FEASIBILITY STUDY ON STEVIA

Ministry of Agriculture, Fisheries and Mining, Agricultural Services Unit

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Scope of the Research

The research will focus on analysing the feasibility of growing stevia locally. The analysis will be categorized under four (4) broad headings, namely; technical, operational, market and financial feasibility. Specifically, this study will seek to answer the following key questions, in addition to incorporating other pertinent information on the subject matter:

1. Does Jamaica have the required climatic conditions for stevia production?
2. What varieties of stevia are best suited to be used as a sweetener?
3. Is the production of stevia a financially viable venture for Jamaica?
4. Is there global acceptance of products derived from the stevia plant?
5. Does Jamaica have the requisite infrastructure to produce steviol glycosides?

Main Points of the Report

- Stevia has been successfully cultivated in both greenhouse and open field conditions in Jamaica.
- Stevia thrives in tropical climates with plenty of sun, water, and heat.
- Studies have shown that the stevia “Rebaudiana Bertoni” plant is the sweetest of all varieties.
- For optimum growth, a stevia plant prefers acidic to neutral (pH 6-7.5) soil and requires a constant supply of moisture.
- Stevia leaves are 25-30 times sweeter than table sugar while steviol glycoside is 250-300 times sweeter than sugar.
- Stevia is classed as “zero-calorie” because of the low-calorie content.
- According to Innova Market Insights, new global product launches with stevia are averaging an annual growth of 15% every year (from 2016 to 2021).
- King’s Jamaican Health & Wellness Company, is the only known manufacturer of products containing stevia in Jamaica.
- Stevia is relatively unknown; over 35% of consumers globally are still not aware of stevia.
- The preliminary local cost of production for stevia is $301/kg.
- Currently, the stevia plant is commercially cultivated in Argentina, Brazil, Columbia, Paraguay, China, Japan, Malaysia, South Korea, Vietnam, Israel, Australia, Kenya, and the United States. High-purity steviol glycosides are approved sweeteners by all major regulatory authorities across the globe.

Introduction

Stevia, also referred to as sweet leaf, is a small shrub that belongs to the Asteraceae family. It is said to originate in the wilds of South America (Paraguay); where it has a long history of being used by the Guaraní people. It thrives in semi-arid environments such as grassland, scrub woodland and mountainous terrain. The use of stevia can be dated back to the sixteenth century where the plant was used as a sweetener and for medicinal purposes.

Stevia is grown for its sweet-tasting leaves and reaches a height of 1-2.5ft. The leaves contain a number of sweet-tasting chemicals known as steviol glycosides, which can be used fresh or dried to sweeten beverages or desserts and can also be commercially processed into powdered noncaloric sweeteners. Steviol glycosides, particularly the chemicals *stevioside* and *rebaudioside A*, can be more than 300 times sweeter than table sugar and are nonglycemic (i.e., they do not affect blood glucose levels). Touted as a healthier alternative to sugar, stevia sweeteners grew in popularity worldwide in the early 21st century.

Varieties of Stevia

The family of Stevia has approximately 240 varieties; however, six varieties are considered the most dominant. These are: stevia eupatoria, stevia ovata, stevia plummerae, stevia salicifollia, stevia serrata, and stevia rebaundiana. The stevia “Rebaudiana Bertoni” plant is considered the sweetest of all varieties (Kinghorn, 2001).

Operational Feasibility

Agronomic Requirement for the Production of Stevia

Climate

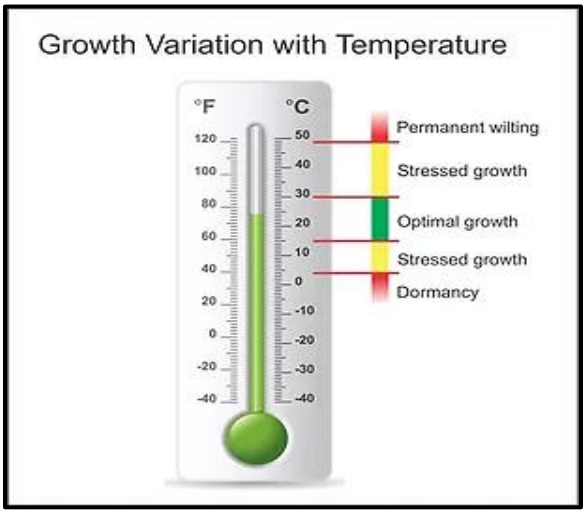
Stevia thrives in tropical climates with plenty of sun, water, and heat. According to Kinghorn (2001)," while stevia can be grown in a variety of climates, it is most commonly planted in areas where the plant will obtain approximately 12 hours of sunlight, which it needs to produce steviol glycosides, the sweet components in the plant's leaves".

Planting and Soil Type

Stevia thrives in organically rich, well-drained sandy loam or loamy soil. For optimum growth, it prefers acidic to neutral soil (pH 6-7.5) and requires a constant supply of moisture. It grows in low-lying areas next to the marshes on sandy acidic soils.

Figure 1

Growth variation with temperature for the Stevia Plant.



Source: Stevia Technology

For the optimal growth of a stevia plant, it thrives within a temperature range of 15 to 30 degrees Celsius. Any temperature extremes, whether too cold or too hot, can hinder its growth and lead to wilting.

Table 1

Soil requirements for growing a Stevia Plant.

