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A Review of Market Price Monitoring Systems: Case studies from Barbados, Saint Lucia and Saint Vincent and the Grenadines

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About the World Food Programme

Reaching nearly 150 million people in over 120 countries each year, the World Food Programme is the world's largest humanitarian organization saving lives in emergencies and using food assistance to build a pathway to peace, stability, and prosperity, for people recovering from conflict, disasters, and the impact of climate change.

WFP Caribbean works with national, regional, and international partners to strengthen the region's resilience to the climate crisis, and other risks. WFP adopts a systems-focused approach as part of its capacity strengthening efforts through research and advocacy, digitalization, human resource development, south-south cooperation, and by investing in critical infrastructure and assets. WFP works with partners to provide direct assistance to populations impacted by shocks when events surpass national and regional capacities.

These investments place the most vulnerable people at the centre of efforts to minimize the combined impacts of climate, economic and other shocks on the Caribbean. WFP Caribbean's multi-country strategic plan¹ supports 22 countries and territories across the English- and Dutch-speaking Caribbean through leveraging its expertise in vulnerability analysis and mapping; end-to-end supply chain management; shock-responsive social protection; food systems strengthening and climate risk financing.

¹https://executiveboard.wfp.org/document_download/WFP-0000135918?_ga=2.66316206.168143545.1679498584-1123234837.1677265273

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List of Acronyms

API	Application Programming Interface
ASCYUDA	Automated System for Customs Data
CARICOM	Caribbean Community
CPI	Consumer Price Index
CSO	Central Statistics Office
FAO	Food & Agriculture Organization of the United Nations
FD-ID	Final-Demand Intermediate-Demand (price index)
GSE	Government Sponsored Enterprise
ILO	International Labour Organization
IMF	International Monetary Fund
MIOA	Market Information Organization of the Americas
OECS	Organisation of Eastern Caribbean States
PAHO	Pan-American Health Organization
PPI	Producer Price Index
SDG	Sustainable Development Goals
SIB	Statistical Institute of Belize
SIDS	Small Island Developing States
UN	United Nations
UNCTAD	United Nations Capital Trade and Development Fund
UNECE	United Nations Economic Commission for Europe



UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USDA	United States Department of Agriculture
WFP	World Food Programme
WTO	World Trade Organisation

Executive Summary

Rising global food and energy prices have hampered the ability of people to meet their everyday needs. As part of a UN Joint SDG Fund Programme to support Barbados and OECS member states in tackling the cost-of-living crisis, the United Nations World Food Programme (WFP) mapped and outlined market monitoring processes in the Barbados and Eastern Caribbean countries, with a view towards harmonizing efforts within governments and across the region and strengthening national price monitoring capacities. A robust market monitoring system should provide timely market information across entire value-chains for critical agri-food commodities, from farm to fork, and disseminate at a global scale. This information can be leveraged as an important tool for early warning and forecasting, informing policy tools such as price controls and subsidies that are implementable by governments, identifying opportunities for foreign and domestic investment, measuring current economic patterns and impact of current policies, and calibrating subsidies and assistance programmes for vulnerable populations.

This report focuses on three countries, Barbados, Saint Lucia, and Saint Vincent and the Grenadines and emerges from desk research and interviews conducted with government officials in all three countries. The mapping of market monitoring systems in each country identified that each government has at minimum four institutions that are collecting market information—the central statistics office, the ministry of agriculture, the ministry of commerce, and the department of customs and excise. Each of these units also maps very cleanly to a discrete segment of their country's agri-food value-chain:²

- Customs and excise departments are recording information on trade-flows, specifically the origin, volume, and price of commodities at the port-of-entry into the country. They all use a United Nations Capital Trade and Development Fund (UNCTAD) developed system known as ASYCUDA to administer their custom, capturing information on agri-inputs and other imported agri-food commodities.
- The ministries of agriculture engage with farmers and other producers at the very beginning of the value-chain, collecting market information of most relevance to the farmer. While ideally this would be the farm-gate and freight-on-board or wholesale price that farmers can sell at, in practice the ministries instead collect retail prices due to the difficulty of collecting the former.
- The ministries of commerce monitor price controls and other price agreements via social compact. Primarily they collect data from retailers, and in several situations, they also receive “backdoor” prices paid by supermarkets, major hotels, resorts, and restaurants for produce. They are the most engaged with the wholesale and distribution tier of the value-chain.

²The agri-food value chain refers to the interconnected system of activities, resources, and actors involved in bringing food products from farm to table across all stages, including production, processing, distribution, retail, and consumption. Actors include governments, farmers, businesses, and ultimately consumers.

- The central statistics offices (CSOs) capture market-information at a comprehensive scale with respect to the end-consumer when tabulating the consumer price index (CPI). Food items comprise the largest number of items within CPI and are monitored monthly across all three countries, primarily from supermarkets and other outlets, but also open-air vendor markets in Barbados, and Saint Lucia monitors one such market.

However, except for the customs and excise departments that furnish information to all the other ministries mentioned above, the rest operate in virtual silos, largely unlinked with efforts undertaken by other ministries and without sharing of others' market data. In reality, the ministries of agriculture, ministries of commerce, and statistical organisations naturally complement each other. Each has a unique comparative advantage with respect to market monitoring and together large-scale synergies can be achieved. However, the current compartmentalisation results in duplication of efforts and unexploited synergies.

The ability to calculate highly informative final-demand intermediate-demand (FD-ID) indices can be used as a meaningful measure of performance for a national market monitoring system. FD-ID price indices aggregate prices of goods and services in an integrated manner, dividing demand into stages of final demand and various stages of intermediate demand, making it possible to track the process of price transmission across goods and services while avoiding the double-counting of inputs. This report recommends several concrete propositions for achieving synergies and creating cohesive national market monitoring systems that enable FD-ID indices to be tabulated:

- Market monitoring efforts between ministries should be harmonized with respect to the tier in the agri-food value-chain that they most immediately map to. A coordinating authority should be appointed for all market monitoring efforts throughout the government. For several reasons the CSOs are in a strong position for this function. They have technical proficiency and a unique bird's-eye-view over all data gathering systems the government has at its disposal. They are also already running the largest and most extensive market-price monitoring operations in each of the three countries and are best positioned to achieve economies of scale with respect to data collection.
- Ministries should not duplicate retail market monitoring efforts and instead focus on their comparative advantages. For the CSOs their comparative advantage is retail price monitoring. For the ministries of agriculture, their advantage is farm-gate and wholesale information, and finally backdoor and wholesale price for the ministries of commerce.
- A step-change in dissemination and data-accessibility is required not only to coordinate amongst the ministries, but simply to execute on their existing market-monitoring commitments. Application programming interfaces (APIs) are a must, as they allow instantaneous electronic data-requests by authorized parties for a myriad of purposes including web applications and analytical software. All national market monitoring information across all three ministries should be brought together in a single-source-of-truth, highly visual, interactive dashboard in every country. This can be easily achieved once APIs are available for the data.

This study found other gaps, which if bridged, could enable more accurate and relevant analysis. First there is a dearth of quality baseline information on expenditures, agri-inputs, crop-yield, and geospatial shapefiles to avail of machine-learning and satellite-imagery, two pivotal technologies forging the future of agriculture and market monitoring. Saint Vincent and the Grenadines has made a bold first-step with their new agricultural census, but consumer expenditure surveys and agricultural censuses are between 15 to 35 years old for the countries reviewed. Secondly, personnel, particularly trained in IT and with an interest to do such ministerial work, are very hard to come across due to both recruitment difficulty and lack of resources. Lastly, climate-change and a commitment by all countries to dramatically reduce their food import bill, makes opportunities to strengthen market monitoring more prescient. These countries are faced with the need to quickly adapt to climate change while increasing agricultural productivity and market competitiveness. This will require investment and new policies which cannot be achieved without a clear understanding of the agri-food value chain.

The Caribbean Community (CARICOM) can play a significant role as a regional coordinator for agri-food market monitoring by facilitating the exchange of information, coordinating efforts, and promoting cooperation among its member states. This can lead to improved market efficiency, increased regional integration, and strengthened food security and regional self-sufficiency. To achieve these aims, CARICOM can establish a uniform interoperable coding system for agri-food commodities, a reporting standard for market information, and a single-source of truth dashboard for market-price information with API capabilities. The establishment of a pan-Caribbean market monitoring system has long been on CARICOM's agenda, and this is a necessary pre-requisite to create international-integrated commodity exchanges in the Caribbean. The 25 by 25 initiative by CARICOM, presents a successful model by which the countries of the CARICOM can improve food self-sufficiency, reduce imports, and reduce food-price volatility; a united effort to modernize agri-food market monitoring is a worthy successor in a common ambition towards these same goals.

1. Background and Objective

Global prices of food and other key commodities have experienced a sharp rise since 2020. Following the declaration of the COVID-19 pandemic, FAO's Food Price Index reported a 28.1 percent increase over 2020 (FAO, 2022). The protracted socio-economic impacts and disruptions to global supply chains caused by the COVID-19 have been further exacerbated by volatile climate conditions impeding production, various tightening of exports and more notably, the Ukraine conflict. These events have converged to compound these impacts, consequentially driving inflationary trends upward.

These global repercussions reverberate decidedly through the Caribbean especially as a region heavily reliant on imports. The Caribbean region is extremely diverse in many facets including geography, cultures, economies, and governing systems. Therein exists complex interplays between available resources and capacities for individual countries to maintain stabilisation of prices, which contributes to overall food security. Convergence of micro-macro factors, such as supply chain disruptions, large scale crop loss, can all affect prices at a regional, national, and sub-national level.

Spikes in food prices have serious implications on vulnerable, lower income households in the region where high inequality exists. A WFP/CARICOM regional survey conducted in August 2022 on food security and livelihoods, and the fifth survey since 2020 found that 99 percent of respondents observed a rise in food prices (WFP, 2022). The survey found that those from lower income households tend to experience more widespread and negative impacts related to food consumption and livelihoods. Many also reported high prices in livelihood inputs, which may potentially prolong recovery and stabilisation of prices even as production recovers to match demand (UN News, 2022).

As part of broader efforts to tackle the cost-of-living crisis, United Nations (UN) agencies – WFP, the Food and Agriculture Organization (FAO), and UN Conference on Trade and Development (UNCTAD) have collaborated to elevate the evidence base for governments and stakeholders in responding to this crisis. This study is part of an initiative that is funded by the Joint Sustainable Development Goals (SDGs) Fund to address the impacts this cost-of-living crisis. Tackling these impacts is especially relevant for the Caribbean region due to heavy reliance on food imports and weak linkages across local food systems.

As part of this Joint Programme covering Barbados and the Eastern Caribbean, the WFP is working with governments to identify ways to strengthen the evidence base with respect to food security impacts and to inform the design of appropriate and timely strategies to support populations affected by current crisis and future shocks. This includes contributing towards a robust price monitoring data framework by:

1. Mapping of current market price monitoring systems, processes and tools around the region, identification of gaps and steps to realize robust price monitoring and alert tools.
2. Identifying a set of common indicators to facilitate monitoring and alerts on food, energy, and fertilizer price trends across the region to enable the inclusion of market price data of participating countries under a common digital platform.

3. Providing policy recommendations to strengthen both national and regional market information and other systems to identify and inform responses to shocks, including through the design of tools and technical assistance.

These efforts are part of the WFP's broader commitment to governments to strengthen food systems and social protection systems, critical for promoting food security and ensuring resilience against shocks.

1.1. Objective of this report

This report analyses the various components that are salient to price monitoring systems. While the focus is on Barbados and OECS member states owing the coverage of the Joint Programme, the analysis is intended to also inform regional market monitoring. It provides background to what market monitoring systems are and why they are important in the Caribbean. Specific analysis is provided of systems in Barbados, Saint Vincent and the Grenadines and Saint Lucia, which serve as a platform for comparison and learning across the region.

This report specifically focuses on market monitoring systems for agri-food commodities. It explores the following questions:

- What are market monitoring systems? Why are they important especially with respect to tackling the cost of living?
- What market monitoring systems are available to the governments in the region?
- How do the most prominent market monitoring systems function? What tools do they use? What are their strengths and weaknesses?
- What are the existing gaps in government systems? How can these gaps be mitigated through specific policy and tools?

Based on the research conducted, this report aims to provide a clear end-to-end mapping of the primary market monitoring systems that are currently being deployed in the region, a thorough understanding of what gaps are present and why they pose concern. Recommendations are provided on how to strengthen processes and maximize their value. These are intended to stimulate discussion on options and pathways forward towards developing a roadmap for creation of a holistic market monitoring system, and the advantages that these would offer for governments and the population at large.

1.2. Scope and Limitations

This report considers market-monitoring systems in its most expansive definition possible. As such, the report covers not only retail price data collection for commonly consumed agri-food commodities, but also any market information along the entire agri-food value chain relevant to consumption, exports, and industry. This information includes agri-input prices, post-harvest and processing costs, harvest yields and stocks on hand; input costs such as packaging, storage, and

transport; and wholesale costs and markups before the commodity arrives to the consumer for consumption.

Ultimately, gold-standard market-monitoring systems should perform the following functions:

- Allow governments to compute and forecast final-demand intermediate demand³ (FD-ID) price-indices across any all economically vital value-chains. This subsumes producer-price indices (PPI), and to a lesser extent, consumer-price indices (CPI).
- Provide timely wholesale and retail market prices for agri-food commodities, including sources and varieties, that can be disseminated globally via existing systems, for example those created by FAO, the World Bank and private-sector market-data providers such as Tridge.com.
- Combine supply, demand, and price data together to derive insights and produce actionable policy recommendations that balance price-stability with availability and encourage sustainable economic growth.

While the report provides a strong entry point to advance on analysis of these issues, there are limitations mainly arising from limited accessibility to various levels of key informants from the units within the government that operate price-monitoring systems, as well as any insights from the population at large. This report also focuses mainly on information attained through key-information interviews with staff from ministries responsible for agriculture and statistics in Barbados, Saint Lucia and Saint Vincent and the Grenadines. The inclusion of additional related information is based on second-hand research and documentation on how these collect data and how it can be accessed.

1.3. Report Structure

The report is structured to provide an end-to-end understanding from what market monitoring systems are, to the activities of the relevant units within the government, and finally the identified gaps, challenges, and recommendations. There are five sections:

1. **Introduction** – This section introduces basic aspects around market monitoring systems from what they are, how data is collected, and finally what relevant information products are subsequently produced and disseminated, from various indices to forecasts.
2. **Relevance to the Governments** – Information from market monitoring systems is used for a gamut of purposes by multiple organs of the government. This section examines these in

³FD-ID price indices aggregate prices of goods and services in an integrated manner; divided into final demand and various stages of intermediate demand, producing the Final Demand Index (FD index) and the Intermediate Demand Indexes (ID indices). Using the FD-ID price indices makes it possible to price transmission across the entire value-chain for goods and services while avoiding the multiple counting of inputs at various stages of the chain (Bank of Japan, 2022).

detail and explores current initiatives and policies undertaken by the respective governments where this information is critical.

3. **Current Market Monitoring Systems** – The various market monitoring systems in place across the ministries of the respective governments are mapped out in detail. Specifically, this section dives into the data collection and information-management tools built by the responsible units.
4. **Gaps in Current Market Monitoring Systems** – Following the mapping of the various systems, this section identifies gaps and challenges with the current status-quo, why they need to be addressed, and what may be the root-cause behind these gaps.
5. **Recommendations** – Finally, this report provides recommendations that can be implemented by the governments to not only improve their market monitoring systems, but also create synergies between ministries, achieve efficiencies, and move towards a best-in-class system. These are ordered based on the ease of implementation.

2. Introduction

Prices are the coordinating force in a market economy. They communicate more than just profit and revenue and act as signals coordinating a vast web on economic activity, spanning global supply chains and international markets. Therefore, market monitoring systems play a key role in tracking and stabilisation of markets, often with significant government resources directed towards it. The below section introduces the preliminaries of marketing monitoring systems from what they are, how they work, and what data products they produce. The purpose is to ensure the reader has a foundational understanding of market-monitoring systems before delving into the specific systems in Barbados, Saint Lucia, and Saint Vincent and the Grenadines.

2.1. Importance of Market Monitoring Systems

Prices across value-chains serve as economic x-rays, revealing the organs of production and disclosing ailments in the hands of a skilled practitioner. Without adequate public knowledge of these prices, markets themselves can fail to function, falling prey to price in-transparency and imperfect information, which are classic causes of market failure. While this report focuses on agri-food commodities, market monitoring systems are vital across almost all sectors of the economy. The lack of high-quality and regularly updated market information risks resulting in organizations and governments engaging in suboptimal actions if they do not have a holistic overview of this complex and changing reality.

With respect to the agri-food sector, market information enables transparency and fair returns for the actors in the value-chain, including consumers. It provides early-warning signals of food-insecurity, informs tariffs and quotas for agri-food imports & exports, and gives the impetus for responses to market disruptions and price shocks, such as the provision subsidies to those who need it. *The Agricultural Market Information System* guide points to the following benefits these systems provide (Inter-American Institute for Cooperation on Agriculture, 2016):

- **Reduces production risk** – Encourages a healthy degree of supply while avoiding over production and enabling producers to forecast input costs.
- **Reduces market risk & sales cost** – Greater transparency reduces margins for middlemen, while higher-resolution supply/demand forecasts reduce volatility due to supply-chain pathologies such as the bull-whip effect⁴.
- **Identifies business opportunities** – Encourages the entry of new entrepreneurs and exporters including in smaller, less developed geographies and sectors.

⁴ Phenomenon where small changes in consumer demand transmit amplified variations upstream in the supply-chain, which can lead to wrong amounts of inventory, increased costs, and reduced efficiency. Lags in the supply-chain create an oscillation cycle between excess and scarce supply that can take many months if not years to stabilize.

