

Review of the Bermudian Agricultural Sector

A Report Prepared by

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for the Government of Bermuda
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Executive Summary

Bermuda is a small island located approximately 600 miles off the east coast of the United States. With its strategic location, it served for many years as home to both naval and air bases for the United States, Canada, and Great Britain. With the end of the Cold War, these bases were closed. Bermuda has also been a desirable tourist destination with its sub-tropical climate and proximity to the population centers of the Northeastern United States. Bermuda's new economic thrust was to become home to a wide array of insurance and financial service institutions seeking to take advantage of Bermuda's favorable tax laws. With an influx of employees for these companies, there has been an increase in the demand for commercial and residential real estate. This increased demand has raised concern regarding the future of Bermuda's agricultural sector.

A research team comprised of Dr. Thomas H. Spreen, Dr. Ed Stover, and Mr. Kevin Athearn, all of the University of Florida, was commissioned to conduct a study on various aspects of the agricultural and food industry of Bermuda. The research team conducted interviews with all of the large commercial farmers and several of the smaller farmers. Those involved in organic produce production were also interviewed. Based upon these interviews, estimates of domestic produce production were calculated. The costs and returns for eight major crops were also estimated. All produce importers were contacted and data on produce imports were collected. The timings of produce embargoes for 1999 through 2001 were tabulated. Chefs were consulted regarding the quality of locally-grown produce and the impact of embargoes on restaurants.

The study also considered backyard gardening in Bermuda. A small survey was conducted in an attempt to estimate the acreage devoted to backyard gardening. This

information was crosschecked with data from retail purveyors of transplants and seeds. These data suggested that backyard gardening in Bermuda encompasses approximately 140 acres in Bermuda.

The major findings of the study are:

- The availability of produce items is not adversely affected by the imposition of embargoes.
- The main benefit of produce embargoes is price stability.
- Major drawbacks of the embargo system are inconsistent quality and lack of availability of specialty products.
- The Government Marketing Centre provides important services to Bermudian farmers.
- Potato storage at the Marketing Centre needs to be improved. One approach is to halt Government purchase of potatoes and provide low cost storage to farmers.
- It is suggested that Government review its tax policy with respect to agriculture to bring it in alignment with other programs that promote agriculture, i.e., tariffs on agricultural inputs serve to increase farmers' production costs.
- It is suggested that Government consider a flexible alternative to the embargo system through the imposition of seasonal tariffs.
- Backyard gardening is widespread in Bermuda. It is suggested that Government evaluate the need to provide more support in terms of technical advice.
- There is demand for organic products in Bermuda. Government should consider fostering organic production through a certification program.
- A strategic planning exercise that includes all participants of Bermuda's food system is strongly recommended to assist Government in articulating a cogent policy with respect to agriculture.

Section 1

Overview of Agriculture in Bermuda

1.1 Introduction

Located at 32° N latitude, but in the warm Gulf Stream (700 miles east of North Carolina), Bermuda has a mild subtropical climate and possesses the northernmost coral reefs in the Atlantic Ocean. This fortunate setting combined with modest natural resources has made Bermuda a highly desirable place to live and an attractive tourist destination. The 2001 census indicates a Bermudian population of approximately 64,000. With a total land area of 55.2 square km (World Gazetteer, 2002), Bermuda has a high population density of over 1,160 people / km². Further crowding results from tourist arrivals which were estimated at 534,000 in 2000 (World Information, 2002).

Although tourism has been an economic mainstay, Bermuda is experiencing rapid growth in personal wealth from a new source of employment. So-called “Exempt Companies,” primarily from the United States, are increasingly using Bermuda as a site for management operations because of Bermuda’s attractive tax laws. Resulting growth in personal income has increased demand for home construction and has greatly escalated land prices over the past several years. Detached single-family homes remain the standard for Bermudians, and undeveloped areas are few, so there is increasing pressure to build on sites that have been historically used for agricultural production. Large profit potential for developers and landowners are at odds with concerns about maintaining open space and are increasing scrutiny of related public policies.

With a long history of agricultural production and a desire to maintain quality of life for its citizens, Bermuda has had laws for more many years intended to sustain arable

land and maintain a small but healthy agricultural industry. Inevitably, such laws are not enforced without some cost to the country's economy, and with even greater cost and considerable inconvenience to some individual sectors of the Bermudian public. In the enactment of such laws, the intent was that the benefits of such policies would greatly exceed the costs, however, cost/benefit relationships are not static and this study was initiated to provide an updated assessment.

Our study team assessed information from a wide array of sources including interviews with commercial farmers, produce retailers, produce wholesalers/importers, government officials, restaurateurs, and backyard gardeners. We also assessed public attitudes through surveying citizens. Through these procedures we have assembled an array of quantitative information and have also attempted to extract qualitative issues that are no less important to these issues. In this document, we report our findings and use this information to propose a series of public policy options that reflect different weightings of the various issues expressed as Bermudian priorities.

1.2 Agriculture in Bermuda

Agriculture contributes about 1 per cent to GNP and employs 1.5 per cent of the workforce (World Information, 2002). Around 80 per cent of food requirements need to be imported (World Information, 2002). In recent years, the agricultural sector has been on a downward spiral. Today, agricultural production is limited to horticultural crops, dairy, honey, and one egg operation. Although exact figures are not available, based upon the information collected for this study, the approximate wholesale value of Bermuda's produce industry is more than \$5 million¹.

¹ This figure does not include the value of flower and herb production.

1.3 Tourism in Bermuda

For the last fifty years, tourism has been the foundation for the Bermudian economy. As recently as 1980, 55 per cent of GDP, 50 per cent of foreign exchange earnings and 65 per cent of the workforce were employed either directly or indirectly through tourism (World Information, 2002). Tourism, however, has been declining in recent years, at a rate of 3% and 15% in 2000 and 2001 respectively (World Information, 2002).

1.4 Organization of the Study

This report is divided into seven sections including a brief introduction. In Section 2, production of horticultural products in Bermuda is reviewed. This review includes identification of the main production system used for each crop along with fertilization and pest control practices. Cost of production is estimated for eight of the more important crops. In Section 3, government policy with respect to agriculture is discussed. The Government of Bermuda intervenes into the agricultural sector in a variety of ways; the most conspicuous is the imposition of embargoes on horticultural products. The likely impacts of government policy are identified. This section includes estimates of the volume of produce imports into Bermuda and prices paid for produce products. The discussion also includes a report on the Government Marketing Centre. In Section 4, the marketing channels for produce in Bermuda are identified. It is noted that these channels are quite different depending upon whether produce is produced locally versus imported.

In Section 5, backyard gardening in Bermuda is reviewed. Two approaches have been taken to estimate the acreage devoted to backyard gardening. Both estimates

suggest that backyard gardening in Bermuda is significant and produce from backyard gardens is an important component of total domestic produce production. The newly opened Farmers' Market is also discussed. Section 6 deals with the potential for organic agriculture in Bermuda. This section details certification procedures for organic products that have been implemented in other countries.

Section 7 provides a summary of the study and identifies policy options for Government and suggestions to participants in the horticultural industry of Bermuda. It is not the role of economic consultants to establish the "best" option for Bermuda agriculture. Rather, our role is to collect relevant information, distill that information into a format that is useful for decision makers, and help those decision makers establish their priorities with respect to agriculture, domestic food production, and land use.

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Section 2

Commercial Agriculture in Bermuda

2.1 Introduction

Commercial production of fruits and vegetables in Bermuda occurs on about 380 acres of land², on numerous plots of 0.3-4 acres (averaging less than 0.5 acre) scattered throughout the island. An additional area of approximately 400 acres has been identified as arable, but are currently in lawn, horse paddocks, and athletic fields. Most agricultural land is in depressional areas within the landscape, which have greater soil depths since erosion has moved soil from the surrounding slopes. Only a small proportion of the farmed land is actually owned by the farmers with most land leased from private owners or obtained on bid from the government. Interestingly, capital improvements such as storage barns, cold-storage facilities, wells, and even greenhouses are routinely built on land rented through long-term leases.

As of June 2002, eleven people were devoted to farming as a full time occupation (one focusing on hydroponic production) with a number of additional people registered as farmers and pursuing agriculture on a part-time basis. Information in this report was gained through intensive interviews with the eight full-time farmers with largest production and five selected part-time commercial farmers, along with numerous less formal discussions with many people involved with Bermudian agriculture.

Approaches to farming vary widely among Bermudian farmers. Some farmers view themselves as “full service” farmers, providing a wide array of seasonal produce, and delivering their products to numerous clients around Bermuda. In contrast, some

² This figure is based upon information provided by the Government Marketing Centre. As seen in Table 2.1, actual farmed acreage may be somewhat less than this figure although the crops listed in Table 2.1 are not exhaustive of all crops commercially produced in Bermuda.

farmers focus solely on growing potatoes. Many farmers operate between these two extremes. Virtually all farmers sell a portion of their potatoes at a guaranteed price to the Government Marketing Centre (GMC, see section 3.2), with approximately 40% of the annual harvest handled in this manner. The one dedicated hydroponic operation produces only English cucumbers and cluster-tomatoes.

Full service farmers typically attempt to have good quality product of virtually every seasonal Bermudian produce item, this would include all items currently on embargo (see section 3.1) as well as those products for which Bermudian origin is important for some of their customers. These farmers may be simultaneously growing 30 or more types of vegetables and herbs, requiring that they constantly juggle competing demands of planting, growing, harvesting, and marketing each of their crops. In addition, many of these farmers also grow some flowers for sale, and may occasionally benefit from embargoes on these as well. In Table 2.1 the typical acreage and yield of the nineteen most important Bermudian fruits and vegetables are listed.

Overall, one of the most remarkable features of Bermudian produce production is the complexity of managing a “full-service” operation. The large number of commodities and overlapping crop cycles, farming of numerous far-flung plots, and individual packaging and marketing efforts, make these small businesses extremely complicated to manage.

2.2 Marketing Bermudian Produce

A significant proportion of Bermudian produce is distributed through the wholesalers that handle imported produce, however, many full-time and part-time farmers focus on directly servicing the needs of grocers and restaurateurs. The desire to

maintain client loyalty is a major motivation for many farmers to produce so many types of products, making it unnecessary for customers to seek alternative suppliers that may erode their existing trade. To sustain these trade relationships, farmers will sometimes buy produce from other farmers when they are short on specific commodities and occasionally even contract production of certain crops. The hydroponic operation, in contrast, maintains client loyalty by providing a consistent volume and pricing for two premium products throughout the year. The “full service” farmers report that 50% or more of their hired labor’s time is spent on packaging, marketing, and delivering their crops to customers.

Although it represents a small proportion of total produce sales, direct marketing via roadside stands, direct sale to neighbors, or through the Farmers’ Market (section 5.7) can provide a much higher proportion of many farmers’ profits. Farmers who focus on sales to grocers, however, must be sensitive to concerns that they are competing with their primary customers.

A widely expressed concern among farmers is the substantial proportion of many crops that remain unsold and must be destroyed, with estimates ranging from 15-50% among different farm operations. The reality of this concern was evident in our farm visits from discarded piles of produce and bins of vegetables remaining in storage past prime marketability. Reasons reported for unsold produce include failure to institute embargoes early enough, established farmer/customer relationships excluding other farmers from the market, and excess production of specific products. Such losses are routine in U.S. vegetable production areas and are accepted as an unavoidable consequence of free market competition. If maximal productivity of Bermudian farms

were identified as a government priority, much of this waste could be avoided through better coordination among farmers and their customers.

2.3 General Vegetable Field Production Practices

Farming practices are affected by the small scale of most plots, low-capitalization of many operations, and the large number of crops grown. Most farmed areas produce two crops per year with three crops often produced when short-cycle commodities such as lettuce are included in the rotation. For many commodities, to ensure a fresh supply of premium product over the entire season for each crop, an individual “full-service” farmer may initiate sequential small plantings of the same crop over an extended period of time. Since weather conditions are somewhat unpredictable, some plantings will be made somewhat early and late within each cropping season, risking total loss on those stands but providing the potential for extending the season and gaining premium prices. Most farmland also receives a summer cover crop of cowpeas or oats every 1-2 years, which is plowed-in to enhance organic matter and nutrients in the soil. Since summer crops such as corn, cucumbers, peppers, summer squash, and tomatoes are grown on much less acreage than cool-season crops, the Bermuda pumpkin is routinely grown during the summer by some farmers, as a low-input, cash-producing cover crop.

Farmers vary in their approach to crop rotation with most following a rotation based on their perception of how “hard on the land” certain crops are, influence of specific crops on soil tilth, and cross-crop susceptibility to diseases and insects. Some farmers also note a strong preference for certain crops on specific soil types: e.g. carrots and sweet potatoes on sandy soils. For a few farmers, compatibility with herbicides remaining from some crops may also influence crop rotation.

To prepare for planting, farmers will mow stands of remaining crops and typically plow their land 1-2 times, depending on coarseness of remaining crop residues and whether the plot will be direct-seeded or planted with transplants. Farmers with larger plots either own or contract tractors, which are used in land preparation. Plots, which are too small to warrant larger equipment or where farmers lack access to tractors, typically use power tillers such as the Agria to prepare their land.

Selection of planting material varies. Seed potato is either imported directly by the larger farmers or is procured through importers, with Bermuda Import/Export Company the largest supplier. Based on 2001 seed sales and typical planting densities, it appears that somewhat more than half of the island acreage is planted using seeds and strawberry plants procured through the Government Marketing Center. Farmers obtain the remaining seed from numerous sources, with selection based on established preference, personal experimentation to identify disease resistance or performance in the “off-season” weather, or availability in pelletized form for mechanized planting.

Crops such as tomatoes, peppers, crucifers (e.g. broccoli, cabbage, cauliflower), and watermelon are almost always placed into the field as transplants. Commercial farmers prepare their own transplants through either seeding in high-density seedbeds or seeding into transplant trays. Transplant trays are often managed in greenhouses, which vary greatly in sophistication and mechanization. Carrots, cucumbers, green beans, and sweet corn are always direct seeded into the field. Onions are either direct-seeded or sown in a seedbed and transplanted when 5-6” in height. Lettuce is also reported to be direct-seeded or transplanted.

A few farmers reported the use of precision planters for some crops, especially for carrots. Precision planters are used on only a portion of total acreage, however, so thinning of stands to desirable commercial spacing is often necessary when crops are direct-seeded into the field. Since thinning is a manual operation with final plant densities ranging from 10,000-100,000 plants / acre, it is extremely laborious, time consuming and expensive. Several farmers indicated, however, that thinned onion plants were sold to retail nurseries for later sale to the public.

Preplant fertilizer may be incorporated during field preparation, but most farmers largely rely initially on nutrients remaining from the previous crop. Based on preplant fertilization, rainfall, and plant growth, farmers apply one to three side-dress or broadcast applications of fertilizer during the period of growth. Overall, levels of nutrients used appear somewhat higher than U.S. standards, but this varies among farm operations. Although increases in production with increasing fertilization is less at these high rates, farmers are probably receiving good returns on this additional expense because of the high produce value relative to fertilizer cost in Bermuda. In addition, lack of soil or plant nutrient testing on Bermuda makes it more likely that farmers will provide somewhat higher fertilization as insurance.

Weeds are controlled through several cultivations using tractor-drawn implements or motorized tillers. Preemergent and/or postemergent herbicides are used by some farmers on most crop species, while others report little or no use of herbicides.

Plastic mulch is used by several of the larger farmers for crops such as cucumbers, peppers, strawberries, and tomatoes. Normally, the plastic mulch is still intact following harvest of the first crop. Therefore, the crop is burned down with a

dessicant and a second crop is planted into newly cut holes. Fumigation has been used, but is rare since houses often border the small field plots. A few farmers report use of *Trichoderma*-based biocontrol agents to control root fungi in lieu of fumigation.

Irrigation is used on a small proportion of Bermudian acreage, usually as drip irrigation beneath plastic mulch. Desalinization using reverse-osmosis systems is practiced in a few areas while others have wells with water suitable for irrigation without treatment. Water provided by commercial water suppliers is very expensive and poor ground water quality (high salinity) often precludes the use of wells.

Farmers diverge widely in their spray control practices with some indicating use of pesticides only after a problem is apparent, and others using routine cover sprays for prevalent pests. Most farmers apply two to four disease and insect-controlling sprays in a typical crop cycle, using “skid-load” sprayers that are mounted on skids for easy loading and unloading from truck beds or backpack sprayers. Backpack sprayers may be motorized or hand-pumped, and require frequent refilling even for small plots. With a skid-load sprayer, spray applicators will position the truck and sprayer so that they can walk through the field dragging a hose (up to 400 feet long) delivering spray through a hand gun or spray boom. Skid load sprayers are powered by integral gas engines and typically carry sufficient volume for 1-2 acres. At least three farmers routinely use three-point hitch mounted tractor-mounted sprayers.

Fungal control is the focus of spray programs for some crops, with routine cover sprays to control the primary diseases of concern. Initial sprays of insecticides (Ambush or diazinon) may be applied for cutworm control when seedlings emerge or immediately after transplanting, but most insecticides are applied only when pests are observed, using

them as a tank-mix with the cover spray. Some farmers also reported including nutritional materials such as seaweed extracts and adjuvants such as stickers in their pesticide sprays.

Harvesting of most crops occurs by hand with direct packing of products in the field. There are a few mechanized harvesting implements on Bermuda: potato diggers are fairly widespread, with several mechanical potato harvesters, and one mechanical bean harvester reported. When produce is sold directly to grocers, it is cleaned, packaged and presented to the grocer in a shelf-ready form, with almost all operations conducted with no or minimal mechanization. Some culling is practiced in the field and packaging barn, but no routine grade standards are observed, and there is little effort to sort produce by size or other attributes. A number of farmers have limited cold storage capacity and most also store some produce in the GMC coolers.

Detailed summaries are presented below for several crops, which differ substantially in production practices. Spray programs and fertilization are highly variable between farm operations making it difficult to portray average production.

2.4 Potato Production

Potatoes remain one of the most important agricultural products of Bermuda, accounting for 18% of total crop acreage. Many Bermudians indicate a preference for the flavor of the local potatoes, but government price supports and embargoes (sections 3.1 and 3.2.1) appear to largely account for the emphasis on potato production.

Two crops of potatoes are usually grown, with the larger crop planted in late December-early January and harvested April–June and a second smaller crop planted in September using undersized potatoes from the first crop, and harvested in December.

Farmers typically plow their land 1-2 times before planting. Preplant fertilizer may be incorporated during field preparation, or the farmer may initially rely on nutrients remaining from the previous crop.

Seed potato is purchased from North America (primarily Maine and New Brunswick) and is often imported directly by the farmer. Major varieties planted include 'Chieftain', 'Red Pontiac', 'Kennebec', and 'Yukon Gold'. Seed pieces are placed at a depth of 3-4 inches at a spacing of 26-27" X 8-10" so that seed potato use ranges from 1000-2000 lbs per acre. There are several tractor-drawn potato planting implements on Bermuda. All farmers contacted report either owning or borrowing this equipment for planting, but indicate that some smaller farmers may plant their potatoes by hand.

Seed pieces are covered in a smoothing operation using either tractor-drawn or motorized walk-behind equipment. Weeds are typically controlled with 0-1 herbicide spray and 1-2 cultivations using different implements on the same equipment. Around six weeks after planting, soil is hilled around the potato plants. Three to four sprays are applied in a typical season. Fungal control (early and late blight) is the focus of the spray program with insecticides added as needed.

Largely depending on use of preplant fertilizer, and based on plant growth, farmers apply one to two side-dress applications of fertilizer. Total N usage reported ranged from 135-275 lbs per acre, with similar to somewhat less K_2O and little PO_4 .

Prior to harvest, most farmers either mow or bush-hog the potato plants or spray them with a vine-killing dessicant. Decreased damage occurs during harvest and handling if potato skins are allowed to cure by waiting two weeks between vine-kill and harvest. Harvest occurs using primarily potato-digger implements on tractors. Potatoes

are then manually bagged in the field after which bags are collected and transported. A few farmers have potato harvesters that dig the potatoes and transfer them via conveyors into bags, which are continually tied off and replaced by workers riding on the implement. Using this system, bags are unloaded directly from the harvester to trucks in the field. Approximately 40% of total potato production is sold to the Government Marketing Centre without washing or grading. Many farmers wash a portion of their harvest and sell them directly to grocery stores, food service establishments, and/or the public. A few sort out the smallest potatoes and sell them for a premium price. Reported yields range from 8-12 times the amount of seed potato sown for the main crop, with a yield of about 5-6 to 1 for the fall crop which is also planted on much less acreage overall. Thus, per acre production for the spring crop ranges from 160 to 500 bags (8,000 to 25,000 pounds.)

2.5 Crucifer Production

Production of broccoli, cabbage, cauliflower, collards, kale, mustard, turnips, and brussel sprouts are reported in Bermuda. The first three crops predominate, accounting for 23% of total crop acreage, and is the subject of this section.

Broccoli, cabbage and cauliflower are available as fresh product from local farmers for about eight months of each year. To achieve this, small plots are planted at regular time intervals between August and April to provide optimal maturity. Farmers typically plow their land 1-2 times before planting. Preplant fertilizer may be incorporated during field preparation, or the farmer may initially rely on nutrients remaining from the previous crop.