Parameters	Acceptable range
pH	6. –7.5
Organic carbon as a measure of available nitrogen	> 0.5%
Available nitrogen by alkaline permanganate method	> 400 Kg/ha
Available P_2O_5 by Olsen method	> 90 Kg/ha
Available potassium by neutral ammonium acetate method	> 250 Kg/ha
Calcium by neutral ammonium acetate method	> 3.0 milliequivalent/100g
Magnesium by neutral ammonium acetate method	> 2.0 milliequivalent/100g
Zinc by DTPA method	> 0.6 ppm
Manganese by DTPA method	> 2.0 ppm
Copper by DTPA method	> 0.2 ppm
Iron by DTPA method	> 2.0 ppm
Boron by hot water extraction method	> 0.5 ppm
Molybdenum by ammonium oxalate method	> 0.2 ppm

Source: Stevia Technology

The soil pH should fall within the range of 6 to 7.5 for it to be considered acceptable as seen in Table 1. The table depicts the optimal soil conditions for the stevia plant, highlighting varying levels of nitrogen, magnesium, iron, and manganese.

Fertilizer Requirement

According to a case study conducted by the Department of Horticulture India, the recommended fertilizer dose for stevia is 60:30:45 kg NPK per hectare under tropical climate conditions.

Pest and Disease Control

Stevia cultivation is most efficient in tropical climates. However, these conditions are ideal for the development of pests that negatively affect the crop growth. The main pests and diseases which affect the plant are identified in Appendix 3.

Spacing in Plantation

Transplanting of stevia is done on raised beds. The raised beds should be about 12 to 15 cm tall and 50 to 60 cm in width. Row-to-row separation should be 40 to 45 cm and plant-to-plant spacing should be around 30 cm. This count gives Stevia plant density of 20,000 to 25,000 plants per acre of land.

Propagation

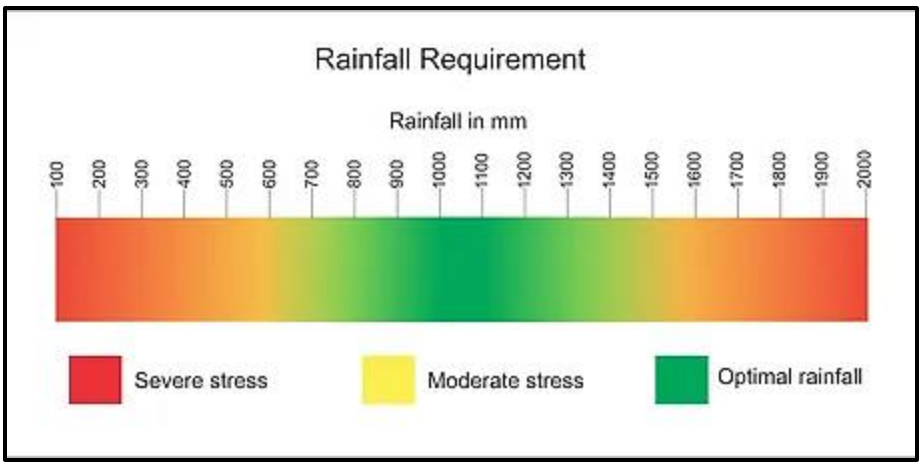
Stevia seeds need direct sunlight for germination; and will not germinate if covered by soil. Therefore, vegetative propagation is the preferred method for growing the commodity.

Irrigation and Water Requirements

Stevia cannot grow in dry conditions and as such; irrigation is the most significant part of stevia farming. Typically, the sprinkler system or by drip irrigation technique, however, sprinkler irrigation is found to be advantageous since the herb is highly sensitive to water stress and requires frequent light irrigation.

Figure 2

The rainfall requirement for a Stevia Plant



Source: Stevia Technology

As observed in Figure 2, the ideal amount of rainfall necessary for the complete lifecycle of the stevia plant ranges from 800mm to 1400mm. This translates to a daily water requirement between the range of 6.6mm and up to 11.6mm.

Harvesting and Storage

The first harvest of the crop can be done four months after planting with continuous harvesting being done once every three months. The ideal time for harvesting stevia is in the morning when it has the highest sugar content. Once stevia leaves are dried, they can be stored for 12 months in airtight containers or plastic bags.

Extracting Steviol Glycosides from the Stevia Plant

Stevia leaves are harvested and dried in order to extract the plant's intense sweetness. Below are the steps used to covert the stevia leaf to sweetener (Real Stevia, 2016):

Step 1: The harvested leaves are set to dry.

Step 2: The dried leaves are steeped in hot water. The water extract is discharged into a holding tank and the spent leaves are discharged unto a conveyor belt.

Step 3: Filtration

Fibers, salts, and the green colour are removed via a series of filters. The undissolved elements are removed using mechanical filters, while the dissolved salts and other ions are separated based on their molecular charge in large columns filled with charged particles that attract the ions needed in order to extract the liquid. Food grade ethanol is poured over the charged particles, causing them to release and mix with the ethanol. This process increases the concentration of steviol glycosides by removing all impurities and contaminants that could affect the taste.

Step 4: Concentration

The majority of the ethanol is captured and stored for later use. This occurs during a concentration step in which the temperature is raised under low pressure in order to rapidly and efficiently evaporate the ethanol.