- **Optimizes productive investment** – Allows both government and private sector to prioritize investment in capital equipment and infrastructure; creditors and investors receive the needed assurance that the business-case exists to front the capital.
- **Encourages the development of secondary capital markets** – Such markets allow investors to buy and sell existing debt, equity, and other instruments such as options and futures essential to agri-food commodities. This not only increases the capital base, but also de-risks investment, reduces supply and price volatility, and permit producers to take advantage of economies of scale.

2.2. Defining Agri-food Market Monitoring Systems

The purpose of agri-food market monitoring systems is to collect timely, reliable, and accurate market information that can be used by the different actors in the agri-food sector and decision-making processes, including government bodies, farmers, wholesalers, vendors, and consumers. The Market Information Organization System of the Americas' (MIOA) Price Collection & Information Dissemination Manual (Mesoamerican Fruitculture Project, 2015) provides the following elements to characterize a well-functioning agri-food market monitoring system:

- **Reliability and impartiality** – The information provided should accurately and objectively reflect market conditions.
- **Timeliness** – Information should be available to users in the shortest possible time after collection.
- **Relevance** – Provided information should be meaningful to the producer and the buyer based on the importance of product and marketing strategy.
- **Accessible** – There should no special privileges derived from its use with information available to all stakeholders.

Given the wide scope described above, an overview of these systems are provided in the nature of step-by-step over the kinds of information it collects; where, how and from whom to collect it; and finally, what informational products are produced as a result.

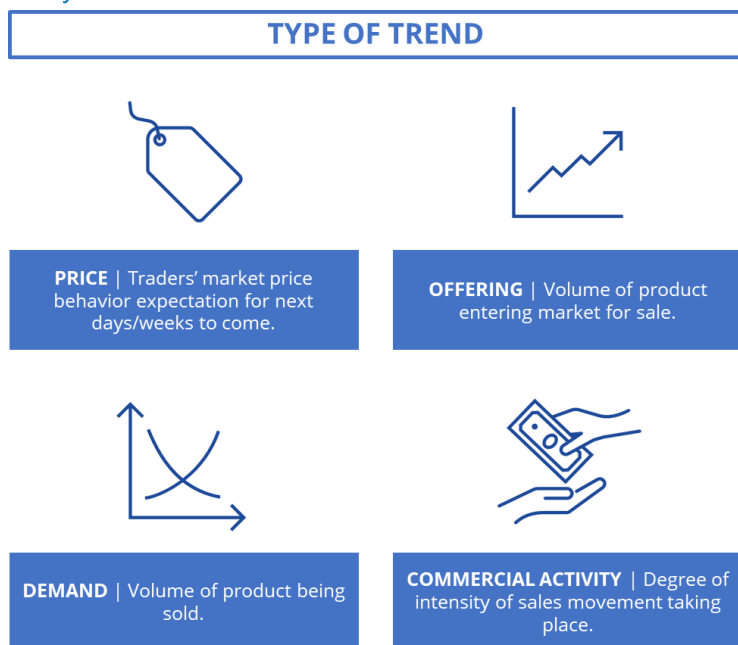
2.3. Information Collected

With respect to agri-food commodities, information is not only limited to prices per quantity unit of measure but also includes information of supply, quality, varietal, origin, constraints on trade, price of input factors and market conditions (Mesoamerican Fruitculture Project, 2015; WFP - VAM, 2010):

- **Supply** – This is the best way to estimate consumer demand for commodities; the livelihood of traders depends on their ability to forecast demand correctly. This quantity can include stocks on-hand and stocks in-order.

- **Quality** – Often the first lever traders utilize to keep sale prices stable in the face of rising input costs is to reduce quality (first lever of elasticity). Quality includes not only innate characteristics of the product (taste, ripeness, firmness, colour, lack of defects), but also its post-harvest handling characteristics, or *condition*.
- **Varietal/Cultivar** – Even a straight-forward agri-food commodity such as black-pepper can have many different varieties (six in the case of black pepper – Malabar, Tellicherry, Cochin, Sarawak, Lampong, Belem) each with different desirability and market-value (Tellicherry is the most desirable per black pepper). Hence why this is needed for any accurate estimate of price/supply/demand dynamics for an agri-food commodity.
- **Origin** – Where was the item produced? Is it domestic or imported? This information can give valuable insights into how the market may be adapting to over/under supply of certain commodities.
- **Constraints on trade** – These may include constraints placed on business due to long-lead times on procurement; high costs of storage, transport, or packaging; limited warehousing capacity; and/or unavailability of credit.
- **Prices of Input factors** – For agriculturalists this includes raw material such as seeds, fertilizer, herbicides/pesticides, and land rents. For wholesalers and other middlemen this may include costs of packaging, storage, transport, and processing. For retailers, rents and labour costs may be big factors.
- **Market Conditions** – This is the trend and tone of stocks and supplies in the market, demand, and amount of business conducted. This is further broken down in Figure 1:

Figure 1: Trend and Tone of Market Conditions



Source: Author

- **Constraints on trade** – These may include constraints imposed on business due to long-lead times on procurement; high costs of storage, transport, or packaging; limited warehousing capacity; and/or unavailability of credit.
- **Prices of Input factors** – For agriculturalists this includes raw material such as seeds, fertilizer, herbicides/pesticides, and land rents. For wholesalers and other middlemen this may include costs of packaging, storage, transport, and processing. For retailers, rents and labour costs may be big factors.

Finally, often times the quantity used to denote the price may be a non-standard metric such as a *bagful* or *bundle*. Factors converting such prices into standardized, universally usable units of measure are another key piece of information captured by the market monitoring system. It may not always be practical or necessary to collect all the above information, but this does encompass the base of data that denotes *market information*.

2.4 Collection methodology

The collected information must also be *representative*, another term that has broad meaning. Parsing this into its constituent components, the system must collect data in a manner that is (WFP - VAM, 2017):

- **Timely** – Information should be provided to stakeholders at the frequency needed for their decisioning actions, or the frequency with which prices are sensitive to external conditions. Additional factors may drive the need for additional frequency, for example when a natural disaster occurs.
- **Spatially & demographically representative** – The catchment areas of the selected markets should cover 25-50 percent of the population with balanced representation amongst demographic groups (especially urban vs rural). Markets that serve as hubs for regional distribution or particular value chains are of particular importance.
- **Encompasses the entire value chain** – Agri-food commodities are produced, bought, and sold at multiple levels with usually a minimum of three levels—producers, wholesalers, and retailers. Additional tiers can include import and processing depending upon the nature of the commodity.
- **Covers representative volume** – Ideally the data collected should be representative of 50 percent of the volume in the market, meaning it as close as possible to potential post market volume spikes within the collection interval and from a representative cross-section of traders covering both large and small amounts of volume.
- **Includes a representative cross-section of items & varieties** – Commodities covered should comprise not only a representative household food basket, but also include major import and export commodities and seasonal items. It is also important to consider different varieties that are either important as a socioeconomic measure or capture substitution effects (e.g., whole vs broken rice).

Data is generally collected using one of two modalities by well-trained enumerators. Either the market monitoring system relies on statistical sample surveys composed of statistically representative samples taken from shops and other retailers across a representative cross-section of agri-food commodities or uses key-informants when statistically representative surveys are not possible. Data is instead collected from a selected traders who have been trained and incentivized to provide quality information.

2.5. Information Products and Dissemination

Many different information products can be constructed from the data as there are a myriad of uses stakeholders have, from street-vendors knowing which market to sell goods at all the way to central-bankers forecasting inflation and setting monetary policy. The most important of these information products are detailed below:

- **Price indices & sub-indices** – This is the most evident output, describing the price-time-series of a commodity over time. This can be further subdivided by geography and different varieties. However, these indices are often far more than simple arithmetic averages. Careful attention needs to be paid to observation-weights observations to ensure the price-index is representative spatiotemporally and across varieties of the underlying commodity that it represents. Furthermore, given inflation and the panel-structure of data, the arithmetic-mean itself is often a poor choice, requiring more advanced statistical techniques for index construction.
- **Consumer Price Index (CPI)** – The CPI is the price of a representative basket of goods purchased by a household and is a weighted sum of the above price-indices. Just like with prices, the CPI can be broken down geographically and careful attention needs to be paid to weights that may vary spatiotemporally . The annual percentage change in CPI is used as a measure of inflation. More importantly, the CPI represents the real purchasing power of households given fixed wages and is used to adjust pensions, wages, interest rates and a host of other economic levers.
- **Producer Price Index (PPI)** – The PPI measures average changes in prices received by domestic producers for their output, therefore it is composed of prices at the wholesale or farm-gate level and agri-commodities either grown or processed indigenously. Like all indices it can be broken down sub-nationally and by industry. It is viewed as a good pre-indicator of inflationary pressures.
- **Farm Input Price Index (FIPI)** – The FIPI, as its name suggests, measures change in input prices for agriculturalists (EuroStat, 2020). The FIPI is in general a class of FD-ID indices that track prices at each stage of the value chain. Conveniently, they can be constructed using CPI and PPI sub-indices. FD-ID indices for various agri-food value-chains are the gold-standard for well-functioning market-price information systems.
- **Minimum Expenditure Basket (MEB)** – This is equivalent to the CPI but with respect to a pared-down basket of goods representing the minimum the average household needs for food, shelter, and other essentials. The MEB is frequently used to determine poverty levels.

- **Labour Terms of Trade** – Normalising the daily-wage (unskilled or low-skilled) wage-labour prices by the MEB gives the terms-of-trade for labour (i.e., ratio of daily wages earned to minimum expenditure needed). As wages usually change much more slowly than prices, this is a powerful measure of the household budgeting pressures consumers face given changes in prices.
- **Price Spikes and Early Warning** – Increased price volatility, in particular unexpected spikes and/or troughs, can be a powerful early warning signal indicating supply chain issues, crop-failure, or other economic pressures. WFP's *Alert for Price Spikes* (ALPS) is a functional example of such a product (WFP - VAM, 2014).
- **Elasticity** – Elasticities measure how quantities demanded will adjust in response to a price or income change - or, inversely, predict price changes due to changes in supply. This enables policymakers to gain a sense of how consumers and businesses may react to price, supply, and income fluctuations.
- **Market Integration** – This measures the degree to which markets balance supply and demand by bringing commodities from areas of surplus to those with deficit. Such integration is desirable as it lowers volatility and creates market resilience. Poorly integrated (segmented) markets can indicate high transaction costs, poor infrastructure, or monopolistic (and often illegal) rent seeking by businesses.

Lastly, price and demand forecasts are invaluable to businesses and producers. Small surpluses in supply can cause commodity prices to crash, while supply deficits can cause inputs to become prohibitively expensive (especially if the commodity is inelastic). Production, including farming, has long-lead times and resources are wasted if the product cannot be sold. Such forecasts may also encourage businesses to pre-book orders, not only reducing price volatility but generating revenue stability that is needed undertake long-term capital expenditure.

All these information products must be disseminated for users to make use of them. The importance of this cannot be understated, in the United States the Agriculture and Food Act of 1981 mandated transmission/dissemination costs to be covered for anyone that wanted access to this information. While publishing on websites and printing reports are standard practice, in our current technological age the application programming interface (API) reigns as the supreme tool. This is a *software* interface (as opposed to a *user* interface) by which any authorised web application can query and retrieve the information using standard web-application programming frameworks. Via APIs, pre-existing open-source tools allow many user products to be built, from dashboards to rich visualisations, to easy global dissemination through platforms such as FAO Stat's Food Price Index, WFP's Market Monitor, and the World Bank's Commodity Pink Sheets.

3. Relevance to Governments

The price of food and agriculture products are dominant concerns for countries throughout the Caribbean. Barbados, Saint Lucia, and Saint Vincent and the Grenadines are no exceptions with food comprising a very large amount of the household expenditure basket, a high dependency on food imports, and vulnerability to food price inflation. Poverty rates as measured by individuals below the country's respective minimum income threshold are respectively 14 percent, 20.3 percent, and 30 percent for Barbados, Saint Lucia, and Saint Vincent and the Grenadines (World Bank - Open Data, 2023). Such households already spend a much higher share of their income on food, and are particularly vulnerable, often forced to reduce already meagre spend on other essentials such as healthcare, education, and housing. Furthermore, spells of acute food insecurity may lead to potentially devastating consequences, including malnutrition, stunting, and other chronic health problems, particularly in children.

Table 1: Agri-food Economic statistics of Barbados, Saint Lucia, and Saint Vincent and the Grenadines

	Barbados	Saint Lucia	Saint Vincent & Grenadines
GDP per capita (2021 Est)	USD 19,000	USD 9,415	USD 8,666
% CPI corresponding to food	30%	27%	22%
Annual Food Price Inflation (2022 Est)	6%	5%	5.7%
% of Food imported (2021 Est -abs. value)	25% (USD 367 million)	37% (USD 168 million)	32% (USD 64 million)
% Food contributes to total imports	22%	28%	21%
% Agri-food contributes to total exports (abs. value)	23.4% (2021 Est) (USD 82 million)	51% (2019 Est) (USD 30 million)	53% (2021 Est) (USD18 million)
% Agricultural Employment (2021 Est)	2.5%	10%	10%
% Contribution of agriculture to GDP (2021 Est)	1.5%	1.8%	6.7%

Source: World Bank - Open Data and WITS, 2023; WTO - Trade Profiles, 2023

The policies, institutions, and legislative frameworks of these countries are deeply impacted by the prices of agri-food commodities, affecting everything from government finances to the food security. As these countries have a high degree of administrative centralization, there are at least five immediate domains of responsibility where this information is vital for government policy formulation and decision-making.

Figure 2: Market monitoring information relevance



Source: Author

3.1. Price Controls (via Social Partnerships and Regulation)

In all three countries the government either directly implements price controls through legislation or indirectly through industry agreements on price as part of a social compact model. Transparent market monitoring mechanisms enforce these agreements and improve the efficiency of these

negotiations, providing accurate and updated data on price fluctuations and ensuring adherence through potential legal repercussions.

3.1.1. Barbados

The Government of Barbados has put in place price controls on refined petroleum products, which includes diesel fuel, gasoline, kerosene, Liquefied Petroleum Gas enforced under the Miscellaneous Controls Act (Cap. 329) first passed in 1970. All other items previously regulated under this legislation are no longer subject to price controls, including agricultural products (FAO - FAOLex, 2023). The Department of Commerce and Consumer Affairs is responsible for determining the items to be put under price control and computing prices for such items. Social partnerships that were formed between the government, private sector, and trade unions during the economic crisis in the 1990s were previously leveraged by the Department of Commerce to determine price caps for various industrial and agricultural commodities (Forde, 2023). These social partnerships have held legal recognition in Barbados since the Second Protocol of 1995, allowing social partners to negotiate with respect to minimum wage and price levels. Since then, the scope of such partnerships has expanded to cover policy related inputs as well. In July 2022, the government introduced soft price controls on 44 key consumer goods such as cooking oils, rice, macaroni, and milk for a period of 6 months after negotiating an agreement with the private sector to limit price increases (Forde-Craig, 2022).

3.1.2. Saint Lucia

Food constitutes roughly 27 percent of the household budget as measured by the CPI. Food price inflation crossed 5 percent in July 2022 against the long-term average slightly exceeding 1 percent (St. Lucia Central Statistics Office, 2022). The Ministry of Commerce via the Department of Consumer Affairs is responsible for monitoring prices of goods necessary for the daily sustenance of the average consumer. Prices are continuously monitored, and directives are periodically issued specifying the maximum mark-ups that can be applied, modifications to taxes and import duties, or the price of goods themselves. In total, there are 13 commodities that are under price control, including oil, milk, tuna fish, salted biscuits, sardines, baby foods, cement. In June 2022, when food inflation soared as a consequence of the Russia-Ukraine conflict, the government abolished the 6 percent service charge on many agri-food commodities such as biscuits, sardines, milk, oil, and more (St. Lucia Consumer Affairs Department, 2022).

3.1.3. Saint Vincent and the Grenadines

The annual average inflation reached 5.7 percent in 2022 for Saint Vincent and the Grenadines compared to 1.6 percent in 2021. Amongst these, the group “food and non-alcoholic beverages”, which constitutes 22 percent of the CPI indices, recorded an increase of 14.8 percent (SVG Statistical Office, 2022). In June 2022, following global food price inflation, the Ministry of the Public Service, Consumer Affairs and Sports, responsible for controlling prices, issued a directive under the Prices and Distribution of Goods Act to increase the wholesale and retail prices of flour (McTair, 2022). It had earlier utilized this law to regulate the prices of liquified petroleum gas, the country’s most

common cooking fuel (SVG - Govt of, 2021). Historically, the government has placed limits on mark-ups of certain essential commodities such as rice, flour, and milk to promote consumer and farmer welfare.

3.2. Economic Indices, Fiscal and Monetary Policy

The central statistics offices (CSO) of all three countries have a wide mandate ranging from the census to the computation of the CPI. Statistics and indicators for labour force wages and participation, merchandise trade, tourism and manufacturing activity, gross domestic product, and poverty rates usually fall under the purview of the CSO as well. This information in-turn is crucial for the central bank of the country to avail of the monetary tools at its disposal including management of foreign reserves, dictating bank reserve ratios, and regulation of various interest rates.

In particular, the CPI and terms-of-trade are pivotal. The central banks must maintain their currency's fixed peg to the US dollar, and so must work closely with the government to routinely emphasize policy measures and preserve foreign reserves. Fiscal stimulus can also very quickly lead to inflation if the productive capacity is not present to convert to sustained economic growth, in turn putting pressure on the peg and thus creating a negative feedback loop. Likewise, the ministries of finance must set fiscal policy and issue interest-bearing treasury-notes and bonds that are sensitive to the inflation rate, of which food products contribute between 20-30 percent per the CPI depending on the country.