Many crucifer seeds are purchased from the GMC, but farmers also import their own seed to obtain desired varieties or acquire pelletized seed for mechanical planting of flats. Broccoli varieties planted include 'Liberty' and 'Pirate'. Important cabbage varieties planted include 'Atlantis', 'Fortuna' and 'Constanza'. Important cauliflower varieties planted include 'Snow Crown', 'Minuteman' and 'Pathfinder'. Transplants are uniformly reported for field planting. Commercial farmers prepare their own transplants through either seeding in high-density seed beds or seeding into transplant trays.

Broccoli and cabbage are transplanted at 5-7 weeks when 7-8" tall while cauliflower is transplanted when slightly smaller and younger. Row spacings of 24-26" are typical with final plant populations of approximately 13,000 plants / acre for broccoli and cauliflower. Somewhat tighter spacings are used for cabbage to produce smaller heads, resulting in 22-24,000 plants per acre. Weeds are typically controlled with 0-1 herbicide spray and 1-2 cultivations. Two to four cover sprays are applied in a typical season. Cabbage loopers and black rot are primary targets of the spray program.

Largely depending on use of preplant fertilizer, and based on plant growth, farmers apply one to two side-dress applications of fertilizer. Total N usage reported ranged from 165-460 lbs N per acre, with somewhat less to no K₂O and PO₄.

An individual planting is harvested according to customer demand, over about a three-week period, with typically three harvests per week. Produce is field packed into waxed boxes and transported to customers. During periods of excess supply, a portion of crucifer production is placed in cold storage at the GMC where availability of ice makes broccoli storage especially prevalent. A significant amount of later crucifer plantings remains unharvested due to bolting and reduced quality from warm weather. Reported

yields range from: 3,000 to 13,000 lbs / acre for broccoli; 5,000 to 26,000 lbs /acre for cauliflower; and 15,000 to 32,000 lbs /acre for cabbage. The high values are near the Florida average, except for cauliflower, which is almost three times the Florida average.

2.6 Carrot Production

Fresh carrots are on permanent embargo to avoid introduction of the carrot rust fly (*Psila rosae*) into Bermuda. As a result, it is an important horticultural product accounting for 13% of total crop acreage. Many Bermudians indicate a great fondness for local carrots and all varieties planted are strongly conical in shape rather than the cylindrical shape characteristic of commercial carrots in North America

Carrots are planted continuously from August through March with plantings staggered through this period to provide timely harvest with minimal needs for storage. Larger acreage is planted to carrots for the final harvests, which provide produce for storage and sale over the summer as well as meeting immediate needs.

Farmers typically plow their land at least two times before planting, since the soil must be well prepared for direct planting of fine carrot seeds. Preplant fertilizer may be incorporated during field preparation, or the farmer may initially rely on nutrients remaining from the previous crop.

Almost all carrot seed are purchased through the Government Marketing Centre. Varieties planted are primarily 'Yardley' and 'Andros' with smaller amounts of 'Danvers 126-C', 'Early Gold', 'Goliath' and 'Abaco'. Seed are placed at a depth of 1/4 inch at widely varying spacing depending on the seeder used. Seeds are primarily planted using mechanical punch or precision seeders to use a total of 1.5-4 lbs per acre. The herbicide

Lorox is typically applied before seedlings emerge with one more application as needed, and this appears to be the most uniform usage of herbicide for any crop in Bermuda.

At six weeks, carrots not planted with a precision seeder are thinned by hand to a 1.5-3” spacing. Weeds are controlled through several cultivations using a motorized walk-behind cultivator. Zero to four pesticide sprays are applied in a typical growing cycle, with greatest insect pressure in the summer. Some farmers report that control of *Alternaria* blight is the focus of the spray program with insecticides added as needed, while others report no fungicide application to carrots.

Largely depending on use of preplant fertilizer, and based on plant growth, total fertilizer is applied in one to two broadcast applications. Total N usage reported ranged from 67-150 lbs per acre, with similar rates for K₂O and similar to half-rates of PO₄.

Harvest occurs through hand pulling with harvest spread over three weeks for a typical field. To reduce damage during harvest, some farmers schedule their final cultivation 3-4 weeks prior to harvest to loosen the soil as well as reducing weed competition. For immediate sale, carrots are washed in the field or farmyard, their tops are trimmed, and they are packaged in plastic bags. Carrots are often stored unwashed in feed bags if they are being placed into cold storage for later sale. Little grading is conducted according to size, and carrots are typically sold by the bunch in cool weather and may be sold by weight in warm weather when carrot tops are less attractive and are completely removed through trimming. Reported yields range from 6,800– 30,000 lbs / acre. The higher value is typical for average U.S. yields.

2.7 Sweet Corn Production

Fresh sweet corn is on permanent embargo to avoid introduction of the European corn borer (*Ostrinia nubilalis*) into Bermuda. As a result, it is an important horticultural product accounting for 10% of total crop acreage.

Corn is planted at regular time intervals between February and June to provide optimal maturity for five months between May and September. Almost all sweet corn seed are purchased through the Government Marketing Centre. Varieties planted include 'Precious Gem', 'Incredible', and 'Bodacious'. Seed are placed at a depth of 1-2 inch and typically 24-27" between rows and 6-12" between plants. Actually seeding ranges from use of precision planters to use of push planters using a total of five pounds of seed per acre.

Some farmers apply herbicide preemergence, while others indicate no use of herbicide on corn: weeds are further controlled through several cultivations. Two to four sprays are applied in a typical season. Control of lepidopteran pests is the focus of the spray program.

Largely depending on use of preplant fertilizer, and based on plant growth, farmers apply one to two side-dress applications of fertilizer. Total N usage reported ranged from 150-460 lbs N per acre, with little or no K₂O and PO₄.

Harvest occurs over three weeks for a typical field. Ears are stripped, cleaned, and placed in half-dozen packages by the farmer for shelf-ready sale. Reported yields range from 560 to 2,500 dozen /acre which is estimated at ~5,000-15,000 /acre, with the higher value near the reported Florida average.

2.8 Banana Production

Banana plants are evident in small commercial plantings and dooryard settings throughout Bermuda. Banana accounts for about 4% (20 acres) of total crop acreage. Interestingly, total dooryard acreage of banana appears to be three to four times commercial acreage. Unlike all of the other crops described in this report, bananas are grown as perennials with individual plantings established and maintained for 6-15 years, with rejuvenation scheduled when production significantly declines. Citrus was once widely grown for commercial fruit sales, but banana is now the only significant commercial perennial fruit produced in Bermuda.

‘Dwarf Cavendish’ is by far the most important banana cultivar, with some ‘Grand Nain’ and very few plants of other cultivars. ‘Dwarf Cavendish’ is highly susceptible to choke throat, a physiological disorder that develops in cool conditions and short day lengths that occur outside the tropics, which can substantially compromise production. ‘Grand Nain’ is not susceptible to choke throat and was suggested as a superior alternative by a consulting horticulturist some years ago. The greater size of ‘Grand Nain’, however, makes it far more susceptible to lodging in high winds and ‘Dwarf Cavendish’ appears likely to remain the premier Bermudian banana until other choke resistant, dwarf cultivars are identified.

Sites selected for banana production are often sites already planted in banana. Although bananas are known to prefer deep soils, some growers note that sites with some rock outcroppings can be used for banana since they will not require tillage for each crop cycle. May was cited as the best time to rejuvenate banana plantations, but demands from other farm activities makes October the most popular time for replanting.

Nonbearing pseudostems of 3-5 feet in height are selected and placed aside: they can be healed in if replanting will not occur within a few days. The remaining plants are pushed to one side of the field and allowed to rot before the debris is spread and incorporated for production of vegetables. The area designated for replanting bananas is tilled, and young trees are planted to a depth of 18-20" at a spacing of 7-10' X 9-10'. About two pounds of a balanced fertilizer, such as 15-15-15, is spread around each tree shortly after transplanting. Frequently, this wide spacing makes it attractive to interplant another crop in the year following banana rejuvenation.

The first banana crop will be harvested beginning about nine months after replanting. The first bunches, from the planted pseudostems, will be small, but subsequent crops will produce normal bunches characteristic of mature plantings. As the plants sucker and spread, the number of pseudostems per acre and resulting bunches increases. Most growers report annual control of weeds using glyphosate or Rely, and clean-up of debris from the banana trees.

Fertilization practices vary widely. Some growers report application of two pounds of 15-15-15 /tree broadcast around the base of each tree every three months. Most farmers use two applications per year, with reports of total annual application at: 4400 lbs / acre of 10-5-10-3; 1000 lbs/acre of 15-15-15; and 1200 lbs/acre of urea. These disparate practices result in a use range of 150 – 550 lbs N / acre / year or even higher.

No farmer reported routine sprays for bananas. The only spray mentioned was to control a single incidence of cigar end rot. Chickens and rats were reported as significant pests of banana. Hurricane force winds, as experienced in October 2001 can significantly disrupt plantings and reduce yields.

Bananas are harvested year round from a typical field. Green bunches of fruit that have filled out to have a round cross section are cut and placed in waxed banana boxes holding 40 lbs. Fruit are carried to the GMC for ripening with ethylene or are handled in their own ripening rooms and are either marketed by the farmer or by the GMC. Farmers indicate that an individual field will be harvested every two weeks in July and August, with 2+ year-old plantings producing 800-1000 pound per acre at each harvest. Production is lower for the rest of the year and is lowest in the winter: harvest occurs every four weeks yielding as much as 600 lbs per acre per harvest. Annual production reports for mature bananas range from 3000-17,000 lbs / acre.

2.9 Lettuce Production

Production of diverse lettuces has lately increased in Bermuda, with production of leaf lettuces, Bib, endives, escarole, and frissee along with more traditional iceberg and Romaine. Romaine and leaf lettuces can be produced for seven months of the year, ranging from November through May with best quality after days begin to lengthen in January and before warm weather arrives, but cracking of iceberg heads limits its production to only the coolest months. To achieve this broad window of production, small plots are planted at regular time intervals between August and April to provide optimal maturity. Farmers committed to lettuce production report making new plantings (each with multiple varieties) every ten to fourteen days with 4-5 weeks required for production of transplants and 5-6 weeks from field planting to first harvest. Transplants are produced in carefully prepared and irrigated seed beds or in flats using soil-less mix in greenhouses. A few growers reported that lettuces are sometimes direct seeded into field and thinned to achieve desired spacing.

About half the lettuce seeds are purchased from the GMC, with farmers importing their own seed to obtain desired varieties or acquiring pelletized seed for mechanical planting of flats. Lettuce varieties from GMC include 'Romulus' Romaine and 'Tropical Emperor' iceberg with only small sales of leaf lettuces. Transplants are carried to the field in flats or bare-root in baskets on cloudy days. Row spacings of 14-20" are reported with 8-10" in row spacings. Final plant populations are 30,000-50,000 plants per acre, with the tighter spacings used for Romaine and Bibb by some growers to take advantage of their more upright growth. Weeds are typically controlled with one cultivation with a hand tiller and one to two hoeings. No herbicide use is reported on lettuces. Zero to four pesticide sprays are applied in a typical season with fungicides and insecticides selected and tank-mixed based on pest pressure and weather conditions.

One to two side-dress applications of fertilizer are made. The first application is often made within two weeks of transplanting and is incorporated by cultivation. Total N usage reported ranged from 80-120 lbs N per acre, with similar K₂O and half to no PO₄.

An individual planting is harvested according to customer demand, over a 2-3 week period. Heads are cut in the field and packed into waxed lettuce boxes for delivery to customers. Farmers report that 20 to 50% of each planting is not commercially harvested because of over-maturity splitting or other cause of unacceptable quality. Reported commercial yields range from: 3,200 to 25,000 heads per acre. Lettuces are sold by the head rather than by weight and head size appears to vary widely from ½ to 2 lbs per head based on variety and season.

2.10 Tomato Production

Tomato production is quite diverse in Bermuda, with a wide range of field-grown varieties, and a substantial hydroponic facility, which provides for a substantial proportion of the island's cluster-tomato demand. Field grown production primarily focuses on standard table tomatoes, but cherry and grape tomatoes are widely planted with some production of plum tomatoes.

Field grown tomatoes are available as fresh product from local farmers for about nine months of each year (hydroponic cluster-tomatoes are available for eight months / year). To achieve this, small plots are planted at regular time intervals between July and March to provide optimal maturity. Different varieties are often planted at different times of the year to maximize productivity and quality in different environmental conditions. Farmers typically plow their land one to two times before planting. Preplant fertilizer may be incorporated during field preparation, or the farmer may initially rely on nutrients remaining from the previous crop.

Some tomato seeds are purchased from the GMC, but farmers also import their own seed to obtain desired varieties or acquire pelletized seed for mechanical planting of flats. Varieties obtained through the GMC include 'Heatmaster', 'Heatwave', 'Celebrity', and 'Sanibel'. Identity of varieties imported directly by farmers is often confidential since they feel that the time they have invested into identifying superior varieties provides a significant business advantage. Transplants are uniformly reported for field planting. Commercial farmers prepare their own transplants through either seeding in high-density seed beds or seeding into transplant trays. Some farmers report

initial seeding at very high rates in flats, followed by transfer to cell trays for final transplant production.

When transplants are 5-6" they are transferred to the field with planting densities of 4000-10,000 per acre with widely varying spacings. Several farmers are using plastic mulch and drip irrigation routinely for tomato production. All tomatoes are grown using either bamboo or stake supports and are tied up with string (the "Florida weave method"). Bamboo supports are usually comprised of four sticks tied together (the "teepee method"), which involves considerable labor. Weeds are typically controlled with 0-1 herbicide spray and 1-2 cultivations. An initial insecticide application is usually made at transplanting to control cutworms. Farmers report that three to six fungicide cover sprays (primarily for early and late blight and bacterial spot) are applied in a typical season, with 2-4 insecticides tank-mixed as needed.

Largely depending on use of preplant fertilizer, and based on plant growth, farmers apply one to two side-dress applications of fertilizer. Total N usage reported ranged from 75-140 lbs per acre, with similar K_2O and similar or less PO_4 .

An individual planting is harvested according to customer demand, over about a four-week period, with typically three harvests per week. Fruit are usually harvested as vine ripe with some harvested as breakers. All produce is field packed into waxed boxes or storage containers and either transported to customers or with breakers, held at cool temperatures for several weeks to achieve market color. Reported yields range from 16,000 to 20,000 lbs /acre. Occasionally, high production can occur before establishment of an embargo, resulting in high losses of produce.

The hydroponic facility produces cluster tomatoes and English cucumbers using a high wire system with 30,000 square feet of greenhouse space devoted to tomatoes. Pest control focuses on use of bio-control and is reported to follow the UK-based Assured Produce Scheme recognized by Tesco and Sainsbury's. Annual production of tomatoes per acre is reported to be more about 10 times greater than that obtained from conventional farming in a single crop cycle, and occurs in a structure which is not on arable land.

2.11 Sweet Potato Production

Fresh sweet potato is on permanent embargo to avoid introduction of the sweet potato weevil (*Cylas fornicarius*) into Bermuda. It is a fairly minor horticultural product accounting for only 2% of total crop acreage, but is included in this report because of its distinctive production and embargo status.

Sweet potato is grown during two seasons with plantings established between January and March and again between June and September for harvest 4-6 months after planting. Sweet potato is planted using young shoots (known as slips) emerging from the crown of growing plants, so propagation source vines must be grown continuously. Widespread virus infection in existing material led to the recent importation (by the Plant Protection Lab) of clean material from North Carolina. Greater yields appear to have resulted from this virus-free stock, which is of the varieties 'Beauregard', 'White Delight' and 'O'Henry'. Slips of 6-12" length are collected on the morning of planting. Slips are placed vertically to a depth of 2-4 inches, typically 20-24" between rows and 12-24" between plants, and are covered by hand. Plant populations range from 10,000 to 20,000

per acre. Several farmers report that the best sweet potato quality from sandy soils and indicate that this crop is tolerant of shallow soils only 18” in depth.

In Bermuda, most farmers grow sweet potato with minimal inputs, relying solely on residual nutrients from the previous crop. Excess nutrients are reported to be a problem with high nitrogen resulting in aggressive vegetative growth and little yield. Most farmers report a single cultivation to control weeds and one spray, if needed, to control spider mites or Lepidoptera larvae. One farmer is experimenting with intensive management of sweet potato and has grown several crops using plastic mulch and drip irrigation with the new virus-free material.

Harvest occurs over two months for a typical field ranging from 4-6 months after planting, resulting in availability from May-August and November - February. Vines are mowed or sprayed with Rely prior to harvest. A potato digger is used to unearth the crop, which is then collected by hand and field packed into potato bags. Reported yields range from 5,000 to 20,000 pounds /acre with low input culture to a reported 30,000 pounds/acre yield using plastic mulch.

2.12 Onion Production

Onion production has a long history in Bermuda, which is known for its sweet-tasting product. Onions are available “fresh” from local farmers for about one month each year, while dried mature onions may be available for up to eight months / year. Farmers typically plow their land one to two before planting. Preplant fertilizer may be incorporated during field preparation, or the farmer may initially rely on nutrients remaining from the previous crop.

Some onion seeds are purchased from the GMC, but many farmers also import their own seed. Varieties obtained through the GMC include ‘Mercedes’ and ‘Equanex’. Several growers indicate that they obtain ‘Flat Bermuda’ seed from outside sources. Commercial farmers prepare onion sets through seeding in high-density seed beds or direct seed into the final field. Around eight weeks after seeding, onion sets are removed for field planting, or thinned where direct-seeded. Many onion sets produced by Bermuda farmers are sold to garden centers for sale to the public.

Typical field planting densities are around 100,000 / acre with 12-13” between rows and 4-6” between plants within rows. Weeds are a major problem in onion production with 0-2 herbicide sprays and 1-3 cultivations. An initial insecticide application is usually made shortly after emergence to control cutworms. Zero to four fungicide cover sprays (for seedling and leaf blight) are reported as typical applications, with additional insecticides tank-mixed as needed.

Largely depending on use of preplant fertilizer, and based on plant growth, farmers apply one to two side-dress applications of fertilizer. Total N usage was reported at around 150 lbs per acre, with similar K₂O and somewhat less PO₄.

Premium prices for less time and effort are reported for bunch onions with the tops intact, but only a portion of most farmers’ crops can be harvested while the tops are still attractive. Remaining onions are dried in sheds or greenhouses and sold by the pound. Reported yields range from 15,000 to 30,000 lbs /acre. The six-month cycle for dried onions is frequently cited as a major drawback for onion production.

2.13 Strawberry Production

Local strawberries are highly prized in Bermuda and are reported to outsell imported berries even when they command substantially higher prices. Interestingly, strawberries are never on embargo.

Farmers typically plow their land one to two times before planting. Virtually all strawberry plants are obtained through the GMC, with 'Sweet Charlie' accounting for 99% of sales. Strawberries are planted at 14,000-20,000 plants / acre, with most planting occurring in November for harvest in January through May. Although strawberries can be grown as a perennial, they do poorly in the summer and are managed as annuals in Bermuda.

The high value of this crop frequently justifies more intensive production practices. Several farmers are using plastic mulch and drip irrigation routinely for strawberry production. One farmer indicated that Vapam was applied beneath the plastic mulch via the drip system and allowed to dissipate for four weeks before planting strawberries. Another farmer reported control of weeds through chemigation with Goal herbicide. Several farmers also indicated use of fertigation with strawberries. Use of additional soil amendments was also reported by two farmers, using chicken manure + slow release fertilizer or kelp extract in the bed beneath the plastic mulch. Total N use per acre ranged from 100 to 260 lbs / acre

Strawberries are subject to a host of pests. One farmer reported dipping plant roots in Rovral prior to planting. One to six Rovral or Benlate applications are made after fruit production begins to control botrytis and leather rot: sprays are typically applied after a rain or after a harvest where rot is evident. To control disease, harvest of rotten fruit and transfer away from the field is practiced by some growers. Following

extensive rainfall, this can be an expensive and time-consuming job. Spider mites can be a problem in dry weather and may be controlled with Kelthane. Additional insecticides may be applied as needed. Birds can significantly reduce production in some fields.

An individual planting is harvested over a four-month period, with typically two harvests per week. All produce is field packed shelf-ready into strawberry boxes or clamshell containers and receive no further handling unless covered with rain-thrown soil. Reported yields range from 12,800 to 14,300 lbs /acre.

2.14 Costs and Returns Associated With Selected Crops in Bermuda

Based upon information collected from interviews with farmers, the costs and returns associated with producing selected horticultural crops in Bermuda were estimated. These figures are shown in Tables 2.2-2.9. These estimates were not derived using statistical techniques, but were computed using a consensus approach. Costs and returns for individual farmers may deviate significantly from those reported here, due to differences in production practices. Estimated net returns denote net returns per acre to management as nearly all agricultural land in Bermuda is rented. In most cases, machine costs have not been included.

Based upon the data provided to the research team, carrots appear to be the most profitable crop produced in Bermuda with an average estimated return per acre of nearly \$17,000. The next most profitable crop is sweet potatoes with an average net return of over \$10,000 per acre. Onions rank third in profitability at \$9866 per acre. Estimated net returns for broccoli was \$9438 per acre. The other four crops considered: potatoes, bananas, sweet corn and lettuce (all varieties) had estimated net returns ranging from \$4200 to \$5200 per acre.

These figures have several interesting implications. First, the fact the estimated net returns per acre for four of the crops are similar suggest that farmers have adjusted both acreage and production intensity so as to equalize returns across those crops. Second, lower estimated net returns for potatoes likely arises because of the lower price risk associated with potatoes. Government guarantees purchase of a portion of all farmers' potato crop that likely encourages overproduction of potatoes relative to the other crops. Third, the high net return associated with onions is likely due to the labor-intensive nature of onion production and post harvest handling. Most farmers indicated that they disliked onion production even though Bermuda onions are of high quality because of the tedious work involved post harvest.