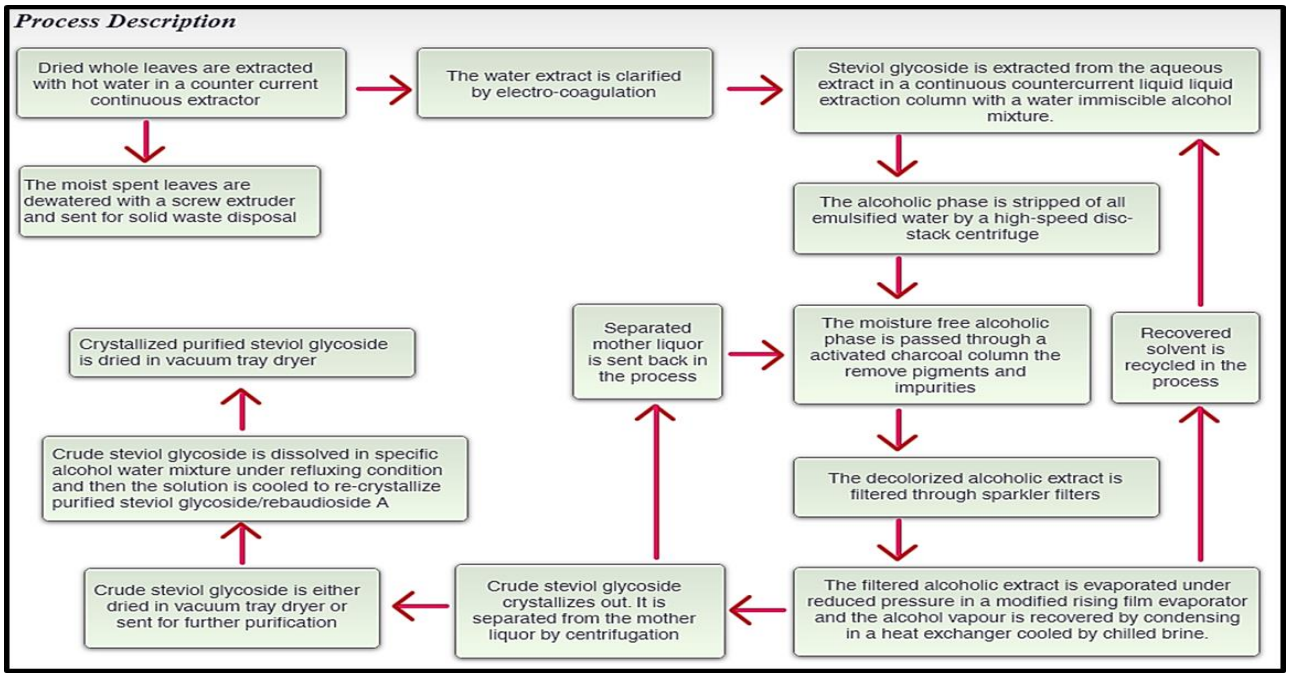
Step 5: Drying and Crystallization

A large tower is used to dry the concentrated steviol glycoside and ethanol mixture using the spray drying technique. The spray drying process entails spraying the liquid

into the tower while warm, clean air is blown into it. The liquid quickly dries, and the crystallized steviol glycosides fall to the bottom of the spray dryer, where they are collected. Stevia extract is purified by ultrafiltration and concentrated by nano filtration.

Figure 3

A flow diagram detailing the process of extracting stevia glycosides.



Source: Stevia Technology

The flow diagram above illustrates the process for obtaining steviol glycosides from the Stevia plant. This method ensures the production of high-quality and pure steviol glycosides, which are natural sweeteners widely used in the food and beverage industry.

Market Feasibility

Global Acceptance of Stevia

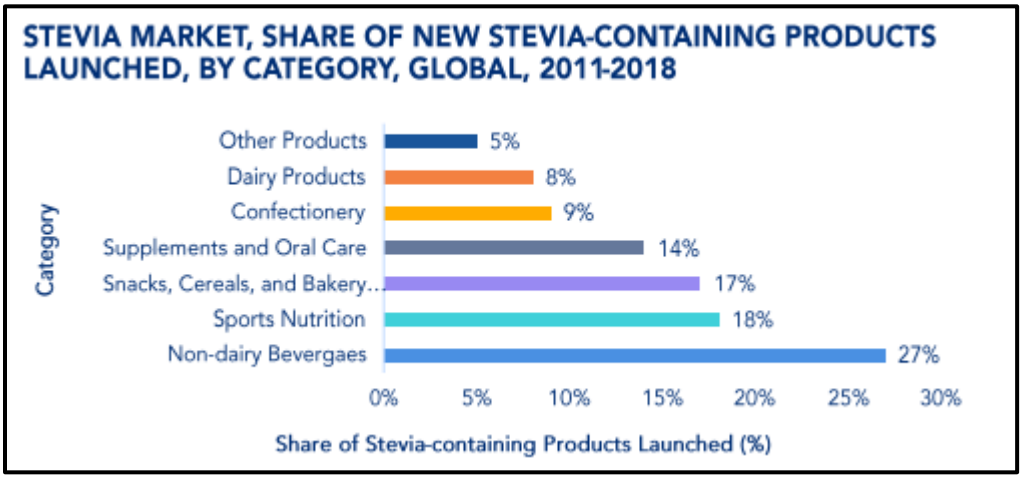
High-purity steviol glycosides are Generally Recognized as Safe (GRAS); a regulatory review process category used by the U.S. Food and Drug Administration (FDA). GRAS requires expert consensus that a food ingredient is safe for its intended use. In 2008, the FDA made its first GRAS determination on a stevia sweetener, rebaudioside A, purified from Stevia rebaudiana (Bertoni). However, whole stevia leaves and crude stevia leaf extracts are not approved food additives because there is not enough toxicological information available, according to the FDA. Therefore, stevia leaves and crude stevia leaf extracts are only used in dietary supplements as they are not subjected to FDA food additive regulations. Similarly, the European Food Safety Authority (EFSA), the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and many other regulatory agencies recognize steviol glycosides as safe for human consumption, resulting in the approval of stevia sweeteners in over 100 countries.