3.2.1. Barbados

Food imports for consumption constituted USD 340 million or approximately 7 percent of the country's total GDP in 2021 (Madden, 2023). As Barbados is a small island developing state with debt to GDP exceeding 100 percent (IMF, 2022), even small changes in interest rates, exchange rates, or government borrowing can have major consequences on public finances. The International Monetary Fund (IMF) is also lending support to Barbados' Economic Recovery and Transformation (BERT) put in place in 2022 which restructures the government's debt and facilitates external financing across several sectors of the economy including climate change adaptation and enhanced food production (Barbados - Govt. of, 2022). However, provisions of the plan include maintenance of primary budget surpluses and increased domestic savings and investment, both acutely under duress due to food-price inflation.

3.2.2. Saint Lucia

Saint Lucia and Saint Vincent and the Grenadines are both part of the Eastern Caribbean Currency Union (ECCU). They share a single central bank, the Eastern Caribbean Central Bank (ECCB), and the legal tender is the Eastern Caribbean Dollar (XCD) which is pegged to the United States Dollar (USD) at a fixed rate of XCD 2.70 to USD 1.00.

Given that tourism accounts for 65 percent of Saint Lucia's economy (World Bank - Open Data, 2023) and imports approximately 40 percent of its total food consumed (above the regional average) (World Bank - WITS, 2023), monitoring prices for inflation is critical for Saint Lucia. Simple and

difficult-to-predict fluctuations in tourist inflows or shipping and procurement lead-times can quickly lead to price inflation if not properly checked. Likewise rises in food import costs can require swift action by the ECCB to defend foreign reserves, requiring a robust system to ensure food price stability.

3.2.3. Saint Vincent and the Grenadines

Saint Vincent and the Grenadines only imports approximately 32 percent of the total food (WTO - Trade Profiles, 2023) and is far less reliant on tourism compared to neighbouring countries, contributing only 24 percent to GDP (World Bank - Open Data, 2023). Like its neighbouring countries, the government has recently instituted a five-year plan under CARICOM's *25 by 25* initiative to reduce their total food import-bill by 25 percent (St. Vincent Times, 2022). Their 2013-2025 National Economic and Social Development Plan also imposes hard targets on inflation rates and current account deficits⁵ (Govt of SVG, 2013), not to exceed 3 percent and 2.5 percent of GDP respectively. Most recently their current account deficit was 23.4% of GDP (World Bank - Open Data, 2023) with food-price inflation contributing significantly as a factor.

3.3. Agriculture and Farmer Welfare

Agriculture is dominant throughout the Caribbean despite the limited amount of arable land. The countries have made strides in self-sufficiency particularly with respect to poultry which constitutes 80 percent of the region's meat consumption (Morgan, 2022). Caribbean states are able to meet approximately 65 percent of this requirement autonomously. All three countries also have dominant export-quality cash-crops, respectively sugarcane, bananas, and arrowroot for Barbados, Saint Lucia, and Saint Vincent and the Grenadines. Saint Vincent and the Grenadines is in fact the world's largest exporter of arrowroot (Tridge.com - Ag Intelligence Platform, 2023), a commonly used cooking starch. All three countries have recently instituted programmes renewing their focus on agriculture aiming to boost exports and increase the local capture of the agri-food value-chain.

3.3.1. Barbados

As part of an agreement with the IMF and fiscal discipline, the government intends to scale back the subsidies and services to the Barbados Agriculture Management Corporation (BAMC) by creating strategic alliances with the private sector (both structural benchmarks set by IMF for end-of-June 2023) (IMF, 2022). The BAMC currently provides price floors for specific agricultural products, especially sugar. The Government will transfer the factory operations to the private sector to anchor the sustainability of the industry with the cogeneration of electricity, which will require less subsidy, and enable the conversion of part of the crop into specialty sugars and fancy molasses that will not require a subsidy. This approach is likely to provide more sustainable support for rural communities, raise agricultural productivity, and generate savings for the government. However, ownership by the

⁵A current account deficit refers to a situation where a country imports more than it exports, resulting in a net outflow of foreign currency, depleting the country's foreign reserves and increasing its debt. It is often a reflection of a country's competitiveness and overall economic health.

private sector will require transparency on price and other metrics with relevant splits for type of crops, region, and other factors.

3.3.2. Saint Lucia

To curb their rising food-import bill, the government, in partnership with Taiwan, launched the second phase of their Seven Crops project in February 2022, targeting new export crops such as soursop, sugar apple, pumpkin, squash, corn, eggplant, dragon fruit, cabbage, zucchini, and carrot (St. Lucia Ministry of Agriculture, 2018). The programme aims to diversify food production, strengthen sales and marketing, boost climate-smart agriculture, and improve the food security of inhabitants. In September 2022, the government announced a 30 percent subsidy on inputs for banana farming to promote production and exports (St. Lucia Ministry of Agriculture, 2022). Considering the renewed focus on agriculture and especially market access reforms, price monitoring becomes necessary to track different layers in the supply chain, value add at each layer and introduce policies to improve efficiency and incentivize production.

3.3.3. Saint Vincent and the Grenadines

In 2021, the government, in partnership with FAO, launched the first agricultural census in 22 years for the country (FAO, 2022). The census, to be completed in 2024, aims to capture detailed data such as size of land holdings, land tenure, land use, area harvested, irrigation, livestock, labour, and other agricultural inputs to ultimately enable the public, researchers, farmers and policymakers to make informed decisions. Additionally, the survey aims to develop an integrated agricultural statistics system that will include regular agricultural surveys and administrative data presumably to capture and monitor prices at each point in the supply chain.

3.4. Commercial Promotion & Industrial Planning

As small island states, the ministries of commerce in the three countries have been quite successful at fostering tight-knit relationships with the business-sector in their respective countries. Additionally, tourism is the major source of income for all three countries, accounting at 17.5 percent for Barbados, 65 percent for Saint Lucia, and 24 percent for Saint Vincent and the Grenadines of their GDP respectively (World Bank - Open Data, 2023). This industry is highly sensitive to agri-food costs and the governments work with them closely to monitor prices of meals and hotel rooms. Moreover, economic development funds, investment, and industrial subsidies are all very meticulously directed by these ministries, requiring them to have transparent information on industrial organization, supply chain dynamics, and market structure for various sectors of the economy.

3.4.1. Barbados

The government is collaborating with Guyana and Suriname to establish a USD 16 million food terminal in Barbados (Madden, 2022). One of the goals of the project is to contribute to CARICOM's goal of reducing the regional food import bill by 25 percent by 2025 (CARICOM, 2022). This

collaboration is expected to commence in late 2023. Barbados will serve as a hub combining local production with goods from Guyana and northern Brazil to meet the requirements of the cruise lines. This initiative also establishes part of an international joint venture between the Destination Management Cooperative of Barbados (DMCB) and the Destination Management Company of Florida (IMF, 2022).

To facilitate trade via the joint venture, the Ministry of Tourism is creating a single purchasing platform for all goods, services, and experiences from DMCB (IMF, 2022). This builds upon an earlier initiative with UNCTAD towards establishment of a single-window trade facility, a one-stop-shop for anyone desiring to import or export anything to and from Barbados (UNCTAD, 2021). At a macro scale, market monitoring provides the basis for these facilities to be effective, ensuring transparency, guarding against market-failure, and enabling traders to avail of the most competitive prices on offer in a unified marketplace.

3.4.2. Saint Lucia

Saint Lucia derives around two thirds (65 percent) of its GDP from tourism and 48 percent of its employment which poses a concentration risk for the economy (ILO, 2020). In some ways, other sectors have lagged in development. Macroeconomic shocks such as COVID-19 have caused wide fluctuations in tourist numbers and impacted allied industries in agriculture and related food businesses. This in turn impacts industry wages, the aggregate food import bill, and overall food-price inflation. Therefore, demand planning and agri-food market monitoring is critical for the Government of Saint Lucia. Further, it is imperative that the country adopts resilient agriculture practices given limited arable land and potentially high risk of natural resource degradation due to climate change.

3.4.3. Saint Vincent and the Grenadines

When Saint Vincent and the Grenadines launched its National Economic and Social Development Plan 2013-2025 (Govt of SVG, 2013), among other objectives, the plan sought to boost the construction sector and develop their information and telecommunication sector. The plan also aims to increase the contribution of renewable energy to the overall energy supply in order to reduce fuel imports and stabilize their external account. The plan envisages that such support be provided in the form of both financial and non-financial incentives. To design these incentive regimes an appropriate price monitoring mechanism is required to deliberate on the goods and subsidy levels to target.

3.5. Social Protection, Food Security, and Nutrition

A recent FAO study reports that the Caribbean region (and Latin America) have the highest costs to achieve healthy diets when compared with other regions.⁶ Unaffordability of nutritious foods, and limited dietary diversity has attributed to high rates of non-communicable diseases and obesity in

⁶ <https://www.fao.org/publications/sofi/en/>

the region (PAHO, 2015). Obesity rates in the region are at 23 percent (PAHO, 2021), with Barbados and Saint Lucia once again particularly affected at 36 percent and 48.1 percent respectively (Global Nutrition Report, 2023). Moreover, according to data collected in August 2022 from the CARICOM Food Security and Livelihoods Survey, more than half (57 percent) of persons in the Caribbean are reported to experience a moderate or severe level of food insecurity, exhibiting a rise of 1.3 million when compared with February 2022, prior to the start of the Ukraine Crisis.

Agri-food market monitoring systems help ensure that vulnerable populations have access to sufficient affordable and nutritious food, vital to social protection, food security, and nutrition.

- **Social protection** – By monitoring food prices, policymakers and aid agencies can identify when prices are increasing beyond what many people can afford. This can help them to target social protection programs, such as cash transfers or food subsidies, to those who are most in need.
- **Food security** – Market monitoring can help identify food insecurity and inform responses to it. When food prices rise, households that are already struggling to access enough food may be pushed further into food insecurity. Monitoring food prices can help to identify where and when this is happening, so that interventions can be targeted to those who need them most.
- **Nutrition** – When households are unable to afford sufficient food or are forced to buy cheaper, less nutritious food, this can result in malnutrition. By monitoring food markets, policymakers and aid agencies can identify when certain foods are becoming out of reach for many people and can take action to promote access to a diverse range of nutritious foods.

3.5.1. Barbados

The government recognizes the urgent need to take action through its review of fiscal policies, legislation, and institutional frameworks to improve the quality and quantity of healthy nutritious food made available, particularly increasing their consumption within school environments. A key consideration in this initiative is statistical information on critical categories and the design of policies that would subsidise healthier food alternatives (FAO, 2020). This in turn creates a requirement to effectively monitor input prices including vegetables, dairy, and meat as to determine subsidy amounts for various welfare schemes such as the Summer Nutrition Program and the government pension scheme (Barbados Treasury Department, 2023).

3.5.2. Saint Lucia

While the COVID-19 pandemic brought striking declines to the per capita GDP of all three countries, Saint Lucia was particularly affected, with GDP 20 percent lower in 2021 from its 2019 peak, as compared to 8 percent and 0.25 percent for Barbados and Saint Vincent and the Grenadines respectively (World Bank - Open Data, 2023). This in turn greatly exacerbated poverty, which went from 25 percent to 47 percent at its peak (UNDP, 2020). WFP and the Government of Saint Lucia have worked together since 2019 on expanding public assistance programmes which are calibrated in part by minimum food expenditure basket costs (St. Lucia Times, 2023). Although the pandemic

has subsided, poverty and food insecurity remain persistent concerns. A recent WFP report surveying 165 households highlights that respondents continue to consume smaller portions and lower quantities than they did prior to the pandemic (WFP, 2021). Moreover, one of five households experienced difficulty accessing food markets almost exclusively due to high food prices.

3.5.3. Saint Vincent and the Grenadines

The government of Saint Vincent and the Grenadines has committed to reformulating its National Social Protection Policy in order to ensure smooth delivery of programming and rate of implementation. The remodeling of systems governing provision of goods and services has been spearheaded through its Public Sector Reform Programme. Saint Vincent and the Grenadines is still feeling the impacts of the La Soufriere Volcano Eruption in April 2020, with some households who continue to be displaced and reliant on social assistance. On top of the COVID-19 pandemic and the current cost-of-living crisis, the Government of Saint Vincent and the Grenadines, through its National Social Protection Policy is looking to ensure the most vulnerable people have access to basic income and social services.

4. Current Market Price Monitoring Systems

While the function of market monitoring of agri-food commodities has usually been seen to rest within a government's ministry of agriculture, there are multiple overlapping market monitoring systems in place by various units of the government. At minimum there are four institutions within each government that are systematically collecting market information, with five in the case of Barbados. Of the four institutions it is only the ministries of agriculture and commerce that explicitly and advertently operate market monitoring systems for their intended purpose of disseminating knowledge of prices to the public. However, the most comprehensive and important market monitoring systems are in fact embedded as components of much broader information systems. As a result, they are generally overlooked as explicit primary sources of market information. This is the case with ASCYUDA operated by the customs and excise department; and the CPI function of the various CSOs. This section examines all these information systems, the respective governments have built for market monitoring, regardless of whether that goal is their primary function.

4.1. Government Sponsored Enterprises (GSE)

The Barbados Agricultural Development and Marketing Corporation (BADMC) is the only significant GSE of the three countries that operates across multiple agri-food commodities. There is the Banana Industry Trust Corporation in Saint Lucia, but it operates only within a single vertical, limited to banana production primarily for export.

BADMC has a mandate to inform, facilitate, and develop Barbadian crop and livestock production, food innovation, and processing and marketing opportunities for local agri-entrepreneurs and food enterprises. Among its many functions, some of its most critical ones directly require market monitoring for agri-food commodities (BADMC, 2023):

- Operation of a central packhouse for wholesale trading of agricultural commodities;
- State-trading enterprises that manage the importation and distribution of import-controlled agri-food commodities and agri-inputs;
- Agriculture services for farmers including land preparation, harvest machinery rental, and land leasing; and
- Assistance in securing arrangements for purchase, handling, transportation, exportation, shipping, and marketing or sale of produce whether within or outside of Barbados.

As a GSE, BADMC must operate as an independent enterprise with a separate profit/loss ledger, balance sheet, and mandate to turn a marginal profit. Usually, such enterprises must employ modern software-based accounting and control systems.

If the aforementioned scenario is existent, BADMC should have extremely granular information on the following:

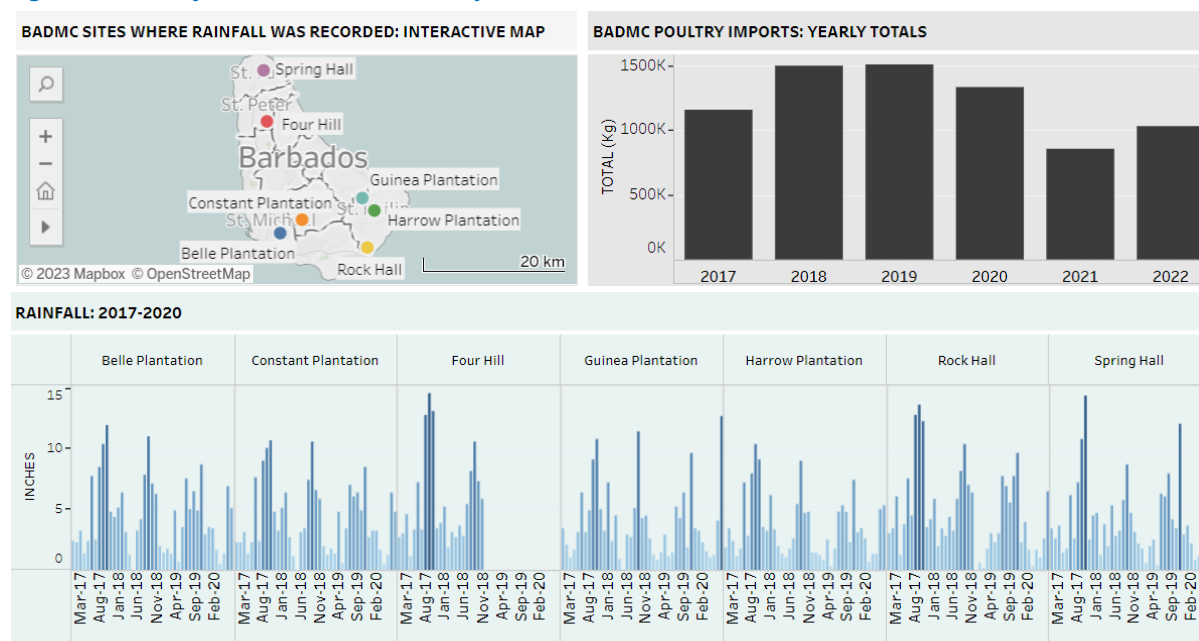
- Type (including varietal), volume, origin, and price of agri-food commodities purchased by state-trading enterprises;
- Price, destination, and volume of sold commodities by state-trading enterprises;
- Wholesale prices of commodities being traded at their pack house;
- Demand calendar for agri-inputs as required for agriculture services; and
- Cost of other inputs such as transport, storage, and packaging.

Typically, as most agri-food wholesale markets have a leader-follower dynamic, large traders such as BADMC must be setting the price, trend, and tone for the whole market in certain critical commodities. Unfortunately, an interview with BADMC was not in the scope of this report’s prior research, and further details could not be ascertained.

There is evidence to suggest that BADMC already possesses a high degree of technical sophistication regarding data, as they have several publicly available Tableau dashboards. Such dashboards require modern databases and APIs with the relevant data to be operational.