It is clear that the phytosanitary restriction on carrot imports makes this a highly profitable crop. Even though sweet potatoes are low input, they too enjoy year-round protection from imports. Farmers should consider expanding production of both crops given the high net returns associated with them.

One important caveat to the figures presented in Tables 2.2-2.9 is that these numbers apply to an average crop. Actual returns to an individual field clearly depend upon harvestable yield. Harvestable yield is a function of weather, pest infestation, and market conditions. Therefore, a particular field may realize a shortfall in production due to poor weather or pest and/or disease problems. A field with a good crop still may not be fully harvested if market conditions are poor and customers cannot be found for that product.

Table 2.1: Estimated acreage and production from interviews with the 13 largest farm operations in Bermuda.^a

<i>Product</i>	<i>Acres of Cropping/Year</i>	<i>Mean Pounds/Acre</i>	<i>Total Tons/Year</i>	<i>% of Total Acreage</i>
Potatoes	81.5	16,201	660	18.5
Broccoli	61.0	5,390	164	13.8
Carrots	57.3	19,857	568	13.0
Sweet Corn	44.0	11,604	255	10.0
Pumpkins	40.0	6,982	140	9.1
Bananas	20.1	11,767	118	4.6
Cauliflower	20.0	13,831	138	4.5
Cabbage	19.5	19,533	190	4.4
Romaine Lettuce	16.0	13,846	111	3.6
Squash	15.3	12,000	92	3.5
Tomatoes	12.8	17,515	112	2.9
Sweet Potatoes	10.0	16,143	81	2.3
Cucumbers	8.8	12,825	56	2.0
Iceberg Lettuce	8.3	11,929	49	1.9
Onions	7.3	25,407	92	1.6
Green Beans	7.0	N/A	N/A	1.6
Peppers	4.5	17,429	39	1.0
Spinach	3.8	1,630	3	0.9
Strawberries	3.8	11,825	22	0.9

^a Total farmed acreage was 257 acres (most acreage was cropped twice), with crop acreage per year at 441 acres.

Table 2.2: Estimated cost and return associated with growing potatoes in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (6 months)				300.00
Land preparation				125.00
Seeding				840.00
Seed (bags)	40	18	720.00	
Labor (hours)	8	15	120.00	
Fertilization				373.00
Labor (application)	2	50	100.00	
15-15-15 (50 lb bags)*	27.3	10	273.00	
Pest control (sprays)				245.00
Material (application)	3.5	20	70.00	
Labor (application)	3.5	50	175.00	
Weed control				372.50
Cultivation	2.5	135	337.50	
Herbicide	0.5	70	35.00	
<i>Total cost</i>				2,255.50
<i>Harvest and Post-Harvest</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Bag</i>
Harvest and bag				1.36
Bag**	1	0.36	0.36	
Labor	1	1.00	1.00	
Washing	1	1.00	1.00	1.00
Delivery	1	1.00	1.00	1.00
<i>Total cost</i>				3.36
<i>Net Return</i>	<i>Yield</i>	<i>Sell Price</i>	<i>Dollars</i>	<i>Dollars</i>
Selling price			23.40	
Harvest and post-harvest cost			3.36	
Net selling price			20.04	
Yield per acre (323 bags)				
Adjusted revenue	323	20.04	6,472.92	
Production cost			2,255.50	
<i>Net revenue</i>				4,217.42

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

** Assumes that 30% of the bags are reused.

Table 2.3: Estimated cost and return associated with growing broccoli in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (6 months)				300.00
Land preparation				125.00
Transplants				332.10
Plants (number)	13,000	0.0117	152.10	
Labor (hours)	12	15	180.00	
Fertilization (300 lbs of N)				550.00
Labor (application)	3	50	150.00	
15-15-15 (50 lb bags)*	40	10	400.00	
Pest control (sprays)				210.00
Material (application)	3	20	60.00	
Labor (application)	3	50	150.00	
Weed control				237.50
Cultivation	1.5	135	202.50	
Herbicide	0.5	70	35.00	
<i>Total cost</i>				<i>1,754.60</i>
<i>Harvest and Post-Harvest</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Carton</i>
Harvest				3.25
Box (12 heads)	1	1.25	1.25	
Labor	1	2.00	2.00	
Washing	1	1.00	1.00	1.00
Delivery	1	0.25	0.25	0.25
<i>Total cost</i>				<i>4.50</i>
<i>Net Return</i>	<i>Yield</i>	<i>Sell Price</i>	<i>Dollars</i>	<i>Dollars</i>
Selling price			25.00	
Harvest and post-harvest cost			4.50	
Net selling price			20.50	
Yield per acre (546 cartons, 6,552 heads)				
Adjusted revenue	546	12.75	11,193.00	
Production cost			1,754.60	
<i>Net revenue</i>				<i>9,438.40</i>

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

Table 2.4: Estimated cost and return associated with growing carrots in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (6 months)				300.00
Land preparation				300.00
Planting				600.00
Seed	750,000	0.0002	150.00	
Labor (hours)	30	15	450.00	
Fertilization (120 lbs of N)				235.00
Labor (application)	1.5	50	75.00	
15-15-15 (50 lb bags)*	16	10	160.00	
Pest control (sprays)				140.00
Material (application)	2	20	40.00	
Labor (application)	2	50	100.00	
Weed control				375.00
Cultivation	2	135	270.00	
Herbicide	1.5	70	105.00	
<i>Total cost</i>				<i>3,150.00</i>
 <i>Harvest and Post-Harvest</i>	 <i>Quantity</i>	 <i>Unit Cost</i>	 <i>Total Cost</i>	 <i>\$/Bag</i>
Harvest				4.11
Bag** (50-lb)	1	0.36	0.36	
Labor	0.25	15.00	3.75	
Washing	1	0.50	0.50	0.50
Delivery	1	1.00	1.00	1.00
<i>Total cost</i>				<i>5.61</i>
 <i>Net Return</i>	 <i>Yield</i>	 <i>Sell Price</i>	 <i>Dollars</i>	 <i>Dollars</i>
Selling price			55.00	
Harvest and post-harvest cost			5.61	
Net selling price			49.39	
Yield per acre (407 bags)				
Adjusted revenue	407	49.39	20,101.73	
Production cost			3,150.00	
<i>Net revenue</i>				<i>16,951.73</i>

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

** Assumes that 30% of the bags are reused.

Table 2.5: Estimated cost and return associated with growing sweet corn in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (6 months)				300.00
Land preparation				125.00
Seeding				235.00
Seed (pounds)	5	8	40.00	
Labor (hours)	13	15	195.00	
Fertilization (300 lbs of N)				386.00
Labor (application)	2	50	100.00	
25-4-16 (50 lb bags)*	22	13	286.00	
Pest control (sprays)				210.00
Material (application)	2	30	60.00	
Labor (application)	3	50	150.00	
Weed control				305.00
Cultivation	2	135	270.00	
Herbicide	0.5	70	35.00	
<i>Total cost</i>				<i>1,561.00</i>
<i>Harvest and Post-Harvest</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Dozen</i>
Harvest				0.50
Labor	0.033	15.00	0.50	
Shuck and bag	0.1	15.00	1.50	1.50
Delivery			0.25	0.25
<i>Total cost</i>				<i>2.25</i>
<i>Net Return</i>	<i>Yield</i>	<i>Sell Price</i>	<i>Dollars</i>	<i>Dollars</i>
Selling price per dozen			7.00	
Harvest and post-harvest cost			2.25	
Net selling price			4.76	
Yield per acre (1,290 dozen)				
Adjusted revenue	1,290	4.76	6,133.95	
Production cost			1,561.00	
<i>Net revenue</i>				<i>4,572.95</i>

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

Table 2.6: Estimated cost and return associated with growing bananas in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (12 months)				600.00
Land preparation (\$350 per acre for 5 years)				70.00
Transplants				96.80
Trees (484 trees per acre, free)	0	0	0.00	
Labor (\$484 for 5 years)	484	1	96.80	
Fertilization				620.00
Labor (application)	3	50	150.00	
15-15-15 (50 lb bags)*	47	10	470.00	
Pest control (sprays)				0.00
Material (application)	0	0	0.00	
Labor (application)	0	0	0.00	
Weed control				80.00
Cultivation	0	0	0.00	
Herbicide	1	80	80.00	
<i>Total cost</i>				<i>1,466.80</i>
<i>Harvest and Post-Harvest</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Carton</i>
Harvest				1.36
Box (40-lb)	1	0.50	0.50	
Labor	0.5	15.00	7.50	
Ripening	1	1.25	1.25	1.25
Delivery	1	1.00	1.00	1.00
<i>Total cost</i>				<i>10.25</i>
<i>Net Return</i>	<i>Yield</i>	<i>Sell Price</i>	<i>Dollars</i>	<i>Dollars</i>
Selling price			33.00	
Harvest and post-harvest cost			10.25	
Net selling price			22.75	
Yield per acre (265 cartons)				
Adjusted revenue	265	22.75	6,028.75	
Production cost			1,466.80	
<i>Net revenue</i>				<i>4,561.95</i>

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

Table 2.7: Estimated cost and return associated with growing lettuce in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (4 months)				200.00
Land preparation				170.00
Transplants				1,008.00
Plants	40,000	0.0117	468.00	
Labor (hours)	36	15	540.00	
Fertilization				245.00
Labor (application)	1.5	50	75.00	
10-5-10 (50 lb bags)*	20	8.5	170.00	
Pest control (sprays)				140.00
Material (application)	2	20	40.00	
Labor (application)	2	50	100.00	
Weed control				900.00
Cultivation	60	15	900.00	
Herbicide	0	0	0.00	
<i>Total cost</i>				<i>2,663.00</i>
<i>Harvest and Post-Harvest</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Carton</i>
Harvest and box				2.50
Box (12 heads)	1	0.50	0.50	
Labor	1	2.00	2.00	
Storage	1	0.25	0.25	0.25
Delivery	1	1.00	1.00	1.00
<i>Total cost</i>				<i>3.75</i>
<i>Net Return</i>	<i>Yield</i>	<i>Sell Price</i>	<i>Dollars</i>	<i>Dollars</i>
Selling price			16.00	
Harvest and post-harvest cost			3.75	
Net selling price			12.25	
Yield per acre (323 bags)				
Adjusted revenue	629	12.25	7,705.25	
Production cost			2,663.00	
<i>Net revenue</i>				<i>5,042.25</i>

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

Table 2.8: Estimated cost and return associated with growing sweet potatoes in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (6 months)				300.00
Land preparation				125.00
Fertilization				0.00
Pest control (sprays)				70.00
Material (application)	1	20	20.00	
Labor (application)	1	50	50.00	
Weed control				135.00
Cultivation	1	135	135.00	
Herbicide	0	70	0.00	
<i>Total cost</i>				<i>630.00</i>
 <i>Harvest and Post-Harvest</i>	 <i>Quantity</i>	 <i>Unit Cost</i>	 <i>Total Cost</i>	 <i>\$/Bag</i>
Harvest and bag				1.36
Bag* (50-lb)	1	0.36	0.36	
Labor	1	1.00	1.00	
Washing	1	1.00	1.00	1.00
Delivery	1	1.00	1.00	1.00
<i>Total cost</i>				<i>3.36</i>
 <i>Net Return</i>	 <i>Yield</i>	 <i>Sell Price</i>	 <i>Dollars</i>	 <i>Dollars</i>
Selling price			50.00	
Harvest and post-harvest cost			3.36	
Net selling price			46.64	
Yield per acre (323 bags)				
Adjusted revenue	240	46.64	11,193.60	
Production cost			630.00	
<i>Net revenue</i>				<i>10,563.60</i>

* Assumes that 30% of the bags are reused.

Table 2.9: Estimated cost and return associated with growing onions in Bermuda.

<i>Production</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Acre</i>
Land rent (8 months)				400.00
Land preparation				125.00
Seeding				680.00
Seed	200,000	0.0007	140.00	
Labor (hours)	36	15	540.00	
Fertilization				300.00
Labor (application)	2	50	100.00	
15-15-15 (50 lb bags)*	20	10	200.00	
Pest control (sprays)				227.50
Material (application)	3.5	15	52.50	
Labor (application)	3.5	50	175.00	
Weed control				340.00
Cultivation	2	135	270.00	
Herbicide	1	70	70.00	
<i>Total cost</i>				2,072.50
<i>Harvest and Post-Harvest</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total Cost</i>	<i>\$/Bag</i>
Harvest and bag				2.86
Bag** (50-lb)	1	0.36	0.36	
Labor	1	2.50	2.50	
Sort	1	1.00	1.00	1.00
Delivery	1	1.00	1.00	1.00
<i>Total cost</i>				4.86
<i>Net Return</i>	<i>Yield</i>	<i>Sell Price</i>	<i>Dollars</i>	<i>Dollars</i>
Selling price			26.00	
Harvest and post-harvest cost			4.86	
Net selling price			20.04	
Yield per acre (560 bags)				
Adjusted revenue	560	21.14	11,838.40	
Production cost			2,072.50	
<i>Net revenue</i>				9,765.90

* Analysis of fertilizer used varied widely among farmers, but would not markedly influence production costs.

** Assumes that 30% of the bags are reused.

Section 3

Bermudian Agricultural Policy

The Government of Bermuda uses several different policies that affect the agricultural sector of the country. These include support of the Government Marketing Centre, the imposition of embargoes on selected produce items, application of tariffs on imported agricultural inputs, enforcement of sanitary and phytosanitary (SPS) regulations intended to prevent the importation of pests and/or diseases that might harm the environment and citizens of Bermuda, and recently, the opening of the Farmers' Market in Hamilton. In this section, these policies are discussed, and the likely impacts they have on agriculture and consumers are analyzed. The Farmers' Market is discussed in Section 5.

3.1 Agricultural Embargoes

The Government of Bermuda uses periodic embargoes of horticultural products as its main tool to protect domestic agricultural producers from imports. Agricultural produce imported when embargoes are not in effect is subject to an import duty ranging from 5 to 10 percent.

When Government establishes that the supply of local produce is sufficient to meet local demand, an embargo may be imposed. Producers must request that the embargo be imposed. The embargo remains in effect as long as Government can establish that local supplies are adequate. Personnel from the Government Marketing Centre are responsible for communicating with farmers and visiting farm sites to establish the existence of adequate local supplies. Importers and other produce buyers are notified of the imposition of an embargo via FAX on the Friday before the embargo is

to take effect the following Friday. Embargoes remain in effect for least one week and could stretch over several months. When an embargo is lifted, buyers are again notified via FAX on the Friday before the embargo is lifted the following Friday. The items embargoed during 1998, 1999, and 2000 and the duration of each embargo are shown in Tables 3.1-3.3.

The average number of weeks each item was on embargo over the three-year period 1998 through 2000 is shown in Table 3.4. Note that the average number of embargo weeks varies widely across commodities. Most of the specialty lettuces are on embargo for less than 10 weeks per year. Other products such as potatoes and pumpkin are on embargo for 20 or more weeks per year.

Each week, an embargo sheet issued by the Government Marketing Center identifies the items on embargo. An example of an embargo sheet is shown as Figure 3.1. As can be seen in Figure 3.1, at any particular point in time, several items may be on temporary embargo. Other items including carrots, sweet corn, and sweet potatoes are on year-round embargo. In the case of carrots, a pest known as the carrot rust fly is the reason for the embargo. Prevention of the importation of corn borers eliminates importation of sweet corn. Sweet potatoes are not imported because of concerns related to the sweet potato borer. Other items that may be imported in special circumstances include Florida citrus.

Also shown on the embargo sheet is a suggested price for each embargoed item. This price is based upon information provided to the Government Marketing Centre on the cost of imported produce of similar type. Conversations with produce purchasers indicate that most farmers insist that the price shown on the government embargo sheet

be the price of that produce item for that week. Therefore that price serves as an “administered price” and may not reflect current market conditions³. The fact that price may not adjust downward in times of large local supply likely results in local product not being harvested and ultimately plowed under.

The effect of the embargo is to guarantee a market for Bermudian produce. Given the strong demand for fresh produce from both households and food service, the embargo undoubtedly meets its primary objective. It does, however, have some unintended side effects. A primary problem mentioned by produce purchasers is the lack of a grading system in Bermuda. For example, with potatoes, a wide range of sizes is typically found in individual retail packs, such as five-pound poly bags in grocery stores. The price floor for potatoes is in force regardless of the size distribution of the potatoes. A related problem is that late in the harvest season, quality begins to deteriorate, but the price shown on the government embargo sheet remains in effect despite declining quality. With the embargo remaining in place, buyers are faced with little or no alternatives to obtain produce of sufficient quality to meet their needs.

3.2 The Government Marketing Centre

The Government Marketing Centre is a somewhat misnamed entity that provides several services to agricultural producers. These services include the purchase of potatoes under quota directly from farmers; storage of agricultural produce; procurement of agricultural inputs including seed, pesticides, cartons, and bags; production and sale of ice; banana ripening; and providing farmers with information related to agricultural production practices. Employees of the Centre are also responsible for imposition of the

³ There are indications that in time of heavy local supply, some farmers are willing to undercut the price

agricultural embargoes. When embargoes are in place, the Centre also serves a brokerage function in matching buyers and sellers of produce items.

3.2.1 Direct Purchase of Potatoes

The most direct involvement of Government in agriculture is through the direct purchase of potatoes. Farmers are allocated a quota based upon historical production levels. Government purchases potatoes directly from farmers for \$23.40 per 50-pound bag up to the quota allocated. Currently, the total quota is 10,000 bags. Government estimates that total production on the island averages 25,000 bags per year so that Government purchases account for approximately 40 percent of average annual production⁴.

After purchase, the bags are placed in cooled storage. After the harvest season ends, the embargo on imported potatoes remains until Government stocks are exhausted. Government sells potatoes for \$26.00 per bags, a markup of 11.1 percent over purchase cost (or 10 percent of the sales price.)

Buyers complain that potatoes purchased from storage may be of poor quality. Given the condition of the storerooms at the Government Marketing Centre, poor quality potatoes are more likely the result of potatoes of poor quality being placed into storage rather than mishandling by the Government Marketing Centre. It is possible, however, that for some reason, less than optimal storage conditions exist at the Government Marketing Centre, and measures need to be implemented that would improve the quality of stored potatoes.

shown on the embargo sheet for certain customers. The extent of this practice could not be documented.

⁴ Estimated potato production shown in Section 2 is nearly 30,000 bags per year so that the government potato purchase may represent approximately 34 percent of total production.

Government storage of potatoes serves a useful function with respect to the Bermudian potato market. Given the large level of production, if potatoes were not stored, prices would be likely be severely depressed during the harvest season. The effect of the Government purchase is to smooth out potato supply and limit seasonal price fluctuations. In fact, since the Government price of \$26 per bag appears to prevail throughout the embargo period, price variability has been essentially eliminated. In the long-run, steady prices benefit both producers and consumers.

3.2.2 Storage of Agricultural Produce

Producers can make use of facilities at the Government Marketing Centre for cold storage. Products stored include broccoli, cauliflower, cabbage, carrots, tomatoes, peppers, and potatoes (not purchased under Government quota). The Marketing Centre charges \$.66 per pallet per day for storage.

This practice provides a useful function for agricultural producers at an attractive price. Both the fixed and variable costs associated with cold storage are high. There are also significant economies of scale associated with cold storage as larger facilities can take advantage of inherent cost savings through better insulation. The potato storage rooms are also unused several months per year and leasing this space to individual growers makes good economic use of these rooms. Furthermore, storage serves to extend the marketing season and helps smooth short-run supply fluctuations that could result in a high level of short-term price variability.

All of the large farmers have privately owned cold storage. Their storage facilities, however, are limited in capacity. Most of space is used for short-term storage including chilling of recently harvested product.

3.2.3 Input Procurement

The Government Marketing Centre serves as a procurement agent for several agricultural inputs. The Marketing Centre imports seed, pesticides, bags for potatoes and onions, and cartons for other produce products. These products are imported in bulk and sold to farmers at 10 percent over landed cost. The Marketing Centre also stores these products in appropriate storage facilities.

Many of the larger producers import seed for their own use. The Marketing Centre does not deal with fertilizer, potting soil, and other bulk items. Farmers must import spare parts for machinery, irrigation supplies, and potting trays directly.

The role of the Marketing Centre in agricultural input procurement is one that makes a great deal of sense, especially given the size of agriculture in Bermuda and the high cost of transportation. The Marketing Centre is likely obtaining better prices than would individual farmers by buying in bulk and can more efficiently make use of the container needed for shipment. Centralized storage provided by the Marketing Centre reduces per unit storage costs.

A major drawback of this system is that it may reduce the likelihood of innovation by individual farmers. One farmer pointed out that he had identified a new variety of a particular product. When he asked the Marketing Centre to procure that new variety, the Centre indicated that it must make it available to all farmers on the island. As a result, there was overproduction of that product and the farmer was not rewarded for his innovation.

The Government Marketing Centre also supplies ice to farmers at a cost of \$.10 per pound. This ice is used to cool highly perishable items such as broccoli. Clearly, the provision of this service serves to decrease production costs.

