTECH/KIT Agricultural Science Technology and Innovation (ASTI) system provides such a framework to examine the interdisciplinary nature and the diversity of factors that shape the interactions among actors and how these impact on the actors' individual and collective abilities to learn, adapt and innovate.

Within this context, the banana industry in St Vincent and the Grenadines was evaluated within the framework of the ASTI. Specifically, a broad systemic analysis was conducted of the actors in the banana industry; their traditional habits, practices and linkages and the way these are shaped by different policies and reward structures. In addition, an assessment was made of how the various actors contribute to the overall performance of the ASTI system.

MATERIALS AND METHODS

The evaluation consisted of three components. (i) A review of secondary data that included national policies, strategic plans, production and marketing data from Ministry of Agriculture and Trade. (ii) Stakeholder meetings with private and public sector which included Growers Associations, Ministry of Agriculture, credit facilities. (iii) Surveys of banana farmers and organisations with which they interact.

Of the approximately seventeen hundred banana farmers in St Vincent and the Grenadines, 194 were interviewed from all the banana producing districts on the island. The survey instruments sought to gather information on general demographics; age, size of farm, ownership. Questions also addressed the level of training the farmer received, financing, collaboration and networking. Surveys were also conducted with 18 organizations, all of which were involved in agricultural based activities.

RESULTS

The agriculture sector

The role of agriculture in the economy of St Vincent and the Grenadines Agriculture was once the mainstay of the economy, contributing approximately 21% to the Gross Domestic Product (GDP) in 1990. Traditionally, banana was the main contributor to the sector (11%); however during the last decade with the decline in the banana industry there has been a downward trend in the performance of the sector (Table 1, 2).

The agricultural sector is dominated by small farmers with less than 5 acres (2ha) of land (Government of St. Vincent and the Grenadines, 2000). Increased competition from other sectors resulted in a 40% decrease in available land for agriculture between 1985 and 2000. Other contributing factors include: inadequate marketing arrangements, limited value addition, limited research and technology development, inadequate infrastructure, technical capacity and credit systems for sustainable production in non-banana agriculture.

Table 1 Percentage contribution of the agricultural sector to Real Gross Domestic Product (2002-2006)

	2002	2003	2004	2005	2006
Agriculture	11.66	11.09	9.87	9.09	9.28
Crops	8.68	7.79	6.80	6.27	6.50
Bananas	2.97	1.80	1.81	1.33	1.25
Other crops	5.71	5.99	4.99	4.94	5.25
Livestock	0.87	0.86	0.82	0.82	0.78

Source: Statistical Office, Ministry of Finance and Economic Planning, St Vincent and the Grenadines

Table 2 Rate of Growth in the Agricultural Sector (2002-2006)

	2002	2003	2004	2005	2006
Agriculture	7.77	-2.24	-4.86	-5.96	7.58
Crops	15.78	-7.80	-6.74	-5.68	8.28
Bananas	15.70	-37.89	7.80	-24.88	-10.05
Other crops	15.83	7.87	-11.10	1.30	13.79
Livestock	1.48	1.82	1.97	1.93	2.07

Source: Statistical Office, Ministry of Finance and Economic Planning, St Vincent and the Grenadines

The banana sub-sector

Banana is important to the economy because of its contribution to Gross Domestic Product, export earnings, employment, income distribution, social and gender equity and land use. In 1990, banana revenues accounted for 53.9% of merchandise exports. This has declined significantly but the contribution of banana export earnings to the economy remains crucial (Table 3). Total banana exports accounted for 42.9% of all merchandise exports from the country over the period 1991 – 2000 and 33.9% over 2001 to 2005. In 2006, banana exports accounted for 4.8% of exports. This is due in part to unfavourable market conditions and natural disasters. The robust growth rates in the 1990s were due to favourable trade arrangements. The buoyant economy also facilitated high levels of

public sector investment in infrastructure. Government provided support to the industry through subsidies, technical assistance, lobbying, diplomatic missions and income tax relief.

The decline in the value of the pound sterling relative to the eastern Caribbean Dollar in the early 1990s contributed to the start of the decline of the banana industry. This led to worsening of the terms of trade, prices fell sharply, farmers left the industry and banana cultivation was significantly reduced.