An example of one can be seen below:

Figure 3: Publicly Available Dashboards from BADMC (BADMC, 2023)



4.2. Department of Customs and Excise

The departments of customs and excise typically oversee revenue in the form of customs duties, excise taxes, and value-added taxes on imported goods. They play a crucial role in market monitoring systems by monitoring the movement of goods and enforcing trade regulations. By

collecting data on imports and exports of agricultural and food commodities, they can provide important information on prices, volumes, and trends of key imported and exported commodities. As is common amongst small island developing states (SIDS), so much food is imported across almost every category, that the customs and excise function becomes, unknown to most, amongst the most comprehensive and timely price monitoring systems available to the government. Prior to import, shippers must have filed an electronic warrant that declares the items imported, quantity, weight, value, any associated tariffs and taxes paid and/or owed, and finally the local importer of said goods.

In all three countries, this warrant is filed in a world-class, internationally inter-operable system known as ASYCUDA (Automated System for Customs Data) developed by UNCTAD and used by 102 countries to administer customs and related foreign-trade procedures. Commodities are also categorized according to an international standard, the Harmonized Commodity Description and Coding System (HS) system developed by the World Customs Organization (WCO). Data is easily disseminatable through ASYCUDA's high quality APIs that lets the software interface with any entity involved in the international movement of goods from transporters to agents, to government bodies. Currently the CSOs of all three countries produce monthly trade statistics through summaries easily extracted from ASYCUDA's APIs.

However, despite the sophistication of ASYCUDA, the system does present several challenges. First, discrepancies often arise between the warrant and the shipment; the counter-signed invoice from the importer should have the same HS code and value as declared on the warrant, but often does not. Reconciliation is a process that is not readily digitised, requiring manual, random checks. Second, the HS codes applied to a consignment are often insufficiently granular to be meaningful; as an example, a shipment of automobiles and automobile tires can all fall under the exact same HS code. Finally, customs officers are primarily focused on revenue collection and so they often record data unreliably, particularly quantities can be wildly different than those estimated from other sources.

Figure 4: Example warrant within ASCYUDA (ASCYUDA, 2022)

								A OFFICE OF DESTINATION	
		2 Exporter No. _____		1 DECLARATION		BOBR		Boarding Office Bird Rock	
				3 Forms 1 4 Load List 1		C 34		24/03/2014	
				5 Items 1		6 Nbr packages 50		7 Reference number 2014 RMU1	
		8 Consignee No. 9999		9 Financial No. _____					
		UNLISTED TRADER PLEASE PUT IN ADDRESS & ACTUAL NAME OF IMPORTER, , , , ,		11 Trading US con. US ctly.		12 Value details 0.00		13 C.A.P.	
		14 Declarant No. 2966		15 Country of export United States of America		15 C.E. Code a) US b) _____		17 C.D. Code a) KN b) _____	
		ROYAL LOGISTICS LTD SANDS COMPLEX, UNIT B1 PACCECTDDC		16 Country of origin United States of America		17 Country of destination Saint Kitts and Nevis			
		18 Identity and nationality of means of transport at arrival TROPIC SUN VC <input type="checkbox"/>		19 Ctr. <input type="checkbox"/>		20 Delivery terms CFR			
		21 Identity and nationality of active means of transport crossing the border TROPIC SUN VC		22 Currency & total amount invoiced USD 50,000.00		23 Exch. rate 2.7000		24 Nature of transac.	
		25 Mode transport 1 at border		26 Inland mode Transport		27 Place of discharge USAAA Attalla		28 Financial and banking data Bank Code	
		29 Office of entry BOBR Boarding Office Bird Rock		30 Location of goods KTNSHED1		Terms of payment			
31 Packages and description of goods		Marks and numbers - Containers No(s) - Number and kind		32 Item 1 No.		33 Commodity code 15079000 000		Product Identification	
		Marks & no DOM4587956				34 Cty. orig. Code a) US b) _____		35 Gross mass (kg) 50,000	
		Nbr & Kind 50 CS Case				37 PROCEDURE 4000 000		38 Net mass (kg) 50,000	
		Containers No(s)				40 AWB/BL Number / Previous document PACEX3		39 Quota	
		OTHER				41 Supplementary units NMB 250		42 Item Price 50,000.00	
34 Add. info Documents Produced Certificates and authorization		Licence No 0.00+0.00+0.00+0.00-0.00		D.Val		D.Qty		43 V.M. code	
		A.D.				A.I. Code		45 Adjustment 1	
								46 Statistical value 135,000.00	
47 Calculation of taxes		Type		Tax base		Rate		Amount	
		ICD		135,000.00		10.00		13,500.00	
		CSC		135,000.00		6.00		8,100.00	
		VAT		156,600.00		17.00		26,622.00	
		Total		48,222.00		1		48 Deferred payment PP2966	
								49 Identification of warehouse	
								B ACCOUNTING DETAILS	
								Mode of payment ACCOUNT PAYMENT	
								Assessment number / Date	
								Receipt number Date	
								Guarantee 0.00 Date	
								Total fees 0.00 XCD	
								Total declaration 48,222.00 XCD	
50 Principal		No. _____		Signature				C OFFICE OF DEPARTURE	
51 Intended offices of transit		Represented by		Place and date					

4.3. Ministry of Commerce

The ministries of commerce oversee an incredibly wide mandate ranging from formulating and implementing policies related to domestic and international trade to consumer protection and regulating various economic activities to ensure fair market competition. The specific functions may vary depending on the country and its economic priorities, but in all three countries it is for this latter function that the ministries of commerce have implemented retail price surveillance systems. This is either to directly enforce price controls as is the case in Saint Lucia and Saint Vincent and the Grenadines, or to monitor private-sector adherence to *social-compacts*⁷ between the government, unions, and private sector on wages and prices as is the case in Barbados.

These surveillance programmes generally comprise the simplest form of market monitoring systems available to the government. Data is collected on a narrow set of goods, usually from big supermarkets and other retailers and presented either as-is or with minimal aggregation, without the complexities of sample weighting or index construction. They are the most frequent and accessible system for the public, disseminating prices via newspaper and radio on a battery of essential food commodities across the country sometimes as frequently as every week.

In Saint Lucia price monitoring by the Ministry of Commerce takes on an additional legal dimension, strictly enforcing prices on 13 commodities and mark-ups on a range of other commodities. This is undertaken by price-control officers employed by the Price Control and Supply Unit (PCSU) within the Department of Consumer Affairs. Traditionally, such officers randomly visit retailers and wholesalers in plain-clothes, posing as a customer, and then check prices and invoices on price-controlled goods. As this unit was not consulted for the study, more information was not gathered on how frequently these random market assessments are performed or how extensive they are. With inflation a pressing concern owing to the global price crisis, the PCSU has increased its enforcement of price controls. Violations usually result in fines and possible seizure of goods, but in the extreme case suspension of business and prison is possible. However, as the activities of the PCSU are also considered a legal matter, it is not clear what if any price information is systematically retained by these officers, if any digital monitoring system is present, or whether and how the data could be made public.

4.3.1. Information Collected & Methodology

While similar, there is some variation in the frequency, number of commodities, and number of locations surveilled in Barbados and Saint Vincent and the Grenadines, as outlined in the table below. Saint Lucia is excluded as officials from the Ministry of Commerce were not interviewed. The term '*item*' in the table below refers to a specific brand and quantity if it is a packaged item. For non-packaged produce, item does differentiate between variety or origin, but rather refers to the most commonly available, commonly consumed produce type (e.g., common vine tomato).

⁷ In 1993 in response to an economic crisis, the Government Barbados instituted a tri-partite arrangement between itself, the private-sector, and labor unions to work together on issues of national economic and social development. In 1995 this took upon an additional legal dimension, becoming a social-compact used by the government to "soft-implement" desired policies such as price-caps.

Table 2: Market surveillance by ministries of commerce

	Barbados	Saint Vincent and the Grenadines
Items	47 core items and 300 additional essentials agreed upon through the social partnerships' arrangement.	12 price-controlled goods and 28 other common food and non-food essentials.
Frequency	Core list of 47 items is monitored bi-weekly. The additional 300 items are collected monthly.	All collected bi-weekly.
Location	For the core-list only the 22 largest supermarkets of Barbados are surveilled. The additional items are also collected from mini-markets and gas-stations.	Limited to 4 major supermarkets serving Saint Vincent Island.

Only in Barbados do enumerators have tablets, otherwise data collection is done with pencil and paper and later entered into a computer. Also in all situations, except upon the larger list of 300 items in Barbados, is any aggregation performed. Officers simply check for discrepancies against previously reported prices, manually verify or substitute, if need be, and report the data as is. A table of prices by item by supermarket is made available to the public.

Of note, but not materially significant as of the time of publication, is the ability to collect point-of-sale data in Barbados. Two supermarkets have commenced a trial under the social partnership compact, giving access to all point-of-sale information to the government for the 47 aforementioned commodities. Such point-of-sale data can be immensely valuable if scaled, able to easily furnish volume, market co-integration, price-elasticities, and more.

4.3.2. Outputs & Dissemination

The overall goal of disseminating information collected by the Ministry of Commerce is to improve transparency and efficiency in the market and support informed decision-making by stakeholders. The tabulated prices are largely disseminated to the public via radio, newspaper, and social media—mainly the Ministry of Commerce's Facebook page. In Barbados the ministry of commerce, known as the Department of Commerce and Consumer Affairs, also does publish on their website, but the information has not been updated since 2020. However, Barbados is experimenting with newer, novel ideas, including a phone-based app that would also allow agri-food wholesalers to post lots for sale. None of the ministries are standardising their items against commonly recognized codes used either internationally or with other ministries, leaving its interoperability limited, for example when

comparing to data with ASCYUDA or commonly available agri-commodity price information on FAO Stat.

4.4 Ministry of Agriculture

As small island developing states (SIDS), the importance of agriculture to the countries of the Caribbean is difficult to understate. Hence, the ministries of agriculture have traditionally played an incredibly active role in economic affairs and to that end have broad data collection responsibilities which they enable through agriculture information management systems (AIMS).

AIMS traditionally are designed around a customer relationship management framework, allowing the government to register farmers; provide, log, track subsidies and other assistance; while recording yield, crop-losses, and other relevant information to ensure stable food supplies. However, as agriculture has modernized, these systems have become increasingly high-tech, integrating tightly with geospatial information systems (GIS) to include 3D geolocated topographic maps, hazard risks, yield predictions, recommendations, market-prices, and more. Much of the information collected is highly relevant either directly—in terms of capturing farm-gate prices, production quantity, and inputs—or indirectly, for example, farm geo-coordinates that can be used to forecast supply.

The digital implementation of such systems has usually piggybacked on top an agricultural census, conveniently allowing enumerators to simultaneously register farmers, measure acreage, and link to socio-demographic data. However, in all three countries the agricultural census far predates their AIMS, making farmer registration quite difficult. This bounds the utility of the system, which only increases exponentially with farmer participation.

Given the limited resources, the countries have adapted to these challenges in different ways. Saint Lucia for example has the most advanced system while having registered the fewest number of farmers. The situation is vice versa for Barbados. The table below summarizes where each country is in their AIMS journey.

Table 3: Current agricultural information management systems

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Previous agricultural census/survey	National Agricultural Survey of 2006 and Irrigation Survey of 2007. Previous census from 1989.	Census of Agriculture of 2007	The Agricultural Census of 2000 (Another scheduled for 2024)

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Name of AIMS system	Barbados Agricultural Management Information System (BARMIS)	Agricultural Data Management & Enterprise Resource Planning (iFarm)	National Agriculture Management Information System (NAMIS)
Farmers registered	Approximately 17,000 – all farmers with over 10 acres, all farmers receiving subsidies or using irrigation infrastructure	Approximately 4,000 (of 15k) - all farmers licensed for foreign export, or receiving financial credit	Approximately 10,000 – all farmers receive technical assistance and incentives from the ministry.
Farmers sampled	All farmers with over 10 acres or using irrigation with respect to 42 crops. For farmers under 10 acres, a representative panel is sampled.	All farmers growing one of 12 commodities, regardless of if registered or not.	All farmers except those that refuse to participate or are exceptionally difficult to reach.
Timing & Frequency of data collection	Extension officers go to the field every week and try to interview farmers at least once per month, particularly around key planting and harvest dates.	Extension officers visit approximately once per month, but farmers can log information themselves through the app.	Extension officers collect data from the SVG nine agriculture districts every week.
Modality of data collection	Currently officers only have paper-based forms, then they must be manually entered into BARMIS.	Officers have tablets to collect all information, using World Bank's <i>Survey Solutions</i> tool.	The ministry is currently undergoing a transition from collecting data on paper to using tablets for digital record-keeping.
Additional Features	Trading platform for agriculturalists	Designed to serve as a farm information management tool as well, providing recommendations on predicted crop-yields	The NAMIS is currently in active development to serve as the platform for the 2024 census.

4.4.1. Market Price Monitoring

Each of the AIMS systems incorporates retail price monitoring as one of its primary functions. This is for several reasons. First, retail prices are of significant interest to farmers themselves; they use this as an indicator of when and where it is best for them to sell their goods. In numerous studies this information has been shown to increase farmer incomes (Goyal, 2010). Furthermore, this is also useful as a policy and coordination tool amongst farmers and policymakers to avoid the boom and bust cycles that are common in agriculture due to imbalance of supply and demand forces. As most agri-food commodities have limited shelf-life, the health of the marketplace corresponds directly to food-security for consumers, income for farmers and food-processors, and the stability of the agri-food value chain. In all cases the ministry of agriculture strictly monitors indigenously produced commodities.

A common feature to all countries in the region is the reliance on supermarkets for surveillance. As the islands are small, typically a farming household is able to engage as a both a producer and distributor if the need for processing is limited (e.g., fresh fruit and vegetables). Cooperatives are present for only or a limited number of export-oriented commodities such as sugarcane in Barbados and bananas in Saint Lucia. Furthermore, the number of supermarkets on the islands is limited, with 59 in Barbados, dominated by five chains: to just 12 in Saint Vincent and the Grenadines. Hence a supermarket can provide prices at both a retail-level and at wholesale level through the backdoor prices it pays to its suppliers. Like with the price-surveillance programmes under the ministries of commerce, the datasets are small, and prices calculated using simple summary statistics without weights. The protocols for price surveillance by the ministries of agriculture are detailed in the table below.

Table 4: Retail price surveillance protocol by ministries of agriculture

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Commodities Collected	33	20	Information not obtained
Quantity & Units of Measure	No systematic measurement of produce to ascertain mean unit weights but all produce prices collected by weight.	Systematically measure produce every quarter to attain unit weights.	No systematic measurement of produce to ascertain mean unit weights.
Retail: Timing & Frequency	Weekly	Weekly	Weekly

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Retail: Locations & Sampling	Information not obtained	10 supermarkets and 1 open-air vendor market (10 samples per market)	6 supermarkets
Retail: data collection modality	Paper, but moving towards tablets.	Tablets, using survey-solutions.	Paper, each supermarket self-fills form
Wholesale: Timing & Frequency	Quarterly but this information is delayed by as much as 2 months.	Quarterly	Weekly collection of wholesale agriculture prices from (cont.) (cont.) supermarkets, open markets and vendors.
Wholesale: Locations & Sampling	22 supermarkets throughout Barbados.	10 supermarkets and the 49 biggest hotels and resorts on the island, no one is monitoring vendor markets	
Wholesale: data collection modality	Backdoor prices directly provided by businesses		
Price calculation methodology	Mean and range for both the week and the month (and spatial division)	Samples are weighted by the outlet revenue. Prices are aggregated for the whole island by mean, median, and mode.	Mean and range for both the week and the month for the whole island.
Dissemination	Published in BARMIS and ministry website. However, data is two months old.	Published on the govt website and on iFarm farmer app. However, has not been updated since 2019.	Information is used internally and shared with the statistical office. It is also available to the public upon request.

It is important to note that supermarkets are not the only places that consumers buy food, and often have higher prices than open-air markets which are extremely popular with consumers, especially amongst more vulnerable communities. Such markets however often present a challenge

for data collection, not just in the OECS region but globally. The markets are usually held at fixed morning times either one or two days per week and the same vendors are not consistently available. Furthermore, vendors have a general reticence to participate, finding the process cumbersome and worried they may lose sales.

4.4.2. Additional Information Collected

The ministries of agriculture and their AIMS systems collect a wide-range of additional information that is not only invaluable to understanding various aspects of agri-food markets, but also creates a richness of insight that can only be captured from directly interfacing with farmers. Market prices are only one small part of a much bigger agri-food value-chain. The ministry of agriculture is providing much of the other information necessary to understand it holistically. Generally, this information is relevant per one or several of the reasons below:

- **Harvest yield prediction and measurement of crop development** - This subset of variables includes land features, weather patterns, agri-inputs such as fertilizer and pesticide, and hazards like pests and diseases. They help provide accurate guidance on predicted harvest yields for a given crop.
- **Forecasting supply in-market and timing** - Once the crop is harvested, additional losses occur in processing and storage before yielding the final amount to sale. These variables combined with timing information can accurately predict the quantity, quality, and timing of supply entering the market.
- **Profitability and agricultural productivity** - Pricing and agri-input variables then subsequently provide the full picture of the farmers' business, allowing agronomists and policymakers to examine the agricultural economy in detail and understand the full effect of subsidies or other interventions.
- **Price-transmission and market structure** - After the crop has been sold by the farmer, it passes through usually one if not more stages of either aggregation, processing, or both. These wholesalers attach their own premium and have further input costs, such as transport, packaging, and warehousing, that are further transmitted to the consumer.