The global stevia market was estimated to be worth around 750 million U.S. dollars in 2021. By 2026, forecasters predict a growth to over one billion U.S. dollars (STATISTA, 2011). The stevia plant is now commercially cultivated in Argentina, Brazil, Columbia, Paraguay, China, Japan, Malaysia, South Korea, Vietnam, Israel, Australia, Kenya, and the United States. High-purity steviol glycosides are approved as sweeteners by all major regulatory authorities across the globe. According to ABC Machinery, the increasing consumer awareness of the health benefits of low-calorie consumable products is a major catalyst for the market's growth of Stevia. As the number of obese and diabetic people rises, stevia is likely to become the best sugar alternative due to its

zero-calorie property. Ground stevia can also be sprinkled with lightly overcooked vegetables, meat, cereals, and salads. Besides adding a sweet taste, it significantly enhances the flavour and nutritional value of food, thereby leading to its increased demand in the market. The global demand for clean-label or natural food products is rising, owing to growing consumer awareness of the adverse health effects of artificial ingredients. Stevia is the only natural high-intensity sweetener that fits best to zero/reduced calorie or no-calorie food products.

Figure 4

Percentages of Stevia- containing products in the Stevia Market (2011-2018)



Source: Mordor Intelligence

Within the Global Market, stevia-containing products are categorized by dairy products, bakery, beverages, confectioneries, dietary supplements, and other applications. Among these segments, beverages hold the largest share, accounting for 27% of the market, whereas dairy products have a comparatively smaller share of 8%.

Figure 5

Examples of stevia-based products that has emerged in the Global Market

Source: Stevia Technology

The beverage sector has been a major driver of the demand for stevia. Stevia is being used as a natural, calorie-free sweetener in beverage products to mitigate against obesity and diabetes. The strict regulation on the use of artificial sweeteners is leading to increased demand for natural sweeteners like stevia in China (Asia-Pacific).

Some of the top manufacturers of stevia include:

- GLG Life Tech Corporation – (Ice-Tea, Baked goods, Beverages)
- PureCircle Ltd. - (Stevia Sweetener)
- Tate & Lyle PLC – (Cereal Bars, Yoghurt, Low Calorie Iced-Tea)
- Stevia First Corp- (Stevia Sweetener)
- Sweet Green Fields LLC- (Sauces, Jams, Diary)

Derivatives of Stevia

Based on product form, the market is segmented into four categories, namely, powdered, liquid, crude and leaf. In 2021, the stevia market was valued at USD 790.6 Million (Emergen Research, 2021).

What Does the Future Hold for Stevia?

The numerous health benefits that stevia provides have attracted the attention of manufacturers for the utilization of the product in yogurt, tea, coffee and drinks. According to Innova Market Insights, new global product launches with stevia are average an annual growth of 15% during the period 2016 to 2021. The data also show that global product launches with stevia have increased by 21.9% over the past 10 years (2011 to 2021). For this period, the majority of product launches took place in North America, Asia and Western Europe. Furthermore, there has been an increase of more than 35% of new product launches with stevia in regions such as Eastern Europe, Australia, Africa and the Middle East in this same time period. Codex Alimentarius is a collection of standards, guidelines and codes of practice adopted by the Codex Alimentarius Commission, which is part of the joint Food and Agriculture Organization/World Health Organization food standards program. Codex has approved steviol glycosides production technologies, which is expected to open more markets for the use of stevia. However, data analysis from the market researcher highlights that over 35% of consumers globally are still not aware of stevia.

Top Exporters & Importers

Table 2

Top exporters & importers of stevia powder (2021).

Name of Country	Export Value (USD)	Share in Export Value (%)	Import Value (USD)	Share in Import Value (%)
China	$365.23M	16.94	$296.5M	13.77
France	$327.47M	15.19	$99.9M	4.64
Thailand	$229.25M	10.63	-	-
Netherland	$191.07M	8.86	$108.5M	5.04
United States of America	$151.07M	7.01	$178.5M	8.29
Belgium	$97.71M	4.53	-	-
Indonesia	$81.54M	3.78	$98.2M	4.56
Germany	$81.25M	3.77	$151.3M	7.03
Malaysia	$77.13M	3.58	-	-
Austria	$51M	2.37	-	-
United Kingdom	-	-	$72.1M	3.35
Ireland	-	-	$68.6M	3.19
Philippines	-	-	$54.5M	2.53

Source: Tridge

Table 2 above highlights China as the largest exporter of stevia in 2021 accounting for 16.94% of the year's export value share totalling $365.23M. Additionally, China was the largest importer of stevia in 2021 accounting for 13.77% of the year's import value share totalling $296.5M. From the information gathered, we can conclude that China is the largest producer, exporter and importer of stevia in the world.