Additionally, more attractive wage sectors of the economy drew labour away from agriculture. The stringent quality requirements imposed by EUREPGAP also acted as a deterrent and farmers unable to comply, left the industry.

Table 3 Exports Earnings from Agricultural Exports versus Total Merchandise Exports (US\$ million)

	2002	2003	2004	2005	2006
A. Total Merchandise Exports	39.4	38.5	37.0	40.3	41.6
B. Food	32.0	26.5	28.0	28.6	28.0
Bananas	16.0	12.0	13.2	12.0	10.3
Other Food Exports	16.0	14.5	14.8	16.6	17.7

Source: Statistical Office, Ministry of Finance and Planning, St Vincent and the Grenadines

Review of policy framework

The important regulatory and developmental policies which impact on the banana industry in St Vincent & the Grenadines include: (i) Plant Protection Act (1941) which provides for the prevention, eradication and control of diseases and pests affecting plants; (ii) Banana Restructuring Act of 2001; (iii) National Irrigation Authority Act 2004; (iv) St Vincent and the Grenadines Development Plan 1991-1995 and (v) the St Vincent and the Grenadines Medium Term Economic Strategy Plans, 1998-2000, 2002-2004, 2006-2009 (ASTI 2007). These policies seek to assist the development of a more competitive banana industry by the implementation of strategies and programmes to reduce operational costs and improve production and productivity.

Initiatives arising from these policies included: the provision of tissue culture plantlets from high yielding varieties e.g. Williams, Grand Name and Robusta; establishment of major irrigation infrastructure; implementation of a feeder road rehabilitation programme and a subsidy on inputs

These initiatives had limited success for several reasons, the major factor being the non-adoption of farmers of all aspects of the production technologies recommended. Farmers readily adopted tissue culture plantlets, which are now the main means of crop establishment. The expected yields were however never achieved due to the non-adoption of other recommended production practices like irrigation and improved fertilisation. Government recognised the importance of linkages and recommended in its Medium Term Economic Plan 2006-2009: (1) Strengthening the linkage between the Tissue Culture Laboratory, the St Vincent and the Grenadines Banana Growers Association and the Agricultural Input Warehouse; (2) Improving the linkage between primary producers and consumers, especially supermarkets, restaurants and hotels. The entities in listed in (1) still operate

quite independently of each other and the restaurants, hotels and supermarkets are still not major outlets for farmers' produce.

The major functionaries in the banana industry are detailed in Appendix 1

Survey of banana farmers

A total of 194 banana farmers in St Vincent and the Grenadines were contacted during a survey to determine the profile of banana farmers.

The largest proportion of farmers interviewed was in age group 50-60 years (34.0%), and the smallest amount in the 20-30 years age group (1.5%). Of the sample of farmers interviewed, 68.4% were males and 31.6% were females. The majority of farmers (39.2%) established their enterprises in the 1980s, 20.6% in the 1970s, 18.0% in the 1990s, 10.8% in the 1960s and 3.6% in the 1950s. It was found that 4.1% of the farmers began their operations between 2000-2003. The number of years farmers were involved in banana production ranged from two to 56 years. Most of the farmers (37.1%) have been farming for 20 to 29 years, followed by 20.6% farming for 30 to 39 years, 19.1% for 10 to 19 years, 16.5% for 40-56 years and 6.7% for 2 to 9 years.

Most of the farms were small-sized, with 53.6% of the respondents having farms less than 5 acres (2ha) - small-sized, 38.7 % with farms 5 to 10 acres (2-4ha) - medium-sized while only 7.7% had farms more than ten acres (4ha) in size.

Of the farmers interviewed 91.2 % considered themselves fulltime farmers while 8.8% were part time. Farmers' enterprises were involved mainly in production and contract farming as expressed by all (100%).

Land is held under a variety of tenure arrangements. The distribution of tenure is illustrated in (Figure 1). Only 1.0% of respondents stated that the land is owned, while 12.9% had family land. The majority (85.1%) held land under various forms of insecure arrangements: rent or lease, freehold and sharecropping.