All three of the governments face human resource and other constraints that limit the information they can capture. Namely, farm-gate and harvest-related activities, quantities, and prices are notably absent while being the most vital to the four goals mentioned above. The table below summarizes the additional information being captured. The relevant category above is indicated by the superscript preceding the variable description.

Table 5: Additional information collected by the Ministries of Agriculture

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Farmer ID, land-tenancy, & socio-demographics ^{1, 4}	Land tenure and basic socio-demographic data are present. In Saint Vincent and the Grenadines this will expand in 2024 to the full census data.		
Land & farm features (geo-coords, soil-type, equipment, etc.) ¹	Land area only, can be matched to gross maps of soil-type and terrain.	Land area, GPS coordinates, number of trees for tree crops; drone-team in place that can provide precise aerial maps; however, scaling is a challenge.	Land area only; GPS to be added in 2024 with the completed census.
Area planted and/or livestock count (by crop & varietal) ^{1, 3}	Collected for all farmers in sample for 42 commodities.	Collected for all of farmers in country for 12 commodities.	Information is collected for all farmers for a diverse range of commodities
Subsidies disbursed ³	Yes, integrated such that farmers must register to receive subsidies.	Yes, but maintained in a separate system. Farmers not mandatorily registered to receive subsidies.	Yes, integrated into system and requirement for farmer subsidies.
Planting & harvest activity dates ²	This is one of the main focuses of the field-data collection.		
Farming inputs (price & quantity) ^{1, 3}	Not collected, simply coarsely estimated based on acreage, planting-pattern, and soil & weather conditions.	Collected, but not rigorously. Instead, grossly estimated using tech-packs that advise on agri-inputs per crop per area cultivated. However, tech-packs are often out-of-date.	Not collected, simply coarsely estimated based on acreage and planting-pattern.

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Crop development, disease, & field damage <small>1, 3</small>	This is one of the main focuses of the field-data collection. In Barbados they are also recording abundance of animal pests such as monkeys.		
Total harvest yield ²	Collected but not rigorously. Instead, coarsely estimated using gross productivity factors by land-type and crop-condition adjusted for crop-losses.	Rigorously collected for 12 commodities.	Rigorously collected for agriculture commodities. Many farmers opt not to report to avoid tax repercussions.
Farm gate prices & quantities sold <small>1,4</small>	Not Collected	Data is collected quarterly from supermarkets on backdoor purchase prices. Saint Lucia is sufficiently small that farmers directly distribute to supermarkets with no wholesaler in between.	Data is collected on farm gate prices but not on quantity sold.
Intermediate input costs (e.g., transport, packaging, processing) ⁴	Not Collected	The system of national accounts is able to capture some of this information on an annual basis, but it is not collected by the ministry.	Only collected from major food-processors on an annual basis.

In addition, all governments have disaster preparedness measures facilitated by the ministries of agriculture. As part of the programmes, the ministries annually collect information on stocks in the country on-hand for all non-perishable essentials and a select group of perishable foods.

4.5. Central Statistics Office

The central statistics office (CSO), which in Barbados is named Barbados Statistical Service (BSS) and in Saint Lucia the Statistical Office of the Ministry of Finance, has an incredibly wide mandate as discussed in Section 3. Common to all is the production of the Consumer Price Index (CPI) for which all these offices have dedicated teams. Before diving further, it would be helpful to understand what CPI and its relevance to market price information is.

What is CPI? How is it computed?

The CPI is a commonly used economic measure of the prices faced by consumer in the market, composed entirely of data on prices collected from consumer goods and services outlets. Hence it is an incredibly rich source of market information. CPI also serves as the primary measure for inflation and is vital for many economic and monetary functions. It is constructed in the following manner (IMF, 2020):

- **A representative household basket of goods along with associated quantities is tabulated for the population of interest.** This basket should include all the consumption required for a representative household from shelter, food, transport, clothing, medicine, education, and more for a specified period of time (usually one month). This basket is typically hundreds if not thousands of items with incredible variation across different socio-demographic groups.
- **A representative set of prices is computed for each item in the above basket.** When one considers the sheer number of varieties and brands that even a single item such as “coffee” may have, computing a single representative price can be quite a challenge. There is usually a need to first compute weights across the many products available in the market that map to a particular item in the CPI. Moreover, there is also a need to ensure the prices themselves are collected in a representative manner, covering a representative range of outlets from street-vendors to luxury shopping malls. Therefore, if the price sampling itself is not representative, then another set of weights is required. The result is a price index on the item level (e.g., Coffee Price Index).
- **The CPI is calculated for the representative basket of goods normalized against a particular time-period.** The calculation of the CPI is fairly straightforward once the individual price indices are computed in step 2. Often times multiple CPIs are calculated by geography and/or socio-demographic groups. Moreover, the CPI is usually referenced to a particular time period (e.g., the year 2000) and normalized, so the index represents the percent increase/decrease in consumer-prices since that year. The CPI can also be computed in *nominal* terms as just described, or in *real* terms where we remove labor-cost inflation. The latter statistic allows us to truly understand changes in purchasing power for the population.

4.5.1. Information Collected & Methodology

Broadly speaking the methodology is similar across countries. First, an expenditure basket is assembled following a household expenditure survey. This expenditure survey determines the weights of the items in the basket, the subsequent sampling frame from which future market price observations will be drawn from, and the base year of the index against which prices are measured. Finally, the actual index construction is also almost always the same methodology, using a technique called Geometric Laspeyres, described below.

Geometric Laspeyres Index Construction

Geometric-Laspeyres is a recommended best-practice (IMF, 2020) to produce CPI and other price-indices. This kind of construction arises naturally from the fact that the relationship between prices is usually multiplicative in nature. This means that prices go up or down on a percentage basis rather than an absolute basis. For example, a shopkeeper may adjust all prices by 5% to account for inflation, but never add \$5 blanketly across prices. Intuitively, one can understand why this percentage basis innately makes sense. In a Geometric-Laspeyres index takes then the weighted geometric average of the log-ratio of the current price with the reference period price for the item. The log-ratio puts the percentage-basis discussed earlier on a mathematical footing resulting in a rate of change for price, while the geometric mean indicates the center-of-tendency for such rate variables.

In fact, this technique is built-in by default within UNECE's Price-index Processing Software (PIPS), used by all but Barbados (preferring Microsoft Excel) to tabulate CPI (UNECE, 2023). However, there are nonetheless differences in the CPI methodology followed by each of these countries, owing to the many details inherent in basket construction, data collection, item substitution, and more.

Table 6: Consumer price index methodology followed by CSOs

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Previous household budget survey	Household Budget Survey 1998 – 1999	Household Budget Survey 2005-2006	Household Expenditure Budget Survey 2007-2008
Initial base year and last rebase year	May 1994 with rebase in July 2001	January 2008	January 2001 with rebase in January 2018
No. of price quotations	3,171 per quarter of which ~1529 correspond to food	Information unavailable at time of drafting	~3,000 for the month
No. products / items in expenditure basket	340 items (product-types) of which 118 correspond to food. Number of specific products is unknown at the time of drafting.	~2000 specific products	1,338 specific products corresponding to 187 items (product types). 72 belong to food.

	Barbados	Saint Lucia	Saint Vincent and the Grenadines
Item weights in basket	Each item has been assigned a unique weight. Unique products belonging to an item are equally weighted. No other weights by outlet or region.	Information unavailable at time of drafting	35 categories by COICOP groups and classes to which items are mapped. No other weights by outlet or region.
Locations sampled	191 outlets (including open-air markets)	50 outlets (including open-air markets)	243 outlets
Timing & frequency	Prices of perishable food items are collected from the five main markets on the island, weekly on Fridays. Prices of manufactured or processed food items, alcoholic beverages and tobacco, personal effects and other semi-durable or durable items, are collected every mid-month from 101 outlets. For other goods and services prices are collected quarterly.	All outlets surveyed mid-monthly.	Price collection begins the first Friday of each month. Frequency varies by category. For major categories collection such as food collection is monthly but limited to select outlets (e.g., only 12 supermarkets for food monthly). Data is collected quarterly across all categories and outlets.
Observation Substitution	If unavailable for 6 consecutive months or the outlet has closed	No substitution, with so many items it is simply imputed until unavailable for 6 months then dropped.	If unavailable for 3 consecutive months.
Item Imputation	A missing price for a single month is moved forward. Thereafter, a missing price index is proxied by its parent index, i.e., if a specific product's index in an outlet is missing due to missing prices, the index of the product group it belongs to will be taken as representative.		
Outlier Detection	Deviations of 20% from the previous observation are flagged as possible outliers. Three methods used to verify, built into PIPS: z-scores, box-plots, and log-normal z-score.		

4.5.2. Producer Price Index (PPI) Data

While no country is collecting PPI⁸ data at scale, the CSOs of Barbados as Saint Lucia have made progress on this front. Saint Lucia have implemented a PPI for hotels and restaurants, and the PPI in Barbados is limited to all establishments operating within the manufacturing industry, including the largest 50 manufacturers on the island. There is concerted effort on scaling these to construction and other sectors to produce quarterly PPI indices for the country at large. However, there is no specific plan in place for collecting such intermediary prices with respect to agri-food commodities either independently or in-concert with the ministry of agriculture.

In lieu of direct-measurement, FAO Stat publishes annual PPI indices both at the farm-gate and wholesale level in all three countries across a wide array of agricultural commodities. Most data originate from country sources received through the FAO questionnaire on annual and monthly producer prices received by farmers for primary crops and livestock products. In addition, where no official data are available, these are complemented by FAO estimates (FAO - FAOStat, 2023).

4.5.3. Outputs & Dissemination

Disseminating information is a fundamental challenge across all three countries, and the CSOs seem to be the leading government agencies in charge of performing this function. The CSOs of Barbados and Saint Vincent and the Grenadines consistently produce monthly CPI bulletins with approximately a two-month gap between data collection and publication. The bulletins are richly detailed with many tables and graphs that segment the CPI into different household expenditure categories. The notable exception is St. Lucia. The last readily available figures on CPI are from July 2022, and the last update from October 2022, 5 months prior to the writing of this report. Neither does the CPI have a published document round its methodology.

⁸The Producer Price Index (PPI) measures the average change in the prices received by domestic producers for their output over time. It is used as an economic indicator to track inflationary pressures in the production process and can provide valuable insights into the supply-side dynamics of an economy.

5. Gaps in Market Price Monitoring Systems

The previous sections reveal how each country has up to five different institutions collecting market information, often in sophisticated ways. However, these are largely operating in silos, with extremely valuable data inaccessible in any automatable way between various government systems. It is certainly within reach to have gold-standard agri-food market-information systems, producing monthly Final Demand-Intermediate Demand (FD-ID) and CPI or retail price indices across multiple agri-food value chains. The primary impediments are not insurmountable information gulfs, technology, or technical expertise, but perfunctory information gaps and coordination efforts that can be addressed without significant resource expenditure as explained in the proceeding section. This section explores these gaps and challenges and highlights that biggest challenge is in digitizing and integrating information already being collected and/or generated by various units within the government.

5.1. Information Gaps

Rising food prices in response to global supply chain crises, Ukraine-Russia war, COVID-19 increase the urgency with which global food systems need to respond with optimized food production. Yet, there are a range of information gaps in existing market monitoring systems across Barbados, Saint Lucia and Saint Vincent and the Grenadines that limit the ability of citizens, governments, and businesses to respond effectively.

Key gaps across the three countries include:

- **Quality and availability of data-inputs** - Currently, there seems to be a lack of accurate and complete data on various aspects of agriculture and food production, which can hinder effective policy making and decision-making. The incomplete or inaccurate data ranges from incomplete production, trade, and consumption data to insufficient market trends and demand patterns data. Governments and other stakeholders may face difficulties in making informed decisions and developing effective policies without accurate and comprehensive data on these aspects.
- **A lack of coverage across commodities and different parts of the value chain** - Insufficient data is available on various aspects of the agricultural value chain, particularly for informal markets and small-scale traders. There is also a lack of information on post-harvest losses and waste, which impacts food security and economic sustainability. Value-added activities such as processing, packaging, and transportation are also inadequately documented, which hinders the competitiveness of the agri-food sector.
- **Dearth of up-to-date base-layer information** - There is a lack of current and comprehensive baseline information. Current data on consumer behavior, such as spending habits and food preferences, is crucial in calibrating CPI and identifying market patterns. Similarly, current agricultural census data is required to estimate crop yields, market supply, and guide investment decisions and technological adoption. Information on weather patterns, soil quality, demand patterns, and climate change informs farming practices and crop selection. Not having this data can lead to lower yields and economic losses.

5.1.1. Commodities collected

Across none of the three countries does the ministry of agriculture believe they are monitoring an adequate number of commodities. Tree crops are commonly cited as missing from the list along with produce that is only seasonally available. The CSOs on the other hand do collect a robust list of foods, but on the other hand use a basket that is rather outdated meaning certain foods may also not be present. Ministries of agriculture commonly cite 60-80 as the number of items would like to monitor within the country. Currently in Barbados they monitor 33, and in Saint Lucia just 20. For the vast majority of agri-food commodities the data simply is not present at the retail level in anyway.

5.1.2. Timeliness of data

Especially regarding the prices paid by businesses for agri-food commodities, whether they be supermarkets or hotels, representatives from all three countries lamented how the data often comes to the ministry months late. Hence there is an incredible lag in understanding retail vs the limited wholesale price information that is available.

5.1.3. Coverage of open-air vendor markets

Except for Barbados and the Ministry of Agriculture in St Vincent and the Grenadines, the CSOs of the countries in scope have limited ability to collect data from open-air markets. However, open-air markets are tremendously popular with the public, as food is generally cheaper and discounts available for bulk purchases and long-time customers. Moreover, vendors at such markets are much faster to respond to fluctuations in supply and demand than grocery stores. Prices in open-air markets can vary day by day, while grocery stores are much slower to adjust prices. One cannot obtain a complete picture of retail prices without data from these sources.

5.1.4. Wholesale and intermediate input prices

Saint Lucia and Saint Vincent and the Grenadines are relatively smaller markets so individual food producers often act as their own distributors - without any need for an intermediary aggregator-wholesaler. Hence, the backdoor prices collected by Saint Lucia serve as a fair proxy for wholesale prices. However, in Barbados and Saint Lucia this information is still largely missing, and in all countries, there is very limited information on the prices of intermediary inputs from the time the farmer harvests the crop until they are sold to the consumer. Apart from this backdoor data there is in fact almost no information regarding the middle aggregation, processing, and distribution tier of the agri-food value chain, without which not only prevents FD-ID indices from being calculated, but also limits policymakers' ability to understand the core determinants of food-price inflation and methods to curb it.

As mentioned before, BADMC is one of the largest single food importers and wholesalers in Barbados. It also is mandated to operate as a private company with its own profit/loss ledger, balance sheet, and requirement to turn a marginal profit. Presuming modernised accounting and

control systems are present, BADMC should have information that can at minimum fairly proxy wholesale and intermediate input prices. BADMC should have both quantities and prices for goods it is both importing and purchasing indigenously (e.g., buying remaining inventory from farmers). Furthermore, BADMC must have data for both intermediary inputs such as storage, transport, and packaging costs, and final outputs, that is the wholesale price to which it sells to retailers and other vendors. Given the size of BADMC and the leader-follower structure of most markets, it is likely the margins and costs of other wholesalers are quite similar. In fact, many wholesaler margins are already pre-set by price-control laws.

5.1.5. Agri-Inputs by commodity

Especially in light of climate change, a step-change in farm productivity is required to achieve the stated common objective of a 25 percent reduction of total food import costs. However, at the moment, the input side of the equation is fundamentally missing. This information is valuable for many reasons:

- Given the cost-of-living crisis, it may serve as an invaluable policy lever, as agricultural input subsidies are a highly cost-effective method to curb food prices;
- Clear transparency and predictability over costs and schedules also encourages capital investment in agriculture and other long-horizon projects;
- Advance procurement enabled by accurate schedules can dramatically diminish costs for agri-inputs, a benefit that can be passed to the farmer;
- Price transmission of food commences with the agri-input requirements of producers. This is especially true for these three countries due to limited domestic production of fertilizers, pesticides, herbicides, and other key inputs; and
- On a global level, this is recognized as a cross-sectoral commitment by organizations such as FAO, IMF, WBG and WTO (FAO, IMF, WBG, WFP, & WTO, 2022).

Agri-inputs include seeds, buds or sprouts; fertilizers, herbicides, and pesticides; capital and labour costs; and natural resources such as water and soil. Having a clear picture of inputs is helpful to understand how resources and budgets should be allocated and the quantity and commercial value of the yield. Considering that natural resources are scarce, and their use is strictly regulated in many of these countries (e.g., water from irrigation and certain chemical pesticides), these inputs also inform environmental impact and further strategies to mitigate the externalities related to their use. As such, data collection should be reinforced with the following elements:

- Source of seeds (e.g., purchased, provided, or re-sown from previous harvests);
- Use of proprietary or specialized fertilizers vs organically derived products;
- Estimation of water and energy usage; and
- Soil degradation from cropping and time needed for recovery.

It is also important to understand the impact of certain inputs on the yield proportionality. For example, incorrect fertiliser usage can unnecessarily increase cost of farming without having an impact on yield proportionality. This is a concern that was mentioned by the ministries of agriculture

for both Barbados and Saint Lucia. Currently Barbados and Saint Lucia have some limited information in the form of tech-packs. However, as mentioned earlier they are often outdated or quickly becoming outdated due to climate change's effect on cropping practices.

5.1.6. Harvest and post-harvest costs, losses, and yield

While the previous section detailed the input-side of the farm-economy equation, this section highlights the output side. Yield information can be difficult to capture, as agricultural produce remains a living commodity far after it leaves the field, undergoing changes both in quantity and quality through the entire post-harvest process which can include threshing, drying, storage, transport, and handling. Accurately capturing yield, losses, and associated costs along the harvest and post-harvest path informs the quantity and timing of supplies available, the variability within that forecast, and the nature and extent of inefficiencies in the first tier of the value-chain. In general, almost none of this information is being measured across the three countries in scope.