3.2.4 Banana-Ripening

The Government Marketing Centre has a banana ripening room. It offers banana-ripening services at a cost of \$1.25 per 40-pound carton. Given the large number of small banana growers on the island, it would be impractical for each grower to have his/her own banana-ripening facility. Banana ripening performed by trained staff in a properly equipped facility reduces the cost of supplying ripened banana to consumers.

3.2.5 Source of Agricultural Information

The Government Marketing Centre serves as a source of information on production of horticultural commodities. The role that it serves in this function is limited, however, by the small staff of the Government Marketing Centre. Currently, there are two professional employees at the Marketing Centre. These two employees spend the majority of their time dealing with the agricultural embargoes. While these staff members periodically attend seminars in the United States, the amount of time available for providing education related to innovative production practices is minimal.

The Marketing Centre could greatly expand its ability to provide know how to agricultural producers with more staff. It is likely that at least one additional professional staff member is needed whose prime role would be to provide extension services to agricultural producers. These services could include diagnoses of production problems

and introduction of new practices from other production regions through field demonstrations.

3.2.6 Produce Brokerage Services

As noted in Section 2, large produce buyers typically form relationships with one or two large farmers. These farmers become the supplier of choice for that buyer. During the local harvest season, the buyer depends upon these farmers to supply a wide array of products. With the lack of public information related to the local supply of individual produce items, local buyers often look to the Government Marketing Centre to help locate specific products. This role becomes even more important when embargoes are in place because imported product is not available.

The Government Marketing Centre is in a unique position to play this role given the manner in which the embargoes are imposed. Remember that farmers contact the Government Marketing Centre to indicate that their product is ready for market as a prelude to the imposition or maintenance of an embargo. Therefore, if a buyer's prime supplier(s) does not have the product available, the Marketing Centre is the logical source for information on which farmers would have that product. The buyer can call the Marketing Centre and obtain the information. It may be the case that the desired product is stored at the Marketing Centre. For this service, the Marketing Centre collects no fee other than the cost of storage. In some instances, the Marketing Centre does take ownership of agricultural products other than potatoes. In this case, a 10 percent brokerage fee is charged for this service.

3.3 Imposition of Tariffs on Agricultural Inputs

A primary limitation facing agricultural producers in Bermuda is that nearly all agricultural inputs must be imported. To some extent, the Government Marketing Centre simplifies this process through its importation of seed, pesticides, bags, and cartons. There are other inputs, however, that farmers require to produce crops. These items include machinery, spare parts, fuel and lubricants, fertilizer, PVC pipe for irrigation, plastic trays for transplant production, and materials for greenhouse construction and maintenance. For all of these items listed, producers must pay the full tariff identified on the Bermudian import tariff schedule. This practice runs contrary to that found in most other countries where agriculture is provided an exemption to most taxation except income and property taxes.

The logic behind tax exemption for agriculture is to promote domestic agricultural production and reduce the cost of food for the general public. As taxes of any sort raise the cost of production, ultimately higher prices will result for food products.

A related issue is the cost associated with agricultural labor. Most agricultural producers in Bermuda depend upon imported labor. These workers come from the Caribbean, the Philippines, and the Azores. Employers must pay an annual fee of \$560 per worker⁵ to Government to obtain the proper documentation. In addition, employers must advertise locally to insure that there are no Bermudian citizens willing to accept farm work. Advertisement costs between \$250 and \$400. Hence, farmers are faced with an additional charge in excess of \$800 per worker just to obtain proper documentation from immigration.

⁵ The fee charged is not tied to the wage paid to the employee. Thus the fee paid when employing a professional such as an accountant or lawyer is the same as that paid for farm workers.

3.4 Phytosanitary Standards

With its tropical climate, Bermuda is vulnerable to importation of pests and diseases that could thrive and result in significant damage to its ecosystem. At the present, several items are on permanent embargo. These items are listed in Table 3.4 and also identified on the weekly Government embargo sheet, an example of which is shown as Figure 3.1. The year-round embargoes imposed in carrots, sweet corn, and sweet potatoes clearly benefit Bermudian farmers. As noted in Section 2, these three crops are among the most profitable grown by farmers in Bermuda. There may be scientific support for the year-round embargoes imposed on these crops, but this issue needs periodic review to ensure that a legitimate threat exists and that the phytosanitary embargoes are not simply acting as a technical barrier to imports.

3.5 The Impact of Produce Embargoes on Product Availability and Price

To evaluate the impact of produce embargoes on Bermudian horticultural markets, two data gathering exercises were completed. First, the average monthly wholesale price for selected produce items was estimated. This was accomplished by averaging the weekly prices sheets provided by Amaral's Produce and Butterfield and Vallis to the Government Marketing Centre over the year 2001. The results are shown in Table 3.5.

Second, all produce importers in Bermuda were identified and data was collected on their produce imports. The companies contacted are shown in Table 4.1 in Section 4. They include the major retailers on the island: Market Place, Lindo's, and White's and other produce importers: Butterfield and Vallis, Dunkley's Dairy, Amaral's Produce, and Atlantic Imports. In some cases, actual import data was provided. In other cases,

estimates of produce imports by item and month were provided. These numbers were aggregated and are presented in Table 3.6. Please note that data from various importers covered the period from 1999 through the first part of 2002. Thus small levels of importation are shown for individual products even though embargoes were imposed for part of the month.

In this section, an assessment of the impact of the embargo system is presented. This assessment is not conducted with statistical methods, as insufficient data are available. A qualitative assessment is possible, however, by examining the impact of the imposition of an embargo on wholesale prices and product availability.

To compare the produce market in Bermuda with and without embargoes, estimated domestic production of selected produce items was considered as reported in Table 2.1. The average number of weeks that a particular production is on embargo is shown in Table 3.4. Dividing estimated local production by average embargo weeks gives a rough estimate of the volume of local produce available during the embargoes. It is acknowledged that some local product is marketed outside of the embargo period, so that this calculation likely overestimates the volume of local produce available during embargoes. These numbers are shown in Table 3.7.

Also shown in Table 3.7 are import volumes of selected produce products in the month before embargoes are generally imposed and the month after embargoes are lifted. This approach was used in an attempt to account for seasonality of demand for most of the products considered. Bermuda's population does exhibit some seasonal variation, and tastes and preferences for some produce products also show some change across seasons.

The figures shown in Table 3.7 provide some surprising results. For all products shown, only spinach shows a decrease in availability when an embargo is imposed. For other products such as onions, romaine, tomatoes, and potatoes, availability of local produce is near or slightly larger than imports. The level of green peppers locally available is approximately 50 percent higher than imports before and after the embargo is lifted. If imports of red and yellow peppers are included, then imports outside of embargo are comparable to local production during embargo. For iceberg lettuce, local production is nearly double imports. In the case of iceberg lettuce, the rise of popularity of bagged salad mixes might explain, in part, why imports of iceberg lettuce are not higher. Cabbage is similar to iceberg lettuce in that local production under embargo is nearly double imports. Again, import of cole slaw may explain part of this difference. For both winter and summer squash, local production is approximately two and one-half times imports before and after the embargo is in effect.

The difference between local availability and imports is largest, however, for broccoli, cauliflower, and pumpkin. In the case of pumpkin, retailers generally indicated a strong preference for locally produced pumpkin over imports from Jamaica. Pumpkin consumption is generally consumed in soups and stews that are more popular in the cool season when local production is available.

The fact, however, that estimated local production of broccoli is approximately two times higher than imports and that availability from local production of cauliflower is five times higher is both surprising and not easy to explain. There is importation of organic broccoli that may not be included in the import data. There may also be significant importation of frozen broccoli which is not included here. Both broccoli and

cauliflower may also be produced in periods when embargoes are not imposed, although farmers indicated that crucifer production declines as temperatures increase in the late spring and an adjustment has been made in attempt to account for production outside of the embargo period.

The clear conclusion to be drawn from the data presented in Table 3.7 is that imposition of the embargoes does not adversely affect the availability of produce in Bermuda. If the embargoes do not have an adverse effect on supply, what is their impact? More importantly, why is there such widespread opposition to embargoes among produce buyers in Bermuda? The answers to these questions are twofold. First, the imposition of an embargo has the immediate effect of limiting the choices available to produce buyers. Second, is that when an embargo is imposed, the Government Marketing Centre also issues an embargo sheet in which “recommended” prices are shown (Figure 3.1). Even though potatoes may represent an extreme case, the wholesale price that prevails in Bermuda is that shown on the Government Market Centre price. Though unintended, the prices shown on the Government Marketing Centre embargo sheet become “administered prices.” In other words, these prices become the minimum price at which farmers are willing to sell their product. In times of extreme oversupply, some farmers may choose to undercut the price shown on the embargo sheet, but these discounts usually remain in place for short periods of time.

The implication of administered prices is that even though farmers are “protected” from import competition because of the presence of embargoes, the true benefit of the embargo system is that a price floor is established for a particular product. With some exceptions, farmers are guaranteed the price shown on the embargo sheet. The negative

effect of this arrangement is that price cannot adjust to local supply and demand conditions. This will lead to short periods of both under and over supply because the price adjustment process is not able to perform its function of balancing supply with demand.

Table 3.1.d: 1998 embargo dates.

Dates imply "the week of" (e.g., Jan4 implies January 4 to 10). B = begin embargo. E = end embargo. X = embargo continues for entire week.

Product	Oct11	Oct18	Oct25	Nov01	Nov08	Nov15	Nov22	Nov29	Dec06	Dec13	Dec20	Dec27	Total
Beans, Green													5
Broccoli								B	X	X	X	X	17
Cabbage, Green													19
Cauliflower													5
Celery													6
Coleslaw													18
Cucumbers	X	X	X	X	X	X	E						24
Cucumbers, English				B	X	X	X	X	X	X	X	X	27
Eggplant	B	X	X	X	X	X	X	X	X	E			15
Lettuce, Grn Boston													13
Lettuce, Grn Oakleaf													0
Lettuce, Greenleaf										B	X	E	14
Lettuce, Iceberg													3
Lettuce, Redleaf							B	X	X	X	X	X	20
Lettuce, Romaine							B	X	E				15
Lettuce, Red Boston													10
Lettuce, Red Oakleaf													0
Onions, Yellow													8
Parsley (not Italian)									B	X	X	X	21
Peppers, Green		B	X	X	X	X	X	E,B	X	X	E		11
Potatoes, Red & White													22
Potatoes, Russets													19
Pumpkin	X	X	X	X	X	X	X	X	X	X	X	X	23
Radicchio													23
Spinach								B	X	X	X	X	14
Squash, Butternut													9
Squash, Zucchini													12
Strawberries													0
Tomatoes, Cherry Red	E	E											13
Tomatoes, Plum&VnRp													13
Turnip, Yellow										B	X	X	5

Table 3.2.a: 1999 embargo dates.

Dates imply "the week of" (e.g., Jan3 implies January 3 to 9). B = begin embargo. E = end embargo. X = embargo continues for entire week.

Product	Jan03	Jan10	Jan17	Jan24	Jan31	Feb07	Feb14	Feb21	Feb28	Mar07	Mar14	Mar21	Mar28	Apr04
Beans, Green														
Broccoli	X	X	X	E				B	X	X	E		B	X
Cabbage, Green	X	X	X	X	X	E			B	X	X	X	X	X
Cauliflower	X	X	X	X	E						B	X	X	X
Celery														
Coleslaw	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cucumbers														
Cucumbers, English	X	X	E		B	X	E						B	X
Eggplant														
Lettuce, Grn Boston														
Lettuce, Grn Oakleaf									B	X	E			
Lettuce, Greenleaf						B	X	X	X	X	X	X	X	X
Lettuce, Iceberg														
Lettuce, Redleaf	X	E				B	X	X	X	X	X	X	X	X
Lettuce, Romaine					B	X	E		B	X	X	X	X	X
Lettuce, Red Boston														
Lettuce, Red Oakleaf														
Onions, Yellow														
Parsley	X	X	X	E					B	X	X	X	X	X
Peppers, Green														
Potato, Red & White												B	X	X
Potato, Yukon Gold												B	X	X
Pumpkin	X	X	X	X	X	X	X	X	E					
Radicchio	B	X	X	X	X	X	X	X	X	X	X	X		X
Spinach	X	E							B	X	X	X	X	X
Squash, Butternut													X	
Squash, Zucchini														
Strawberries														B
Tomato, Cherry Red	X	X	X	X	X	E								
Tomato, Plum&VnRp		B	X	X	X	X	E							
Turnip, Yellow	X	X	E						B	X	X	E		

Table 3.3.a: 2000 embargo dates.

Dates imply "the week of" (e.g., Jan2 implies January 2 to 8). B = begin embargo. E = end embargo. X = embargo continues for entire week.

Product	Jan02	Jan09	Jan16	Jan23	Jan30	Feb06	Feb13	Feb20	Feb27	Mar05	Mar12	Mar19	Mar26
Beans, Green													
Broccoli	B	X	X	X	X	X	X	X	X	X	X	X	X
Cabbage, Green					B	X	X	X	X	X	X	X	X
Cauliflower	B	X	X	X	E	B	X	X	X	X	X	X	E
Celery													
Coleslaw	B	X	E										
Cucumbers													
Cucumbers, English	B	X	E										
Eggplant						B	X	X	E				
Lettuce, Grn Boston	B	X	E						B	X	X	X	X
Lettuce, Grn Oakleaf													
Lettuce, Greenleaf			B	X	X	X	X	X	X	X	E		
Lettuce, Iceberg													
Lettuce, Redleaf		B	X	X	X	X	X	X	X	X	X	X	X
Lettuce, Romaine	B	E		B	X	X	X	X	X	X	X	X	X
Lettuce, Red Boston								B	X	X	X	X	X
Lettuce, Red Oakleaf													
Onions, Yellow													
Parsley (not Italian)	B	X	X	X	X	X	X	X	X	X	X	X	X
Peppers, Green													
Potato, Red & White										B	X	X	X
Potato, Yukon Gold													
Pumpkin	B	E											
Radicchio		B	X	X	X	X	X	X	X	X	X	X	X
Spinach	B	X	X	X	E				B	X	X	X	X
Squash, Butternut													
Squash, Zucchini													
Strawberries													
Tomato, Cherry								B	X	X	E		
Tomato, Plum&VnRp		B	X	X	X	E			X				
Turnip, Yellow				B	X	X	X	X		E			

Table 3.3.b: 2000 embargo dates

Dates imply "the week of" (e.g., Jan2 implies January 2 to 8). B = begin embargo. E = end embargo. X = embargo continues for entire week.

Product	Apr02	Apr09	Apr16	Apr23	Apr30	May07	May14	May21	May28	Jun04	Jun11	Jun18	Jun25
Beans, Green						B	X	X	X	E			
Broccoli	X	E		B	X	X	X	X	E				
Cabbage, Green	X	X	E	B	X	X	X	X	X	X	E		
Cauliflower		B	X	X	E								
Celery				B	X	X	X	X	E				
Coleslaw													
Cucumbers							B	X	X	X	E		
Cucumbers, English													B
Eggplant												B	X
Lettuce, Grn Boston	X	X	X	X	X	E							
Lettuce, Grn Oakleaf													
Lettuce, Greenleaf					B	E							
Lettuce, Iceberg	B	X	X	X	X	E							
Lettuce, Redleaf	X	X	X	X	X	X	X	X	X	E			
Lettuce, Romaine	X	X	X	X	X	X	X	X	E				
Lettuce, Red Boston	X	X	X	X	E								
Lettuce, Red Oakleaf													
Onions, Yellow							B	X	X	X	X	X	X
Parsley (not Italian)	X	X	X	X	X	X	X	X	E				
Peppers, Green													B
Potato, Red & White	X	X	X	X	X	X	X	X	X	X	X	X	X
Potato, Yukon Gold				B	X	X	X	X	X	X	X	X	X
Pumpkin													
Radicchio	X	X	E										
Spinach	X	X	X	X	E								
Squash, Butternut										B	X	X	E
Squash, Zucchini	B	X	X	X	X	X	X	X	X	X	X	X	X
Strawberries	B	E											
Tomato, Cherry					B	X	X	X	X	X	X	X	X
Tomato, Plum&VnRp					B	X	X	X	X	X	X	X	E,B
Turnip, Yellow	B	X	X	X	X	X	E						

Table 3.4. Number of weeks on embargo, by commodity and year.

	1998	1999	2000	Avg Week
Beans, Green	5	6	4	5
Broccoli	17	18	19	18
Cabbage, Green	19	25	17	20
Cauliflower	5	17	16	13
Celery	6	2	4	4
Coleslaw	18	27	4	16
Cucumbers	24	16	11	17
Cucumbers, English	27	15	10	17
Eggplant	15	14	25	18
Lettuce, Grn Boston	13	3	12	9
Lettuce, Grn Oakleaf	0	17	1	6
Lettuce, Greenleaf	14	4	8	9
Lettuce, Iceberg	3	4	6	4
Lettuce, Redleaf	20	19	20	20
Lettuce, Romaine	15	16	20	17
Lettuce, Red Boston	10	4	11	8
Lettuce, Red Oakleaf	0	6	1	2
Onions, Yellow	8	5	8	7
Parsley	21	17	22	20
Peppers, Green	11	11	8	10
Potatoes, Red & White	22	24	22	23
Potatoes, Russets or Yukon Gold	19	11	32	21
Pumpkin	23	15	23	20
Radicchio	23	16	14	18
Spinach	14	18	14	15
Squash, Butternut	9	10	7	9
Squash, Zucchini	12	12	14	13
Strawberries	0	3	1	1
Tomatoes, Cherry	13	23	18	18
Tomatoes, Plum&VnRp	13	18	19	17
Turnip, Yellow	5	16	11	11

**DEPARTMENT OF CONSERVATION SERVICES
GOVERNMENT MARKETING CENTRE**

TEL. 292-4611/292-4356 P.O. BOX CR 52, CRAWL, CRBX FAX 292-1967

JUNE 30- JULY 6, 2002

COMMODITY	UNT	PRICE	EMBARGO ON
ANISE (Off Sunday July 7, 2002)	LB	\$ 1.35	3-Jun-02
*BEETS(LOOSE)	LB	\$ 0.80	15-Mar-02
*CUCUMBERS, ENGLISH	DZ	\$ 20.00	17-Jun-02
DAIKON	LB	\$ 1.60	26-Apr-02
LEEKs	DZ	\$ 36.00	5-Apr-02
*PEPPERS, GREEN (BELL)	LB	\$ 1.20	24-Jun-02
PEPPERS, JALAPENO	LB	\$ 2.50	24-Jun-02
*POTATOES, RED & WHITE SKIN TABLE	BAG	\$ 26.00	1-Apr-02
*POTATOES, CREAMERS (RED & WHITE)	BAG	\$ 36.00	19-Apr-02
POTATOES, RUSSETS	BAG	MKT	17-May-02
POTATOES, YUKON GOLD	BAG	\$ 32.00	17-May-02
POTATOES, CREAMERS (YUKON GOLD)	BAG	MKT	24-May-02
*PUMPKIN	LB	\$ 0.90	21-Jun-02
SQUASH, ZUCCHIN	LB	\$ 1.35	24-Jun-02
TOMATOES, CHERRY(RED)	BX	\$ 24.00	10-May-02
TOMATOES, CHERRY (YELLOW)	BX	\$ 30.00	28-Jun-02
*TOMATOES, GRAPE	BX	MKT	17-Jun-02
*TOMATOES, ALL RED	BX	MKT	10-Jun-02
TURNIP, PURPLE TOP	LB	\$ 0.90	22-Mar-02
TURNIP, WHITE	LB	\$ 0.90	7-Jun-02
BASIL	DZ	\$ 18.00	14-Jun-02
CHIVES,GARLIC	DZ	\$ 18.00	15-Apr-96
MINT	DZ	\$ 18.00	12-Apr-02
OREGANO	DZ	\$ 18.00	28-Aug-96
THYME	DZ	\$ 12.00	21-Jun-02
READILY AVAILABLE:			
ORANGE FLESH SWEET POTATOES (YAMS)	LB	MKT	PERMANENT EMBARGO
CARROTS	LB	MKT	PERMANENT EMBARGO

EMBARGOES ON:

TOMATOES, YELLOW CHERRY - FRIDAY JUNE 28, 2002

EMBARGOES OFF:

CABBAGE, GREEN - THURSDAY JUNE 27, 2002

ONIONS, JUMBO - THURSDAY JUNE 27, 2002

STARGAZER LILIES - THURSDAY JUNE 27, 2002

CUCUMBERS - SUNDAY JUNE 30, 2002

SQUASH, YELLOW - SUNDAY JUNE 30, 2002

TOMATOES, PLUM (ITALIAN OR ROMA) - SUNDAY JUNE 30, 2002

ANISE - SUNDAY JULY 7, 2002

JUNE 30 - JULY 6, 2002

IMPORTANT INFORMATION

The information contained on this page may change weekly. Please be aware of any changes to the embargo clarifications and plant quarantine regulations.

If you or your supplier is unsure if an item is allowed to be imported when an embargo is imposed please consult with this Department. If changes or clarifications are made concerning plant quarantine or other prohibited items, a letter from the Department of Conservation Services may follow this notification. Please keep records of these notices for future reference.