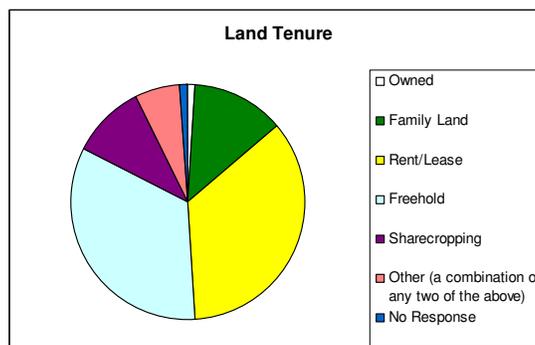


Figure 1 Ownership structure for farmers

When asked if affiliated with a national organization, network association, consortium or corporation, 97.9% of respondents answered in the affirmative. The organizations were mainly the St. Vincent

Banana Growers Association 4.8% and Fairtrade 93.1%. The majority (66.5%) of the sample only received primary level education, 20.1% received a secondary education while 8.8% received tertiary education.

In many cases the farmers had no collaboration with most of the actors listed in Appendix 1 except with the Windward Island National Farmers' Association and the Agricultural Input Warehouse. None of the respondents thought that they had an intense collaboration with the Tissue Culture Laboratory which is involved in producing the tissue culture plantlets.

When questioned about their outlook for the banana industry, the response given by 45.5% of the farmers was negative. Of the total, 40.2% made positive comments and 12.8% of the respondents were indifferent (Figure 2).

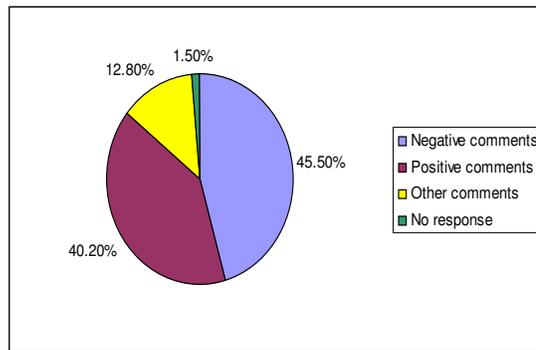


Figure 2 Farmers' outlook for the banana industry

Survey of farmer organisations

Eighteen organisations associated with banana farmers, e.g. (farmer associations, finance institutions and government agencies) were surveyed.

The oldest of the organisations surveyed was established in 1908 while the most recently established was in 2005. Nine (50%) were locally owned (private), six were public/government owned, two were foreign owned (private) and one was owned on the basis of local equity. Ten of the organizations are parts of larger groups while the remaining eight were not.

The highest level of academic qualification among members/staff of the organizations was a Masters degree (44.4%). The organisations involved in research said that their research work was directed towards local agriculture. Only three organisations claimed to have had a formal training and development programme in agriculture. Nine (50%) of the organisations interviewed claimed to have had overseas collaboration, with marketing and distribution being common among four organisations and financing common among six.

Local collaboration was common to 13 organisations, particularly in the areas of teaching, research, product development, marketing and distribution, financing and banking and extension services. The

organisations' assessment of the domestic science and technology infrastructure for supporting agricultural activities was favourable. Most thought they were adequate.

DISCUSSION

The findings revealed that farmer innovations were either not evident or not adopted in the banana industry. The farmers still for the most part operate as they did more than two decades ago. The need to innovate for sustainability of the industry is crucial.

The following recommendations are made to improve the incidence and sustainability of innovation in the banana industry:

- (1) Management of the industry could be greatly enhanced by the restructuring of the government appointed board to make it more farmer friendly
- (2) The aging farmer population threatens sustainability. Emphasising agricultural science in primary and secondary schools, is particularly desirable
- (3) The weak collaborative linkages between the various actors in the industry need to be strengthened. This shortcoming serves as a hindrance to innovation
- (4) Research, which is a vital part of the innovation process, has not been identified as a priority. The roles of CARDI as well as the UWI should be examined with a view to increasing their contribution to the industry
- (5) Banana extension needs to be strengthened to assist and advise farmers in the use of improved production practices for increased productivity
- (6) Financing should be made more accessible to farmers. The major commercial banks do not now have any special concession for farmers. Collateral free or low interest loans should be considered
- (7) The government should expand available subsidies. Farmers suggested 100% financing for farm vehicles
- (8) A land bank system should be instituted to make land available for landless farmers interested in expansion or youths interested in starting up.