Loss and cost estimation is largely dependent on survey data collected by the ministries of agriculture. Effectively capturing it from producers requires at least some incentive from local food producers to report without perceived risk of heavy taxation on their surplus outputs. Guidance released by FAO (Grolleaud, 1998) contains recommendations on the type of losses incurred during processing (e.g., moisture related or chemical degradation) by commodity. Adapting these recommendations to field surveys conducted by the ministries of agriculture would be a vital first step.

5.1.7. Farm gate prices and volumes

Farm gate information is defined as the price and quantity of commodities sold by farmers at time of production, prior to commercialisation and distribution. Packaging, transportation, and marketing related costs are added to the freight-on-board (FOB) price when the commodity is offloaded to the customer. The differential between farm-gate and FOB prices can be quite significant and directly influences farmer livelihoods, if not disclosed. Proactively collecting this information addresses four major gaps from the fact that the countries in scope are all SIDS countries:

- **Market information** around supply, demand, pricing trends, and other patterns that enable farmers and other stakeholders to make informed decisions about production levels, marketing strategies, and investment in new technologies or crops.
- **Price discovery** for farmers allowing them to negotiate fair prices for their products. Accurate data on farm gate prices and volumes helps establish a fair market for both farmers and consumers.
- **Policy development** that supports policy makers in strengthening the agricultural sector, either by allocating resources to particular crops in high-demand or price-supports and import protections when prices are lower than expected.
- **Trade negotiations** with international partners allow the countries to demonstrate with data, their capacity to produce high-quality agricultural products and negotiate favorable trade agreements.

However, obtaining farm gate data can be challenging. The ministry of agriculture usually has few other options other than proactive survey data collection at the time of harvest. This presents a challenge as the harvest window is of short duration, broad swaths of farmers participate at once, and enumeration staff is limited. Estimates from past years prices can also be misleading as agricultural markets are highly volatile and rapidly change in response to seasonal changes, inflation, the cost of agricultural inputs and consumer demand. Finally, farmers are disincentivized to self-report due to concerns around additional taxation.

Currently, there is almost no data on farm gate pricing in the three countries. However, Saint Vincent and the Grenadines collects farm gate prices for various commodities from farmers. Barbados and Saint Lucia have some existing and future provisions to capture farm gate data. In Saint Lucia this is meaningfully proxied by backdoor supermarket prices. In Barbados, BADMC almost certainly has some of this information it is not publicly available. Capturing the effects of inflation on commodity prices is trickier via use of farm gate pricing as the initial indicator of an inflationary shock is in the quality of the goods which is generally not captured.

5.1.8. Conversion factors from units to weight

Often-pricing for commodities especially at the wholesale level is just available in heaps, bundles or sacks, and thus prices are recorded in these units. However, this kind of counting data is not compatible with any of the other agri-food price information currently being collected and represents a significant impediment to inter-operable market information.

The Saint Lucia ministry of agriculture undertakes the effort every quarter to create standardised tables that convert units of 20 commodities into weights. This is yet to be implemented in Barbados. However, Saint Vincent and the Grenadines has started implementing this practice to convert some commodity units into weights.

5.1.9. Constraints on trade

Considering the macro determinants of post-COVID food-price inflation, there are opportunities for Barbados, Saint Lucia, and Saint Vincent and the Grenadines to invest in the long-term competitiveness of their agricultural sector. This may include credit, capital equipment, infrastructure, or even a single-trade window system that enables an online one-stop-shop for sellers of agri-food commodities to export their goods. Unfortunately, there is no systematic data collection on any of these countries with respect to this thematic area to either develop proposals or directly ascertain farmer needs. Credit is an especially important trade constraint as not only can a dearth of credit sink supply and create wild price fluctuations, but it is also needed to develop an export base, as exporters usually require trade credit to enable the transaction. Analysis of the countries' market monitoring systems and mechanisms indicate that further capacity building is required to address these trade constraints.

5.1.10. Market trend and tone

At present, the governments of Barbados, Saint Lucia, and Saint Vincent and the Grenadines do not have a coordinated mechanism to capture information on expected quantities required by large-scale wholesalers and distributors of commodities (main drivers of domestic or international demand). As seen in other SIDS, traders are closest to this source of information and are considered best placed to provide a picture of the existing market. Systematically capturing information on the expectations of wholesale traders is a pre-requisite to accurate forecasts of price movements and supplies. Traders are often the closest to the source, and thus able to piece together accurate market theses from the limited information they have.

5.1.11. Outdated consumer expenditure surveys

The consumer expenditure survey in any of the three countries is no less than 15 years old. When the survey is so old, several issues can arise with the CPI:

- The expenditure survey composes the basket and constructs the weights of the CPI. As the weights and basket no longer reflect household consumption patterns, the CPI becomes an inaccurate measure of inflation.
- Over time new categories of goods and services emerge, thus entire categories of goods are inevitably missing from the basket of prices being measured.
- The quality of data inevitably decreases over time as the number of substitutions pile-up. After such a long period of time, the same goods from the beginning of the index are often no longer on store shelves.

Inaccurate CPI measures may lead to poor policy decisions, but moreover hampers the ability of CSOs to effectively monitor prices in the economy, having to expend considerable resources to monitor an inaccurate consumer basket.

5.1.12. No recent agricultural census or survey

None of the countries reviewed has conducted any agricultural survey or census in 16 years (Saint Vincent and the Grenadines is expected to complete one by 2024). Yet in the last 20 years these countries have undergone significant agricultural shifts; they have cultivated well known agricultural exports, dramatically reduced their food import bill, and face wholesale changes in cropping and planting practices due to climate change. The agricultural census is the base through which agronomists can construct accurate forecasts and estimates for agri-input usage, yield, prices, and the farm-economy writ-large. These forecasts in turn drive agricultural markets.

Of specific concern are land-use, soil-degradation, and water-usage. They are not only predominant agri-inputs that affect prices but are also amongst the most difficult to measure and so rely on complex models produced by the ministries of agriculture. These models can only be accurate with updated information. Additionally, farm-level geo-coordinates and Geographic Information System (GIS) shapefiles are becoming de-rigueur information for ministries. With the advent of satellite data and machine-learning, pin-point accurate forecasts can be realized at the farm-level. However, the

shapefiles and training data for these models do need to come from up-to-date, large-scale agricultural surveys.

5.2. Indicators & Outputs

As mentioned earlier, the ability to produce FD-ID price indices especially across a wide array of economically important agri-food value chains—otherwise known as FIPI indices when produced at the farm level—is the overarching standard to which the government should aspire to have its market-information systems. This would enable creating not only national PPI, but producer-price indices across value chains. However, there remain several other indicators that any market for agri-food commodities needs to function well:

- **Price and demand forecasts** - Major importers, wholesalers and distributors place orders on commodities up to 18 (even 24) months in advance, hence prior knowledge and predictions around pricing dips or peaks is essential for order placement, supported with a calendaring tool leads to superior inventory management, demand-planning, and ultimately profitability for agri-businesses.
- **Crop yield and supply forecasts** - While the ministries of agriculture are already doing this to some extent, they remain gross estimates using acreage and planting patterns as inputs. With farm geo-coordinates and satellite imagery, today it is possible to produce highly accurate, customized, farmer-level yield prediction at scale, updated in real-time.
- **Price indices for common agri-food commodities** - None of the CSOs decompose the CPI into finer-grained agri-food categories, at best only publishing numbers for a bulk food-price index. It would take minimal effort to decompose the CPI into separate price indices for the 9 major food categories in COICOP.
- **Labour terms of trade** - Dividing the CPI's expenditure basket cost by the daily-wage rate produces a highly insightful indicator to measure cost-of-living.
- **Shock impact and simulation modelling** - With the current CPI data, the household budget survey data, and labour data, the CSOs can and should implement a macro-economic shock impact and simulation modelling tool. WFP has already built such a tool that countries can readily deploy known as Shock Impact Simulation Modeling (SISMod) (World Food Programme - VAM, 2013). Such a system can provide ex-ante and ex-post quantitative information as to how vulnerable populations will be affected given sudden changes in price or supply.

5.3. Other Gaps

5.3.1. Standardisation & oversight

Of the four major price-capture systems in place in each country, commodities are coded in completely separate ways by each system:

- The ASCYUDA system uses HS codes which are the global standard for classifying internationally traded commodities, sanctioned by the World Trade Organization and also used by the USDA;
- The CSOs use COICOP codes that are specific to household expenditures; however, they can be easily mapped to HS codes via Centralized Product Classification (CPC) codes. CPC codes are maintained by the United Nations Statistical Commission and are intended to be the international standard for organizing all trade, national accounts, and production information; and
- None of the agriculture and commerce ministries use any kind of standardized coding system.

Moreover, there is significant replication of retail price data collection across the CSOs and ministries of agriculture and commerce. In the countries that participated in the case study, each of these ministries operate in complete silos with little knowledge of what other ministries are doing with respect to market monitoring or where to find their data.

5.3.2. Stakeholder participation

Market monitoring systems rely on the participation of stakeholders, including farmers, traders, and consumers, to provide data and feedback. However, in many cases these stakeholders are reticent to participate. They question the government's motives and needs in demanding the data, they find the process of collection cumbersome, and often fear the information can be used against them, as an example to search for financial malfeasance. In addition, they fail to see or receive any reward for participation.

5.3.3. Dissemination

Even when data is collected and analysed, its dissemination to relevant stakeholders is quite limited in all three countries. This reduces the impact of the market information system and its effectiveness in supporting decision making. The CSOs by far do the best job at dissemination, consistently publishing monthly bulletins (with the exception of Saint Lucia that has not done this with consistency since 2017). In general, the dissemination gaps can be categorized as follows:

- **Information is not timely** as many ministries lack the capacity to maintain and provide open access to updated data.
- **No ministry has any publicly available data API** through which relevant data can be accessed by an authorised party and served in a machine-readable format. At best there is

the ability to download MS Excel spreadsheets, but information in this format cannot be readily consumed by other electronic applications.

- **There are no data visualization tools** that allow users and decision makers to understand data in an intuitive manner. Data tends to be presented in tables and static images. The CPI bulletins that are produced by Barbados and Saint Vincent and the Grenadines could readily be replaced with web-enabled dashboards, as the bulletins are almost entirely graphics and tables, which would be far more convenient for the user while eliminating an unnecessary process for the ministry.
- **There are limited channels through which information is disseminated** with the ministries relying mostly upon government websites and Facebook. There is no pull-system by which citizens and businesses can easily request prices either through a mobile-app or SMS.

5.3.4. Technology

A lack of use of technology further inhibits data collection, aggregation, and robust analytical processes performed at scale. Processes around data collection, analysis, and dissemination need to be updated to take advantage of available technologies. Some common themes across all three countries include:

- The use of antiquated survey tools with the notable exception of Saint Lucia. Not only are enumerators using paper, but also the enumeration modality is reliant on a dedicated full-time work force and therefore vulnerable to staffing challenges.
- The inability to centralize market data across all ministries into a single source-of-truth dashboard would be of immense value to political leaders and decision-makers.
- No APIs available to fulfill data requests from other units within the government or connect to modern computers or web applications.
- Outdated price-index processor software running on antiquated databases or sometimes even no database. The process of computing price indices for sub-baskets of goods is unnecessarily manual.
- No modern data visualization tools (with the exception BADMC) to make the data accessible to the lay public.
- No real-time information and price information that is available on the ministry website is usually out of date. Updating the website is a manual process that can take weeks.
- Concerns around privacy with respect to collecting point-of-sale data.

At the state-of-the-art, data collection happens in near real-time without enumerators but instead point-of-sale terminals, satellite imagery, and other devices, whereby machine-learning models produce sophisticated analyses displayed in real-time on web-based maps and other data-visualization tools. Modern survey tools allow for completely flexible enumeration workforces that work through location-basedapp, guiding the enumerator through the whole workflow.

5.3.5. Human Capital

Government initiatives across all three of the countries face implementation challenges due to lack of manpower and technical training with respect to market monitoring, econometrics, agronomy, and increasingly data-science and IT. Upscaling technical capacity for market monitoring is a priority by all three governments but there is reticence to allocate budgets towards it.

An important consideration is that linear career trajectories and demographic trends create skills gaps in the ministries once experienced officials retire. Confidentiality and impartiality related principles also underpin silo-driven work that limits information exchange. Recruiting young talent to take their place is increasingly becoming a challenge. The local markets require statisticians and economists with extensive, specialized training to undertake this work, yet there is very limited outreach to encourage young people to pursue such career paths. When ministries are able to recruit young talent, they often become disillusioned by the silos and the ancillary status of technology within the ministry.

6. Recommendations

While this report takes an expansive view on identifying gaps, it is not within the scope to layout all actions required to close these gaps. Many of these gaps are already being addressed by the dedicated teams within the various ministries and others may require an unrealistic level of resources. The report seeks to create a dialogue around the subject, therefore the overview below is by no means a comprehensive list of recommendations and focuses on those that were most readily apparent from key interview discussions. Recommendations are ordered with respect to ease of implementation. The first section details the most prescient recommendations common to all countries. The subsequent section delineates recommendations specific to the country. Finally, more resource intensive recommendations are offered in a subsequent section.

6.1. Overall Recommendations

The recommendations stem from two guiding principles. First, as a gold standard a market monitoring system should provide all the information needed for a country to compute both current CPI and FD-ID indices across a broad set of vital agri-food value chains. This is an informative benchmark due to the sheer number of prices and volumes across different parts of the economy that need to be collected for such a task. The second principle is one of efficiency, having minimal overlap and duplication between governmental units and maximal leverage of existing resources.

It is immediately apparent from the second principle that the different tiers of the agri-food value chain map cleanly to the three ministries currently performing retail price monitoring in each of the three countries:

- The ministries of agriculture are the only entities directly engaging and collecting data from farmers, the first tier in the value chain.
- Similarly, the ministries of commerce regularly collect data and engage with businesses, corresponding to the middle tier of the chain.
- The CSOs have a mandate to collect large volumes of price data every month from retailers, the final tier of the value chain, and have been skillfully doing so for decades.

The recommendations given below carefully consider how these governments can move to a single cohesive market monitoring system that achieves both aims in an order that minimises upfront costs and maximises ease-of-implementation. In an ideal scenario, cost savings from efficiency and removal of redundancy can finance all or part of the recommendations listed below.

Figure 5: Recommendations for streamlining market price monitoring



6.1.1. Central coordinating body for all market monitoring across government

As a first step to deduplicate market monitoring efforts, a government unit could be appointed as a centralising body to coordinate market data collection across these different government bodies. In all three countries the CSOs are a logical choice. Their function is unique, almost exclusively producing data to be consumed by other units within the government and beyond. Hence, they also all have a bird's eye of the data landscape across the government, knowing where that data exists, whom to ask, and how it can be used. In this manner these CSOs unite three critical functions that any coordinating body must possess:

- **High degree of technical advisory expertise** – Market information data collection can become a highly technical endeavor as hopefully this report elucidates. Great thought needs to be put into what data needs to be collected, how to connect to other data sources, and finally how to tabulate and produce meaningful information. This is precisely CSO's mandate, and they have more experience and expertise here than other units within their respective governments.
- **Ability to create highly valuable new analyses and data products** – Given access to data across the government and high technical expertise, the CSOs can also create additional value by coordinating and aligning price-data collection efforts across their respective governments. These products include producer-price indices, price forecasts, market alerts, and more.
- **Ability to interface with interested external stakeholders** - Communicating and facilitating information about price and market data is part of their role. CSOs must communicate and disseminate information not only to governmental units, but also a gamut of international, academic, and private-sector organizations. A one-stop shop for relevant data incites international partnerships and statistical capacity strengthening (PARIS21 for instance).

Currently, each government ministry operates independent of the other with respect to market monitoring, acting in the best interest of their respective unit's mission. However, in doing so, broader objectives and creative synergies are lost, and considerable effort is duplicated. A coordinating function or unit within the government can guide a holistic, big picture approach to market monitoring systems.

6.1.2. Standardized coding for agri-food commodities

Almost all countries across the world implement two globally standardized coding schemes for commodities depending on the function. CSOs rely upon COICOP codes to specify household expenditures and customs and excise departments rely upon HS codes. Fortunately, the two schemes are interoperable via Centralized Product Classification (CPC) codes. Unfortunately, none of the other market information collected by any of the governments can readily map to an international standard.

USDA-style HS codes are an obvious choice for such a coding scheme. While the standard HS code is 6 digits, the coding scheme allow for flexibility and customization. The USDA model has ten digits which is the most detailed implementation of the HS code scheme. FAO's Codex Alimentarius (also known as FAOCodex) is another powerful convention for agri-food commodities which offers far more granularity than HS codes (FAO, 2023). Nonetheless, standardised coding is imperative so various market monitoring initiatives by the government can combine cohesively as a single comprehensive system with the ability to globally disseminate information and foster trade.