Jamaica's Stevia Development

The research shows that stevia has been grown in Jamaica on a small scale. Furthermore, a Gleaner article written by Mr Paul Williams in 2011, highlighted Mr Linton Neil as being a farmer of the crop. From the article, it was noted "Linton Neil's preferred way of propagating the shrub is by cutting the stems and setting them in

water. After roots have sprouted, he would transfer them to pots. The article further stated that Mr Neil boiled the stevia leaves with other herbs such as mint and fever grass to make teas. By so doing, there was no reason to add table sugar. When contacted, Mr. Neil informed us that he is no longer growing the stevia plant and has ventured into other commodities such as St. Vincent yam (purple yam).

Keith Bingham, a retired farmer, was also identified as a former stevia planter. Mr Bingham imported his seeds from the USA and grew his plants in a nursery. His growing method was sowing the seeds in a seed tray. He would then transfer the seedlings into pots until the plant is ready for harvest. Mr. Bingham planted stevia for recreational purposes; however, he discontinued his practice approximately 10 years ago. Currently, King's Jamaican Health & Wellness Company is importing stevia powder and using it as the sweetener for their products for approximately one year; specifically, in their line of tea sachets (coffee, cocoa, chocolate) and Moringa water.

Figure 6

Local products with Stevia being used as sweetener- King's Jamaican.

Source: King's Jamaican

The health effects of sugar-based food and beverages on relatives and close family friends were the ultimate motivation for Mr Alexander Archer, founder of the King's Jamaican brand to begin his venture. Mr Archer was inspired to start his own stevia production after receiving positive feedback for his products. He had imported seedlings to cultivate the plant, however owing to poor agronomic practices, the plants died. Mr. Archer is now importing the stevia powder to use in his products. King's Jamaican products can be purchased in select pharmacies and supermarkets across the island. It is also available on websites such as www.kingsjamaican.com, amazon.com and Walmart.com. Mr Archer has recently expanded his line of stevia products to include ketchup and jerk sauces. Noteworthy, the company Tai Tai is another example of a local company that utilizes stevia sweeteners. Representatives from the company expressed that stevia is the preferred choice of 35% of their customer base. Stevia sweetener is particularly popular among the older clientele and individuals who have explicitly expressed a preference for Stevia over honey or sugar. The company purchases Stevia sweetener at PriceSmart for a total price of $1,815.85. At present, local supermarkets such as Pricesmart import stevia powder and market it under their Member's Selection brand. Caribbean Dreams was also identified as an importer of stevia powder, which is used to sweeten their cinnamon mint herbal tea. The success of stevia growth in Jamaica on a small scale is evidence that there is potential for its commercialization.

Financial Feasibility

An Economic Analysis of Stevia Cultivation in Jamaica

Stevia is considered to be a safer and healthier sugar substitute that can sweeten foods without the negative health effects linked to table sugar. It's associated with several impressive health benefits, such as reduced calorie intake, lower blood sugar levels, and risk of cavities (Link, 2019). As was highlighted previously, the plant is commercially grown in many countries and continues to gain popularity within the global manufacturing industry. In Jamaica, the plant is predominantly unknown and as a result, limited information is available. The Economic Planning Division of the Ministry of Agriculture, Fisheries and Mining recently conducted a preliminary cost of production for stevia in which it was stated that it would cost $301 to produce a kilogram of stevia, conversely, cost of production information obtained from the Sugar Industry Authority placed the cost to produce a kilogram of sugarcane at $8.54.

Table 3

Price comparison per kg sugar cane and stevia. Source Sugar Industry Authority

SUGAR	STEVIA
Cost of Production (KG)	**Cost of Production (KG)**
$8.34	$363.00

***Source:** Economic Planning Division MOAF.*

The prices above indicate that the cost to produce sugar cane is approximately 44 times more economical than stevia (See appendices 1 and 2 for detailed cost of production). It is to be noted that sugar cane has been grown in Jamaica for over half a century, while stevia is relatively new to the country and is not commercially grown locally. The tenure of these commodities could be a contributing factor to the vast difference between their local costs of production as reported.

Technical Feasibility

The processing of stevia involves the extraction of steviol glycosides contained in the leaves of the plant, and further processing resulting in the formation of crystals or powder for distribution. Food laboratories therefore appear to be the primary infrastructure required for the local production of steviol glycosides to be used in consumption.

Currently, there are seven accredited food labs in Jamaica; all of which have conveyed that they lack the necessary machinery for processing the stevia plant into steviol glycosides.

Figure 7

Stevia Machine used for extracting Steviol Glycosides

Source: Alibaba

Figure 7 displays a specialized equipment designed for the extraction of steviol glycosides from the stevia plant, ensuring efficient and high-quality production. This machine has the capacity to be modified to process other commodities. However, the

specific capabilities and compatibility of the stevia machine with other commodities would depend on factors such as the nature of the commodities.