CONCLUSION

The preceding recommendations can support a sustainable industry which despite the many challenges is still regarded as viable by many of the farmers interviewed. It is clear that the innovation process in the banana industry is limited. Industry decline did not spur the farmers to innovate. The "secure" market arrangements might have lured them into a false sense of security for which they are now paying a heavy price.

There is need to look at the industry in a global context. The fact that banana is still critical to the economy of St Vincent and the Grenadines, provides the avenue to explore other opportunities for e.g.; value addition, niche marketing and capitalising more on Fairtrade marketing.

ACKNOWLEDGEMENT

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APPENDIX 1 MAJOR FUNCTIONARIES IN THE BANANA INDUSTRY

Actors	Description
<p>• Management St Vincent Banana Growers Association (SVBGA)</p> <p>Windward Island Crop Insurance (1988) Limited (WINCROP)</p>	<p>The SVBGA was established by the Banana Restructuring Act 2001. It is responsible for controlling the cultivation of bananas, conducting research, promoting improvement in production techniques and acts as the agent for all registered growers.</p> <p>WINCROP 1988 membership consists of Banana Growers Associations in the Windward Islands. Banana is currently the only crop granted insurance coverage.</p>
<p>• Production Tissue Culture Laboratory</p> <p>Irrigation Management Unit (IMU)</p> <p>Agriculture Input Warehouse (AIW)</p> <p>Hadley Blooms</p>	<p>This facility is jointly operated by the Ministry of Agriculture, Forestry and Fisheries and the Mission Taiwan. It is responsible for producing clean planting material for farmers.</p> <p>The IMU is managed by a government appointed board which was set up in 2006 to ensure that banana growers had a reliable source of water for improved production. It conducts research in irrigation, fertigation and banana production.</p> <p>This is a government owned input supplier, which provides all banana inputs at a subsidised price. It is controlled by a board and prices are fixed by government.</p> <p>A private flower producer, who does second stage hardening for banana plantlets</p>
<p>• Marketing The Windward Islands Banana Development and Exporting Company (WIBDECO)</p> <p>Windward Island National Farmers' Association/Fair Trade (WINFA)</p>	<p>WIBDECO is a private company with responsibility for the marketing and distribution of Windward Island Bananas. The Shareholders are the Governments and the Banana Growers Association of the four Windward Islands.</p> <p>WINFA administers the Fairtrade label for banana growers in the Windward Islands. Growers under this label must undertake to reduce the use of pesticides and herbicides.</p>

Actors	Description
<p>Traffickers</p> <p>National Properties Ltd (NPL)</p>	<p>Primarily responsible for inter-island trade. They buy second grade bananas either directly from the growers or from the Banana Growers' Association.</p> <p>A government owned, private sector run organization. The board is cabinet appointed and deals primarily with the marketing of agricultural crops in St Vincent. It is responsible for marketing first grade bananas regionally.</p>
<p>• Research</p> <p>University of the West Indies (UWI)</p> <p>Caribbean Agricultural Research and Development Institute (CARDI)</p>	<p>The UWI with campuses located on three Caribbean Islands is not involved in banana research in St Vincent.</p> <p>The Caribbean Agriculture Research and Development Institute (CARDI) is a regional research institute operating in 12 Caribbean countries.</p>
<p>• Financial Institutions</p> <p>Banks</p> <p>Credit Unions</p>	<p>These comprise First Caribbean International Bank, Bank of Nova Scotia, Royal Bank of Trinidad and Tobago, National Commercial Bank and First St Vincent Bank.</p> <p>Credit Unions in St Vincent and the Grenadines are: Teachers Credit Union, Kingstown Cooperative Credit Union, Government Employees Cooperative Credit Union and the Marriaqua Cooperative Credit Union. Payment from the Banana Growers Association for produce sold is deposited into farmers' accounts at these institutions. Some growers also access the loan facilities.</p>

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