6.1.3. CSOs lead current retail-price monitoring activities

Fundamentally the retail price market monitoring efforts particularly by the ministries of agriculture and commerce, duplicates the CSOs' efforts with respect to CPI data collection. It is quite possible to have the CSO's current CPI data collection subsume other retail-price monitoring activities with minimal increase of overall data collection efforts by the CSO. These reasons are listed below:

- The commodity list of the CSOs significantly overlaps with other food prices which other entities are collecting. In Barbados, the CSO collects 340 items of which 118 corresponds to food, while the agriculture ministry collects 33 commodities. In Saint Lucia, the CSO collects 2000 specific products while the ministry collects 22. For all three countries the CSOs can, without too much effort and investment, cover all needed products.
- CSOs can enhance their data collection frequency from monthly to weekly, as is the requirement by the ministries of commerce and agriculture, with minimal additional cost if they adopt the Statistical Institute of Belize's CPI App (see section 6.1.9). Even without this app, the CSOs have the fundamental databases and tools on hand to do data collection at scale. CSOs can use the personnel that would have been dedicated to CPI data collection for other data collection activities that are relevant to their respective organizations. For example, they could collect data on social welfare, health, environment, demography, employment, etc.
- Open-air vendor markets are vitally important sources of food for the population at large but are often missing from market information as it is difficult to do. In Barbados and Saint Lucia such markets are only covered by the CSOs, while in Saint Vincent and the Grenadines, dedicated enumerators are assigned to collect commodity prices from such markets. Agriculture extension officers have multiple responsibilities that make such data collection cumbersome, whereas the CSO has dedicated enumerators to focus on the task.

This is a more transformative recommendation and would require consultation, consensus and strong coordination efforts. An operational model that would allow the CSOs to subsume all retail food-price data collection could be as follows:

- A core list of 80 or so food items are collected from select grocery stores and open-air vendor-markets once per week.
- A broader list of all food items that comprise the CPI (approximately 250) is sampled once per month from an expanded cross-section of relevant outlets, including convenience stores and the major open-air markets on the island.
- The full CPI data collection remains conducted quarterly.

To safeguard the success of such a model it is vital for the ministries of commerce and agriculture to be able to flexibly add and/or substitute certain items, retrieve data easily through APIs and other electronic means, and deeply engage in a dialogue with their respective CSO counterparts to ensure their needs are also fulfilled. This follows the model of Statistics Canada which serves as the single focal point for all statistical data collection throughout Canada including agriculture and food statistics.

6.1.4. Harmonization of efforts across government units

The CSOs, ministries of commerce, ministries of agriculture, GSEs, and customs & excise departments in large part comprise the entire market monitoring system of the government. However, in all three countries, these units currently operate independently, resulting in fragmented data collection and a lack of inter-operability. Being able to centralize all this data in an interoperable fashion would significantly improve upon the current status quo. To achieve this, the ministries would need to collaborate on the following action items:

- **Training for customs and excise officers to record data reliably** – While inadvertent, ASYCUDA is one of the most important price monitoring systems domestically available, used by almost all departments to understand volumes and price of imported goods. However, it is of limited use if the data is unreliable. This can only change if customs officers are also trained to understand why data, particularly on volumes, needs to be recorded carefully and diligently.
- **Development of processes for GSEs (i.e. BADMC) to regularly summarize and transmit relevant information from their financial control system (applicable to Barbados only)** – The agricultural GSEs like BADMC have a treasure trove of information on intermediate prices, procurement costs, selling prices, volumes, and the other costs incurred in aggregating, processing, and distributing agri-food commodities all neatly stored within an existing database if they are using any modern financial control software. The fact this data is not readily accessible is a tremendous, missed opportunity. In particular, for each of the relevant agri-food commodities in the GSE's portfolio they should provide to the agricultural statistics unit of the ministry of agriculture (1) weekly procurement costs, wholesale prices and volumes (2) quarterly information on additional costs by line-item. Ideally this should all be updated in real-time and immediately accessible by any authorized party through an API (explained in section 6.1.5.).
- **Collecting data from trade associations and businesses under the direction of the ministries of commerce** – In all three countries studied, the ministries have done an impressive job building strong relationships with the business community at large, yet the ministries are not exploiting their comparative advantage with respect to data collection. The ministries should work to attain data from trade associations who usually have a plethora of valuable information on prices and volumes, especially for intermediate inputs like transport, packaging, and processing. Furthermore, they can work with the business

community to sensitize them to the importance of market monitoring, allowing data to be collected directly from point-of-sale systems and financial statements. Particularly with respect to attaining data to compute PPI, the ministries of commerce have the relationships and know-how to enable it.

- **Capturing information about constraints on trade** - While this may be ancillary market information, knowledge on constraints to trade can be invaluable. Credit is a major factor that drives changes in prices. Credit is needed to smooth demand; hence a dearth of credit can result in wild price fluctuations, especially when demand peaks coincide with supply troughs. There is currently no unit within the governments that is trying to systematically capture this information except for the Farmer Support Company (a GSE that facilitates affordable credit for farmers and agri-businesses) in Saint Vincent and the Grenadines to some extent through their engagement with cooperatives and farmers.
- **Development of high-quality APIs to fulfill data requests instantaneously between authorized parties** (see next subsection)

With just the aforementioned recommendations, each of these countries would have the basic information on-hand to determine prices and costs along every step of the value chain from farm to fork across a wide range of agri-food commodities. This information is also of interest for developing FD-ID indices. CSOs would have insight into ancillary costs to consumers arising from transport, storage, and packaging; the ministries of commerce could deeply understand how prices are being transmitted; and ministries of agriculture can proxy farm-gate prices.

6.1.5. APIs for improved coordination, dissemination, and single dashboard

The CSOs, Ministries of Agriculture, and Customs and Excise departments all have tremendous volumes of data that need to be disseminated both to other parties within the government and external stakeholders. Currently such data requests are slow and cumbersome, spreadsheets published on the ministries' respective websites are often not up to-date and if the user requires granularity beyond country level summaries, that information is almost always not present.

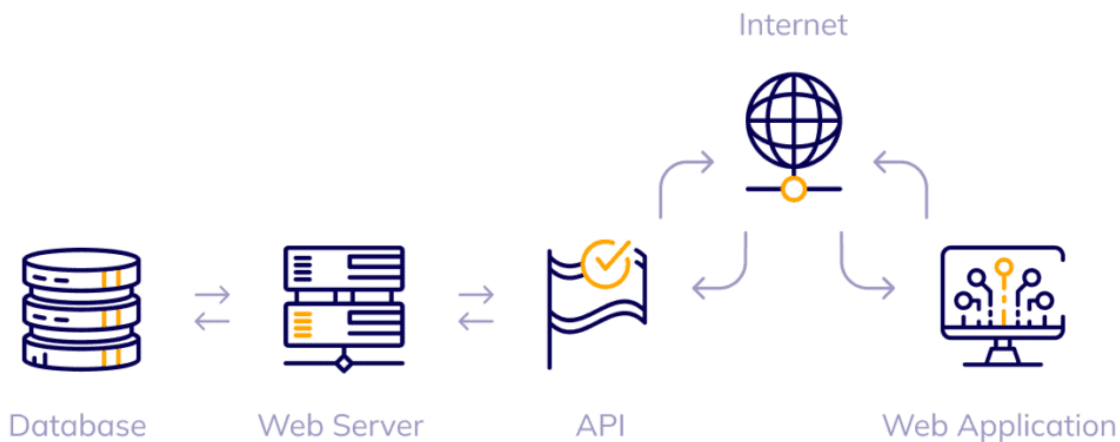
PDF documents and spreadsheets are no longer sufficient means to disseminate information. Data must be just as readily provided to other web and computer applications. APIs allow data requests to be filled instantaneously for any authorised web or computer application. As mentioned earlier, APIs are means by which data can be instantaneously transferred electronically from one computer application to another. Fortunately for the customs and excise departments this task has been made easy by UNCTAD, which has already developed an API module for ASYCUDA known as ASYHUB, that enables a standardised data integration between ASYCUDA and almost any external system (ASYHub, 2022). Implementation is technologically straightforward and does not require any additional infrastructure or resources.

The situation for the CSOs and the ministries of agriculture is more complex as they use self-developed databases for their CPI and AIMS systems respectively. As these ministries are mutually

producing information required by the other party, it makes sense that their systems incorporate robust interoperable APIs with the ability to serve finalized data at any specified level of granularity from observations to aggregations whether by district, item, time period, or all three. The Humanitarian Data Exchange⁹ (HDX) provides a nice example of just such as an API (<https://data.humdata.org/faqs/devs>). Fortunately, APIs are fairly simple to develop, requiring proper database software (e.g., MySQL or PostGRES) and a lightweight server, the former of which is free and the latter no more than USD 20/month if using Amazon Web Services.

By providing APIs, governments can make it easier for developers, researchers, and other organizations to access and analyze government data, which can lead to the development of innovative new applications and services. One such example is the Jamaica Open Data Portal, which provides a central location for government agencies to publish data in a standardized, machine-readable format using APIs. The portal includes APIs for data on a range of topics, including demographics, education, health, and crime. The Jamaican government has made efforts to ensure that the data published through the portal is of high quality and is relevant to the needs of stakeholders. The portal includes feedback mechanisms that allow users to provide input on the quality and relevance of the data, which can help the government improve its data collection and publishing processes. Another good example is India which currently has 187,930 APIs listed on its Open Government Data Platform (OGD) (<https://data.gov.in/>).

Figure 6: How an API works (Flat Logic, 2022)



⁹HDX It is a repository of data sets, maps, and visualizations from a variety of sources, including UN agencies, NGOs, academic institutions, and governments. that cover a wide range of humanitarian issues such as health, education, water and sanitation, food security, and more. It has been instrumental in improving access to timely, reliable, and relevant data to support decision making and coordination during humanitarian crises. The platform is open to anyone to use and contribute to.

Once API(s) are available, many different dissemination applications can be built on top that improve domestic market access for both producers and buyers. Of particular importance would be:

- Easy access to known retail and farmgate prices via a phone-based messaging service
- Public access to projected crop yields and current inventories
- Public access to wholesale prices and trade-statistics for various agri-food commodities by varietal

A crucial missed opportunity for these three countries, is that almost none of their monthly agro-economic information is indexed and incorporated into global trade and agriculture information databases maintained by World Bank, FAOStat, Tridge.com, and others. This can be easily rectified by inviting these institutions to consume relevant information through the ministries' APIs, once these are put in place. Access to a global audience brings many benefits including increased export opportunities for agri-foods, expanded global capital connectivity, and the attention of world-class researchers in agriculture, economics, and finance. This data is the cornerstone upon which billions of dollars of agri-commodities are moved globally every day.

Dissemination of market information writ large across all ministries, commodities, and value-chain tiers (farm gate, wholesale, and retail) should be brought together on a web single platform with modern data-visualization capabilities. With APIs in place building such a platform would not be a very difficult task. Such single dashboards are key policy making tools for government officials and others who need condensed information, quickly, and easily digestible.

6.1.6. Capture of point-of-sale data from supermarkets

Capturing point-of-sale (POS) directly from supermarkets, albeit currently in its infancy, is an incredible innovation by the Barbados Ministry of Commerce. POS has the potential to absolutely transform data collection and economic statistics for every government institution with an interest in retail prices, in particular the CSOs and price control units. Not only is data collection tremendously simplified, eliminating time and resources invested into enumeration teams then data cleaning and preparation, but also data is attained in near real-time across thousands of agri-food commodities, providing both volume information as well as prices.

To understand the potential, one must take into consideration that consumer expenditure surveys in these countries are anywhere from 15 to 25 years old, seasonal variation is substantial both in terms of availability of agri-food commodities and people's dietary preferences, and subsegments of the population also have vastly different consumption patterns. All of this is obscured in their current constructions of CPI which is representative of a single average basket over a year's time for an average consumer 15 years ago or later. With POS data, the expenditure basket can be updated quarterly, by season, every year, and even segmented by different consumer groups. Additionally, the ministries can compute elasticities that enable policy makers to understand how consumers shift their preferences in response to government interventions and market conditions. Finally, demand forecasting becomes highly simplified, with real-time data available across a slew of

different products and product categories. Knock-on effects may even include consumer savings as advance procurement usually yields significant cost reductions.

Scaling acquisition of POS data can be challenge due to privacy concerns and other technological barriers. Therefore, action on this item must coincide with the following item as well.

6.1.7. Government interventions and privacy-preserving technology

The data for market monitoring must come from businesses and citizens, and so can only occur with their willing participation. As such, the respective governments should implement solutions to enhance data collection, increase sensitization towards awareness of the role of market monitoring, and make their work more familiar and attractive to increase the participation of farmers, wholesalers and producers.

Currently, businesses and citizens at best find participation to be time-consuming, and at worst they fear it can result in fines, taxes, and other potentially negative ramifications. Almost all the countries of this report do their best to make their process minimally cumbersome, going so far as to send staff to fill in forms on behalf of the business. However, this has proven not be sufficient. There are three available tools that the governments have to address this problem:

- Workshops, training, and public messaging towards farmers and the business community to explain the importance of market monitoring.
- A public governmental stance that allows the CSOs to take a neutral position and provide public assurance that they cannot and will not make legal referrals for any data that may reveal financial crimes.
- Privacy-preserving technological tools whereby businesses can provide their data anonymously. For example, rather than supermarkets providing entire point-of-sale histories, they can upload their data to a trusted third-party server that only transmits the requested analysis of the data (usually simple summary statistics) to the relevant ministry. Using public-private key encryption disables the server from being able to further read or make use of the uploaded data, thereby relieving businesses of concerns over the misuse of their data.

A final solution is legislation itself that both mandates data to be provided by farmers and businesses and provides them legal immunity from use of the data. This is common throughout North America and Europe. The first to have done so is the USA, in 1916 with the Shepherd Amendment, which allowed the USDA to demand any agri-food related price or volume data from anyone without a specific reason. This information is also shared for free to anyone who requests it and is foundational to today's global agri-food commodity markets. Since then 120 countries have followed suit.

6.1.8. Ministries of Agriculture improve farm-level data collection

Not only is this data critical to the success of the AIMS systems the ministries of agriculture are investing considerable resources into, but it is also the very comparative advantage of these

ministries — they truly operate at the grassroots of the agri-food value chain. As such the ministries of agriculture should redouble their efforts to capture the data needed to understand their respective country's farm-economy end-to-end. In particular this aligns to three items of high priority:

- **Creating agri-input schedules and capturing their usage and costs through surveys and/or national rebate program** – While high quality “tech-packs” have been created in Barbados and Saint Lucia for a handful of commodities, the current effort falls quite short of the countries’ stated refocus on agriculture as a means to both increase exports and reduce their total food import bill. There are two methods by which ministries can collect this data. First of course are adding questions to traditional farmer surveys that the ministries’ already have in their toolkit. A second far superior and more comprehensive approach is to link modest discounts on agri-inputs directly to farmer IDs. Via legislation all vendors of agri-inputs are then obligated to provide these discounts which the then government reimburses when the vendor furnishes the proof of farmer ID corresponding to the sale. Ideally such a system would be digital and therefore perfectly seamless end-to-end, enabling the ministry to automatically track agri-input usage, at the farmer level, in real-time, at scale for the entire country large.
- **Building a training dataset to enable forecasts of total yield, harvest and post-harvest losses and costs through satellite imagery** – Harvest and post-harvest losses account for anywhere from 25-40 percent of total yield (McKinsey, 2021), and harvesting costs are generally the second highest component of overall production costs (Myers, 2022). However, currently even crop yield is not systematically collected by the ministries. In the past this was information was rather difficult to capture as surveys were the only method and farmers were reticent to answer due to tax concerns. However, machine-learning models using satellite imagery have been proven to even exceed the accuracy of such surveys in certain situations (Lobell, 2020) with the added benefit of real-time, at-scale forecasts with minimal data collection effort. Conversely, the success of such modeling hinges greatly on the availability of high-quality training data. This is essential effort the ministries must undertake through high quality survey data capturing yield, and inputs, costs, and losses both during and post-harvest on a per-commodity basis.
- **Capturing farm-gate prices and volumes through farm-management software and tech-enabled wholesale markets**–Farm-gate prices and volumes are arguably the most crucial piece of data in the entire agri-food value chain, representing the revenue generated for the producer and the subsequent inventory levels and stocks of commodities, which sets the entire market’s trend and tone. This again is traditionally a challenge to collect, highly reliant on survey responses by reticent farmers worried about tax-implications. Ideally countries should encourage farmers to capture this data themselves through freephone-based farm management software linked to subsidies and other government benefits with farmer incentives for regular usage. Saint Lucia has already embarked on this path through their iFarm AIMS system. Another option is digital scales and point-of-sale equipment at the centralized markets where wholesale produce is traded. Configuring the

equipment such that it requires farmer IDs at the time of sale enables real-time, at-scale data collection with minimal human intervention. However, at best these initiatives are nascent, ergo in the meanwhile it is essential for the ministries of agriculture to execute high-quality farm-gate surveys on a seasonal basis.

A common theme impeding data collection by the ministries is the reticence of the farmer to participate in surveys, due to perceived risk and no tangible reward for the farmer. In an age where agriculture is being transformed globally through digitization, the government must take immediate action to change this equation. If nothing else farmers should be highly incentivised to answer survey questions and provided full legal immunity for agricultural data and incentives in the form of payment or subsidies.

With the above data in place, the ministries will have the ability to estimate and forecast farmer income, devise and delineate more productive growing strategies, anticipate supply constraints, forecast farmgate prices, and finally compute Farm Input Price Index (FIPI). These indices are an invaluable barometer for development, measuring changes in agricultural productivity and the impact of agricultural policies over time.