EMBARGO CLARIFICATIONS

- **BEETS LOOSE DOES NOT INCLUDE BUNCHED BEETS**
- **PEPPERS, GREEN INCLUDES SUNTAN PEPPERS**
 - **POTATOES (RED & WHITE SKIN) INCLUDES RED AND WHITE SKIN TABLE POTATOES, BULK POTATOES AND 5 LB BAGS. POTATOES, CREAMERS (RED & WHITE) INCLUDES BULK BAGS AND SMALLER CONSUMER PACKS. POTATOES, RUSSETS (BAKING POTATOES) INCLUDES ONLY 5 LB BAGS AND LOOSE COUNT (70, 80, 100, etc.). IT DOES NOT INCLUDE FOIL WRAPPED BAKING POTATOES.**
 - **TOMATOES, ALL RED INCLUDES VINERIPES, VINE SELECT, BEEFSTEAK VINERIPE, TOMATOES ON THE VINE (CLUSTER TOMATOES). IT ALSO INCLUDES INDUSTRIAL PACK TOMATOES EX. 5X6, 6X6, 6X7.**
 - **TOMATOES, GRAPE - INCLUDES BULK AND SMALLER CONSUMER PACKS**
 - **ENGLISH CUCUMBERS ARE ALSO KNOWN AS SEEDLESS OR BURPLESS CUCUMBERS**
 - **PUMPKIN INCLUDES WEST INDIAN PUMPKIN AND CALABAZA**

2. ORGANIC AND BABY PRODUCE:

EMBARGOED ITEMS THAT ARE CLASSIFIED AS "ORGANIC" OR "BABY" ARE ALLOWED TO BE IMPORTED EXCEPT CARROTS, CORN AND SWEET POTATOES OR UNLESS OTHERWISE STATED IN THE CLARIFICATION.

3. QUARANTINE EMBARGOES:

- **CARROTS, CORN AND SWEET POTATO ARE ON *PERMANENT QUARANTINE EMBARGO.***
 - **The only fresh product allowed of these items is SHREDDED or CUT *CARROTS* that are no larger than 2mm in diameter or approved by the Department of Environmental Protection.**
- **NORTH AMERICAN 'YAMS' ARE ACTUALLY SWEET POTATOES AND ARE NOT ALLOWED ENTRY.**
- **JAMAICAN MANGOES, CITRUS AND SOFT FRUITS FROM OTHER HIGH RISK COUNTRIES ARE ON EMBARGO UNTIL FURTHER NOTICE.**
- **ORNAMENTAL OR INDIAN CORN IS PROHIBITED.**

Table 3.5.a: Prices for selected produce items in Bermuda, 2001.

Product	Jan02	Jan08	Jan15	Jan22	Jan29	Feb05	Feb12	Feb19	Feb26	Mar05	Mar12	Mar19	Mar26
Bananas	27.85	27.85	27.85	27.85	27.85	27.6	27.4	28.8	31	33.15	32.2	29.8	30.25
Broccoli	33.8	24.9	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75	30
Cabbage, Green	22.5	22.5	22.5	22.5	22.5	24.5	24.5	24.5	22.5	22.5	22.5	22.5	22.5
Cauliflower	19.2	19.2	19.2	19.2	19.2	23.2	19.2	19.2	19.2	19.2	23.8	24	23
Cucumbers, English	20.5	20.3	20.5	21.05	25.9	24.5	24.5	24.5	24.5	25.35	20.3	20.3	20
Lettuce, Iceberg	36	38.05	36	34.6	41.8	37.4	37.4	37.4	45.7	50.7	45.7	43.5	35
Lettuce, Romaine	73.2	31	31	59.3	59.3	34	45	34	34	34	34	34	34
Onions, Yellow	22.4	22.4	22.4	22.8	26.5	26.5	26.5	26.5	26.5	24	26.5	26.5	26.5
Peppers, Green	30	58.5	46.7	59.3	61	59.6	50	43	47	44.4	43	43	43.5
Potato, Red & White	20.85	20.85	20.85	22.8	20.85	20.85	20.85	20.85	20.85	21	20.85	20.85	21
Potato, Yukon Gold	24	37.8	24	56.8	37.8	73.2	30.6	32.4	24	24	24	24	24
Pumpkin	45	45.6	45	20.85	65	65	65	65	65	59.5	54	65	65
Spinach	17.4	18.1	18.8	37.8	20.2	14	16	16.6	15.5	15	14	14	14
Squash, Zucchini	20	22	24.2	46.2	26	26	26	26	19	19.5	20	20	19.25
Strawberries	49.5	51.85	48.5	18.8	35.5	34	33.45	33.45	33.8	34.15	39.2	43.1	28.95
Tomato, Cherry	24	23.25	22	39.2	30	30	27	28	22	23.35	22	22	30.25
Tomato, Plum&VnRp	24	30	26	34.5	28.5	28.5	28.5	28.5	28.5	26.1	26.5	29.5	41.4

Table 3.5.b: 2001 Bermuda produce prices.

Product	Apr02	Apr09	Apr116	Apr23	Apr30	May07	May14	May21	May28	Jun04	Jun11	Jun18	Jun25
Bananas	27.4	28.35	27.4	27.4	28.35	33.15	31.7	31.2	31.2	31.2	31.2	29.3	25.95
Broccoli	21.5	33.75	33.75	33.75	33.75	33.75	33.75	33.75	28	23.5	22.5	22.5	23
Cabbage, Green	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	23.25
Cauliflower	22	23	19.2	19.2	19.2	19.2	19.2	21.2	23.2	23.5	22.5	26	35.4
Cucumbers, English	20	20	20	20	20	20	20	17.75	15.5	20	20	20	20
Lettuce, Iceberg	28	30	33	30	30	30	49.9	38	33	33	34.6	34	32
Lettuce, Romaine	34	34	34	34	34	34	34	34	34	34	34	30	30
Onions, Yellow	26.5	26	26	26	26	26	26	26	26	26	26	26	26
Peppers, Green	37	20	22	23.5	25	25	33	29	21.5	21.5	22	22	28.75
Potato, Red & White	19.85	25	25	25	25	25	25	25	25	25	25	25	25
Potato, Yukon Gold	24	24	24	24	24	24	24	30	30	30	30	30	30
Pumpkin	65	65	65	65	65	65	65	65	65	65	65	65	53.4
Spinach	14	14	14	14	14	14	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Squash, Zucchini	18.5	24	24	24	24	24	24	24	24	24	24	24	24
Strawberries	32.15	33.45	50	50	54/45	23.35	22.05	21.35	21.35	26.5	28.4	28.4	24.5
Tomato, Cherry	27	27	21	19.5	18	18	19	25	25	25	25	25	25
Tomato, Plum&VnRp	35	29	25	22.75	20.5	20.5	23	26	27.5	27.5	27.5	27.5	27.5

Table 3.5.d: 2001 Bermuda produce prices.

Product	Oct01	Oct08	Oct15	Oct22	Oct29	Nov05	Nov12	Nov19	Nov26	Dec03	Dec10	Dec17	Dec24	Weight or Count
Bananas	28.6	27.4	26.4	25.95	25.95	24	26.4	27.4	28.6	29.8	29.8	29.8	29.8	25lb
Broccoli	22	20	19.5	19.5	19.5	19	19	20.5	20.5	20.5	20.5	25	33.75	14ct
Cabbage, Green	24	23.5	23.5	23	23	23	23	23	23	22.5	22.5	22.5	22.5	50lb
Cauliflower	25	24.5	24.5	24	24	24	24	24	25.5	24.5	27	19.2	19.2	16
Cucumbers, English	16.1	16.1	16.1	16.1	16.1	20	15.5	15.5	18.9	18.9	18.9	20.5	23.1	12ct
Lettuce, Iceberg	37	33	30.5	30.5	30.5	29.5	29.5	29.5	31	30	32	29.5	47.1	24ct
Lettuce, Romaine	31	31	30	33	28	28	28	28	30	30	30	32	34	24ct
Onions, Yellow	27	27	27	27	27	26	26	26	26	26	26	26	26	8
Peppers, Green	28.75	28.75		21	21	21	20	20	20	21	21	21	21	25lb
Potato, Red & White	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	50lb
Potato, Yukon Gold	35	35	27	27	27	27	27	27	27	27	27	27	27	50lb
Pumpkin	45	45	45	45	45	45	45	45	45	45	45	45	45	50lb
Spinach	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	5lb
Squash, Zucchini	16.5	16	16.5	16.5	16	16	16	19	18	16	21.6	24.3	27	16lb
Strawberries	44.95	39.75	43.1	26.5	26.5	26.5	34.15	43.1	60.6	55	53.9	43.65	44.95	Flat
Tomato, Cherry	23.9	23.9	26.7	33.7	33.7	33.7	29.5	29.5	30.9	30.9	30.9	30.2	29.5	12pts
Tomato, Plum&VnRp	21	22	25	25	24	24.5	24.5	24.5	24	23	23	22.75	22.5	25lb

Table 3.6 Imports of selected produce items into Bermuda.

	January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.
	-----pounds-----										
Bananas	117114	116367	135676	119083	115990	143509	120340	131460	114600	119283	133727
Broccoli	12448	4915	5082	6530	6167	38766	34562	38697	37694	38534	37595
Cabbage	30179	29677	15165	14299	13652	31022	53081	53004	46213	49917	44114
Cauliflower	12346	7207	14862	9545	12182	20589	21430	21948	20715	22660	19056
English Cucumbers	8706	8753	10593	7411	11311	6373	14155	4850	3483	13825	12078
Iceberg lettuce	42958	38951	37497	22431	47533	63029	58459	64168	57419	60426	39549
Romaine	29300	17426	18489	513	20519	55343	59599	54612	48324	45525	38921
Onions	63444	77672	97240	55311	32615	30864	67083	65353	58778	69628	88982
Green peppers	20284	19788	21990	23838	23565	24184	7647	6551	8370	16005	17217
Red/yellow peppers	7900	9138	9177	9741	9028	9534	8317	7043	5633	5226	5290
Red/white potatoes	37918	32200	37503	33040	22287	20200	21100	21223	27820	28910	30623
Russett potatoes	182963	211520	244677	102423	26876	3903	3233	33555	202195	255323	206808
Yukon gold potatoes	18625	17400	18338	11458	6083	3200	1375	3325	5925	14125	14800
Pumpkin	0	15901	19093	18408	17758	19015	6969	0	2238	2434	0
Spinach	2241	1487	1213	1084	1697	3042	3452	3257	2650	2798	2811
Summer/winter squash	10569	10325	12234	10073	5446	7414	12569	14703	13449	14867	13298
Strawberries	9952	8490	30305	9688	19919	21530	20653	24715	14524	13612	9696
Tomatoes 6x6, 5x6	38662	34687	43898	44931	37078	4390	9423	38635	45627	51309	42607
Cherry tomatoes	1173	1301	1665	2006	1611	865	1121	1831	1661	1889	1495
Other tomatoes	5812	3828	4855	5052	4306	3517	6909	5937	8783	12580	9540

Table 3.7. Estimated production per week under embargo by commodity and comparison with imports.

Crop	Avg. Embargo Weeks	Total Local Prod.	Estimated Prod. ^a During Embargo	Avg. Prod. Per Week	Imports Before Embargo	Imports After Embargo
-----pounds-----						
Broccoli	18	328,790	279,471	15,526	6,490	9,230
Cabbage, Green	20	380,900	323,765	16,188	7,419	12,638
Cauliflower	13	276,615	235,122	18,086	2,940	4,902
Lettuce, Iceberg	4	98,411	83,649	20,912	10,228	15,007
Lettuce, Romaine	17	221,537	188,306	11,077	8,018	13,177
Onions, Yellow	7	184,204	156,573	22,368	23,152	15,972
Peppers, Green	10	78,429	66,665	6,666	5,758	4,099
Potatoes, Red & White	23	1,320,350	1,188,315	51,666	15,714	56,176
Pumpkin	20	279,298	237,403	11,870	4,527	3,975
Spinach	15	6,194	5,265	351	534	803
Squash, Butternut	9	83,000	74,700	8,300	3,458	2,913
Squash, Zucchini	13	100,000	80,000	6,154	2,398	3,419
Tomatoes, Plum&VnRp	17	223,315	178,652	10,509	9,853	12,955

^a Based upon estimates provided by the Government Marketing Centre.

Section 4

Marketing Channels for Bermudian Produce

Since produce is supplied to Bermuda through both import and domestic suppliers, it is important to distinguish the channels through which produce are marketed. The fact that these channels change when embargoes are imposed is a source of frustration to importers, retailers, and food service entities.

4.1 Marketing Channels for Imported Versus Domestic Produce

The marketing channel for imported produce is shown in Figure 4.1. The central player in this marketing system is the produce wholesaler/importer. A list of wholesalers is shown in Table 4.1. Although Butterfield and Vallis is the largest wholesaler, all companies operate in a similar fashion. They form a relationship with a produce wholesale company in the United States and another company in Europe. This discussion focuses on the United States, although it operates in a similar fashion for products imported from Europe. The Bermudian wholesaler/importer places an order with its U.S. counterpart. The U.S. company may procure product from growing areas throughout the Western Hemisphere although California, Florida, and Mexico are the most important production areas. The origin of the product depends upon the product itself and season. The U.S. supplier transports the product to its port facilities which are typically located in New York or Philadelphia. At that point, produce is packed into refrigerated containers and transported to Bermuda. Presently, ships arrive on Monday and Thursday. Wholesaler/importers indicate that orders must be placed at least five days in advance to insure arrival on the desired day.

For highly perishable products such as strawberries, airfreight may be used in lieu of ocean shipment. The cost associated with airfreight is substantially higher and as such, is avoided where possible.

Once the product arrives in Bermuda, the wholesaler/importer clears customs and then delivers to its customers. Deliveries are made by truck. Certain products may first be transferred to a central warehouse for storage before delivery. In Figure 4.1, the major classification of wholesalers' customers is retailers and food service entities (which include restaurants and hotels) and institutional food providers (such as schools and hospitals). The largest retail chain on the island, Marketplace Supermarkets, is both a direct importer and may occasionally use wholesaler/importers for selected products. Two other retailers, Lindo's Foods and White's also import produce containers. Other retailers on the island deal with the Bermudian wholesalers to procure imported produce.

The marketing channel for Bermudian grown produce is shown in Figure 4.2. As noted in Section 2, Bermudian agricultural lands are highly fragmented, thus agricultural production is scattered throughout the island. The geographic spread of agricultural lands serves to complicate the food distribution process. Farmers sell to at least six different outlets. Several of the larger farmers sell directly to retailers and food service, effectively bypassing the wholesalers. Two large farmers and several smaller farmers also sell at the newly formed Farmers' Market that takes place on Saturday morning in Hamilton. Several of the large farmers also have roadside stands. Farmers also sell potatoes under quota to the Government Marketing Centre. When a product is on embargo, wholesalers, retailers, and food service may also use the Government Marketing Centre as a broker to identify which farmers have embargoed produced available (although the Government Marketing Centre does not collect a fee for that service). Consumers

can obtain product from four outlets: the Farmers' Market, roadside stands, retailers, and food service.

The existence of divergent marketing channels for imported and domestically grown produce is a source of major disagreement between growers and produce buyers including retailers and wholesalers. Wholesalers expressed concern that when Bermudian produce is in season, farmers choose to bypass them and sell directly to retailers and food service. They assert that this arrangement results in suppliers becoming competitors.

When embargoes are imposed, the volume of business done by wholesalers goes down. This occurs because large farmers sell a portion of the output directly to retailers and food service. The existence of roadside stands and the Farmers' Market also likely siphons produce sales away from commercial outlets. On the other hand, increased availability of local produce may well stimulate domestic consumption.

4.2 The Food Service Industry in Bermuda

With nearly 400,000 tourists annually visiting Bermuda, a major outlet for produce consumption in Bermuda is food service, namely restaurants and hotels. Seven executive chefs were interviewed regarding their perceptions of the produce available in Bermuda. Three of these chefs were affiliated with restaurants associated with hotels, while the other four worked for independent restaurants. All seven establishments were in the mid-level to high priced range of restaurant alternatives in Bermuda⁶.

With one exception, the chefs interviewed were generally positive regarding Bermudian-grown produce. Several expressed their willingness to support the Bermudian agricultural sector. The positive comments regarding Bermudian-grown produce focused on freshness and

⁶ The estimated cost of a four-course dinner at the seven establishments ranged from \$45 to \$100.

taste. On the other hand, all of the interviewees expressed frustration with the embargo system. Imposition of embargoes limits the alternatives available to local chefs when weather events result in deterioration of local produce. Many indicated that early in the harvest season, Bermudian produce is generally of high quality.

In the case of high-end users such as gourmet restaurants, the embargo system may not be serving its intended purpose. For some recipes, chefs may have highly specialized needs for specific items, whose production may be beyond the capabilities of local farmers. Specialty lettuce may well be an example of a product that can only be consistently supplied, on a high quality basis, by a producer who specializes in it. There may be other products whose demand is on such a small scale, the return is insufficient to cover the investment needed to produce it properly. In these cases, broad embargoes may only serve to unduly deny local users access to specialized products without expanding local demand.

4.3 Expansion of the Role of the Government Marketing Centre

Several stakeholders in the Bermudian produce sector indicated interest in expanded function of the Government Marketing Centre or some similar entity to facilitate assembly and distribution of Bermudian grown produce. Such a centre would operate in a fashion similar to the terminal produce markets found in the United States and elsewhere. All product intended for commercial sale would be delivered to a central facility (it is conceivable that more than one facility would be needed) where it would be inspected and graded. Buyers would come to this site and make their purchases.

The advantages of such a system are numerous. First, it would facilitate collection of data on production of horticultural products and thereby aid the price discovery process. In times of embargo, the quantity of product at the Government Marketing Centre would represent the

total supply of product on the island. Second, implementation of a grading system would aid high-end users in the discovery of those producers able to supply their needs. In other words, a two or three tier grading system would allow the market to sort out premium products and impute appropriate price premiums. Third, it would enable both small producers and small buyers to compete more effectively with large producers and large buyers. Currently, smaller operators, both buyers and sellers, complain that they are caught unaware of shifts in the market due to imposition or lifting of embargoes, adverse weather events, or other stochastic factors that distort available information. Given both delay in obtaining deliveries from the United States or Europe and the high degree of perishability in many horticultural products, accurate, current information is crucial in making proper business decisions. Fourth, implementation of both an inspection and grading system would eliminate many of the disagreements that arise between buyers and sellers over product quality. Several buyers indicated that product quality is often inadequate, especially as the embargo period nears its end. As weather conditions change, product quality begins to deteriorate, but with the embargo still in place, buyers are left with few options.

There are also disadvantages associated with a central assembly system. It is worth noting that the volume of product passing through similar markets in the United States has been declining in recent years as large retailers have shown preference for direct purchases from produce shippers. Other disadvantages are that increased costs might be realized in the transport of produce from farm to retail and food service outlets. Additional employees would be required at the Government Marketing Centre. The facilities that currently exist at the Government Marketing Centre would have to be expanded or more likely, relocated to another site to handle the volume of traffic that would be realized during peak harvest periods.

Table 4.1 List of produce importers in Bermuda.

Company Name	Company Type
Butterfield and Vallis	Wholesaler
Dunkley's	Wholesaler
Atlantic Produce	Wholesaler
Amaral's	Wholesaler
Market Place	Food retailer
Lindo's	Food retailer
White's	Food retailer

Figure 4.1. Marketing channel for imported produce.

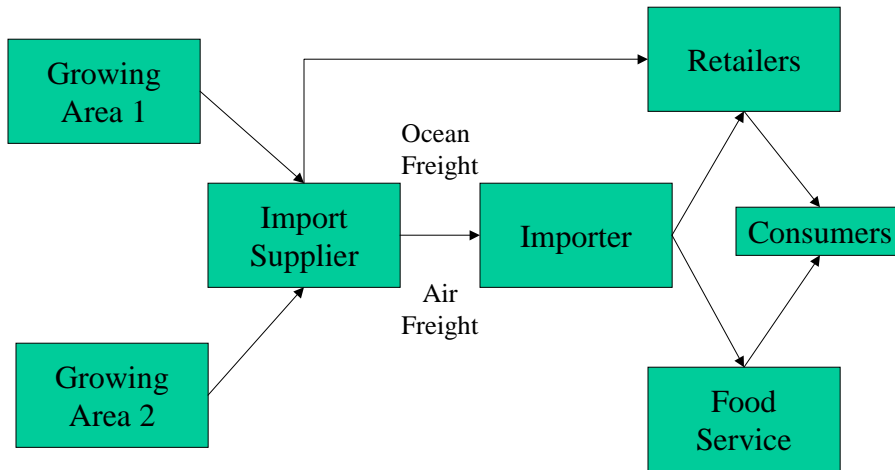
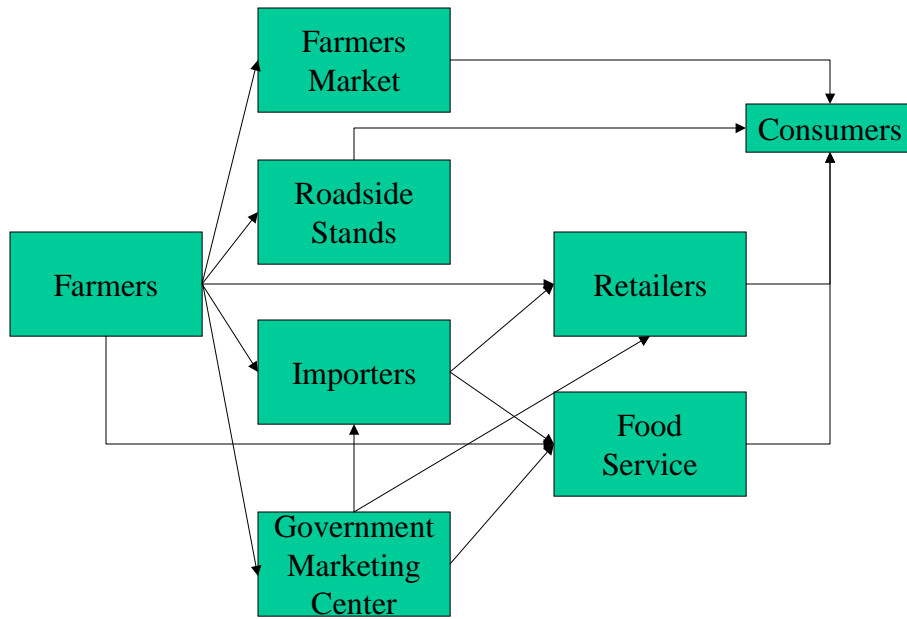


Figure 4.2. Marketing channel for Bermudian-grown produce.