Figure 7a

Essential details of Steviol Glycoside Extraction Machine

Place of Origin:	Zhejiang, China	Brand Name:	wenxiong
Model Number:	DNT	Application:	Liquid
Condition:	New	Warranty:	5 years
Applicable Industries:	Food & Beverage Factory	Key Selling Points:	Multifunctional
		Showroom Location:	United States, Colombia
Video outgoing-inspection:	Provided	Machinery Test Report:	Provided
Marketing Type:	New Product 2020	Warranty of core components:	5 years
Core Components:	Motor	After-sales Service Provided:	Engineers available to service machinery overseas,
Function:	extraction and concentration	Model:	DNT200
Total volume of extractor:	220L	Heating area:	0.96 m2
		Total volume of sediment tank:	230L
Steam consumption:	150 kg/h	Vacuum pump power:	2.2 kw
Motor power of concentrator:	0.37 kw	Dimension (L*W*H):	2.8*0.975*2.5 m
		After Warranty Service:	Online support
Local Service Location:	Argentina, United States, Mexico, Colombia, Brazil, Chile		

Source: Alibaba

Usage:

This machine is widely used in studying the parameter for new processes in Research and Development and new medicine research in the herb's extraction processes at universities and in labs.

Machine composite:

This machine includes the following units: extractor tank, sediment tank, single effect concentrator, condenser, oil/water separator, vacuum pump, sanitary pump, pipeline and control panel. All systems use SS support frame.

Machine operation mode:

Manual operation & automatic operation.

Cost: The cost of the machine ranges between $US20,000.00 - $US30,000.00.

Conclusion and Recommendation

In conclusion, the plant can be grown on the island and a growing global demand for steviol glycosides has been observed. The Rebaudiana Bertoni variety has been identified as the most suitable for use as a sweetener, as mentioned earlier. Moreover, stevia is a highly marketable commodity due to its numerous health benefits, and research confirms that stevia sweeteners contribute very low to 0% calories or carbohydrates to the diet, which means it will not contribute to your weight gain.

It is worth noting that acquiring the machine depicted in Figure 6 would enable the Scientific Research Council (SRC) to extract stevia glycosides. Furthermore, the FDA has granted approval for the Generally Recognized as Safe (GRAS) status of powdered stevia, ensuring its safety for consumption. However, it should be acknowledged that the crude extract and stevia leaves have yet to receive GRAS recognition. Additionally, a significant concern is the financial outlay required to produce the crop commercially, at $363.00/kg, local farmers may not be incentivized to plant the commodity if a well-established and consistent demand is not available.

In light of these factors, it is not recommended that the Ministry advises farmers to plant stevia until the FDA grants approval for the GRAS status for stevia leaves and its crude extracts.

References

Arpita Das, M. B. N. M. (2010, October 4). *An economic analysis of Stevia (stevia rebaudiana bert.) cultivation through stem cutting and tissue culture propagule in India*. Science Alert. Retrieved from https://scialert.net/fulltext/?doi=tae.2010.216.222

Hossian, M. et al (2017). Cultivation and Uses of Stevia (Stevia Rebaudiana) A Review. African Journal of Food, Agriculture, Nutrition and Development, 12745-12757.

Huber Brandon, B. E. (2016). e-Gro Alert. Retrieved from e-Gro Alert: https://www.e-gro.org/pdf/2016_539.pdf

Import Alert 45-06, (2021). Retrieved from the U.S. Food and Drug Administration https://www.accessdata.fda.gov/cms_ia/importalert_119.html#:~:text=With%20regard%20to%20use%20in,subject%20to%20food%20additive%20regulatio

Kinghorn, A.D. (2001). Stevia: The Genus Stevia. Taylor & Francis Inc.

Links, R. (2019). Is Stevia Safe? Diabetes, Pregnancy, Kids, and More. Retrieved from Healthline: https://www.healthline.com/nutrition/is-stevia-safe

Petruzzello, M. (n.d.). Britannica. Retrieved from Britannica: https://www.britannica.com/plant/stevia-plant)

Ministry of Agriculture and Fisheries, Economic Planning Division: Stevia Cost of Production

Mini Stevia Extraction Machinery. Mini Stevia| Steviol Glycoside Extraction Machinery| Technology at Factory Price. (n.d.). Retrieved from http://www.bestextractionmachine.com/herbal-extraction/mini-stevia-extraction-machinery.html

Rawhi, S. A. (2016). Feasibility of growing Stevia (Stevia rebaudiana) at Jabal Al-Akhdar, Journal of Agricultural and Marine Sciences Vol. 22, 63-66.

Ramesh, K. (2006). Cultivation of Stevia [Stevia rebaudiana (Bert.) Bertoni]: A Comprehensive Review. Retrieved from Science Direct: https://www.sciencedirect.com/science/article/abs/pii/S0065211305890030

Samuel, P., Ayoob, K., Magnuson, B., Wölwer-Rieck, U., Jeppesen, P., Rogers, P., Rowland, I., & Mathews, R., (2018). Stevia Leaf to Stevia Sweetener: Exploring Its Science, Benefits, and Future Potential, *The Journal of Nutrition*, Volume 148, Issue 7, Retrieved from https://doi.org/10.1093/jn/nxy102

Stevia cultivation project report, cost and Profit. Agri Farming. Retrieved from https://www.agrifarming.in/stevia-cultivation-project-report-cost-and-profit

Stevia extraction technology. stevia. (n.d.). Retrieved from https://www.steviashantanu.com/

Stevia Industry - Statistics & Facts. (2021). Retrieved from STATISTA: https://www.statista.com/topics/2304/stevia industry/#dossierContents__outerWrapper

Stevia market analysis - industry report - trends, Size & Share. Stevia Market Analysis - Industry Report - Trends, Size & Share. (n.d.). Retrieved from https://www.mordorintelligence.com/industry-reports/stevia-market