6.1.9. Replacement of CSO's Price Index Tabulation Software

Currently the CSOs of the countries use PIPS (Price Index Processor Software published by UNECE and IMF) which was last updated in 2011 (Barbados instead uses Microsoft Excel). While the CSOs have been considering replacing PIPS with CPI+, the *CPI App* created by the Statistical Institute of Belize (SIB) is currently amongst the most state-of-the-art systems anywhere, with the added advantage that it comes from a neighbouring CARICOM country,

SIB's CPI App combines all the benefits of tablets and digitization with a complete rethink of how price data collection is even performed. Currently the process is highly non-scalable. Enumeration staff must be hired, trained, and kept on staff. To then ensure proper utilization, they must be tightly scheduled and planned accordingly carefully. Vehicles must also be provisioned for their transportation to data collection sites. SIB replaces all these exigencies with an on-demand Uber-style model that fundamentally shifts the data collection paradigm:

- **Flexible Workforce** - Enumerators are temporary workers hired and trained by SIB for the purpose of price data collection. They typically have other income sources as well, but spend anywhere from 2-5 days per month on price-collection with SIB. As the enumerators are hired locally, this allows SIB to run an efficient data collection enterprise throughout the country with minimized travel-time.
- **Parallel Data Collection** - Enumerators need not be co-located in the capital at the ministry. They can be dispersed throughout the country and called in to work as when, and where needed without scheduling vehicles and large transport times.
- **Remote management of enumerators** - The enumerator-side app (for use via tablet) delivers end-to-end coverage of the tasks required of enumerators in a matter similar to

commonly used gig platforms such as Uber. Supervisors can configure items and outlets, monitor progress, and approve and modify substitutions all in-situ.

- **Economies of scale** – The app allows SIB to deliver market-data at a lower unit cost than any other entity amongst its government counterparts as fixed costs are limited, SIB can potentially achieve remarkable economies of scale via this app.

The app itself is composed of two components, a tablet-based app that covers the enumerator workflow, and a web-based admin console for supervisors. Once data collection commences, the app performs the following functions:

1. Each enumerator receives a detailed map of his or her enumeration area with the outlets that he or she must visit on the map.
2. Once at the outlet, the enumerator receives the full list of items in the order of a counterclockwise circumnavigation of the outlet.
3. By selecting an item in the list, the enumerator receives a detailed description, desired quantity, the previous period's price, and picture of the item.
4. If the price difference is more than 20 percent of the previous period's price or 20 percent of the average price in the enumeration area, then the enumerator must also write a detailed description as to why this is the case.
5. Finally, if the enumerator enters a poor connectivity area, the app has full-offline with re-sync functionality. While this might seem straight-forward, engineering such functionality can be quite difficult.

Last but not least, the software offers the same extensive slicing and aggregation functionality as PIPS, with the security of full-data audit functionality such that raw source-of-truth, staging, and production versions of datasets are always readily available and constructable from raw form.

If this is of interest, WFP would be privileged to facilitate a dialogue with the CSOs of Barbados, Saint Lucia, and Saint Vincent and the Grenadines with SIB and potentially provide support such that the software can be implemented in partnership with limited costs other than that needed for development and integration.

Figure 7: CPI App of Statistical Institute of Belize



6.1.10. Production of FD-ID indices

Almost every ministry consulted mentioned the lack of producer price indices to be a crucial data gap. These indices are subsumed within FD-ID indices, which chains PPI across the value-chain until it reaches the consumer. These indices are particularly important for the SIDS countries due to their high food-import bill and vulnerability to external shocks. The indices shed light upon the structure, composition, and degree of external dependence in the value chain segment-by-segment. This includes the degree of vertical integration and the level of specialization within different business sectors. Policymakers can thus gain a much richer understanding of the economy, identifying opportunities to reduce external-dependence, comparative advantages that diversify the economy, and value-added activities that create jobs and increase income.

With the above recommendations in place, each of these countries would have a world-class market monitoring system that achieves the gold-standard objective of furnishing everything needed to produce such FD-ID indices. The only missing piece is the weights used to reflect the relative importance of the different categories of expenditure or inputs. With respect to agri-food commodities this information should already be collected by the ministries of agriculture, allowing the CSOs to construct weights. Only with respect to non-agri-food commodities would the CSO need

to work closely with their respective ministry of commerce to conduct producer surveys and construct the required weights.

6.1.11. Regional dissemination of data

Regional entities such as CARICOM can have a role to play as a convener of market price information from member states, to be disseminated at a regional level that ensures data is freely accessible for the public good. Consolidation and visualisation of the data from member states into a regional platform, which presents data in a way that is functional for decision making can serve as an early warning tool for price spikes alerts and promote market stabilisation. This is especially important in a region where supply chains are inherently sensitive and linked inter and intra-regionally. A complimentary bottom-up approach would see CARICOM, along with partners such as WFP, support individual member states in strengthening their market monitoring systems and tools. Cognizant that CARICOM member states are at various maturity levels of their market price systems, an initial mapping process, such as this study can find entryways to boost the base level of member states to address data gaps throughout the value chain - from producers all the way to decision and policy makers. Opportunities to modernise processes and approaches that support innovation and should be prospected.

6.2. Country-specific recommendations

6.2.1. Barbados

- **Real-time market monitoring directly at BADMC packhouses** - This is perhaps the simplest method by which the Barbados ministry of agriculture can capture wholesale prices. In fact, as the packhouse grades and packages produce directly from the farmer, there is also an opportunity to capture price effects due to quality and other ancillary costs from packaging, transport, and marketing. Furthermore, the demand patterns of the clientele, usually high-end hotels and restaurants, serve as a valuable barometer of their business (Carrington, 2017). Market monitoring at the packhouse should include market trend and tone in addition to prices and quality.
- **Automated market monitoring embedded at food terminal** - The Barbados food terminal is expected to be able to store over 40 shipping containers of food onsite, equipped with its own processing, packaging, and storage facilities for a wide gamut of agri-food commodities (CariCom Today, 2023). With vendor registration systems and smart connected devices for weighing, handling, and purchasing/selling commodities, it is conceivable to capture price and volume across every step of the entire value chain from the moment raw foods enter the terminal to the time they are offloaded to the customer. The value-added service at the terminal is expected to comprise a significant percentage of Barbados' agriculture and food sector. The government has the chance to not only capture every facet of it, but also attract the attention of a broad base of potential international clientele for the terminal.

- **Improve capture and dissemination of wholesale prices** – Barbados has great potential to participate in advanced-economy agri-food commodity markets, potentially expanding its agricultural export and capital investment base. However, the full, real-time, disclosure of the required price information is a severe impediment. Currently prices on BARMIS are many months old and often incomplete. Given initiatives like the Barbados food terminal, where presumably commodities will be quickly bought and sold in large volumes, BARMIS should aim to have data updated daily at scale for many dozens of commodities at both a wholesale and retail level displayed in a live, visual dashboard that updates without human intervention.

6.2.2. Saint Lucia

- **Step change improvement in dissemination and timeliness** – At present a timely market monitoring system for the public is not readily available in Saint Lucia despite the fact that the dedicated staff of the CSO and ministry of agriculture are collecting prices monthly and weekly respectively. Dissemination seems to be happening only through limited channels. This can be improved by adopting open data policies, using digital platforms to disseminate information like websites, social media and mobile apps, creating APIs, investing in data analytics tools, and collaborating with stakeholders.
- **Vendor registration system and smart-scales for vendor markets** – Vendor markets in Saint Lucia continue to use heaps, bags, units and other non-standard measures for quantity. Implementing tools and systems that incentivize if not force a move towards mass as the measure of quantity. One such method, as proposed by the ministry of agriculture, is to combine vendor registration with smart weighing-scales and sale terminals that require vendor ID cards for use and automatically record the weight of produce sold and capture it against the vendor ID.
- **Scaling data collection for vendor markets** – Currently only one vendor market is covered in the entire country, Castries Market, is covered. There are at least five additional markets where data should be collected as well.

6.2.3. Saint Vincent and the Grenadines

- **Build AIMS system to manage new agricultural census** – As Saint Vincent and the Grenadines is undertaking an agricultural census in 2023, expected to be completed in 2024, its AIMS system (NAMIS) should be built or modified such that it serves as the platform over which the census is conducted. This is what Belize did for its 2018 agricultural census to great success. What was their workhorse for managing data collection for their census became the Belize Agricultural Information Management System (BAIMS) which remains state-of-the-art today.
- **Monitoring of vendor markets** – As mentioned earlier currently Saint Vincent and the Grenadines does not monitor open-air vendor markets (for the CPI, price-controls, or

agricultural commodity prices). This is quite a gap owing to their popularity with the public and higher price volatility. Steps should be taken to include them in price monitoring.

- **Improvement in dissemination and timeliness** – Similarly to what was recommended for Barbados and Saint Vincent and the Grenadines, adoption of open data policies, investment in data analytics and APIs can support timely dissemination via digital platforms more widely through websites, social media, mobile apps, SMS, can benefit all key stakeholders and the general public.

6.3. Additional recommendations

6.3.1. Additional data collection

- **Consumer expenditure survey** – As mentioned earlier under Section 5 (Gaps in market monitoring systems) amongst the countries in scope, the current consumer expenditure surveys are dated and no longer represent current consumer consumption patterns. Moreover, entire categories of consumer expenditures may be missing, and the compounding effect of substitutions within the basket impact the quality of the end-use CPI. Undertaking new expenditure surveys would offer substantial benefits in updating these important pictures.
- **Updated agricultural survey** – As also mentioned in Section 5 of this report, machine-learning upon satellite imagery is becoming the de-facto modus operandi the world over for crop monitoring, forecasting, and even agri-input estimation. Furthermore, climate change is quickly reducing the utility of existing tech-packs as farmers must quickly adapt to a new reality. To give the ministries of agriculture access to these state-of-the-art tools, the foundational data in terms of accurate geospatial shapefiles of farms, crop yields, agri-inputs, and other costs must also be available. While Saint Vincent and the Grenadines is executing upon a new census, Barbados and Saint Lucia should do so as well.
- **Expanded Producer price surveys** – Every CSO consulted cited the expansion of produce price surveys as very high on their wishlist. PPI has utility far beyond tracking inflation, allowing the government to monitor the business cycle and track profitability trends. Saint Lucia are tracking PPI for their hotel and restaurant sector while Barbados is tracking PPI for the manufacturing sector Saint Lucia has put forth concrete plans to extend to construction, while Barbados has started collecting data with respect to manufacturing. All governments would benefit from scaling up and expanding this effort, in particular to food processors, wholesalers, and distributors.
- **Capturing wholesale prices, surveys of distributors and wholesalers** – Governments should be tracking all costs that create the differential between the farm-gate and freight-on-board cost. However, such surveys are often arduous, requiring visits to the market very early in the morning. Traditionally this has fallen under the purview of the ministry of agriculture; However, given their broad portfolio of responsibilities, it may be pertinent to

consider that if it is not already the case (such as in Saint Vincent and the Grenadines), dedicated enumerators instead of field officers to adopt the task. CSOs and ministries of finance usually do have dedicated enumerators on staff for just such tasks.

6.3.2. Additional indicators & technical recommendations

- **On-Chain indices for CPI** - Chain-weighted CPI considers changes to consumer spending patterns over time. Given point of sale data, this begins to make sense as one can track expenditure patterns over time without new expenditure surveys.

6.3.3. Personnel & Training

- **IT personnel** – This is universally highlighted across every country and every ministry as a pressing priority that restrains their ability to implement new solutions while imposing additional constraints on their time owing to manually performing easily automatable processes. Ministries find it difficult to attain the resources to hire quality IT capacities, especially given the competition with the private sector. Ideally such capacities could be shared across ministries, but that would require changes in the ways ministries operate.
- **Dedicated enumeration staff for markets** – Particularly the ministries of agriculture find themselves with very stretched capacities for undertaking market monitoring given the broad footprint of their data collection responsibilities. Agricultural extension officers may struggle to manage collecting prices from markets which generally occur rather early morning when they must also extensively engage with farmers, and moreover it is an inefficient use of resources as they are deeply trained in highly technical minutiae regarding farm-level data collection.
- **Training in R and/or Python** – Having data stored in Excel spreadsheets, which are then coalesced to perform analyses also in Excel, is no longer tenable as data proliferates. The robust and long-term solution is to have data properly stored in databases, retrieved via API, and analyzed using a proper scientific programming tool such as R or Python. R is quite suited for the CSOs' mission due to their focus on econometrics and statistical techniques. Python is better suited for the ministries of agriculture due to its many modules for processing satellite imagery.
- **Training in Yield Forecasting with Satellite Imagery using Google Earth Engine** – Google Earth Engine allows a programming-light interface to build machine-learning models and produce summary statistics over satellite imagery. Such training would be ideal for the ministries of agriculture given their high technical expertise. Google Earth Engine is also offered for free or greatly reduced cost for institutions and governments depending on whether they are using it for commercial or non-commercial purposes.

6.3.4. Technology & Equipment

- **Tablets, including software and training** – The Barbados ministry of agriculture and the different ministries of Saint Vincent and the Grenadines still heavily rely on paper forms for almost all their data collection, however, the Ministry of Agriculture in St Vincent and the Grenadines is in possession of tablets and is transitioning from paper to tablet use. Tablets of course offer numerous advantages, but the impediment to their adoption is often not the cost but often the associated support required in terms of software selection and setup and unfamiliarity with subsequent data collection and analysis workflows.
- **Drones and related training** – The ministries of agriculture have extensive utility for drones. A specific example mentioned by the Saint Lucia ministry of agriculture, is using drones for performing an orchard census, tagging each tree by its crop type and geospatial coordinate. Other uses abound, including precise geo-coordinated shape files of farms, surveillance of crop development, alerts of disease and pests, and combined with satellite imagery to forecast yield. The Ministry of Agriculture in St Vincent and the Grenadines has also invested in drones and will be undertaking extensive training with the assistance of FAO.
- **Equipment to measure soil effects due to climate change** – While not directly related to market monitoring, the need to detect changes in soil conditions was specifically mentioned by the Barbados ministry of agriculture as a point of concern. However, it is a problem of global significance to all SIDS; climate change is affecting the moisture and temperature of their soil, and as all irrigation is ultimately rainfed in these countries, careful management of this resource is becoming more and more prescient. The required equipment is relatively inexpensive and can provide valuable insight to help SIDS countries world-over adapt to climate change.

6.4. Regional cooperation on market monitoring under CARICOM

The Caribbean Community (CARICOM) should play a significant role as a regional coordinator for agri-food market monitoring, drawing from the successful Market Information Organization of the Americas (MIOA) model. As a regional organization, CARICOM can facilitate the exchange of information, coordinate efforts, and promote cooperation among its member states in the agri-food sector. These efforts can achieve several advantages for not only the three countries in scope for this report, but across the Caribbean as many of the countries share concerns and challenges that mirror other SIDS.

- **Improved price transparency and market efficiency** – Price discovery is often a problem for importers and exporters within small, fractured markets. There is not a single benchmark price they can reference or a single source of truth that can highlight prices received by peers. The ability to share such information across the region allows producers, traders, and consumers to make better informed decisions. As a corollary the reduced information

asymmetry also fosters more efficient markets, benefitting all stakeholders in the value chain.

- **Increased regional integration and development of agri-food value-chains** – Enhanced market information on a regional scale across the Caribbean also promotes regional market opportunities for producers, encouraging traders to source regionally when they cannot source locally. In turn this creates opportunities for additional value-added products and services that are otherwise captured by importers of raw agricultural products from the Caribbean.
- **Climate change resilience and support for small-scale farmers** – Shifts in seasonality, agricultural production, and lessons on mitigating climate-change impact are invaluable to producers who are on the frontlines of climate-change impact. Moreover, this also supports small-scale farmers who can now respond to regional supply and demand signals and thus optimise their production strategies as to compete with larger foreign agricultural operations.
- **Strengthened food security and regional self-sufficiency** – Increased cooperation and dissemination of market information can help to identify potential food shortages or surpluses, enabling coordinated responses to mitigate the impacts of food crises and improve regional food security. This also is an opportunity to further build upon CARICOM's successful 25 by 25 model to reduce food imports by channeling surpluses within the region.

In order to achieve these aims, CARICOM can mirror the most pertinent recommendation in section 6.1. Specifically, as a start CARICOM simply engage in these four initiatives:

- **Establishing a uniform interoperable coding system for agri-food commodities throughout the Caribbean** – The same problems of interoperability of data that plague the national market monitoring systems of countries, also extends throughout the Caribbean. A system built on HS codes is both flexible for countries to adapt to their needs while being interoperable with codes used by the USDA, with the US being the largest regional trading partner.
- **Establishing a uniform reporting standard for market information** – All market information can be captured in a surprisingly succinct number of fields. At minimum one only needs just seven fields - the commodity, currency, price, quantity, unity of measure, location, and timestamp. There are many additional fields that can be included; however, simply having a uniform standard to report these seven fields would allow countries to have interoperable systems.
- **Creating an API and single-source of truth dashboard for market-price information amongst CARICOM countries** – This would be the first step toward the establishment of a pan-Caribbean market monitoring system. An API would both allow this data to be easily consumed and pulled from other CARICOM countries (provided they have APIs too), and put into a single dashboard that can serve as a source-of-truth for any interested stakeholder.
- **Funding shareable IT capacity** – The lack of sufficient IT capacity is a stumbling block across all these countries towards broader initiatives. An in-house CARICOM IT unit that can assist countries in jump-starting IT initiatives such as creating APIS or implementing AIMS systems would have an immediate impact and move the whole region forward.

Finally, the establishment of a Caribbean market monitoring system has long been an objective for CARICOM. However, this objective now takes upon an additional valence, given the cost of living crisis and the macro-trend away from global supply chain and towards regional supply chains. To foster trade, economic growth, and regional food security a Caribbean market monitoring system is the necessary foundation for creating commodity futures and options exchanges in the Caribbean. Such markets allow producers and buyers to hedge against price volatility, manage risk more effectively, attain affordable insurance against crop losses, and moreover attract long term capital investment into the agri-food sector thereby increasing agricultural productivity and fostering the development of financial services tailored to the agri-food sector. Ultimately it is the region's food security that is most improved, through increased food self sufficiency, diminished imports, and reduced food price volatility.

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