Section 5

Backyard Gardening and Farmers' Market

5.1 Introduction

The long agricultural history of Bermuda continues to be important in the identity of Bermudians. Even though Bermuda is now largely urban/suburban, many Bermudians maintain a connectedness to the land and routinely grow at least a few vegetable plants and fruit trees. As open space continues to be lost to development, the area used as backyard garden increases as a proportion of total "agricultural land" and sustained arable space. Therefore backyard gardening represents a significant contributor to agricultural production while helping maintain the "Bermuda Look" which is so important to quality of life for residents and appeal to tourists.

5.2 Plant Materials Sold to Home Gardeners

Purveyors of transplants and seeds to backyard gardeners report a strong growth trend in sales of vegetable planting stock, exceeding 10% per year for the last five years. Mr. Edward Lindo of Gorham's True Value Outdoor Center indicated that sales of flower and vegetable seeds have been so brisk that they have gone from two racks to eight in the last few years. The two largest providers of vegetable and herbs as transplants (Hollis and Aberfeldy) and seeds (Aberfeldy and Gorham's), reported combined 2001 sales of 160,000 assorted transplants, 40,000 onion sets, 20,000 bundles of strawberries and 25,000 packets of seeds. One firm provided the identity of transplants, which were comprised of about 30% tomatoes, 25% lettuces, 20% crucifers, 15% peppers, 10% cucurbits, and small numbers of herbs and other vegetables. One firm provided species breakdown of seeds and another firm provided the proportion of the largest selling

vegetable seeds. Altogether, and assuming a sampling efficiency of 80%, this quantity of plant material would be sufficient to plant 60 acres. To compensate for partial use of seeds, estimations are based on high commercial planting rates for fresh vegetable production (Table 5.1). Actual acreage planted could be as great as 100 acres.

5.3 Broad Survey of Bermudians on Home Gardening and Produce Buying

To further approximate the extent of home gardening in Bermuda, and the motivation of gardeners, a survey was conducted of 97 randomly selected Bermudian residents on May 7-8, 2002. Individuals leaving grocery and drug stores were interviewed using the questions shown in Appendix 5.A. Time of day and location across the island were varied to survey a broad sample of Bermudians, and the demographics of the sample group closely paralleled Bermuda as a whole (In the sample group race and age were estimated for each respondent: 53% Black, 43% White, mean age 44 yrs). Overall, a surprising 39% of interviewees indicated that they grow vegetables and/or fruit around their houses. Reported size of gardens was highly variable, ranging from half acre plots providing all family produce needs, to plots of only a few square feet. Based on an estimate of 25,000 households in Bermuda (projecting 10% above 1991 census), the average plot size of 240 ft² would project to around 140 acres of home gardens on all of Bermuda. One outlier was removed from our sample, with 0.5 acres of gardens, inclusion of this data would increase our estimate to 254 acres. Based on our estimate of 60 acres of vegetables in home gardens from gardening centre sales (Section 5.2), it appears that about half of home garden acreage must be comprised of fruit trees. About eighty acres of fruit trees (including bananas) would be realized with an average of 0.3 tree per household. Observation of Bermudian yards suggests that this may be a low

estimate, since bananas, loquats, and avocados are widespread, with citrus, peaches and mangoes also observed.

Interviewees report a broad range of reasons for growing home gardens. Freshness and quality of backyard produce was listed by 39% of interviewees; 34% indicated that it was a hobby, fun, or “they enjoyed working on the land”; 24% indicated that their parents had gardened or farmed; 24% indicated that high cost of produce was their motivation; and 21% grew food because of concern about pesticides on purchased produce.

In the same survey, when respondents with and without gardens were combined, 56% indicated a high level of importance that food purchased was grown without pesticides, but many indicated that they did not look for organic produce or even think of pesticide use considerations when making purchases. This apparent contradiction has been previously reported for food pesticide issues, with high disparity commonplace between survey response and market behavior.

Concern about Bermudian origin of produce was widely divergent, with 38% indicating it was very important, 30% indicating it was totally unimportant or only slightly important, and the remaining respondents indicated intermediate concern. Comments by respondents included: strong desire to support of Bermudian agriculture, indication that certain Bermudian products were superior (items mentioned included potatoes, strawberries, and carrots), unwillingness to pay high prices for local products, and concern that products from Bermuda may contain higher levels of pesticides than comparable U.S. products.

5.4 Detailed Survey of Identified Gardeners

A more detailed survey was administered to a pool including many identified gardeners in an effort to capture better statistics on the economic impact of home gardening. The survey attached as Appendix 5.B was sent to the recipients of the monthly newsletter distributed by the Department of Agriculture and Fisheries. Of the 82 respondents, 68% indicated that they have a garden in all or most years, while 21% indicated that they sometimes had a garden. As expected, this group indicated a much higher average garden size than was found in the broader survey. More than 2.5 acres of total garden acreage were reported by the 68 respondents indicating plot sizes, for a mean of 1630 square feet per garden. Table 5.2 indicates the percentage of gardens reporting production of each crop and the yield per year per garden that they reported. Estimates were also projected on the total pounds of each product produced per year by survey respondents and through extrapolation to the entire 140 acres of home gardens estimated on Bermuda (described in Section 5.3). It must be noted that this process involves many assumptions that cannot be tested within the context of our study, and the values should be interpreted only as rough estimates. Interestingly these data also indicate that fruit trees represents around 50% of home garden production.

Home production of bananas and peppers are projected to be substantially greater than commercial Bermudian production while tomatoes and strawberries are projected to be similar in magnitude. Projected home production of all other crops is much less than our estimates for commercial production.

Only nine home gardeners indicated that they sold any of their produce, representing less than half of the total acreage reported. Indicated reasons for gardening

were predominately fun/hobby/recreation (49% of respondents), food/savings/home use (45%), and quality/freshness of home produce (28%). The next highest category was tradition/agricultural heritage at 4%. Only 3% of respondents indicated that production of pesticide-free food was a primary motivation, although 54% of individuals indicated pesticide-free production (31% of acreage) and 41% indicated they used organic production techniques (13% of acreage).

Respondents indicated an annual expenditure averaging \$0.64 per square foot of garden with a high degree of variability. If average expenditure is projected to the estimated 140 acres of home gardens in Bermuda, this would represent an annual expenditure of about \$4 million. Interestingly, the individuals indicating some sales of produce only reported a 40% increase in value of sales over garden costs.

The Ministry of Environment was indicated as the primary source of information on gardening by 52% of respondents, followed by books at 25%, friends/family/other gardeners at 22% and nurseries/garden centers at 9%. Seventy-five percent of respondents felt they received information on gardening adequate for their needs, representing 49% of acreage. Nineteen percent of individuals (32% of acreage) felt they were not having their informational needs met and the remainder were unsure. Twenty percent of respondents indicated that they would plant a larger garden if land were available in a nearby community garden.

5.5 Home Gardening Practices

Horticultural practices of home gardeners varied widely. Orderliness and productivity are sources of pride for some gardeners while others are happy to obtain produce with more intermittent effort or even a conscious decision to permit substantial

weed growth. Few home gardens achieve commercial levels of productivity, but a few receive levels of care well beyond that commercially feasible. Most home gardens are managed by residents, but the services of professional gardeners contracted by some households often include fruit tree care.

The survey team visited six backyard gardeners, representing a range of approaches, who all sell a substantial amount of their produce. All of the gardeners we visited expressed a desire to limit pesticide usage, but they varied in their willingness to use chemical fertilizer supplements, or use conventional pesticides against particularly troublesome pests.

All of these backyard gardeners used rototillers or tractor-drawn implements to prepare their land for planting. Fertilization was usually accomplished through preplant growth of a green manure or application of manure, composted seaweed, or chemical fertilizers, which were tilled into the root zone. Additional fertilization was applied as a side dressing in some gardens based on perception of plant needs. The proprietors of Windybank Farm, the sole egg operation on Bermuda, indicated that most of their chicken manure (from an 8,000 chicken operation) was sold to backyard gardeners.

Propagules were planted as seeds, seed potato, or transplants as appropriate for the plant type. Most propagules were purchased from local garden centres, but two gardeners purchased some seed from the Government Marketing Centre and two other gardeners focusing on organic production obtained seed designated as organic from the United States. Gardeners with larger plots usually grew their own transplants for crops such as tomatoes and broccoli from purchased seed.

The gardeners visited indicated various strategies for selecting types of plants to grow. All grew a broad array of produce to satisfy the needs of their families and friends, but some indicated an effort to identify varieties that would be interesting to purchasers or that would achieve premium prices by producing early or late within the standard season. A few gardeners indicated that certain plant types were too much trouble to grow, due to problems such as mildew attacking cucurbits or birds damaging strawberries. Several gardeners indicated that through experience they have identified types of vegetables, which grow well, provide a good return, and have manageable problems. All gardeners included small plots of bananas, which were almost exclusively 'Dwarf Cavendish'.

Only two of the farmers had a source of water for irrigating, with others solely dependent on rainfall for moisture. Weed control was the most widely variable practice, with some farmers utilizing pre-emergence herbicides and others totally dependent on manual weed removal. Tolerance of weeds also varied widely, with considerable weed competition in several gardens. One organic gardener indicated that weeds were allowed to grow in the hope that insects would preferentially feed on some weed species, while another organic gardener maintained a level of weed control comparable to a well-run commercial farm.

These gardeners reported use of few pest control products. Several gardeners reported use of neem oil, pepper spray, or BT products. Others reported use of carbaryl or diazinon for insect control and purchased chemical fungicides but were not sure of the compounds used. One gardener attempting organic production was skeptical that BT was acceptable. Several growers indicated a willingness to hand-remove insects and

infected/infested leaves to avoid use of chemical control agents, and even removed entire plantings if problems appeared too severe.

It is our assessment that poor weed control and inefficient land use greatly reduced productivity on several of the small-scale farms we visited, and such problems are likely to be widespread. Information on fertilization, pest control, plant selection, and postharvest handling appeared likely to be of great benefit to these gardeners. Only one grower indicated a strong desire for additional information, however, it is apparent that most backyard and semi-commercial gardeners would greatly benefit from proactive extension information.

5.6 Rationale for Growth in Home Gardening

The growth in home gardening reported by purveyors of plant material cannot be explained simply by the Bermudian agricultural tradition, since growth in home gardening greatly exceeds the 0.7% rate of population growth (World Information, 2002). It seems more likely that external forces are interacting with this tradition to encourage a return to greater working of the land.

While it is difficult to quantify, several individuals suggested that crowding and residential and commercial development on Bermuda could be compelling people to gardening as a source of psychological or spiritual comfort. This argument suggests that the natural cycles of planting, growth, and harvest provide greater connection to nature as Bermudian employment and lifestyles are increasingly urbanized.

Food safety concerns may be a major motivation for increases in home gardening. A few respondents in our broad survey volunteered that their food pesticide concerns have arisen only in the last few years. Although production of pesticide-free food was a

stated motivation of only 21% of backyard gardeners in the broad survey, heightened food safety concern was central to discussions with all other sectors associated with backyard gardening. For example, the largest Bermudian garden center holds weekly training sessions and has regular attendance of 125-135 people. Topics at these training sessions include organic gardening. The purchasing manager of Gorham's True Value Hardware indicates surging customer interest in organic production and will be attending a company-sponsored workshop in the United States to train employees on organic production materials and methods. Organic gardening is discussed in more detail in Section 6.

Our interviews indicate that home gardeners have routinely given or sold small amounts of surplus produce to neighbors with some gardeners making regular sales to restaurants or groceries. Expense and time required for deliveries was regularly reported as a major constraint to such commercial sales. Emergence of the Bermuda Farmers' Market appears likely to enhance commercial sales opportunities for backyard gardeners and may provide marked stimulus for semi-commercial backyard production.

5.7 Bermuda Farmers' Market

After a hiatus of four decades, the Bermuda Farmers' Market resumed operation on February 2, 2002. For a space-fee of \$20, vendors can sell their Bermuda-grown produce at in the Bulls Head car park in downtown Hamilton, with designated hours of 8 AM to 1 PM every Saturday. Frances Eddy, chairman of the Board of Agriculture and a part-time commercial grower, organized the Farmers' Market to "support local agriculture" and give smaller growers a ready outlet for their produce.

Our study team visited the Farmers' Market on two consecutive Saturdays, May 4th and 11th of 2002. Of the eight produce purveyors, two were among the largest commercial farming enterprises on Bermuda (M. DeSilva Farming and Wadson's Farm) while the remaining six were smaller scale backyard/semi-commercial gardeners.

Customer interest is reported to have been strong since the reopening of the Farmers' Market. During our visits, customer numbers ranged from 12 to 40 at any one time, with most purchasing substantial amounts of produce. Total customers per day were estimated at 300. Interviews were conducted with 15 randomly selected customers to assess their reasons for visiting the market.

Of the 15 Farmers' Market customers, 13 indicated that they were regular visitors and many indicated that they shopped there weekly. Better freshness and quality were uniformly expressed as reasons for frequenting the Farmers' Market, but 10 of the 15 indicated buying Bermudian products was also an important contributor. One interviewee indicated that her children were consuming markedly more fresh produce because the Farmers' Market products had such superior taste. In other interviews, unrelated to the Farmers' Market, this observation was expressed by several other backyard growers selling produce to neighbors.

Perception of prices at the Farmers' Market varied widely among the people interviewed, with equal numbers indicating that prices were slightly higher than the grocery store vs. about the same, and a few reporting that prices were lower than the store. Half of the interviewees indicated that they would gladly pay somewhat higher than grocery store prices for the high quality they obtained at the Farmers' market.

Interviewees indicated that purchases at the Farmers' Market accounted for ten to 100% of their total weekly produce purchases with the average being 70%. This percentage will likely decline as fewer local products are seasonally available, but is indicative of a healthy nucleus of support.

The array of vegetable products available during our visits to the Farmers' Market was quite impressive (Table 5.3), with only strawberries and bananas available among fruits. The quality appeared to be very high.

Two of the eight produce purveyors advertised organic or pesticide-free produce, while others indicated that some individual products were grown without pesticides. Interestingly, from the sample of market customers interviewed, only 20% (3 of 15) indicated a strong motivation to purchase organic or pesticide-free products.

Reports of total retail sales ranged from \$300-600 per week among the smaller Farmers' Market purveyors. One part-time farmer indicated that perceived opportunity for sustained profits encouraged the recent purchase of a small tractor. It appears likely that further development of the Farmers' Market will increase expansion of small-scale farming in Bermuda.

5.8 Rationale for Further Government Support for Public Gardening

The estimated scale of backyard gardening in Bermuda suggests that it has the potential for significantly contributing to the agricultural economy of the country. At 140 acres, backyard gardens would represent 27% of the land currently used for production of fruit and vegetables. Such gardens provide most of the benefits realized through commercial production (such as maintaining open space, improving balance of trade, and enhancing food security) with negligible governmental investment, albeit at much lower

levels of productions. Furthermore, these benefits are realized without detrimental effects to any economic sectors, unlike governmental policies supporting local commercial agriculture. A network of “activist-gardeners” appears to provide a low-cost opportunity for further enhancing interest and expertise in local gardening. Their work is already evident in the highly successful Paget Community Garden. Government involvement through leasing or providing more sites for community gardens, providing venues for educational meetings, and increasing sites for Farmers’ Markets may prove an important and economical supplement to other policies designed to enhance open space and agriculture in Bermuda.

Even greater benefit to Bermuda may be realized by hiring an extension horticulturist to help provide in-depth educational programs and problem-solving for backyard gardeners. Given the small scale of commercial farming, a single extension individual could significantly benefit all sectors of Bermudian agriculture.

World Information. 2002.

<http://www.worldinformation.com/World/Namerica/Bermuda/profile.asp?country=441> (accessed April 2002)

Appendix 5.A. Bermuda Supermarket Shopper Survey

All questions verbally administered

Location: _____

Estimated by survey administrator

Respondant

Gender: _____

Race: _____

Approximate age: _____

1. Are you a resident of Bermuda: Yes (continue questions)
No (survey ends)

2. Do you have a vegetable or fruit garden? Yes (go to 3) No
(go to 5)

3. How big is your garden in square feet?

4. Why do you enjoy gardening? (don't suggest, just record)
 - i. Enjoy working outside on the land
 - ii. Concerned about pesticides in produce
 - iii. Upgrade diet of family
 - iv. High cost of store-bought produce
 - v. Freshness/taste/quality/variety
 - vi. Other _____

5. On a scale of 1-5, 1 being not important at all, and 5 being very important, how important is it to you that the fresh produce you buy is grown without pesticides?

6. Using the same scale, how important is it you that the fresh produce you buy is grown in Bermuda?

Appendix 5.B Survey of Backyard Gardening in Bermuda

(Sent to the recipients of the monthly Government Marketing Centre Newsletter)

The Government of Bermuda has initiated a comprehensive assessment of horticulture in Bermuda. This process is intended to help formulate government policies relating to horticulture and arable land. As part of this assessment, we have been asked to determine the scale and importance of backyard gardening in Bermuda.

We greatly appreciate your taking five minutes to answer the following questions:

- 1) Do you routinely plant, maintain, and harvest vegetables and fruit from a home or neighborhood garden (circle best answer)

Always Most years Sometimes Never

- 2) What is the size of this vegetable/fruit garden in square feet: _____

- 3) What is your approximate annual production (in pounds) for the following:

Tomatoes: _____

Irish Potatoes: _____

Carrots: _____

Onions: _____

Lettuce: _____

Peppers: _____

Broccoli: _____

Cabbage: _____

Sweet corn: _____

Strawberries: _____

Bananas: _____

Other _____: _____

Other _____: _____

- 4) What is your approximate average expense for growing this vegetable/fruit garden? _____

- 5) Do you ever sell any of the produce? (circle best answer) Yes No

- 6) If so, where is the produce sold? _____

- 7) What is your approximate annual income from these sales? _____

- 8) Is this produce grown pesticide-free? _____

- 9) Is this produce grown organically? _____

- 10) What are your primary reasons for growing this vegetable/fruit garden?

- 11) What are your sources of information for growing fruits and vegetables?

- 12) Do you get adequate information to meet your needs? (circle best answer) Yes No

- 13) Would you plant a larger garden if land were available in a nearby community garden?
(circle best answer) Yes No

Table 5.1. Total reported sales of vegetable planting material to backyard gardeners in Bermuda.^a

Transplants	<i>% of Total Sales</i>	<i>Estimated Total Plants</i>	<i>Potential Acres</i>
Tomatoes	30	48,000	9.9
Lettuces	25	40,000	1.0
Crucifers	20	32,000	0.8
Peppers	15	24,000	1.4
Cucurbits	10	16,000	1.6
Onion sets		40,000	0.5
Strawberries		200,000	10.0

Seeds	<i>% of Total Sales</i>	<i>Total Seed Packets</i>	<i>Potential Acres^b</i>
cole crops, all (cabbage etc.)	18	4,534	4.5
carrot	10	2,613	2.1
beans	10	2,547	1.8
corn	9	2,150	4.7
herbs, all	8	2,018	1.6
lettuce, all	8	1,940	1.4
onion, leek, chives	6	1,471	1.2
tomato	6	1,441	0.5
melons	4	1,051	1.1
pepper, all	4	961	0.4
squash, all	4	961	1.0
beets	3	871	0.7
cucumber	2	601	0.6
others	8	2,016	1.6
<i>Total potential acreage</i>			<i>48.3</i>

^a Data obtained for 2001 from two largest suppliers for transplants and largest suppliers of seeds. Potential acreage is calculated at highest rates for commercial plantings to compensate for planting of partial packages.

^b estimated based on contents of typical seed pack and highest commercial rate for planting.

Table 5.2. Results and projections on vegetable and fruit yield from the detailed survey of home gardeners^a.

<i>Crop</i>	<i>Percentage Indicating Production</i>	<i>Percentage Providing Data on Yield</i>	<i>Mean Yield Per Garden (pounds)</i>	<i>Percent of Total Home Produce</i>	<i>Estimated Total Pounds from Survey^b</i>	<i>Estimated Total Tons Production Per Year Projected to 140 Acres in Bermuda^c</i>
banana	67	52	560	45.3	18260	501
potatoes	19	11	124	8.5	3420	94
pepper	49	34	18	7.4	2996	82
tomatoes	86	60	37	7.2	2887	79
corn	37	23	33	4.1	1668	46
strawberries	22	11	40	2.9	1176	32
broccoli	55	37	25	2.8	1147	31
cauliflower	32	19	24	2.4	986	27
onions	60	45	45	2.3	947	26
cabbage	32	16	36	2.2	890	24
lettuce	58	36	17	2.1	865	24
beans	68	45	28	1.8	734	20
carrots	71	52	44	1.4	552	15

^a Note that the listed crops account for only 90% of production with the remainder comprised primarily of citrus, avocado, papaya (paw paw), loquats, and an array of minor vegetables.