Stevia -plant cultivation - 5.imimg.com. (n.d.). Retrieved from https://5.imimg.com/data5/SELLER/Doc/2021/3/RD/MU/LP/86539219/stevia-plant-contract-farming.pdf

Sugar Industry Authority, Research Projects Branch: Cane Sugar Cost of Production and Prices

The Authoritative Voice for the Stevia Industry. (2022, January 21). Retrieved from https://internationalsteviacouncil.org/resource-center/2019-conversation-analysis/

Umesha, K., Smitha, G., Sreeramu, B., & Waman, A. (2011). Organic manures and bio-fertilizers effectively improve yield and quality of stevia (Stevia rebaudiana). Journal of Applied Horticulture, 13(02), 157–162. https://doi.org/10.37855/jah.2011.v13i02.36

Williams, P. H. (2011). Linton Neil grows stevia, the 'sugarleaf' plant. Gleaner.

Appendices

Appendix 1

SUGARCANE COST OF PRODUCTION ESTIMATES 2023

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Land Preparation							
Ripping (optional)							
Harrowing/Ploughing (Three cuts or operations)/Hectare	92,290						
Furrowing per hectare	29,323						
Sub-Total	**121,613**						
Planting							
Seed cane (material) per hectare	80,000						
Load seed cane per hectare	5,167						
Transport seed cane	11,200						
Scatter seed cane							
Drop & chop seed cane (manually) 4 men for 2 days	23,558						
Covering (mechanically)	33,333						
Cover row ends (2 persons/day for 2 days)	11,779						
Sub-Total	**155,411**						
Fertilizing							
Fertilizer (material 50kg per bag.@ 3 bags/acre (14-28-14)	87,000	87,000	87,000	87,000	87,000	87,000	87,000
Fertilizer (materia,l 50kg per bag.@ 2 bags/acre (16-9-18 or 17-0-17)	44,000	44,000	44,000	44,000	44,000	44,000	44,000
Load and Transport fertilizer	1,463	1,463	1,463	1,463	1,463	1,463	1,463
Drop fertilizer (per bag) $300 per bag	3,750	3,750	3,750	3,750	3,750	3,750	3,750
Sub Total	**136,213**	**136,213**	**136,213**	**136,213**	**136,213**	**136,213**	**136,213**
Weed Control							
Pre - emergence / early post - Material	12,745	12,745	13,183	13,183	13,183	13,183	13,183
Labour cost to apply per hectare	5,143	5,143	5,143	5,143	5,143	5,143	5,143
Spot Spraying - material	5,045	5,045	5,045	5,045	5,045	5,045	5,045
Labour cost (Second application)	3,893	3,893	3,893	3,893	3,893	3,893	3,893

Spray field edges - Material	5,595	5,595	5,595	5,595	5,595	5,595	5,595
Labour cost	6,081	6,081	6,081	6,081	6,081	6,081	6,081
Sub Total	**38,502**	**38,502**	**38,939**	**38,939**	**38,939**	**38,939**	**38,939**
Supplying							
Seed cane (material) – 2.5 tonnes per hectare	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Load and transport seed cane (job; $3750)	5,438	5,438	5,438	5,438	5,438	5,438	5,438
Supplying (2 persons/day for 2 days)	10,250	10,250	10,250	10,250	10,250	10,250	10,250
Sub Total	**30,688**	**30,688**	**30,688**	**30,688**	**30,688**	**30,688**	**30,688**
Inter row cultivation							
Moulding	17,056	17,056	17,056	17,056	17,056	17,056	17,056
Chiseling (optional)							
Tyning (optional)							
Sub - Total	**17,056**	**17,056**	**17,056**	**17,056**	**17,056**	**17,056**	**17,056**
Irrigation & Drainage							
Establish Mains & Drains - Mechanically							
- Manually, $800 / chn	13,200	13,200	13,200	13,200	13,200	13,200	13,200
Maintain Mains and Drains - Mechanically							
- Manually, 2 man days @ $3,000 per day	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Irrigation water @ an average $4,942 per hectare	2,471	2,471	1,236	1,236	1,236	1,236	1,236
Sub Total	**20,436**	**20,436**	**20,436**	**20,436**	**20,436**	**20,436**	**20,436**
Harvesting							
Cut fire guard; optional (4 man days @ $3,000)	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Burn cane (4 men @ $3,000 per burn event)	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Cutting cane /tonne (based on projected tonnes per ha)	49,000	52,750	47,750	45,250	45,250	42,750	41,500
Loading cane	25,944	27,949	25,466	23,939	23,939	22,411	21,934
Transporting cane (infield)	49,340	53,129	48,478	45,551	45,551	42,625	41,763
Contractors fee	7,933	8,550	7,933	7,317	7,317	6,700	6,700
Scrapping per tonne, included in loading cost	3,350	3,601	3,266	3,099	3,099	2,931	2,848

Barbering / stumping, (4 man days per hectare @ $3,000)	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Cess Payment $45 per ton based on projected yield ton per Ha	2,925	3,150	2,869	2,700	2,700	2,531	2,475
Extra charged by some contractors at minimum $100 per ton by projected yield	4,875	5,250	4,750	4,500	4,500	4,250	4,125
Sub Total	**177,384**	**188,241**	**174,529**	**166,526**	**166,526**	**158,524**	**155,669**
Other							
Supervision							
Lease	14,300	14,300	14,300	14,300	14,300	14,300	14,300
Sub - Total	14,300	14,300	14,300	14,300	14,300	14,300	14,300
TOTAL	711,601	445,435	432,160	424,157	424,157	416,155	413,300
Contingencies 10% of total cost	71,160	44,543	43,216	42,416	42,416	41,615	41,330
	782,761	489,978	475,376	466,573	466,573	457,770	454,630
Projected Yield	65	70	64	60	60	56	55
Cost per tonne	**12,018**	**7,013**	**7,467**	**7,798**	**7,798**	**8,192**	**8,295**

Average C.O.P per Tonne for 7 years	**8,357**

Appendix 2

Crop		Stevia
Crop Maturity		6 Months
Reaping Period		5 Years
Planting Distance (l x w)	cm	60 x 30
	inches	24 x 12
Plant Population		21780
Terrain		Relatively Flat Land Farm
Land Preparation		Mechanical
Irrigated/Rain fed		Irrigated
Area	0.4 hectare	0.4 hectare
Man-day Charge (excluding lunch)		$3,000
Projected Marketable Yield (Kg)		8900
Cost of Production $/Kg		**$363**

Labour Operations	Unit	Cost/Uni	Year 1	Year 2	Year 3	Year 4	Year 5
Land Clearing	MD	3000	3,000				
Ploughing	tractor	15000	15,000				
Harrowing	tractor	10000	10,000				
Furrowing	tractor	10000	10,000				
Irrigation Installation	MD	3000	9,000				
Installing Mulch	MD	3000	9,000				
Nursery Operation	MD	3000	18,000				
Transplanting	MD	3000	48,000	24,000	12,000		
Pesticide Application	MD	3000	48,000	48,000	48,000	48,000	48,000
Weed Control	MD	3000	18,000	12,000	12,000	9,000	9,000
Fertilizer Application	MD	3000	6,000	6,000	6,000	6,000	6,000
Harvesting	MD	3000	48,000	72,000	96,000	96,000	96,000
Lunch		500	34,500	27,000	29,000	26,500	26,500
SUBTOTAL			**276,500**	**189,000**	**203,000**	**185,500**	**185,500**
Material Inputs							
Planting Material	packs	10,786	215,720				
Plastic Mulch	rolls	5	95,000		95,000		95,000
Irrigation Equipment	acre	1	320,000				
Water	monthly	3,000	27,000	27,000	27,000	27,000	27,000
Fertiliser:							
NPK 11-22-22	50 kg	13,500	27,000	27,000	27,000	27,000	27,000
Urea	50 kg	14,000	28,000	28,000	28,000	28,000	28,000
Insecticide:							
Agree 50 WP	500 g	4,570	27,420	27,420	27,420	27,420	27,420
Caprid	litre	8,000	24,000	24,000	24,000	24,000	24,000
Fungicide:							
Carbendazim	litre	2,500	7,500	7,500	7,500	7,500	7,500
Diathine	500 g	1,100	13,200	13,200	13,200	13,200	13,200
Herbicide:							
Glyphosate	litre	1,650	3,300				
Fusilade	litre	7,500	22,500	15,000	15,000	15,000	15,000
SUBTOTAL			**810,640**	**169,120**	**264,120**	**169,120**	**264,120**

Other Costs					
**Tools discounted for 5 years	7,000	7,000	7,000	7,000	7,000
Land Charges per crop cycle	15,000	15,000	15,000	15,000	15,000
Supervision (15 percent of labour and mate	163,071	53,718	70,068	53,193	67,443
SUBTOTAL	**185,071**	**75,718**	**92,068**	**75,193**	**89,443**
TOTAL	**1,272,211**	**433,838**	**559,188**	**429,813**	**539,063**

Note: This Model shows a five year cycle to reflect the reaping period of the crop.

Credit :https://vikaspedia.in/agriculture/crop-production/package-of-practices/medicinal-and-aromatic-plants/stevia-cultivationas to be purchased in subsequent years due to each plant producing multiple suckers to start new crop cycle.

Initial land clearing cost are not included given the wide variations present

Appendix 3

Pest and Disease Control

Stevia cultivation is most efficient in tropical climates. Consequently, these conditions are ideal for the development of pests that negatively affect the crop growth. Mainly:

Aphids (General): Aphids are small, soft-bodied insects with long, slender mouth parts that they use to pierce stems, leaves, and other tender plant parts and suck out fluids.

Chemical Control: The most effective method for controlling Aphids is to keep applying dichlorvos, imidacloprid or synthetic pyrethroids

Thrips: Thrips are tiny, slender insects with fringed wings. They feed by puncturing the epidermal (outer) layer of host tissue and sucking out the cell contents, which results in stippling, discolored flecking, or silvering of the leaf surface.

Chemical Control: To reduce pest resistance, use as little pesticides as possible. Apply synthetic pyrethroids like permethrin or conventional insecticides like selecron and caprid***.***

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Tomato Spotted Wilt Virus (TSWV) is known to affect many plant genera, including a recent discovery in Stevia rebaudiana. Chlorotic ring spots, necrosis and wilt are common symptoms of this virus. The virus is transmitted to young plants through insect vectors such as Western Flower Thrips (Frankliniella occidentallis) from other infected plants. Controlling the population of Western flower thrips (Frankliniella occidentallis) is the best practice in managing virus spread as there is no discovered treatment.