^b Mean percentage of yield by crop for subset of survey with complete data was extrapolated to entire 2.55 acres .

^c Divided total yield estimate from survey by proportion of Bermudian backyard gardens this is projected to represent (2.55 acres/140 acres).

Table 5.3. List of produce available at Bermuda Farmers' Market in Hamilton on May 4, 2002.^a

<i>Commodity</i>	<i>\$/Unit</i>	<i>Sales Unit</i>	<i>\$/Pound</i>
Arugula	2.50	bunch	8.30
Asian greens	2.50	bunch	N/A
bananas	1.50	pound	1.50
Basil	2-2.5	bunch	3.3-4.2
beets (golden)	2.00	pound	2.00
beets (red)	2.00	pound	2.00
bok choi (large)	4.00	each	N/A
bok choi (small)	2.75	each	N/A
broccoli	2.40	pound	2.40
cabbage	1.00	pound	1.00
carrots	3.25	bunch	1.35-2.2
cauliflower	2.40	pound	2.40
Celery	3.25	head	1.44
cucumbers (hydroponic)	2.75	each	2.75
Daikon	2.40	pound	2.40
dill	2.50	bunch	12.50
eggplants (baby)	2.40	pound	2.40
Kale	2.75	bunch	5.50
Leeks	3.50	bunch	2.20
lettuce (green leaf)	2.50	head	2.50
lettuce (iceburg)	2.50	head	1.92
lettuce (red leaf)	2.50	head	2.1-4.2
lettuce (Romaine)	2.50	head	2.00
onions (Bermuda-type)	1.50	bunch	1.50
Oregano	2.50	bunch	8.30
Parsley	1.50	bunch	3.75
potatoes (red skin, large)	4.50	bag	1.50
potatoes (red skin, small)	5.00	bag	1.65
pumpkin	1.60	pound	1.60
radicchio	6.00	pound	6.00
Rosemary	2.00	bunch	5.00
Rutabaga	1.00	pound	1.00
spinach	3.00	pound	3.00
strawberries	7.00	quart	4.11
Sweet corn	10.00	dozen	1.19
Sweet potatoes	1.50	pound	1.50
Swiss chard	2.75	bunch	N/A
Thyme	1.50	bunch	N/A
tomatoes (hydroponic)	3.00	pound	3.00
turnips	3.00	bunch	N/A

^a Costs listed are from stalls which posted prices and may not reflect complete range of prices among purveyors.

Section 6

Organic Agriculture and Certification

Organic agriculture refers to holistic farming systems that conserve or enhance biodiversity, especially soil biological activity, promote ecological balance, and integrate agronomic, biological, and mechanical practices, without using synthetic fertilizers, pesticides, or herbicides. A small, but growing number of farmers and consumers are turning to organic agriculture as an alternative to conventional, chemical-intensive agriculture. Demand for organically grown products has been growing rapidly at annual rates of 10-30% in major world markets. Though still small as a share of total food sales, organic food sales reached an estimated \$8 billion in the U.S. and \$1 billion in the U.K. in 2000 (FAO et al., 2001).

Supporters of organic agriculture suggest several benefits, including little or no pesticide residues on organic fruits and vegetables, improved soil conservation, and less harmful impacts on wildlife (birds, fish, etc.), water quality, and farm worker health. Preference for organic methods of agriculture may be based on philosophical or spiritual beliefs as well. There are some drawbacks, however, to organic production. Typically, organic farms achieve lower yields than well-managed conventional systems. Organic agriculture requires more labor and more knowledge-intensive, site-specific farm management. Also, the storage life of fresh organic fruits and vegetables may be lower than that of products treated with fungicides or other pesticides.

Studies confirm that pesticide residues on organic produce are significantly less than residues on conventionally grown produce (Burros, 2002). Differences in long-term health effects have not been scientifically substantiated however. Also, some scientists dispute the environmental benefits of organic agriculture, mentioning improvements in

modern agricultural chemicals, harmful effects of some “organically-approved” compounds, and a heavy reliance on animal manures among organic growers.

6.1 Government Policy and Standards for Organic Agriculture

A few governmental and non-governmental entities have developed organic standards (guidelines for organic production and handling) and created certification and labeling programs. Two major world standards are the European Union Organic Standard (Regulation EEC2092/91)⁷ and the U.S. National Organic Standard (7 CFR Part 205).⁸ The International Federation of Organic Agricultural Movements (IFOAM) and the FAO/WHO Codex Alimentarius Commission have created guidelines for organic production as well.

Although the basic concepts of organic production and handling are the same among these standards, they vary in specific details and requirements. Organic standards generally include production, handling, and processing restrictions, labeling regulations, certification procedures, minimum transition periods for converting to organic production, a list of allowed and prohibited substances, and record keeping requirements. Farm production standards cover land requirements, soil fertility and nutrient management, seeds and transplants, timing of manure application relative to harvest, crop rotation, and pest, weed and disease management. Pesticide residue limits may be set as well (the pesticide residue limit under the U.S. organic standard is 5% of the EPA or FDA tolerance levels). Some sort of monitoring and enforcement mechanism is also a necessary feature of organic programs.

⁷ see <http://europa.eu.int/eur-lex/en/search/index.html> Year: 1991 Number: 2092

⁸ see <http://www.ams.usda.gov/nop.htm>.

Governments develop uniform standards and guidelines and oversee certification and labeling in order to reduce consumer confusion and increase consumer confidence in organic claims. Such information-based policies improve the efficient functioning of markets and enable consumers to express preferences more accurately and achieve fuller satisfaction from markets. Certification and labeling programs also may serve to raise awareness and promote organic products. Depending on consumer willingness to pay premiums for organic products, these programs can increase returns to producers who can cost-effectively meet organic production criteria, rewarding farmers already producing in this manner, and encouraging others to convert to organic methods.

Despite the lack of a strong consensus on the benefits of organic agriculture, some European governments, notably Denmark and Austria, have embraced organic agriculture as a means of reducing agricultural overproduction, encouraging agricultural extensification (as opposed to intensification), supporting small-scale farmers and reducing environmentally-harmful effects of agriculture. European government policies have included payment of certification costs, subsidies to farmers during the conversion period or for on-going organic production, and promotion and education campaigns.

6.2 Organic Certification Procedures

Certifying bodies may be public or private entities. The government may accredit private certifying bodies. To prevent conflicts of interest, a certifying body should not be directly affiliated with or have financial ties to any producer, producer group, or other entity with a significant stake in the decisions of the certifying body.

Certification procedures generally work in a three-step process (QCS, 2002; USDA, 2002). First, the grower or handler must obtain an application and certification packet

from the certifying body. The grower or handler must complete the application and provide all information requested by the certifying body. The certifying body reviews the application and supporting documents, and additional information is requested if needed. Second, an on-site inspection is arranged. The inspector verifies that the production or handling practices being used are consistent with the organic standard and the documents provided by the grower or handler. He or she also checks for signs of the use of prohibited substances. The inspector may request samples of soil, water, waste, seeds, plant tissue, or products for testing. Finally, the certifying body reviews the on-site inspection report and any test results. It either grants certification or notifies the grower or handler of noncompliance. The grower or handler may be given the chance to correct minor non-compliances.

Certification costs vary, depending on the certifying body, farm size and complexity of operation, location, and farm revenue. For a small to medium farm, organic certification fees may total \$500-\$1000 per year. Typically, certification must be renewed on an annual basis.

A key document required of growers and handlers by the U.S. National Organic Program is an organic system plan (QCS, 2002; USDA, 2002). This farm plan consists of six components:

1. Description of farming methods and frequency and timing of specific practices, such as manure applications, pest control techniques, etc.,
2. List of all substances used in production and product handling,
3. Mention of indicators that will be used to measure or evaluate the organic system, such as productivity, soil organic matter levels, etc.,

4. Description of record keeping system to be used as an audit trail,
5. Explanation of management practices or physical buffers that will prevent contamination of organic products with prohibited substances,
6. Additional site-specific information requested by the certifying body.

Organic farming systems will vary according to site-specific conditions, and farmers are given some flexibility to create unique farm plans within the guidelines of the organic standard.

6.3 Demand for Organic Products in Bermuda

A survey of 97 Bermuda residents resulted in 56% responding that they felt it was “very important” that the fresh produce they buy is grown without pesticides. Some Farmers’ Market shoppers indicated that the availability of fresh produce grown without pesticides was a significant reason for coming to the Farmers’ Market. Also, several home gardeners mentioned their concern about pesticides as a major reason for growing their own fruits and vegetables. Although these results are a rough indication that the issue of pesticides is a significant concern to Bermuda residents, they do not necessarily reflect a willingness to pay premiums for produce that is grown without pesticides.

Interviews with seven restaurant chefs revealed weaker interest in pesticide-free or organic products. Of those interviewed, only one chef indicated some current use of organic products. When questioned about their interest in using organic products if they were more readily available, only two chefs expressed any eagerness to feature organic products on their menu.

Three upscale supermarkets in Bermuda reported organic sales ranging from 0.5% to 10% of total fruit and vegetable sales. Produce managers at these supermarkets indicated

recent growth in this area. Supermarkets were observed selling organic potatoes, onions, lettuce, salad mix, bok choy, tomatoes, and apples. Organic price premiums vary considerably, but typically range from 10% to 50% above conventional prices.

Currently, almost all organic produce sold in supermarkets is imported. Although produce managers are aware that a few Bermuda farmers are growing at least some items “close to organically,” they are reluctant to label local items as such without certification. The three produce managers interviewed thought that organic certification of Bermuda products would be beneficial, if it were feasible.

6.4 Organic Produce Production in Bermuda

At least two small (part-time) growers appear to be using practices that would qualify as organic according to internationally accepted standards. A few other part-time growers and backyard gardeners report using low-input or pesticide-free methods that may be close to meeting organic standards. Organic gardening methods are reportedly being used at Paget Community Gardens as well. Also, a couple of the larger (full-time) growers are promoting some of their products as low-input, pesticide-free, or close to organic.

Fruits and vegetables grown by part-time organic or pesticide-free operations include carrots, onions, potatoes, corn, string beans, turnips, lettuce, kale, Asian greens, bok choy, squash, broccoli, cristophines (chayotes), radishes, tomatoes, strawberries, bananas, and papaya. The part-time organic growers interviewed do not keep detailed production records, and local production volume of organically grown fruits and vegetables is not available. Market outlets for the part-time, organic growers include the Farmers’ Market, supermarkets such as Miles Market and Harrington Hundreds, and direct sales to

neighbors. The Farmers' Market is described as a very beneficial market outlet for these growers.

Organic production methods vary, but include some common elements. Of the part-time growers interviewed, the two "most organic" growers import organic seeds (mostly from the United States). Chicken manure is commonly used as a fertilizer. Cowpea is used as a cover crop and green manure by at least one organic grower. Composting and vermiculture are used by another. Other inputs used as sources of nutrients or pest control agents by organic or pesticide-free growers include Neem oil, liquid fish and seaweed oil, pepper spray, Dipel, seaweed, and cedar wood ashes. Hand weeding is the main method of controlling weeds. A tractor or rototiller is used to till the soil prior to planting.

6.5 Feasibility of Certification or Expansion of Organic Farming in Bermuda

The close proximity of farms to one another and to roads and residential property has been mentioned as a problem for organic certification. This may indeed be a problem in some cases. For example, the U.S. National Organic Standard states that "[organic] fields and farm parcels must...have distinct, defined boundaries and buffer zones to prevent contact with the land or crop by prohibited substances applied to adjoining land" (USDA, 2002: Subpart C). Specific criteria are lacking, however, and certifying bodies use their best judgment in determining whether buffers are adequate to prevent contamination from drift or run-off, according to site-specific conditions. A minimum distance of 25 feet is sometimes used as a general rule of thumb, but the presence of physical barriers and the types of activities on surrounding property affect the certifying body's judgment of an appropriate distance. Some, but certainly not all, of the smaller

farm plots in Bermuda are separated from neighboring property by stands of trees, hedges, or stone walls. Such barriers should provide adequate separation from surrounding fields in most cases. A particular crop may be used as a buffer, as well. The “buffer” crop may not be sold as organic however. The two farms that seem to be growing in closest accordance with organic standards appear to have adequate buffers from neighboring property.

The Bermuda policy of spraying herbicide along roadways is also a concern for organic growers. It seems reasonable to assume, however, that measures could be taken by growers or Public Works to prevent run-off from roadways onto farm plots. Growers could erect (or plant) barriers separating their fields from the roadside. This could represent an additional cost to growers and might deter some from obtaining organic certification. An agreement might be reached with Public Works to designate roadsides bordering organic farms as “no-spray zones.” In that case, either the farmer or Public Works could mow these sections of roadside to control the weeds.

Larger growers that wish to receive organic certification may have more difficulty preventing contamination on parcels with much longer boundaries to protect. Under the U.S. National Organic Standard, however, split production is allowed, as long as adequate measures are taken to prevent contamination of organic certified area and products. The NOS requires “an operation that produces both organic and non-organic products to describe the management practices and physical barriers established to prevent commingling of organic and non-organic products” (USDA, 2002: Subpart C). In other words, one option for larger growers is to designate a portion of their property as organic and provide adequate buffers around the designated area.

The possibility of contaminants or traces of prohibited substances in manure supplies is also a concern for organic producers in Bermuda. The European organic standard allows the use of non-organic manure from extensive animal husbandry systems, but not from “factory farms” (EU, 2002; Rundgren, 2001). According to the U.S. NOS: “The producer may not use any fertilizer or composted plant and animal material that contains a synthetic substance not allowed for crop production on the National List or use sewage sludge” (USDA, 2002: Subpart C). Despite the strong wording in the U.S. NOS, many organic growers in the United States use animal manures that come from conventional (non-organic) operations. Certifying bodies are aware of this, but do not usually find that contamination of manure presents a problem. They may require documentation from the manure supplier however. For example, a statement indicating that wood shavings mixed with the manure do not come from chemically treated wood may be required.

Organic production is certainly feasible, at least on a portion of Bermuda’s agricultural land. However several factors may discourage growers from obtaining certification or expanding organic production. These factors include certification costs, required conversion period, limited availability of arable land and animal manure, labor costs, availability and cost of inputs, a lack of information and advice, and consumer trust and willingness to pay.

Certification costs may discourage some growers, especially smaller (part-time) farmers, from obtaining certification. If inspectors must travel from overseas, the high cost of accommodations and travel to Bermuda will translate into high inspection fees. Although part of the total certification fee is usually a percentage of sales revenue, a large portion of the certification fee is a fixed cost, which does not vary with output or farm

size. For this reason, certification fees represent a greater burden for the smaller, low revenue growers. In Bermuda, the small size of most farming operations and a lack of domestic inspectors may reduce the ability of farmers to pay for organic certification.

Conversion periods required for switching from conventional to organic production may deter growers from obtaining certification as well. According to the U.S. standard, harvest cannot be certified organic until three years have passed since last use of prohibited materials. The European standard requires two years of organic management prior to sowing for annuals and three years prior to harvest for perennials. The IFOAM standard requires a conversion period of 12 months prior to sowing and 18 months prior to harvest. The first two standards allow the conversion period to start retrospectively, prior to application for organic certification (EU, 2002; Rundgren, 2001, USDA, 2002). During this conversion period, the parcel to be certified must be managed organically, but the produce cannot yet be sold as organic. In other words, per unit costs are typically higher during the conversion to organic, but organic price premiums cannot be obtained. Especially if there is considerable uncertainty about the future market for organic products, growers may be discouraged from initiating the costly transition to organic production.

Bermuda's arable land is very limited and under heavy pressure from development. Several small farmers mentioned that it is very difficult or costly to obtain more land for farming. One small farmer who is growing organically indicated that he would like to expand his acreage, but cannot find land that has not been treated with agricultural chemicals. The previous use of agro-chemicals does not prevent the conversion to organic, but a transition period would be required before certification could be obtained.

Organic farming usually relies on animal manure or compost as a major source of nutrients for crops. In Bermuda, most farmers that describe their operations as close to organic use chicken manure purchased from the one chicken (egg layer) farm on the island. According to a contact at this farm, they sell all the chicken manure that is produced and cannot expand sales of this product. Some owners of horses and cows use these manures on their gardens and provide some to neighbors. Some growers report purchasing horse manure or cow manure, but others indicate that it is in limited supply and difficult to obtain in large quantities. Imported bags of cow manure are a big seller at garden supply stores, but mostly to home gardeners. The limited availability of animal manure and the high cost of imported supplies pose constraints on the expansion of organic agriculture in Bermuda. Different types of composting (using food waste, seaweed, or other plant materials) could be investigated as an alternative or supplement to the use of raw manure.

Labor use in organic production is typically higher than in conventional production. The high cost of labor in Bermuda may hinder the expansion of organic production methods. Labor costs should not discourage smaller growers that rely almost entirely on their own labor, but could prevent larger growers that hire significant amounts of labor from switching to organic production.

Certain organic inputs, especially untreated organic seeds, cannot be obtained locally or through the Government Marketing Centre. Whereas conventional growers rely on the Government Marketing Centre to obtain volume discounts on many agricultural inputs, this service is not available for organic inputs. Currently, at least two growers order organic seeds over the Internet. Some organic inputs (organic pest control agents and

nutrient sources) can be obtained from local garden supply stores. The high cost of obtaining organic inputs from retail outlets or from individual overseas orders may discourage some growers from organic production.

The knowledge and experience required to be successful at organic farming is considerable. To maintain soil organic matter, reduce pest damage and control weeds, organic farming relies on ecological principles and a variety of methods that tend to be more site-specific and adaptive than conventional methods. The few Bermuda producers oriented towards organic production consult books, the Internet, and overseas sources for information and advice on organic farming. Seminars and demonstrations held at garden supply stores and Paget Community Gardens provide some information on organic gardening as well. Several growers mentioned that they would like more information on organic methods. Growers accustomed to conventional methods may be discouraged from attempting organic production when reliable advice on organic methods suitable for Bermuda is not readily available. Lack of domestic research and extension on organic agriculture may hinder the expansion of organic farming methods.

Finally, consumer trust in an organic claim and willingness to pay an organic premium are essential factors influencing the feasibility of expanding organic methods for commercial production. For some growers, especially smaller ones with considerable expertise in organic production methods, per unit costs may be similar to those of conventional farms. However for most growers, organic production entails higher per unit costs, and significant price premiums are necessary to induce them to convert to organic methods. A segment of consumers is willing to pay premiums for organic produce. Their willingness to pay a premium is affected by their trust in the organic label

(or farmer, if purchasing directly). A major purpose of creating uniform organic standards and certification procedures is to reduce consumer confusion and increase trust in an organic label. The lack of certification for Bermuda grown produce reduces the trust of produce managers and consumers in an organic claim. This absence of standards may reduce the ability of growers to obtain a premium for organic products and undermine incentives for organic production.

A few farmers who already are growing at or near internationally accepted organic standards mention philosophical or health reasons for growing organically. These growers may not be as sensitive to cost and price differences in terms of their decision to grow organically. It seems likely that these growers will continue to grow organically (or close to it) whether they can be certified or not. Other growers will be more sensitive to the factors discussed above.

6.6 Policy Options Regarding Organic Agriculture

Government can take on various roles relating to organic agriculture within a market-based system. Government can become involved in the oversight and monitoring of product-related information, such as organic claims. This approach may include the standardization of the organic definition and labeling or involvement in an organic certification process. Subsidies to organic growers, promotion of organic products, or support for alternative market outlets could be considered as a means of encouraging organic agriculture as well. Dissemination of technical information to organic farmers is another policy option. Finally, the Department of Conservation Services and the Government Marketing Center could expand their existing policies to organic growers.

Information is a key element necessary for the efficient functioning of markets. Product attributes that cannot be conveyed to the consumer will not be valued by the market. Labels can be used to signal product attributes that otherwise would not be easily verifiable. However the potential for consumer fraud exists when consumers cannot readily verify the information presented on a product label. Furthermore, consumers can become confused when information is presented in different manners or when the interpretation of label claims is ambiguous. Government can reduce consumer confusion and facilitate the communication of credible information to consumers by overseeing and monitoring the truthfulness of label claims or by requiring the standardization of label formats and certain types of claims. Without agreement on a comprehensive and explicit definition, the meaning of the term “organic” is unclear. For this reason, various governments and non-governmental organizations have developed standards, which provide a clear definition of the term “organic.” Regarding an organic standard, Bermuda has two main options. Bermuda could adopt or rely on foreign standards or create its own unique standards.

The government could mandate that all products labeled as organic must conform to a particular foreign standard, or it could allow organic labels that conform to other standards as well. Currently, most organic produce sold in supermarkets is imported from the United States. After October 2002, the USDA Organic Seal will appear on all organic fruits and vegetables marketed in the United States. It is likely that organic imports from the United States will bear this seal as well. The advantage to Bermuda growers of adopting the U.S. organic standard is that consumers will already be familiar with the USDA Organic Seal. Assuming that the U.S. standard and organic seal maintain

a solid reputation, consumer trust in the label should carry over to Bermuda grown, USDA organic certified, fruits and vegetables. Another advantage of adopting a foreign standard is that the costly and time-consuming process of developing a unique standard would be avoided. A disadvantage of this approach is that the foreign standard may not be ideally suited to the situation of Bermuda growers or the concerns of Bermuda consumers.

To better suit the needs of domestic producers and residents, Bermuda could create its own unique standards for organic agriculture. Ideally, such standards would be developed with considerable input from producers, consumers, and other interested parties.⁹ From an economic perspective, changes in producer costs resulting from changing standards should be balanced against changes in the price consumers are willing to pay. For example, if Bermuda growers were able to reduce or eliminate pesticide use at little added cost (per unit) and Bermuda consumers were willing to pay a premium for pesticide-free produce, then pesticide restrictions would be an appropriate part of standards for Bermuda. On the other hand, if it were costly for Bermuda growers to rely entirely on untreated, organic seeds and Bermuda consumers did not care whether the seeds were organic or not, then restrictions on the use of seeds would not be an economically justifiable element of organic standards. Since certain requirements may be easier for some producers to meet than others and different consumers have different concerns, multiple labels could be considered. For example, in Japan there are six different “green” labels for food: organic, organic in transition, no pesticides, reduced pesticides, no chemical fertilizers, and reduced chemical fertilizer (Vrolijk, 2001).

Advantages of creating unique standards for Bermuda are that the standards would be well-suited to Bermuda's needs and concerns and would not be dependent on situations and events in other countries. Disadvantages include the high costs involved with developing and updating standards.

Regardless of whether foreign standards are adopted or a unique Bermuda standard is created, foreign certifying bodies could provide certification in Bermuda. Several private certifying bodies in the United States are accredited to certify according to the U.S. NOS. For a limited time, the USDA has agreed to waive accreditation fees (but not travel costs) for certifying bodies located outside the United States. Certifying bodies in the United States and other countries are able to certify Bermuda growers according to the U.S. organic standard. It may prove more difficult or costly to find foreign certifying bodies willing to certify according to a unique Bermuda standard. The travel and accommodation costs of sending foreign inspectors to Bermuda may make certification prohibitively expensive. If a foreign certifying body were used, the presence of a trained inspector residing in Bermuda could reduce certification costs.

Government involvement in a certification process could take various forms. The government of Bermuda could consider training staff to carry out inspections. It could set up a government certifying body and train staff to carry out the entire certification process. The government certifying body could become accredited to certify according to the U.S. NOS or other foreign standard. If a unique Bermuda organic standard were created, the government could accredit private certifying bodies to certify according to the Bermuda standard.

⁹ In the U.S. a National Organic Standards Board, composed of growers, representatives from agricultural and food industries, consumer groups, environmental organizations, and scientists, is charged with

Of course, another option is for the Government to do nothing regarding organic certification and labeling. In that case, it is likely that a few Bermuda growers would continue to provide organically grown or low pesticide produce, but would continue to have difficulty obtaining premiums for these products. It is possible that growers could arrange certification themselves through a foreign certifying body according to a foreign standard. Another possibility is that private or non-governmental organizations in Bermuda could set up voluntary certification and labeling schemes. Although this “hands off” approach would be the lowest cost option for the government, the public interest (if organic agriculture is deemed to be in the public interest) probably would be under-served by private entities. Consumers may be confused by different organic claims and labels, and a lack of trust in these labels could erode their willingness to pay premiums. Growers, especially the smallest ones, may find it too difficult or costly to obtain certification without government assistance.

Information-based policy relating to standards, certification, and labeling is only one type of policy available. Various other policy tools could be used to support organic farming. Certification costs could be paid or subsidized by the government. Several European governments have paid subsidies to farmers who are in the process of converting to organic production. A few European governments have subsidized organic farms on a continuing basis. Governments also may assist with public awareness or promotional campaigns, if they are deemed in the public interest. Support for alternative market outlets, such as the Farmers’ Market, school-lunch programs, or community-supported agriculture programs could help Bermuda organic growers as well.

continually reviewing and updating standards as new concerns arise or technology and methods change.

Government-sponsored research and extension are important elements of agricultural policy in many countries. Organic farming requires considerable knowledge and methods that are adaptive to site-specific and changing conditions. A lack of information and knowledge necessary to be successful at organic farming may discourage farmers from converting to organic, when conventional practices are more familiar and less risky. Conducting research, disseminating research results, and providing technical advice to organic growers would be an important means of promoting organic farming in Bermuda.

A relatively simple means of supporting organic agriculture in Bermuda would be to extend existing agricultural policies to organic fruits and vegetables. The embargo policy on imported produce could be expanded to cover organic fruits and vegetables. The purchase of organic seeds and inputs through the Government Marketing Center could reduce costs for organic growers.

In summary, government policy towards organic agriculture could take various forms. A minimal market-based approach would simply involve oversight and enforcement of organic claims and private labels. The government may wish to become more involved in the development of standards and the certification process however. The creation of a government certifying body for organic agriculture may not be necessary, but could help facilitate the certification process in Bermuda. Although reliance on a foreign standard, such as the U.S. NOS, may be the most feasible option, the development of a Bermuda organic standard and label(s) could be considered. Payment of certification fees or subsidies to farmers during the conversion period would be another step towards reducing some of the disincentives to organic certification. Engaging in promotion or educational campaigns or facilitating alternative market outlets

could increase demand for organic produce. Dissemination of knowledge regarding organic production methods could help those farmers currently growing organically and encourage others to convert to organic methods. Expansion of existing agricultural programs and policies to include organic fruits and vegetables would be a relatively easy way to increase support for organic agriculture in Bermuda. As with any policy change, political will and the interests of all stakeholders influence the feasibility and success of a particular course.

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Section 7

Report Summary and Policy Options Relating to Agriculture in Bermuda

7.1 Introduction

Existing Bermudian policies were implemented to sustain a national agricultural industry. Interested groups, ranging from the farmers to produce retailers, indicate that the current embargo system does help maintain farming in Bermuda and may be necessary for its continued health. In addition, policies preventing development of arable land are crucial to prevent loss of this dwindling resource, given the high value of land for development. While these policies and the functions of the Government Marketing Centre are clearly beneficial to the farming sector, they occur at some cost to the citizens of Bermuda and reduce potential profits for some elements of the Bermudian economy. This being said, it must also be noted that a significant proportion of Bermuda's farmers are disaffected with their role in society and indicate that they are considering abandoning production of vegetables. This suggests that a change in government policies, to further provide incentives for farming, may be advisable if the goal is to maintain farming at its current level.

Development of conflicting interests between beneficiaries and those hampered by unwelcome constraints is an inevitable result of policies intended to affect a society's development. Over time, any changes in policy are also likely to elicit complaints from the principal policy beneficiaries about erosion in services, which become an entitlement. It is our interpretation that the agricultural survey presented in this document was sought to provide information in reconsidering these conflicting concerns, with the possibility of altering existing policies.

From our discussions with interested parties in 2002 and a reading of earlier reports, there does not appear to be a clear underlying philosophy for maintaining an agricultural base in Bermuda. Since policy options would vary widely in their effects on Bermudian agriculture and other sectors of the public, we attempt to outline some of these options within the context of different goals for maintaining a local agricultural industry. The most frequently cited reasons for maintaining agriculture in Bermuda are: 1) sustain a semi-rural appearance for the quality of life of residents and continued attractiveness to tourists; 2) maintain a local industry that reduces the flow of dollars out of Bermuda and contributes to the local economy; 3) provide a local food supply for national security in case of international trade disruptions; and 4) cultural/psychological/spiritual benefits of maintaining widespread connectedness to the cycles of food production.

7.2 Summary of Findings

7.2.1 Efficiency of Bermuda Agriculture

Agricultural producers in Bermuda appear to be following sound production practices. Reported yields are comparable to that found in the United States for most crops. Chemical use does not appear to be excessive. Crop production costs are in line with those found in the United States adjusted for the high cost of both inputs and labor. Farmers do not make extensive use of pesticides. The level of pesticide use is actually lower, in many cases, compared to that found in other developed countries.

On the other hand, marketing costs appear to be high. There is a high use of hand labor in preparing product for market. Distribution costs are high as each farmer is responsible for delivery to the end-user.

7.2.2 The Impact of Embargoes

The primary impact of embargoes on both producers and consumers of horticultural products in Bermuda is to stabilize prices. This impact is clearly seen with the purchase by Government of potatoes, but also extends to other crops. Stable prices tend to encourage production. At the same time, stable prices means that the market mechanism is not adjusting supply and demand so that both product shortages and unharvested product result.

The absence of a grading system means that embargoes may result in uneven quality. Local buyers do not have the option of using imports to augment local supplies when embargoes are in effect. Therefore, the quality of product presented to consumers can be highly variable.

7.2.3 The Government Marketing Centre

The Government Marketing Centre provides important services to farmers which serve to reduce the cost of production. The citizens of Bermuda are ultimately served through maintenance of a viable agricultural sector and lower food prices. It would be useful, however, to conduct a detailed evaluation of the Centre to determine how its performance could be improved especially with respect to the purchase and storage of potatoes.

7.2.4 Government Policy Towards Agriculture

It is apparent that Government does not have a well-articulated policy with respect to agriculture. A number of apparently conflicting policies appear to be in place. Lack of tariff exemptions on spare parts for agricultural machinery, irrigation parts, and other items serve to increase agricultural production costs. Apparent inconsistent enforcement of zoning regulations serves to continually erode the land available for agricultural production. At the same time, Government support for agriculture can be found through the embargo system and the existence of the Government Marketing Centre.

Government needs to decide if a viable agricultural sector is desired in Bermuda. If not, then the direct and indirect support given to agriculture should be eliminated, and market forces will likely cause its destruction. If Government desires to maintain agricultural enterprises in Bermuda, it should review all policies that affect agriculture and modify those that currently serve as an impediment.

7.2.5 Backyard Gardening

It is apparent that backyard gardening is an important activity in Bermuda. Our estimates suggest that approximately 140 acres are devoted to backyard gardening in Bermuda. It clearly provides leisure activity for thousands of Bermudians as well as augmenting the domestic supply of fruits and vegetables. Presently, Government provides virtually no support for backyard gardeners. The Farmers' Market is an important first step in assisting backyard gardeners in finding outlets for their marketable surplus. Sorely lacking, however, is technical support and advice.

7.2.6 Organic Agriculture

Organic agriculture currently operates on a small scale in Bermuda. There is clearly demand for organically produced horticultural products given the space allocated by supermarkets for organic produce. There is no organic certification program currently in place.

The lack of natural sources of nitrogen, however, means that it would be difficult for Bermuda to expand produce production under an organic certification program similar to that found in the United States and Europe. It is possible, however, to expand production under a “pesticide free” certification given support of Government.

7.3 Policy Alternatives Relating to Agriculture in Bermuda

In this section, several policy options are presented that should be considered by participants in the food system of Bermuda. The advantages and disadvantages of each option are briefly discussed. Some of these options may appear to conflict with others, but the intent is to provide a complete list of alternatives.

7.3.1 Alternatives to Produce Embargoes

Clearly, the produce embargoes are the most controversial aspect of Bermudian agricultural policy. Government could choose to leave the embargo system intact. As noted in Section 3, the main benefit of the embargo system to Bermudian farmers is price stability. The main drawback of the present system is sporadic lack of access to imports, which means that produce buyers are forced to accept local produce irrespective of its quality. For most crops placed on embargo, imposition of embargoes does not cause produce prices to increase. Other drawbacks include the difficulties facing importers as

embargoes are lifted. This occurs due to the lag between when imports are ordered and ultimately delivered to Bermuda.

Government could choose to eliminate the embargo system and expect domestic producers to compete directly with imports. Under this option, it is likely that local agriculture would shrink. Some products including onions, strawberries, pumpkin, winter and summer squash, and tomatoes would still be produced locally. If sweet corn, sweet potatoes, and carrots remained on permanent embargo, they would also be produced. Production of potatoes, broccoli, peppers, and lettuce would likely decline.

A third option is to modify the embargo system with another mechanism that would provide local farmers with protection from imports while giving importers more flexibility. One approach is the implementation of a variable tariff on produce imports. Currently, produce imports are subject to tariffs ranging from five to ten percent *ad valorem*. Therefore the apparatus is already in place to collect tariffs from produce imports. The proposal here is to adjust these tariffs seasonally in response to local production. When local production is significant, tariffs would be increased to 30-50 percent. Tariffs at this level would establish a sizeable price wedge between domestic and imported product.

Seasonal tariffs could be activated two ways. One approach is simply to announce *a priori* the exact timing of the increased tariff. For example, the primary season for broccoli is January through mid-May. Government would announce that the tariff on broccoli is at an increased level during that period. On May 15, the tariff would be reduced to a lower level and remain there until the following January.

The other approach is a modification of the present system. When Government determines there is sufficient local production, the tariff would be increased to a level to discourage imports. As the season ends and Government establishes that imports are needed, the tariff is reduced.

The main advantage of seasonal tariffs is the increased flexibility provided to importers. For example, restaurants that desire a special variety of a certain product would likely be willing to import that product with a high tariff. Furthermore, since the restaurant would not or could not buy that product from a local farmer, this importation would not represent substitution of imports for local production. Another obvious advantage is additional tariff revenue would be collected.

The pre-announced approach to implementation of a seasonal tariff system offers the additional advantage that both farmers and importers would know exactly when higher levies are in force and could plan accordingly. Furthermore, Government Marketing Centre personnel would not be required to check if farmers do in fact have product available for sale. On the other hand, this approach is a major change from the present system; the second approach involves simply replacement of the embargo system with variable tariffs. The Government Marketing Centre would still play a central role in adjusting the tariff and monitoring local production.

The main drawback to this approach is that importation would be allowed when local produce is available. It is possible that some import substitution could occur. If tariffs are set at the appropriate level, however, it is likely that only specialty products would be imported and import substitution should not be an issue.

7.3.2 Change in Services Provided by the Government Marketing Centre

There was extensive comment regarding the Government Marketing Centre during our discussions with farmers, retailers, importers, and others; there was little consensus on whether the role of the Government Marketing Centre should be expanded. The most radical proposal is to return the Government Marketing Centre to the role it held several years ago when all produce was brought to the Centre; it functioned essentially as a central market for produce.

The advantages of creation of a central market for produce is that marketing costs for many items would be substantially reduced, and with more buyers facing more sellers, the price determination process would be more efficient. The parade of delivery trucks from various farmers passing each other as they travel the island would cease. A central market would also facilitate the implementation of a produce grading system overseen by Government personnel. The clear disadvantage is that the present facility for the Government Market Centre is inadequate to serve as a central market for all produce grown on the island. A new facility would be needed at substantial cost.

While some smaller farmers and several produce buyers supported the idea of a central market, most large farmers were opposed. These individuals are those who have established a base of clients and believe that they benefit under the present marketing system. These are the same individuals, however, that indicate that 50 to 75 percent of their hired labor costs are associated with post harvest handling and delivery. Creation of a central marketing centre would substantially increase the participation of Government in agriculture. It would likely entail increased government expenditures to staff and properly run the facility.

There was little criticism of the present operation of the Government Marketing Centre except in two areas. The present architecture of the facility is such that forklifts are not used. In most cases, deliveries are offloaded by hand. Low clearance at the opening of storage rooms limits the volume that can be stored in those rooms. Therefore, Government should consider the cost of remodeling the Centre structure to improve the efficiency of operation. The other complaint refers to the use of non-professional personnel at the Centre. There is a general feeling among farmers that these individuals are presently under-employed. Dealing with the issue of remodeling the Centre facility might result in a need for fewer employees to perform the tasks required to provide the present level of services.

7.3.3 Government Purchase of Potatoes

Presently, Government guarantees the purchase of 10,000 bags of potatoes at a fixed price of \$23.40 per bag. Once the supply of potatoes from farmers has been exhausted, Government becomes the prime supplier of potatoes from its stockpiles. There is general agreement that the quality of government-stored potatoes is often poor. It is suggested that Government halt the potato purchase program. In its place, producers could avail themselves of storage at the Government Marketing Centre at nominal cost.

The advantage of this proposal is that it would effectively end direct government support of potato production in Bermuda. The embargo system or the variable tariff system proposed in Section 7.3.1 would still insulate Bermuda potato farmers from potato imports. Another advantage of this proposal is that producers might be more careful in selecting which potatoes to put into storage. Given the fact that producers would retain ownership of stored potatoes means that they would incur the losses associated with

potatoes that rot during storage. The main disadvantage associated with this proposal is that an important component of government support to agriculture would end. Some of the smaller farmers depend upon the government potato purchase for income support. Its end might result in these farmers exiting agriculture.

7.3.4 Tariffs on Farm Inputs

Presently, Government imposes import duties on a wide array of farm inputs including irrigation equipment, spare parts for farm machinery, and administrative fees on the importation of farm workers. Inputs imported through the Government Marketing Centre are also subject to tariff including cartons and bags. It is proposed that all farm inputs be allowed to enter Bermuda duty-free. To limit abuse of this exemption, farmers would be required to keep adequate records to ensure that imports imported duty-free are in fact used on farm.

The advantages of this proposal are that input purchase costs for farmers would be reduced. This would ultimately lower the cost of production which, in turn, would lower consumer produce prices. The main disadvantage of this proposal is the loss of government revenue from reduced collection of import duties.

7.3.5 Government Support of Backyard Gardeners

Presently, Government provides little support to backyard gardeners. The Paget Community Garden and the Farmers' Market are two examples of government involvement in this activity. If domestic food production and maintaining open space are important goals of Government policy, increased Government support for backyard gardening may be advisable. It is proposed that Government hire a full-time

horticulturist to provide technical assistance and advice primarily to backyard gardeners and part-time farmers. This individual would need at least a B.S. in horticulture or agronomy plus some experience or preferably, an M.S. in horticulture with some training in economics and marketing. The main advantage to this proposal is the provision of technical advice related to pests, disease, and soil fertility, as well as advice on marketing surplus production. The main disadvantage is the cost to Government, which is estimated to be \$50-60,000 per year.

It is also proposed that Government widen the community garden program through purchase or leasing of agricultural lands. The vacant parcel located between the Government Marketing Centre facility and the stadium would represent an excellent site.

7.3.6 Certification of Organic Produce

Although organic agricultural production operates on a limited scale in Bermuda, there does appear to be substantial demand for organic produce in Bermuda. It is not clear how encouragement of organic food production fits into Government policy goals, but may serve as further encouragement for backyard gardening, providing attendant increases in domestic food production and conserving open space. If encouragement of organic production is identified as a policy goal, it is proposed that Government initiate a certification program for Bermudian-grown organic produce. Such a certification program would entail the addition of at least one professional staff member. It is possible that the position recommended under Section 7.3.5 could be combined with this position.

The greatest challenge facing organic farmers in Bermuda is the lack of natural sources of nitrogen. With limited animal agriculture in Bermuda, composted manure is not widely available. Importation of composted manure would likely occur at prohibitive

cost. Therefore, the goal of the certification program could focus on pesticide-free agricultural production. The term “Bermuda Organic” might not coincide with organic certification in other countries, but would still accomplish what a portion of consuming public desires: food produced without pesticides.

7.3.7 Review of Phytosanitary Restrictions on Produce Imports

Given its tropical climate, high level of transient residents, and high level of importation, it is prudent that Bermuda impose strict sanitary and phytosanitary (SPS) measures to protect its natural environment and prevent the importation of pests, diseases, and exotic plants. One can already see that Brazilian pepper has become a plant that has become established in Bermuda and threatens the survival of naturally occurring species. On the other hand, some SPS measure can evolve into trade barriers that unnecessarily restrict the importation of products desired by consumers. It is suggested that all SPS measures that relate to agricultural products be reviewed. The purpose of this review is to verify that there are risks that can be scientifically validated associated with the importation of particular products. To assure that the review is conducted in an unbiased manner, outside experts should be consulted.

7.3.8 Technical Support for Commercial Farmers

Currently, there is one Government employee who is responsible for both overseeing the embargo system as well as providing technical support and advice to farmers. When surveyed regarding the source of new information related to new varieties, pest control, and other issues, most commercial farmers responded that the Government Marketing Centre was their primary source. While the review team found a

high level of technical expertise among the commercial farmers, we found the lack of access to new production practices to be a concern. Therefore, it is suggested that Government make a commitment to increasing the awareness of commercial farmers of new technology. This could be accomplished in several ways; two are suggested here.

One approach would be to identify an individual(s) in the United States or Europe who would be placed on retainer. This individual would travel to Bermuda at least once yearly to inspect agricultural operations, make recommendations, and make presentations regarding new production practices. The estimated cost of this approach is \$20,000 per year. Another approach is to hire an additional staff member who is trained in the evaluation of new production practices including new varieties. The Department of Agriculture and Fisheries had an individual performing these duties in the early 1990's, but has not replaced this person since their retirement. The second approach is more expensive than the first approach, but more services would likely be provided by a full-time employee versus a part-time consultant.

7.4 Closing Comments

A large volume of information has been presented in this report. It is the hope of the review team that the citizens of Bermuda find this information useful in their deliberations regarding agriculture in Bermuda. The review team would argue that this effort represents a good "first step" in initiating a dialogue among commercial farmers, backyard gardeners, produce importers, consumers, and Government. It is suggested that the next step be a strategic planning exercise led by Government and the Agricultural Board. The goal of the strategic planning effort is to articulate Government policy with respect to agriculture. Will agriculture play a role in Bermuda's future? Are there other

approaches to maintaining open space besides a subsidized agricultural sector? Is it wise to become fully dependent upon imports to meet the food needs of the island? What role might organic agriculture play in Bermuda? Should Government actively encourage backyard and community gardening? These are a sample of the questions that need to be addressed.